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Item 9 – Forecasting demographic components: migration

Model to forecast re-immigration of Swedish-born

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SUMMARY

In the latest forecast "The Future Population of Sweden 2009-2060", the model used for estimating re-immigration of Swedish-born persons is only described in broad terms. This report intends to give a more detailed description of the model.

Swedish-born persons comprise one of the largest immigrant groups. Unlike other immigrant groups, it is easier to construct a mathematical model to forecast re-immigration of Swedish-born persons.

In order to estimate the return immigration of Swedish-born persons, a model has been developed in which information on immigration and emigration for 1851-2007 has been used to build up a population of Swedish-born persons abroad. For each year, Swedish-born persons who have emigrated have been added to the Swedish population abroad, re-immigrants have been subtracted and the expatriate Swedish population has been reduced with the same death risks that applied to Swedes living in Sweden. According to these estimates, 780 000 Swedes lived abroad in the early 1900s. Afterwards, the number of Swedish-born persons living abroad decreased until the 1980s, when the number of expatriate Swedes again began to increase. In the forecasting model, re-immigration of Swedish-born persons is based on the estimated information on how many Swedes can be assumed to be abroad, combined with information on emigration of Swedish-born persons three years earlier.

1.   INTRODUCTION

Swedish-born persons comprise one of the largest immigrant groups. Therefore it is an important group to study more closely to be able to make predictions on Sweden's future immigration and emigration. Unlike other immigrant groups, it is easier to construct a mathematical model to forecast re-immigration of Swedish-born persons. The frame for how many people can re-immigrate is set by the number of people who emigrate, which can in turn be estimated based on emigration risks.

The model for re-immigration is built in three stages. The first stage is to estimate how many Swedish-born persons are abroad and thus belong to the risk population. The second stage is to estimate the re-immigration risks based on information on re-immigration and the size of the risk population. Finally, a model is constructed based on risks for re-immigration.
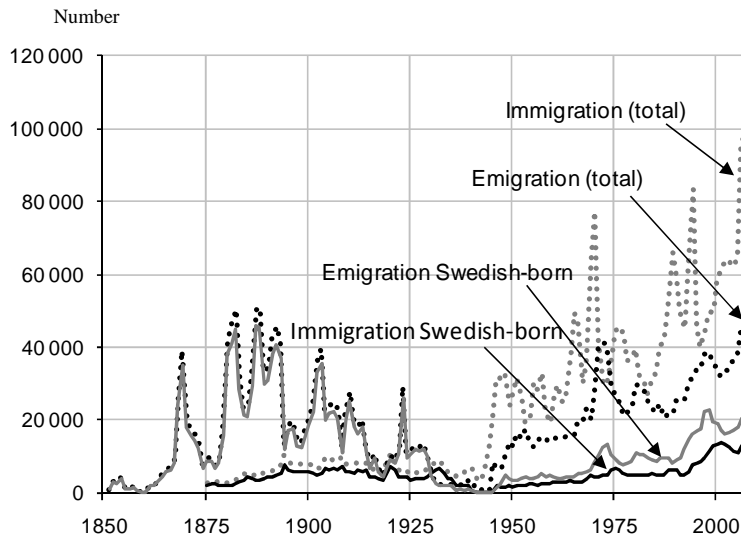
2.   SWEDES ABROAD

To determine the risks of re-immigration, information is first needed on Swedish-born persons who are abroad. This information is based on one-year categories and sex. There is no comprehensive register of Swedes abroad. The Swedish Social Insurance Agency has information on persons who live abroad and who have or have had an income in Sweden. However, this information does not include those who have not had an income in Sweden, such as those who emigrate at a young age. The National Tax Board has information on those eligible to vote who are outside of the country. But this information is only saved for ten years. After ten years, persons are removed who have not applied to remain in the register for another ten years. Therefore the number of Swedes living abroad must be estimated. These estimates are based on information on emigration and immigration by country of birth.

Immigration and emigration of Swedish-born persons

As illustrated in figure 1, Sweden was a nation of emigration for nearly one hundred years. From 1850 to 1930, nearly 1.5 million people emigrated from Sweden. 1.2 million of these emigrants went to North America. Emigration was highest 1881-1882 and 1887-1888 when the harvests were poor in Sweden and the economy was booming in the US[1]. Roughly 20 percent of the men and 15 percent of the women born in Sweden during the latter part of the 1800s emigrated from the country. The pattern changed after World War II and since then immigration has been higher than emigration, with the exception of 1972 and 1973. As a result of the high labour force immigration a few years earlier, emigration was particularly high during these years.

Figure 1 - Immigration/emigration 1850-2007, in total and for Swedish-born persons

The increased emigration during these years consists largely of children of labour force immigrants who return to their home countries.

During the 1990s, the number of Swedish-born emigrants doubled from some 10 000 people per year during the 1970s and 1980s to more than 20 000 people per year by 1998. Emigration then decreased for a few years but it has picked up momentum in recent years. In 2008 the number of Swedes who took up residence abroad amounted to almost 21 000 people. The tendency to emigrate is greater among Swedish-born persons who have a parent born abroad and greatest for those with both parents who were born abroad. In line with increased emigration of Swedish-born persons, re-immigration has also increased. Thus, it seems there is a clear connection between immigration and emigration. This connection will be studied closer in a coming section.

Data sources

Several different register based data sources have been used to follow immigration and emigration of Swedish-born persons the years 1849-2008. In the data the Swedish population is available by sex and one year age groups. More about the registers can be found in the full paper available at www.scb.se

Number of Swedish-born persons living abroad

Estimations of the number of Swedish-born persons are based on the compiled information on immigration and emigration of Swedish-born persons.

The population of Swedish persons abroad is created in about the same way as in a population forecast, but is based on actual observed immigration and emigration instead of estimations of those components. For each year that a newly emigrated Swedish-born person is added to the population of Swedish persons abroad, re-immigration is subtracted and the number of Swedish persons abroad is reduced by the same death risks that are observed for Swedes living in Sweden. It may be so that those who emigrated had been somewhat healthier than those who stayed behind, but this has not been taken into consideration. To estimate the Swedish-born population abroad the following formula has been used.

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[1] Statistics Sweden (2004) Immigration and emigration in the post-war period, Demographic Reports 2004:5

All calculations are made for one-year categories and sex.

The number of Swedish-born persons living abroad is calculated:
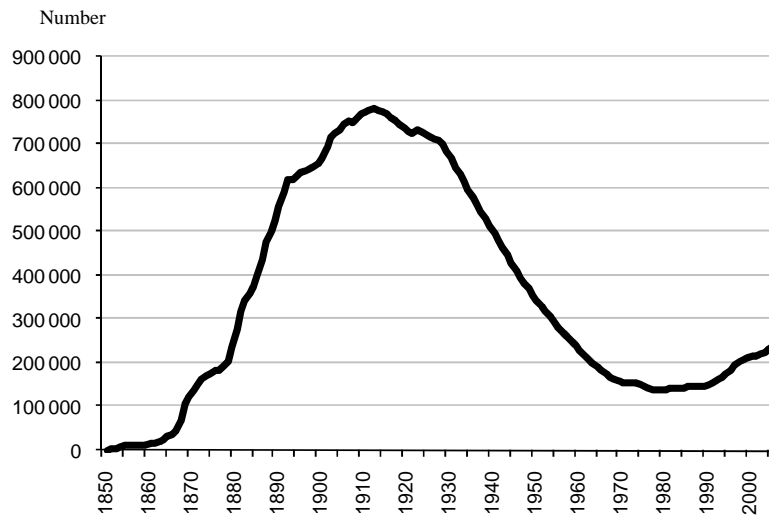
$$B_t = E_t - I_t + B_{t-1}(1 - q_t)$$

where E_t is the number of emigrants in the year t

I_t is the number of immigrants in the year t

q_t are the death risks in the year t

The estimated number of Swedish-born persons living abroad was highest in 1913 when roughly 780 000 Swedes were living abroad. Afterwards, the number of Swedish-born persons abroad drops when those who emigrated at the end of the 1800s begin to reach ages where death risks are high.

Figure 2 - Estimated number of Swedish-born persons abroad 1851-2007

According to a review[2] of censuses from different countries, it was assessed that 693 000 Swedish-born persons were living abroad in 1900, which is relatively close to the above estimation of 657 000 persons. The difference is probably because of a low registration number for emigrants[3].

Table 1 - Swedish-born persons living abroad around 1900

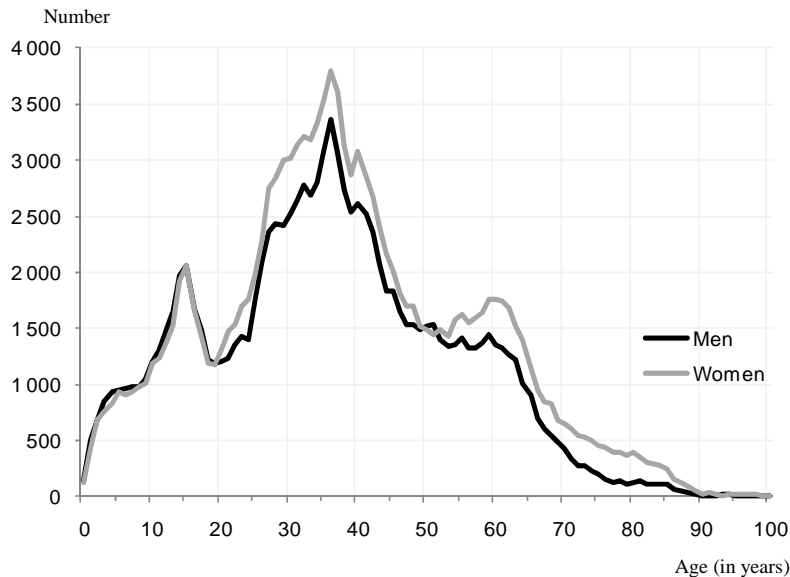| Country	Number of Swedish-born persons
North America	574 625
Norway	49 662
Denmark	35 555
Finland	1 597
Germany	12 191
United Kingdom	6 195
Other European countries	4 000
Rest of the world	10 000
Total	693 825

Source: Statistiska centralbyråns underdåniga berättelse för år 1900, A Befolkningsstatistik.
(Statistics Sweden's Report to the King for the year 1900, Population statistics)

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[2] SCB (1907) Statistiska centralbyråns underdåniga berättelse för år 1900, A Befolkningsstatistik, Ny följd. XLII: 3 (Statistics Sweden (1907) Statistics Sweden's Report to the King for the year 1900, Population statistics XLII: 3)
[3] Emigrationsforskningsgruppen (1976), Uppsala University, From Sweden to America: a history of the migration

According to the Emigration study [4] the official statistics on emigration would need to be increased by at least two-thirds for the 1850s, by 20 percent from 1860-1870 and by 10 percent for 1880-1884. During the period 1885 - 1893, the lists of the number of emigrants seem to be nearly exact. After 1893, the statistics once again worsened because permission to emigrate was no longer given to those liable for military service. As a result, illegal emigration occurred and was not registered in the church records or official statistics. If emigration is written up by 67 percent for the years 1851 - 1859, 20 percent for 1860 - 1879, 10 percent for 1880 - 1884 and by 10 percent from 1894 to 1913 (the year before World War I broke out) - we arrive at a population of 720 000 persons for Swedish-born persons abroad in 1900 and at most 870 000 persons in 1913.

Figure 3 - Sex and age structure for the estimated number of Swedish-born persons living abroad in 2007

3. FORECAST MODEL

When the population of Swedish-born persons living abroad is estimated, it is possible to estimate the risks for re-immigration for the persons in this population. The first step is to study the possibility to predict re-immigration based only on risks for re-immigration. Then, we test the possibility to improve the accuracy of the forecast by combining the risk-based re-immigration with information on the size of emigration at different points in time before re-immigration.

Risks for re-immigration

Information on re-immigrating Swedes is divided by the number of Swedes living abroad. By doing so, we create age and sex-specific re-immigration risks. Risks for re-immigration are calculated for the years 2002 - 2005 and 2007. 2006 has not been included because in that year Swedish-born children of persons who received resident permits were affected by the temporary change in the asylum law[5] which drove up the risks for those of very young ages.

Re-immigration risks based on 5-year average values are calculated for ages 0 - 74 as:

$$\hat{R}_t = \frac{\sum_{i=0}^{4} I_{(t-i)}}{\sum_{i=0}^{4} M_{(t-i)}}$$

where I_t is the number of Swedish-born immigrants in year t

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[4] Emigration study (1910), appendix IV Pages 251-252
[5] On 9 November 2005, the Swedish Parliament decided that temporary legislation for residence permits would apply up until the new Aliens Act which would be enacted on 31 March 2006. The temporary legislation was mainly directed towards families with children who had lived in Sweden for a long time and to people from countries where deportation is not an option. Roughly 31 000 matters were handled according to the temporary legislation, and about 17 000 residence permits were granted.

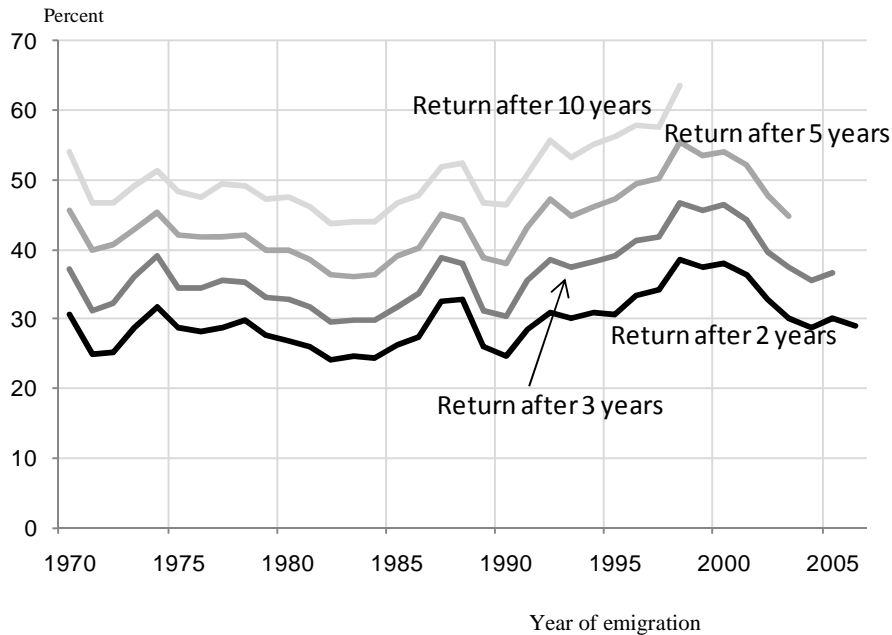M_t is the average size of the Swedish-born population living abroad in year t

The following calculation is used for those aged 75 and above

$$\hat{R}_t = \frac{\displaystyle\sum_{i=0}^{4}\sum_{x=75}^{\infty} I_{(t-i)x}}{\displaystyle\sum_{i=0}^{4}\sum_{x=75}^{\infty} M_{(t-i)x}}$$

Business cycle fluctuations

As illustrated in graph 4 below, the percentage of those who re-immigrate differs among the different emigration cohorts[6]. The variations in the percentage of those who re-immigrate occurred during the first and second year after emigration, and then evened out somewhat with time. It is thus the first and second year after emigration that the percentage of those who re-immigrate differ from the different emigration cohorts. As a result, these years are the most sensitive for fluctuations in the business cycle. In figure 4 this can be seen because the lines move in parallel over the years that the differences in levels of the first years' re-immigration have not changed especially.
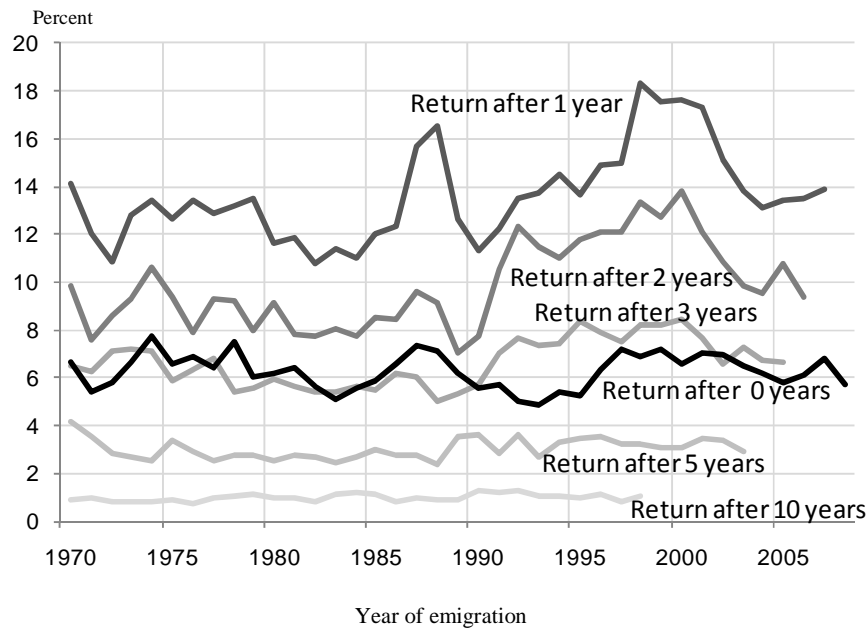
Figure 4 - Proportion of Swedish-born persons that has re-immigrated after 2, 4, 5 and 10 years,
by year of emigration 1970-2007

Comment: Of those who emigrated in 1995, 30 percent had re-immigrated to Sweden after two years,
and 55 percent had re-immigrated after 10 years.

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[6] Emigration cohorts refer here to persons who emigrated during a certain year.

Figure 5 - Proportion of re-immigrated Swedish-born persons who re-immigrate
by year of emigration 1970-2007 and time since emigration

Comment: Of those who emigrated in 1995, roughly 5 percent re-immigrate before one year has passed (1 to 12 months),
14 percent re-immigrate after they have been abroad for one year (13-24 months) etc.

Figure 6 illustrates the risk to re-immigrate in relation to the number of employed persons in Sweden. On the right axis we see development of the total re-immigration risks, while the left axis shows the development of the number of employed persons according to Statistics Sweden's Labour Force Survey (LFS). As seen in the graph, the risk to re-immigrate increases when the number of employed persons increases. This could be interpreted that those who emigrate just before a slowdown in the economy do not re-immigrate to the same degree as those who emigrate just before a boom in the economy. A linear regression where total risks of re-immigration[7] is the dependent variable and the number of employed persons is the independent variable, results in a significant connection on the one percent level with a coefficient of determination of 25 percent. However, a coefficient of determination of 76 percent is received when only looking at the years 1993-2007. The possibility to change jobs and get a new job in one's home country seems to affect re-immigration to a certain degree. It may be because if a person stays abroad somewhat longer for various reasons, the probability of staying abroad increases.
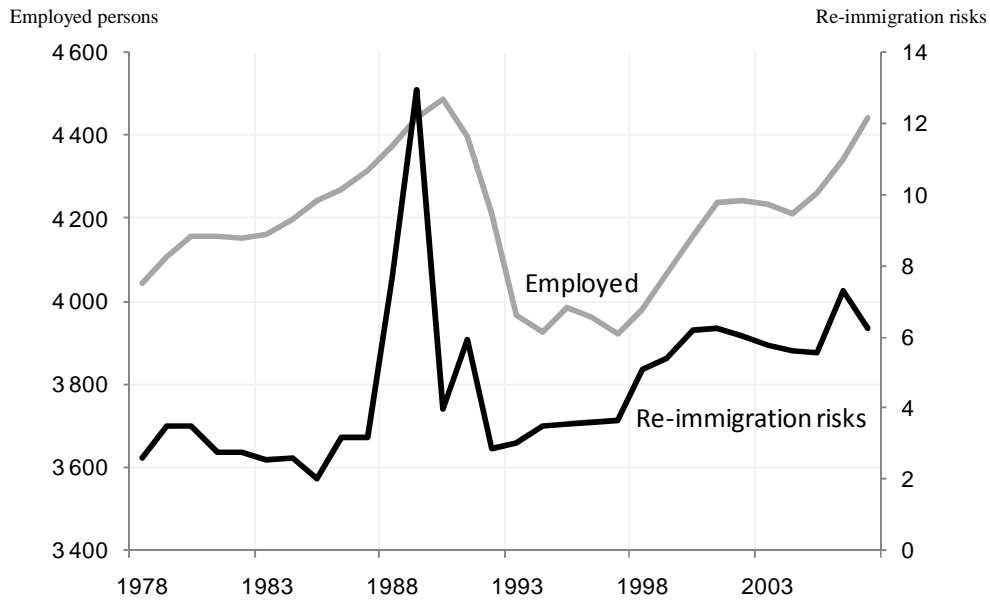
This type of behaviour would be in line with observations for foreign-born immigrants who come to Sweden, where the tendency to re-immigrate decreases the longer the immigrant stays in the country [8].

The connection between the economic cycle and the tendency to re-immigrate would be interesting to study in more detail, but in this paper we only conclude that such a connection exists.

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[7] Total risks of re-immigration inform how many times an emigrant would on average re-immigrate if that person was abroad during an entire lifetime (0 - 75 years) according to age-specific re-immigration risks. Just because it gives an average re-immigration for more than one time does not mean that everyone re-immigrates. This is because those persons who actually re-immigrate do so within a short period of time. When 50 percent have re-immigrated after five years, we get risks than imply that after 75 years abroad, a person would have re-immigrated a couple of times on average.
[8] Statistics Sweden (2004) Immigration and emigration in the post-war period, Demographic Reports 2004:5

Figure 6 - Total re-immigration risks (age 0-75) and number of employed persons (thousands) in Sweden 1978-2007

Model for immigration of Swedish-born persons

As illustrated in graph 7, an estimation of immigration only based on re-immigration risks does not follow the observed development particularly well. In the graph we also see that re-immigration follows emigration quite well, but with a delay by a few years. However, a linear regression where immigration created by re-immigration rates, combined with information on emigration three years earlier gives a goodness of fit. This regression has a coefficient of determination of 97 percent when it is based on the years 1981 - 2007, and 71 percent when based on the years 1998 - 2007. This is also illustrated in graph 7. Both of the regression equations give a re-immigration that lies quite close to the results according to the Total Population Register. It is natural that the equation that is created from the data between 1981 - 2007 also shows a trend that is closest to the outcome for this period. However, it is interesting that the equation that is created for the years 1998 - 2007 gives a re-immigration that is also close to the outcome for the years before 1998.

The latter equation based on the years 1998 - 2007 will be used in the model. Because the model has shown to work well in estimating trends back in time, it is also assumed to function as a model to forecast the future re-immigration of Swedish-born persons. The model also has the best fit for recent years. In today's globalised world with increased mobility, we can assume that the most recent years will contribute to a better basis for estimation of future migration patterns, than by using a migration pattern from a time when mobility was less.

Migration three years previously is the variable that gave the best coefficient of determination, but the variable also has the advantage that the economy does not have as great an influence after three years, compared to the first two years after emigration. The model is thus not as sensitive for economic swings, as it would be if the first two years had been included in the calculations.
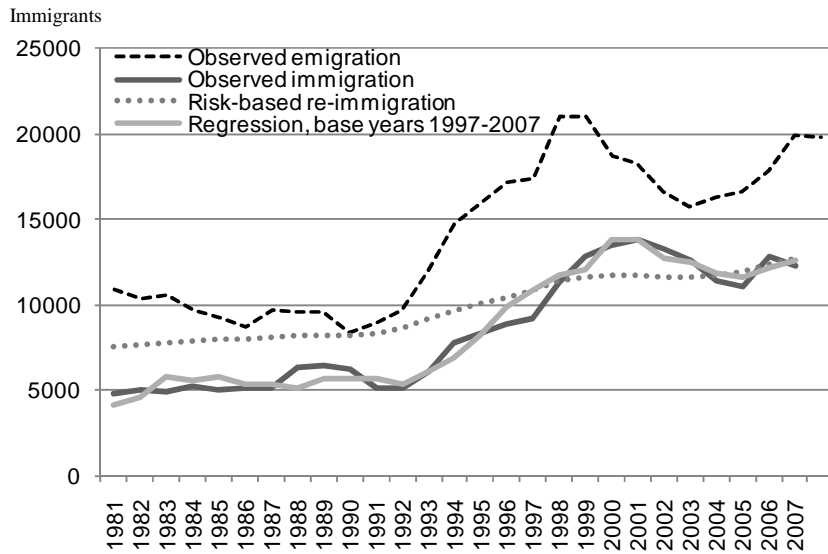
The forecast is calculated as follows:

$$\hat{I}_t^r = \hat{R}_t^5 \cdot B_{t-1}$$

$$\hat{I}_t^{reg} = -5059 + 0{,}90683 \cdot \hat{I}_t^r + 0{,}37266 \cdot E_{t-3}$$

$$B_t = E_t - \hat{I}_t^{reg} + B_{t-1} \cdot (1 - q_t)$$

For those aged 0, $B_t = E_t$

Figure 7 - Forecast for 1981-2007 based on re-immigration risks and regression model where the re-immigration risks are combined with data for the emigration three years earlier, and the observed immigration and emigration
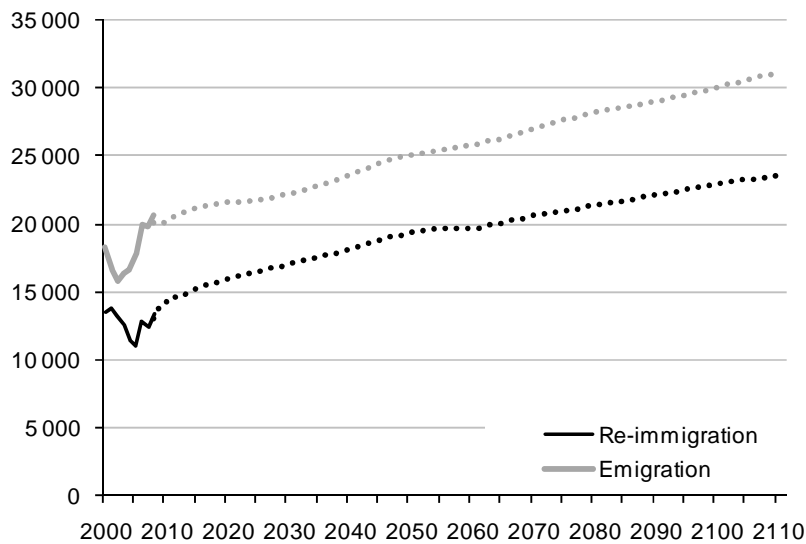

4. RESULTS

As an example of results from the model, we illustrate here the forecast of immigration and emigration of Swedish-born persons in the latest population forecast[9] where the model was used for the first time.

Immigration of Swedish-born persons

The forecast model gives a re-immigration that increases during the entire forecast period. The long-term increase in the estimated number of persons re-immigrating during the forecast period is because the number of Swedish-born persons abroad increases according to the calculations. However, the annual variations are largely due to the size of emigration three years earlier, which in turn depends on how many Swedish-born persons living abroad are of the age when the tendency to emigrate is considerable.
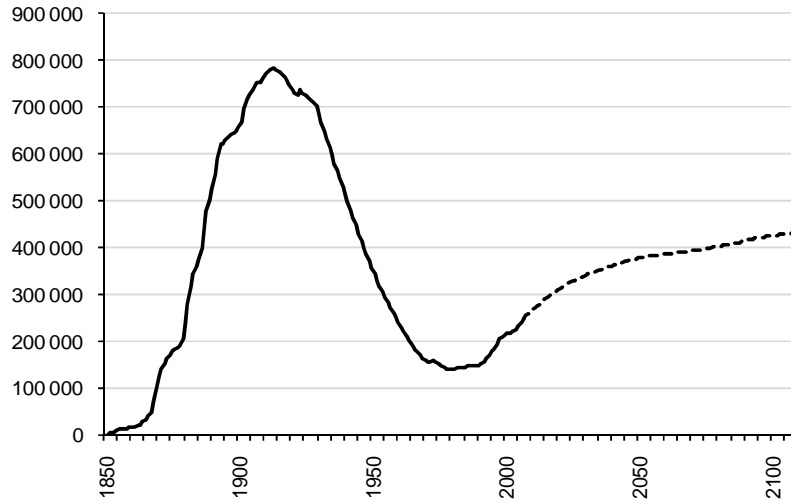
Figure 9 - Forecast of emigration and re-immigration for 2009 - 2010

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[9] Statistics Sweden (2009), The future population of Sweden 2009-2060, Demographic Reports 2009:1.

In the beginning of the forecast period it is assumed that the number of Swedish-born persons abroad will increase rather sharply, and will then stabilise at a level of just below 400 000 at the end of the forecast period (see figure 10). The lower rate of increase of Swedish-born persons abroad is because those who emigrated at the start of the 2000s have reached an age where death risks are high.

Figure 10 - Forecast of number of Swedish-born persons living abroad 1850 - 2100

The age structure of those who re-immigrate is based on the observed distribution for the years 2003 - 2005 and 2007 - 2008[10]. There are roughly equal numbers of men and women among Swedish-born immigrants (see figure 11). The women are somewhat younger than the men when they leave Sweden, which is also reflected in immigration.

Figure 11 - Age and sex distribution for re-immigrants, based on data for 2003 - 2005 and 2007 - 2008

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[10] When the asylum law was temporarily changed in 2006, many children born in Sweden with foreign-born parents received residence permits. This has influenced the age structure in 2006, and thus this year is excluded.

5. REFERENCES

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