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21- 23 September 2015, Brussels**

**Session I**

**Statistical production on entrepreneurship combining statistical business registers with other data sources**

**Business demography in Mexico  
Progress and Perspectives**

**Abstract**

The National Institute of Statistics and Geography (INEGI) of Mexico published its new statistical development on “Life expectancy of businesses in Mexico 2015”, prepared through a longitudinal analysis that involves tracking the historical life lines of businesses captured from the 1989 up to the 2009 Economic Censuses (five censuses), building 16 business generations during this period, through which the demographic phenomena of survival and death were studied.

Indicators referred to the probability of occurrence of the mentioned phenomena were obtained through this monitoring; how many businesses survive and how many die, as well as life expectancy according to the distribution of age, and size. These indicators were concentrated in tables which are similar to those related to human demography. These tables were called "Tables of business survival and mortality "; built at national, state and activity sector level (Manufacturing, Trade, Private non-financial services and the national total) and by the measurements of business size according to the strata of persons employed.

Furthermore, other indicators were obtained from the tables of survival and mortality according to the breakdown expressed above, such as the occurrence of survival or death at certain age, or at a range of future ages, and even considering a fixed age at a point.

All resulting indicators are available for consultation through a computer application developed online: "System for consulting indicators on economic demography ", developed by INEGI, Mexico.

One of the most important contributions of this study is providing information for the design and development of policies in the fields of entrepreneurship and the preservation of established businesses.

This paper presents the study methodology, some relevant results obtained, as well as the perspective for future research conducted for obtaining indicators on economic demography in more detailed categories, from the geographical and economic classification point of view.

## Introduction

This document is divided into four general sections, the first corresponds to initial measurements on the birth and death of businesses that were conducted over a period of five years, which were based approaches for further study, the second refers to the technical steps that were used in sequence for building the elaboration methodology for statistical development, entitled: "Life expectancy of businesses in Mexico 2015", mainly in the construction of survival and mortality tables that concentrate key indicators on business survival and death in Mexico: probabilities of survival or death, how many survive and the years they are expected to survive, according to their age distribution.

The third section denotes the presentation of the main results at national level and its comparison with those related to the 32 states that constitute the geographical structure in Mexico, expressing this comparison by economic sector and according to the size of businesses through three main concepts of the economic demography: business life expectancy, survival and mortality.

The fourth and last section expresses the conclusions and future plans of this study, both in the research process and in the expected results of the work being done from this date up to the end of 2015.

### I. Initial measurements

The analysis of the phenomena such as business survival and mortality in Mexico has its most recent history in the comparison performed between the last 2 census periods; from the 2009 to the 2014 economic censuses, period in which the events related to the mortality or birth of the businesses were estimated.

In this exercise interesting results were obtained as follows:

- 1) *The business mortality rate was 37.6% and the birth rate was 51.4% during the mentioned period.*
- 2) *The birth and mortality rates during the referred interval, have different behaviors by economic activity sector:*
  - For trade 17.4% in mortality and 21.7% in births.
  - Regarding the private non-financial service sector, rates of 14.4% for deaths and 21.5% for births in the referred period were estimated.
  - Manufacturing registered rates of 3.5% and 5.3% for the phenomena of mortality and birth respectively and the rest of the sectors rates of 2.3% in business mortality and 2.8% in births.
- 3) *Business mortality and birth have different behavior by state during the referred period:*
  - The highest mortality rate (between 40.1% and 52.9%) occurred in the states of: Baja California, Baja California Sur, Sonora, Coahuila, Nuevo León, Tamaulipas, Guerrero, Estado de México, Morelos, Tabasco, Campeche y Quintana Roo.

- The highest birth rates (between 46% and 55.6%) occurred in the states of: Baja California, Baja California Sur, Chihuahua, Coahuila, Nuevo León, Aguascalientes, Colima, Guanajuato, Querétaro, Hidalgo, Estado de México, Morelos, Oaxaca, Tabasco y Quintana Roo.

## **II. Methodology**

The three previous findings allowed an approach aimed at formalizing the study on the phenomena of business survival and mortality, through the following questions that were taken as research hypothesis for the study “Life expectancy of businesses in Mexico 2015”:

- What is the probability of business survival or death in Mexico?
- Do these probabilities depend on the size of the business, the activity it performs or on its geographical location?
- What is the life expectancy of a business in Mexico?

To answer the questions initially posed, the following procedures that structure the work methodology were performed in sequence:

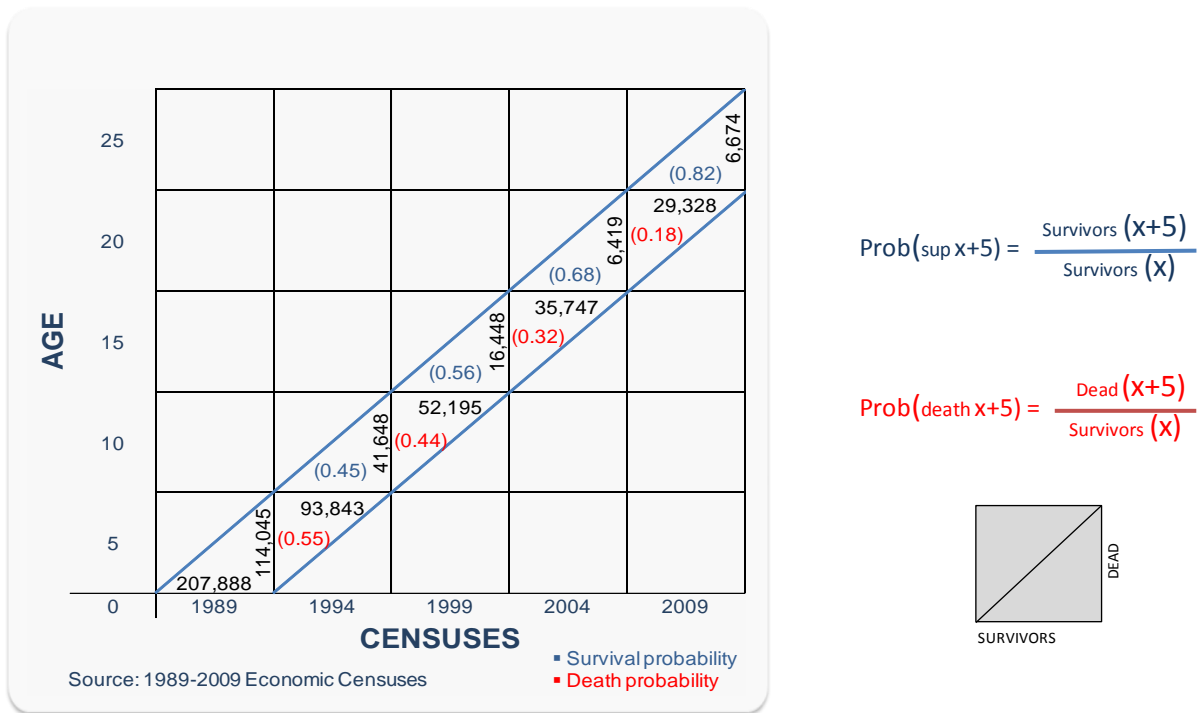
### **STEP 1: Definition of Categories**

The categories that cover the results of the statistical development “Life expectancy of businesses in Mexico 2015”, have a geographical breakdown, both at national level by state (32 entities), the results by economic sector are detailed within these (manufacturing, trade, private non-financial services and the national total), also by business size according to the strata of persons employed.

### **STEP 2: Generational Monitoring**

Within each category the monitoring of the business lifelines was performed during the period between 5 economic censuses: 1989, 1994, 1999, 2004 and 2009, through which the generation of business births were defined, structuring a total of 16 generations, as well as their age obtaining a first approximation of the probabilities of survival and death between each census. An example of this type of generational follow-up is presented below through the denominated **Lexis Diagrams**:

**FIGURE 1.** The Lexis Diagram of the 1988 generation in national total category.



**STEP 3: Quinquennial probability calculation**

In the previous example, the quinquennial survival and death probabilities of businesses from the 1988 generation in the country are presented, observing those that survived and died from the 1989 to the 2009 censuses. For each generation within each category these probabilities were calculated, so the total number of the quinquennial probability concentration frames, considering 16 generations, 3 sectors, 8 business sizes and 32 states, plus the national concentrate resulted in 12,672 frames.

**STEP 4: Calculation of annual probabilities**

Based on the quinquennial probabilities between censuses, annual probabilities were estimated linearly, from age zero up to the age of 60, under these calculations we obtained a first approximate of the tables of survival and mortality for every generation within each category with annual data.

**STEP 5: Estimating survival function**

From the work methodology point of view, the task of finding a mathematical function that models the behavior of the survival phenomenon for every category, was one of the problems to be solved, for which we proceeded as follows:

- a) In each category, the average survival of its 16 generations was calculated, obtaining the column of survivors through the age of the businesses.
- b) A linear model that correlated business age to its maximum with the average survival vector of all the generations was adjusted to the resulting column, relation that presented fairly high correlation coefficients in every category, between 0.94 and 0.95, indicating an excellent positive linear association of the selected model, as well as a good adjustment level.

### STEP 6: Obtaining definite tables of survival and mortality

With the survival value adjusted in every category through the model, we have the number of survivors for every (x) age, which is input for understanding the rest of the economic demography indicators: survival probability at (x) age, death probability before reaching (x) age, number of deaths before reaching (x) age and business life expectancy at (x) age. The table below is an example of these tabulations for the category of (0 to 2) persons employed.

<b>Table of business survival and mortality from 0 to 2 persons employed</b>					
<b>x</b>	<b>p(x)</b>	<b>q(x)</b>	<b>S(x) ajusted</b>	<b>e(x)*</b>	<b>d(x)</b>
0	0.6160	0.3840	100,000	6.9032	38,405
1	0.3197	0.6803	61,595	7.2875	29,626
2	0.2996	0.7004	31,969	7.6932	2,010
3	0.2808	0.7192	29,959	8.1215	1,884
4	0.2631	0.7369	28,075	8.5736	1,765
5	0.2466	0.7534	26,310	9.0510	1,654
6	0.2311	0.7689	24,656	9.5548	1,550
7	0.2165	0.7835	23,106	10.0868	1,453
8	0.2029	0.7971	21,653	10.6483	1,361
9	0.1902	0.8098	20,292	11.2411	1,276
10	0.1782	0.8218	19,016	11.8669	1,196
11	0.1670	0.8330	17,820	12.5276	1,120
12	0.1565	0.8435	16,700	13.2250	1,050
13	0.1467	0.8533	15,650	13.9612	984
14	0.1374	0.8626	14,666	14.7385	922
15	0.1288	0.8712	13,744	15.5590	864
16	0.1207	0.8793	12,880	16.4252	810
17	0.1131	0.8869	12,070	17.3396	759
18	0.1060	0.8940	11,311	18.3049	711
19	0.0993	0.9007	10,600	19.3240	666
20	0.0931	0.9069	9,933	20.3998	625
21	0.0872	0.9128	9,309	21.5354	585
22	0.0817	0.9183	8,723	22.7343	548
23	0.0817	0.9183	8,175	24.0000	0

\* years of life

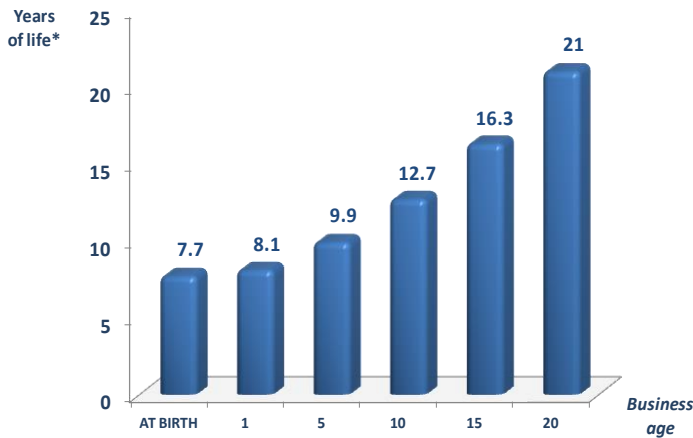
### III. RESULTS

Taking the table of survival and mortality as input for the categories this study covers: 32 states plus the national level, 3 sectors and 8 sizes, resulted in a total of 792 tables, from which the following results were obtained:

#### III.1 Some general results

##### On life expectancy

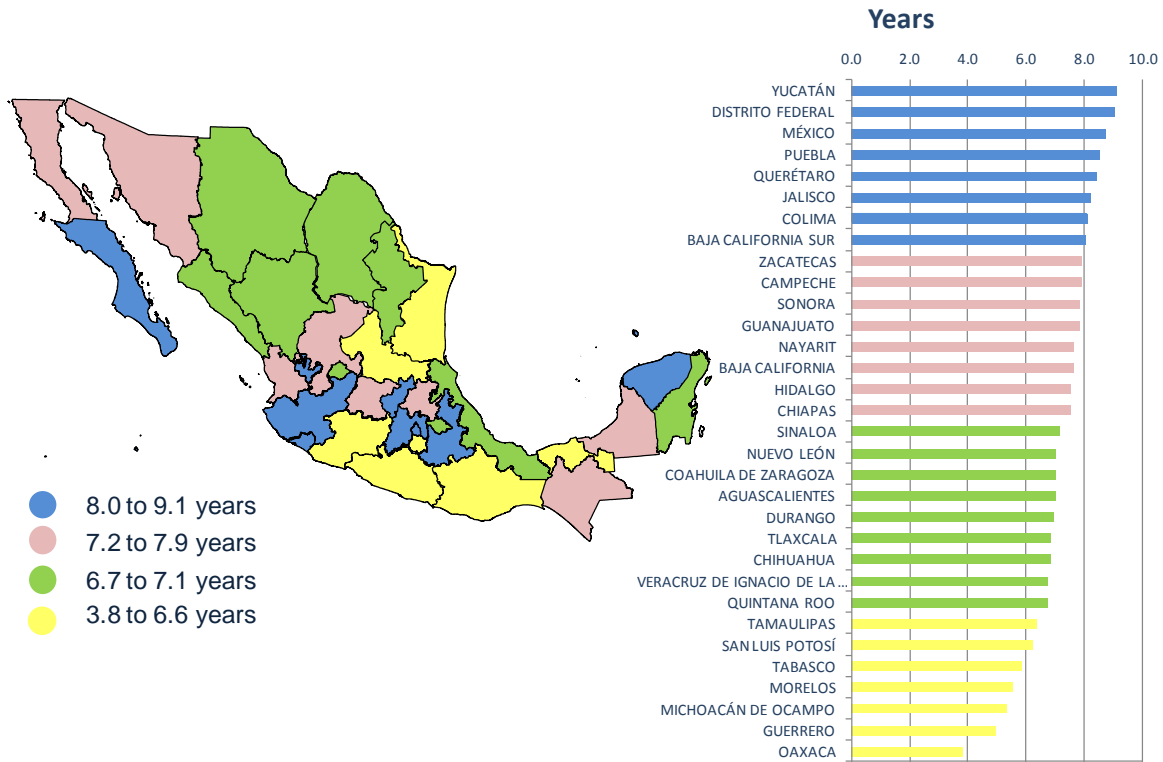
**FIGURE 2.** Life expectancy of businesses in Mexico, according to age.



**COMMENTS:**

- Life expectancy of businesses in Mexico increases with the age, at birth this indicator is in 7.7 life years at national level.
- Life expectancy of businesses when reaching 5 years of age increases from 7.7 to 9.9 more years of age.
- Businesses that survive age 10 already have 12.7 more years to live.
- When businesses reach 20 they have 21 more years of life.

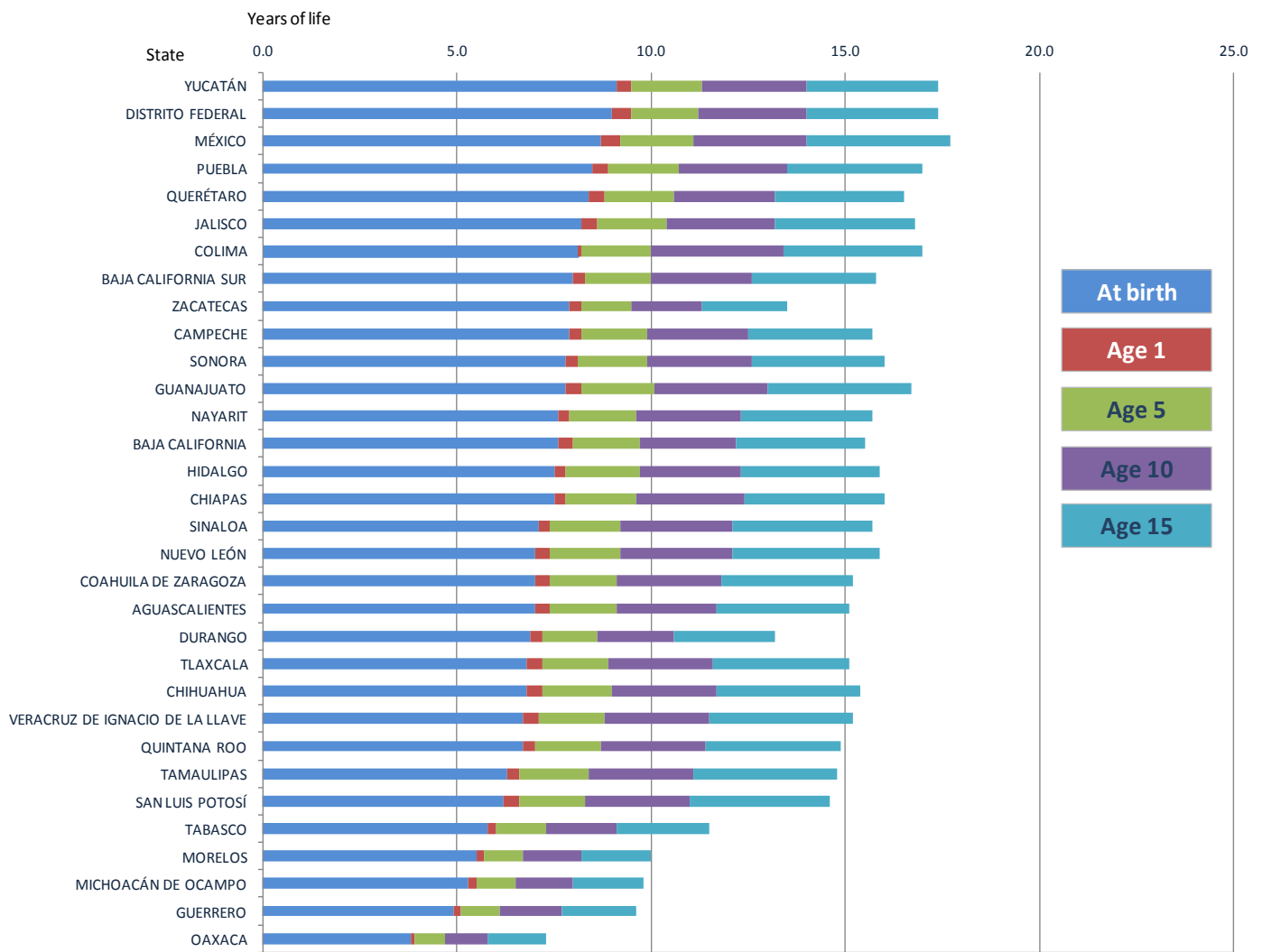
**FIGURE 3.** Business life expectancy by state.



COMMENTS:

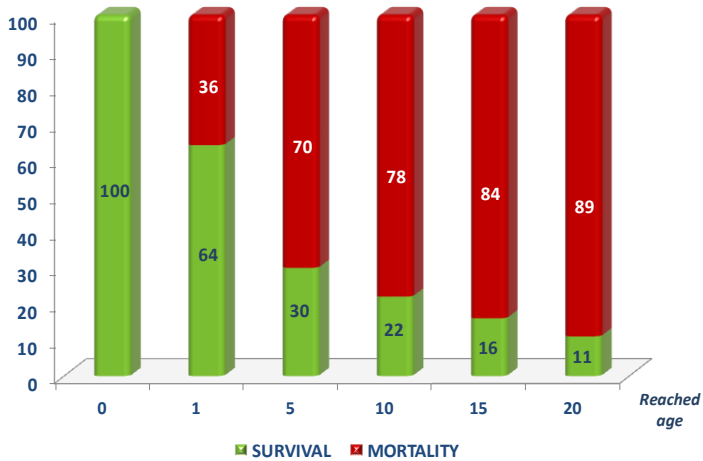
- Considering that life expectancy at business birth in Mexico is 7.7 years of life, approximately half of the states are above this national average.
- There are 8 states whose life expectancy at birth is between 8.0 and 9.1 years, which are from high stratum.
- There are 7 states whose life expectancy is the lowest range, between 3.8 and 6.6 years.
- The growing trend of life expectancy, as age increases, has specific conditions by state, it can be seen how in everyone of them the indicator increases according to the age, this is observable in the following figure:

FIGURE 4. Business life expectancy by state, according to age.



## On survival and mortality

**FIGURE 5.** Cumulative survival and mortality of businesses in Mexico, according to age.



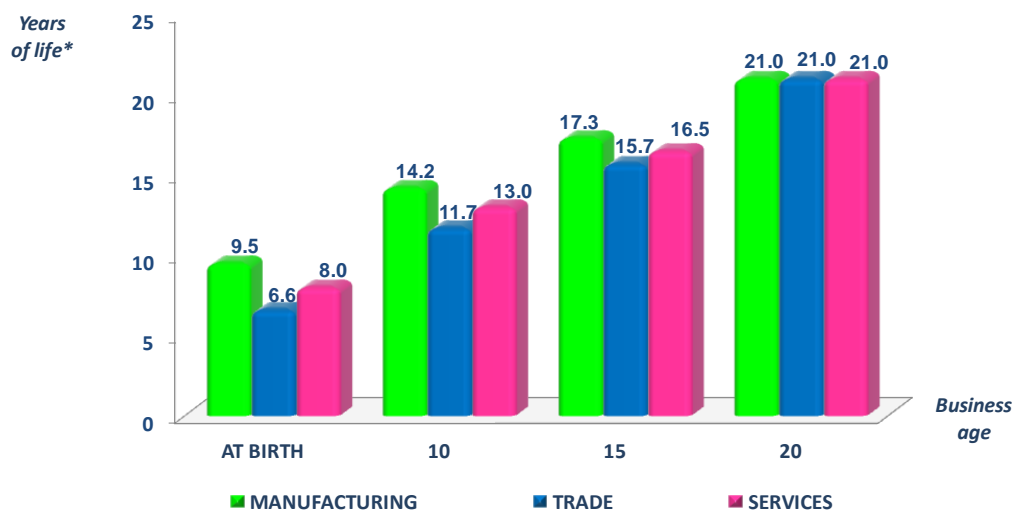
### COMMENTS:

- For every 100 businesses born in Mexico, 64 survive and 36 die during the first year of life.
- During the first 5 years of life, 70 die and 30 survive.
- As of 5 years of age, a decrease in business mortality in Mexico is observed.
- At age 20 only 11 survive, which are those that remain alive until the end of the survival and mortality table.

## III.2 Some results per sector

### On life expectancy

**FIGURE 6.** Business life expectancy in Mexico by economic sector, according to age.



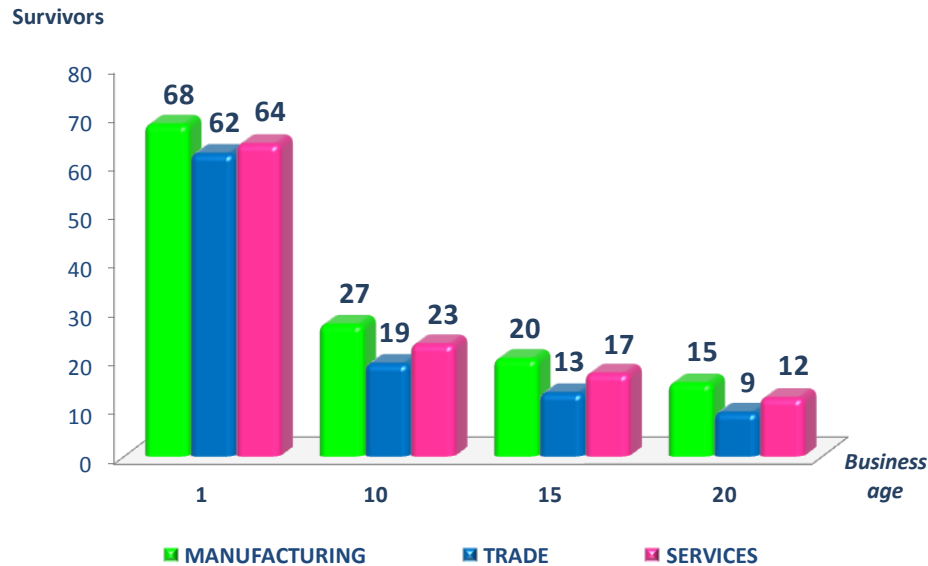
### COMMENTS:

- The manufacturing businesses have higher life expectancy at birth (9.5 years), service businesses 8.0 and trade businesses 6.6 years of life.
- Life expectancy of these three sectors grows as business age increases until it stabilizes at age 20 with 21 more years of life.



## On survival and mortality

**FIGURE 7.** Survivors from every 100 businesses entering the economic activity by sector, according to age in Mexico.



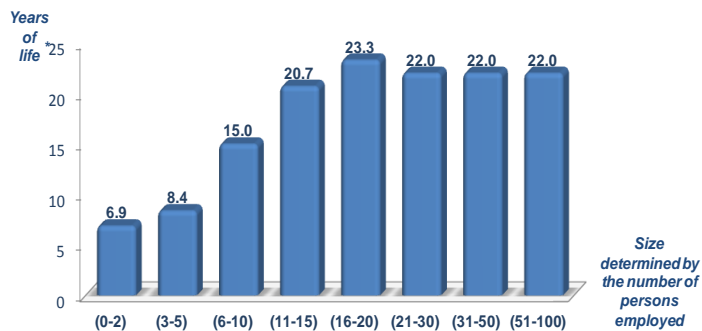
### COMMENTS:

- The figure shows that the sector with the least volatility in terms of survival according to age in Mexico, is the manufacturing sector, given that at the end of the first year of life, 68 out of 100 survive, when reaching age 20 only 15% survive.
- The businesses with the highest volatility are those in the trade sector, given that at the end of the year 62 out of 100 survive, and at age 20 only 9 out of 100 survive.
- In case of the service sector, 64 survive the first year of age and at age 20 only 12% survive.

## III.3 Some results according to size

### On life expectancy

**FIGURE 8.** Life expectancy at birth according to business size in Mexico

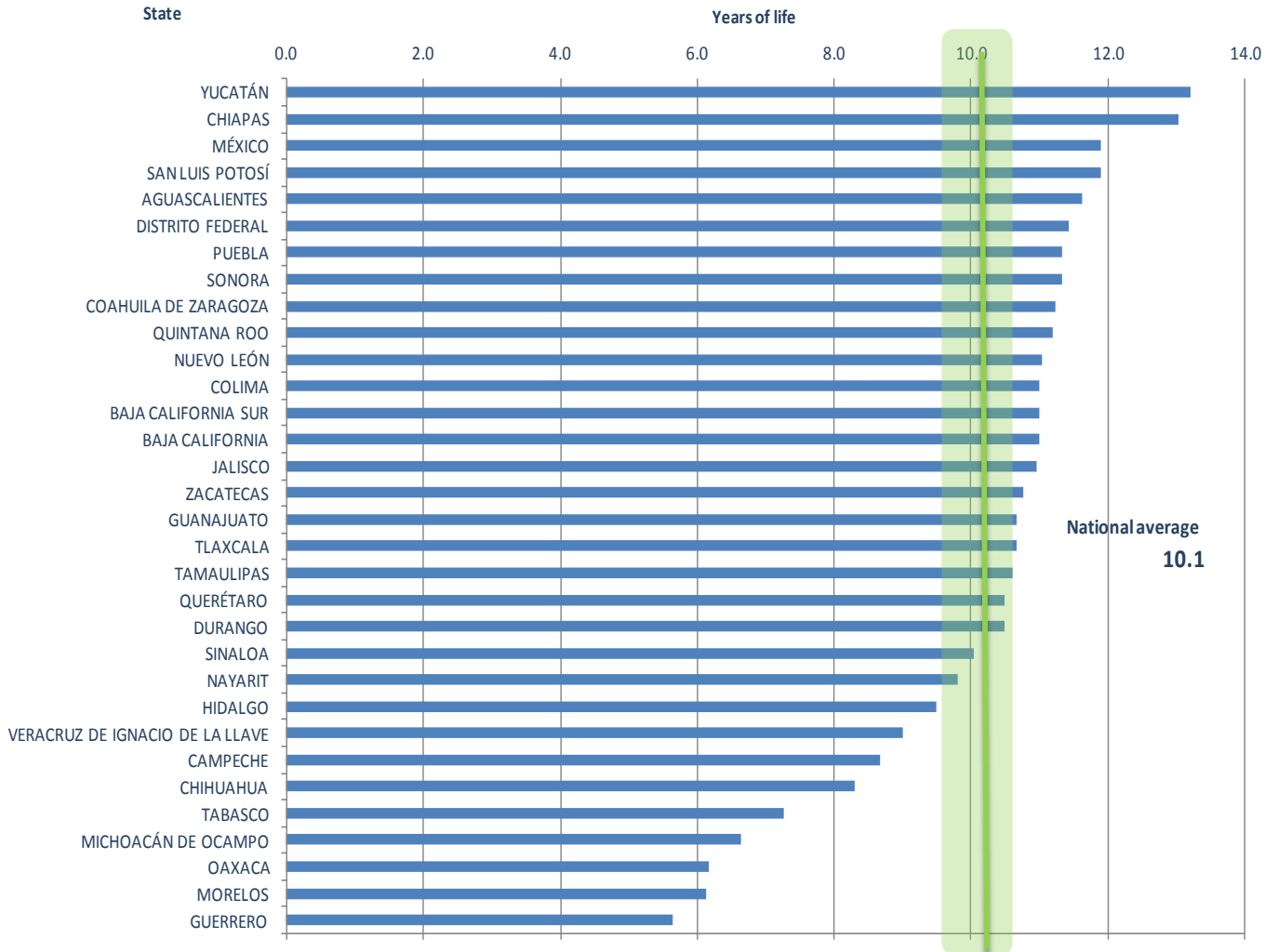


### COMMENTS:

- Life expectancy at business birth in Mexico increases according to its size
- The life expectancy indicator by size is the result of a balance of higher mortality in small businesses and higher survival in large businesses.

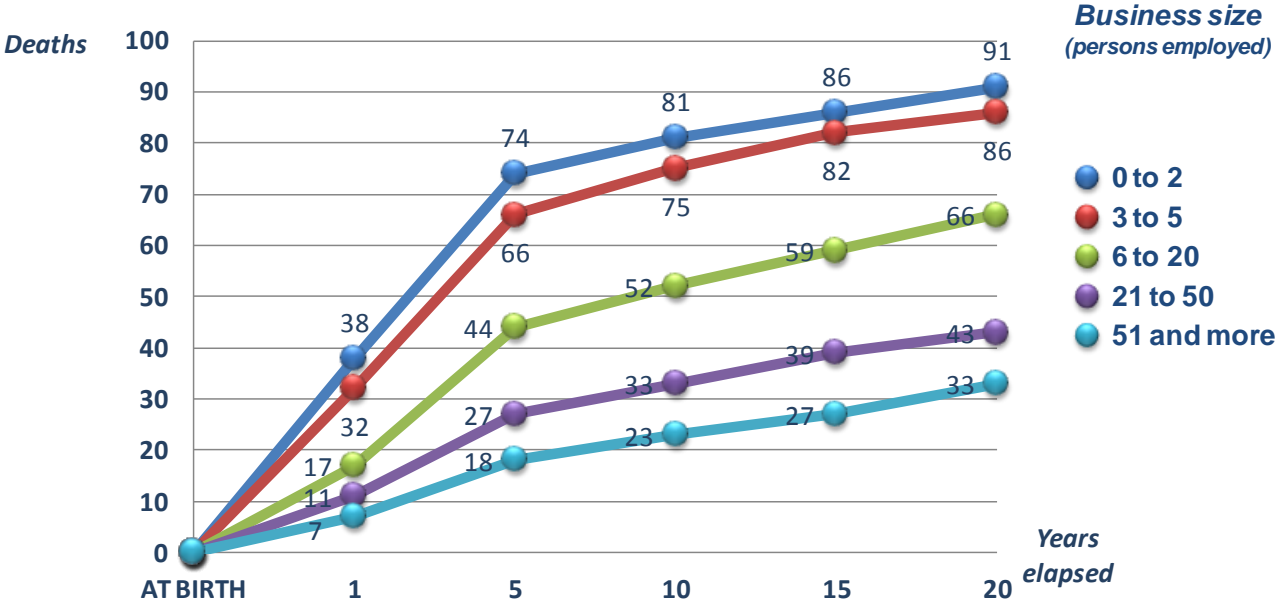
- Mexico is a country where most of its businesses are in the range between 0 to 10 persons employed, since 95% of all the businesses in the country are in this range, according to the 2009 Economic Censuses; this stratum has an average of 10.1 years of life expectancy at birth.
- This indicator presents different measures by state regarding business size, when observing figure 8, we see differentiated behavior in each state regarding the national average by size 0 to 10 persons employed, as follows:

**FIGURE 8.** Life expectancy at business birth, from 0 to 10 persons employed, by state.



**On survival and mortality**

**FIGURE 9.** Cumulative mortality of businesses from every 100 entering the economic activity in Mexico, according to their size.



**COMMENTS:**

- The highest mortality of businesses in Mexico occurs during the first 5 years of age, which means that the smallest businesses are more volatile, the following table shows the number of deaths occurred during this period according to the strata of persons employed.

Size	% of deaths in the first 5 years of life
(0 a 2)	74
(3 a 5)	66
(6 a 20)	44
(21 a 50)	27
(51 and more)	18

- It is observable in the figure that as of age 5, although mortality is increasing in all the sizes, it tends to stabilize.

**III.4 Conditional indicators**

Both at national and state level and within these by sector and size, indicators were designed, whose source of information are the resulting tables of survival and mortality for each category, these

indicators refer to the probabilities of business survival or death in a determined future age or a period of ages, since the business currently has a fixed age, the series of indicators are listed below:

- Probability of a business surviving at a future age  $(x+n)$  years, since it currently has a fixed age  $(x)$ .
- Probability of a business dying at a future age  $(x+n)$  years, since it currently has a fixed age  $(x)$ .
- Probability of a business surviving at a future age  $(x+n)$  years and dying the following year, since it currently has a fixed age  $(x)$ .
- Probability of a business surviving in an interval of future ages  $(x+n)$ ,  $(x+n+m)$  years, since it currently has a fixed age  $(x)$ .
- Probability of a business dying in an interval of future ages  $(x+n)$ ,  $(x+n+m)$  years, since it currently has a fixed age  $(x)$ .

The whole combination of indicators previously mentioned was programmed through the Indicator Query System on Economic Demography by state, developed by INEGI of Mexico.

#### **IV. CONCLUSIONS AND FUTURE PLANS**

Based on the outcome of the development denominated "Life expectancy of Businesses in Mexico 2015", the following conclusions are established, they positively prove the hypotheses posed:

- Business survival and life expectancy indicators have different behavior by sector, size, age and the region or state they belong to.
- At national level, manufacturing businesses are the least volatile, followed by those in the private non-financial services, while those in the trade sector are the most volatile.
- In general, the smallest businesses are the most volatile.
- Business life expectancy has a growing trend as the business age increases.
- These indicators are a powerful tool for policy planning and decision-making for the public, private and social sectors.

The work prospects for the rest of the year in completing the development of business life expectancy in Mexico, lies in the following research:

- Measuring the business survival, mortality and life expectancy indicators for more detailed geographical and economical coverage.
- Studying the demographic phenomena of survival, mortality and life expectancy at enterprise level.