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Test of an estimation method for annual migration flows between EU-EFTA countries

Note by the Statistical Office of the European Union (Eurostat)

Abstract

This paper is a first step in the exploration of estimation methods proposed in the international scientific literature to overcome problems of data quality and availability in migration statistics. The method here considered has been originally developed to estimate broad migration flows on global scale over time using population stocks broken down by place of birth. The test has shown that this method cannot provide a full coverage of migration flows within the EU-EFTA region primarily due to lack of input data, but can estimate the flows of persons born in specific countries. It has also be found that the method can profitably be applied using any breakdown of population stocks, such as by citizenship or educational attainment, which opens the way to interesting applications. The same logic can actually be used on population data with no breakdowns to get an estimate of the entire migration flows within the region. However, a real application requires much further work to identify additional information (offsets) to be used in the estimation model to overcome the limiting assumption about the maximum number of stayers (persons not migrating) used in the standard approach.

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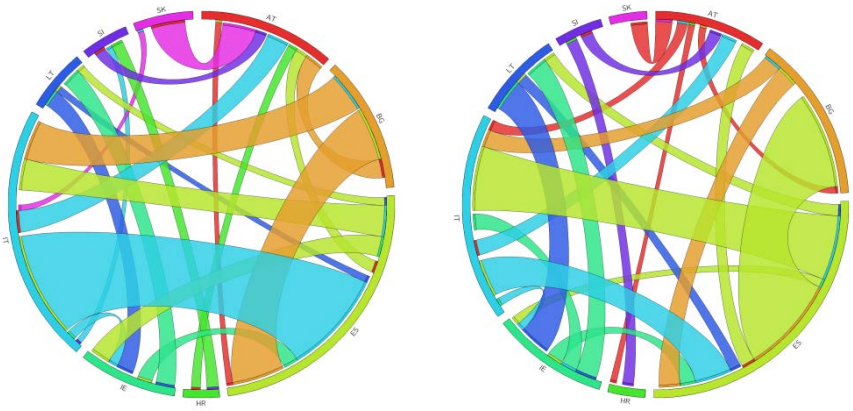
Introduction

1. Migration statistics are since long being known as very challenging to produce. In a recent note (Lanzieri, 2014) it was argued that statisticians in charge of producing these data may look at estimation methods to improve their quality and/or overcome problems of data availability. It was there also suggested that some of those methods proposed in the scientific literature may be better applied from an international perspective.

2. Due to the freedom of movements between their Member States and their close economic ties, the European Union (EU) and the European Free Trade Association (EFTA) may be seen all together as a migration system, here basically meant as a network of countries linked by flows and counter-flows of people. They are thus an ideal set to test the validity of the estimation methods which target origin-destination migration tables. Other areas, such as the former Soviet Union, may represent interesting regions of application but the attention is here focussed on the former group of countries due to the developments in the field of migration statistics done in this region over the latest years.

3. Issued in 2007, an EU Regulation on migration statistics[1] has since then contributed to improve data availability and quality. Despite of all efforts, still in the latest reported year there are important discordances between migration flows observed in the receiving countries (thus based on immigration data) as compared to those recorded in the sending ones (based on emigration data). The Figure 1 shows for selected European countries the different messages that users may get looking at immigration or emigration data to analyse migration flows in 2012. For instance, from immigration data one may conclude that the largest flows among the selected countries were from Italy to Spain (the thickest light blue ribbon) and from Bulgaria to Italy and Spain (the light orange ribbons), whilst looking at emigration data they seem to be from Spain to Bulgaria and Italy (the light green ribbons).

Figure 1: circular graphs[2] based on immigration data (left panel) and emigration data (right panel) of migration flows between nine selected European countries in 2012



[1] Regulation (EC) No 862/2007 on Community statistics on migration and international protection (OJ L 199, 31.7.2007, p. 23) and its implementing measures.

[2] Graphs produced using Circos (Krzywinski, M. *et al.*, 2009). On this kind of circular layout specifically applied to migration data for the first time, see Sander *et al.* (2014). For the sake of readability, only the largest flows are represented in the graphs.

4. Among the methods available in literature[3], the one proposed by Abel (2013) makes use of population stocks data broken down by country of birth in a selected set of countries to estimate migration flows between them. The method was developed basically to obtain global flows at broad regional level over time. Although it was thus thought for a larger scale, its features make it interesting for the EU case. In fact, due to the obligations stemming from the EU Regulation on migration statistics, the EU-EFTA countries report annually to Eurostat various migration data. Population by single country of birth is provided on voluntary basis, because that legal obligation applies only for the native-born/foreign-born breakdown, without distinction by single country of birth. Besides stocks data, these countries report to Eurostat also about migration flows but, again, the obligation to report is only for rather aggregated data, and the detail by single country of origin/destination (more precisely, country of previous/next residence) is provided only on voluntary basis. As noted above, these flows data are still affected by issues of international consistency. It may be interesting to note that, because these annual statistics are based on the concept of usual residence, for which a migration is qualified by a change of residence lasting for a period of at least 12 months, there is virtually a one-to-one correspondence between events (migrations) and persons experiencing the events (migrants).

5. This note presents the results of a very first application of the method of Abel (2013) to estimate migration flows occurred between selected EU-EFTA countries. This is part of a wider plan of assessment of the performances of various estimation methods proposed in the scientific literature in view of their regular use. The application is here limited to the estimation of the flows in the year 2012, which is the most recent available year, because the implementation of the EU Regulation has had (and it is still having) a progressive beneficial effect on the data availability and quality, and some of the post-census revisions are already taken into account. The intention here is however to make a test on 'real' data, thus working also with data which may be affected by issues of quality. A more comprehensive assessment would require wider time coverage, but for illustrative purposes the single year is deemed sufficient. Section II of this note illustrates the preparation of the data input, a quite relevant step in the method under test. Section III analyses the results of its standard application. Section IV and V present some developments and Section VI concludes. Data are reported separately in two annexes: the first contains the main results and it is annexed to this note; the second includes several tables that can help the reader to replicate the data preparation procedure, and it is available from the author upon request.

I. Data preparation

6. The Abel's method starts from tables reporting the number of person residing in each country (columns) by their place of birth (rows). The set of countries of residence must be the same set used to categorize the place of birth of the persons. In other words, the method would better be applied to a region as 'exhaustive' as possible as for the migration flows of relevance, although it can take into account migrations crossing the borders of this region.

7. All data used in the current application are from the Eurostat public database[4]. For the population on 1 January 2012 and 2013[5] (Table II-1 and Table II-2), data are available from the following 21 countries (listed according to the EU protocol order): Belgium (BE),

[3] For a list of scientific proposals over the latest two decades, see Lanzieri (2014).

[4] Website: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

[5] The population data actually refer to the end of the previous year (thus to end of 2011 and end of 2012), but they are conventionally disseminated as of 1 January of the following year.

Bulgaria (BG), the Czech Republic (CZ), Denmark (DK), Ireland (IE), Spain (ES), Italy (IT), Latvia (LV), Hungary (HU), the Netherlands (NL), Austria (AT), Poland (PL), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE), Iceland (IS), Liechtenstein (LI), Norway (NO) and Switzerland (CH). Thus about two third of the countries of the EU-EFTA region provide these data. Although major European immigration countries are missing (namely Germany, France and the United Kingdom[6]), they represent a good enough variety, from net sending to net receiving countries, with old and recent immigration, as well as of different population sizes[7]. In this application, the starting data are thus two 21x21 tables, one referring to the 1 January 2012 (moment t_1) and the other to the 1 January 2013 (moment t_2). However, the population residing in those countries but not born in any of them is grouped in an additional row "Others". Such population is here computed as residual from the total population and thus it includes those persons with unknown country of birth[8]. As for migration flows data by single country of origin or destination, for 2012 (the most recent available year) they are available for 16 out of the 21 selected countries[9] (Table II-3). These data by country of previous/next residence represents a source of information against which results from the estimation can be confronted.

8. Basically, there are four reasons for a change in the "country-of-birth" – "country-of-residence" table between two moments in time t_1 and t_2: live births, deaths, migration to/from outside the region, migration within the region. The former three are progressively removed in order to isolate the component of interest, i.e. the migration flows between countries of the region.

9. By definition[10], live births in a country are affecting the size of its native-born population only. Assuming that there is no emigration of newborns, the number of live births (Table II-4) can thus be deducted from the population born in the same country in which they reside at the time t_2 (at the time t_1 they were not yet there...).

10. Deaths may obviously occur to persons of any country of birth and they should then be deducted from the corresponding population at risk. Lacking the information on deaths by single country of birth, Abel (2013) suggests deducting the deaths occurring in the period between t_1 and t_2 from each population by country of birth at the time t_1 proportionally to their size (Table II-5). However, by doing so, it is implicitly assumed that native-born population and the various foreign-born populations all share the same mortality pattern and that their population structure is the same at the time t_2. Particularly this latter assumption may be rather inappropriate in countries where immigration is a relatively recent phenomenon. The data available in Eurostat allows distinguishing for some countries between deaths of native-born persons and those of foreign-born persons: the former are then deducted from the native-born population residing in the country at the time t_2, while the latter are proportionally attributed to the foreign-born populations of the same country (Table II-6). Such distinction reduces the influence of different population

6 The Office for National Statistics (ONS) of the United Kingdom only provides data for those resident foreign-born populations with the largest sizes.

7 In this set of countries, population data by country of birth or by citizenship are pre-census only for Italy and Romania as of 1 January 2012. All the rest are post-census data.

8 Alternatively, it could be computed as residual from the total *foreign-born* population, and then the unknown could be redistributed across the various countries of birth.

9 The missing countries are: the Czech Republic, Latvia, Hungary, Poland and Romania.

10 It is irrelevant whether the live birth occurred by a native-born or a foreign-born mother, because the event took place in the reporting country, and therefore the new-born has that same country as place of birth. For the same reason, it is as well irrelevant whether the live birth occurred to a mother born in a country not considered in the set.

structures within a country. In this application it is found that using the proportional allocation in net receiving country in general would under-estimate the number of deaths of native-born populations, and vice-versa for net sending countries (or countries of recent net immigration)[11]. Further caution, in order to properly attribute deaths in proportional way across the countries (of birth) considered in this application, it is necessary to consider the quota of their population size on the total number of resident persons, and not on their sum.

11. After having removed the effect of vital events, any difference in the totals by row between two moments in time t_1 and t_2 is attributable to migration to/from the considered region. In fact, excluding births and deaths, a person born in a given country may also migrate in another country of the region, but this would not affect the overall row total. For each country of birth, if the row total in t_2, cleaned by vital events, is bigger (smaller) than in t_1, then some persons born in that same country have moved to (outside) the region[12]. The number of persons born in each selected country and *immigrated* in the region, estimated by the difference between the total population size of the same country of birth in t_2 (the row total) minus the corresponding value in t_1, is then subtracted from the total in t_2. That number is deducted from each country of residence proportionally to the size of the resident population at the time t_2 of the same country of birth being considered[13] (Table II-7). Likewise, the number of persons born in each selected country and *emigrated* from the region, estimated by the difference between the total population size of the same country of birth in t_1 (the row total) minus the corresponding value in t_2, is then subtracted from the total in t_1. Again, that number is distributed across columns proportionally to the resident population at the time t_1 born in the same country[14] (Table II-8). It must be noted that, by using the proportional criterion, the bulk of the migrations are attributed to the native-born populations: thus, either they are persons who have emigrated from their native country to outside the region, or they are persons who migrate back to their country of birth from outside the region[15]. It must be noted that these flows exclude immigration/emigration flows of people whose country of birth is not part of the selected set (e.g., to/from China or African countries, but also to/from Germany, etc.).

12. At this point, the two tables with population stocks have the same row totals (Tables II-9 and II-10). Differences in the single cells of the same row between the two tables are imputable to migrations within the region. However, a simple computation by difference would not give the information about the countries of origin of the flows. To overcome this point, the tables can be split by single country of birth and re-arranged differently: the row of the (modified) population stocks table referring to t_1 are the row marginal values of a new table origin/destination with the same set of countries, and the corresponding row of the table referring to t_2 are the column marginal values. Because the corresponding row totals in the modified population stocks tables are equal, the column and row marginal values of these new tables sum up to the same quantity. By doing such re-arrangement, the problem is now expressed in the form of origin-destination matrices (as many as the number of countries of birth under consideration) with known marginal values and empty cells, which can be dealt by the iterative method of estimation proposed in Abel (2013).

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11 For 2012, there are 14 EU-EFTA countries for which data on deaths by country of birth are available. The average bias for Denmark, Spain, Italy, the Netherlands, Austria, Finland, Sweden, Iceland and Norway is -6.1%, meaning that the proportional allocation would attribute to the native-born population fewer deaths than actually recorded. For Latvia, Hungary, Romania, Slovenia and Slovakia, that average relative difference between proportional and observed deaths is +5.7%.

12 This is only the net effect.

13 Abel (2013:522) suggests instead allocating proportionally to the population size in t_1. However, the allocation here proposed seems more coherent with the logic used for live births and deaths.

14 Abel (2013:522) suggests allocating proportionally to the population size in t_2.

15 Alternative criteria of allocation could be used in further refinements of the method.

13. Filling the cells of these new origin-destination tables specific for each country of birth implies the estimation of the diagonal cells, i.e. of the number of persons who actually stay in the same country. For each diagonal cell, Abel (2013) suggests to take the maximum possible number of "stayers", given the constraints of the marginal values, although warning that other criteria are well possible. This assumption has the effect of minimising the flows between countries in those origin-destination tables. Removing the diagonal cells and summing up all the tables specific to each country of birth returns the estimated overall origin-destination migration table between the selected countries.

14. All the operations can be easily performed thanks to the R package *migest* developed by Abel (2014), where the input is the original population stocks tables, supplemented by the data about births and deaths. Alternatively, one can input altered population stocks and (fake) null births and deaths.

II. Results using country of birth data

15. The estimated migration flows are shown in the Table 1, with about 331 thousand people estimated to having moved in 2012 between the selected countries. At a first glance, some of the results may look unusual. For instance, only 2 persons would have moved from Belgium to Italy, against 814 to Spain, or Finland is estimated to have fewer emigrants than Lichtenstein, etc. On the other side, some expected relevant flows between countries seem caught, such as the between Belgium and the Netherlands, or the Czech Republic and Slovakia. The largest outflow is estimated to occur from Romania, with relevant destinations Italy and Hungary, the first flow representing in fact about 31% of the overall flows. While such results for emigration from Romania seem sound, those for another net sending country – Bulgaria – are less convincing, because emigration is there estimated to have involved only about 1500 persons. The smallness of the flows for some countries may also be the consequence of the assumption of maximisation of the number of stayers (see paragraph 13 above).

16. These flows can be compared only partially with official immigration/emigration statistics, because they represent the migrations of persons born in the selected countries and not the overall flows. Therefore, in principle, these estimated flows cannot be bigger than the official statistics of migration flows. Because the disaggregation by single country of origin/destination is provided on voluntary basis by the national statistical offices, a direct comparison can be done here for 16 out of the 21 selected countries (see Table II-3), and using immigration rather than emigration data, given the notorious additional difficulties to measure this latter flow. The comparison between estimates and official statistics of origin-destination migration flows between these 16 countries show that, for most cases, the estimated flows are only a quota – sometimes very limited – of the entire flows (Tables II-11 and II-12). For instance, the estimated outflow from Bulgaria would be only a very little part of that recorded in official statistics, implying that the majority of emigrants from Bulgaria to one of the 15 countries considered in the table are persons who were born neither in Bulgaria nor in any of the other twenty countries of this exercise. In some cases, however, the estimated flows are bigger than the official statistics – occasionally remarkably bigger. This may be due basically[16] to three reasons: errors in the statistics of population stocks, errors in the immigration official statistics, or bad performance of the estimation method. The answer requires an in-depth investigation which

[16] There may also be other reasons, such errors in the number (and breakdown) of vital events (the proportional attribution is considered part of the estimation procedure), but they should be here of less importance.

is beyond the scope of this paper, but the finding highlights the need to assess against comparable data, possibly extending the coverage of the countries included in the estimation exercise.

17. To partially overcome this latter limitation, it could be enough to add a column to the list of countries of residence reporting data about all other countries (in fact, the counterparts of the bottom row "Others" reported in some tables for the countries of birth other than listed) and to retrieve information also about the corresponding vital events. By using data referring to the world as a whole, such data could be derived by difference between the world total and the sum of the values of the set of considered countries. Data on total population, as well as on annual live births and deaths for the entire world, are estimated/projected by the United Nations Population Division. The only missing piece of information is the breakdown of the global population by country of birth for two successive years. In other words, there are no data about how many people were born in one of the selected countries and living in the entire world for the years of interest (and anyway they would not be available on regular basis). Due to this lack of data, such extension cannot be implemented and therefore it is not possible to estimate the entire migration flows for the selected EU-EFTA countries using the Abel's method with country of birth data.

III. Extending the applicability of the method: flows by citizenship

18. The Abel's method has been developed using information on population stocks by country of birth. This has several advantages, among which the fact the country of birth is an unmodifiable[17] characteristic of the person and thus there are no moves across the categories of this variable from one year to another due to a change of status. However, there is at least another breakdown for which there may be relevant migration policy interest, which is by citizenship. Policy-makers may be interested to know the migration flows for specific citizenships, the very same way they are estimated in the origin-destination tables mentioned in the paragraph 12 above. The same may apply for other characteristics which are of interest from a migration policy perspective, such as educational attainment.

19. The estimation of the migration flows based on citizenship can follow the same procedure described above, but with some adaptations. First of all, live births may not be any more allocated uniquely to the host population, because the rules for the citizenship of newborns may be different from the *jus soli*. If information about the way citizenship is attributed to a newborn in a given country is not known, they could be allocated in a proportional fashion. Secondly, unlike for the country of birth, a person may change the citizenship during the considered period, which corresponds to a move across rows of the starting table reporting the population stocks by citizenship. The issue related to multiple citizenships should be of minor relevance, because anyway the person will be categorized according to the prevalent citizenship, most probably the one of the host country.

20. The data availability of population stocks by citizenship is slightly richer than by country of birth. Besides the 21 countries considered so far, data are available also for Germany and Portugal, as well as for Candidate Countries such as Turkey. However, for the sake of comparability, the exercise is limited to the 21 countries considered so far

[17] Provided that there are no changes in the geographical borders of the country. For instance, persons born in former Yugoslavia would now be categorized in one of the countries originated by its dissolution.

(Tables II-13 and II-14). The total resident population for each country is obviously the same as in the tables based on country of birth.

21. Data on live births by citizenship of the mother (Table II-15) and deaths by citizenship of the deceased person (Table II-16) are available for all 21 countries but Belgium, Ireland and Poland. For these latter countries, live births and deaths are distributed proportionally to the size of population groups at the time t_1 within each country. For the other eighteen countries, vital events related to foreign population is attributed proportionally to each foreign group, whilst those of national population are taken from official statistics. For live births, this means that, unlike for the breakdown by country of birth, the events are not attributed only to the host population. The implicit assumptions are that the citizenship of the father does not matter and the newborn takes the citizenship of the mother (*jus sanguinis*) and not the one of the country of occurrence[18] (*jus soli*). As in the case of country of birth data, deaths are deducted from the population at the time t_1, while live births from that at the time t_2.

22. Changes between rows (citizenships) are the extension here introduced. Data on acquisitions of citizenship in 2012 by single former citizenship are available for all 21 countries but Romania, for which data from 2009 are taken (Table II-17). The assumptions behind the attribution of changes in citizenship may be not straightforward. A person may well acquire another citizenship without necessarily renouncing to the one(s) already held, especially within EU countries; however, most probably the person will take the citizenship of the country in which resides and will thus be classified as national citizen even if holding additional citizenship(s). Thus, the total number of acquisitions of citizenship of a country can be deduced from the national population, while the number of former citizenships re-attributed to the foreign population of origin, operation which does not affect the total resident population size. Such redistribution across rows (citizenships) is done on the population stocks at the time t_2.

23. After removing the vital events and the changes due to acquisitions of citizenship, the situation is the same as in the paragraph 11 above. Residual differences in the row totals are imputable to migration (of persons whose citizenship is one of those considered) to/from outside the region composed by the 21 countries. The same procedure is thus applied here again, with proportional attribution across countries based on the adjusted population sizes at the time t_1 for flows to outside the region, and at the time t_2 for flows from outside the region. The flows to outside the region are then subtracted from the populations at the time t_1, while those from outside are deducted from the populations at the time t_2. The resulting re-estimated population stocks by citizenship have now the same row totals in the two times t_1 and t_2 (Tables II-18 and II-19). These tables are then processed with the R package *migest* (Abel, 2014) to produce the estimates of origin-destination migration flows within the region reported in the Table 2.

24. The considerations that can be drawn from the results using citizenship are similar to those done when using country of birth and are not repeated here. It may however be worthwhile to note that some of the odd outcomes, such as for Italy, may be also explained with the data used as input. In general, one of the major advantages of this approach is the possibility to get results for specific categories (a citizenship, a country of birth, etc.), while the estimation of the entire migratory flows is subordinate to the availability of breakdowns data on global scale.

[18] This point could be improved with information about the actual citizenship policy of the countries.

IV. Is a breakdown needed? Working on entire flows

25. It may be useful to recall now the basic demographic accounting equation for a generic country *c* of a selected set *C*:

$$P_{t_1} + B[t_1, t_2] - D[t_1, t_2] + I_R[t_1, t_2] + I_O[t_1, t_2] - E_R[t_1, t_2] - E_O[t_1, t_2] = P_{t_2} \quad \textbf{[1]}$$

where besides the usual standard notation, there is the distinction of migratory flows to/from countries within the considered region (subscript *R*) and those to/from outside (subscript *O*). The **[1]** can be rewritten as follows:

$$\begin{aligned}\left(P_{t_1} - D[t_1, t_2] - E_O[t_1, t_2]\right) + I_R[t_1, t_2] - E_R[t_1, t_2] \\ = \left(P_{t_2} - B[t_1, t_2] - I_O[t_1, t_2]\right)\end{aligned} \quad \textbf{[2]}$$

where the reader can recognise the corrections, described in the Section II on data preparation, made to the original population stocks, the difference being that they were made on subpopulation groups. Thus, the **[2]** can be written as:

$$P^*_{t_1} + I_R[t_1, t_2] - E_R[t_1, t_2] = P^*_{t_2} \quad \textbf{[3]}$$

where the *P** are the re-estimated altered population stocks in the Abel's terminology. When the **[3]** is summed over all the countries of the region *R*, the internal flows compensate each other and therefore $\sum_R P^*_{t_1} = \sum_R P^*_{t_2}$. This means that if the population stocks of the countries of the region at two different times are used respectively as row and column totals in an origin-destination table, the sum of those margins (i.e., the bottom-right cell in the table) is the same.

26. When a breakdown is taken into account, the same logic applies. In fact, given the modality *v* of an unchangeable characteristic *V* (such as the country of birth), the **[2]** can be expressed as:

$$\begin{aligned}\left(P_{t_1,v} - D_v[t_1, t_2] - E_{O,v}[t_1, t_2]\right) + I_{R,v}[t_1, t_2] - E_{R,v}[t_1, t_2] \\ = \left(P_{t_2,v} - B_v[t_1, t_2] - I_{O,v}[t_1, t_2]\right)\end{aligned} \quad \textbf{[4]}$$

whose sum over *v* obviously returns the total for the entire resident population of the country. In a table where the columns report data about the country of residence *j* and the rows data about any breakdown *i* of those resident populations, it is:

$$\begin{aligned}\left(P_{t_1,ij} - D_{ij}[t_1, t_2] - E_{O,ij}[t_1, t_2]\right) + I_{R,ij}[t_1, t_2] - E_{R,ij}[t_1, t_2] \\ = \left(P_{t_2,ij} - B_{ij}[t_1, t_2] - I_{O,ij}[t_1, t_2]\right)\end{aligned} \quad \textbf{[5]}$$

and when the variable represents a changeable characteristic, such as citizenship:

$$\begin{aligned}\left(P_{t_1,ij} - D_{ij}[t_1, t_2] - E_{O,ij}[t_1, t_2]\right) + I_{R,ij}[t_1, t_2] - E_{R,ij}[t_1, t_2] \\ = \left(P_{t_2,ij} - B_{ij}[t_1, t_2] - I_{O,ij}[t_1, t_2] + N_{ij}[t_1, t_2] - X_{ij}[t_1, t_2]\right)\end{aligned} \quad \textbf{[6]}$$

indicating by *N* the entries in the state *j* from the state *i* and by *X* the corresponding exits (returns), with $\sum_j N_{ij}[t_1, t_2] = \sum_j X_{ij}[t_1, t_2]$, $N_{i,j=i}[t_1, t_2] = 0$ and $X_{i,j\neq i}[t_1, t_2] = 0$. For each category *i* of the considered breakdown, the relation with altered population stocks is thus again:

$$P^*_{t_1,i} + I_{R,i}[t_1, t_2] - E_{R,i}[t_1, t_2] = P^*_{t_2,i} \quad \textbf{[7]}$$

27. The procedure described in previous sections can then be applied in the general case of 'unbroken' data. Unlike for the case of the breakdowns by country of birth or citizenship, estimates about the total population size and number of events are available from UNPD (2013). The set of 21 countries can thus be complemented with information about the 'rest of the world'. At this point, this set of countries could easily be extended to cover the entire EU and EFTA (and any additional country, such as Candidate Countries), but it is here limited to the original set to easier the comparison with previous results.

28. The Table 3 shows the process of preparation of the data. Columns from 2 to 5 report the figures about population stocks and vital events as available from official

statistics, where data about the rest of the world are derived by difference. Column 6 and column 7 show the population stocks at the two moments in time cleaned from vital events, respectively deaths and births. Now, because summing over countries the intra-flows compensate each other, the total population of the selected set of countries should be equal in t_1 and t_2, unless migrations to/from outside the region have occurred. The difference in 2012 is found to be about 2.2 million persons having left any of the 21 countries to outside the region; in contrast, the rest of the world has received the same flow. Because it is here assumed that the country of departure is not known, these emigrants are simply redistributed proportionally to the population size. It should be noted that this is only a net effect, and inflows with larger outflows may well have occurred. It can also be noted that on global scale, net migration is (correctly) zero, i.e. the two population stocks cleaned by vital events are equal. The next two columns report the populations adjusted for migration outside the region and the last two columns the migration inflows and outflows within the region respectively, obtained by the simple difference between the adjusted population stocks. The totals of both the latter columns are equal to about 1.7 million persons, which represents the overall estimated intra-flows occurred in the region in 2012.

29. The adjusted population stocks in t_1 and t_2 can be considered respectively the row and column totals of an origin-destination migration table, whose cells can be estimated by applying the Expectation-Maximisation (EM) algorithm (equivalent to an iterative proportional fitting, see Willekens 1999). However, such a table would still include those persons who did not migrate, and a crude application of these techniques may return implausible values. Two alternatives may then be considered. The first, like in Abel (2013), is to assume that the number of stayers is as high as possible, given the constraints of the margins of the table. This means that for each country c the row and column totals are respectively equal to $P^*_{t_1,c} - \min\left(P^*_{t_1,c}, P^*_{t_2,c}\right)$ and $P^*_{t_2,c} - \min\left(P^*_{t_1,c}, P^*_{t_2,c}\right)$, which are in fact the last two columns of the Table 3. Therefore, the assumption of the maximum number of stayers actually generates a table of net flows. Using this data input, the algorithm allocates outflows to Italy and Romania only, and inflows to all the other 19 countries, as shown in the Table 4. However, while the intra-flows distribution looks rather implausible, their sum (equal to about 1.7 million persons) may represent the overall value of reference, against which partial sums derived using estimations based on breakdowns by country of birth or other could be compared. In other words, the 'missing' flows of which in the paragraph 16 above would be given by the difference between the overall sum in the Table 4 and the one in the corresponding table obtained using the specific breakdown (here 331 thousand persons using country of birth and 200 thousand using citizenship, see Table 1 and Table 2).

30. It is now interesting to note that any breakdown of the resident populations adds further detail, but the way it works is exactly the same as in the wider case of aggregated populations. In fact, the tables computed for each country of birth in the Abel's approach look like the Table 4, but the empty cells in the overall table are reduced by summing over the various countries of births. Here a clarification is necessary about the meaning of country of birth. This variable identifies (part of[19]) migrants residing in a country at a given moment. However, because the Abel's method starts from two population stocks of resident population, that migration has occurred *before* the beginning of the period under consideration. Migration flows in the period $[t_1, t_2]$ refer to events occurring to the *resident* populations, regardless whether those persons had previously migrated (and settled in the country) or not. The increase of the level of detail in the computations can thus be achieved by any breakdown (possibly meaningful from a migration perspective) and it is not peculiar of the country-of-birth disaggregation.

[19] It excludes the native-born return migrants.

31. Alternatively, auxiliary information can be used to 'drive' the EM algorithm to more plausible outcomes for the origin-destination migration estimates. For instance, including in the model ancillary data summarised by an identity matrix whose unitary values in the diagonal have been multiplied by 1000 returns the estimates shown in the Table 5, where the stayers have been removed from the diagonal and thus the table is now a 'pure' migration table. It can be noted that the differences between the outflows (the row totals) and the inflows (the column totals) for each country practically match the net flows estimated in the two last columns of the Table 3; however, the gross flows (the overall sum) are much larger than before, being estimated at more than 4.8 million persons. Also some outcomes are not fully convincing, such as the flows estimated for Lichtenstein, apparently too large for a country whose population size is about 36 thousand persons. In general, the overall flows are depending on the values attributed in the ancillary matrix. For instance, with diagonal values equal to 100 the migration flows would be about 33.5 million persons, while with diagonal values equal to 10,000 would be about 1.9 million persons, the lower the diagonal value, the closer the net effect to the one estimated with the maximum number of stayers. Further work is clearly necessary to identify a proper auxiliary matrix, possibly making use also of available migration flows data of good quality.

V. Conclusions

32. This paper is a first step in the exploration of estimation methods proposed in the international scientific literature to overcome problems of data quality and availability in migration statistics, under the consideration that the community of official statisticians should benefit of their application when the performances of such methods are proved acceptable. The method here considered has been developed by Abel (2013) to estimate migration flows on global scale and wide time intervals using place of birth data. This note has tested the performance of the Abel's method when applied on local scale and with annual time intervals.

33. The method has showed limited applicability for the estimation of annual migration flows between EU-EFTA countries, mainly due to lack of data on global scale about the structure of populations by country of birth (and related vital events) on annual basis. Further, like in any estimation, there are various operational choices and/or assumptions and/or external inputs which may be determinant for the quality of the final outcome. For instance:

a. The probabilistic model behind the estimation procedure is based on Poisson regressions, which assume independent events (migrations). Although this is virtually the standard for migration models, in principle would not be appropriate for cases such chain migration, family reunification, etc.

b. As any method, good quality of data input is a must. In particular, because this method works on population stocks, it is potentially affected by all discrepancies in the demographic balance equations[20] (statistical adjustments).

c. The proportional allocation of vital events when they are not available with the same disaggregation of the population stocks may be not optimal. The same applies for data on changes of status.

[20] The case of Italy, for which population data are pre-census for 2012 and post-census for 2013 (see footnote 7), is a good example in this application.

d. The assumption of the maximum number of stayers defines indirectly the (minimum) overall flows and makes the estimation procedure to be executed in fact on net migration flows.

34. A finding of this paper is that the method of Abel (2013) does not actually require a breakdown by place of birth. Potentially, any breakdown of the resident population can be used, where the characteristic being considered can be permanent (like the country of birth) or not. Additionally, this note advances on the Abel's method showing how it can be extended to be applied on changeable characteristics such as citizenship. This opens the way to further potentially policy-relevant applications, such as the estimation of migratory flows of highly educated persons or of selected citizenships, provided that the required category-specific data are available also for the whole world. If these global data are missing, estimation is still possible, but it is limited to the flows of those specific categories and the overall sum (all categories together) remains unknown.

35. A further finding is that the logic of the method can also be applied on aggregated data (i.e., without breakdown) and, by doing so, the overall flows can be estimated. Here, data on world scale are readily available from UNPD (2013), although the sensitivity of the results for regional estimates to those global estimates should be assessed. However, following the standard approach based on the maximum number of stayers may return less convincing estimates, and the use of ancillary data seems much preferable. Because the step from theory to practice is never trivial, the choice of a proper matrix with additional information requires further work which is beyond the scope of this paper. Nonetheless, it has been showed how the results may look like using offsets instead of simply estimating on marginal totals based on net flows. Ancillary data should actually be used also when breakdowns are included in the model, even when the estimate concerns only one specific category of that breakdown.

36. In summary, this test has allowed gaining better insight of the Abel's method and to elaborate some developments. By preparing the data as showed in the Table 3, it is possible to prepare the input for estimation procedure for both aggregated and disaggregated population data, such as citizenship-specific or education-specific categories. However, in order to get sufficiently acceptable results, work remains to be done to identify suitable additional information to be included in the estimation model. Several other methods will be tested before any conclusion is drawn about the regular production of estimates of annual migration flows of EU-EFTA countries.

VI. Acknowledgments

37. Comments by Guy Abel and Frans Willekens are gratefully acknowledged.

VII. References

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ANNEX I: main results

Table 1: estimated origin-destination migration flows in 2012 using country of birth data

	BE	BG	CZ	DK	IE	ES	IT	LV	HU	NL	AT	PL	RO	SI	SK	FI	SE	IS	LI	NO	CH	**Sum**
BE	0	206	35	88	4	814	2	4	112	892	112	81	0	1	43	46	85	5	0	104	334	**2969**
BG	336	0	87	107	0	0	345	7	9	91	185	4	0	15	18	27	51	2	0	91	69	**1444**
CZ	29	46	0	46	0	81	1277	2	47	43	0	51	0	0	897	14	78	0	2	115	298	**3025**
DK	0	35	7	0	2	143	0	1	32	32	45	17	0	4	9	16	35	73	0	498	71	**1020**
IE	1468	119	394	638	0	883	1315	56	253	2112	1121	230	107	16	237	218	939	44	3	2553	1008	**13715**
ES	4047	804	398	1019	0	0	5400	32	282	2274	1628	211	5404	48	154	343	967	42	8	1822	3377	**28259**
IT	3596	671	308	702	188	6674	0	12	769	1570	1928	562	0	249	305	251	827	12	234	687	12288	**31833**
LV	108	22	37	249	0	224	214	0	13	352	132	25	4	5	11	99	385	0	0	1069	145	**3094**
HU	367	12	85	481	0	449	1213	2	0	1104	5073	23	0	19	320	101	296	2	5	334	1361	**11247**
NL	1689	229	87	157	3	584	75	19	322	0	326	91	0	6	23	54	315	0	0	289	267	**4537**
AT	44	134	78	32	0	215	3254	4	594	13	0	118	0	0	291	21	58	0	63	86	885	**5889**
PL	3934	117	272	1407	0	0	1236	0	225	6308	2104	0	0	30	79	312	2131	116	2	6849	1688	**26808**
RO	12666	323	1416	4073	10	7849	101990	65	21909	2646	11004	396	0	131	956	598	2846	88	21	2869	4236	**176091**
SI	11	30	21	45	3	100	1026	0	41	14	466	5	0	0	14	5	35	0	6	48	304	**2174**
SK	37	10	4296	200	0	0	3280	4	560	85	2387	23	0	8	0	20	54	4	6	403	1079	**12456**
FI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	0	**6**
SE	0	92	70	282	0	1181	11	1	174	132	238	98	0	2	31	935	0	49	1	1138	51	**4486**
IS	1	2	2	1	7	48	12	0	4	1	10	15	0	0	5	5	132	0	0	355	18	**618**
LI	0	0	0	2	1	6	7	0	0	0	0	0	0	0	0	1	0	0	0	0	37	**55**
NO	0	40	18	108	75	591	36	24	20	0	38	101	0	0	64	23	83	2	0	0	0	**1225**
CH	0	2	1	8	3	30	1	1	2	1	2	5	0	0	2	5	3	0	0	14	0	**82**
Sum	**28333**	**2893**	**7611**	**9646**	**295**	**19873**	**120696**	**236**	**25367**	**17669**	**26797**	**2057**	**5515**	**533**	**3458**	**3096**	**9321**	**439**	**351**	**19329**	**27517**	**331033**

Table 2: estimated origin-destination migration flows in 2012 using citizenship data

	BE	BG	CZ	DK	IE	ES	IT	LV	HU	NL	AT	PL	RO	SI	SK	FI	SE	IS	LI	NO	CH	Sum
BE	0	53	33	79	1	559	0	1	90	176	135	11	178	3	149	63	57	0	2	117	328	**2034**
BG	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	**4**
CZ	58	0	0	54	0	14	0	1	209	4	602	6	67	0	1194	24	31	0	2	140	325	**2730**
DK	0	2	5	0	1	112	0	1	2	0	12	2	28	0	10	1	72	0	0	241	32	**522**
IE	1255	53	64	417	0	689	0	19	209	1170	869	18	321	18	721	159	519	19	3	1451	966	**8939**
ES	5581	494	476	1125	25	0	0	34	281	2390	1976	30	1081	142	489	349	1044	35	6	2320	4048	**21925**
IT	19575	1080	1904	5717	1062	12939	0	61	11011	6624	13636	219	21536	588	2407	1080	3992	140	48	7953	11993	**123566**
LV	183	23	45	277	0	257	0	0	20	415	168	7	20	5	13	119	423	0	1	1248	181	**3406**
HU	582	9	148	554	0	436	0	4	0	1316	6496	20	1290	56	637	99	493	0	5	408	1774	**14327**
NL	2681	83	53	74	1	77	0	9	244	0	229	18	349	12	109	32	162	0	5	190	148	**4474**
AT	39	36	13	9	0	53	0	0	187	0	0	8	460	10	4	8	15	0	17	38	295	**1193**
PL	1869	21	35	586	0	0	0	0	78	2638	861	0	117	11	40	124	806	37	1	2745	662	**10631**
RO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
SI	32	12	9	34	0	62	0	0	31	49	499	1	20	0	24	3	20	0	2	27	217	**1042**
SK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
FI	0	1	2	3	0	21	0	0	2	0	3	2	11	0	1	0	1	0	0	16	0	**62**
SE	0	54	55	364	3	833	0	3	81	8	224	33	325	3	69	1210	0	0	1	412	82	**3761**
IS	12	2	2	13	0	51	0	1	6	2	19	2	17	0	10	10	104	0	0	301	27	**580**
LI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**2**
NO	0	0	1	1	0	10	0	0	1	0	4	0	1	0	0	35	0	0	0	0	1	**54**
CH	0	2	3	3	0	47	0	0	2	0	5	2	18	0	4	0	0	0	0	25	0	**111**
Sum	**31867**	**1926**	**2846**	**9310**	**1094**	**16160**	**0**	**135**	**12456**	**14792**	**25740**	**378**	**25838**	**848**	**5883**	**3315**	**7739**	**231**	**93**	**17633**	**21080**	**199364**

Table 3: data preparation for the case of entire populations (no breakdown)

	P_{t_1}	$B[t_1,t_2]$	$D[t_1,t_2]$	P_{t_2}	$P_{t_1}-D[t_1,t_2]$	$P_{t_2}-B[t_1,t_2]$	(Net) $E_O[t_1,t_2]$	(Net) $I_O[t_1,t_2]$	$P^*_{t_1}$	$P^*_{t_2}$	(Net) $E_R[t_1,t_2]$	(Net) $I_R[t_1,t_2]$
BE	11 094 850	128 051	109 076	11 161 642	10 985 774	11 033 591	87 330	0	10 898 444	11 033 591	0	135 147
BG	7 327 224	69 121	109 281	7 284 552	7 217 943	7 215 431	57 378	0	7 160 565	7 215 431	0	54 866
CZ	10 505 445	108 576	108 189	10 516 125	10 397 256	10 407 549	82 652	0	10 314 604	10 407 549	0	92 945
DK	5 580 516	57 916	52 325	5 602 628	5 528 191	5 544 712	43 946	0	5 484 245	5 544 712	0	60 467
IE	4 582 707	72 225	28 848	4 591 087	4 553 859	4 518 862	36 201	0	4 517 658	4 518 862	0	1 204
ES	46 818 219	453 348	401 122	46 727 890	46 417 097	46 274 542	368 989	0	46 048 108	46 274 542	0	226 434
IT	60 820 696	534 186	612 883	59 685 227	60 207 813	59 151 041	478 617	0	59 729 196	59 151 041	578 155	0
LV	2 044 813	19 897	29 025	2 023 825	2 015 788	2 003 928	16 024	0	1 999 764	2 003 928	0	4 164
HU	9 931 925	90 269	129 440	9 908 798	9 802 485	9 818 529	77 924	0	9 724 561	9 818 529	0	93 968
NL	16 730 348	175 959	140 813	16 779 575	16 589 535	16 603 616	131 877	0	16 457 658	16 603 616	0	145 958
AT	8 409 699	78 952	79 436	8 451 149	8 330 263	8 372 197	66 221	0	8 264 042	8 372 197	0	108 155
PL	38 538 447	386 257	384 788	38 533 299	38 153 659	38 147 042	303 299	0	37 850 360	38 147 042	0	296 682
RO	21 355 849	201 104	255 539	20 020 074	21 100 310	19 818 970	167 735	0	20 932 575	19 818 970	1 113 605	0
SI	2 055 496	21 938	19 257	2 058 821	2 036 239	2 036 883	16 187	0	2 020 052	2 036 883	0	16 831
SK	5 404 322	55 535	52 437	5 410 836	5 351 885	5 355 301	42 544	0	5 309 341	5 355 301	0	45 960
FI	5 401 267	59 493	51 707	5 426 674	5 349 560	5 367 181	42 526	0	5 307 034	5 367 181	0	60 147
SE	9 482 855	113 177	91 938	9 555 893	9 390 917	9 442 716	74 652	0	9 316 265	9 442 716	0	126 451
IS	319 575	4 533	1 955	321 857	317 620	317 324	2 525	0	315 095	317 324	0	2 229
LI	36 475	357	224	36 838	36 251	36 481	288	0	35 963	36 481	0	518
NO	4 979 711	60 255	41 992	5 049 223	4 937 719	4 988 968	39 252	0	4 898 467	4 988 968	0	90 501
CH	7 954 662	82 164	64 173	8 039 060	7 890 489	7 956 896	62 725	0	7 827 764	7 956 896	0	129 132
Sum	**279 375 101**	**2 773 313**	**2 764 448**	**277 185 073**	**276 610 653**	**274 411 760**	**2 198 893**	**0**	**274 411 760**	**274 411 760**	**1 691 760**	**1 691 760**
RoW	6 759 660 399	135 955 687	54 246 552	6 843 568 427	6 705 413 847	6 707 612 740	0	2 198 893	6 705 413 847	6 705 413 847		
World	7 039 035 500	138 729 000	57 011 000	7 120 753 500	6 982 024 500	6 982 024 500	0	0	6 982 024 500	6 982 024 500		

Table 4: estimated origin-destination migration flows in 2012 using aggregated data under assumption of maximum number of stayers

	BE	BG	CZ	DK	IE	ES	IT	LV	HU	NL	AT	PL	RO	SI	SK	FI	SE	IS	LI	NO	CH	Sum
BE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
BG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
DK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
IE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
ES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
IT	46186	18750	31764	20664	411	77383	0	1423	32113	49881	36962	101390	0	5752	15707	20555	43214	762	177	30929	44130	**578155**
LV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
HU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
NL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
AT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
PL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
RO	88961	36116	61181	39802	792	149051	0	2741	61855	96077	71193	195292	0	11079	30254	39592	83237	1467	341	59572	85001	**1113605**
SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
SK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
FI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
IS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
NO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Sum	**135147**	**54866**	**92945**	**60467**	**1204**	**226434**	**0**	**4164**	**93968**	**145958**	**108155**	**296682**	**0**	**16831**	**45960**	**60147**	**126451**	**2229**	**518**	**90501**	**129132**	**1691760**

Table 5: estimated origin-destination migration flows in 2012 using aggregated data with auxiliary information (offsets)

	BE	BG	CZ	DK	IE	ES	IT	LV	HU	NL	AT	PL	RO	SI	SK	FI	SE	IS	LI	NO	CH	Sum
BE	0	7537	9612	6838	5175	21017	11414	3474	9408	12764	9128	21062	2907	3727	6454	6739	9952	1340	398	7173	9414	**165533**
BG	9974	0	8932	6355	4809	19531	10607	3229	8743	11862	8483	19573	2701	3464	5997	6263	9248	1245	370	6665	8748	**156802**
CZ	11322	7950	0	7213	5459	22169	12040	3665	9924	13464	9629	22218	3066	3931	6808	7109	10498	1414	420	7566	9930	**175796**
DK	8400	5898	7522	0	4050	16448	8932	2719	7363	9989	7144	16483	2275	2917	5051	5274	7788	1049	312	5613	7367	**132594**
IE	9070	6369	8122	5779	0	17760	9645	2936	7950	10786	7714	17798	2456	3149	5454	5695	8410	1133	337	6061	7955	**144577**
ES	23344	16392	20905	14873	11256	0	24824	7557	20463	27762	19854	45810	6322	8106	14037	14658	21645	2915	866	15600	20475	**337661**
IT	55368	38879	49583	35277	26697	108419	0	17924	48535	65847	47091	108654	14995	19227	33293	34767	51338	6914	2055	37001	48564	**850423**
LV	5885	4132	5270	3749	2837	11523	6258	0	5159	6999	5005	11548	1594	2044	3539	3695	5457	735	218	3933	5162	**94741**
HU	10900	7654	9761	6945	5256	21344	11592	3529	0	12963	9271	21391	2952	3785	6554	6845	10107	1361	405	7284	9561	**169460**
NL	13664	9594	12236	8705	6588	26755	14530	4423	11977	0	11621	26813	3700	4745	8216	8580	12669	1706	507	9131	11984	**208146**
AT	9542	6700	8545	6079	4601	18684	10147	3089	8364	11348	0	18725	2584	3313	5738	5992	8847	1191	354	6377	8369	**148590**
PL	19147	13445	17146	12199	9232	37492	20361	6198	16784	22770	16284	0	5185	6649	11513	12023	17753	2391	711	12795	16794	**276870**
RO	72943	51220	65323	46475	35171	142834	77569	23613	63941	86749	62039	143144	0	25330	43861	45803	67634	9108	2707	48746	63979	**1178188**
SI	5560	3904	4979	3542	2681	10887	5912	1800	4874	6612	4729	10911	1506	0	3343	3491	5155	694	206	3715	4877	**89378**
SK	8603	6041	7705	5482	4148	16847	9149	2785	7542	10232	7317	16883	2330	2988	0	5402	7977	1074	319	5749	7546	**136120**
FI	8244	5789	7383	5253	3975	16144	8767	2669	7227	9805	7012	16179	2233	2863	4957	0	7644	1029	306	5509	7231	**130220**
SE	9882	6939	8850	6296	4765	19351	10509	3199	8663	11753	8405	19393	2676	3432	5942	6205	0	1234	367	6604	8668	**153135**
IS	2232	1567	1999	1422	1076	4371	2374	723	1957	2655	1898	4380	604	775	1342	1402	2070	0	83	1492	1958	**36378**
LI	672	472	602	428	324	1316	715	218	589	799	572	1319	182	233	404	422	623	84	0	449	590	**11015**
NO	7161	5029	6413	4563	3453	14023	7615	2318	6277	8517	6091	14053	1939	2487	4306	4497	6640	894	266	0	6281	**112823**
CH	8769	6158	7853	5587	4228	17171	9325	2839	7687	10429	7458	17208	2375	3045	5273	5506	8131	1095	325	5860	0	**136322**
Sum	**300681**	**211668**	**268741**	**193061**	**145781**	**564086**	**272283**	**98905**	**263428**	**354104**	**256745**	**573549**	**64582**	**106209**	**182080**	**190367**	**279586**	**38607**	**11533**	**203324**	**265454**	**4844773**