

Distr.: General  
6 September 2017

English and Russian only

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## United Nations Economic Commission for Europe

Conference of European Statisticians

### Group of Experts on Population and Housing Censuses

#### Nineteenth Meeting

Geneva, Switzerland

4–6 October 2017

Item 2 of the provisional agenda

#### Innovations in census methodology and use of new data sources

## Estimation of the Total Population in the 2020 Integrated Census in Israel

Note by the Central Bureau of Statistics, Israel<sup>1</sup>

### *Summary*

In the integrated census in Israel, the total population estimate is a challenge, since it is based on imperfect sources of information. The initial population frame relies on the population register that includes only Israeli citizens (partial census population), among which about 10% are Israelis who live abroad (non-census population).

Data on exits and entrances to Israel that are closely monitored, are used and can further supply the information needed for harmonization of the stock of Israelis abroad with the aggregates of immigration flows, while adhering to the international recommendations.

Employment permits and employers survey, along with infiltrators' register, will be used for the first time for the global and local estimates of legal migrant foreigners in Israel. Working assumptions will be used for generating the total number of illegal foreigners, and for their geographic distribution. This methodology implies that the foreigners' population, who has not been part of the process in the 2008 census, will be included in the Integrated Administrative File in 2020, and generic census processes will be applied to them.

After having the population frame, weights will be assigned to the IAF records to adjust for local coverage. It will be done in three iterations, engaging bottom-up and top-down approach, using improved coverage surveys and demographic analysis.

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## I. Introduction

1. In a census operation, the aim is to estimate all the people defined as ‘census population’ and only them, in their ‘census addresses’ (place of usual residence). All three critical requisites present challenges in the integrated census in Israel. In a traditional census the total population in a country is estimated based on a full count. In an administrative census, it is based on a good population register (or a set of registers). In the integrated census in Israel, the total population estimate is a challenge, since it is based on imperfect sources of information (Blum & Feinstein, 2016). The initial population frame relies on the population register that includes only Israeli citizens (partial census population), among which about 10% are Israelis who live abroad (non-census population).

2. In the process of correcting the register for emigration; different definitions are used for Israelis abroad as a stock (in the census) and for emigration as a flow (in the on-going demographic estimates). This situation produces discrepancies that have not been solved so far. Data on exits and entrances to Israel are closely monitored, and can supply the information needed for harmonization while adhering to the international recommendations.

3. As for emigration, legal migrant foreigners, mainly those who arrived with work permits, and infiltrators, are registered with the Population and Migration Authority. These registers will be used for the first time, for supplementing the population frame. The geographic distribution of the workers is known only partially, and additional data collection is planned in an employers' survey. The employers are the people who apply for employment permits, and therefore their contact information is registered and can be used in the survey. On the other hand, illegal foreigners are not identified in administrative sources, their precise number is not known, and working assumptions are needed in their estimation and in their geographic distribution.

4. After having the population frame for the census, additional adjustment is needed on the global and on the local levels, mainly because of migration flows that have not been registered properly. Over and under-coverage surveys along with demographic analysis produce adjusted weights, calibrated to the adjusted population frame. ICBS is looking for improving the quality of the surveys by improving the infrastructures and the business processes. Plans are also made for improving the quality of the demographic analysis by improving the reference data and the logic of the decisions tree, used in the process.

## II. Israelis abroad

5. Following the UNECE (2015) definition of de jure population, people are enumerated at their place of usual residence, i.e. the country where a person lives a continuous period of time of at least 12 months. Persons, who regularly live in more than one country during a year, are to be enumerated where they live most of the time, irrespective of whether or not they are present in the reporting country at the census reference time. This is also the recommended definition for long-term migrants.

6. The Israeli census is based on an administrative frame that has to be corrected, inter-alia, for global over-coverage. This over-coverage is mainly of

7. Israelis who are listed in the population register as living in the country, but their usual residence, according to the definitions above, is not in Israel. The challenge resides in their identification, using administrative files, before engaging a supplementary fieldwork operation.

8. ICBS receives population stock, and population flows registered in the Central Population Register (CPR) on a daily basis. The stock includes records of all Israelis ever registered. The flows are of reported births, deaths, change of marital status, change of address, change of religion etc. and crossing borders, to and from Israel. The (almost) perfect registration of border-crossing of Israelis, on a daily basis, provides most of the information needed for the identification of the population of interest: Israelis living abroad (Emigrants, not belonging to the census population).

9. The economic prosperity, along with globalization processes, is increasing the number and variety of trips abroad, made by Israelis, for work and vacation purposes.

Table 1

**Departures of Israelis** (in thousands)

<b>Year</b>	<b>Departures</b>	<b>Population</b>	<b>Departures per person</b>
2000	3,529.6	6,369.3	0.55
2001	3,561.1	6,508.8	0.55
2002	3,272.9	6,631.1	0.49
2003	3,298.6	6,748.4	0.49
2004	3,614.1	6,869.5	0.53
2005	3,687.4	6,990.7	0.53
2006	3,713.1	7,116.7	0.52
2007	4,147.4	7,243.6	0.57
2008	4,206.8	7,419.1 <sup>1</sup>	0.57
2009	4,005.9	7,552.0	0.53
2010	4,269.1	7,695.1	0.55
2011	4,387.2	7,836.6	0.56
2012	4,348.6	7,984.5	0.54
2013	4,756.7	8,134.5	0.58
2014	5,180.7	8,296.9	0.62
2015	5,891.1	8,463.4	0.70
2016	6,780.9	8,628.6	0.79

<sup>1</sup> 2008 Census of Population

10. The overall increase of departures per capita overtime (Table 1) reflects much higher growth of exits of specific population groups. According to the Social Survey 2014, only 13% of the ultraorthodox Jews, who are about 10% of the population, travel abroad for a vacation, comparing with 42% of the rest of the Israeli society.

11. This phenomenon of travelling more, and more often, makes the identification of place of usual residence, more complex, especially in the administrative part of the census, where no information regarding the purpose of the travel is available. Yet, since the census surveys correct for over-coverage of the administrative file, the census approach of defining Israelis abroad, as a stock, is more relaxed than the approach implemented in calculating emigration as a flow.

### **A. Israelis abroad: Stock**

12. At the end of 2016, the CPR included 11.4 Million records of Israelis ever lived in the country, of which 9.3 are flagged as active. Inactive records are mainly of people who died, and people who notified the authorities that they migrated abroad.

13. ICBS adds another 700,000 records to the stock of Israelis abroad (not belonging to the population), who do not meet the usual residence criteria. The Borders Control provides data on exits and entrances, while the National Insurance Institute (NII) assigns non-resident status to people who have stayed less than 90 days a year in Israel during the last five years, people who have claimed none of the benefits they are entitled to, and people who are over 110 years old and are probably out of the country and dead. Their death is not recorded since they have emigrated before 1980, the year from which exits and entrances to the country have been fully computerized, and since they are not buried in Israel (it would have been recorded in their CPR records).

14. There are two population groups that are treated differently in the administrative part of the integrated census: People, who migrate to Israel under the Law of Return ("Olim"), and returning Israelis:

15. Olim become Israeli citizens upon their entrance to the country and they are defined as belonging to the population from day one. The assumption is that these people, Jews and their families, intend to continue living in Israel. In the UNECE recommendations for the 2010 censuses, "intention" was added, and therefore including them is in accordance with the recommendations. Yet, since not many mirror exercises are practiced on the global level this is a source of double counting of migrating population, once in their country of origin and once in their country of destination. Following the UNECE and EUROSTAT (2010) Guidelines, an effort should be made to count them in their country of origin (Israelis abroad).

16. Returning Israelis are also included in the census population, even if they do not meet the criteria of usual residence in the last 12 months. Those who were abroad most of the year but are present in the country on reference day are counted in since intention to live in Israel is assumed. However, this is a very lenient criterion for inclusion and therefore a source of over-coverage. All Israelis living

abroad, who are present in the country in reference day, are not defined correctly in the administrative part of the census.

17. As for the others, whose exit was registered without a following entrance, they go through a set of tests. They are defined as Israelis abroad if they meet the following criteria (Sabah, 2006; Sabah, 2012):

- They are out of the country for over a year continuously,
- They go back and forth but have stayed in Israel less than 90 days continuously during the last year,
- They were not enumerated in the 1983 and 1995 censuses (traditional censuses) and no sign of life was recorded in their CPR records ever since. This criterion is needed for those who emigrated many years ago, when exit recording was done manually and before Israelis were obliged by law to use their Israeli passports in the borders.

18. The field survey which estimates over-coverage corrects for wrong inclusion in the Integrated Administrative File (IAF). Nevertheless, a better IAF will improve the quality of the census, since the characteristics of the emigrants are not identical to the rest of the population and assigning weights according to the surveys does not correct for those attributes. In the 2008 Census, the correction for over-coverage was wrongly applied uniformly across the entire population, although emigrants, who have not been identified in the process of constructing the IAF, were of specific population groups and different from the Israelis who stayed in the country. Moreover, the IAF is built and used several times a year for non-census purposes, i.e. its ongoing quality influences the quality of other domains of official statistics in Israel.

## B. Emigration: Flow

19. The annual population estimates are based on the Population estimates at the end of the previous year plus natural growth and migration balance. The weights for each estimation group are re-calculated as follows (Ben-Hur, Hleihel et al, 2011):

$$\hat{w}_i^{2016} = \frac{P_i^{2008} + \hat{C}_i^{2008-2016}}{IAF_i^{2016}}$$

Population in the last census plus the changes registered in the CPR since the census until the end of the calculated year, divided by the population in the current IAF. The advantage of advancing the weight this way is that changes occurred along the years after the census influence the weight (We do not have to assume the same reporting patterns as in 2008). However, this weight gets closer to 1 over time; the reported flows (C) in the register and the corrected stock (IAF) are based on the same source, the last census estimates are less and less influential, and the population estimates are managed on an aggregated level (population by area and by age).

20. For the migration balance in the population estimates, Borders Control supplies data for identifying Israelis living abroad. The Israeli Emigrants Database is updated according to the annual flows. The flow is created for two population groups: new emigrants and returning Israelis.

21. An Israeli who was abroad for at least 90 days continuously, as detected in any day of the estimated year, become a potential emigrant. If he stays abroad at least one year continuously, and he is not included in the previous year emigrants' database, he is defined as a new emigrant.

22. The criterion for returning emigrants is staying in Israel for 90 days continuously.

23. The implication is that the registration of borders-crossing is an enabler of reliable statistics, but the full registration of borders crossing is translated into too rigid definitions. An Israeli who lives abroad and visits Israel at least once a year, is not counted as an emigrant. An Israeli, who lives in Israel and once has been defined as an emigrant, stays an emigrant if he does not accumulate 90 days of presence in the country without crossing borders.

24. Since 2016, the demographic changed reported to the CPR are sent to ICBS on a daily basis (before that it was sent on a monthly basis). It is an opportunity to improve the definition of Israelis abroad and to harmonize the definitions used for the census stock and the population flows. Today's border crossing in Israel is less likely to be migration motivated and therefore, measuring continuous stay may not reflect accurately in or out migration.

### **C. Bridging the gaps between stock and flows of Israelis abroad**

25. Shifris (2012) compared emigration estimates calculated according to several definitions, based on two components: length of stay abroad continuously (90, 60, 30 days), and number of days being abroad during the last year (275, 305, 365 days). He found out that using the 90 days continuously and the 275 days of stay abroad during the last year, produces emigration estimates not significantly different from those produced with the 365 days criterion.

26. These findings imply that the prerequisite of one year continuously can be replaced by 275 days a year, in the estimation of the emigration flows as done in the census stock. It also implies that the continuous 90 days test (and not less) reflects migration and can be used as a threshold.

27. Moreover, Shifris found that 63% of the Israelis, whose usual residence was abroad but were in Israel on reference day, were not returning emigrants. Assigning an intention to return to Israel, to those who are present in the country is a source of inconsistency and asymmetry in definitions. The 90 days criterion should be implemented for returning Israelis as well. In the administrative part of the integrated census those who are present in Israel but have not completed the 90 days present, will not be flagged as returning Israelis. For national purposes, the returning Israelis are a group of interest and therefore should be counted in. Their under-count in the IAF in reference day can be corrected by the field survey.

Moreover, it is possible to assign intention to return to Israel, ex-post. Israelis abroad, who are present in Israel on reference day, who have not completed the 90 days length of stay, can be followed in the administrative files, and if they complete the required length of stay, they can be included in the population. For the population estimates, these returning Israelis will be defined as such the following year.

Table 2  
**Definitions of Israelis Abroad**

	<b>Emigrants Stock</b>	<b>Emigration Flow</b>	<b>Modification and Harmonization planned</b>
<b>Starting point</b>	CPR status of inactive record due to reported emigration		Adding NII records of non-residents, after validation:
	Records with no signs of life since 1980, not enumerated in 1983 and 1995 censuses		People who stayed less than 90 days a year in Israel during the last five years, People who have claimed none of the benefits they are entitled to, People who are over 110 years old with no signs of life...
<b>Israelis abroad/ New emigrants</b>	275 days abroad during last year	At least one year abroad continuously	90 days abroad continuously + 275 days abroad last year
<b>Returning Israelis</b>	More than 90 days in Israel during last year	90 days in Israel continuously	90 days in Israel continuously
	Present in reference day		For census purposes, also: Assigning intention ex-post (up to 90 days after reference day)
<b>New Immigrants ('Olim')</b>	Present on reference day		Adjustment to returning Israelis

### III. Foreigners

28. Estimating the population of foreigners in Israel is a challenge, in spite of the relatively closed borders. The main obstacles are of three types:

- Problems of pairing entries and exits: Passport number may differ in exit (new passport), phonetic translation of foreign names to Hebrew may vary, and although it is improved over time, older records remain open (registered entrance only, or registered exit only). It is unclear how many unpaired records represent foreign workers and tourists, who overstayed their visas.
- No information on illegal foreigners who are not asylum seekers: Between 2007 and 2012, Israel was flooded by infiltrators, mainly from Eritrea and South Sudan, who crossed the borders between Israel and Egypt. Most of them were asylum seekers who were registered and got

work permits. Yet, not all were caught or reported their presence in the country.

- Lack of information regarding the exact location of foreigners in Israel: The official records of legal foreign workers carry the employer's address, yet they may work in different locations. Moreover, these workers may be hired by other employers and their records may not reflect it (intentionally or not).

29. There are no high quality administrative data-sources that can close the information gap. Furthermore, the fieldwork operation generates only partial data due to two main reasons: (a) The regular census process misses foreign workers who reside in non-residential areas, like construction sites, and commercial and industrial regions; (b) Foreigners, especially illegal ones, do not tend to cooperate with official representatives of the government, and at times of deportation, they are hard to contact.

30. Since the foreigners' population is not homogeneous, their estimation plan includes their characterization and division to four distinct groups: Legal migrant workers with a working visa; foreigners who are eligible for Israeli citizenship by the Law of Return, but do not implement their right to do so (hereafter Jewish Temporary Residents); refugees/infiltrators; and illegal migrants. Each group has its own unique coverage characteristics in the administrative files, unique visibility attributes in the field, and different tendency to cooperate with the authorities. Therefore, their enumeration and estimation processes are adjusted accordingly.

#### **D. Legal Migrant Workers**

31. At the end of 2016, there are about 65,000 registered legal foreign workers in Israel. They are comprised of three main employment groups:

- Nursing workers and care takers are about 60% of the legal migrant workers. Most of them are women from Eastern Asian or Eastern European countries. Their working visa is for five years and they live in Israeli households. In many cases, their address is their employer's address.
- Agricultural workers are about 25% of the group. Most of them are men from Thailand. They live in agricultural farms (Moshavim). The Population and Migration Authority renders the permits to employ foreign workers in agriculture, and therefore maintains a register of permits by employer. The employer's record includes among others, quotas allotted and detailed contact information.
- Construction workers are about 10% of the legal migrant workers. Most of them are men from China, usually living near construction sites. There is a good registration of visas and quotas allocated to the corporations responsible for them, but there is no indication to their geographic location in Israel.

The other 5% includes clergy, diplomats, students and hi-tech workers.

### **E. Jewish Temporary Residents**

32. The Jewish temporary residents are usually Yeshiva (Talmudic College) Students, with or without their families, who arrive to Israel with a student visa or a companion visa, and choose to live in Israel without exercising their right of return (become citizens under the Law of Return). They are entitled to national insurance and health insurance, and thus are well registered with the National Insurance Institute. The data in their records are very similar to the CPR data for Israelis and include family ties, address details and contact information. This group is estimated to include about 22,000 people.

### **F. Refugees, Asylum seekers and temporarily undeportable foreigners**

33. There are about 41,000 refugees, asylum seekers and temporarily undeportable migrants in Israel. Most of them came from Eritrea and South Sudan and entered Israel illegally, through unofficial border crossing. Due to their arrival circumstances, they are not deportable, and consequently have an interest to be known and to be registered by the authorities, including address and contact information. In 2007 and up to 2012, this group increased in number significantly. Since 2013, the phenomenon has been reversed and in recent years there are more departures from the country than entrances. This group is expected to further decrease in size.

### **G. Illegal Migrant Workers**

34. Illegal foreigners are hard to identify and they are estimated in a wide range of 30,000-70,000 individuals. Part of them entered Israel as tourists and is actually working without a visa. Others entered with a working visa that has expired. Administrative information regarding this group is very vague. It is assumed that illegal foreign workers are similar in their characteristics to legal foreign workers; they live in their vicinities and assimilate with them (Levy, 2015).

Table 3  
Enumeration and Estimation of Foreigners

Population	Coverage	Enumeration and estimation methodology
1. Legal Migrant Workers - Nursing workers and care takers	Global coverage: High quality administrative data, very similar to IAF data on Israelis.	To be included in the central path of the integrated census by adding their records to the IAF).
2. Jewish Temporary Residents	Local coverage: Distributed among the general population.	Assessment and correction processes will be conducted through the over and under-coverage surveys and the dual system estimation method.
3. Refugees, asylum seekers, temporarily undepotable		
4. Legal Migrant Workers - Agricultural and Construction workers	Global coverage: High quality administrative data. Local coverage: No data on geographic location. Usually not found in residential areas.	Employers' survey for verification of the administrative data and for collecting information regarding the geographical location of the workers. Separate estimation processes of the total population and of the geographic distribution.
5. Illegal Migrant Workers	Very poor coverage information.	Producing a total estimate (mainly entrances (-) exits by country of origin). Statistical geographic distribution according to that of legal foreign workers.

35. The implication of the methodological processes is that foreigners, who have not been part of the process in 2008, will be included in the IAF in 2020, and more generic processes will be applied to them. Yet, it will be possible to count them separately and in most cases individually, in order to exclude them from the population if their absence lasts 12 months or more (UNECE Secretariat, 2008).

#### IV. Estimation of the total census population

36. The approach adopted to generate the total population in the Israeli census is bottom-up and top-down:

37. Building the initial population frame means moving from the CPR's active records to the Integrated Administrative File (IAF) by erasing records of those who do not belong to the census population (either dead or abroad) and adding those who are not included in the CPR (foreigners).

38. Assigning weights to the IAF records is done in three iterations, by age group: First, by using the under-coverage and the over-coverage surveys for generating an integrated weight on the Statistical Area (SA) level; second, by using the coverage surveys for generating weights on the locality level, and calibration of the SAs estimates to the derived locality estimates. This process improves the SA

weights since the estimates on the locality level are not exposed to the geo-coding errors and to the errors introduced by the imputation of SA within a locality.

39. The third iteration is done top down from the country level to the SA level. The IAF is compared with the demographic population file (the demographic project), which is a statistical register on the individual level, built in the last traditional census in 1995, and maintained by integrating the demographic flows reported to the CPR. Discrepancies on the individual level, between linked records of the IAF and the demographic project, are thoroughly checked and a new global population estimate is produced. In 2008 census about 65.5 thousands records were deducted from the 7.472 million IAF records (0.8%), mainly of Israelis abroad who were included in the IAF and were not identified as over-coverage in the census survey and also not in the imputation process of over-coverage, in cases of non-response (Hleihel, 2009). The new global population estimate provided new demographic margins for calibration on hierarchical nested levels of locality and statistical area.

40. It is suggested to further improve the calibration process to the total population estimate, by the production of detailed demographic margins of a single age, gender and religion estimation units. Moreover, the calibration process can add districts as estimation units in the calibration process when moving from the country level to the locality level, in the top-down process. However, the multiple calibration process has its own cavities in its influence on the structural composition of the population, and should be considered carefully.

## V. Future work

41. Qualitative estimation of the total population, based on administrative sources, consolidates the foundations of a good integrated census. ICBS plans to expand and improve the use of existing data sources for identifying the place of usual residence of Israelis, in and out of the census area, and to better identify foreigners who should be counted in.

42. The use of Signs of Life (SoL) data, in conditions of open borders and growing migration flows in Europe (Fiorio et al, 2017; Gallo et al, 2016; Tiit&Vähi, 2017), is planned to be adopted and adapted to the Israeli reality for improving the local coverage estimation in the census. The addresses repertoire and sources in the SoL database will define the individual's address, up to the building level, and Statistical Area estimates, in the administrative part of the integrated census, will be improved.

43. The 2020 Census is planned to provide better infrastructures and improved methodology, while advancing in the direction of a full administrative census in Israel.

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