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Differences in Population Estimates Between an Administrative System and Census: The Case of Israel

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The component method of population estimation relies on census counts, vital statistics, and internal and international migration. In Israel, all individuals' events are registered. To apply the component method, individuals' records from the census and the administrative data are aggregated to give population estimates. However, this method disconnects individual from aggregated characteristics, and differences appear in individual characteristics between census and administrative data. The Israel Central Bureau of Statistics conducted individual follow-ups. The pros and cons of each method are presented. On average, individual estimates on statistical areas are larger than aggregate estimates, and the differences are stable after several years. The individual estimates are preferable under at least four situations: in conducting a registry of emigrants; in conducting a census of institutions; where administrative files are available; and where census method is suitable to this method.

Keywords: statistical areas; population estimates; census; component method; population registry; administrative files

INTRODUCTION

Population estimates for statistical areas are essential for planning and budgeting and need to be as accurate as possible. Population censuses are an exclusive source of estimating the population of statistical areas. In the years between two censuses, the Israel Central Bureau of Statistics estimates population for statistical areas from the last census with adjustments of changes taken from the population registry. Although demographic registration in Israel is thorough, there are delays and inaccuracies in registration, leading to inconsistencies

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between the estimates from the census and the updated statistics following the census. The longer the period elapsed after the census, the less accurate the population estimates for statistical areas. In other parts of the world, especially in European countries, where administrative data from population censuses are used extensively to estimate populations in statistical areas, accuracy and timeliness of the data are the main problems (Laihonen et al., 1998; Scheuren, 1999).

I will examine the level of accuracy of the population registry in Israel by comparing two methods of estimating population for statistical areas. The two methods can be distinguished by the way they apply demographic changes to update the estimates. Updating population estimates at the level of individuals will turn out to be preferable to aggregated updating. I will show that (a) maintaining a registry of residents of institutions, (b) maintaining a registry of emigrants from Israel, and (c) ensuring that future population censuses allow the construction of a suitable base population are necessary for individual updating to be more effective than aggregated updating.

THE ADMINISTRATIVE SYSTEM IN ISRAEL AND POPULATION ESTIMATES

The population registry of Israel, founded in 1948, registers people according to their identity card numbers. Residents are required by law to register any demographic change to the authorities, which in turn report to and update the population registry. The Ministry of Health is responsible for registering births and deaths; the Ministry of the Interior for registering changes of address in the country; and the Border Police for registering arrivals to and departures from Israel. Lists of individual changes are sent to the Central Bureau of Statistics, which estimates the population.

Two major problems affect population estimates. One is the lack of an emigration register, and the other is the lack of correspondence between the actual addresses of residences and those listed in the population registry (Kamen, 2004). The Central Bureau of Statistics has had difficulty compiling an emigration register because of inaccurate registration of departures and arrivals of Israelis up to the 1980s. Also, since many Israelis have dual citizenship, their arrivals and departures can be registered under different passports, and it is difficult to know how long they have stayed abroad. In the 1995 census, 25% of the enumerated residents lived at an address different from the one listed in the population registry. Although there is no documentation for this discrepancy, my experience working with the files and with the 1995 census suggests that there are three main types

of people whose actual addresses of residence differ from those in the registry:

1. People who just moved and did not update their files. This tends to underestimate the registered population in areas established in recent years.
2. People who reside at temporary addresses ("floating people"), including young singles, university students, and people living in long-term residential institutions. This tends to overestimate the registered population in areas with long-term residential institutions or in areas that attract young singles and university students.
3. People who list an address in the registry different from their actual address of residence in order to benefit from services such as parking, school registration, or tax discounts. This tends to underestimate the registered population.

Population estimates in Israel are based on the most recent census and updated with the latest population movements. The Israeli Central Bureau of Statistics has been using the aggregated method (AGRM) to convert the last census and the administrative records from the level of individuals to the level of cells (a cell is a class of given demographic and geographic characteristics). Even though both sources for estimating population derive from individual records, the method forbids individual identification of change. This generates bias in statistical areas.

The Israeli Central Bureau of Statistics conducted the Individual Method (INDM), in which the population is estimated from population census files and population registry at the level of individuals. This system enables us to examine whether address changes reported to the administrative system are new or late. In order to link records through the Personal Identification Number (PIN), all records in the population base constructed from the 1995 census should be defined in terms of the PIN, but this was not possible, and the base population had to be reconstructed.

METHODS

Both methods rely on the Census of Population and Housing for the base population, and on administrative files to update the population. Both methods are applied to estimate population size P_i^t in area i at the end of year t, using the component method (Eq. 1), which takes all demographic changes into account. Because all these changes come from the administrative system, both methods use the same

components and the same records: total number of births $N_{B,t}$, total number of deaths $N_{D,t}$, internal migrants $N_{E,t}$, total number of immigrants to Israel $N_{II,t}$, and total number of emigrants out of Israel $N_{IO,t}$.

$$P_i^t = P_i^{t-1} + \Delta_i^t \tag{1}$$

where

$$\Delta_i^t = \sum_{j=1}^{N_{B,t}} B_{ij} - \sum_{j=1}^{N_{D,t}} D_{ij} + \sum_{j=1}^{N_{E,t}} EI_{ij} - \sum_{j=1}^{N_{E,t}} E0_{ij} + \sum_{j=1}^{N_{II,t}} II_{ij} + \sum_{j=1}^{N_{IO,t}} IO_{ij}$$

and B_{ij}, D_{ij}, EI_{ij}, EO_{ij}, II_{ij}, IO_{ij} indicate the updates in births, deaths, in-flow of internal migration, out-flow of internal migration, in-flow of international migration and out-flow of international migration, respectively. An update in each component is 0 when the population in area i of person j is not updated, or 1 otherwise (see Table 1). Updating is by movement and not by a person; if one of the components is 1 the others are 0.

Differences in the Base Population

Population estimates at the level of statistical areas are based on the results of the 1995 census. The census results were assessed in a "Post Enumeration Survey" (PES) based on the 1983 census and on demographic projection using vital statistics between 1983 and 1995. PES revealed an undercoverage of 0.7% for the entire country; the demographic projection indicated the groups needing adjustment (State of Israel, 1998). We searched records with characteristics similar to those groups. One of the problems with this adjustment was allocating our imputation among statistical areas. In AGRM, these records came from the census (hot deck imputation method), and random allocation was conducted among the various areas, weighted by the size of the area. Similar allocation cannot be done in INDM because it requires real records with identity card numbers. The base population had then to be reconstructed, with emphasis on (1) the identification of 4% of the Israelis without identification numbers – PIN was completed by replacing these unidentified records with records from the "registry excess",[1] who had similar geographic and demographic characteristics. The addresses from the census were left unchanged. (2) For the adjustment of the shortage in the census target groups, we searched people

[1]"Registry excess" includes the list of people in the registry who are listed as alive but were not found in the census (by linking through PIN) and were not defined specifically as emigrants.

TABLE 1 Difference in Methods for Deciding to Update or not

Components	Aggregated method decision	Individual method decision
B_{ij} Births	The administrative address at date of birth is area i	The newborn is not in the population at $t-1$, and the administrative address at date of birth is area i
D_{ij} Deaths	The administrative address at date of death is area i	The person is in the population of area i at $t-1$
EI_{ij} Internal Migration (into area i)	The destination administrative address is area i	The person is out of area i at $t-1$, and the destination administrative address is area i
EO_{ij} Internal Migration (out of area i)	The source administrative address is area i	The person is in area i at $t-1$, and the administrative target address is not area i
II_{ij} International Migration (into area i)	The administrative address is in area i	The person is not in the population at $t-1$, and the administrative address is area i
IO_{ij} International Migration (out of area i)	The administrative address is in area i	The person is in the population of area i at $t-1$

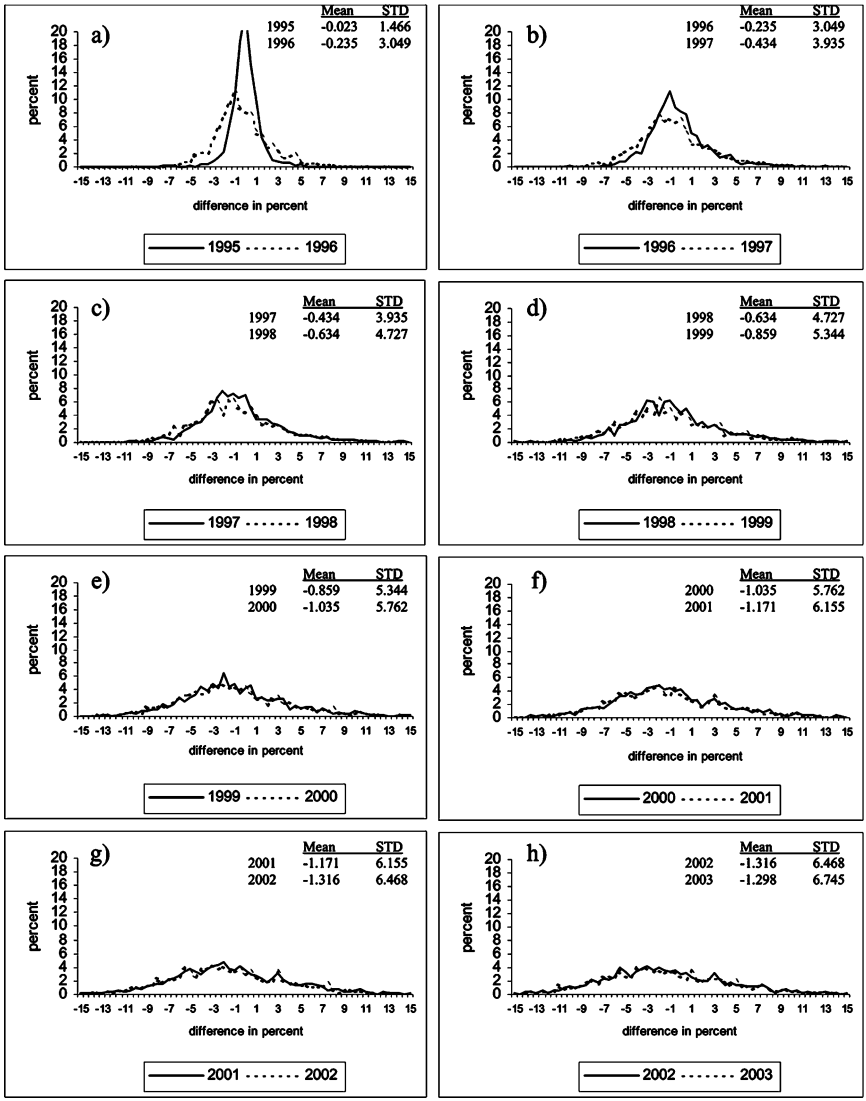

FIGURE 1 Distributions (in percent) of the difference in percent between AGRM and INDM on statistical areas: 1995–2003 (N = 1496).

whose characteristics fit those of the target population in the excess registry ("cold deck imputation method"). The total number of records found in the excess registry, for the various groups, was similar but not identical to the adjustment made using the aggregated method.

The addresses of the added people were those of the population registry, contrary to the aggregated method where addresses were assigned at random. This led to slight differences at the national level between the two methods and to larger differences in statistical areas. For example, PES found 2.38% undercoverage among immigrants who arrived to Israel between 1990 and 1995 (State of Israel, 1998). In the AGRM we added 36,000 immigrants from the former USSR, but in the registry access we found 39.3 thousand people, who were added by INDM.

At the end of 1995 (two months after census day), a difference of 3,247 residents was found in selected areas and a difference of 6,081, or 0.1% of the aggregated estimate, at the national level. Although this difference is small, it matters for statistical areas. On the average, the difference between estimates of the population approached zero, but the standard deviation was 1.5% (see Fig. 1a).

Population Living in Institutions

Because the addresses listed in the population registry for residents of institutions usually differ from those in the census, and because there is no follow-up of those residents, each method deals with this problem differently. In AGRM, the population living in institutions is fixed to the value given in the census, on the assumption that the size, distribution, and demographic characteristics of the population will not change until the subsequent census. Though this assumption is incorrect, it prevents us from reducing the population size in statistical areas by the many persons living in institutions. It is expected that, over time, areas with high concentrations of people in institutions will have many deaths and changes of address.

In the AGRM, persons in regular households are separated from persons in institutions (Rees, Paul and Dominic 2004: 11–12). Therefore, the population in area i at time t is:

$$P(AGR)_i^t = P(AGR - IN)_i^{t-1} + \Delta(AGR)_i^t + IN_i(0) \qquad (2)$$

where

$P(AGR)_i^t$ is the Aggregated Method population at time t;
$P(AGR - IN)_i^{t-1}$ is the population at time $t - 1$, excluding the population of institutions;
$\Delta(AGR)_i^t$ is the net AGRM population increase at year t;
$IN_i(0)$ is the institutional population, which is constant and equal to the institutional population on the census date.

In the Individual Method, the population in area i at time t is:

$$P(IND)_i^t = P(IND)_i^{t-1} + \Delta(IND)_i^t \quad (3)$$

where

$P(IND)_i^{t-1}$ is the total population at year $t-1$, including the population of institutions;
$\Delta(IND)_i^t$ is the net INDM population increase at year t.

In sum, the AGRM method maintains the size of the permanent population in the places where it was enumerated, while updating the demographic changes in the place where the residents are listed in the population registry. The INDM method, by contrast, relates to residents of institutions as a regular population, and changes in that population are updated at the actual place of residence. If that address is different from the one listed in the population registry, then it will be changed to the address of residence regardless of the address listed in the registry.

Subsequently areas with more people in institutions lose more in INDM estimates than in AGRM estimates, and AGRM estimates tend to be higher than INDM.

Differences in Methods of Updating Population Estimates

The problem is when the observed variable takes value x in the census and $y \neq x$ in the population registry. If the same person changes his listing in the registry from y to x, and if these differences are not controlled as in the AGRM, then characteristic y will be updated to x. In the INDM, the differences between the census and the administrative system can be controlled. We update the characteristic only if the new value obtained from the administrative system is different from the value observed in the census. In our case, y and x are not updated and create differences between INDM and AGRM. When we calculate the change in the population, each year we will obtain the difference Δ_i^t, coming from the difference between the decisions about the value of each record change, which is coded 0 or 1. Table 1 presents a summary of the differences for each of the component, regarding the decision of person j.

As shown in Table 1, the differences in the decision about components are influenced by the difference in address listings in the census and in the population registry (one-fourth of the difference derives from the problem of institutional residents). The differences are also

influenced by obtaining demographic changes in the registry for people who do not belong to the population according to the INDM.

MEASURING THE DIFFERENCE BETWEEN THE METHODS

We calculate the difference between the two estimates and follow the development of this difference over time. Because statistical areas differ in size, we calculate the ratio of the percentage of the difference between the two estimates over the estimate obtained by the AGRM.

$$\frac{P_i^{t+n}(AGRM) - P_i^{t+n}(INDM)}{P_i^{t+n}(AGRM)} = \frac{S_i(t+n) + S_i(0)}{P_i^{t+n}(AGRM)} \tag{4}$$

where $t-1$ is the base time (census day); $S_i(0)$ the difference at $t-1$; $S_i(t+n)$ is the cumulative differences between t and $t+n$ affected by the updating difference,

$$S_i(t+n) = \sum_{s=t}^{t+n} \left(\Delta(AGR)_i^s - \Delta(IND)_i^s\right).$$

Since residents of institutions do not cause the difference in the base population, Eq. (4) reflects less the difference between the two methods in their treatment of the population of institutions than the difference between the listing in the population registry and the listing in the census among residents of institutions. The difference in the population of institution residents is expressed mainly on $S_i(t+n)$.

The Convergence of $S_i(t+n)$

The differences in listings of the address founded at census day (base address) and the differences in the way each method treats updates of records outside the population influence the cumulative difference $S_i(t+n)$. If we assume that $S_i(t+n)$ is affected only by the difference in the listing of the base address, then we conclude that a person whose address in the registry differs from the one in the census (registered in area i and counted in area j in the census, $i \neq j$) has an effect only once, corresponding either to a departure from the population (death or emigration), which reduces $S_j(t+n)$ by 1 $((-1)-(0))$ and increases $S_i(t+n)$ by 1 $((0)-(-1))$, or to a change of the listing of addresses of area j. The effect of this change depends on the new target listing as summarized in Table 2. In the first years after the census, we expect that many addresses change, feeding the cumulative difference. After a certain period of time, the marginal addition to the cumulative difference diminishes.

TABLE 2 Difference Between the Two Methods, by Source and Target Addresses Obtained from the Administrative System

Internal migration registration from area j to:	Effect on the cumulative difference over time		
	in $S_i(t+n)$	in $S_j(t+n)$	in $S_k(t+n)$
Area $j \rightarrow$ Area i	$(+1)$–$(0) = +1$	(-1)–$(0) = -1$	(0)–$(0) = 0$
Area $j \rightarrow$ Area $k(\neq i)$	(0)–$(+1) = -1$	$(+1)$–$(0) = +1$	$(+1)$–$(+1) = 0$

If M is the total number of cases in which the address in the census was different from the administrative address, and M^t the total number of cases in which the address in the census was different from the administrative address, and in which the address was changed for the first time or in which the person left the population during year t, then at horizon $t+m$ we obtain $\sum_{s=t}^{t+m}(M^s) \longrightarrow M \Leftrightarrow S_i(t+m) \approx S_i(t+m+1)$. m is dependent on people's address changes and on the reasons why people were listed in one place and enumerated in another. For example, if the discrepancy comes from the person moving to a new address and having no time to register, then the change is expected to occur quickly. If the discrepancy comes from a person seeking to receive services, then the change may take more time to be listed and depends on the person's need for those services.

m does not depend only on the differences in registration of the address. It also depends on changes registered in the population registry for people who disappeared from the list. Though few cases are expected, this can cause incomplete convergence and a permanent discrepancy between the cumulative differences resulting from registration of movements of emigrants.

DATA AND RESULTS

I selected 1,468 statistical areas each counting at least 500 inhabitants, where the majority is Jewish.[2] Localities under 10,000 inhabitants are a single area, and localities over 10,000 or more inhabitants are divided into statistical areas (each statistical area includes between 4 and 6 voting precincts or between 2,000 and 5,000 inhabitants).

[2]The non-Jews areas (Arabs areas) are excluded because people have no address in these areas. Lack of address prevents us from estimating population size in statistical areas.

From 1995 to 2003, the components of Eq. (1) were calculated each year for every area according to Table 1. The population for the end of each December was estimated according to both methods. The difference between the two estimates in the selected areas was 3,247 at the end of 1995 (4,324,848 and 4,346,095 according to the AGRM and INDM, respectively). This difference comes from the difference in the construction of the population base on census day (November 4, 1995) and from the difference in updating the population at the end of 1995. The difference between the two estimates at the end of 2003 (8 years after the census) was 42,629 people (4,859,119 and 4,901,748 according to the AGRM and INDM, respectively). The change in the difference between 1995 and 2003 can be attributed mainly to the difference in updating movements. As shown in Figure 2, the difference in the positive components is smaller than the difference in negative components. The effect of birth was negligible and concerns only 1995. By contrast, the effect of death began with a difference of 9% in 1995 and stabilized at 5%. The percentage of change in the component of immigration to Israel[3] was around 5% throughout the entire period. At the beginning, the percentage of change resulting from immigration to Israel was very high, 60% in 1995 and 30% in 1996. Afterwards, it declined to 10%. Because emigrants had a longer influence than immigrants, the INDM estimates eventually became larger than the AGRM. Consequently, the differences in the variables have INDM larger than AGRM estimate. This ordering disappears when we consider the differences between estimates at the level of statistical areas because of internal migration, whose effect on the area of destination is opposite to the effect on the area of departure.

DIFFERENCES IN STATISTICAL AREAS

The development of differences at the level of statistical areas is influenced first by the difference in updating the components. Unlike at the national level, these components influence in two directions (increase and decrease population), depending on the characteristics of the population. In an area with a difference in positive components, there

[3]The component of immigration to Israel consists of immigrants who did not previously have the status of residents of Israel, and of immigrants who had lived in Israel in the past and returned to live in the country. The difference in updating of the first group is very similar to the one found for the component of birth. Therefore, the main difference comes from Israelis who returned to live in the country. In 2000, about 50% of that group was not updated by the INDM.

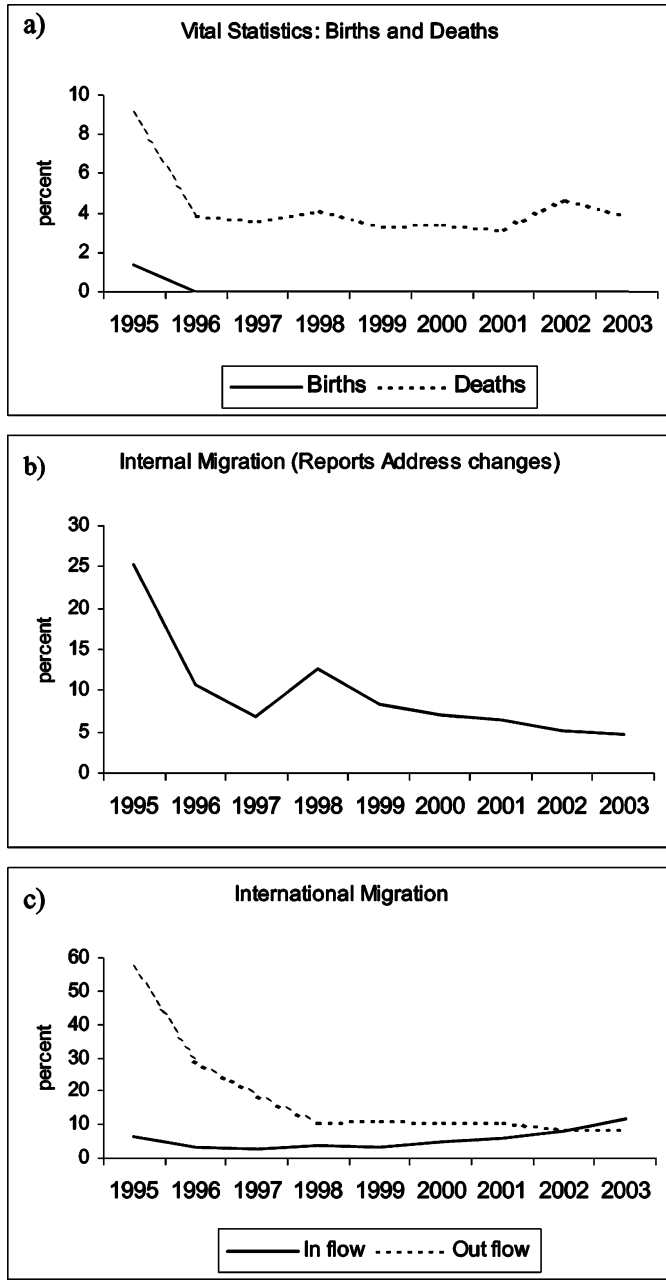

FIGURE 2 Annual percentage of records not updated on the INDM, relative to AGRM, by components (vital statistics, internal migration, and international migration) 1995–2003.

is not necessarily a difference in negative components; the ratio of negative differences to positive differences in one area is not equivalent to the ratio of positive over negative components in all areas. Second, the difference comes from updating internal migration. Though difference in updating internal migration is not much larger than the other components, its effect is considerable because of the important total number of address changes occurring each year. For example, in 2003 there were 420,000 changes of addresses, 38,000 deaths, 145,000 births, 29,000 new immigrants to Israel, 9,500 returning residents, and 28,000 emigrants from Israel.

Comparing the distribution of the percentage of difference between the two estimates during a given year with the percentage from the preceding year (Fig. 1) reveals that:

- over the years, there has been a distribution similar to the normal distribution with parameters that changed with time;
- on average, the AGRM estimate is smaller than the INDM estimate. The average difference decline from -0.023% in 1995 to -1.316% in 2003;
- there is convergence in the distribution of percentages of differences. At the beginning of the survey period (1995–1998), the distribution changed significantly from one year to the next. In recent years (after 2000), the yearly changes in the distribution have not been drastic, as illustrated in Figure 1 with the changes of distribution parameters.

A distinction should be made between different types of statistical areas, based on the factors that cause the record in the population registry to be different from the population census. We mentioned three main factors in our description of the administrative system of Israel, but we do not have enough documentation on them. Therefore, we cannot analyze by type of area. We have only the total number of residents of institutions enumerated in a given area.

Figure 3 portrays two distributions for two types of areas. The first category includes areas when at least 5% of the population resided in institutions in the 1995 census ($N=185$). The second includes the remaining population. The analysis of distributions of the difference between the two groups of areas shows that:

- Though the average is positive in areas with institutions and negative in others, in 1995 there was no significant discrepancy in the distribution of the differences between the two types of areas.

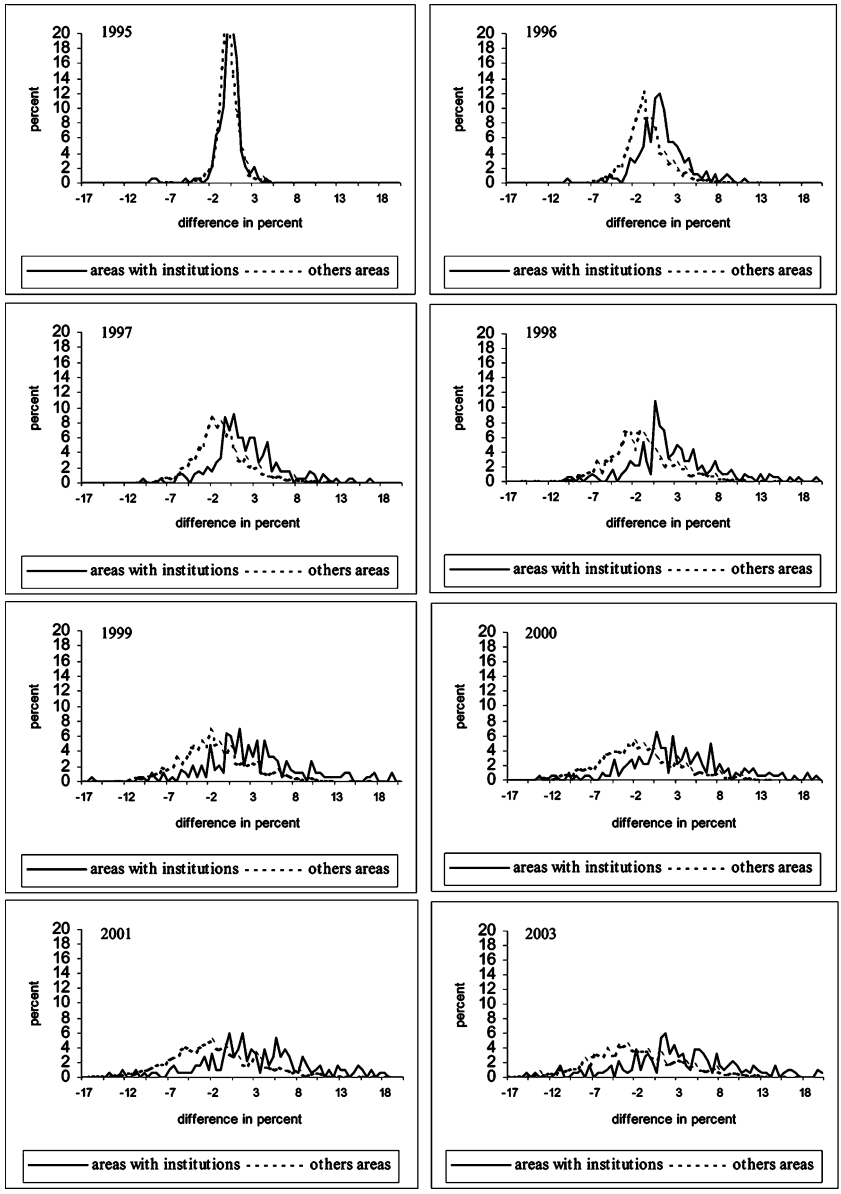

FIGURE 3 Annual change in the difference between the distribution (in Percents) of the difference in percent between AGRM and INDM on areas include Institute population (N = 185) with other areas (N = 1311): 1995–2003.

- The differences between the distributions in the two types of areas increase rapidly. The percentage of the difference between the two methods in areas with institutions increases, and the percentage of difference in other areas decreases. First, the population of institutions has usually been counted outside the location where it was registered. The second cause is the special treatment of the population of institutions in the AGRM. Notably, the aggregated method keeps the framework of institution residents fixed for some time, whereas the individual method subtracts that population from the locality where it was enumerated without updating residents of institutions. In contrast to the AGRM, the INDM eventually ignores residents of institutions. This keeps the average difference between the estimates increasing.
- The change in the average percentage of difference and in the standard deviation is higher in areas with institutions.
- The change in the difference between the distributions of the percentage of the difference by type of area diminishes over time. This is displayed in Figure 3 and Table 3, which present the relative change in the difference in the parameters of the distribution. The convergence of the entire distribution of the percentage of the difference is presented separately for each type of distribution. This is displayed in Figure 4 and Table 3, which present the relative change in the difference in each of the parameters of the distribution separately.

TABLE 3 Annual Mean and Standard Deviation of the Difference Between the AGRM and INDM Distributions, by Type of Area 1995–2003

	All areas		Including areas with institutions (at least 5% of the people residing in institutions in 1995)		Excluding areas with institutions (less than 5% of the people residing in institutions in 1995)	
	N = 1496		N = 185		N = 1311	
Date	Mean	SD	Mean	SD	Mean	SD
1995	−0.023	1.466	0.078	1.525	−0.038	1.457
1996	−0.235	3.049	1.051	3.352	−0.421	2.958
1997	−0.434	3.935	1.811	4.458	−0.757	3.747
1998	−0.634	4.727	2.535	5.355	−1.091	4.449
1999	−0.859	5.344	3.057	6.136	−1.424	4.974
2000	−1.035	5.762	3.508	6.707	−1.687	5.306
2001	−1.171	6.155	3.824	7.320	−1.892	5.616
2002	−1.316	6.468	4.073	7.824	−2.093	5.856
2003	−1.298	6.745	4.386	8.213	−2.119	6.085

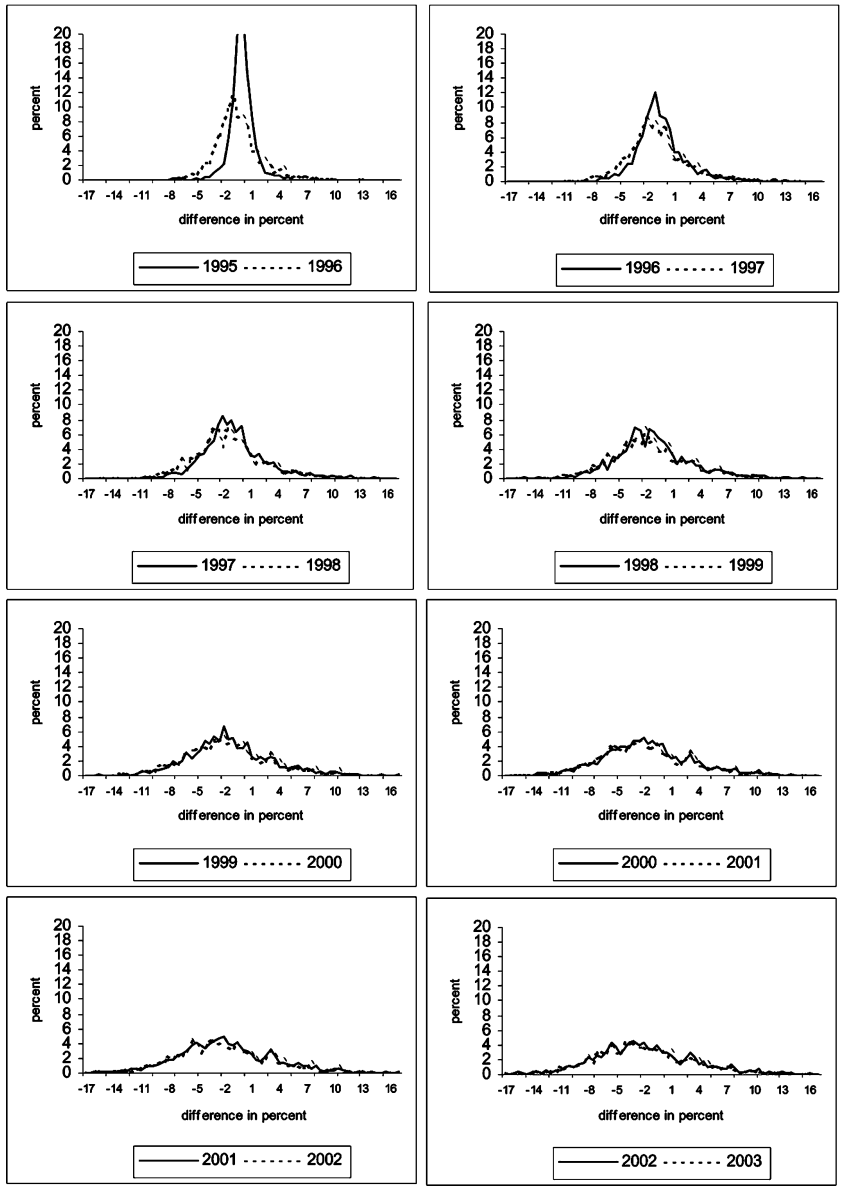

FIGURE 4 Distribution (in Percent) of the difference in percent between AGRM and INDM on statistical areas–excluding areas include at least 5% institute population: 1995–2003 (N = 1311).

- Convergence is slower in areas with institutions.
- After the problem of institutions, which is one of the main differences between the two methods, we still find that the distribution of the percentage of the difference changes over time. The trend of this change is similar to the convergence in all areas with the difference in the parameters of the distribution. This similarity can be attributed to residents of institutions influencing the difference in the areas where they are registered and which are not necessarily classified as areas with institutions. Another attributing factor is that the other areas include other types of populations, which lead to differences not necessarily revealed by our data.

CONCLUSION

The development of differences between INDM and AGRM highlights the accuracy of the Israeli population registry and its influence on population estimates in statistical areas. Both methods reveal inaccuracies in the population registry at the 1995 census day. In particular, inaccuracies accumulated after the 1995 population census cannot be detected in our analysis and it will be detected only in the forthcoming population census. The discrepancies between records in the population registry and the results of the 1995 census are partially solved by using the INDM. This solution improves population estimates in statistical areas by better updating due to discrepancy between census and the population registry on census day. However, the INDM does not solve the problem of residents of institutions, where the population keeps changing. The AGRM solution for institutions is better, though we do not observe the population of institutions and though size and characteristics of the population of institutions are assumed constant over time. Because the INDM excludes residents of institutions, statistical areas with institutions miss the population in those institutions because the negative components of Eq. (1) for residents of institutions are conducted from the place of enumeration instead of the place of registration, contrary to what is done in the AGRM.

The ideal solution for updating the population of institution residents based on the INDM would be to conduct a census of residents of institutions[4] and update it every year. Such a census would make it

[4]This solution would require a yearly administrative census of residents of institutions. A list of residents can be obtained from the administration of the institution (directly from the institution or from the ministries responsible of institutions). In this way, we obtain a similar result as when examining only the changes and not the entire list.

possible that the individual method includes residents of institutions, in order to improve the quality of INDM estimates compared with AGRM estimates.

Counting institutions is not enough to prefer the INDM over the AGRM. Another important condition for preferring the INDM is to enable population censuses that will enable us to use INDM. For the first time in the history of population censuses in Israel, the Central Bureau of Statistics plans to move from a traditional census to an integrated census in 2008, which will combine a sample of 20% in the field with the listing in the population registry (Blum, 2003; Kamen, 2004; Nirel, Glickman and Ben-Hur, 2003). The final census file includes weighted records of all registry records (including emigrants). The total weight of all records in each area yields the estimate of the total population in that area. Therefore, the construction of the base according to both methods is possible. What about the updates of the population in the years after the census? This problem is easily solved by the AGRM, because the component is converted into an aggregate yielding the population estimates. It is still not clear that the INDM does the same. If it is possible to estimate the population with the INDM, there must be at least a clear distinction between residents living in Israel and emigrants. This distinction will be possible only if emigrants from Israel are followed.

The integrated census is an attempt to improve INDM with addresses coming from other administrative sources such as education, the electric company and municipal tax (*Arnona*).

The convergence of the difference between the two estimates does not mean that records having the area of residence declared on the census day different from the area of residence listed in the population registry (about 20% of all records) have led to differences between the two methods (by address change, death or emigration). Between 1995 and 2003, only 56.1% of the records led to at least one change affecting the difference (Fig. 5). Most changes concern changes of address. Why did the remaining 44% not change their addresses in the population registry? To answer we distinguish three groups: (1) People who declared a temporary address and returned to their permanent address after the census, (2) people who intended to change their address but have not yet done it, and (3) people who had no intention of changing their address. We will be able to distinguish between those groups in the 2008 census. Groups 1 and 3 influence the difference between each method and the actual status of the population with no effect on the difference between the methods, because there is no registration. On Group 1 the registration is the actual one and on Group 3 the census is the actual one.

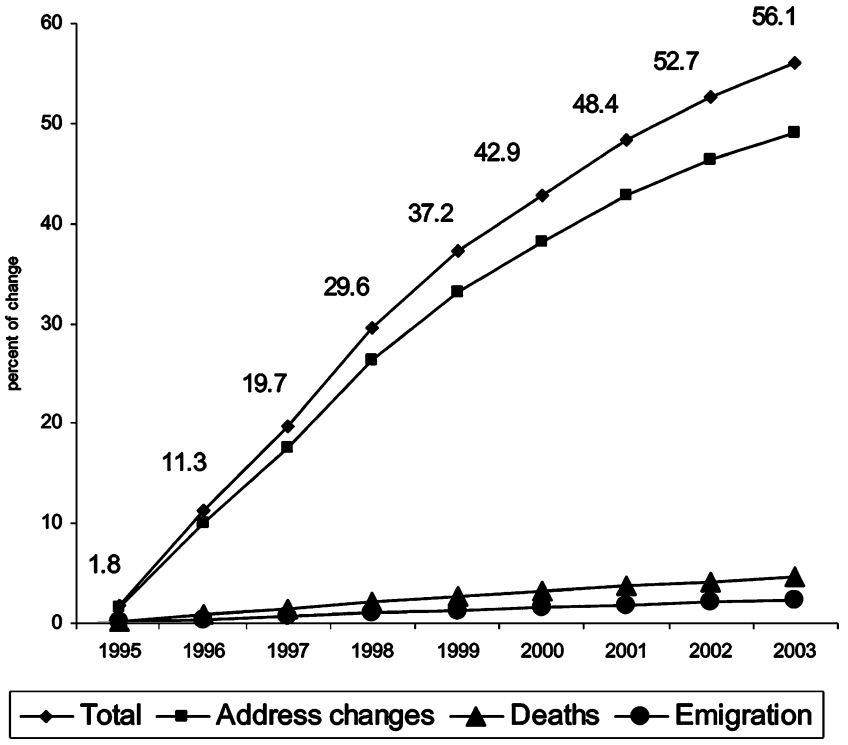

FIGURE 5 Cumulative percent of changes in address, deaths and emigration for people having different addresses in the census and in the population registry at census day $\left(\approx \frac{\sum_{s=1995}^{1995+m}(M^s)}{M}, m = 0, 1, 2, 3, 4, 5, 6, 7, 8\right)$.

If most records are in Group 1, then after a period of several years, the main difference between the INDM and the population registry will come from the distinction between emigrants and residents of Israel, but the addresses of residence on population registry will be more accurate. When a registry of emigrants, a census of institutions, and administrative files are available, population estimates are better in statistical areas. In sum, the INDM will be preferable only if censuses in Israel are conducted every five years (instead of every 11–13 years as it has been the rule). Then it will be possible to produce good population estimates even if not all conditions are met.

Individual management makes it possible to update the population registry correctly and to construct representative surveys. For example, we will avoid sending enumerators to people who do not

belong to the population or whose real address is not listed in the population registry.

The next step is to estimate population by both methods until the next population census in 2008. After that census, the results of the census will be comparable with the results obtained under each of the two systems, using a method similar to that of Simpson, Diamond, Tonkin and Tye (1996) for England and Wales. This comparison would enable us to compare the quality of the two methods with the actual estimates. Then it will be possible to characterize the areas in 2008, compare it with the 1995 census, and choose the best for statistical areas.

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