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Estimation of business population in Mexico
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Session 1: Production of business demography statistics and other statistics by linking the SBR with other data sources

Introduction

Estimates of the size, composition and structure of human populations have been developed in all countries, projecting specific indicators of these populations in order to provide future scenarios on their growth, evolution and demographic mobility caused by phenomena such as mortality, birth, marriage, fertility, among others, to have solid tools for planning future requirements regarding social needs such as education, health, employment and human settlements' infrastructure. Different sources of information are considered for the fulfillment of these projections, such as the censuses of population and housing, sample surveys and administrative records.

Making a similarity of the projections in human populations, in terms of business populations, the National Institute of Statistics and Geography (INEGI) of Mexico has made demographic projections for estimating the future number of businesses in a given year, investigating some phenomena that occur during the life of businesses, such as births, survival and death, producing demographic indicators, which are the result of historical monitoring of businesses' life during the last 6 consecutive Economic Censuses, from 1989 to the latest in 2014, which cover 30 years of evolution of businesses in Mexico.

These indicators refer to the probabilities that all businesses have of surviving and dying at certain age, as well as the number of years they are expected to survive (life expectancy) as of their date of birth. Furthermore, the indicators include the same probabilities and life expectancy when businesses are different ages; through these indicators, it is possible to obtain probabilities of survival or death of businesses at future ages, since they are a certain age "x", i.e. the **conditional probability** of surviving "y" more years, since they are age "x". All the demographic indicators are included, according to age, in the "Tables of survival, mortality and life expectancy of the businesses in Mexico".

The conditional probabilities are the basis for calculating the projection of the number of existing businesses in a given year, since it is based on an initial population formed by businesses of different ages, and there is a different probability of survival for every age.

This document describes the procedure used by INEGI to calculate the projection of the number of establishments that will be operating in the year 2019, based on the existing business population in 2014. However, because the "Tables of survival, mortality and life expectancy of businesses in Mexico" are valid for any population, the procedure can be generalized for estimating the business population in Mexico in a given year.

I. METHODOLOGY

This section describes the methodology developed by INEGI for estimating the number of businesses that will exist in Mexico in 2019, based on the number of existing businesses in 2014.

The methodology is based on the "Tables of Survival, Mortality and Life Expectancy of Businesses in Mexico", which are obtained through monitoring the life of businesses during the Economic Censuses that are conducted in Mexico every five years. For this reason, four segments of the population that needed to be estimated were identified and because of their characteristics, different procedures were used. The description of these segments is as follows:

Segment	Description
Segment 1	Businesses born up to the year 2014, observed in 2014 and that are expected to survive by 2019.
Segment 2	Businesses born during the period 2014 - 2018 (inter-census period) and that are expected to survive by 2019.
Segment 3	Businesses born in 2019.
Segment 4	Businesses belonging to the public sector and religious organizations, born up to 2018 and that are expected to survive by 2019.

The procedures developed for estimating the number of businesses in the different segments are described below:

a) Segment 1:

- The businesses observed in 2014 by the Economic Censuses were distributed according to their age, forming 114 generations (from 1900 to 2013).
- Based on the "Tables of survival, mortality and life expectancy of businesses in Mexico", the conditional probabilities of businesses surviving age "x + 5" were calculated, since they were age "x" in 2014.
- The number of businesses of each age was multiplied by their corresponding conditional probability, obtaining the number of those that survived 5 years later, by then the businesses at age 0 would be 5 years old; those of age 1, 6 years old, and so

on. Thus, the number of live businesses in 2014 was estimated and that are expected to survive by 2019, distributed by age as of 5 years of age.

b) Segment 2:

- The average of the five-year growth was used to estimate the number of businesses born in the period 2014 – 2018 and that are expected to survive by 2019, considering the 1989 to 2014 Economic Censuses; thus obtaining the number of businesses that would be 0,1,2,3,4 years old by 2019.

c) Segments 3 and 4:

- In order to estimate the number of businesses expected to be born in 2019 and the number of existing businesses belonging to the public sector and religious organizations in 2019, their behavior in different editions of the Economic Censuses was analyzed and the number of businesses from both segments was estimated, based on the ratios that each segment presents on the total businesses captured in the 2014 Economic Censuses.

Following these procedures, the total number of businesses expected to exist in Mexico in 2019 was estimated for every one of the previous identified segments, and whose results per segment are shown in Table 1.

Table 1. Projection for 2019 according to business population segments

SEGMENT		NUMBER OF BUSINESSES PROJECTED FOR 2019
Segment 1:	Survivors	2,845,208
Segment 2:	Births (0 to 4 years of age)	1,983,750
Segment 3:	Born in 2019 (year of the census collection)	457,436
Segment 4:	Born up to 2018 from the public sector and religious organizations and that are expected to survive by 2019	320,924
Total		5,607,318

II. METHOD VALIDATION

With the purpose of validating the method described in the previous section, a simulation process was performed for estimating the total of existing businesses in Mexico in 2014, based on the existing businesses in 2009, with the objective of comparing the estimated value regarding the observed value through the 2014 Economic Censuses.

The simulation process was performed using the same methodology, so analogously four segments of the population that needed to be estimated were identified, and whose description is presented as follows:

Segment	Description
Segment 1	Businesses born up to 2009, observed during this year and that survived by 2014.
Segment 2	Businesses born during the period 2009 - 2013 (inter-census period) and that survived by 2014.
Segment 3	Businesses born in 2014, during the period of the 2014 Economic Censuses collection.
Segment 4	Businesses belonging to the public sector and religious organizations born up to 2013 and that survived by 2014.

Analogously, estimations of every segment were performed in the following way:

a) Segment 1:

- Businesses observed in 2009 through the Economic Censuses, were distributed according to their age, forming 109 generations (from 1900 to 2008).
- Based on the "Tables of survival, mortality and life expectancy of businesses in Mexico", the conditional probabilities of businesses surviving age "x + 5" were calculated, since they were age "x" in 2009.
- The number of businesses of each age was multiplied by their corresponding conditional probability, obtaining the number of those that survived 5 years later, by then the businesses at age 0 would be 5 years old; those of age 1, 6 years old, and so on. Thus, estimating the number of live businesses in 2009 and that survived by 2014, distributed by age as of 5 years of age.

b) Segment 2:

- The average of the five-year growth was used to estimate the number of businesses born in the period 2009 – 2013 and that survived by 2014, considering the 1989 to 2009 Economic Censuses; thus obtaining the number of businesses that would be 0,1,2,3,4 years old by 2014.

c) Segments 3 and 4:

- In order to estimate the number of businesses born in 2014 and the number of existing businesses belonging to the public sector and religious organizations in 2014, their behavior in different editions of the Economic Censuses was analyzed and the number of businesses from both segments was estimated, based on the ratios that each segment presents on the total businesses captured in the 2009 Economic Censuses.

The results obtained from the estimate of businesses in each segment are shown in Table 2.

Table 2. Projection for 2014 according to business population segments

SEGMENT		NUMBER OF BUSINESSES PROJECTED FOR 2014
Segment 1:	Survivors	2,187,403
Segment 2:	Births (0 to 4 years of age)	2,044,062
Segment 3:	Born in 2014 (year of the census collection)	476,348
Segment 4:	Born up to 2013 from the private sector and religious organizations and that survived by 2014	254,410
Total		4,962,223

When comparing the projection of the number of existing businesses in 2014 and the data observed during the 2014 Economic Censuses, an error of 0.0027 is obtained, as shown in Table 3.

Table 3. Projection of the business population in Mexico in 2014 and its comparison with the real data on the number of businesses from the 2014 Economic Censuses

Real data on the number of businesses from the 2014 Economic Censuses (A)	Projection for 2014 of the number of businesses (B)	Error in the estimates (B/A) - 1
4,948,879	4,962,223	0.0027

When analyzing this result obtained in the simulation carried out, the conclusion is that the error in the estimation regarding the real data from the 2014 Economic Censuses is acceptable, since it is barely 0.27%, which is equivalent to 13,344 businesses.

III. RESULTS

Although the 99.73% reliability level of the method guarantees good precision for the projections of the number of businesses for the year 2019, it was decided to make an adjustment based on the error observed in the simulation, so such error was discounted from the initially estimated data, the result is presented in Table 4.

Table 4. Projection of business population in Mexico for 2019

Estimated data for 2019 (A)	Error observed in the simulation exercise (B)	Adjusted projection A / (1 + B)
5'607,318	0.0027	5,592,220

Therefore, the number of businesses that are estimated to exist in Mexico in 2019 is **5,592,220**.

IV. CONCLUSIONS

1. The use of conditional probabilities obtained through the use of the "Tables of survival, mortality and life expectancy of businesses in Mexico" allow obtaining reliable projections of the number of businesses in Mexico in a given future year.
2. INEGI currently has the possibility of automatically calculating the conditional probabilities of businesses surviving a specific number of years, since they have already survived the age they currently are. The above can be done for the different geographical categories of economic activity and business size, or any combination of

them, which means that it is possible to calculate projections of business population at future times for more detailed categories.

3. The importance of performing projections of the demographic structure by business' age in Mexico at detailed levels, is a valuable tool for the development of public policies aimed at specific groups, for example for designing policies that attenuate the high mortality of smaller businesses and for underpinning entrepreneurship statistics.
4. Having a precise tool for estimating the structure by business' age, allows doing detailed planning for census field operations and estimating the structure of sampling frames for surveys.