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Economics, Population Dynamics, and Pensions: Model Application for the Mexican Case

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Contents

Abstract

This paper analyzes the relation between population dynamics and the pension system in Mexico by applying an economic-demographic model in three economic scenarios related to the evolution of employment in the formal sector of the economy. The basic point which emerges is that, while rapid growth of employment in the formal sector increases the pension system's contribution base in the near term, it also increases demands upon the system in the long term.

Throughout this paper, the complex nature of the linkages between population dynamics, economic change, and the pension system are emphasized.

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About the Author

Rodrigo Inclán Garza was awarded the 1998 Luis Donaldo Colosio Fellowship which grants one scholarship per year to a young Mexican scientist to join one of IIASA's research projects. Starting in January 1998 Rodrigo Inclán took part in the Social Security Reform Project. He studied and obtained his degree at El Colegio de México, A.C. in Urban Studies, specializing in Urban and Regional Economics. His main research work and interests are related to the analysis of processes of globalization economics and their relation to regional and urban economic and population dynamics.

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Introduction

Structural changes in demography, as well as in the economic and social processes of globalization will be equally important topics for future socioeconomic studies as they are at present. With the issue of aging entering the developing countries, the question arises of how sensitive the economies of developing countries are towards this process.

Studies of population dynamics complement the studies on the future development of the economy since demography and economy are inseparably linked. The analysis of present and future interactions between variables from both fields is very important for planning, developing, and issuing of public policies.

In this context, some of the principal relationships for studying these interacting processes are the relationships between growth of GDP, labor force employed in the formal and informal sectors, occupational and economic conditions, salaries and pensions of the old population, as well as changes of the population structure. How can the evolution of these relationships be predicted in order to start improvement now?[1]

The complexity of ongoing processes, as well as the interactions of macro- and micro-economies and their demographic dynamics necessitate the use of models. Thus we present in this paper a small economic-demographic model with an emphasis on projecting future socioeconomic conditions of the old population and the pension system. This model may be regarded as a first step for a more detailed and comprehensive future analysis, incorporating other demographic and economic variables according to different research interests.

The main objective of the numerical experiments is to realize in which way different assumptions on labor force participation rates, the shares of formal and informal employment and GDP growth rates, combined with different population projections, will affect the future proportion of the retired population, salaries, pension contributions and benefits, and the balance of the pension systems.

[1] In the context of this paper wealth means growth of GDP, GDP per capita, and growth of salaries and pensions. We can assume that the growth of these variables in a country (along with other social variables such as education, life expectancy, health, and a healthy natural environment) leads to better individual and social conditions.

Also, for the application of public policies the results of the numerical experiments give us an insights into the future informal employment and the inactive population, and an approximation of the future old population not receiving any pension.

In this paper we present an empirical application of the projection methodology for the case of Mexico. The country is characterized by a significant share of the informal sector of the economy. In this connection there are discussions of law reforms on labor force enrollment and the integration of the informal sector into the formal economy. Concerning demography, Mexico recently started experiencing the impacts of aging. Finally, the country had a major reform of the national pension system in the most important social security institution, changing from the governmental Pay-as-You Go system to private pension schemes.

The scenario analysis presented in this paper is helpful for approximating and, to some extent, for forecasting future paths. It is an important starting point for a discussion on the direct and indirect consequences and relationships between the macro- and micro-economic variables studied, and demographic dynamics, and for reconsidering optimal public policies related to present and future economic and demographic processes.

In summary, this work presents a mathematical projection methodology for an economic-demographic study applied to the Mexican case, which analyzes three different scenarios.

1. Economics, Population Change, and Pension Projection Analysis

The purpose of this chapter is to describe the main features of the economic-demographic mathematical model developed with the idea of projecting the relation between structural change of the population, growth of real GDP, labor force participation rate and formal employment share in the labor force, and their consequences on productivity, salaries, pension contributions, pension benefits, growth of labor force and formal employment[2], the proportion of the retired population, and the consequences of these factors on the pension system.

In the first part we explain the methodology used for the analysis and projections. In the second part we point out the limitations and possibilities of the model, in particular as to which questions have already been answered by present studies, and which will be addressed later. In this context we will discuss possible adjustments and extensions of the model for its application in different economic sectors and regions.

1.1. Explaining the Conceptual Methodology of the Projection Analysis

At the center of the analysis there are two assumptions:

- The difference between the real GDP growth rate and the growth rate of the labor force is equal to the growth rate of productivity, which is equal to the growth rate of the average salaries of formal employees.

[2] By growth of formal employment we understand the absorption of new employees and informal employees in the formal sector.

- The present year's proportion of the population over 65 years old eligible for pension is equal to the lagged proportion of formal employment of the 15-64 age group.[3]

Along with these assumptions the model incorporates exogenous population dynamics, participation rates of labor force, different shares of formal employment[4] and GDP rates of growth.

As a result of the model simulation we obtain the number of future formal and informal employees, the number of retirees with or without pension[5], the salaries of the formal sector, pension benefits, different balances of the pension system and its percentage in the GDP[6].

Changing the assumptions for one of the exogenous variables and preserving the others, allows to analyze the responses of the dependent economic variables separately for each of the variabilities involved.

The variables can be divided into three sets: the exogenous variables for all the years of projection[7] (A), the variables which are exogenous for the first year and dependent for subsequent years (B), and dependent variables for all years (C).

The scenario analysis has been implemented in Microsoft EXCEL and the spreadsheet presentation of its main variables is given below:

POPULATION

Pop(t) (0-14) (A)

Pop(t) (15-64) (A)

Pop(t) (65+) (A)

PopTotal(t) (A)

ShPop(t) (0-14) (C)

ShPop(t) (15-64) (C)

ShPop(t) (65+) (C)

ShPop(t) (0-14,65+) (C)

YoungDepRatio(t) (C)

OldDepRatio(t) (C)

DepRatio(t) (C)

[3] These two assumptions will be discussed in more detail in the next part of this chapter.

[4] Here formal sector employees are labor force population who pay a mandatory contribution to the pension system (private or public).

[5] Here the pensioned population is the population over 65 receiving pension benefits. It includes widows.

[6] For the complete mathematical description of the model see Appendix 1.

[7] These exogenous variables can be projected linearly or with jumps for different years, depending on the assumptions made.

GrowthRatePop(t) (0-14) (C)
GrowthRatePop(t) (15-64) (C)
GrowthRatePop(t) (65+) (C)
GrowthRatePopTotal(t) (C)

LABOR FORCE, FORMAL AND INFORMAL EMPLOYMENT, UNEMPLOYMENT AND RETIRED POPULATION

PartRateLaborForce(t) (15-64) (A)
PartRateLaborForce(t) (65+) (A)
PartRateTotalLaborForce(t) (15+) (C)

LaborForce(t) (15-64) (C)
LaborForce(t) (65+) (C)
TotalLaborForce(t) (15+) (C)

GrowthRateLaborForce(t) (15-64) (C)
GrowthRateLaborForce(t) (65+) (C)
GrowthRateTotalLaborForce(t) (15+) (C)

ShEmplFormSect(t) (15-64) (A)
ShEmplFormSect(t) (65+) (A)
ShTotalEmplFormSect(t) (15+) (C)

EmplFormSect(t) (15-64) (C)
EmplFormSect(t) (65+) (C)
TotalEmplFormSect(t) (15+) (C)

Growth RateEmplFormSect(t) (15-64) (C)
Growth RateEmplFormSect(t) (65+) (C)
GrowthRateTotalEmplFormSect(t) (15+) (C)

UnemplRate(t) (15-64) (A)
UnemplRate(t) (65+) (A)
TotalUnemplRate(t) (15+) (C)

Unemployment(t) (15-64) (C)
Unemployment(t) (65+) (C)
TotalUnemployment(t) (15+) (C)

ShEmplInformSect(t) (15-64) (C)
ShEmplInformSect(t) (65+) (C)
ShTotalEmplInformSect(t) (15+) (C)

EmplInformSect(t) (15-64) (C)
EmplInformSect(t) (65+) (C)
TotalEmplInformSect(t) (15+) (C)

GrowthRateEmplInformSect(t) (15-64) (C)
GrowthRateEmplInformSect(t) (65+) (C)
GrowthRateTotalEmplInformSect(t) (15+) (C)

PropInactPensioned(t) (65+) (B)*
InactPensioned(t) (65+) (C)
GrowthRateInactPensioned(t) (65+) (C)

PropInactNotPensioned(t) (65+) (C)
InactNotPensioned(t) (65+) (C)

GDP AND PRODUCTIVITY

GrowthRateGDP(t) (A)
GDP(t) (B)
GDPperCapita(t) (C)
GrowthRateProductivity(t) (C)

ANNUAL SALARIES, EMPLOYEES, FORMAL SECTOR AND PENSION CONTRIBUTIONS

AvSalTotalEmplFormalSect(t) (15+) (B)
TotalSalTotalEmplFormalSect(t) (15+) (C)
ShSalContPensionSystem(t) (A)
TotalContPensionSystem(t) (C)
GrowthRateTotalContPensionSystem(t) (C)
PropGDPTotalContPensionSystem(t) (C)

PENSION BENEFITS

PercentAvAnnPension(t) (65+) (A)
AvAnnPension(t) (65+) (C)
TotalAnnPension(t) (65+) (C)

GrowthRateTotalAnnPension(t) (65+) (C)

PropGDPTotalAnnPension(t) (65+) (C)

GENERAL RESULTS

BalancePensionSystem(t) (C)

PropGDPBalancePensionSystem(t) (C)

*More years than the first one are exogenous variables (depending on the assumptions made)

1.2. Limitations and Possibilities of Application

Basically, the main limitations of the projection methodology (which will be addressed in future work) are the following:

- It is not admissible to directly translate the extent of the productivity growth rate into the growth rate of the average salaries of the formal employees. This is, firstly, because total productivity not necessarily equals the formal sector productivity; and, secondly, though it is possible that in the long run the growth of average salaries depends on and moves into the same direction as the growth of productivity, this not necessarily true in the short and medium term.
- Since the average annual pension benefits in the model are a percentage relative to the average salaries, their growth partially depends on the productivity as well, which is not necessarily related either to the PAYG system or to the private system. This can only serve as an indication of how the pension benefits would grow (or we can exogenously assume a growth rate of the average pension benefits which would be different from the growth rate of the average formal sector salaries).
- Furthermore, we can see that the average annual salaries and pension benefits do not reflect the difference in incomes inside the individual groups, which would, however, be very important for the social and economic analysis.
- Another limitation of the actual characteristics of the model is the assumption that the present proportion of the population over 65 retired with pension benefits in the total population over 65 is equal to the past year's proportion of formal employment of the 15-64 age group in the total 15-64 age group. Although it is certain that the present old-age pensioned population depends directly on the past number of formal employees, the problem lies in the assumption that the proportion is similar and moves into the same direction for all the years. This assumption does not take into account the changes in life expectancy and normative laws.
- Finally, the general results of this model are not complete, especially with regard to the balance of the pension system, which reflects the interrelation of all the variables, because at the moment the modeled pension system does not differentiate between the PAYG and the private system. In their present form the results reflect only an annual balance either of the PAYG and/or the private system (no accumulation) without taking into account such factors as pensions for a population of less than 65; transition costs and/or accumulated savings and

dissavings (money drawn from private accounts) in the private system[8]; the interest rate and administrative costs of the pension contributions and benefits; the normative, economic, and administrative differences between the government pension systems and private institutions; the maximum quotation for a system's pension contribution (the maximum salary or limit for calculating the pension contribution, which is not always equal to the salary income); the differences in the percentage of the quotation for the contribution; etc.

The above list of limitations is mainly based on a lack of information, providing, at the same time, a list of possibilities for improving and extending the model and for using part of it to focus on one of the topics.

In the first step we used the model for working out good approximations to reality for analyzing the short-, medium- and long-term behavior of various variables.

The application of the model on the national level is important as it allows for different applications of the pension system and of the population's occupational characteristics by age group, which can help to approximate future tendencies and is necessary for the discussion and the development of public policies, ideas and proposals.

As was already mentioned, it is possible to extend the model and/or focus on specific topics[9], applications and comparative studies concerned with the interrelation and transition of capital (in the PAYG and the private system) between the economic and social sectors and between regions, taking into account their demographic structure and socioeconomic variability.

1.3. Conclusions

The main objective of the model is to address the problems associated with future employment, the retired pensioned population, salaries, pension benefits and the pension system. A further goal is to set a focus on the growing proportion of retirees not eligible to pension payment, and the measures to be taken by the government (in this case social policies) to support this population.

In this sense the purpose of our simulations is to forecast the future number of persons retired with and without pension, and to measure the costs of various social policies.

This means that the model is not only important for private and public pension institutions. It can be used in other institutions such as academic, private and government, engaged in developing labor, economic, and social policies.

From this point of view, the present modeling work tries to analyze the socioeconomic future of certain population groups, assuming implicit and non-implicit demographic, social and economic ideas. The main problem of the study was the lack of information. It was therefore decided to keep the model in its present form and to wait for more

[8] For example, in the Mexican case it is a problem to estimate the future dissaving of private accounts and the transition costs, as the Government is actually paying the population who retired under the last law. In addition to the difficulty of obtaining an approximation of the number of people who will be retired under the old or the new law (they can choose) and the quantity of pension annuities they will receive (dependent on the rate of interest, bank commission, salaries, etc.), the government will take the private savings from the population who will be retired under the old law for paying pensions until these savings are exhausted, and will then pay from public incomes.

[9] For example, there are some countries with a high informal employment share in labor force. This may be due to the fact that the salary of this population is really low, and/or that the administrative costs to incorporate them into the formal sector are higher than their capacity of contributing.

reliable information rather than to add more variables to the model that would entail an even larger number of assumptions.

2. Economics, Population, and the Pension System in Mexico

During the last years Mexico has been a constantly and fast changing country. The Mexicans are facing new possibilities and new problems and challenges. The economy of the country has been part of the world process of economic integration, but, on the other hand, the problem of aging has been encountered by the Mexican population.

The second chapter of this paper gives a general view on the actual economics, population and pension system in Mexico. We focus our analysis on the Mexican economic situation and its impact on the characteristics of the labor force of over 15 years of age, on the socioeconomic conditions of the population of 15-64 years, and, in particular, on the socioeconomic characteristics of the old population. We will conclude this chapter with a general view of the pension system in Mexico, trying to describe its main characteristics and their causes.

2.1. Economics and Population in Mexico: A General View

The economic process of the Mexican market integration displays different regional, sectoral, and demographic socioeconomic impacts. In the regional context, we recognized a fast integration of the central and northern part of Mexico into the new economic process. On the other hand, the southern part of Mexico has not been included in this process and, except for a few tourist and industrial cities and some modern agricultural regions, this region has been isolated from the process, maintaining its rural production and consumption patterns.

On the sectoral level, the economic process of the regional open markets has, in general, developed different kinds of enterprises[10]. Firstly, there are a few big enterprises that are integrated into the process, establishing productive links with international enterprises located in Mexico and in other countries, which are mainly export-oriented. The majority of these firms are transnational manufacturing enterprises (mainly monopolies and oligopolies in the national and international context), with a larger share of foreign high technology in the production process, imported components and the application of some of the new international production patterns. These enterprises produce goods with more added value and a wider range of product innovations.

Secondly there are huge national and international enterprises, which are mainly monopolies or oligopolies in the national context. They are characterized by a Fordist production pattern, using imported technologies and imported resource components. They are producing standard products and goods, consuming a negligible amount of additional natural resources and have a low degree of productivity and product innovation. These enterprises are connected with smaller, low-technology national firms through the supply of intermediate goods. Though the main market for the

[10] We just talk about the industrial sector, without taking into account the agricultural, service and financial sectors, which, though important and related to the industrial process, are not relevant in this context.

majority of these enterprises is the internal market, these firms are important and successful in the export of their goods.

Thirdly, there are some national small and medium-size firms, producing mainly handmade articles, without any or with very low technology, resulting in low value-added goods for the local market.

Without being deterministic, enterprises of the first type are located in the north and at some points in the central part of Mexico. The second type is mainly located in the center of the country with some points in the north (including the export-oriented modern-technology agricultural production located closer to the center and north of Mexico). The third kind of enterprises are located all over the country (depending on their particular characteristics) and, as mentioned before, the low technology and autoconsumption agricultural production is mainly located in the south.

These two regional and sectoral characteristics of an open economy have their causes and consequences. First, they have had an impact on supply and demand, as well as on the movement and concentration of capital, savings and investments in the sectoral and regional, national, and international context. Second, the aspects described above have affected the socioeconomic conditions of the population, the supply and demand of labor (and the labor characteristics) and the consumers, and have influenced the population movements in the regional, national, and international context[11].

In line with the above observation, the characteristics of the Mexican population are as follows: In 1995 the total Mexican population was approximately 91,158,290, of which 44,900,499 were male and 46,257,791 were female (INEGI,1995). 36% of this population are in the age group of 0-14 years, 60% are in the 15-64 years age group, and 4% are in the 65+ age group. This gives us 40% of dependent population in the age groups of 0-14 and 65+ years. In 1995 there was a 2.05% natural growth rate, a 0.32% social growth rate, and a 1.73% population growth rate. Mexico has a life expectancy at birth of about 72.96 years and a life expectancy at 65 years of 15.5 years (CONAPO, 1996).

Taking into account the urban population living in areas with 15,000 or more inhabitants, the Mexican urban population amounted to around 60% in 1995, leaving a 40% share of rural population (INEGI, 1996).

With regard to literacy, 89% of the 1995 population of 15+ years knew how to read and write, leaving 11% of analphabets. In the younger age groups the share of the literate population is higher, i.e., 96% of the population of 15-19 years are literate, while 65% of the population of 65+ are not, which gives an average of 7.22 calendar school years per person aged 15+.

In this context, the population of 15+ without any education amounts to about 10.44%, that with incomplete primary education to 21.13%, and that with completed primary education to 18.84 % (primary education means the first 6 first years of education, normally from 6 to 12 years). The population with medium basic education amounts to 22.10% (3 years of education from 13 to 15 years of age), and medium superior and superior studies accounted for 26.93% (medium usually includes 3 years from 16 to 18, and superior includes bachelor, master and doctor degrees). In this sense the old

[11] In this chapter we try to explain the consequences of the past socioeconomic patterns to the Mexican economy and population, without trying to explain the causes of this process. We just assume that the open economic integration between different regions with different technological and economic levels of development and different characteristics has different consequences on the regional, national, and international movements of capital, goods, and labor.

population has a lower share in the population group with higher education (INEGI,1995).

Table 2.1. presents the educational levels in relation to the size of the living area.

Table 2.1. Educational Level of Rural and Urban Mexican Population over 15 Years of Age , 1995

	Urban Share	Rural Share	Total
Without Education	34.98%	65.05%	100
Incomplete Primary	43.14%	56.86%	100
Complete Primary	57.09%	42.91%	100
Medium Basic Instruction	71.98%	28.02%	100
Medium Superior and Superior Instruction	85.1%	14.9%	100

Source: Conteo de Población y Vivienda, INEGI 1995.

It should, however, be noted that of the total number of 65,241,680 of the 12+ population 55% (35,843,799) are in the labor force and 45% (29,636,690) are inactive population. 67.17% of the labor force are men and 32.83% are women, while 25.77% of the inactive population are men and the 74.23% are women (INEGI,1995)

Table 2.2. Educational Level of the Mexican Population over 12 Years of Age, 1995

	Total	Share
Population 12+	65,241,680	100%
Labor Force	35,843,799	55%
Inactive Population	29,636,690	45%

Source: Conteo de Población y Vivienda, INEGI 1995.

From the total inactive population 31.54% are students, 53.29% are working in the household and 15.7% are classified by another form of inactivity (the retired population). The characteristics change with the age group. For example, from the age group of 15-19 59.13% are students, 27.95% are working in the household and 12.92% are classified by another form of inactivity; in the 25-29 age group 4.25% are students, 85.98% are working in the household, and 9.77% are classified by another form of inactivity. Finally, in the 50+ age group 0.14% are students, 63.19% are working in the household, and 35.95% are classified by another form of inactivity (the author's own results based on INEGI, 1996). In the case of population working in the household, the majority are women; in the composition of students there is a lower share of women in older age groups.

Returning to the labor force, 51.38% have postprimary studies, leaving 48.62% of the labor force with a lower level of education (INEGI, 1996). In this context, the less

educated labor force are in the primary sector, are women, and are in the older age groups.

97% of the labor force are employed in the formal and informal sectors, leaving 3% unemployed population[12]. From the employed population 22.54% are in the primary sector, 24.37% are in the secondary sector, and 52.75% in the tertiary. 37.55% of the employed population live in rural areas and 62.45% in urban areas (INEGI, 1996). Employment in the primary sector is concentrated in rural areas and employment in the secondary and tertiary sectors is more highly concentrated in urban areas.

In 1995 the employed population not receiving any salary or less than the minimum salary[13] was 30.92%, persons receiving from one to five minimum salaries were 54.68%, and 9.55% received more than five minimum salaries (4.85% is undetermined).

Table 2.3. Shares of the Mexican Employed Population by Salaries and Economic Sectors, 1995

	No or Less than one Minimum Salary	One to Five Minimum Salaries	More Than Five Minimum Salaries	Undetermined
Total Employment	30.92%	54.68%	9.55%	4.85%
Primary Sector Employment	65.57%	28.51%	1.73%	4.19%
Secondary Sector Employment	17.01%	70.04%	9.33%	3.62%
Tertiary Sector Employment	22.59%	58.89%	12.96%	5.56%

Source: The author's own results based on Conteo de Población y Vivienda, INEGI 1995.

Finally, the 1995 Mexican GDP was around $1,837,775.5 million in current pesos (OECD,1998), giving $20,160.00 in current pesos per capita[14] (the author's own results based on OECD, 1998, and INEGI, 1996).

Considering the population data and the first economic analysis of this chapter, it is easy to establish connections between these two. In general terms we have seen the main concentrations as well as the division of the population according to region, sector, sex and age group. We have seen the concentration of the better paid and better

[12] The analysis of formal and informal employment will be discussed in the next part of this chapter. In this part we just focus on total employment and labor force.

[13] For 1995 the daily minimum salary was $16.42 in current pesos per day. This gives us an approximation of $5,000.00 in current pesos per year which is equal to $ 760.00 dollars at a 1995 average exchange rate of $6.60 pesos per dollar (the author's own results based on "Banco de México", 1998; INEGI, 1998).

[14] This give us an approximation of $3055.00 at a 1995 average exchange rate of $6.60 pesos per dollar (the author's own results based on "Banco de México", 1998)

educated population[15] in the urban areas, which are mainly in the center and north of Mexico and which show a higher concentration of the more successful secondary and tertiary sectors linked to the economic globalization process. We have seen (or deduce from our own experience) that this regional and sectoral division coincides with the difference between sex and age groups. Women and the old population are the most vulnerable mainly in the rural regions and in the primary sector.

This is reflected in the share of the employed population in the formal and informal sectors and, along with population aging, in the socioeconomic conditions of the old population, as well as in the pension systems of the private and public social security institutions in Mexico.

2.2. Formal Employment, Aging, and the Mexican Pension System

In general, any shifts in the economic and population characteristics in Mexico between regions and economic sectors are due to the administration and provision of social security services and are based on the search for efficiency -- using economies of scale -- in the cost of the administration and in the distribution of the service, i.e., taking advantage of agglomeration economies.

With the advantage of growing social security contributions in the regions with high concentrations of the population and the economy, social security institutions, such as the state service, have used the possibility of transferring some of this money into the rural regions and the poor urban population sectors for the provision of some services. There are two points that have to be mentioned:

- Firstly, rural employees in the formal sector, who pay for social security, lose money as they pay for the concentrated region (and besides, the administration of the pension funds in rural areas is more expensive) and normally do not receive the benefits of the social security service if this is not provided by means of a political decision. The decision to invest in rural areas has become more politically than economically efficient.
- Secondly, with regard to the higher economic efficiency of medical care, child care and administration of in concentrated areas, we can draw the following conclusions: 1) if pensions were a private service, they could be economically efficient, but only in the concentrated areas, in some sectors and for part of the population (in the case of concentration of the service in a private monopoly or oligopoly); 2) if they are a public service, political intervention could make the service economically less efficient (at least in some cases), but increase the possibility of more homogeneity between regions, sectors and population groups[16].

In summary, according to the behavioral characteristics of the social security institutions and the economic and population characteristics discussed above, we can conclude that the social security system works mainly in the better organized economic sectors in the urban areas in the northern and central part of Mexico (i.e., in the public sector and the secondary and tertiary sectors, consisting of enterprises with a more advanced technology, a better organization and bigger incomes); and it works better in

[15] The terms better paid and better educated only refer to the national comparison.

[16] In this context the idea of efficiency is that, with the same amount of money, the least costly provision and administration of the service is the most efficient one.

the better-educated and higher-income population, leaving the majority of the rural sector and the secondary and tertiary small and medium low-technology enterprises as well as the low-income and less educated population mainly working in the informal sector[17] without a social security service.

In 1993 49.8% of the labor force were contributing to a pension system. From this number, 37.3% were in the Mexican Social Security Institute (IMSS) and 12.5% were in the Institute for Social Security and Service for State Workers (ISSSTE) and other local, state, and public pension systems. This means that 50.2% of the labor force did not participate in any pension system (Roberto Ham, 1996). There are other pension systems provided by private insurance enterprises, but their participation is really low and not important for the analysis.

In the same year only 19% of the population over 60 received a pension benefit: 13.2% from IMSS and 5.7% from ISSSTE and other institutions. This means that the rest of the old population, i.e. 81%, were either working in the formal sector (the minority), in the informal sector, or have retired without pension benefits (Roberto Ham, 1996).

If we assume that the 1993 proportion of the 60+ pensioned population reflects the past proportion of formal employment of the 15-59 age group, and assuming that the labor force of the 15-59 age group was half of the total 1993 population of 15-59, only approximately 25% of the population over 60 will receive pension payments in the future.

With the changes in the future population structure related to the fast growth of the share of old people in total population (in total and in percent), we have to anticipate the growth of a population without income, giving rise to social problems of vulnerability and exploitation of the old-age groups, to strong social and political pressure, and probably to a smaller percentage of the population who will be savers or consumers. In addition, the employees' salaries and the pension benefits will be low. In this respect there are three challenges:

- Firstly, an increase in pension benefits and public policies to support the retired population not receiving pension benefits and/or those having worked in the informal sector;
- Secondly, an increase in formal employment and in salaries to provide for a future increase in the proportion of the population receiving a pension as well as better pension benefits in the PAYG and the private systems; and,
- Thirdly, the resolution of the main question of the formal employees' contributions to the PAYG system and/or to other institutions (involving an increase in contribution rates, an increase in formal employees and/or an increase in salaries) to cover the pension benefits of a growing share of old population, in combination with an increase in formal employment and the change in the system towards a private pension system along with a cost transition from the PAYG to the new system paid by government funds from taxes[18].

[17] One of the reasons for the fact that some sectors of informal employment are not integrated into the social security system may be due to the administrative costs of social security and pensions in relation to the low contribution payment of this group.

[18] This does not mean that the growth in salaries and formal employment will avoid a future deficit between contributions and annual pensions, but it could postpone such a deficit in time, depending mainly on the growth (or decline) of formal employment, salaries, pensions, population and life expectancy. This is why this analysis is not only a pension analysis, but also an analysis of the social conditions of the old population.

In 1997, the IMSS, the most important social security institution in Mexico, which has the highest share in formal employees (mainly from private enterprises) and in pensioned population, decided on a second option, i.e., a private pension saving system with a government cost transition period, while the ISSSTE and the other institutions still maintain the PAYG system.

2.3. Conclusions

Instead of summarizing the conclusions of this chapter, we will raise two final questions:

- How will future socioeconomic characteristics of the population affect pension systems, institutions, and the overall government policy?
- What should be the share of private and public systems in the provision of pensions and other support of the old population?

3. Alternative Scenarios of the Mexican Economy, Population Change, and Pension Projections, 1995-2050.

The third chapter is devoted to the analysis of three alternative Mexican scenarios used in the model. Here we discuss their differences and similarities.

The difference between the scenarios lies in the exogenous projection of the share of employment of the formal sector labor force of the 15-64 age group. The assumptions on other exogenous variables are kept equal for all three cases.

A change in data in the scenarios may give similar results for some dependent variables, but it will also show differences that are very important for the application of the model and for the discussion of the likely Mexican future scenarios and the analysis of possible public policies.

3.1. Population, Exogenous Occupational and Economic Variables

With the exception of the share of formal employment in the labor force of the 15-64 age group, all other exogenous variables and assumptions remain the same for the three scenarios presented in this work.

We consider 1995 to be the first year of the analysis because of the reliability of the information for that year. This option was adopted, although the private systems reform in Mexico started in the middle of 1997.

The data considered are as of December 31 of each year. This is why for 1995 the growth rates of the variables are not included in the numerical results. The last year of the projections is 2050.

3.1.1. Population

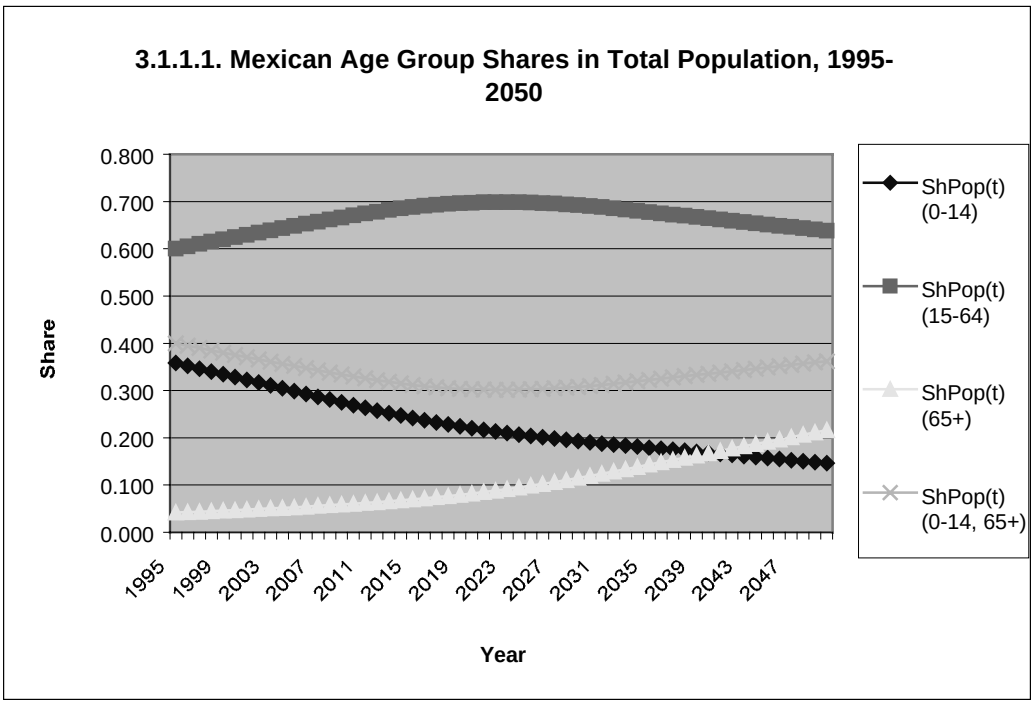
The reason for taking 2050 as the last year of the analysis was that “reliable” population projections are available just up to that year. Thus, from 1995 to 2030 we applied the Consejo Nacional de Población (CONAPO, 1996) projections, and from 2031 to 2050 a linear projection was made of the of growth rate of the total population starting in 2030, with the CONAPO growth rate set to zero in 2050, in accordance with the author's own assumptions. The total population figures for this period were obtained by means of these data.

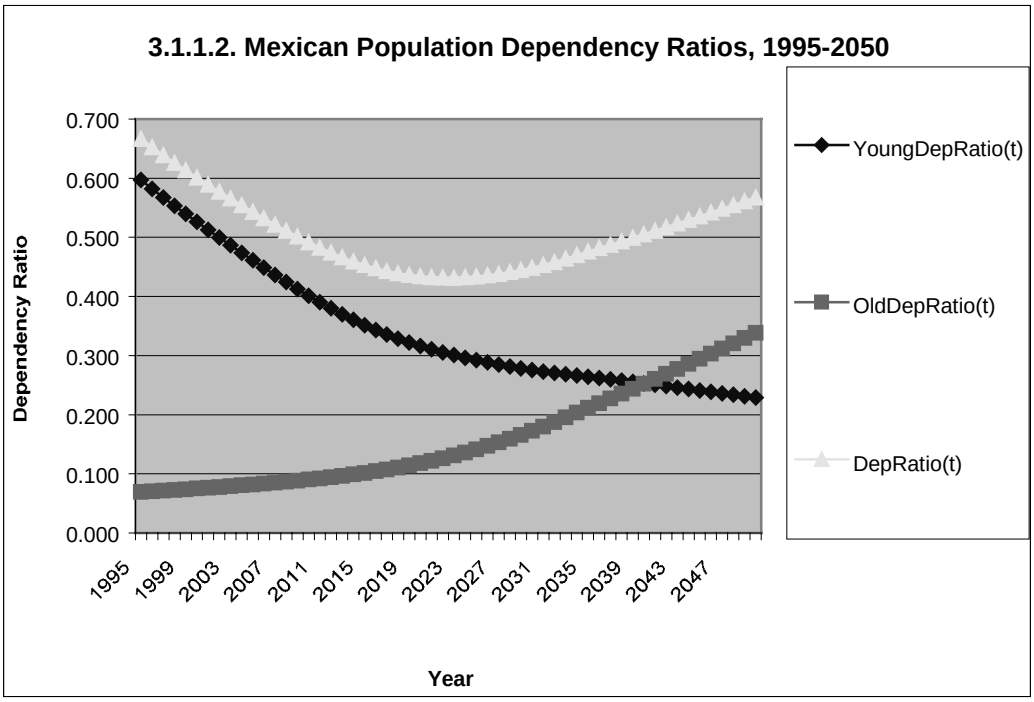
The same method was applied for projecting the shares of total population by age group (CONAPO projections to 2030 and United Nations Low Variant Projections (UN, 1996)). To avoid a rupture (in form of a jump) between the CONAPO and the UN projections we applied the UN shares in 2050 and not the absolute numbers of the different population age groups (the UN low variant projection showed a better approximation to the CONAPO population evolution).

Figures 3.1.1.1. and 3.1.1.2. show the evolution of the shares by main age groups in total population and the dependency ratios during the period, with a total population of 91,606,142 in 1995 and of 137,750,821 in 2050 (see also numerical results in Appendix 2).

As is shown in both figures, during the observed period there is a decrease of the shares and dependency ratios of the 0-14 age group, and, in contrast, an increase of the shares and dependency ratios of the population of 65+.

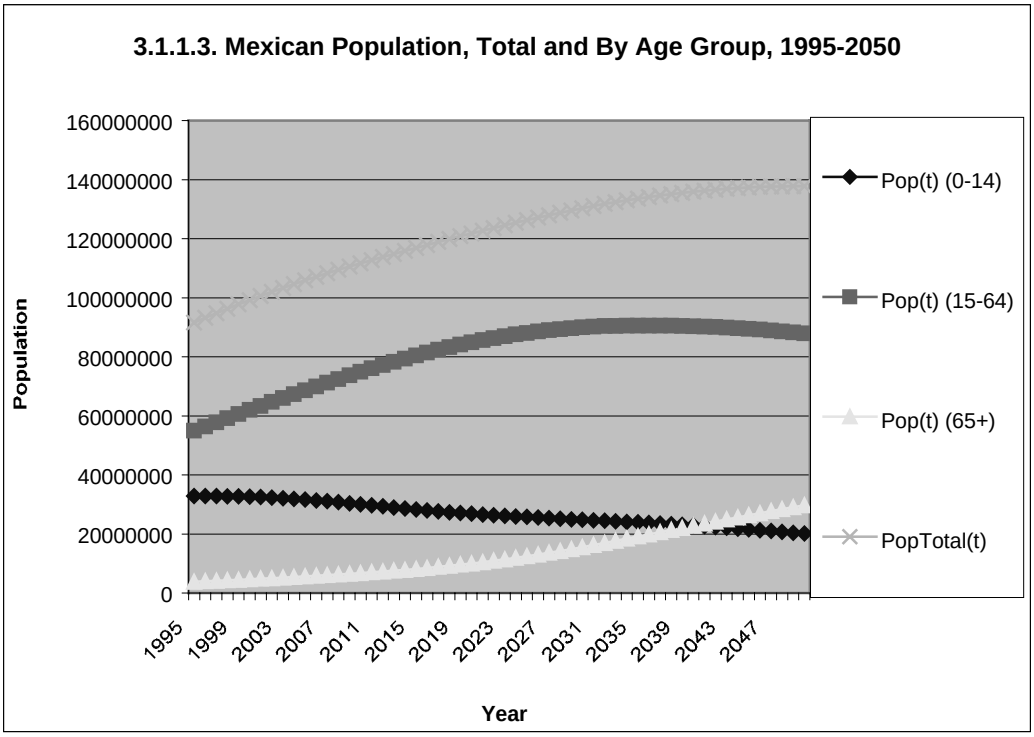
But, considering the shares of the population of 0-14 plus 65+ and the total dependency ratios, we can see that the main change in the Mexican population structure will be due to the absolute and percentage growth in the population of 15-64, who are representative of the growth in demand for houses, employment and more advanced studies.





However, the absolute and relative growth in old population is still important (see also Appendix 2) and will be even higher in the period of 2025 to 2050, but this is not as strongly reflected in the 0-14 plus 65+ dependency ratios for 2050 as in those for 1995, with its large share in population of 0-14.

Figure 3.1.1.3. shows the population in total and by age groups.



On the basis of this figure we can conclude that there is a negative trend in the growth rate of the population of 15-64 as opposed to its absolute and percentage growth until 2040. For the population of 0-14, the tendency reflects a negative growth rate, which means, along with a decline in fertility, a transition of the growth of population of this age group to the 15-64 age group. Finally, the only age group that keeps growing is the population of over 65. This reflects an increasing life expectancy and a strong transition from the population of 15-64 to the 65+ age group; on the other hand, the tendency of the growth rate from 2035 to 2050 is declining.

3.1.2. Labor Force, Employment and Pensioned Population Variables

The participation rate in the labor force of the population of 15-64 was assumed to be 58% in 1995, with a linear growth rate until it reaches a participation rate of 63% in 2050. On the other hand, we assumed a participation rate of the labor force of 65+ to be 30% in 1995, declining to 20% in 2050.

This was based on the assumption of the 1995 total labor force participation rate of the 15+ age group amounting to 56%, which is an approximation of the actual and past real participation rate (see INEGI in the Internet: www.inegi.gob.mx).

The low growth in the labor force participation rate of the age group 15-64 is due to the fact that an increase in the participation rate of women was assumed, together with a growth in the participation of the population of the highest educational levels, whose participation rate is even lower than the growth of women in the labor force.

In the case of the decline in the labor force participation rate of the population of 65+, a harder competition for jobs between the population of 65+ and the better educated population of 15-64 was assumed, which translates into a decline of the 65+ participation rate.

For 1995 we assumed for the formal employment in the 15-64 and 65+ age groups that the 1993 Roberto Ham (1996) share of the total formal employment, which is 49.8% of the labor force, is approximated to the share for 1995. For constructing this variable we assumed a 1995 share of formal employment in the labor force of the 15-64 age group of 48% and a share of 35% in the population of 65+, giving a share of total formal employment in the labor force of 15+ of 47.5%.

As mentioned above, the only changes applied to the three scenarios were in the future tendency of the formal employment share in labor force of the 15-64 age group[19]. For the share of formal employment in labor force of 65+ we kept 35% for all the years, assuming that the work of the old population is normally the lowest paid and this is why it is the most difficult to be identified and controlled in the social security systems. For the latter reasons it is more expensive and economically inefficient for a private or public social security institution (with its own budget, independent from the government) to shift the old population to the formal sector of the economy. Furthermore, the actual and future prerequisites for formal employment are higher skills, which is a disadvantage for the majority of the old population.

The unemployment rate of the 15-64 and 65+ age groups for all the years was assumed to be 3.5% in accordance with an approximated average of the total unemployment rate in the last years (see the INEGI, Internet, 1998). As we maintain the same

[19]The three different assumptions for this exogenous variable are presented in the next section (3.2.) of this chapter.

projections of the labor force participation rates in both age groups for all three scenarios, the total unemployment rate is 3.5%.

Finally, for the proportion of population of over 65+ eligible to pension payment we made the following assumption: From Roberto Ham (1996) we took the proportion of the pensioned population in 1993 in the age group of 60+ (including 60+ widows), assuming that it is the same for the 65+ pensioned population in 1995. Then we assumed that the proportion of the retired population in the population of 65+ in 1995 is equal to the proportion of formal employment in the population of 15-64 in the year 1975.

Then it was assumed that the 1995 proportion of formal employment in the population of 15-64 would be the same as the proportion of the pensioned population in the population of 65+ in 2015. On the basis of these data we made a linear projection of the proportions from 1995 to 2015. Then, for 2016 to 2050 we assumed the proportion of the pensioned population of 65+ to be the same as that of the formal employment in the population of the 15-64 age group 20 years before (i.e., from 1996 to 2030).

3.1.3. Economic Variables

The 1995 GDP was taken from the Mexican OECD (1998) data. It is presented in millions of current pesos (as well as total salaries, pension contributions and annual benefits, i.e., all economic data presented for 1995 are in current pesos).

The GDP growth rate was assumed to be 2.6% per year during the whole projection period. This was taken from the Mexican OECD (1998) GDP data on the average growth rate for 1987-1996.

The 1995 average annual salaries of employees in the formal sector were taken from Gómez de León and Parker (1998), and the 1996 average number of minimum salaries of formal employees in the IMSS were taken from INEGI (Internet, 1998), giving the average 1995 national daily minimum salaries. We assumed that the other social security institutions have the same average and multiplied the data provided by INEGI and Gómez de León for an approximation of the 1995 average annual salaries.

The percentage of the salary for contributing to the pension system was taken from the IMSS data (1997). This percentage (an approximation) of 6.5% is shared between the employers, employees and the government, and represents the percentage provided by the new law, which we kept constant during all the projections (it should be noted that this is the percentage taken from the average salary rather than the percentage taken from the average number of minimum salaries which are paid into the system. This means that in the pension system there are different limits for calculating the percentage of contributions).

Finally, the percentage of an average pension relative to an average salary was assumed for 1995 to be 40%, which is an approximation of the real data (see Goméz de León and Parker, 1998). Then we projected a linear growth rate to 60% in 2050. The underlying assumption that in the private system the real rate of interest will be positive or that it will be compensated by the government as well as by the PAYG system, is based on the urgent need to improve the wealth of the retired population at the government's expense.

3.2. Comparing the Three Scenarios

The first scenario is based on the assumption that the tendency of the share of formal employment in the labor force of the 15-64 age group will grow linearly from a share of 48% in 1995 to a share of 80% in 2015. From 2015 to 2050 this share is kept constant. The fast growth of this share is based on the assumption that by means of public policies the government will promote a fast incorporation of informal employment into the formal sector. In this context it is also assumed that there will always be a share of the informal sector that cannot be incorporated into the formal sector of the economy. This share represents mainly women working in the household and students working part-time in economic activities without or with a low income. This scenario is called Fast Scenario.

The second scenario is based on the assumption that the tendency of the share of formal employment in the labor force of the 15-64 age group will grow linearly from a share of 48% in 1995 to a share of 80% in 2050. The scenario contains the same assumptions as the first one. The difference here is that the growth is slower because the government will incorporate into the formal sector the higher-income informal sector in the course of this period and in accordance with the growth in salaries. This scenario is called Moderate Scenario.

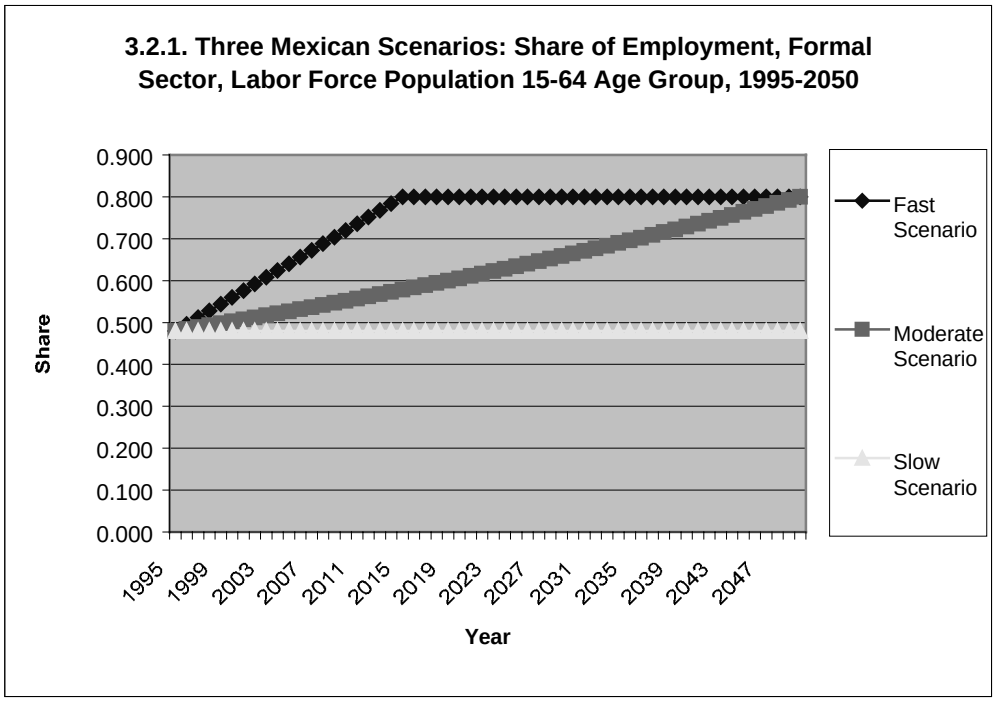
The third scenario is based on the assumption that the tendency of the share of formal employment in the labor force of the 15-64 age group will remain equal at 48% from 1995 to 2050. The scenario assumes that the economy will preserve the regional and sectoral differences between the population. This scenario is called Slow Scenario.

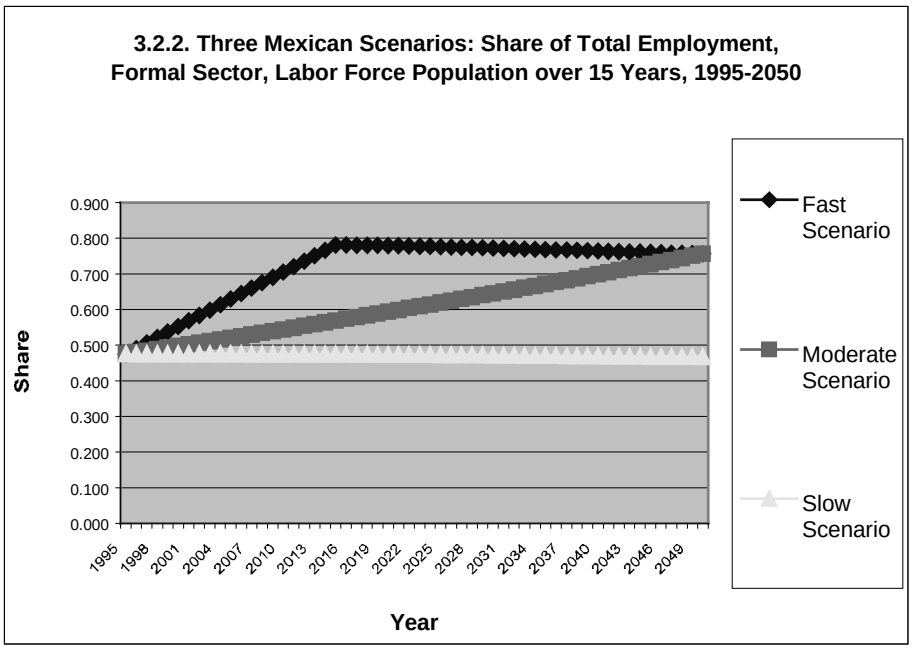
In summary, we have similar exogenous population, occupational and economic data and assumptions for three scenarios. The difference lies only in the share of formal employment in the labor force assumed for the age group of 15-64.[20]

Figure 3.2.1. shows the shares of employment in the formal sector of the labor force of the 15-64 age group for the three scenarios. Figure 3.2.2. presents the behavior of the shares of total employment in the formal sector of the labor force in the age group of over 15 with the same other exogenous variables that were explained in the first part of this chapter.

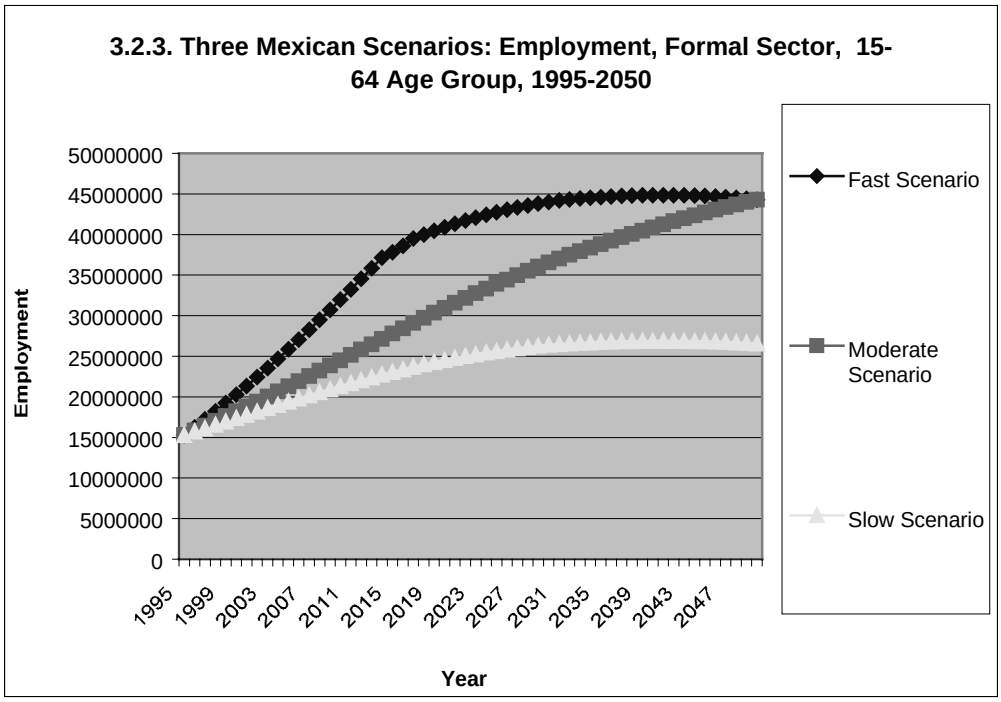
We can see that the weight in the share of total employment in the formal sector in the three scenarios results from the share of employment of the 15-64 age group. The small difference between the two figures comes from the decline of the participation rate of labor force population over 65, with a growth in the old-age dependency ratio (instead of a growth of the participation rate of the labor force of the 15-64 age group), and the same share of formal employment in labor force population over 65. In this example we can see the importance of the population structure. If we had the same population structure for all years, the differences between the two graphics would be smaller; assuming a faster aging process, the difference would be bigger, with a big drop of the share of total employment in the formal sector of the labor force population over 15 in the three scenarios.

[20] For more detail see Appendix 2.





Using the latter results, Figure 3.2.3. presents the employment in the formal sector of the 15-64 age group. The figure shows that the three scenarios have positive growth rates (the fast and slow scenarios become negative close to 2040) with negative tendencies.



As a consequence of the structural population change (with a negative tendency starting in the growth rate of the 15-64 age group), the positive absolute growth rates have a negative tendency; however, the fast (until 2015) and moderate scenarios have a positive tendency of growth in the share of formal employment in labor force, with the same positive growth tendency of the participation rate of the labor force in the 15-64 age group in the three scenarios.

On the basis of the latter result and as a consequence of the same share of employment in the formal sector of the labor force population of over 65 for all years in the three scenarios, Figure 3.2.4. gives the total employment for the formal sector of the population over 15.

Showing the same tendency as Figure 3.2.3., the results of this figure give a positive absolute growth in the three scenarios with a slower tendency of negative growth rates of total formal employment. This is mainly due to the growth in the share of population over 65 in total population, in spite of the drop in the labor force participation rate of the population over 65.

With a 3.5% unemployment rate in the three scenarios and in the two age groups, all variables give a share of employment in the informal sector of the 15-64 age group of 48.5% in 1995 for the three scenarios, of 16.5% in 2050 for the fast and the moderate scenarios, and of 48.5% again in 2050 for the slow scenario. All three scenarios give a 61.5% share of the informal employment sector of the population over 65 for all years.

These results lead to a share of total employment of 49.0% in the informal sector of the population over 15 for the three scenarios in 1995, of 20.9% in 2050 for the fast and the moderate scenarios (in spite of their different behavior during this period), and of 49.8% in the slow scenario for the same year.

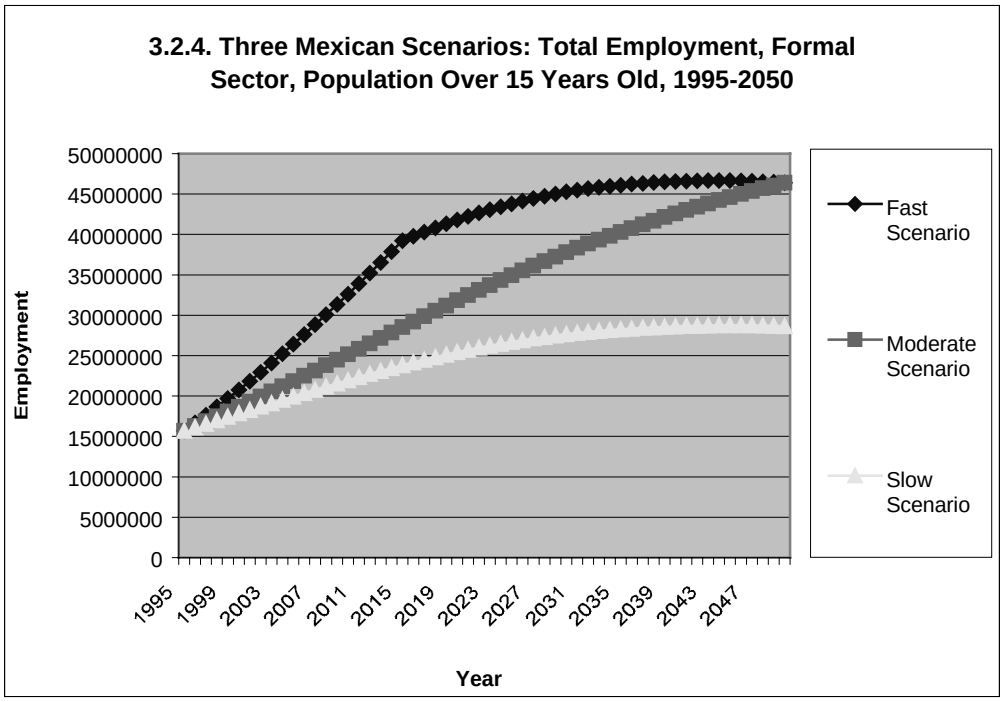
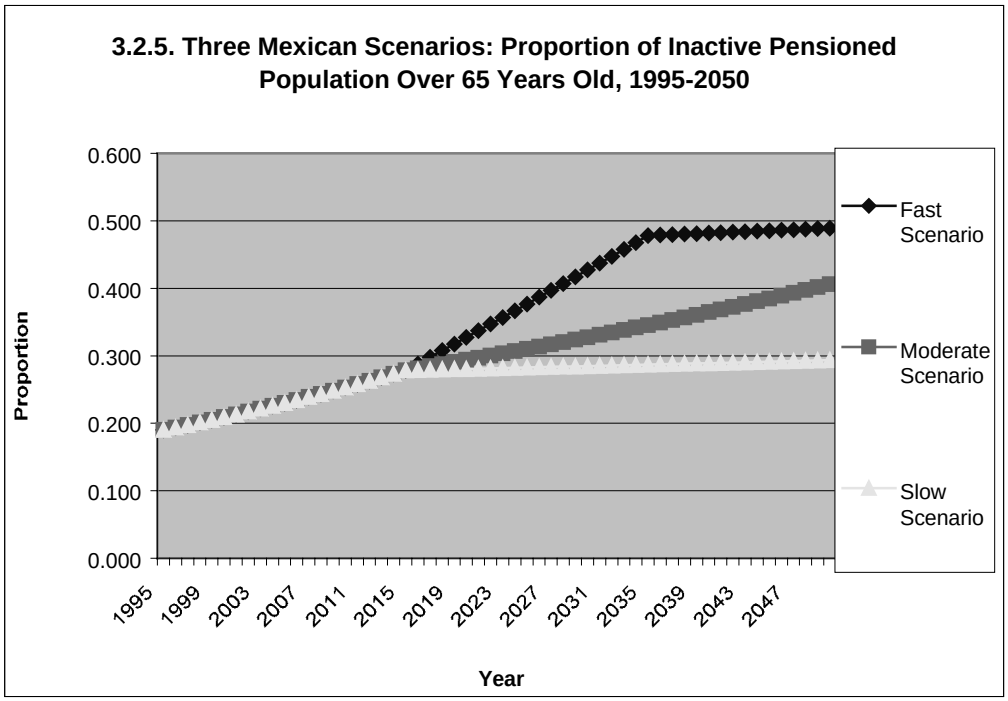


Figure 3.2.5. shows the proportion of the inactive pensioned population over 65 for the three scenarios.



In accordance with the assumptions made in Chapter 1 for the model and in the first part of this chapter for the Mexican case, the three scenarios show the same behavior for the first 20 years. After this period the proportions of the three scenarios start to differ, but they maintain the same tendency with respect to formal employment in the population of the 15-64 age group. However, after 2015 they show similar

characteristics to the share of employment in the formal sector of the labor force population of 15-64 of twenty years ago. We can see a stronger tendency of growth of this share (see, for example, the Slow Scenario) by using the proportion of employment in the formal sector of the 15-64 age group rather than the share in labor force of the 15-64 age group.

This shows that Mexico is still a slow-aging country, in spite of the negative tendency of the growth in the population of 15-64, and the positive tendency in the growth in the population over 65, which demonstrates the importance of linking the population dynamics with the economic behavior.

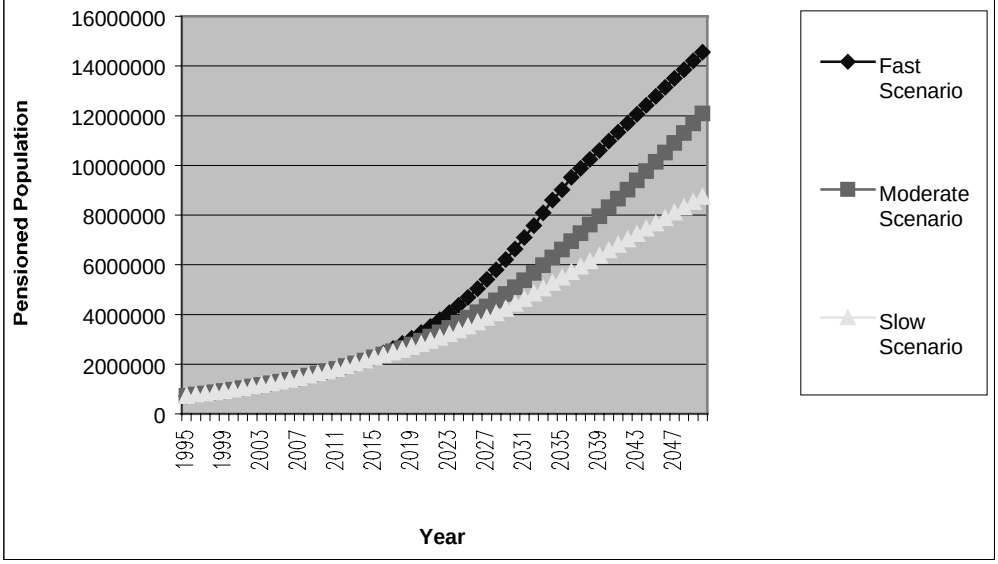
We can also see that the different applications of public policies to a growing formal employment will, in the future, have deep impacts on the conditions of the old population and their incorporation into the pension system.

These characteristics are given in Figure 3.2.6. for the three scenarios for the inactive pensioned population over 65.

Again, the three scenarios in this figure have the same absolute growth until 2015. After this period they change in accordance with the different assumptions applied to the share of employment in the formal sector of the labor force of the 15-64 age group and to the labor force participation rates of the 15-64 age group twenty years ago, as well as the population structure twenty years ago and the actual population structure (for each year of the projection).

As a result of the three similar scenarios of the labor force participation rate in the population over 65, plus the inactive, pensioned population over 65, we get the proportion of the inactive, not pensioned population over 65, which amounts to 51% in 1995 for the three scenarios, and to 31.1% in fast scenario, to 39.4% in the moderate scenario and to 50.7% in slow scenario in 2050.

3.2.6. Three Mexican Scenarios: Inactive Pensioned Population Over 65 Years Old, 1995-2050



Following the presentation of the results and taking into account all occupational conditions of the population mentioned above, we now proceed to the economic variables resulting from this process for the three scenarios.

Assuming a 2.6% GDP growth rate applied to all three scenarios for all years and the same growth rate of the total labor force population over 15, as explained in the first part of the chapter, we obtain the same productivity growth rates, which are equal to the growth rates of the average salaries for the three scenarios.

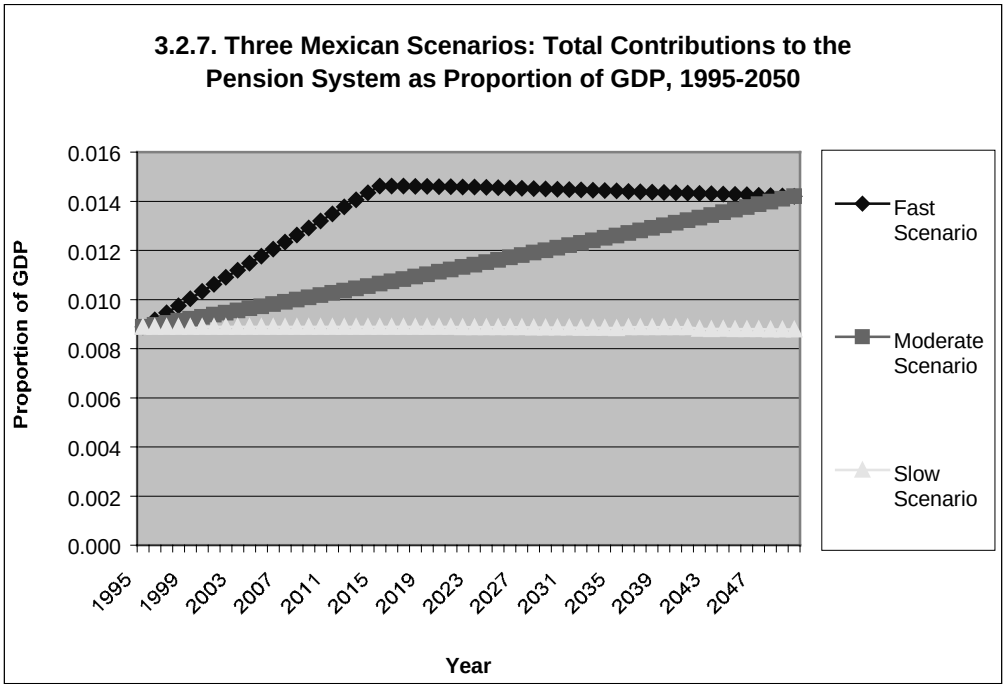
The results are a negative productivity growth rate in the first years, but a positive growth rate with a rising tendency in the near-term future.

This means that the growth of the labor force will drop to less than 2.6% per year in a few years' time, but the desire to keep the GDP growth rate higher than the growth rate of the labor force will present a pressure towards the use of better technologies and a better educated, trained and healthy population, i.e., a population that will produce more innovative products with more added value, a population with a higher income, which, on the other hand, could lead to a bigger socioeconomic division between the population by social sector and region (see next part of this chapter).

With the same GDP growth rate in the three scenarios and a GDP of 1,837,776.0 million 1995 pesos we have a GDP of 7,540,452.7 million 1995 pesos in 2050.

With this same GDP, with the same average salaries for the three scenarios for the various years, with a similar percentage of salary contribution to the pension system, but with a different number of formal employees, we obtain in Figure 3.2.7 the total contributions to the pension system as proportion of GDP for the three scenarios. This means that the main weight of the differences in these proportions is based on the share and number of employees in the formal sector.

3.2.7. Three Mexican Scenarios: Total Contributions to the Pension System as Proportion of GDP, 1995-2050

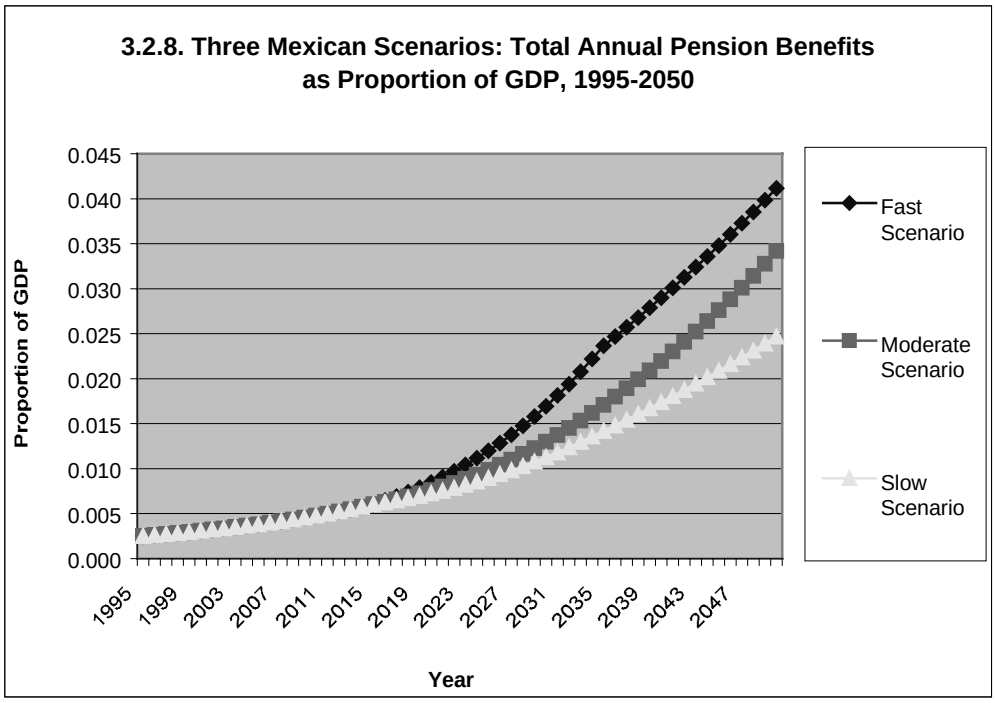


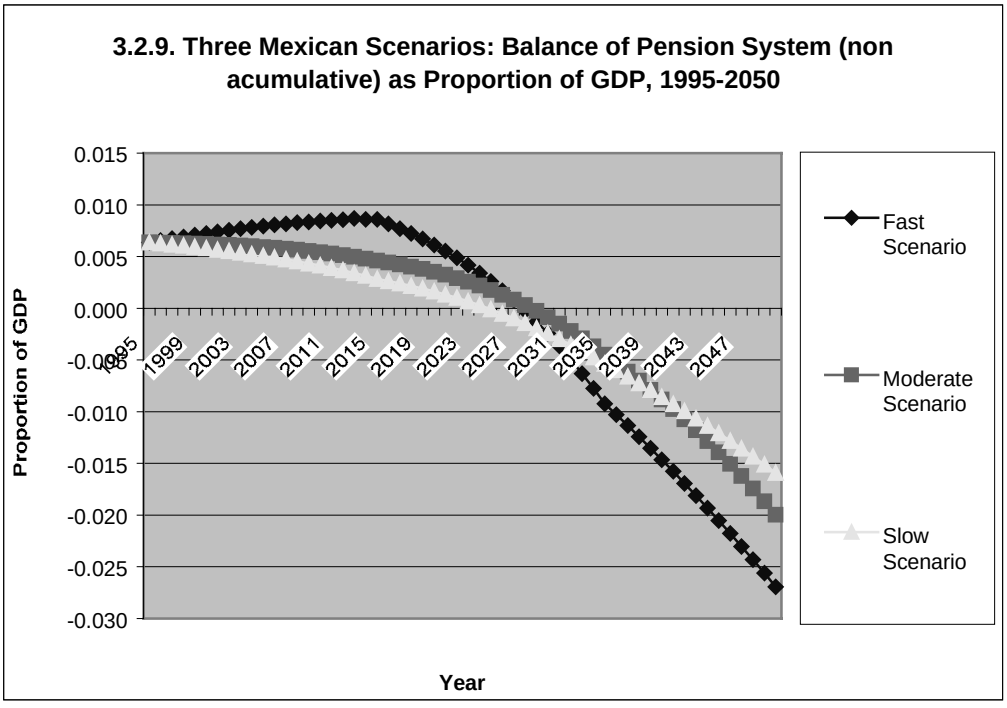
On the other hand, with the same percentage of average annual pension benefits relative to average salaries, which gives us the same average pension in the three scenarios, but with a different inactive, pensioned population over 65, Figure 3.2.8.

gives us three different scenarios of the total annual pension benefits as proportion of GDP.

The results of the latter figure reflect the main weight in the proportion of pensioned population along with the growth in the average annual pension benefit relative to average salary, which have a positive tendency in the three scenarios.

Finally, Figure 3.2.9. shows the balance of the pension system (non accumulative) as proportion of GDP, which is the result of all the variables applied in the model for the Mexican case.





These results indicate that in all cases the pension system will suffer a deficit due to population aging. This deficit will be different in time and in magnitude depending on the actual and medium-term behavior of the formal employment.

However, the findings presented above should not lead to immediate conclusions, but they should help to consider the contradictions generated by the scenario results and to open the discussion not only with regard to the analysis of pension institutions, but also with regard to the analysis of the overall economic and employment policies, with particular emphasis on the social policies for the old population.

3.3. Results, Discussion, and Conclusions

We have seen that different growth rates in the formal employment sector, in combination with a strucutral change in population and economic behavior, give different results over time of the economic and occupational conditions of the population and the pension system. The main conclusion for all scenarios is that population aging will cause a deficit in the pension system. We have seen that the time and size of this deficit is highly dependent on the behavior of the formal employment.

We saw the contradiction generated by the fast scenario, where the promotion of a fast growth of formal employment, with an initial boost to the pension system, and a high share of formal employment with a high future proportion of the pensioned population, led, at the same time, to a higher deficit in the future pension system than in the other scenarios (in accumulative terms).

In this scenario we get a small future participation rate of the labor force of 65+ (with the problem of a large share in the informal sector) and a small proportion of the inactive, not pensioned population of 65+.

This means, in the fast scenario, a transfer of money from other social government agencies to the pension system because of the growth in importance and number of the share of the population of over 65+ in the total population, with the majority having a legal right to receiving retirement benefits.

For the private system there may be three different types of government expenses: the deficit in the administrative costs from incorporating into the formal sector the low-salary employees of the informal sector; the transition costs; and the subsidy for pensions below subsistence level, the low interest rate, or the money lost in high-risk investment.

In the latter case there is another contradiction, i.e., if pension savings require a high rate of return for obtaining a real increase in the savings after inflation and administrative costs, this means that the investments have to be made at a higher risk or in companies with a higher rate of return, which are mainly big international and national enterprises with a smaller participation in the growth of employment. This is contrary to the policies of increasing mainly formal employment. On the other hand, if pension investment goes to small companies with a high growth of employment, the rate of return could be too small to accumulate future pension benefits. In this case the government would end up spending money to subsidize the pension benefits or the rate of interest (e.g. by selling government bonds with a high rate of return to the private pension institutions).

With regard to a decision between the PAYG and the private system in this scenario the following considerations should be made: The advantage of the private system lies

in its capacity of accumulating internal savings and investments, however at the risk of concentrating these in the economic, social and regional sectors, thus defeating the propose of increasing investment and formal employment in medium and small enterprises. The other risk of privatization lies in the possibility of a high deficit affecting the private institutions and the costs to be paid by the government (plus transition costs).

The PAYG system has the advantage that the government can increase pension incomes from new contributions and other sources without paying transition costs. A fast growth of incomes could mean a growth of consumption (not only because of the growth of the average pension, but also because of the growth in number of the old population and their importance as consumers); it could mean a growth of production, of investment, employment and government tax incomes (which could be used for paying the high future deficits in the pension system). Here the contradiction is that this system could increase inflation and, in the particular case of Mexico, the amount of the imports.

The slow scenario has, during all the projections, had a small share of employment in the formal sector with a small proportion of the future pensioned population. In this scenario the pressure is put by the pension institutions on the social government agencies for money to be transferred from the taxes paid by the enterprises and the formal employees to the informal employees and the old, not pensioned population.

This scenario is the less positive because, in addition to the risk of a deficit and the contradictions in the private and the PAYG pension system (in the private system this slow-growth scenario of formal employment could mean that the majority of the investment goes to high-risk and/or big enterprises), it will become necessary to put pressure on the formal economy to transfer money to the informal sector, as well as to the old, inactive, not pensioned population.

Finally, the moderate scenario could be the most positive or realistic. It presents a growth of formal employment with the idea of incorporating the informal into the formal sector and increasing salaries. This means that the higher incomes of the informal employees will be incorporated into the pension system during that period, with the intention of avoiding the high administrative individual and group deficits in the administration of low-income social services and pensions.

This scenario reflects a higher participation and coordination of the different social security and pension institutions in collaboration with the social government agencies during the whole projected period. It reflects, on the smallest scale, the necessary mix of public policies of the fast and slow scenarios. The transfer of money in the private and the PAYG pension systems is effected together with other social and economic public policies.

The above observations are more than a summary of the results, they are a general analysis of the contradictions generated whatever decision is taken by the government or by the private and public social security and pension institutions. As we have seen, in Mexico the decision was taken to turn the pension system of the most important social security institutions in the country from a PAYG into a private saving system.

On the one hand, this decision saved the institutions from bankruptcy, as a deficit in their pension balance was foreseeable for the future due to the structural changes in the population and the lack of reserves in the pension budget as a consequence of the past use of these reserves in support of the medical service in Mexico, leading to a higher life expectancy of the Mexican population. On the other hand, the decision in favor of the private system would increase internal savings and could also increase investments and employment.

But such a decision does not exclude the necessity of government intervention with the pension system throughout the whole projection period, in combination with other economic and old-age social polices. And we will see in the medium-term future that it will be necessary to introduce a new reform which will attempt to resolve any new contradictions generated from the pension system and the economic and population dynamics.

4. Final Comments and Suggestions

As we have seen, the model presented in this work can be used for different purposes in the analysis of the relationships between economic and population dynamics. It is applicable to short- and medium-term analysis (in public and private decision making) as well as to long-term analysis for evaluating future possibilities. The model can be improved in some of its assumptions and it can be extended to focus on different regional, sectoral and scientific interests.

With regard to the Mexican case, we have seen that the use of the model is to explain the actual and future economic and social conditions of the population in general, and of the old population in particular. We have focused our attention on the analysis of the pension system and on the contradictions generated by various assumptions on different economic conditions and public policy decisions.

We found that in spite of some medium-term advantages and future possibilities of the new private pension system compared with the past PAYG system in Mexico and in countries with similar characteristics, an intervention of the public sector will be necessary, not only to cover the transition costs, but also for paying other expenses arising from economic and population dynamics, in collaboration with other government agencies in charge of social policies for the old population.

Government intervention would be necessary for any pension system in countries like Mexico, having a similar economic structure and future pattern of population aging. And, probably, the decision for the most efficient system is not even a decision between a PAYG system and a private system.

The PAYG pension system certainly needs to be reformed. However, the real distinction is between a private system and a system of concentration of pension contributions in one government institution (the difference to the PAYG system being that this institution has the possibility to invest and move the money).

The latter has the advantage of avoiding a concentration of investments in certain sectors and large enterprises and of promoting investment in medium and small enterprises. Here the problem is that the investment decisions could be used for short-term political interests.

But, on the other hand, as a consequence of the low salaries and the high administrative costs, we could see a future concentration of pension savings in a few private institutions (forming an oligopoly) that could reach scale economies in the administration.

In this sense the pension system and the future conditions of the old population are important challenges for the Mexican society in general, and for the government in particular. The idea is to reach the politically and economically most efficient decisions to improve future economic and population changes, trying to increase formal employment and productivity, giving rise to better real salaries and more pension payments at higher annual benefits, as well as trying to increase government

income to alleviate the economic and social problems of the old population. In short, the government will have to intervene to guarantee old-age pension payment.

Finally, as a proposal for a future study of the Mexican case, we have to consider how the pension system with all its possibilities and implications will affect the socioeconomic conditions and population movements in the different regions as well as the individual economic sectors, and how the capital of the pension system will be distributed. How would the capital be distributed among regions and economic and social sectors if the PAYG system was maintained, and how would the private pension system develop in dependence on different actors and economic institutions and circumstances?

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APPENDIX 1. MATHEMATICAL DESCRIPTION OF THE MODEL

POPULATION

$Pop_t(0-14)$, Population 0-14, exogenous variable;

$Pop_t(15-64)$, Population 15-64, exogenous variable;

$Pop_t(65+)$, Population over 65, exogenous variable;

$PopTot_t$, Total population, exogenous variable;

$ShPop_t(0-14) = \frac{Pop_t(0-14)}{PopTot_t}$, Share of population aged 0-14 to total population;

$ShPop_t(15-64) = \frac{Pop_t(15-64)}{PopTot_t}$, Share of population aged 15-64 to total population;

$ShPop_t(65+) = \frac{Pop_t(65)}{PopTot_t}$, Share of population over 65 to total population;

$ShPop_t(0-14,65+) = \frac{Pop_t(0-14,65+)}{PopTot_t}$, Share of population in age groups 0-14 and 65+ to total population;

$YoungDepRatio_t(0-14) = \frac{Pop_t(0-14)}{Pop_t(15-64)}$, Young dependency ratio or ratio of population aged 0-14 to population aged 15-64;

$OldDepRatio_t(65+) = \frac{Pop_t(65+)}{Pop_t(15-64)}$, Old dependency ratio or ratio of population aged 65+ to population aged 15-64;

$DepRatio_t = \frac{Pop_t(0\text{-}14, 65+)}{Pop_t(15-64)}$, Dependency ratio or ratio of population in age groups 0-14 and 65+ to population 15-64;

$GrowthRatePop_t(0-14) = \frac{Pop_t(0\text{-}14)}{Pop_{t-1}(0-14)} - (1)$, Growth rate of population aged 0-14;

$GrowthRatePop_t(15-64) = \frac{Pop_t(15\text{-}64)}{Pop_{t-1}(15-64)} - (1)$, Growth rate of population aged 15-64;

$GrowthRatePop_t(65+) = \frac{Pop_t(65+)}{Pop_{t-1}(65+)} - (1)$, Growth rate of population over 65;

$GrowthRatePopTot_t = \frac{PopTot_t}{PopTot_{t-1}} - (1)$, Growth rate of total population.

LABOR FORCE, FORMAL AND INFORMAL EMPLOYMENT, UNEMPLOYMENT AND RETIRED POPULATION

$PartRateLaborForce_t(15-64)$, Participation rate of labor force aged 15-64 to total population aged 15-64, exogenous variable;

$PartRateLaborForce_t(65+)$, Participation rate of labor force over 65 to total population over 65, exogenous variable;

$LaborForce_t(15-64) = Pop_t(15-64) * PartRateLaborForce_t(15-64)$, Labor force in population aged 15-64;

$LaborForce_t(65+) = Pop_t(65+) * PartRateLaborForce_t(65+)$, Labor force in population over 65;

$TotalLaborForce_t(15+) = LaborForce_t(15-64) + LaborForce_t(65+)$, Total labor force or labor force in population over 15;

$PartRateTotalLaborForce_t(15+) = \frac{TotalLaborForce_t(15+)}{[Pop_t(15-64) + Pop_t(65+)]}$, Participation rate of total labor force population over 15 to total population over 15;

$GrowthRateLaborForce_t(15-64) = \frac{LaborForce_t(15-64)}{LaborForce_{t-1}(15-64)} - (1)$, Growth rate of labor force population aged 15-64;

$GrowthRateLaborForce_t(65+) = \frac{LaborForce_t(65+)}{LaborForce_{t-1}(65+)} - (1)$, Growth rate of labor force population over 65;

$GrowthRateTotalLaborForce_t(15+) = \frac{TotalLaborForce_t(15+)}{TotalLaborForce_{t-1}(15+)} - (1)$, Growth rate of total labor force population over 15;

$ShEmplFormSect_t(15-64)$, Share of formal sector employed population aged 15-64 to labor force population aged 15-64, exogenous variable;

$ShEmplFormSect_t(65+)$, Share of formal sector employed population over 65 to labor force population over 65, exogenous variable;

$EmplFormSect_t(15-64) = ShEmplFormSect_t(15-64) * LaborForce_t(15-64)$, Formal sector employed population aged 15-64;

$EmplFormSect_t(65+) = ShEmplFormSect_t(65+) * LaborForce_t(65+)$, Formal sector employed population over 65;

$TotalEmplFormSect_t(15+) = EmplFormSect_t(15-64) + EmplFormSect_t(65+)$, Formal sector employed population over 15;

$ShTotalEmplFormSect_t(15+) = \frac{TotalEmplFormSect_t(15+)}{TotalLaborForce_t(15+)}$,Share of formal sector employed population over 15 to labor force population over 15;

$GrowthRateEmplFormSect_t(15-64) = \frac{TotalEmplFormSect_t(15-64)}{TotalEmplFormSect_{t-1}(15-64)} - (1)$, Employment, formal sector growth rate in population aged 15-64;

$GrowthRateEmplFormSect_t(65+) = \frac{TotalEmplFormSect_t(65+)}{TotalEmplFormSect_{t-1}(65+)} - (1)$, Employment, formal sector growth rate in population over 65;

$GrowthRateTotalEmplFormSect_t(15+) = \frac{TotalEmplFormSect_t(15+)}{TotalEmplFormSect_{t-1}(15+)} - (1)$, Employment, formal sector growth rate in population over 15;

$UnemplRate_t(15-64)$, Share of unemployed population aged 15-64 to labor force population 15-64, exogenous variable;

$UnemplRate_t(65+)$, Share of unemployed population over 65 to labor force population over 65, exogenous variable;

$Unemployment_t(15-64) = UnemplRate_t(15-64) * LaborForce_t(15-64)$, Unemployed population aged 15-64;

$Unemployment_t(65+) = UnemplRate_t(65+) * LaborForce_t(65+)$, Unemployed population over 65;

$TotalUnemployment_t(15+) = Unemployees_t(15-64) + Unemployees_t(65+)$, Total unemployed population over 15;

$TotalUnemplRate_t(15+) = \frac{TotalUnemployment_t(15+)}{TotalLaborForce_t(15+)}$, Share of unemployed population over 15 to labor force population over 15;

$ShEmplInformSect_t(15-64) = 1 - \begin{bmatrix} ShEmplFormSect_t(15-64) \\ + UnemplRate_t(15-64) \end{bmatrix}$, Share of informal sector employed population aged 15-64 to labor force population aged 15-64;

$ShEmplInformSect_t(65+) = 1 - \begin{bmatrix} ShEmplFormSect_t(65+) \\ + UnemplRate_t(65+) \end{bmatrix}$, Share of informal sector employed population over 65 to labor force population over 65;

$EmplInformSect_t(15-64) = ShEmplInformSect_t(15-64) * LaborForce_t(15-64)$ Infor mal sector employed population aged 15-64;

$EmplInformSect_t(65+) = ShEmplInformSect_t(65+) * LaborForce_t(65+)$, Informal sector employed population over 65;

$TotalEmplInformSect_t(15+) = EmplInformSect_t(15-64) + EmplInformSect_t(65+)$ Tot al informal sector employed population over 15;

$ShTotalEmplInformSect_t(15+) = \frac{TotalEmplInformSect_t(15+)}{TotalLaborForce_t(15+)}$, Share of total informal sector employed population over 15 to labor force population over 15;

$GrowthRateEmplInformSect_t(15-64) = \frac{EmplInformSect_t(15-64)}{EmplInformSect_{t-1}(15-64)} - (1)$, Growth rate of informal sector employed population aged 15-64;

$GrowthRateEmplInformSect_t(65+) = \frac{EmplInformSect_t(65+)}{EmplInformSect_{t-1}(65+)} - (1)$, Growth rate of informal sector employed population over 65;

$GrowthRateTotalEmplInformSect_t(15+) = \frac{TotalEmplInformSect_t(15+)}{TotalEmplInformSect_{t-1}(15+)} - (1)$, Growth rate of total informal sector employed population over 15;

$\Pr opInactPensioned_t(65+) = \Pr opEmplFormSect_{t-20}(15-64)$
$= \frac{EmplFormSect_{t-20}(15-64)}{Pop_{t-20}(15-64)}$, Proportion of total economically inactive population over 65 retired with pension to total population over 65 (first 20 years are exogenous variable);

$InactPensioned_t(65+) = PartRateInactPensioned_t(65+) * Pop_t(65+)$, Economically inactive population over 65 retired with pension;

$GrowthRateInactPensioned_t(65+) = \frac{InactPensioned_t(65+)}{InactPensioned_{t-1}(65+)} - (1)$,Growth rate of economically inactive population over 65 retired with pension;

$\Pr opInactNotPensioned_t(65+) = 1 - \left[\begin{matrix} PartRateLaborForce_t(65+) \\ + \Pr opInactPensioned_t(65+) \end{matrix} \right]$, Proportion of economically inactive population over 65 retired without pension to population over 65;

$InactNotPensioned_t(65+) = PartRateInactNotPensioned_t(65+) * Pop_t(65+)$, Economically inactive population over 65 retired without pension.

GDP AND PRODUCTIVITY

$GrowthRateGDP_t$, Growth rate of GDP, exogenous variable;

$GDP_t = GDP_{t-1}\left[1 + GrowthRateGDP_t\right]$, Total GDP (first year exogenous variable);

$GDPperCapita_t = \frac{GDP_t}{PopTotal_t}$, GDP per capita;

$GrowthRate\,\Pr oductivity_t = GrowthRateGDP_t - GrowthRateTotalLaborForce_t(15+)$
$= GrowthRateAverageAnnualSalary_t$

Growth rate of productivity which is equal to growth rate of average annual salaries.

ANNUAL SALARY, EMPLOYEES, FORMAL SECTOR, AND PENSION CONTRIBUTIONS

$$AvSalTotalEmplFormSect_t(15+) = AvSalTotalEmplFormSect_{t-1}(15+) * \left[1 + GrowthRate\,\mathrm{Pr}\,oductivity_t\right]$$

Average annual salary, employees, formal sector (first year exogenous variable);

$$TotalSalTotalEmplFormSect_t(15+) = AvAnnSalTotalEmplFormSect_t(15+) * TotalEmplFormSect_t(15+)$$

Total annual salaries in the formal sector;

$ShSalContPensionSystem_t$, Share of salary of employees, formal sector, contributed to pension system (exogenous variable);

$$TotalContPensionSystem_t = ShSalContPensionSystem_t * TotalSalTotalEmplFormSect_t(15+)$$

Total contribution to pension system;

$GrowthRateTotalContPensionSystem_t = \frac{TotalContPensionSystem_t}{TotalContPensionSystem_{t-1}} - 1$, Growth rate of total contribution to pension system;

$PercentGDPTotalContPensionSystem_t = \frac{TotalContPensionSystem_t}{GDP_t}$, Percentage of the GDP of total contributions to pension system.

PENSION BENEFITS

$PercentAvAnnPension_t(65+)$, Percent average annual pension benefit relative to average salary, exogenous variable;

$AvAnnPension_t(65+) = PercentAvAnnPension_t(65+) * AvSalTotalEmplFormSect_t(15+)$,

Average annual pension benefit paid to economically inactive pensioned population over 65;

$TotalAnnPension_t(65+) = AvAnnPension_t(65+) * InactPensioned_t(65+)$, Total annual pension benefits paid to economically inactive pensioned population over 65;

$GrowthRateTotalAnnPension_t(65+) = \frac{TotalAnnPension_t(65+)_t}{TotalAnnPension_{t-1}(65+)} - 1$, Growth rate of total annual pension benefits paid to economically inactive pensioned population over 65;

$PercentGDPTotalAnnPension_t(65+) = \frac{TotalAnnPension_t(65+)}{GDP_t}$, Percentage of the GDP of total annual pension benefits paid to economicaly inactive pensioned population over 65.

GENERAL RESULTS

$BalancePensionSystem_t = TotalContPensionSystem_t(15+) - TotalAnnPension_t(65+)$,

Annual non-accumulative balance (deficit or surplus) in pension system, which may be reflected in the PAYG and/or the private system and which does not take into account pensions for population less than 65 years .

$PercentGDPBalancePensionSystem_t = \frac{BalancePensionSystem_t}{GDP_t}$ Percentage of the GDP of Balance Pension System.

Appendix 2. Three Mexican Scenarios: Numerical Results

POPULATION

	1995	1996	2000	2005	2010	2020	2030	2040	2050
Pop(t) (0-14) 3 Scenarios	32818111	32820066	32594275	31643254	30048147	26843181	24796960	22851641	20111620
Pop(t) (15-64) 3 Scenarios	54967599	56387974	61955071	68630100	74871601	84915376	89987999	90321297	87885024
Pop(t) (65+) 3 Scenarios	3820432	3973593	4649267	5626682	6764137	10007774	15544007	22772794	29754177
PopTotal(t) 3 Scenarios	91606142	93181633	99198613	105900036	111683885	121766331	130328966	135945733	137750821
ShPop(t) (0-14) 3 Scenarios	0.358	0.352	0.329	0.299	0.269	0.220	0.190	0.168	0.146
ShPop(t) (15-64) 3 Scenarios	0.600	0.605	0.625	0.648	0.670	0.697	0.690	0.664	0.638
ShPop(t) (65+) 3 Scenarios	0.042	0.043	0.047	0.053	0.061	0.082	0.119	0.168	0.216
ShPop(t) (0-14,65+) 3 Scenarios	0.400	0.395	0.375	0.352	0.330	0.303	0.310	0.336	0.362
YoungDepRatio(t) 3 Scenarios	0.597	0.582	0.526	0.461	0.401	0.316	0.276	0.253	0.229
OldDepRatio(t) 3 Scenarios	0.070	0.070	0.075	0.082	0.090	0.118	0.173	0.252	0.339
DepRatio(t) 3 Scenarios	0.667	0.653	0.601	0.543	0.492	0.434	0.448	0.505	0.567
GrowthRatePop(t) (0-14) 3 Scenarios	#VALUE!	0.000	-0.003	-0.008	-0.012	-0.009	-0.007	-0.010	-0.015
GrowthRatePop(t) (15-64) 3 Scenarios	#VALUE!	0.026	0.023	0.019	0.016	0.009	0.003	-0.001	-0.004
GrowthRatePop(t) (65+) 3 Scenarios	#VALUE!	0.040	0.040	0.038	0.037	0.043	0.045	0.033	0.023
GrowthRatePopTotal(t) 3 Scenarios	#VALUE!	0.017	0.015	0.012	0.010	0.008	0.006	0.003	0.000

LABOR FORCE, FORMAL AND INFORMAL EMPLOYMENT, UNEMPLOYMENT, AND RETIRED POPULATION

PartRateLaborForce(t) (15-64) 3 Scenarios	0.580	0.581	0.584	0.589	0.593	0.602	0.611	0.621	0.630
PartRateLaborForce(t) (65+) 3 Scenarios	0.300	0.298	0.289	0.279	0.269	0.250	0.232	0.215	0.200
PartRateTotalLaborForce(t) (15+) 3 Scenarios	0.562	0.562	0.564	0.565	0.566	0.565	0.555	0.539	0.521
LaborForce(t) (15-64) 3 Scenarios	31881207	32754233	36205090	40408449	44416000	51137350	55013089	56053297	55367565
LaborForce(t) (65+) 3 Scenarios	1146130	1183322	1344304	1568040	1816807	2496993	3602684	4903011	5950835
TotalLaborForce(t) (15+) 3 Scenarios	33027337	33937556	37549394	41976489	46232807	53634343	58615773	60956308	61318400
GrowthRateLaborForce(t) (15-64) 3 Scenarios	#VALUE!	0.027	0.024	0.021	0.018	0.011	0.005	0.000	-0.003
GrowthRateLaborForce(t) (65+) 3 Scenarios	#VALUE!	0.032	0.032	0.031	0.030	0.035	0.037	0.025	0.015
GrowthRateTotalLaborForce(t) (15+) 3 Scenarios	#VALUE!	0.028	0.024	0.021	0.018	0.012	0.007	0.002	-0.001

	1995	1996	2000	2005	2010	2020	2030	2040	2050
ShEmplFormSect(t) (15-64)									
Fast Scenario	0.480	0.496	0.560	0.640	0.720	0.800	0.800	0.800	0.800
Moderate Scenario	0.480	0.484	0.503	0.527	0.552	0.605	0.664	0.729	0.800
Slow Scenario	0.480	0.480	0.480	0.480	0.480	0.480	0.480	0.480	0.480
ShEmplFormSect(t) (65+)									
3 Scenarios	0.350	0.350	0.350	0.350	0.350	0.350	0.350	0.350	0.350
ShTotalEmplFormSect(t) (15+)									
Fast Scenario	0.475	0.491	0.552	0.629	0.705	0.779	0.772	0.764	0.756
Moderate Scenario	0.475	0.480	0.497	0.520	0.544	0.594	0.645	0.699	0.756
Slow Scenario	0.475	0.475	0.475	0.475	0.475	0.474	0.472	0.470	0.467
EmplFormSect(t) (15-64)									
Fast Scenario	15302980	16246100	20274850	25861407	31979520	40909880	44010471	44842637	44294052
Moderate Scenario	15302980	15868734	18204508	21283819	24506703	30961344	36549694	40865330	44294052
Slow Scenario	15302980	15722032	17378443	19396056	21319680	24545928	26406283	26905582	26576431
EmplFormSect(t) (65+)									
3 Scenarios	401145	414163	470506	548814	635882	873947	1260939	1716054	2082792
TotalEmplFormSect(t) (15+)									
Fast Scenario	15704125	16660263	20745357	26410221	32615403	41783828	45271411	46558691	46376844
Moderate Scenario	15704125	16282897	18675014	21832633	25142585	31835291	37810634	42581384	46376844
Slow Scenario	15704125	16136195	17848950	19944869	21955563	25419875	27667222	28621636	28659224
Growth RateEmplFormSect(t) (15-64)									
Fast Scenario	#VALUE!	0.062	0.054	0.047	0.041	0.011	0.005	0.000	-0.003
Moderate Scenario	#VALUE!	0.037	0.034	0.030	0.027	0.020	0.014	0.010	0.007
Slow Scenario	#VALUE!	0.027	0.024	0.021	0.018	0.011	0.005	0.000	-0.003
Growth RateEmplFormSect(t) (65+)									
3 Scenarios	#VALUE!	0.032	0.032	0.031	0.030	0.035	0.037	0.025	0.015
GrowthRateTotalEmplFormSect(t) (15+)									
Fast Scenario	#VALUE!	0.061	0.054	0.047	0.041	0.011	0.006	0.001	-0.002
Moderate Scenario	#VALUE!	0.037	0.034	0.030	0.027	0.021	0.015	0.010	0.007
Slow Scenario	#VALUE!	0.028	0.024	0.021	0.018	0.012	0.006	0.002	-0.001
UnemplRate(t) (15-64)									
3 Scenarios	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
UnemplRate(t) (65+)									
3 Scenarios	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
TotalUnemplRate(t) (15+)									
3 Scenarios	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Unemployment(t) (15-64)									
3 Scenarios	1115842	1146398	1267178	1414296	1554560	1789807	1925458	1961865	1937865
Unemployment(t) (65+)									
3 Scenarios	40115	41416	47051	54881	63588	87395	126094	171605	208279
TotalUnemployment(t) (15+)									
3 Scenarios	1155957	1187814	1314229	1469177	1618148	1877202	2051552	2133471	2146144
ShEmplInformSect(t) (15-64)									
Fast Scenario	0.485	0.469	0.405	0.325	0.245	0.165	0.165	0.165	0.165
Moderate Scenario	0.485	0.481	0.462	0.438	0.413	0.360	0.301	0.236	0.165
Slow Scenario	0.485	0.485	0.485	0.485	0.485	0.485	0.485	0.485	0.485
ShEmplInformSect(t) (65+)									
3 Scenarios	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615	0.615
ShTotalEmplInformSect(t) (15+)									
Fast Scenario	0.490	0.474	0.413	0.336	0.260	0.186	0.193	0.201	0.209
Moderate Scenario	0.490	0.485	0.468	0.445	0.421	0.371	0.320	0.266	0.209
Slow Scenario	0.490	0.490	0.490	0.490	0.490	0.491	0.493	0.495	0.498
EmplInformSect(t) (15-64)									
Fast Scenario	15462386	15361735	14663061	13132746	10881920	8437663	9077160	9248794	9135648
Moderate Scenario	15462386	15739101	16733404	17710334	18354737	18386199	16537937	13226101	9135648
Slow Scenario	15462386	15885803	17559469	19598098	21541760	24801615	26681348	27185849	26853269
EmplInformSect(t) (65+)									
3 Scenarios	704870	727743	826747	964344	1117336	1535650	2215651	3015352	3659764

	1995	1996	2000	2005	2010	2020	2030	2040	2050
TotalEmplInformSect(t) (15+)									
Fast Scenario	16167255	16089479	15489808	14097090	11999256	9973313	11292810	12264146	12795412
Moderate Scenario	16167255	16466844	17560151	18674679	19472073	19921850	18753588	16241453	12795412
Slow Scenario	16167255	16613546	18386215	20562442	22659096	26337265	28896999	30201201	30513033
GrowthRateEmplInformSect(t) (15-64)									
Fast Scenario	#VALUE!	-0.007	-0.015	-0.027	-0.045	0.011	0.005	0.000	-0.003
Moderate Scenario	#VALUE!	0.018	0.014	0.010	0.005	-0.005	-0.015	-0.027	-0.045
Slow Scenario	#VALUE!	0.027	0.024	0.021	0.018	0.011	0.005	0.000	-0.003
GrowthRateEmplInformSect(t) (65+)									
3 Scenarios	#VALUE!	0.032	0.032	0.031	0.030	0.035	0.037	0.025	0.015
GrowthRateTotalEmplInformSect(t) (15+)									
Fast Scenario	#VALUE!	-0.005	-0.012	-0.023	-0.038	0.015	0.011	0.006	0.002
Moderate Scenario	#VALUE!	0.019	0.015	0.011	0.007	-0.002	-0.009	-0.018	-0.029
Slow Scenario	#VALUE!	0.028	0.025	0.021	0.018	0.012	0.007	0.003	0.000
PropInactPensioned(t) (65+)									
Fast Scenario	0.190	0.194	0.209	0.230	0.253	0.327	0.427	0.482	0.489
Moderate Scenario	0.190	0.194	0.209	0.230	0.253	0.294	0.327	0.365	0.406
Slow Scenario	0.190	0.194	0.209	0.230	0.253	0.281	0.285	0.289	0.293
InactPensioned(t) (65+)									
Fast Scenario	725882	769543	971890	1294088	1711602	3275053	6639231	10971303	14551889
Moderate Scenario	725882	769543	971890	1294088	1711602	2940624	5087808	8303282	12085012
Slow Scenario	725882	769543	971890	1294088	1711602	2807188	4426154	6582782	8731133
GrowthRateInactPensioned(t) (65+)									
Fast Scenario	#VALUE!	0.060	0.060	0.058	0.057	0.075	0.070	0.034	0.025
Moderate Scenario	#VALUE!	0.060	0.060	0.058	0.057	0.054	0.056	0.044	0.034
Slow Scenario	#VALUE!	0.060	0.060	0.058	0.057	0.045	0.046	0.034	0.025
PropInactNotPensioned(t) (65+)									
Fast Scenario	0.510	0.509	0.502	0.491	0.478	0.423	0.341	0.303	0.311
Moderate Scenario	0.510	0.509	0.502	0.491	0.478	0.457	0.441	0.420	0.394
Slow Scenario	0.510	0.509	0.502	0.491	0.478	0.470	0.483	0.496	0.507
InactNotPensioned(t) (65+)									
Fast Scenario	1948420	2020728	2333073	2764554	3235728	4235729	5302092	6898480	9251453
Moderate Scenario	1948420	2020728	2333073	2764554	3235728	4570157	6853515	9566501	11718329
Slow Scenario	1948420	2020728	2333073	2764554	3235728	4703593	7515169	11287001	15072208
GDP AND PRODUCTIVITY									
GrowthRateGDP(t)									
3 Scenarios	#VALUE!	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
GDP(t)									
3 Scenarios	1837776.0	1885558.2	2089437.5	2375561.0	2700865.7	3491215.0	4512842.8	5833427.6	7540452.7
GDPperCapita(t)									
3 Scenarios	20062	20235	21063	22432	24183	28671	34627	42910	54740
GrowthRateProductivity(t)									
3 Scenarios	#VALUE!	-0.002	0.002	0.005	0.008	0.014	0.019	0.024	0.027
ANNUAL SALARIES EMPLOYEES, FORMAL SECTOR, AND PENSION CONTRIBUTIONS									
AvSalTotalEmplFormalSect(t) (15+)									
3 Scenarios	16000	15975	16000	16279	16814	18765	22227	27651	35537
TotalSalTotalEmplFormalSect(t) (15+)									
Fast Scenario	251266.0	266148.5	331929.6	429926.4	548408.2	784070.2	1006255.3	1287408.2	1648079.1
Moderate Scenario	251266.0	260120.1	298803.7	355408.8	422757.3	597386.7	840423.4	1177430.5	1648079.1
Slow Scenario	251266.0	257776.5	285586.5	324678.3	369169.5	477002.0	614964.0	791425.3	1018453.7
ShSalContPensionSystem(t)									
3 Scenarios	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
TotalContPensionSystem(t)									
Fast Scenario	16332.3	17299.7	21575.4	27945.2	35646.5	50964.6	65406.6	83681.5	107125.1
Moderate Scenario	16332.3	16907.8	19422.2	23101.6	27479.2	38830.1	54627.5	76533.0	107125.1
Slow Scenario	16332.3	16755.5	18563.1	21104.1	23996.0	31005.1	39972.7	51442.6	66199.5

	1995	1996	2000	2005	2010	2020	2030	2040	2050
GrowthRateTotalContPensionSystem(t)									
Fast Scenario	#VALUE!	0.059	0.055	0.052	0.049	0.026	0.025	0.025	0.025
Moderate Scenario	#VALUE!	0.035	0.035	0.035	0.035	0.035	0.034	0.034	0.034
Slow Scenario	#VALUE!	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
PropGDPTotalContPensionSystem(t)									
Fast Scenario	0.009	0.009	0.010	0.012	0.013	0.015	0.014	0.014	0.014
Moderate Scenario	0.009	0.009	0.009	0.010	0.010	0.011	0.012	0.013	0.014
Slow Scenario	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
PENSION BENEFITS									
PercentAvAnnPension(t) (65+)									
3 Scenarios	0.40	0.40	0.42	0.43	0.45	0.48	0.52	0.56	0.60
AvAnnPension(t) (65+)									
3 Scenarios	6400	6437	6640	7010	7512	9025	11508	15412	21322
TotalAnnPension(t) (65+)									
Fast Scenario	4645.6	4953.8	6453.7	9071.2	12857.9	29557.4	76404.7	169086.3	310275.5
Moderate Scenario	4645.6	4953.8	6453.7	9071.2	12857.9	26539.2	58550.8	127967.6	257676.7
Slow Scenario	4645.6	4953.8	6453.7	9071.2	12857.9	25334.9	50936.5	101451.8	186165.3
GrowthRateTotalAnnPension(t) (65+)									
Fast Scenario	#VALUE!	0.066	0.069	0.071	0.073	0.098	0.099	0.067	0.060
Moderate Scenario	#VALUE!	0.066	0.069	0.071	0.073	0.077	0.084	0.077	0.070
Slow Scenario	#VALUE!	0.066	0.069	0.071	0.073	0.067	0.074	0.067	0.060
PropGDPTotalAnnPension(t) (65+)									
Fast Scenario	0.003	0.003	0.003	0.004	0.005	0.008	0.017	0.029	0.041
Moderate Scenario	0.003	0.003	0.003	0.004	0.005	0.008	0.013	0.022	0.034
Slow Scenario	0.003	0.003	0.003	0.004	0.005	0.007	0.011	0.017	0.025
GENERAL RESULTS									
BalancePensionSystem(t)									
Fast Scenario	11686.6	12345.9	15121.7	18874.1	22788.7	21407.1	-10998.1	-85404.7	-203150.4
Moderate Scenario	11686.6	11954.0	12968.5	14030.4	14621.4	12290.9	-3923.3	-51434.6	-150551.6
Slow Scenario	11686.6	11801.7	12109.4	12032.9	11138.2	5670.2	-10963.8	-50009.1	-119965.8
PropGDPBalancePensionSystem(t)									
Fast Scenario	0.006	0.007	0.007	0.008	0.008	0.006	-0.002	-0.015	-0.027
Moderate Scenario	0.006	0.006	0.006	0.006	0.005	0.004	-0.001	-0.009	-0.020
Slow Scenario	0.006	0.006	0.006	0.005	0.004	0.002	-0.002	-0.009	-0.016