Quantifying the impact of COVID-19 on immigration in receiving high-income countries[1]

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Abstract: Previous studies have examined the impact of COVID-19 on mortality and fertility. However, little is known about the effect of the pandemic on constraining international migration. We quantify the impact of COVID-19 on immigration flows in 15 high-income countries by forecasting their counterfactual levels in 2020 assuming no pandemic and comparing these estimates with observed immigration counts. We then explore potential driving forces, such as stringency measures and changes in unemployment moderating the extent of immigration decline. Our results show that immigration declined in all countries, except in Finland. Yet, significant cross-national variations exist. Australia (60%), Spain (45%) and Sweden (36%) display the largest declines, while immigration decreased by between 15% and 30% in seven states, and by less than 15% in four where results were not statistically significant. International travel, mobility restrictions and stay-at-home requirements exhibit a relationship with declines in immigration, although countries with similar levels of stringency witnessed different intensities of decline. Work and school closings and unemployment show no relationship.

Key words: Immigration, COVID-19, cross-national comparison, forecasting, stringency measures.

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The COVID-19 pandemic has had major impacts on global demographic trends. Research has measured reductions in life expectancy (e.g., Aburto et al. 2021; Heuveline & Tzen, 2021) and fertility resulting from the pandemic (e.g., Aassve et al 2021; Sobotka et al., 2021), emphasizing that significant cross-national differences exist. However, less is known about the impact of the pandemic on international migration. Despite some evidence pointing to a reduction in this component (UN, 2021), the extent of this decline and variations across countries are yet to be established. Lack of timely data has prevented to quantify these trends, as information on international migration flows has recently become available for some high-income countries.

International migration is the primary component of population change in aging societies (Lee, 2014; Abel 2018). It increases the number of young adults and elevates fertility (Wilson et al., 2013; Newsham and Rowe 2019). Migration also brings labor force and skills where they are needed (Van Ham et al., 2001), and supports the welfare state and intergenerational transfers by sustaining suitable labor dependency ratios (Lee et al 2014). Thus, understanding shocks to the global network of international migration is essential to ensure appropriate policies in countries where natural change cannot sustain population growth and labor deficits exist.

During COVID-19, restrictions on international travel constrained international movements (IOM, 2020). The impacts of these measures may have been more pronounced in countries with more restrictive travel restrictions and other stringency measures, such as lockdowns and mobility restrictions. Additionally, economic downturn caused by the pandemic decreased labor demand and increased unemployment in some countries (Blustein et al., 2020), constraining the potential need for international workers. Country-specific variations in immigration levels are thus to be expected.

We quantify cross-national impacts of COVID-19 on immigration flows in 12 European countries, the United States, Canada and Australia. We estimate the counterfactual level of immigration during 2020 in the absence of the pandemic and compare this level to observed counts. We also seek to identify the association between stringency measures and unemployment with immigration declines. We seek to address the following research questions: 1) To what extent did immigration decline across countries? 2) How does the extent of decline relate to stringency measures and changes in unemployment?

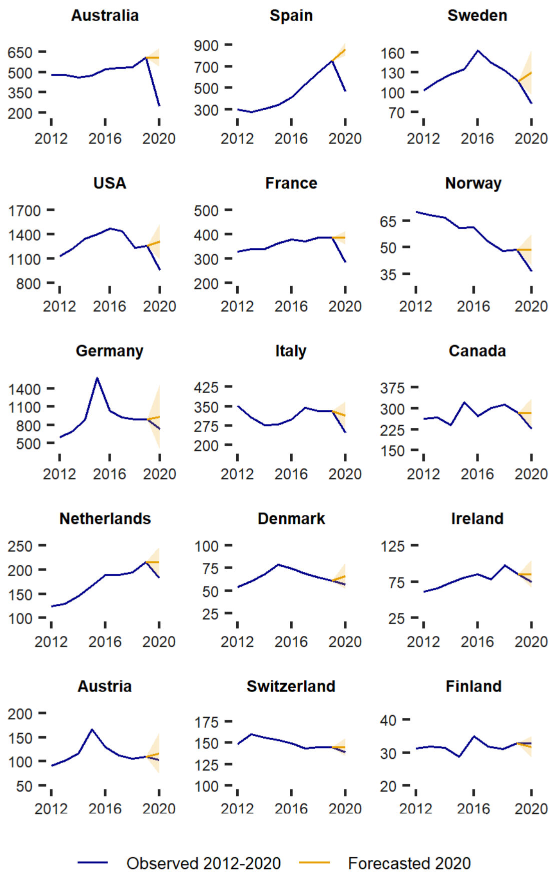
Results

Different immigration declines across countries

Figure 1 shows observed immigration flows between 2012 and 2020 and forecasted values for 2020 assuming continuation of observed historical trends if COVID-19 had not occurred. Figure 2 reports the percentage difference between observed and forecasted immigration counts in 2020. We consider changes in immigration as statistically significant when the observed immigration counts are outside the confidence intervals (CI) of their respective forecast. Overall, the results reveal lower than expected levels of immigration in 2020 for 14 of the 15 countries in our sample. Yet, pronounced variations exist across countries.

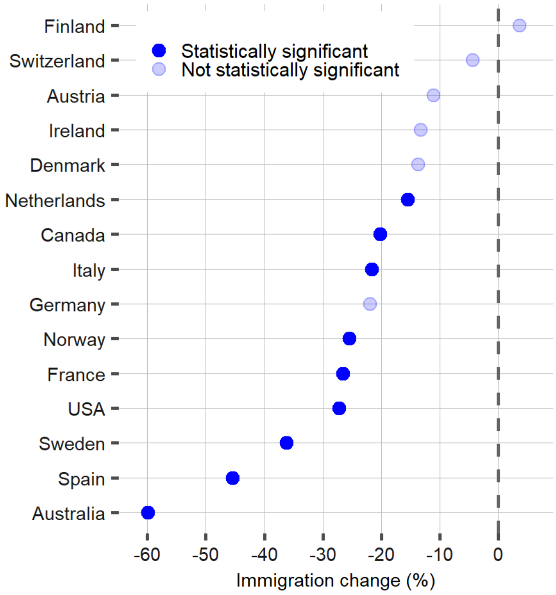
Australia stands out with the largest drop in immigration. The observed number of immigrants (243 thousand) was 59.9% lower than expected (607 thousand). Spain and Sweden recorded drops of 45.4% and 36.4%, declining the number of immigrants from 857 to 468 thousand and from 129 to 82 thousand, respectively. Reductions from 16% to 27% are estimated in the United States (27.2%), France (26.5%), Norway (25.5%), Germany (21.9%), Italy (21.6%), Canada (20.2%) and the Netherlands (15.5%), although results are not statistically significant in Germany due to high levels of uncertainty in the forecast. Non-statistically significant declines between 4% and 15% in Denmark, Ireland, Austria and Switzerland are more aligned with recent historical trends. Overall, the observed patterns may reflect the effects of COVID-19, but disentangling these impacts is challenging due to uncertainty levels forecasting immigration (see sensitivity analysis in the Supplementary Material (SM). Surprisingly, Finland records a slightly higher than expected immigration flow, albeit statistically insignificant.

Figure 1. Immigration (thousands): observed 2012-2020 and expected in 2020



Note: Countries are ordered according to the extent of difference between the observed and forecasted immigration in 2020, from highest to lowest; 95% CI are included with the forecast.

Figure 2. Immigration changes between expected and observed values in 2020



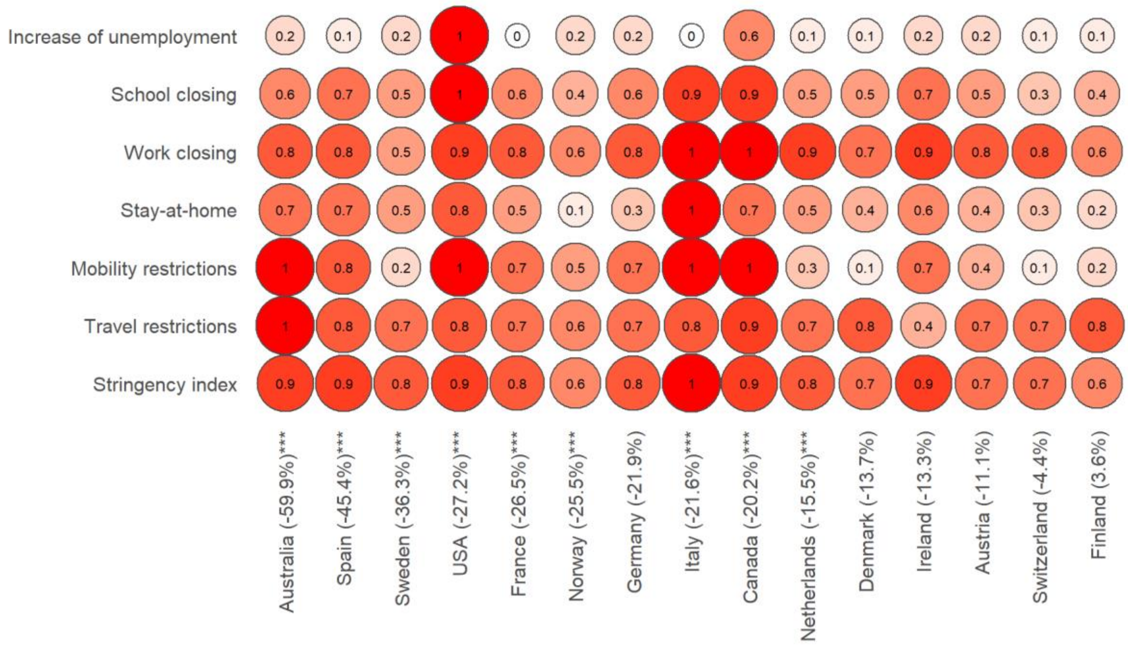
Note: Countries are ordered according to the extent of difference between the observed and forecasted immigration in 2020, from lowest to highest; we consider changes in immigration as statistically significant when the observed immigration counts are outside the 95% CI of their respective forecast.

Association with stringency measures and unemployment change

Next, we examine the association between reductions in immigration with stringency measures and unemployment changes. We selected five indicators capturing specific restrictions including travel, mobility, stay-at-home, work and school closures, and a stringency index summarizing the joint restrictiveness level of all these measures. To enable comparisons across variables, we re-scaled original values to a 0-1 range (see Materials and Stringency measures in the SI). Figure 3 displays a heatmap with countries sorted according to the extent of immigration decline (x-axis), and the various stringency measures and changes in unemployment (y-axis). Larger and darker circles indicate greater levels of stringency and rises in unemployment.

The results indicate that countries with higher overall levels of stringency experienced large (over 35%) or medium (20-30%) immigration declines; though, this relationship is not linear. Norway displays a relatively large drop in immigration despite moderate stringency levels, while Italy experienced a similar decline in immigration but recorded the highest levels of stringency. Restrictions to population movements seem to underpin these patterns. Travel, mobility and stay-at-home restrictions tend to display the highest levels of stringency in countries that report large or medium immigration declines. Australia, for instance, scored the highest levels of travel and mobility restrictions, and the largest decline in immigration. Yet, again, the degree of stringency does not seem to be the only factor determining the extent of immigration decline. Italy, Canada and the United States experienced similar levels of restrictions to Australia, but lower reductions in immigration. Rises in unemployment may have played a role in reducing levels of immigration in the United States and, to a lesser extent in Canada, while they seem less prominent in other countries. Work and school closing do not show a clear relationship explaining cross-country variations in immigration.

Figure 3. Severity of stringency measures and increase in unemployment in 2020 (scale 0 to 1)



Note: *** means statistically significant decline in immigration; countries are ordered according to the relative change in immigration represented in brackets, from highest to lowest.

Discussion

Results show reductions in immigration in most countries in our sample during 2020, except for Finland. Declines ranged from 5%in Switzerland to 60% in Australia but drops below 15% appeared not to be statistically significant due to the uncertainty levels of the forecast. Countries with declines in immigration higher than 20% reported more severe travel and mobility restrictions and stay-at-home requirements. However, the association is not linear. Countries with similar levels of stringency showed varying extents of immigration decline.

Differences in the content of stringency measures, rather than differences in their restrictiveness level, may explain the varying reductions in immigration. Australia, for instance, maintained strict restrictions to international travel from all countries during 2020, while the European Union (EU) gradually relaxed travel restrictions for EU citizens but maintained certain restrictions for other countries. Thus, EU states, which typically receive a large share of immigrants from the EU, may have been less affected by immigration declines. Moreover, variations in stringency measures and pandemic impacts in sending countries could have impacted levels of immigration in destination countries.

Our paper contributes some first empirical evidence of the extent of immigration decline drawing on a global sample of countries. Yet, the long-term impacts of COVID-19 on international migration is still to be established. As travel restrictions are lifted, the risk of COVID-19 mortality decreases, and business activity resumes, immigration may rebound to pre-pandemic levels. Recently released data from national institutes of statistics show that immigration may have returned to pre-pandemic levels in the Netherlands during 2021 but remained at low levels Spain, suggesting cross-national variations immigration recovery. As foreign populations become a pillar of ageing societies, monitoring immigration flows is key to guide migration policy. A one-year reduction may not have a significant effect on accelerating population aging. But, if significant levels of reductions continue to occur, the demographic and economic sustainability of aging countries will be negatively impacted.

Materials

We used annual register data on immigration from Eurostat between 2012 and 2020 for the European countries, from the office of national statistics for Australia and Canada, and the Census Bureau for the United States. We restricted our analysis to immigration because of high levels of underreporting in emigration (Wisniowski et al., 2013). Immigrants are defined as individuals who lived over 1 year in the destination country, except for the United States, where immigration corresponds to the Census Bureau Vintage 2020 foreign-born immigration estimates.

To quantify declines in immigration, we first forecasted immigration counts in 2020 based on observed data between 2012 and 2019. We used country-specific ARIMA time-series forecasting models. We selected models based on a combination of model selecting tools which allows us to identify the model that best fits each trend (see Model specification in the SI). We then used predicted immigration counts for 2020 and compared these with observed values to estimate immigration drops. Observed counts excluded from estimated 95% CIs for predicted counts are considered statistically. To check the robustness our modeling strategy, we performed a sensitivity analysis by forecasting 2019 and compared it with observed values for the same year (see Sensitivity analysis in the SM).

We explored the relationship between immigration reductions, and COVID-19 stringency levels and unemployment changes during 2020. Data on stringency were obtained from the Oxford Covid-19 Government Response Tracker (Hale et al., 2021). From daily data, we produced the yearly average of 2020 in each country. We calculated changes in unemployment between 2019 and 2020 using data from Eurostat for European countries and the World Bank for non-European countries. We standardized stringency and unemployment indicators into a 0-1 scale, where 1 indicates the highest value in our sample of countries for each indicator (see Stringency measures in the SI).

References

Aasen, A., N. Cavalli, L. Mencarini, S. Plach, and & S. Sanders. 2021. Early assessment of the relationship between the COVID-19 pandemic and births in high-income countries, Proceedings of the National Academy of Sciences of the United States of America 118(36): e2105709118. https://doi.org/10.1073/pnas.2105709118.

Abel, G. J. 2018. Non-zero trajectories for long-run net migration assumptions in global population projection models, Demographic Research 38(54): 1635-1662. https://doi.org/10.4054/DemRes.2018.38.54.

Aburto J.M., J. Schöley, I. Kashnitsky, L. Zhang, C. Rahal, T.I. Missov, M.C. Mills, J.B. Dowd, and R. Kashyap. 2021. Quantifying impacts of the COVID-19 pandemic through life-expectancy losses: a population-level study of 29 countries, International Journal of Epidemiology 50(1): 63-74. https://doi.org/doi:10.1093/ije/dyab207.

Blustein, D. L., Duffy, R., Ferreira, J. A., Cohen-Scali, V., Cinamon, R. G., &Allan, B. A. (2020). Unemployment in the time of COVID-19: Aresearch agenda.Journal of Vocational Behavior,119, 103436.https://doi.org/10.1016/j.jvb.2020.103436.

Hale, T., Angrist, N., Kira, B., Petherick, A., Phillips, T. and Webster, S., Cameron-Blake, E., Hallas, L., Majumdar, S., & Tatlow, H. (2020). A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker)." Nature Human Behaviour. https://doi.org/10.1038/s41562-021-01079-8.

Heuveline, P., & Tzen, M. (2021). Beyond deaths per capita: comparative COVID-19 mortality indicators. BMJ open, 11(3), e042934. http://dx.doi.org/10.1136/bmjopen-2020-042934.

IOM. 2020. COVID-19 Analytical Snapshot #3: Travel restrictions & mobility. Understanding the migration & mobility implications of COVID-19. Geneva: International Organization for Migration. https://www.iom.int/sites/default/files/our_work/ICP/MPR/COVID-19_analytical_snapshot_3_-_travel_restrictions_and_mobility.pdf.

Lee R.D., A. Mason, and NTA Network. 2014. Is low fertility really a problem? Population aging, dependency, and consumption, Science, 346(6206), 229-234. https://doi.org/10.1126/science.1250542.

Newsham, N., and F. Rowe. 2019. Projecting the demographic impact of Syrian migration in a rapidly ageing society, Germany, Journal of Geographical Systems (23): 231-261. https://doi.org/10.1007/s10109-018-00290-y.

Sobotka, T., Jasilioniene, A., Galarza, A. A., Zeman, K., Nemeth, L., & Jdanov, D. (2021). Baby bust in the wake of the COVID-19 pandemic? First results from the new STFF data series. https://doi.org/10.31235/osf.io/mvy62.

UN (2021). International Migration 2020 Highlights (ST/ESA/SER.A/452). Department of Economic and Social Affairs, Population Division, United Nations. https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/undesa_pd_2020_international_migration_highlights.pdf.

Van Ham, M., Mulder, C. H., & Hooimeijer, P. (2001). Spatial flexibility in job mobility: Macrolevel opportunities and microlevel restrictions. Environment and Planning A, Economy and Space,33(5), 921–940. https://doi.org/10.1068/a33164.

Wilson, C., Sobotka, T., Williamson, L., & Boyle, P. (2013). Migration and intergenerational replacement in Europe. Population and Development Review, 39(1), 131-157. https://doi.org/10.1111/j.1728-4457.2013.00576.x.

Wisniowski, A., Bijak, J., Christiansen, S., Forster, J. J., Keilman, N., Raymer, J., and Smith, P. W. (2013). Utilising expert opinion to improve the measurement of international migration in Europe. Journal of Official Statistics, 29(4):583–607. https://doi.org/10.2478/jos-2013-0041.

Supporting information for Quantifying the impact of COVID-19 on immigration in receiving high-income countries

Model specification

This paper quantifies the impact of the COVID-19 pandemic on the size of immigration flows in a global sample of high-income countries. We employed Auto Regressive Integrated Moving Average (ARIMA) models to forecast the expected immigration counts in 2020 if the pandemic had not been occurred. We then compared the forecasted immigration count to the observed immigration count in 2020. We used 2012-2019 data to produce country-specific forecasts of immigration counts for 2020. An ARIMA model comprises three components: an autoregressive (AR) process, a moving average (MA) and an integrated (I) element. Intuitively, these components capture the long-term, stochastic and short-term trends of a time series, respectively. Formally, the AR and MA components control for temporal autocorrelation in a time series resulting from two mechanisms. The first assumes a variable (*Y*) at time *t* (Y_t) which is explained by its past value(s) (i.e., $y_{t-1},\ y_{t-2},\ \cdots,\ y_{t-p}$). The second assumes Y_t is a function of current and past moving averages of error terms (e.g., $u_{t-1} +\ u_{t-2} + \cdots + u_{t-q}$); that is, current deviations from the mean depends on previous deviations. A general ARMA (*p, q*) model takes the form of:

$$Y_t = \gamma +\ \alpha_1 Y_{t-1} + \cdots +\ \alpha_p Y_{t-p} - \theta_1 u_{t-1} - \cdots - \theta_q u_{t-q} + u_t \qquad (1)$$

The subscript *p* and *q* denote the order of the autoregressive and moving average terms, respectively. Fitting a time series in a model containing AR and MA parameters (or an ARMA model) requires the data to be weakly stationary. Weakly stationary is characterized by: (1) constant mean and variance of Y_t over time; and (2) the covariance of Y_t to be time-invariant, i.e., to only depend on the lag between the current and past value and not the actual time at which the covariance is computed (Hyndman and Athanasopoulos, 2018). However, weakly stationarity in time series is rare. They often must be integrated (I); that is, time series must be differentiated to be stationarity so its statistical properties, such as mean, variance and autocorrelation are constant over time. Mathematically, Equation (1) can be modified to represent a general ARIMA (*p, d, q*) model:

$$y_t = \theta +\ \varphi_1 y_{t-1} + \cdots +\ \varphi_p y_{t-p} - \beta_1 u_{t-1} - \cdots - \beta_q u_{t-q} + u_t \qquad (2)$$

where: y_t = $Y_t - Y_{t-1}$ for a first order differencing model, and d denotes the degree of first differencing.

We fitted country-specific models. We identified the best fitting ARIMA model using unit root tests to assess for stationarity and the Akaike information criterion to determine the appropriate order of autoregressive, moving average and differencing terms. Models were estimated via maximum likelihood. Through our evaluation, we determine three best fitting model specifications as shown in Supplementary Material Table 1.

Supplementary Table 1. ARIMA Model specification for each country

Order of autoregressive (p), moving average (d) & differencing terms (q)	Model specification	Countries
p = 0; d = 0; q = 0	White Noise model	Austria, Denmark, Germany, Finland, Italy, Sweden, Canada, the United States
p = 0; d = 1; q = 0	Random Walk with a drift	France, Ireland, the Netherlands, Norway, Switzerland, Australia
p = 0; d = 2; q = 0	Random Walk with a drift	Spain

Stringency measures

We used various stringency measures to analyze the association between declines in immigration and the level and type of stringency measures; stringency index, travel restrictions, mobility restrictions, stay-at-home requirements, work closing and school closing. The stringency index is a composite indicator that summaries the joining effect of nine individual stringency measures: school closing, workplace closing, cancelling public events, restrictions on gathering, closing of public transport, stay-at-home requirements, restrictions on internal travel, mobility restrictions and public information campaigns. The original values of this variable vary from 0 (no restrictions) to 100 (the strictest levels of restrictions).

All the individual measures of stringency we used are categorical variables. Travel restrictions has five categories: 0 (no restrictions), 1 (screening arrivals), 2 (quarantine arrivals from some or all regions), 3 (ban of arrivals from some regions) and 4 (full border closure). Mobility restrictions presents the following values: 0 (no restrictions), 1 (recommendation of not to travel) and 2 (prohibiting internal movements). Stay-at-home can be 0 (no restrictions), 1 (recommendation of not leaving home), 2 (require not leaving house with exceptions) and 3 (total confinement with minimal exceptions). Work closing has four categories: 0 (no restrictions), 1 (workplaces can open under sanitation and social distancing requirements), 2 (closing or work from home for some sectors) and 3 (work from home and closure of non-essential activities). School closing also has three levels: 0 (no restrictions), 1 (hybrid in-person/online learning models), 2 (classes being open only for some groups), 3 (all levels of education are then closed).

Stringency measures are provided on daily time series. To obtain a comparable summary indicator to our estimate of immigration decline, we calculated the annual mean of stringency measures based on the original data. Then we scaled the resulting means from 0 to 1, with 1 indicating the highest level in our sample. Scores for other countries are relative to the maximum record. We converted the data to this scale because a homogeneous scale for all variables was needed to produce a heatmap. See equivalences in Supplementary Table 2.

Supplementary Table 2. Equivalences between Oxford stringency measures and scale 0 to 1

Country	Stringency index		Travel restrictions		Mobility restrictions		Stay at home		Work School		School closing		Increase of unemployment	
	Oxford	*0 to 1*	*Oxford*	*0 to 1*	*Oxford*	*0 to 1*	*Oxford*	*0 to 1*	*Oxford*	*to 1*	*Oxford*	*0 to 1*	*Oxford*	*0 to 1*
Australia (-59.9%)* **	55.9	0.9	3.5	1.0	1.6	1.0	1.2	0.7	1.6	0.8	1.6	0.6	25.0	0.2
Spain (-45.4%)* **	56.3	0.9	2.7	0.8	1.3	0.8	1.2	0.7	1.7	0.8	1.7	0.7	10.1	0.1
Sweden (-36.3%)* **	49.0	0.8	2.5	0.7	0.4	0.2	0.8	0.5	0.9	0.5	1.3	0.5	26.2	0.2
USA (-27.2%)* **	56.2	0.9	2.7	0.8	1.6	1.0	1.3	0.8	1.9	0.9	2.5	1.0	120.2	1.0
France (-26.5%)* **	54.3	0.8	2.5	0.7	1.1	0.7	0.8	0.5	1.7	0.8	1.6	0.6	-6.2	0.0
Norway (-25.5%)* **	41.7	0.6	2.3	0.6	0.8	0.5	0.2	0.1	1.2	0.6	1.1	0.4	21.2	0.2
Germany (-21.9%)	51.8	0.8	2.6	0.7	1.1	0.7	0.6	0.3	1.6	0.8	1.6	0.6	24.1	0.2
Italy (-21.6%)* **	64.7	1.0	2.8	0.8	1.6	1.0	1.7	1.0	2.0	1.0	2.2	0.9	-5.1	0.0
Canada (-20.2%)* **	55.8	0.9	3.3	0.9	1.6	1.0	1.2	0.7	2.0	1.0	2.2	0.9	66.7	0.6
Netherlands (-15.5%)* **	49.2	0.8	2.4	0.7	0.5	0.3	0.9	0.5	1.7	0.9	1.3	0.5	7.7	0.1
Denmark (-13.7%)	45.6	0.7	2.7	0.8	0.2	0.1	0.8	0.4	1.4	0.7	1.3	0.5	10.6	0.1
Ireland (-13.3%)	56.0	0.9	1.5	0.4	1.1	0.7	1.0	0.6	1.8	0.9	1.8	0.7	19.6	0.2
Austria (-11.1%)	47.1	0.7	2.4	0.7	0.6	0.4	0.7	0.4	1.5	0.8	1.2	0.5	25.5	0.2
Switzerland (-4.4%)	42.3	0.7	2.4	0.7	0.2	0.1	0.5	0.3	1.6	0.8	0.8	0.3	11.6	0.1
Finland (3.6%)	38.9	0.6	2.9	0.8	0.3	0.2	0.3	0.2	1.1	0.6	1.0	0.4	16.4	0.1

Note: *** means statistically significant decline in immigration; countries are ordered according to the relative change in immigration represented in brackets, from highest to lowest.

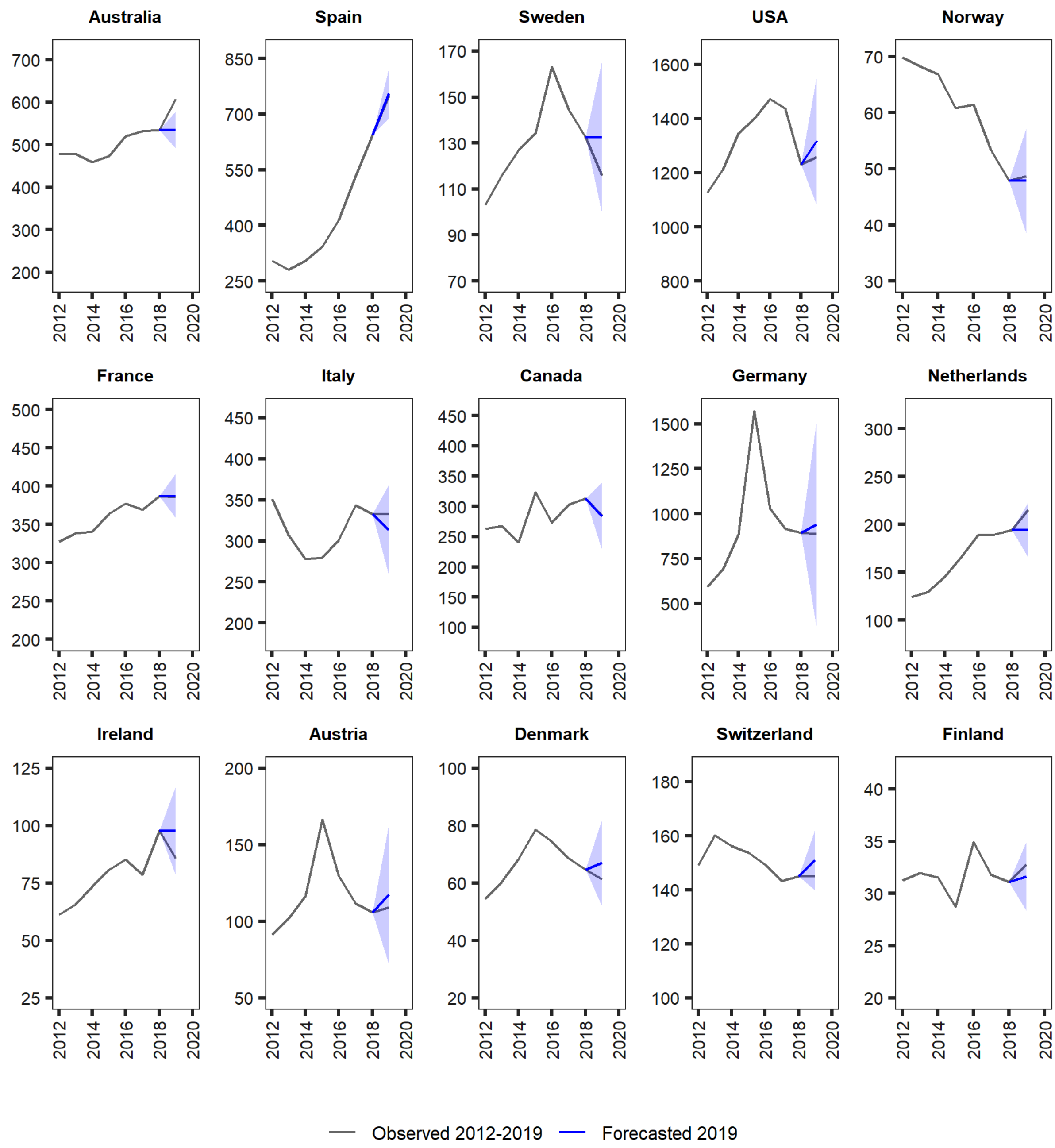
Sensitivity analysis

To check the robustness of our models, we carried out a sensitivity analysis by using data for the 2012-2018 period to forecast the immigration count in 2019, rather than using data for the 2012-2019 period to predict the immigration count in 2020. We used the same methodology and ARIMA model specifications used to forecast 2020, except for Sweden and Switzerland. In these countries, root tests indicated that model specifications best fitted the data were Random Walk with drift for the former and White Noise model for the latter. We do not expect observed and forecasted immigration counts in 2019 to differ as much we do for 2020. We also expect observed immigration counts for 2019 to be within the 95% confidence intervals (CI) of the forecasted values for the same year. If observed and forecasted immigration counts for 2019 differed substantially and the former is outside the forecast CI, this would point to a flaw in our analytical approach.

Supplementary Figure 1 reports observed immigration counts for 2012-2019 and forecasted values of 2019. Supplementary Figure 2 reports the percentage difference between observed and forecasted immigration counts in 2019. Light circles indicate that observed values of 2019 are within the 95% confidence interval of forecasted immigration counts. The results of our sensitivity analysis show that observed immigration counts for 2019 are within the confidence interval of predicted immigration counts in most countries, except for Australia, where an unusual increase of immigration was observed. Differences between observed and forecasted immigration counts for 2019 are below 15% in all the counties, including Australia. Expected and observed immigration values are virtually the same for Spain, Norway, Canada and France. Differences are around 5% for the United States, Italy, Germany, Austria, Switzerland

and Finland. The countries with the highest variations are Denmark, (9%), the Netherlands (11%), Ireland (12%), Sweden (13%) and Australia (14%).

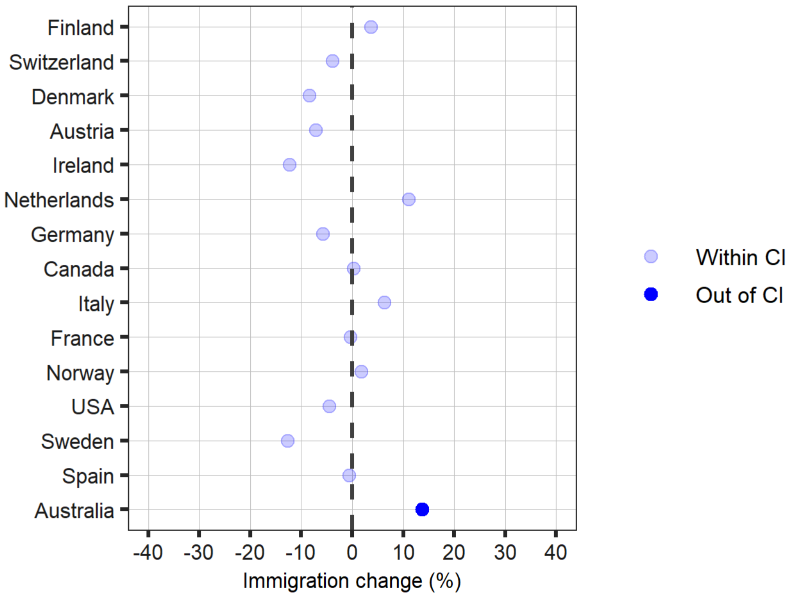
Supplementary Figure 1. Sensitivity analysis of immigration forecasting: observed data 2012-2019 and expected values in 2019 (thousands)



Note: Countries are ordered according to the extent of difference between the observed and forecasted immigration in 2020, from highest to lowest; 95% CI are included with the forecast.

The findings support the robustness of our modeling strategy, as variations below 15% between observed and predicted immigration counts are quite low. In addition, observed data of 2019 are within the CI of the forecasting in all the countries of our sample, except in Australia. Even though, Australia shows 14% variation between observed and predicted values, which is very far from 60% difference from our analysis for 2020. Taking together the results from the sensitivity analysis forecasting 2019 and those from the forecasting analysis for 2020, we can conclude that only immigration declines over 15% in 2020 can be linked to the COVID-19 pandemic. Variations below 15% during 2020 may reflect the effects of the COVID-19, but disentangling these impacts is challenging due the uncertainty levels to predict immigration flows.

Supplementary Figure 2. Sensitivity analysis of immigration change between expected and observed values in 2019



Note: Countries are ordered according to the extent of difference between the observed and forecasted immigration in 2020, from lowest to highest.