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Demographic transition, demographic bonus and ageing in Mexico

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1. Introduction

Demographic transition is a process through which almost all countries in the world are passing or have passed; in general terms, it refers to the shift from a regime characterized by high and uncontrolled levels of mortality and fertility to one of low and controlled levels. Demographic transition in the developing countries, such as Mexico, occurs more quickly than in more developed regions. The rapid changes in the size and age structure of the population entail challenges that are not always resolved, or that take a great deal of time to resolve.

The sharp decline in mortality as a result of the enormous expansion and coverage of health services, as well as the low-cost import of effective drugs discovered in the developed countries, and the pronatalist policy which sought to meet the demand for labour for expanding industry and to populate the national territory, favoured high demographic growth in Mexico throughout the twentieth century, particularly between 1954 and 1974, when the rates of growth of over 3 per cent per year were among the highest ever seen in human history.

The country later adopted a new population policy which sought to reduce population growth thereby enabling a significant progress into the demographic transition during the last quarter of the twentieth century which is expected to end during the next 50 years when the age structure of the population will show a pronounced ageing. On the way towards that final stage, the rapid demographic growth of the past will continue to impact the age structure with the potential benefits and the challenges stemming from the position of this “excess” population in the various stages of the life cycle and will give rise to two changes as

pronounced as they are distinct: first, the population of working age will grow rapidly; later it will be the older adults who will increase significantly in numbers, within half a century reaching ageing ratios similar to those expected in the developed countries. Thus, as late as 2050, there will be traces in the age structure of the rapid growth in the distant past that characterized the generations born during the second half of the twentieth century, the impact of which will finally cease early in the second half of the present century. The consequences of this demographic past are still evident today, but they will be even more so in the coming years when the ageing process intensifies.

This paper reviews the demographic origin of those two changes in the age structure, in other words, how past and future changes in fertility, mortality and migration have contributed, and will contribute in the future, to the formation of the demographic bonus and eventual ageing. It first considers the phases of demographic transition and then goes on to analyse the contribution of each of those three demographic phenomena to changes in the number and age structure of the Mexican population.

[Figure 1]

2. Demographic transition in Mexico

The demographic transition of Mexico has followed a typical profile as can be seen from figure 1. Following the pre-transitional phase which lasted until about 1930, there occurred the first stage: a rapid decline in mortality while birth rates remained fairly steady and even rose between 1945 and 1960. The second phase can be said to begin in 1970 when the decline in fertility, which began during the 1960s, became more marked. The third stage of the process, when the birth and mortality figures converge, will occur during the first half of the present century.

It is estimated that the growth rate increased from 1.4 per cent in 1921 to 1.7 per cent in 1930, to 2.7 per cent in 1950 and to 3.5 per cent in 1965. As a consequence of the decline in fertility, the pace of population growth then began gradually to decrease, falling to 3.1 per cent in 1970, to 2.3 per cent in 1985 and 1.3 per cent in 2000 (figure 2). As can be seen, following a long process of demographic transformation, the Mexican population entered the new millennium with a rate of growth similar to that of a hundred years earlier, but with a population size seven times greater.

[Figure 2]

Changes in demographic variables

A rapid and sustained decline in mortality took place beginning in the 1930s in a context of far-reaching economic, political and social reforms. In 1930, life expectancy at birth reached 35.9 years (34.9 years for men and 36.9 for women), whereas in 2000 it was 74.0 years (71.6 years for men and 76.5 for women). The increase was most striking from 1942 to 1960 when there was an increase of almost one year (0.95) for each calendar year (figure 3). The general fall in mortality was on such a scale that the cumulative overall reduction in the risk of death between 1930 and 2001 is equivalent to 82.1 per cent for men and 85.9 per cent for women. As in many other countries, Mexican mortality fell slowly during the 1960s and the

gain in average life expectancy was ultimately small. The pace of decline picked up later but was not as rapid as it had been previously.

The expansion of education services and sanitation infrastructure are among the main determinants of the sharp decline in mortality, together with the extension of health services, which has been significant since the creation of the Mexican Social Security Institute (IMSS) in 1942 and the conversion of the Department of Health into the Ministry of Health in 1943.

[Figure 3]

According to recent projections (Mexico's National Council on Population (CONAPO), 2002; Partida 2003), life expectancy will increase from 74 years in 2000 (71.6 for men and 76.5 for women) to 76.6 (74.2 and 79.1) in 2010, 79.8 (77.5 and 82.1) in 2030 and, finally, to 81.3 years (79.0 for men and 83.6 for women) in 2050 (figure 3); in other words, average life expectancy in Mexico at the end of the projection period will be similar to the recent figure for Japan (78.4 for men and 85.3 for women in 2003), which is currently the country with the lowest mortality in the world. The anticipated increases in life expectancy could prove relatively conservative since the overall reduction in the risk of death is 44 per cent between 2000 and 2050, whereas it was below 73 per cent during the period 1950-2000.

The decline in fertility did not begin until the mid-1960s. The high and even rising rates before then are an indication of the pronatalist policy prevailing in the country during those years. It should be pointed out that families had about six children in the early twentieth century, a figure which reached a maximum of 7.2 children at the beginning of the 1960s. The gradual spread of the practice of family planning as part of a new policy that sought to regulate population growth in accordance with the agreements adopted by the majority of countries, including Mexico, at the United Nations World Population Conference held in Bucharest in 1974, has contributed to advancing the fertility transition in the country (figure 4).

The total fertility rate (TFR) fell to six children per mother in 1975, to five in 1979, to four in 1985 and three in 1994, and has now reached about 2.2 children (figure 4). As can be seen, the Mexican experience, like that of other countries, demonstrates that, once the fertility transition begins, the pace of decline accelerates but, as it progresses, the successive reductions become less year by year.

[Figure 4]

Mexico's population policy aims at achieving a fertility rate equivalent to the replacement rate in 2005 (a TFR of 2.1 children per mother).[1] It is estimated that in 2000 about 71.4 per cent of women of reproductive age living with a partner used methods of contraception. In order to reach the replacement rate it will be necessary to increase contraceptive use to approximately 73.5 per cent in 2005 with an average annual increase of almost 0.5 per cent which is less than the 0.7 per cent in 1997-2000.[2] The required increase in the use of contraceptives is feasible since Mexico has a strong and comprehensive family planning programme which seeks to

[1] The target was proposed in 1995 in the context of the National Population Programme 1995-2000 and remains in the National Population Programme 2001-2006.

[2] It is estimated that the TFR fell to approximately 0.47 children between 1995 and 2000, corresponding to an annual decrease of 0.09 children. Reaching the population replacement rate in 2005 will entail a smaller annual reduction in the TFR from 2000 onwards.

minimize the unmet demand for the use of contraceptives. The target is likely to be met since the rate of contraceptive use was 74.5 per cent in 2003 according to the National Reproductive Health Survey (Mexican Ministry of Health, 2004).

On the basis of the fertility targets and the rate of contraceptive use assumed by the Mexican Government, and the minimum of 1.85 children per mother suggested by a United Nations group of experts (2002: 18-20), our projection of the TFR is as shown in figure 4, assuming that the figure of 1.85 children remains unchanged from 2030 onwards. Fertility below the replacement level would result in an eventual reduction of population (negative rate of growth).

The net loss as a result of international migration has been significant only since 1960 as can be seen from figure 2.[3] It is estimated that territorial mobility — principally of Mexicans to the United States — is currently reducing the population of the country by 0.4 per cent per annum. Forecasts for the next 50 years indicate that the net emigration rate might fall from 0.39 per cent in 2000 to 0.23 per cent in 2050. If the fertility, mortality and migration rates forecast for 2050 were to remain unchanged, the intrinsic growth rate of the stable population would eventually be -0.78 per cent.

3. The age structure transition

The various phases of demographic transition have left their mark on the age structure of the Mexican population as can be seen from the successive age pyramids in figure 5. The combination of falling mortality and high and rising fertility caused a rapid rejuvenation between 1930 and 1970; the sharp fall in fertility in the following 30 years produced a progressive reduction of the base of the pyramid.

Demographic projections indicate that this process will intensify in the first five decades of the present century. The contraction of the base of the pyramid will be increasingly evident, not only in relative terms but in absolute terms; on the other hand, the inertia of the past rapid growth will be clear first in the working years (age 15-59) and later in old age (60 years and above). The working age population will increase by almost 27 per cent between 2000 and 2015, and by only 3.8 per cent in the following 15 years, and will fall by 9.5 per cent in the last two decades. The number of older adults, on the other hand, will continue to rise by 76.3, 83.3 and 63.2 per cent, respectively.

The changes in age structure can be seen more clearly in the time series for the six functional age groups shown in figure 6. Pool (2004:11) suggests equating these groups with distinct stages in the life cycle: childhood corresponds to age group 0-14 years; youth to 15-29 years; early middle age to 30-44 years; late middle age to 45-59 years; early retirement age to 60-74 years; and old age to 75 years and above. The timeline of the childhood group is similar in pattern to the crude birth rate (figure 1); this is due to the fact that these generations are still “close” to their year of birth. With the passage of time, the likelihood of survival for the most recent cohorts increases as a result of the fall in mortality; however, from 1960 onwards, these cohorts are reduced as a result of the presence of more intense international migration, particularly of young people and adults in early middle age.

Thus, as a result of changes in demographic variables, the expected

[3] The difference between total growth and natural growth is the net migration balance. As the natural growth rates exceed those of total growth, it follows that the net migration rate is negative.

"generational parallelism" between the six age groups does not occur strictly within a periodicity of 15 years (the high point of the 0-14 age group in 1965-1969 does not occur for the 15-29 age group in 1980-1984, etc.) either in the precise displacement of profiles (the shape of the high point of the 0-14 year age group broadens when the same generations are in the 15-29 and 30-44 year age groups), or in the proportion they represent of the whole as time passes.

The panorama is clearer if we consider the potential population growth implicit in the age structure or the "momentum" of the population.[4] Pool (2004:9) suggests assimilating momentum to the increase in population by age group, during a period of time, i.e. the growth potential

[Figures 5.1.2.3.4.5.6]

of each age group, or the amount which each age interval contributes to the overall growth rate. Figures 7.1 and 7.2 show the year-by-year trend in momentum. In this case, the profile is similar between the six age groups and one can even note some "waves" although they are not as marked as in other countries (Pool, 2004, figure 3).

The various stages of the overall population growth rate are most evident in the 0-14 year age group although they are also perceptible in other groups. Thus, for example, the fall in the number of births during the six-year period (1912-1917) during the time of the Mexican Revolution (1910-1921) is less apparent 15 years later (1927-1932) in the 15-29 year age group, 30 years later (1942-1947) in the 30-44 age group and almost disappears (1987-1992) in the cohort of 75 years and above, due principally to the longer survival rate resulting from the fall in mortality.

[Figure 6]

The clearest "wave" is the one that occurs around 1960 which is the result of the policy of promoting and later discouraging large families. Once the fall in fertility slows drastically beginning in 2005 (figure 4) the process of convergence towards eventual stability gives rise to waves although they are much lower than the one that occurred around 1960. The "intergenerational" spacing of these waves will be approximately 15 years throughout the present century although they will be observed only amongin the children and youth until 2050 (figures 7.1 and 7.2).

[Figures 7.1 and 7.2]

Demographic bonus and ageing

On the way to population ageing, there is a period when the most favourable demographic conditions converge and may help to trigger Mexico's economic growth potential if proper and sensible use is made of them. The gradual narrowing of the base of the age pyramid and the movement of the most numerous generations (corresponding to the high growth rates of the past) first to the economically active age groups and then to the older age groups, opens up a favourable scenario for

[4] This concept was originally proposed by Keyfitz (1971) and refers to the number of times by which the present population will be multiplied when stability is eventually reached if the prevailing fertility, together with present mortality, were to fall ipso facto to the replacement rate (net reproduction rate equal to 1). The author finds that the closer the current age structure to the eventual stable age composition, the fewer the times by which the present population will multiply. Thus, the more distant the current age structure from stability (i.e., the more youthful it is), the greater the age structure's "momentum".

employment, the economy and investment characterized by a more favourable relationship between the productive and dependent population groups.

This “window of opportunity”, also called demographic bonus or dividend, will briefly remain open in Mexico, for the first and only time, from 2006 to 2028. Among the various indicators that enable the timing of this “window of opportunity” to be identified, the demographic dependency ratio is the one that is generally used. Although it is a raw and basic indicator, the dependency ratio makes it possible to pinpoint changes in the age structure as the demographic transition advances. The dependency ratio comprises the sum of the number of children and adolescents (0-14) and of older adults (60 years and above), who are regarded as the dependent population, divided by the number of people of working age (15-59 years), regarded as being the income-earning population.

Figure 8 shows the development of the dependency ratio. It can be seen that during the twentieth century the total indicator was almost entirely determined by the youth dependency ratio (children and adolescents from 0-14 years divided by the working-age population), reflecting high demographic growth. As a result of the decline in the number of children and adolescents (0-14 years), caused by a decline in fertility, which was more rapid than the increase in the number of older adults, caused by longer life expectancy, the total dependency ratio was near its historic minimum for a number of years; later, the total dependency ratio increases rapidly as a result of the ageing process, reflected in the increase in the old-age dependency ratio.

[Figure 8]

This pattern can be clearly recognized in the first half of the present century in figure 8. There is no exact value of the dependency ratio that enables the timing of the demographic bonus to be identified. The period taken here is one when the dependency ratio is below 60 per cent. In the years of highest demographic growth (1960-1975) and the rejuvenation of the age structure, for every hundred persons of working age there were as many or more additional consumers. Three decades later (2006-2028) it is expected that the proportion will have fallen to little over half. From the perspective of the demographic dependency ratio, 100 workers in 1969-1970, in addition to supporting themselves, were working to support 117 additional persons. Between 2006 and 2008 they will be doing so for only 60 others. Thus, if the available workforce is adequate and is properly used, over one quarter (1-160/217=0.263) of total consumption in the 1960s and 1970s could be transferred — through domestic savings — to the economy and to investment in the next 22 years. This is what is meant when one speaks of the demographic bonus or dividend.

In the next two sections we shall see how the changes in each of the three demographic phenomena since 1900 have contributed, and will contribute, to the demographic bonus, subsequent ageing and the increase in the available workforce.

4. Contribution of changes in demographic phenomena to changes in the size and age structure of the population and on the labour supply.[5]

Demographic bonus and population ageing

[5] The mathematical formulae for modelling the contribution of demographic variables are given in the methodological annex.

The contribution of changes in each demographic phenomenon to the formation of the demographic bonus and to the ageing process is clearer if we separate trends in the birth rate, mortality and migration into three periods approximately corresponding to the stages of demographic transition: the phase of rapid demographic growth (up to 1969); the decline in fertility (1970-1999) and the convergence of those two phenomena (2000-2050).

In table 1 the contribution of each phenomenon to the formation of the demographic bonus is broken down into three periods. The demographic bonus occurs between 2006 and 2028 (figure 8). On the one hand, changes in fertility and mortality contribute positively (6,552,654 and 6,955,228, respectively); on the other hand, international migration reduces by 8.6 per cent the contribution of the natural growth in the numbers of people of working age (1,152,923 of 13,477,882) and by 11.5 per cent that of people of dependent age (923,995 of 8,049,182).

Table 1
Mexico. Contribution of changes in demographic phenomena to the formation of the demographic bonus

Period of change	*Age*		
	Total	*15-59*	*0-14 and 60 or over*
Population at start of year			
2006*	106 994 248	66 880 244	40 114 004
2029*	126 443 156	79 204 364	47 238 792
Absolute change**	19 448 908	12 324 120	7 124 788
Relative change	18.2	18.4	17.8
Total contribution			
Total	19 450 146	12 324 959	7 125 187
1900-1969	21 470 716	10 134 780	11 335 936
1970-1999	1 189 055	2 863 730	-1 674 675
2000-2028	-3 209 625	- 673 551	-2 536 074
Natural growth			
Total	21 527 064	13 477 882	8 049 182
1900-1969	22 557 638	11 207 607	11 350 031
1970-1999	2 559 377	3 184 351	- 624 974
2000-2028	-3 589 951	- 914 076	-2 675 875
Fertility			
Total	9 031 673	6 522 654	2 509 019
1900-1969	18 306 508	9 900 145	8 406 363
1970-1999	-3 123 683	-1 330 375	-1 793 308
2000-2028	-6 151 152	-2 047 116	-4 104 036
Mortality			
Total	12 495 391	6 955 228	5 540 163
1900-1969	4 251 130	1 307 462	2 943 668
1970-1999	5 683 060	4 514 726	1 168 334
2000-2028	2 561 201	1 133 040	1 428 161
International migration			
Total	-2 076 918	-1 152 923	- 923 995
1900-1969	-1 086 922	-1 072 827	- 14 095
1970-1999	-1 370 322	- 320 621	-1 049 701
2000-2028	380 326	240 525	139 801

* At start of year.
** The differences from the total contributions are due to approximations in the calculation of formula (4) in the methodological annex.
Source: Estimates and projections of the Consejo Nacional de Población (CONAPO) [National Council on Population].

However, if we make a distinction by period of occurrence, the scenario is different. During the years of rapid mortality decline and high and rising fertility (1900-1969), changes in these two components of natural growth contribute positively; and, while the contribution of mortality continues to be positive in the following periods, the contribution of fertility turns negative as a consequence of the sharp decline in fertility rates and it is of such magnitude in the first decades of the present century as to outstrip the positive effect of mortality and migration in both age groups.

In short, most of the growth in the working-age population, the demographic bonus itself, comes from the rapid growth that took place up to 1969, principally owing to high fertility (9.9 million) and to the decline in mortality in the three periods (7.0 million), chiefly the decline that occurred in the last 30 years of the twentieth century (4.5 million) which represents over a third of the total increment (12.3 million). From 1970 onwards, the contribution of population dynamics has diminished significantly. The gain that originated in 1970-1999 is a little over one quarter of what occurred in the previous seven decades (2.8 of 10.1 million) and it then turned negative in the new century. This can be seen more clearly in the contrasting pyramids in figure 9 which correspond to the beginning and end of the period in which we have located the demographic bonus. The increase in the working-age population is concentrated between 29 and 59 years of age, in other words it comes from the generations born between 1946 and 1999.

In the dependent population, the scenario is even clearer. The reduction in the last three decades of the last century is largely due to international migration (1.0 million as against 1.7 million attributable to changes in the birth rate) — principally of older adults when they were of working age; on the other hand the reduction in the first 30 years of the twenty-first century is the result of fertility being below the replacement level with effect from 2006.

The ageing process can be seen more accurately in terms of the overall change in the population by sex and age, as is shown in the superimposed age pyramids in figure 10 which correspond to the beginning and end of the projection. The ageing of the population can be seen from the fact that the net loss of 12.0 million children and young people of under 15 years at mid-century is almost balanced by a gain of 12.3 million in the first 10 years of old age (60-69 years); alternatively, the reduction of 6.5 million in the first 18 working years (age 15-32 years) is offset by an increase of 6.8 million in the following 17 years (age 33-49 years).

[Figure 9] [Figure 10]

The ageing of the Mexican population began some years ago and will significantly accelerate in the present century. In 2000, people aged 60 years or over were 6.8 per cent of the total population of the country and it is expected that, in 2050, they will be 28.0 per cent, as can be seen in table 2. According to the 2004 revision of the estimates and projections of the United Nations Population Division, the proportion of the ageing population in the more developed regions of the world will have increased from 11.7 per cent in 1950 to 32.4 per cent in 2050. Thus, the process that has taken a century in the more developed regions (increasing the proportion by 20.6 percentage points) will take less than half that time in Mexico (an increase of 21.1 percentage points).

The contribution of fertility and mortality to the increase in the number of older people, between the start of 2000 and of 2051, is positive in the three phases of demographic transition; even the high fertility of the past contributes 81.1 per cent (18.4 million out of 22.7 million) of total growth up to 1969, and 78.4 per cent of natural growth (23.4 million). In the population younger than 60 years, the reduction of 18.4 million as a result of fertility being below the replacement level in the next 50 years (2000-2050) more than counterbalances the increase of a similar magnitude (15.0 million) that took shape in the 80 years (1890-1969) of high and rising fertility.

Although the overall reduction in the risk of death is the same (74 per cent) for the two 80-year periods (1890-1969 and 1970-2050) the contribution of the longer survival rate to the growth in both age groups is greater in the second period (6.6 million for older adults and 11.0 million for persons aged between zero and 59 years) than in the first (5.1 and 2.3 million, respectively).

The contribution of international migration might seem to be contradictory. Rather than positive, it would be expected to be negative as in the preceding twentieth century. This is due to the fact that, in current official projections, it is assumed that the migration rates to the United States and back to Mexico which prevailed in 1995-2000 will remain unchanged throughout the projection period. As the latter rate is higher than the former, the combined effect is a reduction in the net rate, although it is negative throughout the period, amounting to the reduction of a loss of 390,000 in 2000 to a loss of 303,000 in 2050, or in an increase of 886,000 inhabitants.

In conclusion, the current ageing process is based principally on the high fertility of the past; however, the reduction in mortality and the incidence of migration will be the most important factors in the distant future, particularly beyond 2050. This fact can be seen in figure 11 in which the age pyramid at 1 January 2051 is contrasted with the age pyramid that would eventually result in stability if the demographic conditions anticipated for 2050 were to remain unchanged. It will be noticed that the age structure of the population will undergo few changes after the middle of the present century; at most, what stands out is the elimination of the last trace of the rapid growth of the generations born during the second half of the twentieth century: the peak between 45 and 65 years in 2051.

[Table 2] [Figure 11]

Table 2
Mexico. Contribution of changes in demographic phenomena to population growth during the ageing process

Period of change	*Age*		
	Total	*60 or over*	*0-59*
Population at start of year			
2000*	99 929 495	6 752 115	93 177 380
2051*	129 480 027	36 488 325	92 991 702
Absolute change**	29 550 532	29 736 210	-185 678
Relative change	29.6	440.4	-0.2
Total contribution			
Total	29 547 562	29 732 281	-184 719
1890-1969	38 470 126	22 658 345	15 811 781
1970-1999	2 345 023	3 511 832	-1 166 809
2000-2050	-11 267 587	3 562 104	-14 829 691
Natural growth			
Total	33 168 886	32 697 041	471 845
1890-1969	40 728 223	23 456 955	17 271 268
1970-1999	4 594 503	6 159 910	-1 565 407
2000-2050	-12 153 840	3 080 176	-15 234 016
Fertility			
Total	8 138 009	20 974 104	-12 836 095
1890-1969	33 378 322	18 381 567	14 996 755
1970-1999	-6 794 642	2 592 537	-9 387 179
2000-2050	-18 445 671	0	-18 445 671
Mortality			
Total	25 030 877	11 722 937	13 307 940
1890-1969	7 349 901	5 075 388	2 274 513
1970-1999	11 389 145	3 567 373	7 821 772
2000-2050	6 291 831	3 080 176	3 211 655
International migration			
Total	-3 621 324	-2 964 760	-656 564
1890-1969	-2 258 097	-798 610	-1 459 487
1970-1999	-2 249 480	-2 648 078	398 598
2000-2050	886 253	481 928	404 325

* At start of year.
** The differences from the total contributions are due to approximations in the calculation of formula (4) in the methodological annex.
Source: Estimates and projections of the Consejo Nacional de Población (CONAPO) [National Council on Population].

Momentum

The inertia of the high demographic growth observed up to 1970 is still present in the age structure and will continue to be so for decades. This is clearly apparent in the contribution of demographic variables to the potential for growth (momentum) from 2000 to 2015, as can be seen in table 3.

The combined effects of the sharp decline in mortality and high and rising fertility (1890-1969) will bring about an increase of 16.2 million, a figure that will fall slightly to 15.8 million as a result of the population dynamics expected in the coming years. The momentum resulting from fertility in the case of the adult population (15.7 million aged 30 years or over) is equal to the expected total growth from 2000 to 2015 (15.8 million). It will be observed how the population growth arising from the fall in mortality (8.6 million) will serve only to mitigate the loss resulting from the drop in fertility (7.0 million in age group 0-29 years) and from the impact of international migration (1.5 million).

In relative terms, the impulse from generations born up to 1969 will raise the population of Mexico by 16.2 per cent between 2000 and 2015 — an average of 1.1 per cent per annum — half of the increase being attributable to mature adults aged between 45 and 59 years (8.1 per cent). At the same time, the contribution of 8.5 per cent from mortality will be nullified by the reduction from declining and below replacement fertility (7.0 per cent)[6] and from the massive emigration of Mexicans to the United States (1.5 per cent).

Thus, the expected growth for the first 15 years of the twenty-first century in Mexico is almost exactly equivalent to the contribution of fertility in the first 70 years of the last century, as if the remaining population dynamics of the country had never occurred.

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[6] The sum of 6.2 per cent for the 10-14 year age group and 0.8 per cent for the 15-29 year age group.

Table 3
Mexico. Contribution of changes in demographic phenomena to population momentum from 2000 to 2015

Functional age groups	*Population at mid-year*		*Increase*	*Period of demographic change*			*Demographic phenomena*		
	2000	*2015*		*1890-1969*	*1970-1999*	*2000-2015*	*Fertility*	*Mortality*	*Migration*
Momentum effects									
Total	100 569 263	116 344 933	15 775 670	16 261 428	1 038 266	-1 524 024	8 689 642	8 584 801	-1 498 773
0-14	33 557 864	28 028 698	-5 529 166	0	-3 230 769	-2 298 397	-6 201 822	563 819	108 837
15-29	29 351 643	31 012 507	1 660 864	0	1 588 502	72 362	- 770 907	1 264 569	1 167 202
30-44	20 231 989	26 589 185	6 357 196	3 748 091	2 406 909	202 196	6 189 753	1 923 593	-1 756 150
45-59	10 557 014	18 602 766	8 045 752	8 113 559	- 268 972	201 165	7 002 609	2 208 458	-1 165 315
60-74	5 117 698	8 886 204	3 768 506	3 322 921	278 639	166 946	2 071 976	1 661 813	34 717
75 or more	1 753 055	3 225 573	1 472 518	1 076 857	263 957	131 704	398 033	962 549	111 936
Change as a percentage of mean population in 2000									
Total			15.7	16.2	1.0	-1.5	8.6	8.5	-1.5
0-14			-5.5	0.0	-3.2	-2.3	-6.2	0.6	0.1
15-29			1.7	0.0	1.6	0.1	-0.8	1.3	1.2
30-44			6.3	3.7	2.4	0.2	6.2	1.9	-1.7
45-59			8.0	8.1	-0.3	0.2	7.0	2.2	-1.2
60-74			3.7	3.3	0.3	0.2	2.1	1.7	0.0
75 or more			1.5	1.1	0.3	0.1	0.4	1.0	0.1

Source: Estimates and projections of the Consejo Nacional de Población (CONAPO) [National Council on Population].

Labour supply

Current projections for Mexico indicate that the economically active population (EAP) will increase from 42.1 million in 2000 to 51.1 million in 2010, to 64.0 million in 2030, and will reach a historic maximum of 66.1 million in 2042 and will then fall to 65.2 million in 2050. The increase in the labour supply, however, will not be of the same magnitude throughout the time horizon of the projection but will fall, and will do so more steeply from 2010 onwards. During the first 15 years of the present century it will be necessary to create over 800,000 jobs per annum — preferably stable and well paid — while the requirements will fall at an annual average of almost half a million in the 2020s and become negative in the 2040s.

The headlong increase of almost 22 million in the labour supply from 2000 to 2030, in other words, during the period of the demographic bonus, arises both from the various phases of demographic transition and from anticipated changes in levels of incorporation in the workforce (Partida, 2004), as can be seen in table 4. One conspicuous fact is that women, both in terms of demographic change and in terms of increased incorporation in economic activity, contribute significantly to the increase in the available workforce; for men, however, even though the demographic transition increases the EAP, the minimal modification in the rate of their incorporation in labour markets before the age of retirement and the growing tendency to take retirement will give rise to a reduction in the EAP of 574,000.

The consequences of the rapid growth in the distant past (1890-1969) are clear in the heavy pressure on the labour markets of the country brought about by an increase in the EAP between 2006 and 2028 and its proper utilization in order not to pass up the opportunity represented by the demographic bonus. For both sexes, the contribution made by the period of the pronatalist policy is preponderant; however, while the figure for men is around 83.7 per cent, among women (3.5 million or 46.4 per cent) the figure is similar to that for the growing incorporation of women in economic activity (3.4 million or 44.9 per cent) anticipated for the 23 years during which the window of opportunity will remain open.

Table 4
Mexico. Contribution of the stages of demographic transition and of anticipated levels of participation in the growth of the economically active population from 2006 to 2028, by sex

Period of change	*Sex*		
	Total	*Men*	*Women*
Population at start of year			
2006*	46 761 458	31 359 014	15 402 444
2029*	63 411 901	40 457 308	22 954 593
Absolute change**	16 650 443	9 098 294	7 552 149
Relative change	35.6	29.0	49.0
Total contribution			
Total	16 651 677	9 099 202	7 552 475
Demographic change	13 833 483	9 673 338	4 160 145
1890-1969	11 122 640	7 615 007	3 507 633
1970-2005	1 468 167	1 115 656	352 511
2006-2028	1 242 676	942 675	300 001
Joining workforce***	2 818 194	- 574 136	3 392 330
Proportional contribution			
Total	100.0	100.0	100.0
Demographic change	83.1	106.3	55.1
1890-1969	66.8	83.7	46.4
1970-2005	8.8	12.3	4.7
2006-2028	7.5	10.4	4.0
Joining workforce***	16.9	-6.3	44.9

* At start of year.
** The differences from the total contributions are due to approximations in the calculation of formula (6) in the methodological annex.
***Only during the period 2006-2028.
Source: Estimates and projections of the Consejo Nacional de Población (CONAPO) [National Council on Population].

According to the National Employment Survey (*Encuesta Nacional de Empleo - ENE*), in 2000-2003 half the labour force employed in the secondary and tertiary sectors were in the informal sector of the economy, representing 40 per cent of the total EAP. The precarious employment conditions characteristic of informal employment hinder the growth of GDP because of its low or zero productivity and, ultimately, slow down job creation; they reduce family earnings, giving rise to the entry of more members of the household into the labour force, and minimizing any possibility of savings. A limited savings capacity not only puts family assets at risk from major unforeseen expenses, but also prevents the accumulation of the resources needed to provide a means of coping in a dignified manner with old age.

Together with the low percentage of workers currently contributing to social security systems, there is the fact that those who do contribute to pension plans do so for too short a time, with the result that the fund so constituted is inadequate for the purchase of an adequate annuity to ensure a dignified old age. If recent patterns of contribution were to remain unchanged in the future, those aged 15 years — some of whom contribute, while some do not, and others have not yet joined the workforce — would spend the major part of their active life outside social security systems and the average number of years during which they would be paying into retirement savings systems — about 12 years for men and 8 for women — is far short of the minimum required (24 years) to enable them to draw the minimum pension guaranteed by the current Mexican Social Security Institute (IMSS) law, which is likely to be extended before long to the other existing pension schemes in the country. At 25 years, the situation is similar, particularly for a professional beginning his or her active life after finishing university education. Thus, if present contribution conditions remain unchanged, people will be poor not only during their working life but also in retirement.

If the recent characteristics of labour markets were to continue until 2050, the proportion contributing to social security systems would begin to diminish in 2018, but the number of newly retired people would soar: the number will have doubled between 2000 and 2016 and increased by a factor of 5 by mid-century.

According to economic forecasts, a constant rate of growth of GDP of 4.8 per cent from 2000 to 2030 would be necessary to ensure that the number of established, productive and well-paid jobs with benefits (including social security) would include 84 per cent of the EAP in 2030 (Hernández Laos, 2004). If that scenario were to occur, the number of people covered would rise rapidly, more than threefold in only a quarter of a century (2010-2035), but, above all, they would represent over 90 per cent of the EAP, thus implying long periods of contribution during the working life of individuals (almost 30 years for men and over 23 years for women). This highly optimistic scenario would involve a virtuous circle. The labour force would have high standards of productivity, thereby supporting high economic growth; the high rates of contribution would create substantial reserves in pension plans, which, in turn, would favour investment and would generate further productive employment. At the same time, the high level of remuneration would forestall early entry into economic activity, keeping adolescents and young people in the education system, with a consequential increase in human capital and a rise in the productivity of labour. Thus, the optimum utilization of the demographic bonus is “merely” a matter of fuelling mechanisms to ensure an annual 4.8 per cent growth in GDP for three decades.

5. Final remarks

Demographic transition in the developing countries, such as Mexico, occurs much faster than in more developed regions. The sharp fall in mortality and the pronatalist policy which sought to meet the demand for labour for expanding industry and to populate the national territory favoured high population growth in Mexico throughout the twentieth century.

The consequences of that demographic past are still perceptible today but will be even more so in the next few years when the demographic bonus will offer the opportunity to promote savings and investment in order, only a few decades later, to face up to rapid and substantial ageing.

A number of public policies have been implemented in recent years that may help in utilizing the demographic bonus, although they were not specifically designed to address the age structure transition. The programme known as *Oportunidades* (Opportunities) is part of the struggle to combat extreme poverty and focuses on the creation of human capital by means of food allowances which are granted on condition that children and adolescents remain in school. Although the programme has been rated a success, it will be possible only in the first years of the demographic bonus to ascertain whether the available workforce is sufficiently qualified to be fully utilized to generate savings and investment.

Another programme which should have a positive influence on the utlitization of the demographic bonus is *Arranque Parejo en la Vida* (Equal Start in Life) which aims to offer the same chance of healthy survival to all newborns and to reduce maternal mortality significantly. The anticipated increases in life expectancy and hence the eventual ageing of the population largely depend on the success of health programmes such as *Arranque Parejo en la Vida*.

Although programmes such as *Oportunidades* and *Arranque Parejo en la Vida* are short and medium term in scope and are useful tools for the utilization of the demographic bonus, the major challenge is the generation of sufficient productive and well-paid employment to enable full use to be made of the growing workforce linked to the rapid increase in the population of working age.

Informal employment now accounts for almost half the economically active population. In addition to this shortcoming it will be necessary to create sufficient employment to meet the annual increase of over 800,000 new entrants to the workforce between 2000 and 2015 and an average of 500,000 during the period 2016-2030. While the window of opportunity remains open (2006-2028), the EAP will increase by 16.7 million of which 12.5 million will correspond to the increased workforce in the 15-59 year age group. The appropriate utilization of the demographic bonus thus rests on the real possibilities of minimizing the informal sector of the economy and creating productive employment for new job seekers, because only in that way can an advantage be taken of the saving and investment opportunities offered by a favourable dependency ratio. Recent economic projections for Mexico indicate that a sustained growth of 4.8 per cent per annum will be needed in order to ensure that in 2030 sufficient formal jobs have been created to absorb almost the entire available workforce. An intermediate scenario would perhaps be more likely, under which the jobs created would absorb between 71 and 76 per cent of the available workforce.

If the current stagnation of the Mexican economy continues for 10 or 15 years, the demographic bonus will become a demographic nightmare, the "window of opportunity" will close with even having been open and, worst of all, Mexico will be doomed to become an old and poor country.

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Methodological annex

The method is based on an old demographic principle: the population of age *x* at the time *t* is equal to the births that occurred at *t-x* plus the cohort's history of mortality and migration. Thus, the increase in the population of a given age at two different times is equal to the sum of the differences of births and the mortality and migration histories of the two cohorts. Horiuchi (1988) originally presented the result and his formulation is reconstructed here, using some of the results of Horiuchi and Preston (1988).

Let $\mu(x)$ be the instantaneous mortality rate (strength of mortality) at age *x*. It is well known that the survival rate at age *a* from birth in the cohort of the life table is given by:

$$p(a) = \frac{\ell_a}{\ell_0} = \exp\left\{\int_0^a \mu(x)\,dx\right\}$$

where ℓ_a are the survivors at age *a* from ℓ_o births. Similarly, in the absence of migration, for a particular cohort born at *t-a* the surviving proportion is:

$$s(a,t) = \exp\left\{-\int_0^a \mu(x,t-a+x)\,dx\right\}$$

where $\mu(x,t)$ is the instantaneous mortality rate (strength of mortality) at age *x* and time *t*. The sign in the exponent on the right-hand side is negative because the rate is positive and mortality reduces the size of the cohort. In order to incorporate the effect of international migration, we use the net instantaneous migration rate, which is positive if there is a net gain or negative if there is a net loss; thus the rate is added to the exponent on the right-hand side:

$$s(a,t) = \exp\left\{-\int_0^a \mu(x,t-a+x)\,dx + \int_0^a \eta(x,t-a+x)\,dx\right\} \qquad (1)$$

Now let $P(a,t)$ be the annual density of the population aged *a* at time *t* and $B(t - a)$ be the annual density of births at time *t-a*; it is clear that:

$$P(a,t) = B(t-a)\,s(a,t)$$

Like the mortality rate, the instantaneous growth rate is derived from the natural logarithm of the population, namely,

$$r(a,t) = \frac{\partial}{\partial t}\ell n\{P(a,t)\}$$

then:

$$\begin{aligned} r(a,t) &= \frac{\partial}{\partial t}\ell n\{B(t-a)\,s(a,t)\} \\ &= r_B(t-a)-\int_0^a \frac{\partial}{\partial t}\mu(x,t-a+x)\,dx+\int_0^a \frac{\partial}{\partial t}\eta(x,t-a+x)\,dx \end{aligned} \tag{2}$$

where $r(a,t)$ is the rate of population growth at age a at time t, $r_B(t-a)$ is the rate of increase in births at time t:

$$r_B(t)=\frac{\partial}{\partial t}\ell n\{B(t)\}$$

and by (1) the derivative of the natural logarithm $s(a,t)$ with respect to time is:

$$\frac{\partial}{\partial t}\ell n\{s(a,t)\}=-\int_0^a \frac{\partial}{\partial t}\mu(x,t-a+x)dx+\int_0^a \frac{\partial}{\partial t}\eta(x,t-a+x)dx$$

If we multiply both sides of (2) for the population at time t, we get the absolute increase in the population at age a:

$$\begin{aligned} \frac{\partial}{\partial t}P(a,t) &= P(a,t)\,r(a,t) \\ &= P(a,t)\,r_B(t-a)-P(a,t)\int_0^a \frac{\partial}{\partial t}\mu(x,t-a+x)\,dx+P(a,t)\int_0^a \frac{\partial}{\partial t}\eta(x,t-a+x)\,dx \end{aligned} \tag{3}$$

One can see the contribution of the change in the birth rate in the first term on the right-hand side of the second equation, the improvement in morality between cohorts in the second term and the effect of net migration change in the third.

The discrete version of equation (3) is:

$$\begin{aligned} \Delta_t P_a(t) &= P_a(t+1/2)\,r_B(t-a) \\ &\quad -P_a(t+1/2)\sum_{x=0}^{a}\Delta_t M_x(t-a+x) \\ &\quad +P_a(t+1/2)\sum_{x=0}^{a}\Delta_t N_x(t-a+x) \end{aligned} \tag{4}$$

where $P_a(t)$ is the population aged a at last birthday at time t, $M_x(t)$ and $N_x(t)$ are the rates of mortality and net migration, respectively, at age x at last birthday in the year that begins at t, and $r_B(t)$ is the growth rate of births:

$$r_B(t) = \ell n\{B_t / B_{t-1}\}$$

with B_t being the number of births during the year that begins at t.

To analyse the contribution of changes in demographic variables and of the beginning of employment, we consider the definition of the rate of participation in working life:

$$A(a,t) = \frac{\text{EAP}\ (a,t)}{P(a,t)}$$

where $EAP\ (a,t)$ is the annual density of the economically active population (EAP) at time t. Thus, the change in the EAP is:

$$\frac{\partial}{\partial t} PEA(a,t) = \frac{\partial}{\partial t} P(a,t)\, A(a,t) = A(a,t) \frac{\partial}{\partial t} P(a,t) = P(a,t) \frac{\partial}{\partial t} A(a,t) \qquad (5)$$

In the first element on the far right one can identify the contribution of demographic change and in the second term the part played by transformations on incorporation into labour markets. The discrete version of equation (5) for the year beginning at t is:

$$\Delta_t PEA_a(t) = A_a(t+1/2)\, \Delta_t P_a(t) = P_a(t+1/2)\left[A_a(t+1) - A_a(t)\right] \qquad (6)$$