WORKING PAPER

DEMOGRAPHIC, SOCIAL AND ECONOMIC ASPECTS OF THE PENSION PROBLEM: EVIDENCE FROM TWELVE COUNTRIES

J.-P. Gonnot

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IIASA
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FOREWORD

This paper belongs to a series of papers originating from the project "Social Security, Family and Households in Aging Societies" and also appears as a publication of the Netherlands Interdisciplinary Demographic Institute (NIDI).

Using a standard approach, it compares the future impact of changes in the age and marital composition of the population on state pension systems in twelve industrialized countries.

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ABSTRACT

In all Western countries included in this study, and under any demographic scenario, the aging of the population will reach, in the first half of the next century, a level which implies a dramatic deterioration of the performance of the state pension systems. In Eastern European countries, a similar level can only be reached if both mortality and fertility fall to an extent unforeseen at present although it is not improbable. Parallel to aging, substantial changes in the marital composition of the elderly and strong improvements in benefit entitlements for women will be observed. Different solutions to the pension problem are tested and compared. These show that there exists much difference between countries in this respect and that the dramatization arising from pure demographic considerations is in most cases exaggerated.

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INTRODUCTION

This paper gives an overview of the results of the international comparative study carried out under IIASA's research project entitled "Social Security, Family and Households in Aging Societies." The study consists of simulations of national state pension systems under a common set of demographic scenarios up to the year 2050. It includes 12 countries: Austria, Canada, Czechoslovakia, Finland, the Federal Republic of Germany, France, the German Democratic Republic, Hungary, Italy, the Netherlands, Norway and Poland.

The methodology of this research is original in two respects. First, it makes use of dynamic projections of the population by marital status while previous works were only based on population projections by sex and age. This substantially improves the accuracy of pension modelling and allows for social and distributional aspects which have been largely ignored. Improvement in accuracy is evident for survivors pensions: current changes in nuptiality and mortality no longer permit to estimate proportions widowed by simply using fixed rates. Moreover, in Western countries, it also applies to contributions and old-age benefits because female participation in the labor force varies with marital status -- it is much higher among unmarried women than among married or cohabitating women, and among the latter it decreases with the number of children. Different birth and marital histories result in different benefit entitlements and the frequency of the marital histories is reflected in the marital composition of the elderly population. Modelling pensions therefore requires modelling family dynamics. This would preferably be done on the basis of de facto living arrangements which, at least in most Western countries, tend to substantially differ from the marital composition of the population. Unfortunately, very few countries can make the necessary information available. Also desirable would be to keep track of the children living with the mother, but the demographic model which is needed is too complex for use in the context of a comparative study. Consequently, family dynamics is reduced to marital status changes.

A second original feature of this work is that pension projections are country-based rather than scheme-based. In many countries, the state pension system does not consist of a unique scheme but encompasses several large schemes -- blue- and white-collar workers, civil servants, self-employed, farmers, etc. -- and possibly tens of small activity-based schemes. Each retiree may and usually does receive more than one pension from different schemes. As scheme-information systems are not linked at present, scheme-specific data only provide a partial view on pensions and cannot be aggregated to obtain statistics on retirees. Relevant information is thus extremely poor: in those countries with such a system, the total number of retirees, the average old-age benefits or the average number of years worked by the new retirees are not known. Obviously, scheme-based pension projections face the same limits. In addition, results of these projections are often difficult to interpret when both substantial socio-demographic changes and changes in the respective share of the different schemes occur -- a situation which will soon prevail in several countries. National projections were therefore preferred, assuming the entire population benefits in all countries from a unique scheme and using indirect estimates of work-histories based on cohort/life-cycle rearrangement of labor force participation rates.

The demographic setting and the results of demographic projections are presented in the first part of this paper with emphasis on aging and changes in the marital composition of the population. Part two deals with pensions. It includes a comparison of state pension systems as well as labor and retirement patterns, a description of the pension model, and a discussion of the results of pension projections. It also pays special attention to the inequalities among

women according to marital history. The third part is devoted to assessing the possible impact of pension reforms. What would be gained by increasing the age of retirement to 65? Would a rise in the participation of women in the labor force solve the pension problem? Would a complementary contributory pension scheme perform better than the existing public pay-as-you-go pension system? These are three questions to which detailed and quantitative answers are given. The conclusion stresses the relevance of this simulation exercise for social policy and proposes to consider the pension problem in a broader socioeconomic context.

1. AGING AND CHANGES IN LIVING ARRANGEMENTS

1.1. Demographic Setting

Table 1, which gives the current basic demographic characteristics of the 12 countries included in the study, shows a great deal of diversity. No country is in all respects similar to another. In Czechoslovakia and Poland fertility is still beyond the replacement level -- respectively 2.17 and 2.32 children per woman -- while the total fertility rate is about 1.50 in Austria, Italy and the Netherlands, and reaches 1.28 in the Federal Republic of Germany. With the exception of Austria, both low and high fertility countries have a low level of illegitimacy while most of the medium level fertility countries indicate a much higher proportion of births outside wedlock. Nuptiality is very high in Czechoslovakia, Hungary and Poland, where more than 90% of the women get married, but much lower in Finland, the Federal Republic of Germany and Norway, where less than 80% were ever married. Divorce is nonexistent in Italy, low in Poland (17% of marriages), concerns between 20 and 25% of marriages in most countries, and 30% in Canada and the German Democratic Republic. The relatively high level of mortality, and the substantial difference between sexes, which is indicated in Czechoslovakia, Hungary and Poland -- life expectancy below 67 for men and 74.5 for women -- contrasts with the low level in Canada, the Netherlands, Norway or Italy where the mean life expectancy is higher by 4/5 years. This is also true for women in Finland and France but not for males, as both countries show the biggest sex-differentials in mortality, respectively 9.5 and 8.8 years.

1.2. Four Demographic Scenarios

Intensity, timing and sometimes direction of future demographic trends are uncertain. In most low fertility countries, fertility has remained relatively stable in the recent past. Nobody really believes in a new baby boom, but some expect or desire fertility to return to replacement level. On the other hand, one can also anticipate a further drop but no one is able to suggest a limit, if any. This is even more acute for mortality, which is decreasing rapidly at older ages in all Western countries and will play a major role in the future of aging. It is also hard to imagine how mortality will change in countries such as Hungary and Poland. Worsening is not unlikely in the short term, but no one can believe than no improvement will occur in the long term. And finally, will the fall in marriage and the rise in divorce continue, and how will this affect fertility?

Country-specific answers to these questions are proposed in the different country case studies prepared under this project. However, the aim of this comparative study is different. It is not to produce realistic forecasts but rather to investigate the range of possible demographic changes and to study their impact in terms of aging and changes in the marital composition of the elderly. For this purpose, four demographic scenarios were selected after different trials. They are designed to allow international comparison and to bring a better understanding of the demographic processes.

Table 1. Demographic settings around 1980/85.[a)]

	Population 1985 (1000s)	Total Fertility Rate	Births Unmarried Women[b)]	Life Expectancy at Birth Males	Females	Difference	Proportion Ever-Married[c)]	Marriages Ending in Divorce[c)]
Austria	7,556	1.48	20.5	69.1	76.8	7.7	80.8	24.5
Canada	25,310	1.77	14.8	73.1	79.8	6.7	85.0	30.7
Czechoslovakia	15,245	2.17	6.2	66.6	74.4	7.8	94.9	25.7
Finland	4,903	1.69	13.8	69.2	78.7	9.5	78.2	26.1
France	55,173	1.88	14.4	70.1	79.0	8.9	82.8	22.0
FRG	61,024	1.28	8.4	70.5	77.6	7.1	77.6	25.2
GDR	16,650	1.84	29.1	68.3	74.9	6.6	88.5	31.8
Hungary	10,646	1.84	7.9	64.7	73.0	8.3	92.8	29.7
Italy	57,139	1.56	4.6	71.3	78.3	7.0	87.8	0.8
Netherlands	14,491	1.53	5.9	72.2	79.7	7.5	81.6	25.5
Norway	4,153	1.66	17.8	71.7	79.3	7.2	77.5	25.9
Poland	37,176	2.32	4.6	66.0	74.4	8.4	93.6	16.9

a) for exact dates, see Appendix 1
b) per 100 total births
c) marital-status life-table statistics

1) A benchmark scenario with rates remaining constant at their 1980-84 level which shows how much change is already embodied in the age and marital-status structure of the population, and serves as a basis for comparison.

2) A fertility scenario which assumes that fertility will return to replacement level. Thus, for 10 countries, it is a high fertility scenario while it corresponds to constant and decreasing fertility in Czechoslovakia and Poland, respectively.

3) A mortality scenario under which age-specific mortality rates are decreased by 30% for women and 45% for men. In terms of life expectancy, it is roughly equivalent to an increase of 8-10 years for males and 4-5 years for females, so that the sex differentials are approximately reduced by one-half.

4) A western low scenario which combines the most extreme demographic rates observed at present in Western Europe: West German fertility (1.28 child per woman), Swedish marriage and divorce (one-third never married, mean age at first marriage of 28 for women and 30 for men, one-third of all marriages ending in divorce), Swiss mortality (life expectation 74 for men and 81 for women).

All changes gradually take place over a transition period of twenty years, 1985-2005.[1]/ Mortality and fertility are assumed to be independent of marital status, an assumption which is aimed at neutralizing the impact of changes in the marital composition on overall mortality and fertility in order to control these two variables.[2]/

1.3. Aging

Aging is certain. But how much aging?

The scenarios' impact on aging is summarized in Table 2, which shows countries according to changes in old-age dependency ratio (OADR) over the period 1985-2030 for each of the scenarios as well as the OADR in 2030.[3]/ Four main conclusions arise from this table. First, aging is certain for both countries and scenarios, the only exception being Czechoslovakia under the benchmark and fertility scenarios. However, sharp differences between countries and a marked dispersion can be noted. The Federal Republic of Germany, the Netherlands and Canada are top-ranking countries and will see their OADR doubling and possibly tripling, reaching a level situated between 35 and 60 in 2030, while at the other end of the spectrum, Eastern European countries will experience a more limited aging. Second, an increase in fertility will be of little help to prevent aging -- minus 2/4 points for all countries and -7 for the FRG -- unless fertility jumps far beyond the replacement level. Third, further mortality improvements would lead to dramatic levels of aging, especially for Western countries: about one-third in the OADR under the mortality scenario as compared with the benchmark scenario, but it is impossible to tell if this is an upper limit. Fourth, aging in Eastern European countries could be as strong as in Western European countries, if fertility drops to the actual West German level and mortality reaches the present Swiss level simultaneously.

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[1]/ There exists no rationale for choosing a transition period of twenty years except it looks believable. However, calculations made using different transition periods show that conclusions are very robust and therefore depend very little on this assumption.

[2]/ Interactions between changes in marital status, fertility and mortality are addressed in the country case study.

[3]/ Number of persons 65 and over per 100 persons between 15 and 59 years.

Table 2. Changes in old-age dependency ratio, 1985-2030.

Changes 1985-2030	Scenario (Country and OADR in 2030)							
	Benchmark		Fertility		Mortality		Western	
30+					FRG	59.1	FRG	51.7
					Netherlands	51.3		
					Canada	47.3		
25-30					Finland	46.0	Canada	43.4
					Italy	45.0	Netherlands	43.7
					Austria	46.1	Finland	43.4
20-25	FRG	45.8			France	40.2	Italy	41.2
	Netherlands	43.7			Norway	44.8	GDR	41.0
	Canada	37.6					Austria	44.7
							Hungary	39.4
15-20	Finland	35.1	Canada	35.2	GDR	37.2	Poland	34.6
	Italy	34.7	Netherlands	36.3			France	39.1
			FRG	39.0			Norway	39.9
10-15	Austria	35.6	Finland	32.5	Poland	28.2	Czechoslovakia	33.5
	France	31.6	Italy	31.4	Hungary	32.9		
	Norway	35.0	France	30.4				
5-10	GDR	28.3	Austria	32.0	Czechoslovakia	27.5		
	Poland	21.2	GDR	27.1				
	Hungary	23.8	Norway	32.3				
			Poland	22.1				
			Hungary	22.7				
0-5	Czechoslovakia	20.7	Czechoslovakia	20.9				

Not only aging but the timing of aging is certain. Figure 1 displays changes in the OADR under the benchmark scenario for each of the four fifteen-year periods between 1985 and 2045. Typically, maximum aging will occur between 2015 and 2030. Beyond this date, seven countries will not age any further or even will slightly rejuvenate, while the other five will experience a very limited additional aging. This pattern is also observed under the high fertility and low mortality scenarios. On the contrary, a fertility drop, as assumed in the western scenario, implies that aging will continue in all countries beyond 2030.

1.4. Major Potential Changes in Living Arrangements

Typically, the current marital composition of the elderly population is characterized by a strong contrast between the high proportion of males married -- between 73 and 82% in our sample -- and the much lower proportion of females married -- between 34 and 49% -- and by the low percentage of single and divorced for both sexes -- between 1.7 and 12.4% single, the proportion being slightly higher for women than for men -- and between 2 and 7% divorced, Italy excluded (see Table 3).

The figures in Table 3 indicate that this pattern will change substantially. A main future demographic trend is definitely the strong increase in the proportion of single and divorced old men (see also Figure 2). While today they together represent no more than 10% except in the Scandinavian countries, they will be more than 20% in 2030 in Austria, Canada, France, the German Democratic Republic and Hungary, and around or more than 30% in Finland, the Netherlands and Norway under constant conditions. Czechoslovakia, Italy and Poland show lower values but will still experience a marked rise. If the western scenario would materialize, the proportion in all countries of single and divorced males would be between 25 and 40% in 2030 and about 45% in 2050. Similar values are reached for women although they correspond to a lesser increase. Under the benchmark scenario the increase is however more limited in Eastern European countries and Italy because the proportion of singles either remains constant or decreases. Figure 3 shows that the increase in the proportion of single and divorced (both sexes) occurs, except in Italy, over the period 1985-2030 with a maximum during the period of fastest aging -- 2015/2030 -- in nine countries.

As very limited changes in the proportion of widowed among males aged 60 and over are expected -- between 10 and 15% under both scenarios -- the increase in the proportion of single and divorced will result in a sharp drop in the proportion of married. On the contrary, much uncertainty remains concerning changes in the proportion of women widowed, which at present ranges from about 40 to 50%, and in the proportion of married. Under constant conditions, little change is observed for widows except in the elderly population of the three German-speaking countries -- Austria, the Federal Republic of Germany and the German Democratic Republic -- and of Finland which shows at present an exceptional sex imbalance -- masculinity ratio lower than 60 (see Figure 4). Similarly, the proportion of women married falls by 7 to 11 percentage points in Canada, Finland, France, Hungary, the Netherlands, Norway and Poland.

On the other hand, both the mortality and western scenarios result in a substantial decrease in the proportion of widowed. With the sex-gap in mortality progressively reduced to one-half of its 1985 level, the masculinity ratio would increase to values over 80 in 2030 and the proportion of widows falls under 40% in all countries except Hungary and Poland. Quite similar changes would occur in eight countries if the Swedish pattern of nuptiality was adopted: Austria, Czechoslovakia, Finland, France, the Federal Republic of Germany, the German Democratic Republic, Hungary and Poland. However, while under the mortality scenario a noticeable increase in the percentage of women married was indicated in some countries -- Austria, Czechoslovakia, the Federal Republic of Germany, the German Democratic Republic and Italy -- the western scenario leads to a decrease -- sometimes substantial as in Canada, the Federal Republic of Germany, the Netherlands or Norway -- in most of the countries.

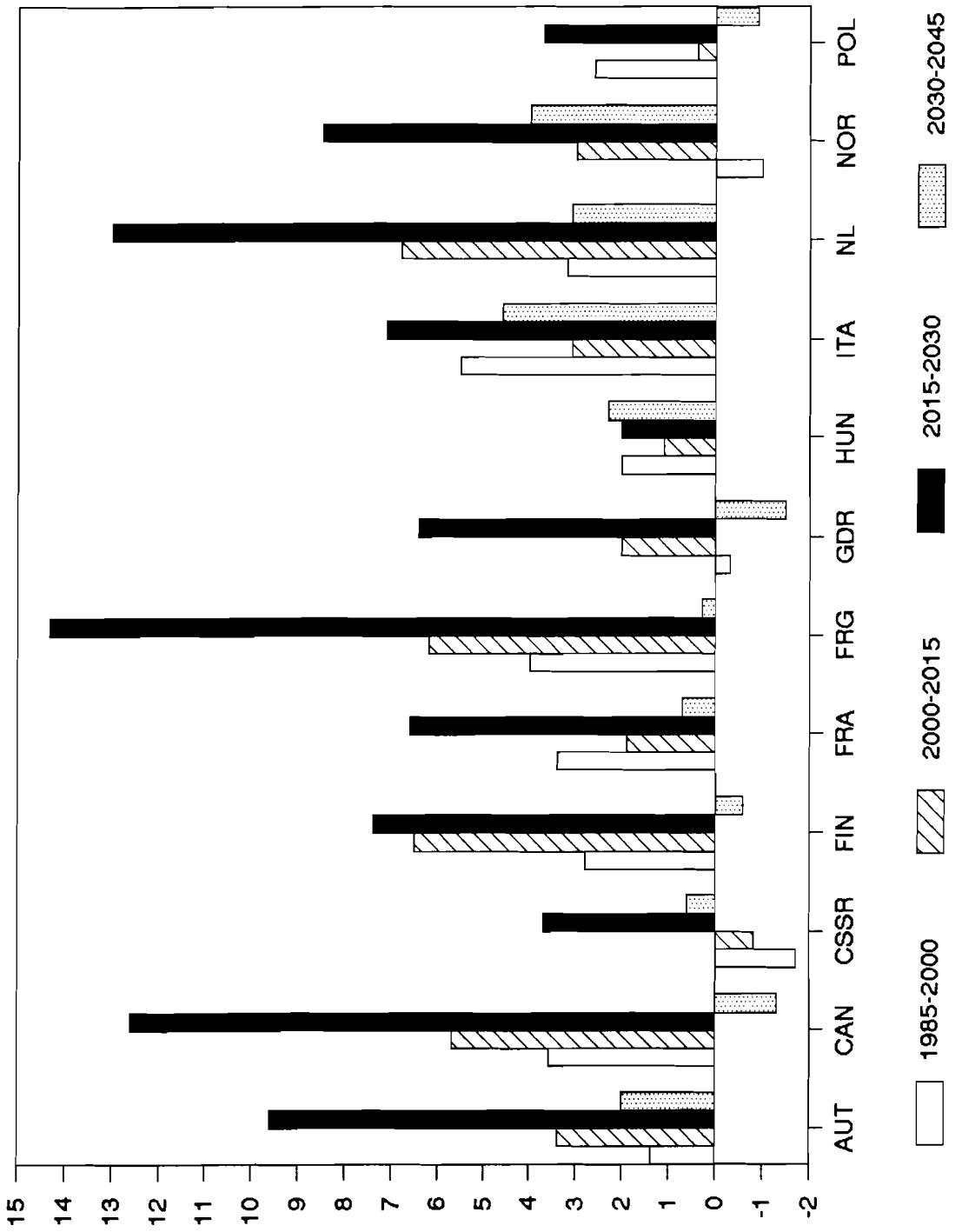

Figure 1. Changes in the old-age dependency ratio. Benchmark scenario, 1985-2045.

Table 3. Marital composition of the population aged 60 and over, 1985 and 2030 (percentage, total equals 100 for each sex).

		Males				Females				Masculinity Ratio[a]
		Single	Married	Divorced	Widowed	Single	Married	Divorced	Widowed	
Austria	1985	5.8	77.4	3.4	13.4	11.0	34.7	5.1	49.2	56.9
	benchmark	16.1	65.1	7.1	11.6	13.8	35.7	11.0	39.5	74.4
	mortality	15.1	65.1	7.1	12.7	13.2	43.9	11.0	31.8	88.1
	western	18.1	54.5	12.2	15.2	13.6	37.1	16.4	33.0	77.3
Canada	1985	7.5	79.2	2.7	10.5	7.9	49.0	2.8	40.3	77.1
	benchmark	12.1	65.4	9.0	13.5	9.0	39.7	12.1	39.3	76.2
	mortality	11.3	65.1	9.6	14.0	8.7	47.1	12.9	31.3	88.6
	western	15.9	56.4	13.8	13.9	10.5	35.4	16.1	37.9	74.5
Czechoslovakia	1985	4.2	76.7	3.1	16.0	6.0	37.3	3.8	52.9	69.1
	benchmark	7.8	69.0	7.3	16.0	3.9	34.8	10.3	51.1	70.8
	mortality	7.5	68.5	7.2	16.9	3.8	45.1	10.4	40.7	86.7
	western	9.4	59.0	17.1	14.5	4.4	36.7	18.2	40.7	77.3
Finland	1985	8.4	73.9	4.4	13.4	13.9	35.9	5.9	44.3	59.5
	benchmark	24.0	51.7	11.6	12.7	16.5	28.6	14.6	40.3	69.0
	mortality	22.4	51.4	11.8	14.3	15.8	36.4	14.8	33.0	84.4
	western	23.5	48.7	14.1	13.8	16.1	30.8	17.5	35.5	77.1
France	1985	7.9	76.2	2.8	13.1	8.6	42.3	3.6	45.5	68.9
	benchmark	16.1	63.4	7.4	13.1	11.8	35.7	10.3	42.3	71.5
	mortality	15.1	62.9	7.3	14.7	11.3	44.1	10.2	34.4	85.3
	western	17.2	56.8	12.7	13.3	12.5	35.4	14.8	37.3	76.8
FRG	1985	3.9	79.4	2.3	14.5	9.2	37.0	4.0	49.9	55.9
	benchmark	23.7	56.7	7.2	12.3	14.5	35.9	9.2	40.4	78.4
	mortality	21.7	56.5	7.1	14.7	13.7	43.4	9.2	33.7	92.1
	western	25.1	50.4	12.6	11.9	23.6	24.5	16.0	35.9	78.6
GDR	1985	1.7	78.7	2.3	17.3	7.2	34.1	6.7	52.0	51.2
	benchmark	11.0	68.7	6.9	13.5	7.1	35.8	12.5	44.6	78.2
	mortality	10.1	67.4	6.8	15.6	6.9	45.1	12.5	35.4	92.3
	western	12.8	60.5	13.9	12.8	7.2	35.5	18.9	38.4	78.5
Hungary	1985	3.7	77.3	3.4	15.7	5.7	37.1	5.2	52.1	68.2
	benchmark	10.6	64.2	9.0	16.2	4.4	28.0	13.8	53.8	67.6
	mortality	9.9	63.5	8.9	17.7	4.3	37.9	13.9	43.9	84.9
	western	11.6	56.1	16.5	15.8	4.8	32.2	19.3	43.7	76.1
Italy	1985	6.8	79.4	0.3	13.5	12.4	41.9	0.3	45.4	72.2
	benchmark	11.3	72.8	0.9	15.0	8.3	42.0	1.6	48.0	75.4
	mortality	10.7	71.3	0.9	17.1	8.3	51.2	1.6	38.9	88.7
	western	15.2	61.1	10.0	13.7	10.0	38.1	9.6	42.2	76.5
Netherlands	1985	6.0	78.2	3.3	12.5	9.6	46.2	3.9	40.4	73.9
	benchmark	18.7	60.8	9.3	11.2	12.4	37.7	13.0	36.8	76.1
	mortality	17.3	61.1	9.3	12.3	11.8	45.3	13.0	29.9	88.4
	western	19.6	55.3	12.2	12.9	12.9	36.3	16.0	34.9	78.3
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	mortality	20.1	53.9	11.8	14.2	13.5	41.8	14.1	30.6	91.1
	western	23.2	50.9	13.7	12.1	15.0	34.1	16.0	34.9	79.7
Poland	1985	2.7	82.0	2.1	13.2	6.9	39.8	2.7	50.6	64.7
	benchmark	9.1	71.2	3.8	15.9	4.9	32.8	7.9	54.5	68.2
	mortality	8.7	70.8	3.7	16.8	4.8	43.7	8.2	43.3	85.0
	western	11.3	58.3	14.0	16.4	5.8	35.5	16.1	42.6	77.6

a) number of men per 100 women.

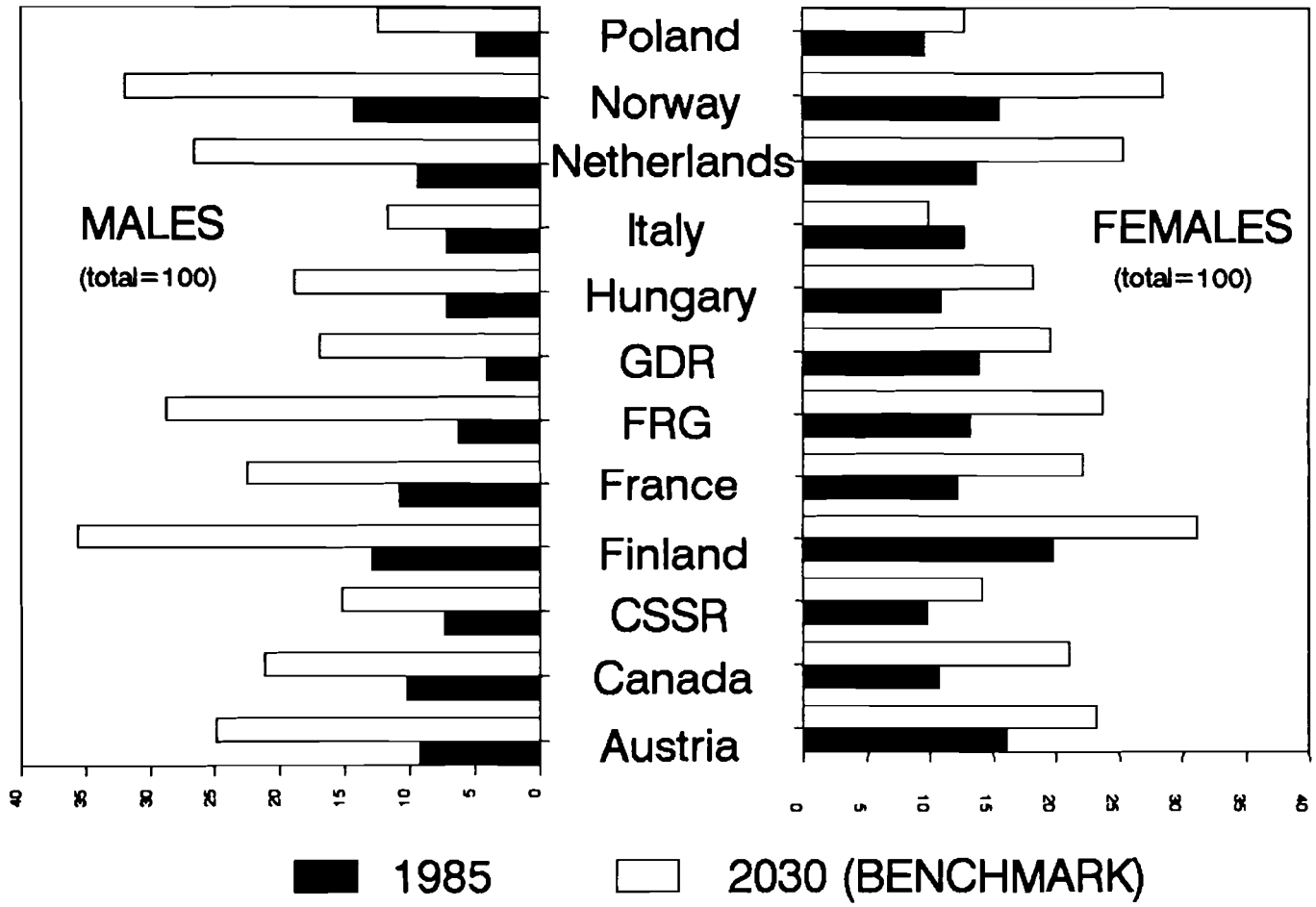

Figure 2. Percentage single and divorced, 1985 and 2030. Population 60 and over.

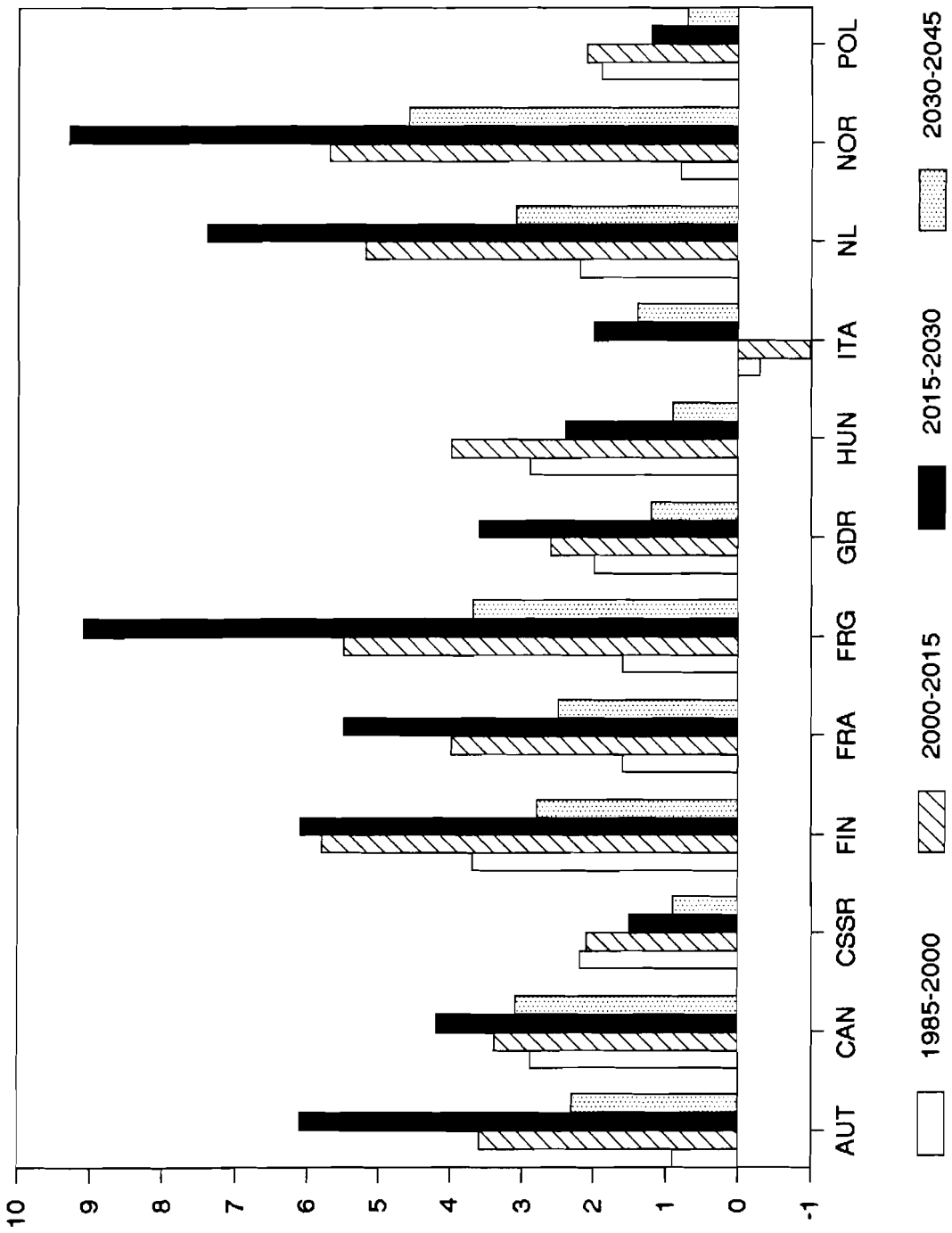

Figure 3. Changes in the proportion single and divorced. Benchmark scenario 1985-2045.

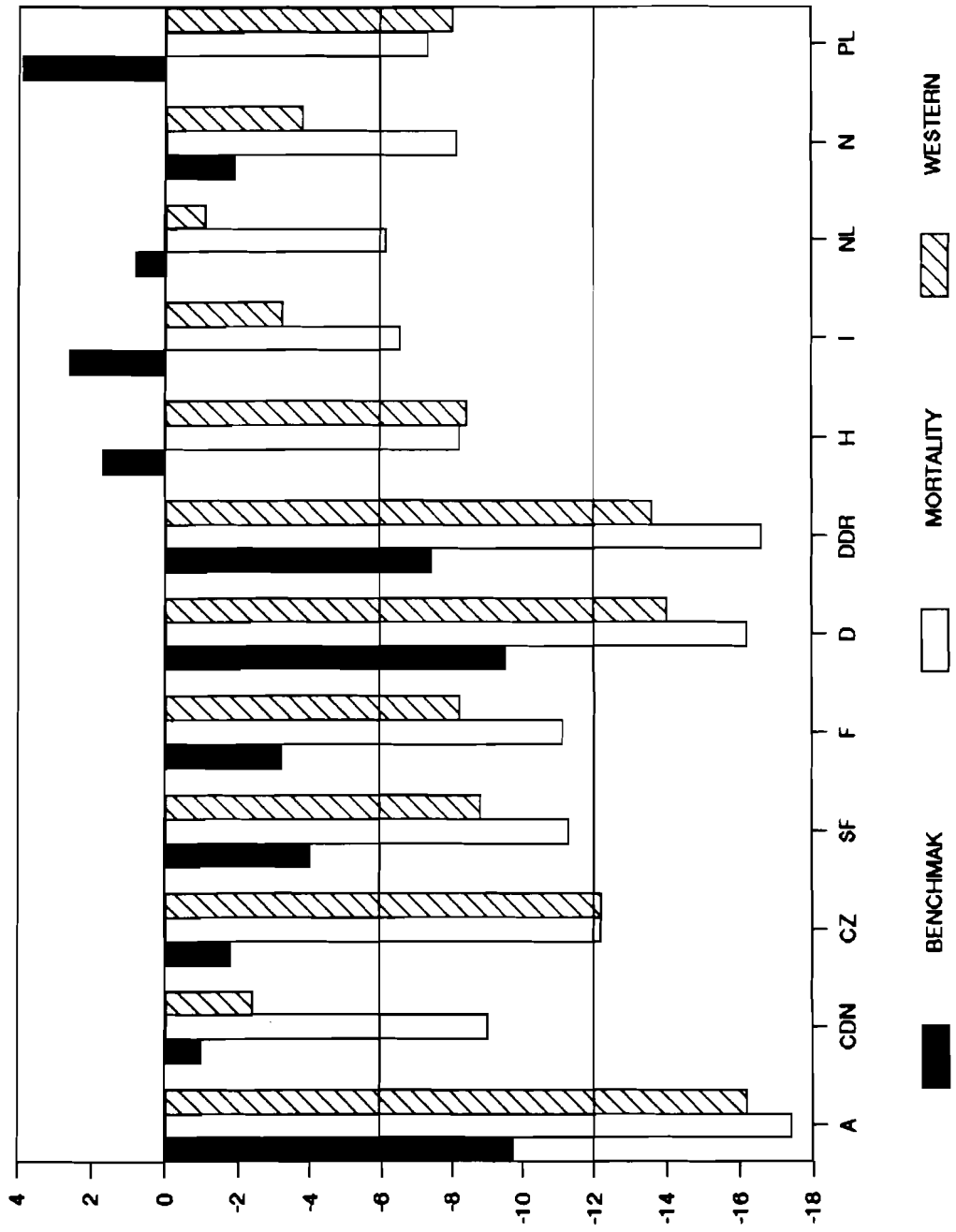

Figure 4. Changes in the proportion widowed, 1985-2030. Women 60 and over.

As both the mortality and western scenarios are not exclusive, the potential for a dramatic fall in the proportion of women widowed is rather important although its likelihood is unknown. On the contrary, much uncertainty and discrepancy among countries exist with regard to both the size and the direction of changes in the proportion of women married.

2. SOCIO-DEMOGRAPHIC CHANGES AND THE FUTURE OF STATE PENSION SYSTEMS

2.1. State Pension Systems

Table 4 presents a simplified synopsis of the different state pension systems. These comprise old-age, disability and survivors pensions but exclude types of pensions which are not taken into account in the calculations: early retirement other than disability, low income and survivors pensions conditional on age, economic or health status.[4]/ Four countries have universal flat-rate old-age pensions: Canada, Finland, the Netherlands and Norway. All countries have earnings-related old-age pensions with the noticeable exception of the Netherlands, and allow early retirement under disability pension schemes. Provisions for survivors pensions for widows exist in 10 countries and represent a fixed share of the earnings-related old-age pension of the deceased husband. Consequently, in countries with universal pensions this concerns only the earnings-related part, and no survivors pension is paid in the Netherlands. In Czechoslovakia, Hungary and Poland survivors pensions cannot be added but if chosen, they can replace old-age pensions. Only the German Democratic Republic has no general plan for widows due to the high female participation in the labor force. Five countries have recently taken general provisions to pay survivors pensions to widowers.

Table 4. Simplified national pension schemes.

	Old-Age		Disability	Survivors	
	Universal	Employment-Related		Males	Females
Austria		*	*		*
Canada	*	*	*	*	*
Czechoslovakia		*	*		*
Finland	*	*	*		*
France		*	*	*	*
GDR		*	*		
FRG		*	*	*	*
Hungary		*	*		*
Italy		*	*		*
Netherlands	*		*		
Norway	*	*	*	*	*
Poland		*	*	*	*

[4]/ For a more detailed presentation of the national pension schemes see the country reports and J-P Gonnot and C. Prinz (1989) Pension systems and social security. Trends and national characteristics. *WP-89-107*. Laxenburg, Austria: International Institute for Applied Systems Analysis.

Figure 5 shows how the national systems differ in terms of old-age benefits granted according to the number of years worked. Countries can be classified into four groups. First and foremost are the countries with pure earnings-related systems: Austria, Czechoslovakia, France, the Federal Republic of Germany, the German Democratic Republic, Hungary, Italy and Poland. Among these countries, benefits are the highest in Italy -- 80% of the salary for 40 years worked -- and the lowest in France and Poland -- 53% and 55% respectively of the salary for 40 years worked. Second, countries with pure or quasi-pure universal pension systems: Canada and the Netherlands. Benefits represent about 40% of the average earnings for single retirees in the Netherlands and Canada -- in Canada, only 25% for those who have never worked. Third, countries with two-tier systems: Finland and Norway. In Finland, minimum benefits amount to about 35% and 50% of the average salary respectively for single men and women, and reaches 65% and 80% for 40 years worked. For low and medium numbers of years worked, benefits are much higher in countries with universal pensions, especially with mixed systems. However, an exception is Poland where the benefits first increase with duration and remain constant after 20 years worked. Similar ceilings are indicated in Finland, Italy and Czechoslovakia, but only at high duration.

Generally, full disability pensions are similar to old-age pensions while survivors pension benefits represent between 50 to 60% -- 80% in Poland -- of the earnings-related pension of the deceased spouse (see Table 5).

Table 5. Survivors benefits (per cent of earnings-related pension of deceased spouse).

Austria	60
Canada	60
Czechoslovakia	60
Finland	50
France	52
FRG	60
Hungary	50
Italy	60
Norway	55
Poland	80

2.2. A Projection Model for Pensions

Projecting pension expenditures under a universal pension scheme is straightforward as per capita benefits vary only with marital status. Under an earnings-related or a two-tier system calculations of benefits are more complex. Earnings-related benefits received by an individual can be expressed as:

yearly benefits rate * number of years insured * salary

a formula which also holds at the aggregate level:

benefits = yearly benefit rate * average number of years insured * average past gross salary * population retired

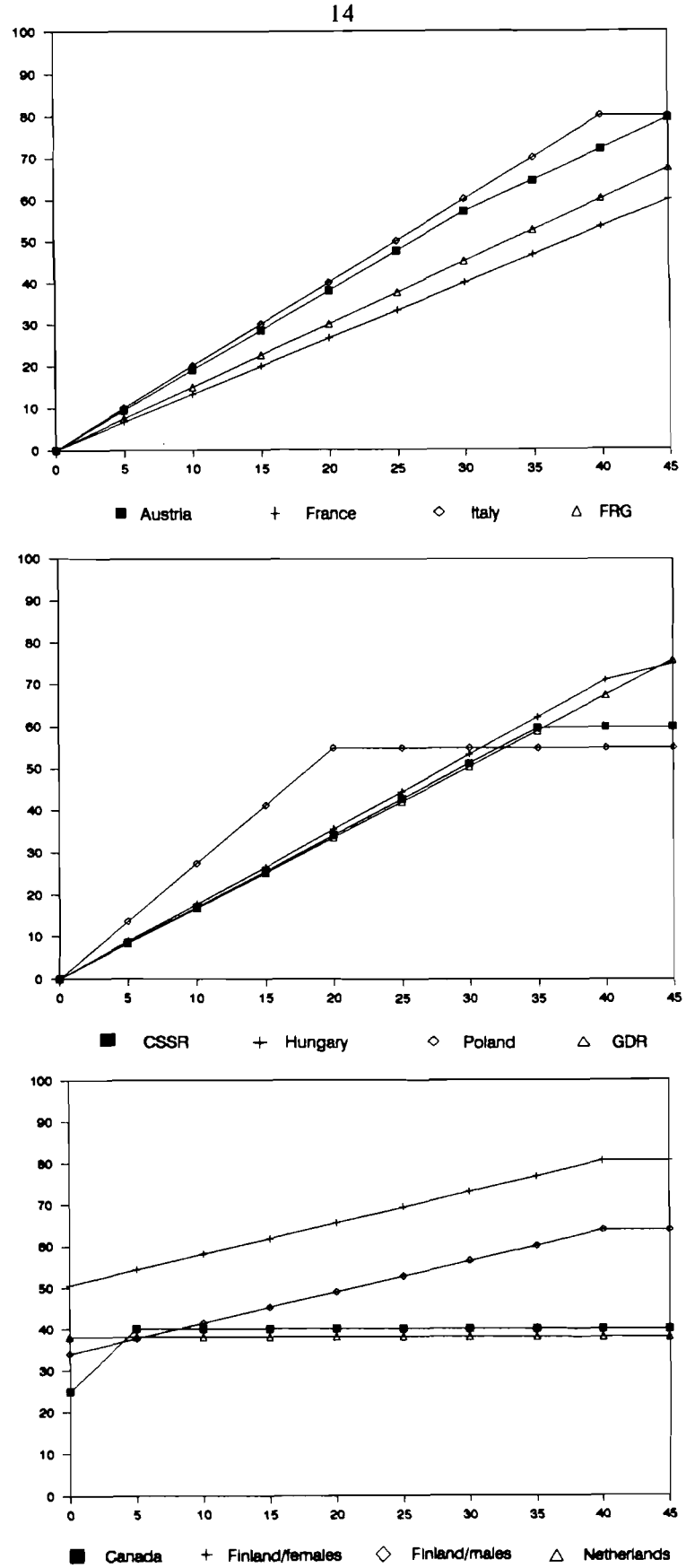

Figure 5. Benefits as a percentage of salary, according to the number of years worked.

As mentioned in the Introduction, earnings, work-history as well as the probability of claiming for a pension are variables which are sex and marital-status dependent. Past salaries are usually reevaluated according to the increase in average salaries between the different years of activity and the retirement date. This suggests the following approximation for benefits at the aggregate level:

benefits = yearly benefit rate * average number of years insured * average gross salary * population retired

where only knowledge of the current average salary is needed to calculate the overall benefits served.

This is equivalent to the assumption of a flat age-pattern of wages. A number of tests made with fairly pronounced age-patterns of wages indicate that this assumption does not introduce any serious bias in the estimate of the average benefits when the average salary is calculated over the whole working-life because of the offset between low salaries at a young age and high salaries at an old age. Moreover, in several countries, there exists a maximum salary which applies to contribution and/or benefits and also tends to average income.

The average number of years insured for married, divorced and widowed women are backward statistics which depend on age at marriage, divorce and widowhood. Exact estimates of these statistics could be obtained using a duration-dependent joint labor-marital status multistate life-table. However, building duration-dependent multistate life-tables for all the scenarios and countries in this project would require more time and data than available. Average number of years worked were therefore estimated from a cohort/life-cycle rearrangement of period sex, age and marital status-specific activity-rates.

The rationale for a cohort rearrangement of period activity rates is that an activity rate of 80% at age 40 in 1970 is equivalent to an average of 0.8 years worked for the members of the cohort 1930. A main simplifying assumption of the model is that within a cohort, all retirees have the same number of years worked corresponding to the mean age at retirement even if they retire before this age. In addition, for women -- for men, no difference in activity by marital status is assumed despite the fact that in some countries there exists marked discrepancies -- it is also assumed that all women who get married do so at the mean age at marriage, all those who get divorced do so at the mean age at divorce, and all widows who become widowed before the mean age at retirement do so at the same mean at widowhood. Women who become widowed after retirement age are considered married with respect to work history. As the classical marital status projection model does not distinguish between these two types of widows, it was decided to distribute them according to the proportion observed in the stationary population associated with the marital status life-table (observed widowhood versus no widowhood beyond retirement age).

As already mentioned, the number of retirees by sex and age is not available from social security sources. The age-pattern of retirement was estimated from the age-pattern of the new retirees because estimates based on labor surveys or micro-census seem to be always biased at older ages. Average survivors pension benefits were simply assumed to be equal to the product of the average old-age pension of the other sex by the proportion paid to the survivor.

Benefits calculated along this line are per capita pension benefits. To calculate per beneficiary benefits as well as the number of retirees, one needs the proportion of retired among the population by marital status. For old-age pensions, this proportion is approximated by the maximum cohort age and marital status-specific activity rate. The idea is that a maximum activity rate of 80% implies that on average 20% of the members of this cohort have never worked and do not qualify for old-age pension. For survivors pension,

the proportion observed, when available, is kept constant over time. In a few Western countries, the distribution of retired widowed according to the type of benefits they get -- old-age + survivors, or survivors -- is also available which permits calculation of the total number of retirees.

Contributions are easily calculated as the product of the labor force by the payroll tax rate and the average gross salary, once labor force is estimated using sex, age and marital status-specific activity rates.

This pension model has been developed to account for the impact of changes in the sex, age and marital composition of the population on earnings-related pension schemes, and thus is designed to be used in connection with projections of population by marital status. It is aimed at picturing the behavior of the key demographic and socioeconomic variables involved in the dynamics of changes. However, due to simplifying assumptions and difficulties to give a rational basis to the behavior of some variables, estimates of both benefits and retirees can differ from observed data in some countries. The main sources of discrepancy are the following.

First, only one pension scheme, the national scheme for salaried workers, is assumed for the whole population while there might exist several schemes with different contribution and benefit rates. This also implies that the whole population is considered as salaried while it is certain that non-salaried workers are quite different from salaried with respect to pensions.

Second, the observed salary basis used for calculating benefits can depart from the average salary when a truncation is applied either at the bottom or at the top of the salary distribution or when benefits are only partly indexed for wage increase. In addition, practice seems not to follow exactly law.

Third, the average number of years worked used in the calculation is an approximation in many respects. It stands for the average number of years insured which is definitely less. Use of activity rates also leads to overestimated activity, especially for women, at ages at which part-time work is frequent. On the other hand, prior to the 1960s women working on family farms were not considered active by census while the corresponding years of activity are usually taken into consideration for calculating benefit entitlements. Finally, because the average number of years worked is calculated at the mean age at retirement, it is not possible to account for the dispersion observed in a given year.

Fourth, the proportion of retired is calculated from the 1985 age-pattern of retirement which can originate some differences at older ages if this pattern has recently changed. And it is not accounted for that age at retirement depends on the sex, marital status and work history of the new retirees. In addition, estimating the proportion claim by taking the maximum activity rate within a cohort gives some rationale to this unpredictable variable, but is only a crude approximation as part of the inactives remain permanently inactive all of their life.

2.3. Retirement, Work, Sex and Marital History

Table 6 gives an estimate of the mean age at retirement in 1985 as well as the pensionable ages for men and women. On average, men claim for old-age pension at age 60.5 and women around age 59, but with marked differences between countries. Czechoslovakia, Hungary, the Netherlands and Poland indicate the lowest ages -- around 59 for men and between 56 and 57.5 for women -- while both sexes retire after age 63 in Canada. Male seniority also differs greatly, ranging from 0 in France to 4.5 years in Italy, and the reverse in Canada, Finland and the Federal Republic of Germany where women retire at an older

age than men. Figures in this table largely illustrate the importance of early retirement practices, especially for males, and the gap between legal provisions and reality.

Table 6. Pensionable age and mean age at retirement in 1985.[a)]

	Pensionable Age		Mean Age at Retirement	
	Males	Females	Males	Females
Austria	65	60	59.8	58.9
Canada[b)]	65	65	63.1	63.4
Czechoslovakia[b)]	60	55	59.3	56.4
Finland	65	65	62.7	63.4
France[b)]	60	60	61.6	61.6
FRG	65	65	60.5	61.6
Hungary	60	55	59.6	56.0
Italy[b,c)]	60	55	60.6	56.1
Netherlands[b)]	65	65	59.2	57.5
Poland	65	60	59.2	57.0

[a)] old-age and disability pensions (claimants for disability pensions aged 50 and over)
[b)] estimate
[c)] 1988

Although men and women retire at quite similar ages they have very different working histories (see Table 7). In 1985, the average number of years worked can be estimated at 40/42 years for men -- about 46 in the GDR, assuming a mean age at retirement of 65 years. For women, it varies from 13 years in Italy to 30 years in Finland and the GDR. However, working behavior has recently changed tremendously (see Figure 6). In most if not all countries, and for both sexes, activity at older ages has decreased following early retirement spreading or lowering of the legal age at retirement. Male activity has slightly decreased while female participation in the labor force has markedly increased, thus reducing the gap between men and women. A close pattern of activity for men and women is now observed in Czechoslovakia, Finland and the German Democratic Republic. On the other hand, in Italy and the Netherlands, female activity is still low. The changes in working behavior will result in tremendous changes in the average working-life: even under ceteris paribus conditions it will be raised by 6.5 years on average in 2030 -- +14 years in Canada and +11 years in Hungary -- namely an increase of one-third in benefit entitlements, while it will decrease by about 3 years on average for men, a fall of 5/7%.

Among women, sharp discrepancies also result from different marital histories. In the five countries included in Table 8, the average number of years worked by married women represents between one-half -- in the Federal Republic of Germany where single women economic participation is close to that of men -- and three-fourths of the work-record of single women (see also Figure 7). In the future, these gaps between single and married women will be reduced, substantially in Canada, France and the FRG, slightly in Austria and Italy. Another future consequence of these differentials is that the increasing proportion of single and divorced, and the eventually decreasing proportion of married in the elderly population will lead to a higher average number of years worked by women: under the western scenario it brings an additional one or two years. Marital discrepancies are also marked with respect to the proportion of women who, partly because they do not qualify,

Table 7. Average number of years worked at mean age at retirement[a] (constant labor force participation rates).

	1985		Changes 1985/2030	
	Males	Females	Males	Females
Austria	40.3	22.6	-3.5	5.0
Canada	42.2	17.1	-2.5	14.1
Czechoslovakia	41.7	25.1	-2.3	8.8
Finland	42.1	29.1	-4.3	6.4
France	41.9	21.8	-3.1	5.0
FRG	42.0	24.2	-3.1	3.2
GDR	46.2	30.8	-1.0	4.6
Hungary	40.3	18.3	-1.8	11.1
Italy	40.2	15.2	-2.6	4.3
Netherlands	40.6	13.0	-4.7	7.3
Poland	40.4	27.5	-3.5	1.3

[a] indirect estimate

Table 8. Average number of years worked at mean age at retirement. Women by marital status, 1985 and 2030[a].

	1985				2030 (constant activity rates)			
	Single	Married	Divorced	Widowed	Single	Married	Divorced	Widowed
Austria	29.5	20.7	26.5	22.4	34.5	25.1	31.4	26.9
Canada	25.3	15.5	22.9	17.7	34.9	29.8	33.5	31.3
France	32.8	19.1	28.9	23.0	33.3	23.3	31.7	27.3
FRG	39.3	21.2	33.4	23.5	36.3	23.7	32.9	25.9
Italy	21.0	13.5	15.7	15.7	26.3	17.7	20.5	20.5

[a] indirect estimate

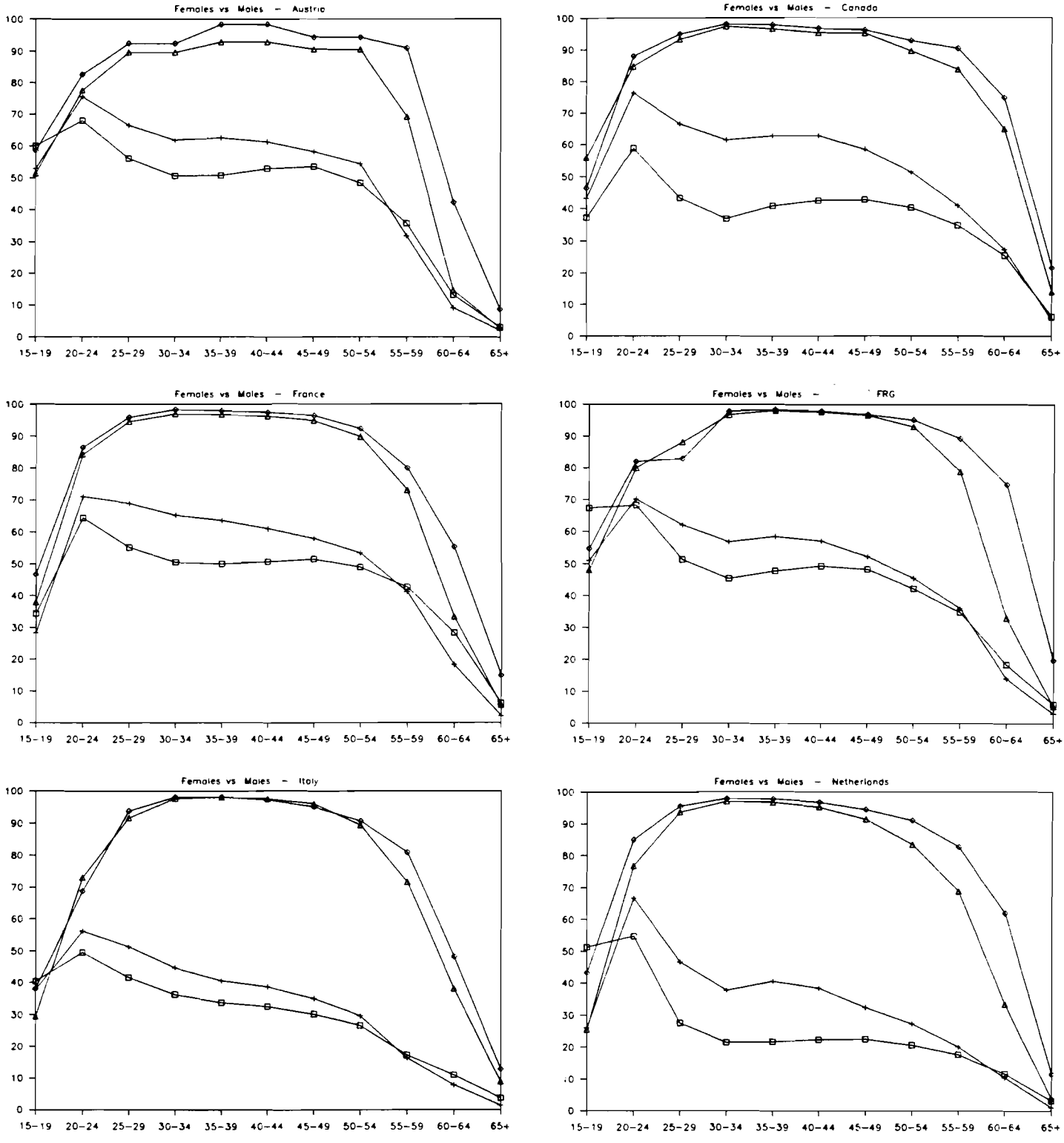

Figure 6. Labor force participation rates, females versus males.

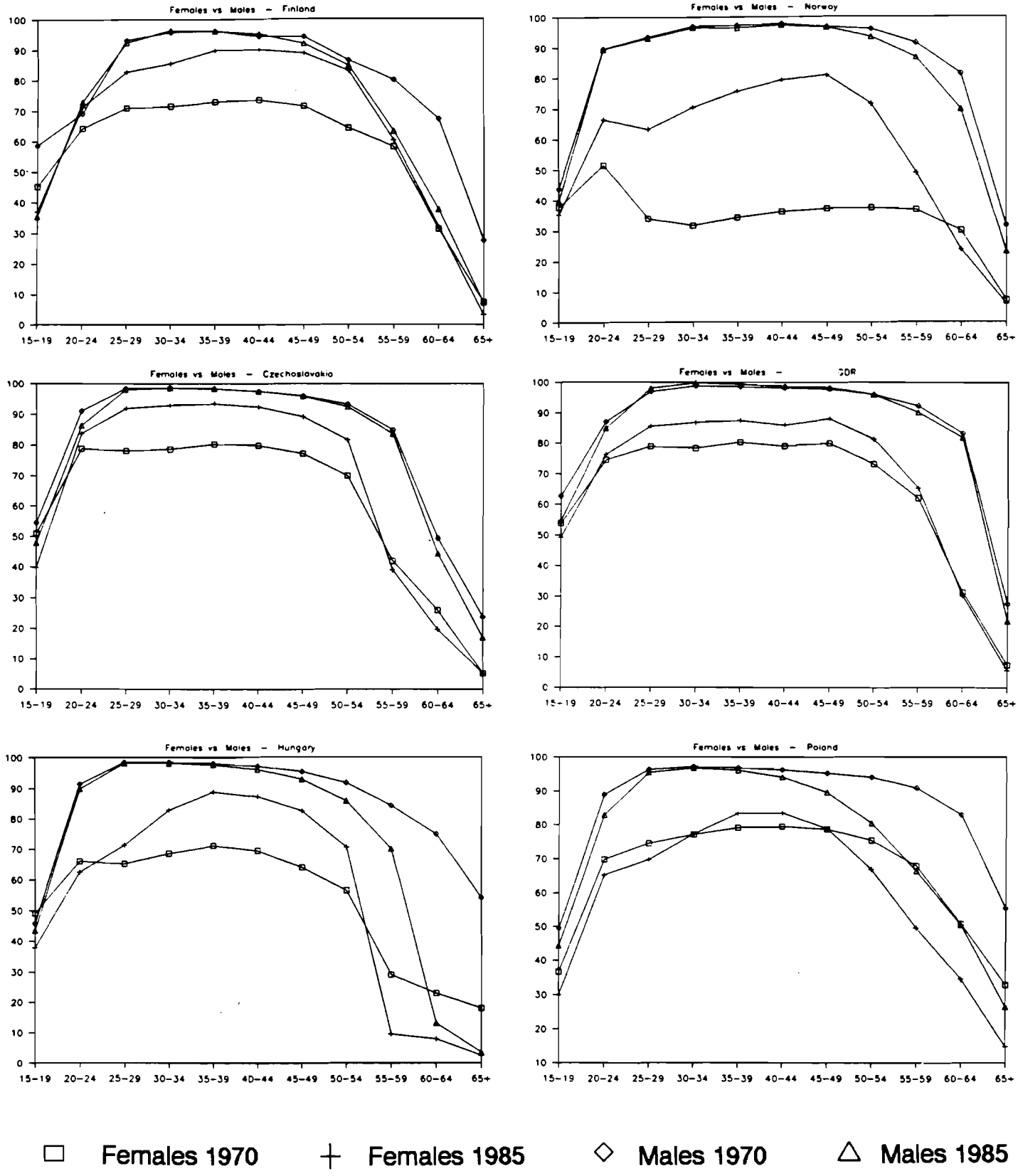

Figure 6. Continued.

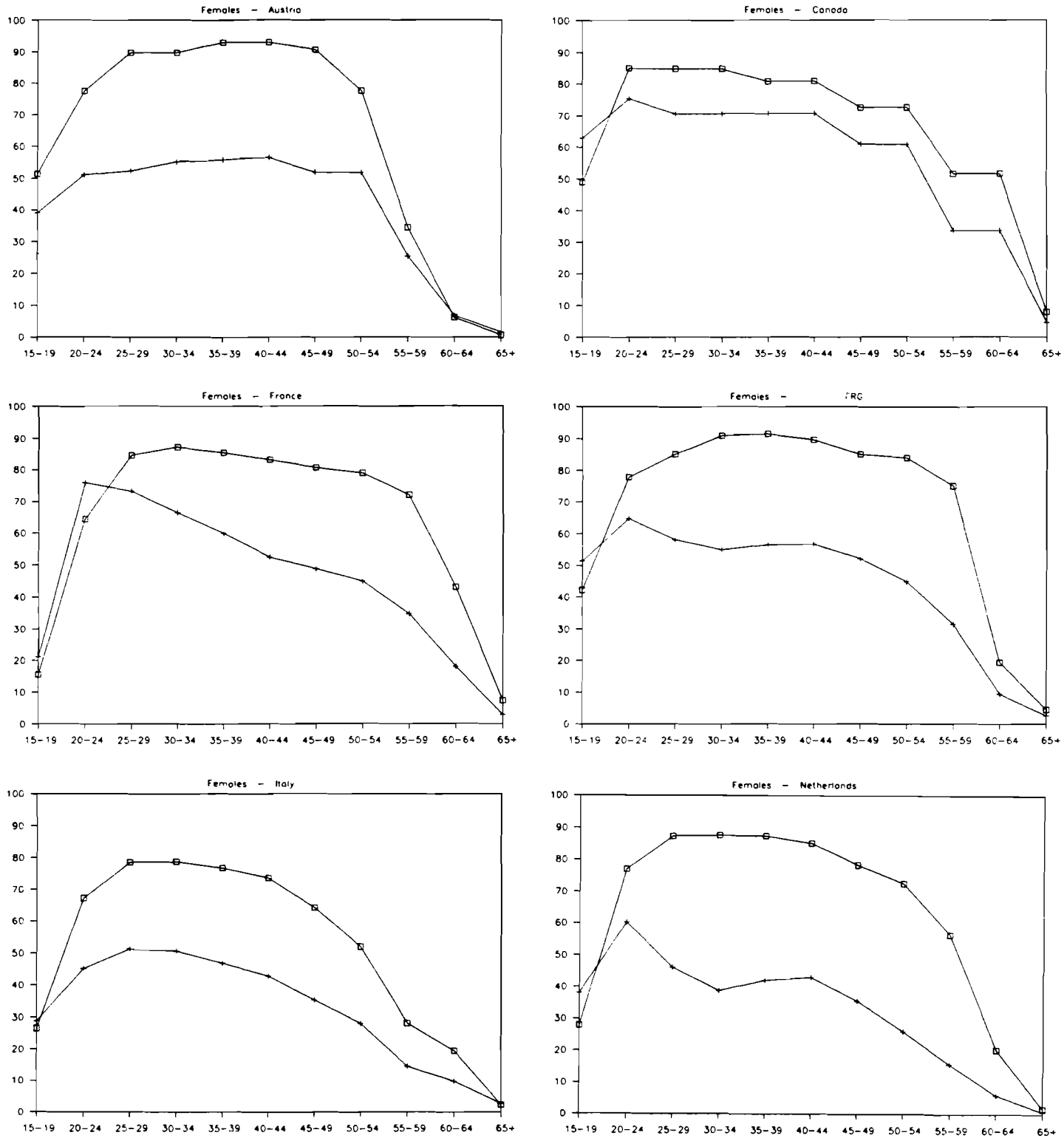

Figure 7. Labor force participation rates, 1985, females unmarried versus married.

partly for other complex reasons, do not claim for old-age pension. Among married women it represents, for instance, about one-third in France and one-half in Hungary. However, this phenomenon will progressively disappear with the improvement in working-life and entitlements, and will add to the increase in the number of retirees due to demographic changes.

2.4. The Retirees Boom

Figure 8 displays the rise in the number of old-age retirees over the period 1985-2030 under three scenarios. Under constant conditions, the number of retirees will increase by 40 to 80% except in Hungary -- only +25% -- and in Canada where it more than doubles. Further improvements in survivorship, as assumed in the mortality scenario, would bring about an additional increase of 40 to 50%, Finland being much above with 60%. Slightly higher figures are even obtained for Czechoslovakia, Hungary and Poland under the western scenario. Important to note is that the three German-speaking countries and Hungary will experience a much lower rise in the absolute number of retirees than the other countries of our sample.

As indicated by Figure 9, under the benchmark scenario, the number of retirees will increase until 2030 and then either stagnate, as in Czechoslovakia and Poland, or decrease. In Hungary, the decrease will already start after 2015. Under the mortality scenario, the pattern of change is similar except that the number of retirees would continue to slowly increase or remain constant beyond 2030 in Czechoslovakia, France, Italy and Poland.

2.5. Rise and Fall in the Labor Force

As opposed to the common upward trend in the number of retirees, changes in the labor force show much variety in both direction and size among the different countries (see Figure 10). Under constant conditions, the size of the labor force in 2030 would increase by about 20% in Czechoslovakia and Poland compared with 1985, remain approximatively constant in Canada and France, decrease by 10 to 15% in Finland, GDR, Hungary, Italy and the Netherlands, and drop by almost 40% in the Federal Republic of Germany. If fertility progressively returns to the replacement level by 2005, it only makes a difference of +5 to 10% on the size of the labor force. As compared with the benchmark scenario, the western scenario implies an additional decrease in the labor force of 5/8 percentage points in Canada, Finland, France, the German Democratic Republic, Hungary and Poland, and of 14% in Czechoslovakia which results from the drop in fertility to the West German level. This contrasts with low fertility countries such as Italy and the Netherlands where no additional changes are observed, or with Austria and the Federal Republic of Germany where changes in the marital composition of the labor force even allow a small differential rise.

The time pattern of change in labor force size is illustrated by Figure 11. Under the benchmark scenario, the two high fertility countries, Czechoslovakia and Poland, would experience an increase in the labor force over the period 1985-2030 while a continuous decrease would be observed in the Federal Republic of Germany. All other countries indicate a rise for the period 1985-2000 and afterwards a steady decrease. Under the fertility scenario, the time pattern of change is similar -- except for Canada where the increase continues during the period 2000/2015 -- but with attenuated downward trends.

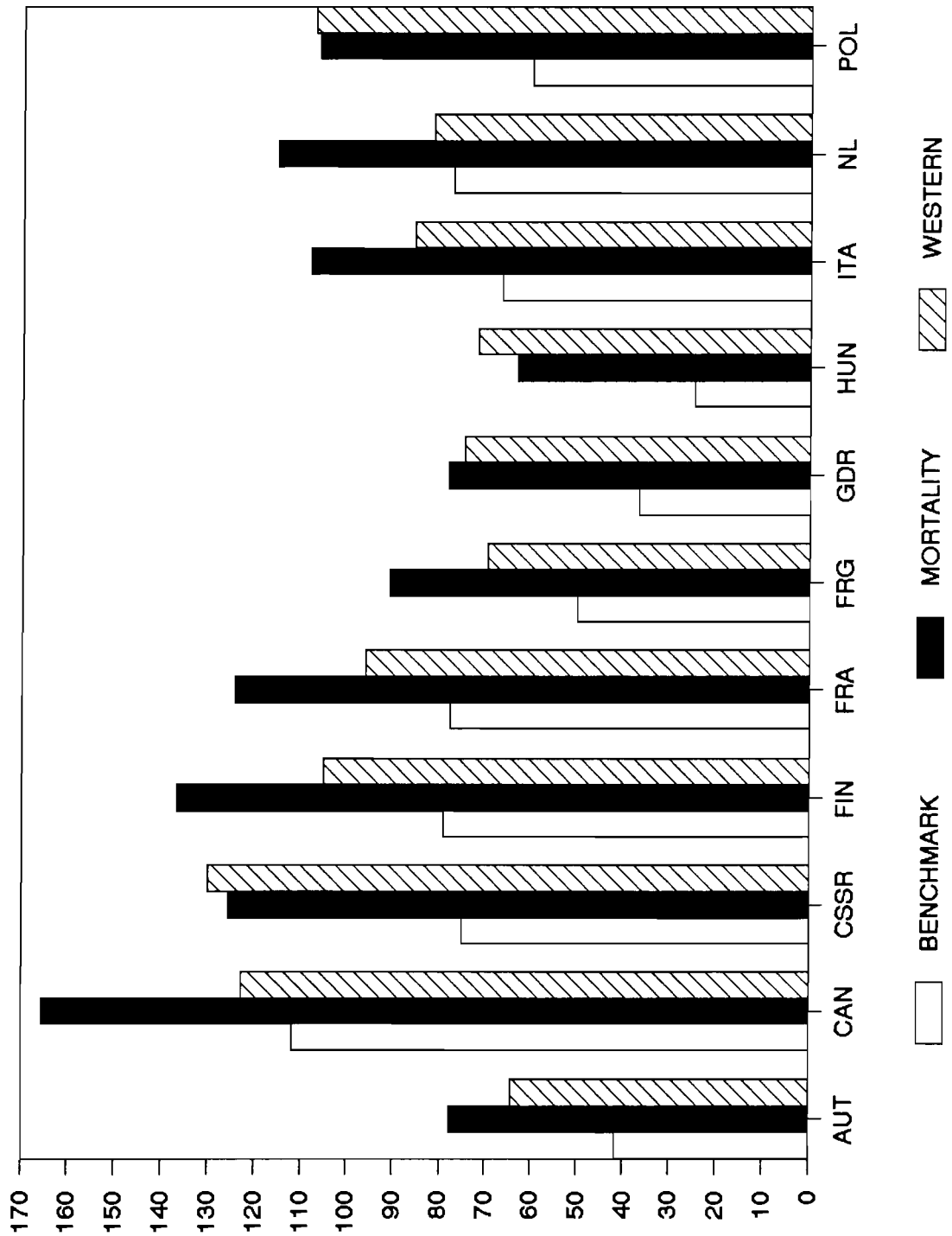

Figure 8. Increase in the number of old-age retirees, 1985-2030 (percentage).

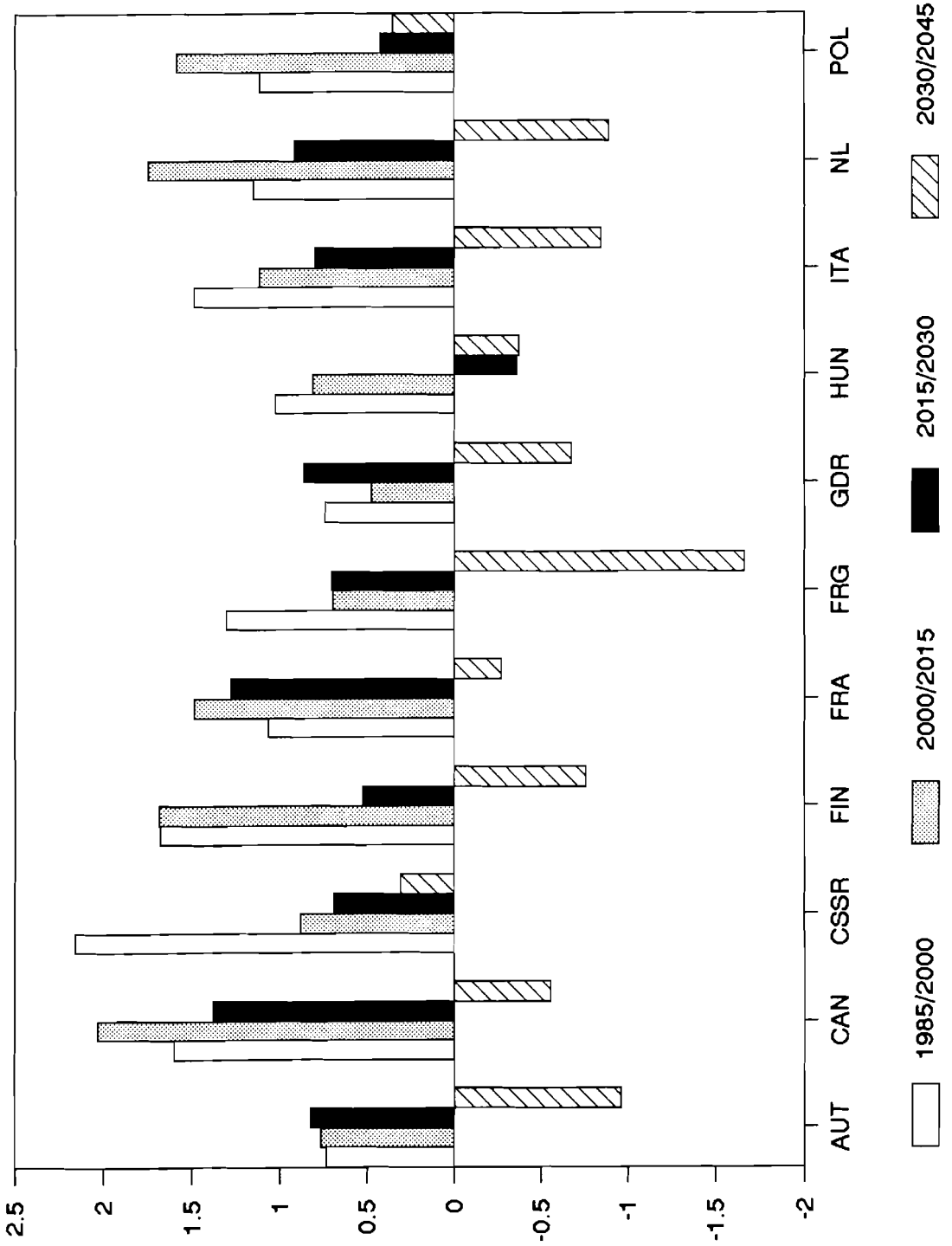

Figure 9. Trends in the number of retirees, 1985-2045. Benchmark scenario/average annual growth rate (in %).

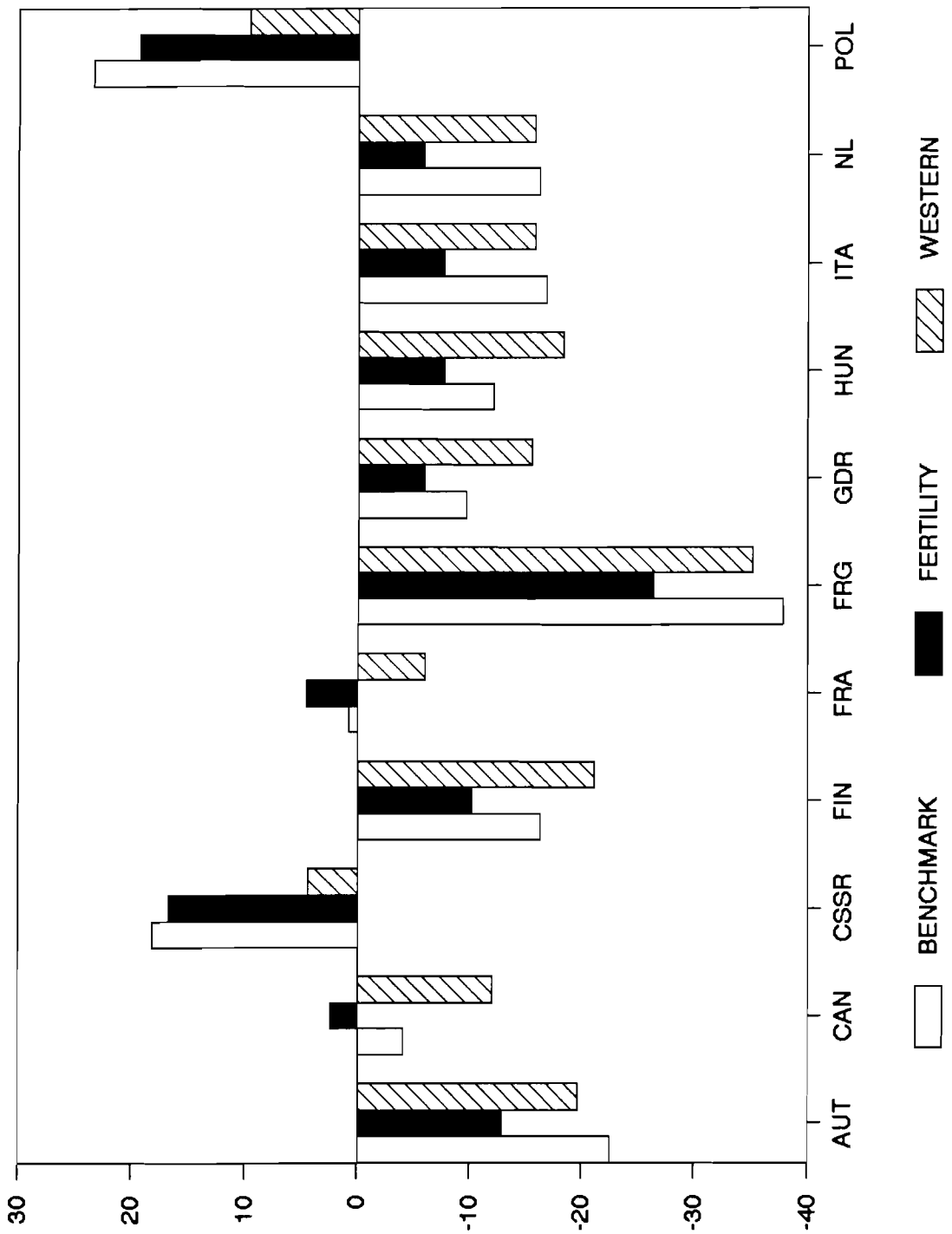

Figure 10. Increase in the total labor force, 1985-2030 (percentage).

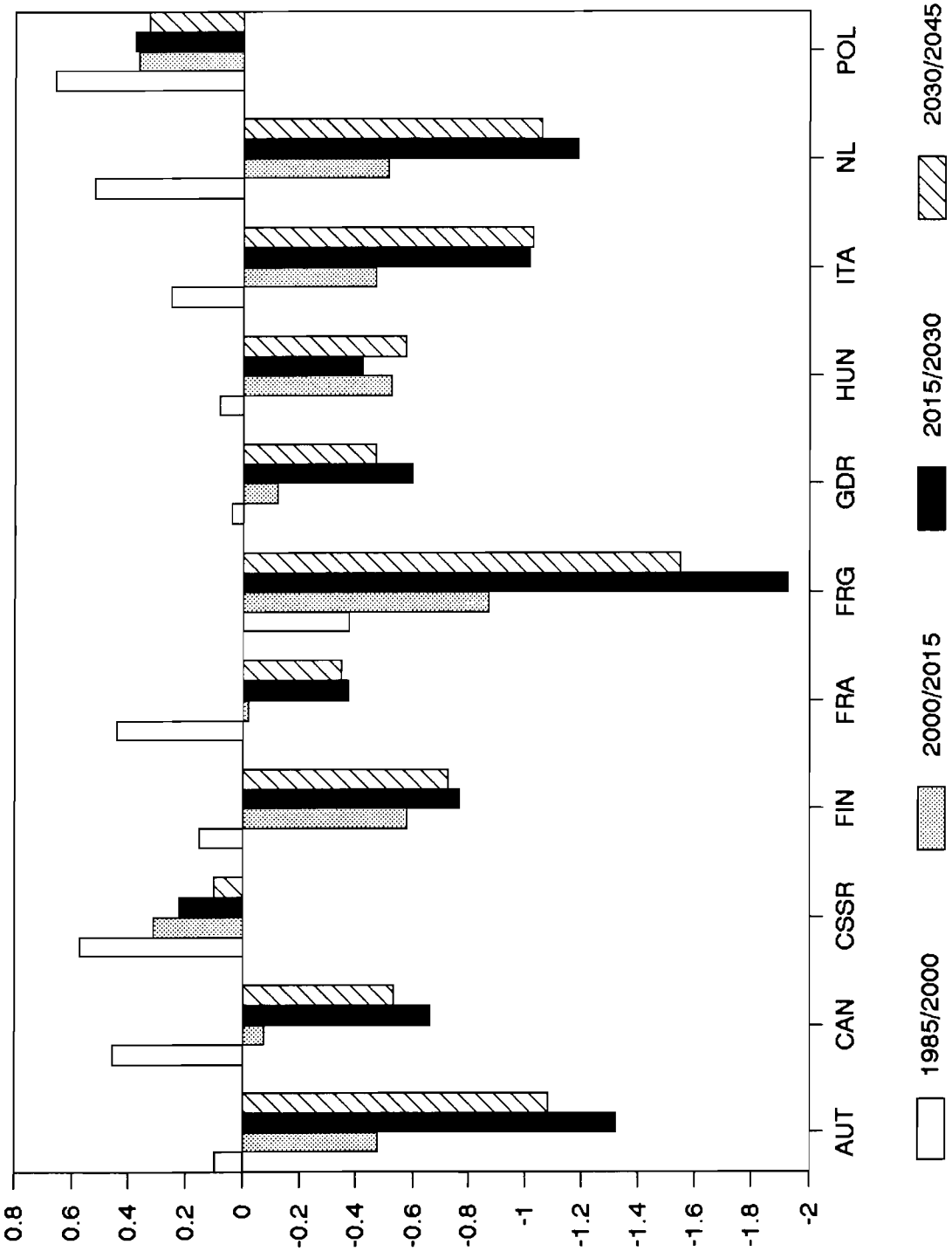

Figure 11. Trends in the total labor force, 1985-2045. Benchmark scenario/average annual growth rate (in %).

2.6. Underfunded Pensions: How much will be paid in 2030?

Table 9 and Figure 12 show the relative cuts in benefits at different time points within the period 1985-2050 which would be necessary under the benchmark scenario in order to keep the balance between receipts and expenses constant at its 1985 level without changing contribution rates. This disregards whether the pension fund is fully, partially or over-funded in 1985. Calculations are based on changes in the ratio contributions/benefits and assume that benefits are fully indexed for wage increases.[5]/ As for Eastern European countries, contributions are not specific to pensions nor do they exist; a virtual payroll tax rate was used but plays no role in comparisons over time.

Table 9. Percentage changes in average benefits 1985-2050, benchmark scenario, constant contribution rates.

	2000	2015	2030	2050
Austria	-3	-18	-39	-41
Canada	-18	-38	-56	-56
Czechoslovakia	-4	-13	-21	-23
Finland	-11	-34	-45	-44
France	-8	-23	-37	-38
FRG	-18	-31	-50	-49
GDR	-36	-52	-62	-60
Hungary	-8	-26	-28	-31
Italy	-11	-23	-42	-44
Netherlands	-9	-36	-54	-56
Poland	-4	-19	-20	-20

2000 shows little difference to 1985 except in Canada, the Federal Republic of Germany (-18%) and the German Democratic Republic where the maturation of the recently implemented complementary pension already necessitates a cut of 36% of average benefits. In 2015, cuts by more than 30% would be necessary in Canada, Finland, the Federal Republic of Germany, the German Democratic Republic (-52%) and the Netherlands, and by about 20% in Austria, France, Hungary, Italy and Poland. Czechoslovakia is the bottom-ranking country with only a decrease of 13%. In Poland, the figure remains constant all for the rest of the period while in other countries maximum values are reached in 2030 ranging from about -20% in Czechoslovakia to more than -50% in Canada, the Federal Republic of Germany, the German Democratic Republic and the Netherlands. Finally between 2030 and 2050, little change is indicated.

Table 10 shows how other scenarios depart from the benchmark scenario in 2030. Fertility returning to replacement level would have no effect in Czechoslovakia and the German Democratic Republic, and a small negative effect in Poland. It would only limit the cut in average benefits by 3 to 9 percentage points in other countries. The narrowing sex-gap mortality scenario would subtract another 6 points in Canada and the Netherlands, about

[5]/ Benefits are partly indexed for price increases in Eastern countries and fully in Canada. However, for long-term prospects, it makes no sense to extrapolate current inflation rates.

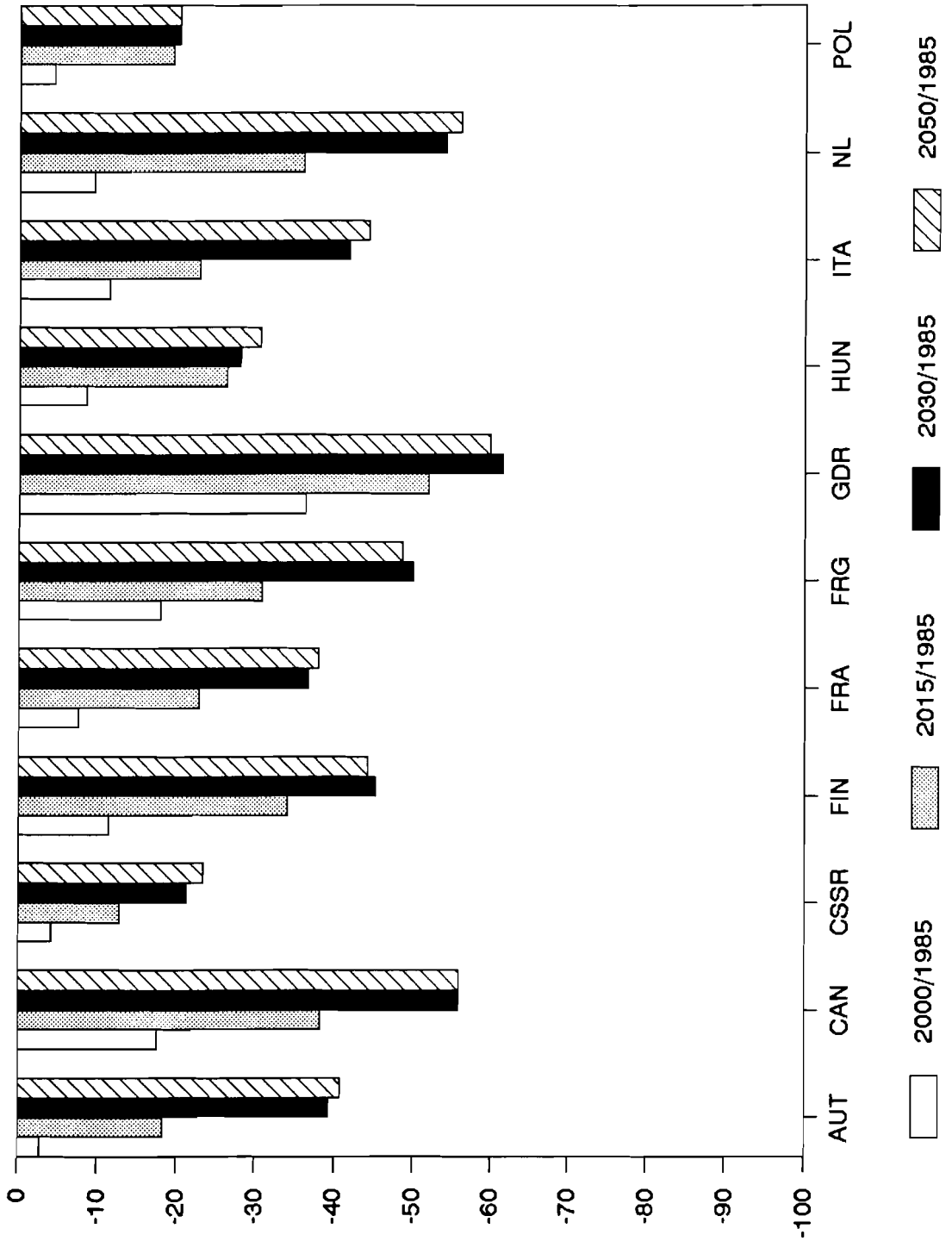

Figure 12. Changes in average benefits, 1985-2050. Benchmark scenario/constant contribution rate.

10% in Austria, Finland, France, the Federal Republic of Germany, the German Democratic Republic and Italy, 15% in Czechoslovakia, Hungary and Poland. As illustrated by Figure 13, this would lead to a fall in the average benefits of about 60% in Canada, the Federal Republic of Germany and the Netherlands, and of 70% in the German Democratic Republic. The Western European scenario would imply benefit cuts of 40% and more in Czechoslovakia, Hungary and Poland, about 70% in the German Democratic Republic, and just a little less than in the case of the mortality scenario in other countries.

Table 10. Percentage changes in average benefits, 2030/1985. Differences with benchmark scenario.

	Fertility	Mortality	Western
Austria	8	-10	-7
Canada	3	-6	-6
Czechoslovakia	0	-15	-26
Finland	4	-11	-9
France	3	-11	-10
FRG	9	-9	-4
GDR	1	-8	-10
Hungary	4	-16	-24
Italy	6	-9	-4
Netherlands	6	-6	-2
Poland	-3	-14	-25

Parallel to the fall in the performance of state pension systems, changes in both nuptiality and mortality and the increase in the proportion of married women claiming for old-age pension result in a decrease in the relative share of survivors benefits in several countries (see Table 11). Sharpest differences are observed in Czechoslovakia and Hungary where survivors pensions cannot be combined with old-age pensions. In the future, survivors pensions will be lower than the primary old-age benefits for women and will therefore disappear. Austria and West Germany also indicate a strong reduction -- around 50% -- which will mostly result, as already mentioned, from improvement in the extremely unbalanced sex-structure of the elderly population.

Finally, differences due to national discrepancies in pension systems are difficult to assess. One can only note that in countries like Canada, the Netherlands, and to a certain extent Poland, where pensions are not or little related to past employment, the substantial rise in the female work-record have little or no impact on pensions. On the other hand, most countries, excluding Czechoslovakia, with earnings-related pensions seem to benefit from the decrease in benefit entitlements for men as the share of women in old-age expenditures either stagnates or decreases (see Table 12).

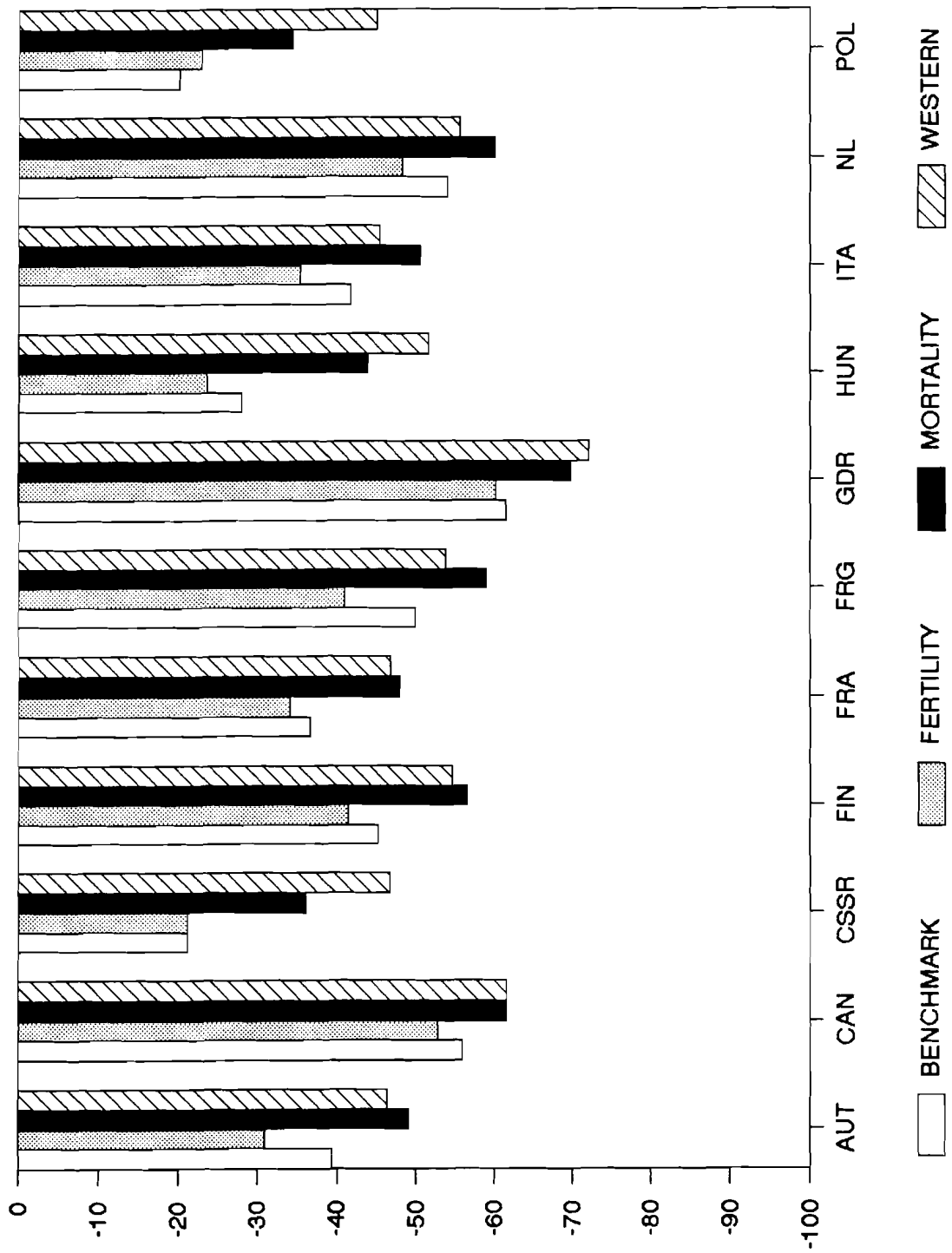

Figure 13. Percentage changes in average benefits, 2030/1985. Constant contribution rate.

Table 11. Share of survivors benefits in total pension expenditures, 1985 and 2030 (percentage).

	1985	2030		
		Benchmark	Western	Mortality
Austria	20.7	14.9	12.5	11.3
Canada	7.0	6.6	6.4	5.4
Czechoslovakia	12.3	0.0	0.0	0.0
Finland	12.4	10.3	8.5	7.4
France	14.6	10.9	9.2	8.1
FRG	25.5	17.1	15.6	13.1
GDR	0.0	0.0	0.0	0.0
Hungary	15.7	0.0	0.0	0.0
Italy	14.6	13.7	11.9	10.8
Poland	0.1	0.1	0.1	0.1

Table 12. Share of women in old-age benefits, 1985 and 2030 (percentage).

	1985	2030		
		Benchmark	Western	Mortality
Austria	36.5	37.0	33.0	36.2
Canada	56.7	57.1	53.2	57.7
Czechoslovakia	41.3	53.9	48.6	51.4
Finland	53.2	49.7	44.1	46.6
France	41.0	44.8	40.0	43.3
FRG	33.7	31.7	28.2	32.1
GDR	67.9	58.3	52.3	56.9
Hungary	42.6	48.9	43.0	45.3
Italy	31.9	36.2	31.9	36.1
Netherlands	64.8	62.4	57.9	61.4
Poland	63.5	61.7	56.3	58.4

3. ASSESSING PENSION REFORMS

The figures discussed in the last paragraph look, in some respects, like the description of an inevitable catastrophe scenario. Indeed, the burden of the demographic fate is impressive and inevitably leads to the question: Is it possible to preserve the actual performance of state pension systems, and which reforms should be undertaken in order to do so? [6]/ Four possible responses were selected among the numerous existing proposals: an increase in female participation in the labor force, a rise in age at retirement, an increase in contributions, and the creation of a complementary contributory-based pension scheme. Both proposals are those most frequently put forward and have a special long-term relevance as they are the ones which are likely to have the greatest quantitative impact.

3.1. Labor and Retirement Policy

A shift in the participation of women in the labor force toward the East German pattern -- one of the highest levels of activity observed among industrialized countries -- would have direct consequences on both the size of the labor force and the benefit entitlements for women. Results for 2030 under constant demographic conditions are illustrated by Figure 14. Compared with the benchmark scenario, an increase in female activity either strongly limits the decrease or substantially adds to the growth in size of the labor force: +30% in Italy and the Netherlands, +20% in Austria and France, and still around 15% in other non-Scandinavian countries. It is important to note that it is much more than that gained under the fertility scenario. On the other hand, an increase in female activity would also raise, sometimes dramatically, the average benefit entitlements: about 70% in Italy, more than 30% in France and the Federal Republic of Germany, around 25% in Austria, 15% in Poland -- where the maximum pension is reached after 20 years of work -- and 10% in Hungary. In Czechoslovakia and Finland, almost no change is observed. The overall impact of both changes on the average benefits is shown in Figure 15. In most countries, it would limit benefit-cuts by about 10 percentage points with a maximum of 15 points in the Netherlands, figures which are above the results of the fertility scenario except for Austria. As already mentioned, in the German Democratic Republic there are no survivors pensions because of the high level of activity among women. If such a system would be totally or partially applied in other countries, this would give additional substantial help to the state pension systems.

An often proposed solution to the pension problem is to raise the age at retirement. In the present scenario, we assume that age at retirement is progressively raised to 65 years for both males and females -- still under constant demographic conditions -- and that no survivors pensions are served under age 60.[7]/ As illustrated by Figure 16, this would limit the increase in the number of retirees to 25% in most countries. Exceptions are obviously those countries with high age at retirement: Canada, France and Finland. An increase in age at retirement also lengthens the average working-life and consequently results in increased benefit entitlements: between +6 and +14% for men and between +4 and +19% for women, namely much less than with an increase in female activity (see Table 13). The positive impact on the average benefits is much more substantial than in the latter scenario in a majority of countries. No deterioration in average benefits would be experienced in

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[6]/ Taking actual performances of pension systems which are exceptional in many respects -- large labor force versus small number of retirees, high female economic activity versus low work-record for women retired -- as a point of reference for comparison is probably questionable but unavoidable from a social or policy point of view.

[7]/ Activity rates for the age-groups 55-59 and 60-64 were also assumed to have an upward shift.

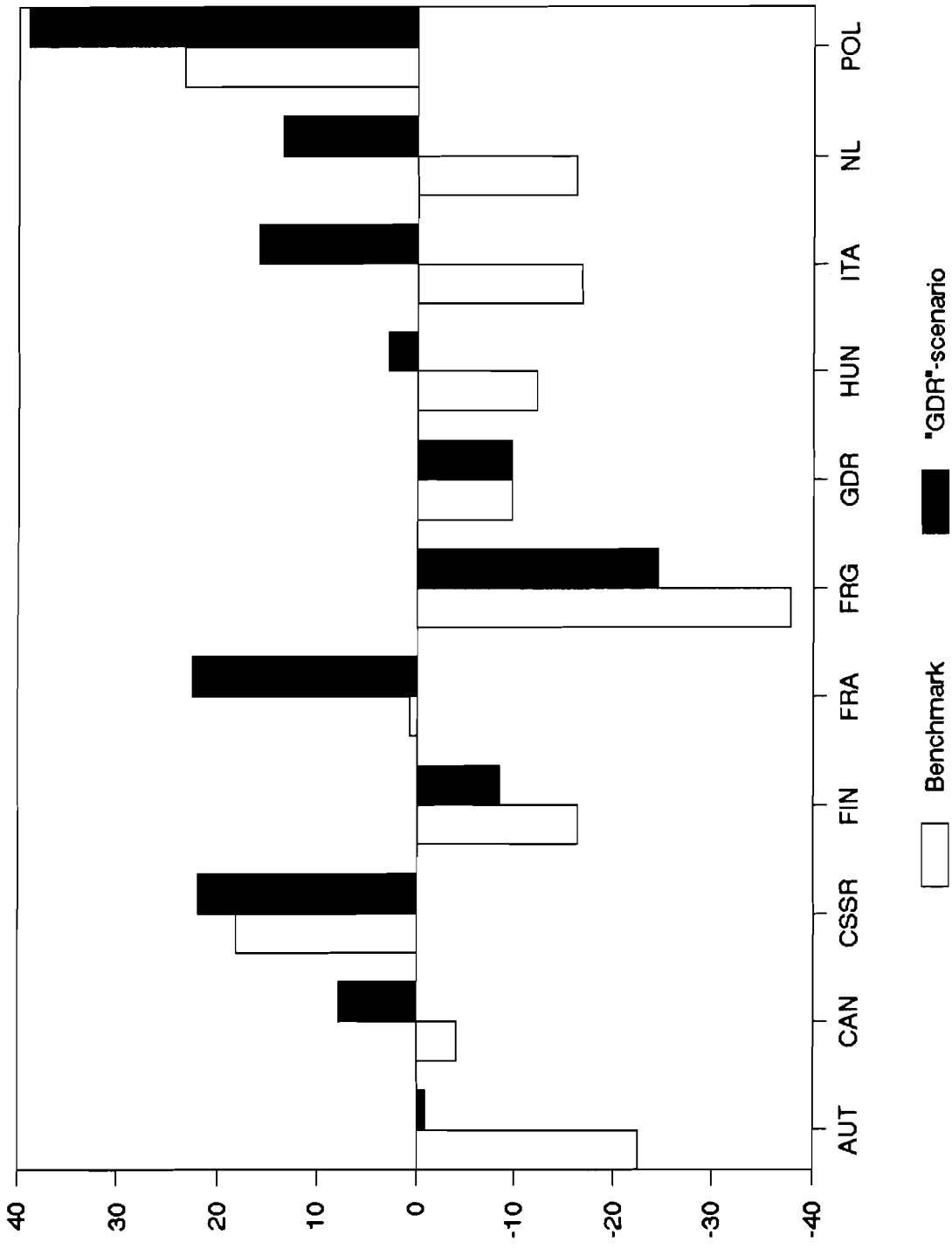

Figure 14. Percentage changes in labor force, 2030/1985. Increased female economic activity versus benchmark.

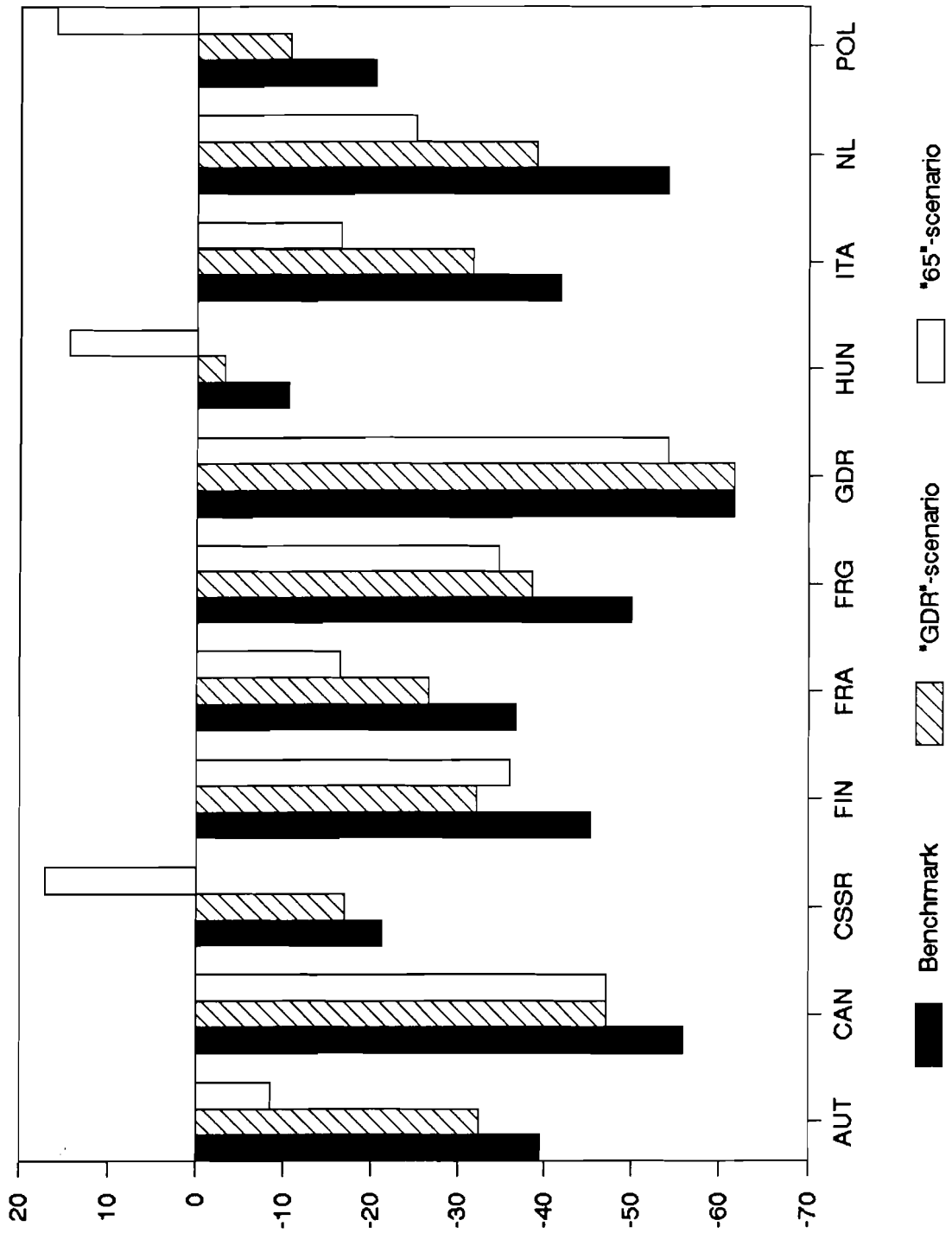

Figure 15. Percentage changes in average benefits, 2030/1985. Constant contribution rate.

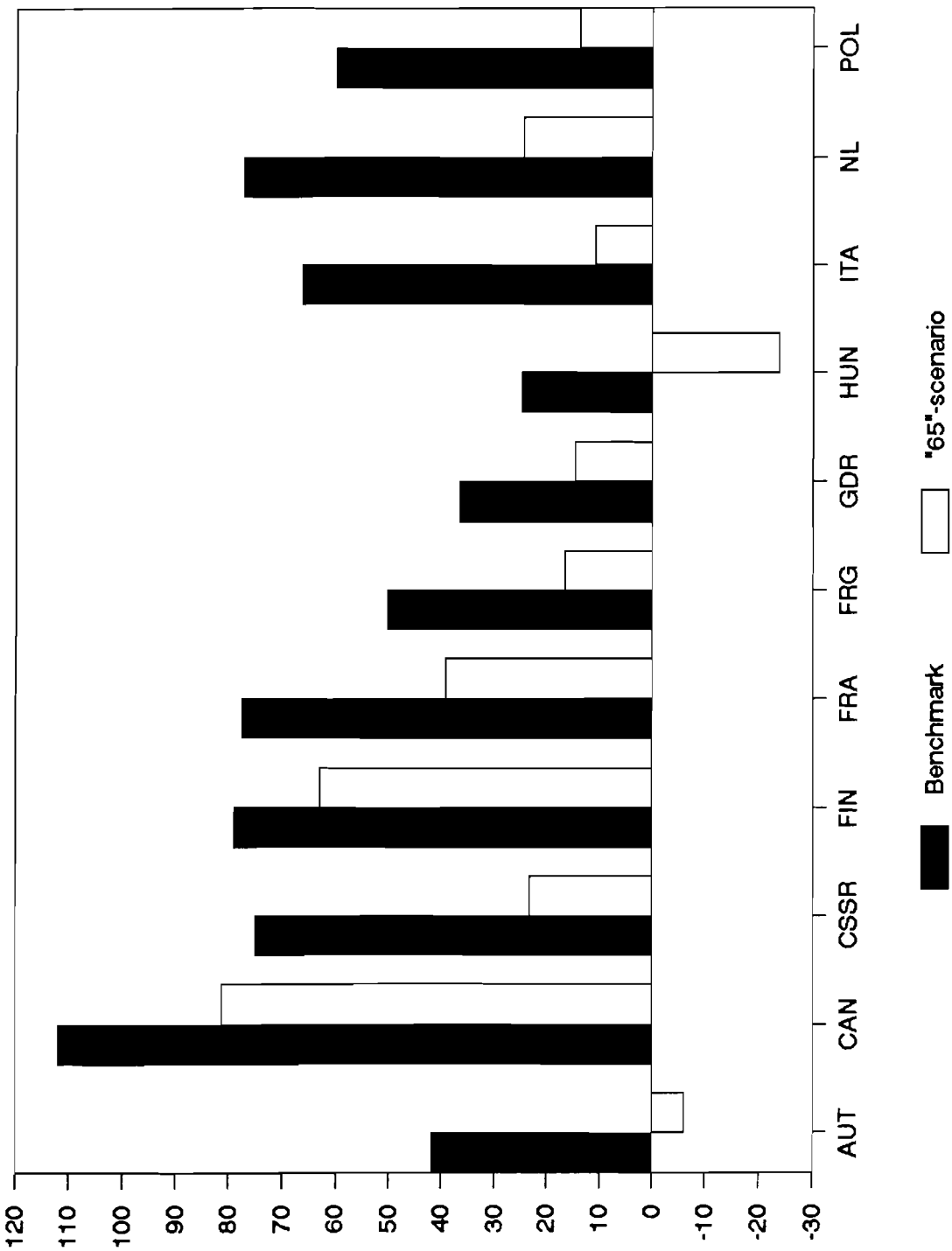

Figure 16. Percentage increase in the number of retirees. Increased age at retirement (=65) versus benchmark.

Czechoslovakia, Hungary and Poland, even under the western scenario for Czechoslovakia and Poland. Cuts in benefits will be limited to less than 10% in Austria and less than 25% in France, Italy and the Netherlands (see Figure 15). Still, cuts would amount to about 35% in Finland and the Federal Republic of Germany, and to about 45% and 55% respectively in Canada and the German Democratic Republic.

Table 13. Impact on average benefits per beneficiary of higher female economic activity and age at retirement (percentage).

	"GDR" Scenario	"65" Scenario	
	Females	Males	Females
Austria	26	14	11
Canada	-	-	-
Czechoslovakia	-3	14	18
Finland	3	6	4
France	34	11	11
FRG	31	12	14
GDR	-	-	4
Hungary	12	13	16
Italy	68	12	19
Netherlands	-	-	-
Poland	-	-	-

3.2. Contributory versus Pay-as-You-Go Systems

Within the framework of a pay-as-you-go system an obvious alternative solution to disequilibriums resulting from wide fluctuations in the size of the cohorts is to increase contributions. Actual payroll tax rates as well as balance rates for Western countries in 1985 and 2030 under the mortality scenario are presented in Table 14. Only in Finland the pension funds are balanced in 1985. Small disequilibriums already exist in Austria, France, the Federal Republic of Germany and Italy. In Canada where the payroll tax rate is extremely low -- 3.6% -- contributions fortunately do not represent the main source of income for state pensions. On the other hand, the over-funding of the Dutch pension fund is due to the extremely high contribution rate under the mandatory disability insurance scheme. Although these figures probably correspond to real situations, they should not be interpreted as an exact measure of the present financial position of national state pension funds because of the many simplifying assumptions on which the modelling is based. Under the mortality scenario -- the worst case -- the state pension fund would be balanced in 2030 in France and Canada if the contribution rate were set to 28% of the gross earnings, and the Netherlands to about 34%. In the first two countries, this corresponds to a substantial increase while no change should be necessary in the Netherlands. Such a level of contribution is high but still socially or economically affordable, as proven by the Netherlands, while in the other countries of this sample, it would not be the case: 41% in Finland, 58.5% in the Federal Republic of Germany, 62.5% in Italy, and about 65% in Austria!

Table 14. Actual and balance contribution rates, 1985 and 2030[a].

	Actual Rate	Balance Rate	
		1985	2030
Austria	22.7	33.3	65.3
Canada	3.6	10.6	27.9
Finland	18.7	17.6	40.9
France	14.0	17.7	34.0
FRG	18.7	24.0	58.5
Italy	24.2	30.6	62.5
Netherlands	33.5	13.5	33.8

[a] mortality scenario

Similar calculations can be carried out for Eastern countries in order to assess at which level to set the payroll tax rate in order to balance contributions and benefits when aging is at a maximum. Table 15 presents estimates for 1985 as well as for 2030 under both the mortality and the western scenarios. In order to fully-fund national pension schemes in 1985, contribution rates should have been set to 9.8% in the German Democratic Republic, 16% in Czechoslovakia, 19% in Poland and 22% in Hungary in 1985. In 2030, the highest increase is observed in the German Democratic Republic -- plus 25.4% for the western scenario -- and the highest rate in Hungary -- 39.4% and 45.6% respectively for the mortality and the western scenarios. Compared with Western countries, Czechoslovakia, the German Democratic Republic and Poland belong in the lower corner while figures for Hungary indicate a more difficult situation.

Table 15. Balanced contribution rate for Eastern countries.

	1985	2030	
		Mortality Scenario	Western Scenario
Czechoslovakia	16.0	25.0	30.0
GDR	9.8	32.6	35.2
Hungary	27.4	39.4	45.6
Poland	19.0	29.1	34.7

If contributions are to be increased, would a complementary contributory-based pension scheme perform better than the existing pay-as-you-go system? A contributory-based pension scheme is similar to a life-insurance except annuities are paid instead of a lump sum. One saves money during activity and gets back interest and principal after retirement. If the scheme is run on a profitable basis, only part of the principal is returned. Such a scheme is advantageous if the premium paid to the insurance company in order to keep benefits constant at their present level is less than the corresponding increase in contribution under the pay-as-you-go system. Calculations have been carried out for Western countries under two assumptions concerning the principal -- the whole principal refunded and only half of the principal refunded -- and for real interest rates ranging from 1 to 3%. It is also

assumed that every active starts contributing in 1990. Results are shown in Table 16 for males and widowed females who usually have a work-record not too different from the average female work-record.

Table 16. Contribution rates corresponding to fully-funded pension schemes, 2030, mortality scenario.

	Pure Pay-as-You-Go System	Pay-as-You-Go + Complementary Private Insurance (rate of interest)			Difference		
		1%	2%	3%	1%	2%	3%
Males		all the principal returned					
Austria	65.3	39.0	34.9	31.8	-26.3	-30.4	-33.5
Canada	27.9	10.1	8.4	7.1	-17.8	-19.5	-20.8
Finland	40.9	29.1	26.6	24.6	-11.8	-14.3	-16.3
France	34.0	25.9	22.9	20.6	-8.1	-11.1	-13.4
FRG	58.5	29.8	26.9	24.7	-28.7	-31.6	-33.8
Italy	62.5	41.2	36.9	33.7	-21.3	-25.6	-28.8
Netherlands	33.8	39.2	37.8	36.7	5.4	4.0	2.9
		half of the principal returned					
Austria	65.3	49.9	40.8	35.1	-15.4	-24.5	-30.2
Canada	27.9	14.4	10.6	8.3	-13.5	-17.3	-19.6
Finland	40.9	36.4	30.7	27.0	-4.5	-10.2	-13.9
France	34.0	34.0	27.3	23.0	0.0	-6.7	-11.0
FRG	58.5	37.1	30.7	26.8	-21.4	-27.8	-31.7
Italy	62.5	52.6	43.0	37.0	-9.9	-19.5	-25.5
Netherlands	33.8	42.9	39.7	37.7	9.1	5.9	3.9
Widowed females		all the principal returned					
Austria	65.3	43.3	39.0	35.6	-22.0	-26.3	-29.7
Canada	27.9	13.4	11.0	9.3	-14.5	-16.9	-18.6
Finland	40.9	31.9	28.6	26.2	-9.0	-12.3	-14.7
France	34.0	29.3	26.0	23.5	-4.7	-8.0	-10.5
FRG	58.5	31.3	28.8	26.8	-27.2	-29.7	-31.7
Italy	62.5	46.8	42.5	39.0	-15.7	-20.0	-23.5
Netherlands	33.8	51.7	48.0	45.1	17.9	14.2	11.3
		half of the principal returned					
Austria	65.3	56.4	46.1	39.6	-8.9	-19.2	-25.7
Canada	27.9	19.5	14.2	11.0	-8.4	-13.7	-16.9
Finland	40.9	40.6	33.3	28.7	-0.3	-7.6	-12.2
France	34.0	39.0	31.3	26.5	5.0	-2.7	-7.5
FRG	58.5	39.6	33.5	29.5	-18.9	-25.0	-29.0
Italy	62.5	60.4	49.6	43.0	-2.1	-12.9	-19.5
Netherlands	33.8	62.4	53.5	48.1	28.6	19.7	14.3

The figures are eloquent. Even under conditions which a priori do not look very appealing for retirees -- only half of the principal returned -- the complementary insurance scheme performs much better than the pay-as-you-go system in all countries except the Netherlands and France for women with an interest rate of 1%. It performs extremely well in two top-ranking countries for aging: the Federal Republic of Germany which indicates the largest difference with the pay-as-you-go system, and Canada where it brings the contribution rate down to a low level. On the other hand, it does not really bring a solution to Austria and Italy where it still requires a contribution rate higher than 35% with an interest rate of 2%. Another negative aspect of this system is that it adds to sex inequalities as the returns depend on the number of years contributed but not linearly as in the pay-as-you-go system. This makes the system less attractive for people with low work-records, especially women. However, the figures in Table 16 underestimate returns from private insurance for women as it was assumed in the calculations that the years worked by women were consecutive.

4. CONCLUSION: Aging: Demographic Fate or Economic Opportunity?

Aging is certain, and the pension question is common to all industrialized countries. Although this statement is definitively supported by our calculations, it is not the last word on the issue. Indeed, results of simulations presented in this paper have revealed another important aspect of the aging process: the specific conditions of this process lead to marked national discrepancies with respect to the solutions of the pension problem.

In our sample, Canada, the Federal Republic of Germany and the Netherlands are top-ranking countries regarding aging. Under any scenario, their population will dramatically age and become very old. Like in all Western countries, the intensity of aging cannot be substantially limited by an increase in fertility, while a further decrease in fertility would not strongly modify the path of aging till 2030 but mainly result in an extension of aging beyond this date. Therefore, the uncertainty regarding the intensity of aging mostly depends on future mortality changes. At the other end of the spectrum, Eastern European countries would experience a limited aging unless both mortality and fertility fall sharply.

Similar levels of aging can correspond to different socio-demographic contexts. In Canada, the main characteristic of aging is the retirees boom while in the Federal Republic of Germany it is the considerable shrinkage in the labor force. A more limited increase in the number of retirees is also a feature common to German-speaking countries and Hungary.

Obviously, figures for Canada, the Federal Republic of Germany, the Netherlands and, on the other hand, Czechoslovakia and Poland widely support the existence of a positive relationship between aging and the deterioration of the return from the state pension systems. In the Netherlands, where there is only a universal flat-rate state pension, the relationship is strict. This is also the case in Canada and Poland where benefits are poorly earnings-related. A main exception is the German Democratic Republic where the fall in the performance of the state pension system is due to the maturation of a recently implemented complementary pension scheme.

Expressed in terms of difference with average benefits received in 1985, the impact of socio-demographic changes on the state pension system is dramatic: already around -20% in 2000 for the three fastest aging countries and the German Democratic Republic, -30% in 2015 and -50% in 2030 under constant demographic conditions, the mortality scenario "only" adding another 5 to 10%. The maximum is reached in the German Democratic Republic where necessary cuts in benefits would represent 70%. In other countries, deterioration starts after 2015 and reaches a maximum of 40% under the benchmark scenario and around 50% under the western and mortality scenarios in Western countries; under the benchmark scenario it reaches 20% in Czechoslovakia and Poland, and 30 % in Hungary, and under the western scenario 45 and 50%, respectively.

Parallel to the deterioration in the return from the state pension system, substantial changes in old-age benefit entitlements will occur. Entitlements for men will decrease by 2 to 12% as a result of decreasing activity at an older age, while sharp rises are to be expected for women: about 15% in both Germanies, 20% in Austria, Finland, France, 30% in Czechoslovakia and Italy, and 60% in Hungary with constant levels of activity and under the benchmark scenario. As a consequence the difference between male and female average benefits will be reduced to 20-30% in most countries. Exceptions are the Scandinavian countries where it will represent 5% and on the other hand Italy with 50%. Under the western scenario, changes in the average marital history would again reduce the difference by another 15% in countries like France, the Federal Republic of Germany and Italy. Similar reductions in the difference of entitlements between women of different marital statuses are also to be expected.

Noticeable changes will as well occur with respect to survivors pensions. In Czechoslovakia, Hungary and Poland, the increase in old-age benefit entitlements for women will put an end to the existence of widow pensions as it is not possible to benefit from both types of pensions. In Austria and the Federal Republic of Germany, the proportion of total pension expenditure represented by survivors benefits -- the highest observed among industrialized countries -- will decrease from 20 and 25% to respectively 15 and 17% under the benchmark scenario, and absolute expenses will drop by 15%. Reductions to a slightly lower level in the share of survivors pensions are also anticipated in all Western countries except Canada where it is already low.

Important to note is that the future living arrangements of the elderly population will substantially differ from the present situation. While in non-Scandinavian industrialized countries no more than 10% of the males and 15% of the females aged 60 and over are today single or divorced, they will represent between 20 and 40% in 2030 depending on countries and scenarios. For men, this means a tremendous increase in the proportion of non-married while for women it is unclear. Under the mortality scenario, the proportion of women widowed indicates a limited decrease and the proportion married a marked rise in the three German-speaking countries, Czechoslovakia and Italy. Under the western scenario, a similar decrease is observed for widows while the three oldest countries -- Canada, the Federal Republic of Germany, the Netherlands -- and Norway show a sharp fall in the proportion of married. To which extent unmarried is and will be equivalent to living-alone is a question beyond the scope of this paper. However, preliminary calculations for the Netherlands based on de facto living arrangements suggest that there will really be a substantial rise in the proportion of the elderly living alone.[8]/

Two types of responses to the question of deteriorating pension funding have been tested, each type offering an alternative: labor policy and pension reforms. First, it was assumed that female participation in the labor force would increase to the level observed in the German Democratic Republic. This would have two direct consequences: a strong increase in the labor force and a sharp rise in average benefit entitlements for women in all countries except Scandinavia and Czechoslovakia. Overall, under constant demographic conditions, this would roughly limit cuts in benefits by 10% with a maximum of 15% in the Netherlands where benefits are not employment-related. Although it brings a clear improvement, this would not be sufficient to solve the pension problem. However, it should be noted that this would strongly reduce the gap in average old-age benefits between sexes to less than 10%. Additional gains of about another 10% are possible in Western countries if provisions for widow pensions are partially or totally released. Widow pensions have been made necessary in a context dominated by a high prevalence of marriage, a low level of economic activity among married women, and large sex-differentials in mortality. With changing patterns of

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[8]/ see Evert van Imhoff (1989) *Modelling the Impact of Changing Household Structure on Social Security in the Netherlands*. NIDI. October 1989.

nuptiality and activity, general provisions will soon appear anachronic if not contrary to the goal of economic independence for women. One open question remains: What would be the influence of a strong increase in the participation of women in the labor force on fertility, and could the fall in births offset the gains in contributions?

Within the framework of a labor/retirement policy, an alternative solution which was simulated is an increase in age at retirement to 65 years. Except in countries with relatively higher ages at retirement -- Canada, France and Finland -- this would substantially limit the absolute increase in the number of retirees while in all countries the entitlements would increase much less than with the latter scenario. Impressively, this would solve the pension problem in Czechoslovakia and Poland under any scenario, and strongly limit cuts in benefits in Austria, France, Hungary, Italy, and the Netherlands. On the contrary, this does not bring a solution to both Germanies, the Scandinavian countries and Canada. However, it should be remembered that age at retirement, except for civil servants, depends on the economic and labor market situation, and cannot be easily modified by decree.

Can the pension problem be solved by an increase in the contribution rate? If we consider the higher observed contribution rate -- 33.5% in the Netherlands -- as a criterion, the answer is definitively positive for Canada, Czechoslovakia, France, the German Democratic Republic, the Netherlands and Poland under both the mortality and western scenarios, namely the worst conditions. In the case of the Netherlands this indicates that, providing the simplifying assumptions used in the pension model do not distort too much reality, the state pension fund is largely over-funded at present.

A more fundamental reform would be to partly move the pension system from a pay-as-you-go to contributory-based. Simulations have showed that for all Western countries with the exception of the Netherlands, a complementary savings-type pension scheme always performs better than the pay-as-you-go system. With a 2% interest rate, contribution rates reach acceptable levels, by Dutch actual standard, in all countries except Austria and the Netherlands. The system performs extremely well in the two top-ranking countries for aging: West Germany which indicates the largest difference with the pay-as-you-go system, and Canada where it brings the contribution rate down to a low level. This system is attractive at a time when the shortfall of savings has become a major political concern in most Western countries. Nevertheless, it requires immediate implementation and limited inflation. Indeed, even with high inflation, it can be profitable if investments are targeted at providing benefits in kind, such as residence-lease or medical care, instead of cash benefits.

Obviously, it would also generate much discrepancy as performance greatly varies from one country to another. A main paradox is that it has little to do with aging as exemplified by the case of the Federal Republic of Germany or Canada which, despite the highest level of aging in the developed world, could relatively easily solve the pension problem. Indeed, the paradox is even deeper if the scheme is run on a profitable basis where only part of the principal and interests are returned to the beneficiary. Then contrary to what is often assumed, the growth of the elderly population could result in a tremendous increase in long-term stable saving, offering large opportunities to investments and possibly boosting the economy.

APPENDIX 1. Period of Reference for Data

1. Population

All projections were based on the average population for 1985 except for Czechoslovakia which is based on an estimate of the 1980 average population.

2. Occurrence/Exposure Rates

Period occurrence/exposure rates for death, marriage, divorce and widowhood were calculated when possible for the period 1980-84. Exceptions are:

- Czechoslovakia: cohort estimates were used
- Finland: 1981-85
- FRG: 1985
- GDR: average between 1980 and 1985
- Italy: 1981, adjusted for infant mortality
- Poland: 1984-1985

3. Retirement

Retirement patterns were estimated from 1985 data except in Italy where information for 1988 was used.

APPENDIX 2. Marital Status Projection Model

Marital status projections were prepared using IIASA's DIALOG Personal Computer software prepared by Sergei Scherbov.[1]/

As several detailed mathematical descriptions of the multidimensional projection model are available, only a brief and simplified presentation is given.[2]/

1. Population Dynamics in a Close Population

$K(t+h) = S(t)\,K(t)$

$K(0,t+h) = S(0,t)\,b(t)$

$K(z,t+h) = S(x,t)\,k(z-h,t) + S(x,t)\,k(z,t)$

where S is the transition matrix corresponding to the time interval (t,t+h), K(t) is the column composition vector of m age groups, n states population at time t, b the number of births, z the last open-ended age-category.

2. The Exponential Model

Under the assumption of constant transition intensities between states i and j or i and d (deaths) over the interval (t,t+h), the matrix S can conveniently be expressed as a function of the matrix M of occurrence/exposure rates Mij(x,t):

$$S(x,t) = [I + h/2\ M(x,t)]^{-1}\,[I - h/2\ M(x,t)]$$

with

$$M(x,t) = \begin{bmatrix} M_{1d}(x,t) + \sum_{j\neq 1} M_{ij}(x,t) & -M_{21}(x,t) & \cdots & -M_{n1}(x,t) \\ -M_{12}(x,t) & M_{2d}(x) + \sum_{j\neq 2} M_{2j}(x,t) & & -M_{n2}(x,t) \\ \vdots & \vdots & & \\ -M_{1n}(x,t) & -M_{2n}(x) & \cdots & M_{nd}(x,t) + \sum_{j\neq n} M_{nj}(x,t) \end{bmatrix}.$$

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[1]/ See Sergei Scherbov and Vladimir Grechucha (1988) "DIAL" - A System for Modelling Multidimensional Demographic Processes. *WP-88-36*. Laxenburg, Austria: International Institute for Applied Systems Analysis.

[2]/ See, for instance, F.J. Willekens and P. Drewe (1984) A multiregional model for regional demographic projection, IN H. ter Heide and F.J. Willekens, eds., *Demographic Research and Spatial Policy: The Dutch Experience*. Academic Press.

3. Specificities of the Marital Status Projection Model

With four marital statuses, the number of possible transitions is nine (see Table A1): three for marriages (first marriage, remarriage of divorced, and widowed), two for marriage dissolution (divorce and widowhood) and four for death. All births occur among singles but result from the addition of natality of both categories.

Table A1. Transition flows-marital status model -- no external migration.

	Marital Status After Event				
Before Event	1.	2.	3.	4.	Death
1. Single (s)	-	1	*	*	2
2. Married (m)	*	-	3	4	5
3. Divorced (d)	*	6	-	*	7
4. Widowed (w)	*	8	*	-	9
Not yet born	10	*	*	*	-

- no event
* impossible event

Then, for each sex, we have the following component-of-growth equations:

$$P_s(t+h) = P_s(t) + B(t,t+h) - M_s(t,t+h) - D_s(t,t+h)$$

$$P_m(t+h) = P_m(t) + M_s(t,t+h) + M_s(t,t+h) + M_d(t,t+h) + M_w(t,t+h) - S(t,t+h) - D_m(t,t+h)$$

$$P_d(t,t+h) = P_d(t,t+h) + S(t,t+h) - M_d(t,t+h) - D_d(t,t+h)$$

$$P_w(t,t+h) = P_w(t,t+h) + W(t,t+h) - M_w(t,t+h) - D_w(t,t+h)$$

where B is birth and D is death, M marriage, S divorce and W widowhood.

As the number of newly married (divorced) women equals the number of newly married (divorced) men as well as the number of newly widows (widowers) equals the number of deaths among married males (females), we also have the following constraints:

$$M_s^m(t,t+h) = M_d^m(t,t+h) + M_w^m(t,t+h) = M_s^f(t,t+h) = M_d^f(t,t+h) + M_w^f(t,t+h)$$

$$S^m(t,t+h) = S^f(t,t+h)$$

$$D_m^m(t,t+h) = W^f(t,t+h)$$

$$D_m^f(t,t+h) = W^m(t,t+h) \quad .$$

Within a multistate demographic framework, events occurring to males are modelled independently of events occurring to females, and conditions arising from the above constraint equations are not likely to be fulfilled. In order to obtain consistent flow figures for the two sexes, Keilman[3]/ furthering the analysis of Schoen[4]/ has proposed to average the observed differences in the number of events between sexes by using a harmonic mean. Under this approach, three steps are necessary for calculating transitions. First, the number of events is computed separately for males and females: for instance, the total numbers of marriage $M^f(t,t+h)$ and $M^m(t,t+h)$. Second, the adjusted total number of marriages $M^*(t,t+h)$ is set to the harmonic mean of these numbers:

$$M^*(t,t+h) = \frac{M^m(t,t+h)M^f(t,t+h)}{.5(M^m(t,t+h) + M^f(t,t+h))} \quad .$$

Third, new numbers of marriages for each age categories are recalculated using the adjustment factor $M^*(t,t+h)/M^m(t,t+h)$ for males and $M^*(t,t+h)/M^f(t,t+h)$.

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[3]/ See N.W. Keilman (1985) Internal and external consistency in multidimensional population projection models. *Environmental and Planning A* 17:1473-1498.

[4]/ See R. Schoen (1981) The harmonic mean as the basis of a realistic two-sex marriage model. *Demography* 18(2):201-216.

APPENDIX 3. The Pension Model [1/]

1. Benefits

with m = single for married under mean age at marriage
with m = married for divorced between mean ages at marriage and divorce

TBEN = ABENc(s,x,m,t-x) * PRET(s,x,m) * P(s,x,m)

ABENb(s,x,m,t-x) = PCLA(s,m,t-x) * ABENc(s,x,m,t-x)

PCLA(s,m,t-x) = Max [LFPR(s,m,t-x), x>20]

RET(s,x,m,t-x) = PCLA(s,x,m,t-x) * PRET(s,x,m) * P(s,x,m)

ASURc(s) = K * ABENc(s,x,m,t-x)

AWY(s,m,t-x,t+5n) = AWY(s,m,t-x,t) * (1-(IR - AR))EXP(5n)

2. Contributions

LF = LFPR(s,x,m) * P(s,x,m)

CON = PTR * W * LF

3. Complementary Savings-Type Pension Scheme

R = ((CON(2030)/TBEN(2030))/((CON(1985)/TBEN(1985))

MISBEN = ABENc(s,x,m) * R

KK = PREM * acum(i,AWY)

PREM is obtained by using tabulations to solve the following system of equations:

CUMBEN = MISBEN(1+i)^1 + MISBEN(1+i)^2 + ...+ MISBEN(1+i)^E(LEAR)

CUMBEN = (KK - PK * (AWY*PREM)) * (1 + dcum(MISBEN,i,LEAR))

where acum is an accumulation factor and dcum is an accumulation/depreciation factor which accounts for both increment due to interests and decrement due to annuities payment.

4. Variables List

ABENc	average per capita benefits
ABENb	average per beneficiary benefits
AR	annual adjustment rate
ASURc	average per capita survivors benefits

[1/] This model is an extension of the one proposed by G. Malabouche (1987) L'evolution a long terme du systeme de retraites: une nouvelle methode de projection. *Population* 1:9-38.

AWY	average number of years worked
CON	total contribution
CUMBEN	cumulated benefits over retirement period
IR	average annual inflation rate
i	real rate of interest
K	share of the old-age benefits of the deceased spouse paid to survivors
KK	capital (principal and interest) accumulated during activity
LEAR	life expectancy at age at retirement
LF	labor force
LFPR	labor force participation rates
m	marital status
MISBEN	difference between funded average per capita benefits and 1985 average per capita benefits
n	number of 5-year projection periods
P	population
PCLA	proportion claimants
PK	proportion of the principal refunded
PTR	payroll tax rate
PREM	insurance premium
PRET	proportion retired
R	changes in the ratio contributions/benefits compared with 1985
RET	number of old-age retirees
s	sex
TBEN	total benefits
W	average salary
x	age
YBR	yearly benefits rate