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Inclusive social protection and demographic change

The implications of population ageing for social expenditure in the Caribbean

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This document has been prepared by Valerie Nam, consultant, and Francis Jones, Population Affairs Officer, of the Statistics and Social Development Unit of the Economic Commission for Latin America and the Caribbean (ECLAC) subregional headquarters for the Caribbean.

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Abstract

As population age structures change over the coming decades, the cost of providing public education, pensions and health care will change significantly. Falling child dependency ratios and increasing old-age dependency ratios will affect the number of people that receive education and pension benefits. The changing age profile of the population will also affect the demand for health services. This study analyses how public expenditure in these areas, in 10 Caribbean countries, is likely to evolve in response to these demographic changes. It describes how populations are ageing in the Caribbean and analyses how current levels of public expenditure are related to age structures in both Caribbean and OECD countries. It uses a projection model in which estimates of social expenditure by age are linked with population age structures in order to produce projections of public expenditure which illustrate the impact of demographic change. A further set of projections are also presented which, in addition, model how these expenditures are likely to evolve as economic growth allows Caribbean governments to fund more generous social spending. The projections presented here are based on a relatively simple demographic and economic growth model which does not capture every detail or national specificity of education, pension or health systems.

Introduction

The world's population is ageing. With the exception of a relatively small number of states, mostly in Africa, countries are seeing an increasing number and proportion of older persons in their populations. Ageing is poised to become one of the most significant social transformations in the twenty-first century, with implications for nearly all sectors of society, for the labour market, the care economy, the demand for goods and services as well as family structures and inter-generational ties.

The process of population ageing is primarily determined by fertility rates and secondarily by mortality rates. The demographic transition theory explains how populations change over time. It describes the transition from high to much lower levels of both fertility and mortality. Throughout most of history, although high levels of births prevailed, population growth was constrained by high levels of deaths. The decline in mortality, which results from improved living conditions and advances in health care and nutrition, usually precedes the decline in fertility resulting in high population growth during the transition period. In the industrialized world, death rates fell relatively gradually with birth rates subsequently following a similar trajectory. There are now around 20 countries where there are more deaths than births. The developing countries benefited from those advances in the developed world with the result that death rates fell more rapidly. Fertility rates in these countries did not however fall as quickly or as significantly as death rates with the result that populations grew more rapidly than ever before.

Demeny (1972) succinctly summarises the process of the demographic transition by stating that in "traditional societies, fertility and mortality are high and in modern societies, fertility and mortality are low. In between there is the demographic transition."

Lee (2003) focuses on the shifts in age distribution which occur during the transition. He argues that such changes "are an integral part of the process which will continue long after the [birth and death] rates have stabilized." He describes how the first phase of the process sees rising child dependency ratios as mortality, especially among children, declines. As fertility declines in the next phase, child dependency ratios decline as "the working-age population grows faster than the population as a whole."

"In a third phase, increasing longevity leads to a rapid increase in the elderly population while low fertility slows the growth of the working-age population. The old-age dependency ratio rises rapidly, as does the total dependency ratio…. At the end of the full transition process… the total dependency ratio is back near its level before the transition began, but now child dependency is low and old-age

dependency is high. Presumably, mortality will continue to decline in the twenty-first century, so that the process of individual and population ageing will continue." (Lee 2003).

Saad (2011), whose focus is the changes in Latin America and the Caribbean (LAC), writes that the demographic changes [typical of those associated with the transition] have intensified in the region in recent decades. The transition from high to low levels of mortality and fertility has resulted in substantial changes in population age structures. The changes observed in the region are in keeping with those described by Lee (2003): declining numbers of children and increases in the working-age population and particularly the older population.

Saad describes how "these changes in age structure mark the onset of a period in which the proportion of people in potentially productive ages grows steadily relative to the number of people in potentially unproductive (inactive) ages. This period, known as the 'demographic dividend,' 'demographic bonus,' or 'demographic window of opportunity,' creates a situation that is particularly conducive for development, because it increases the possibility of saving and investing in economic growth. Nearly all countries in the LAC region are currently in this favourable period of transition. Owing to the unevenness of demographic change, however, for some countries, this window of opportunity is beginning to close, whereas for others it is beginning to open."

The present study focuses on the impact of changes in age structure on national economies and specifically on expenditure by governments in three critical areas of social provision: education, pensions and health. The study is guided by similar work done concerning other developed economies, countries which have felt the impact of the demographic transition much earlier than the developing world. As Lee and Mason (2011) point out, countries must learn from those that have experienced the age transition earlier; they cannot rely on their own experience since these changes are occurring within their own countries for the first time.

In introducing their study of population ageing and the generational economy, Lee and Mason identify their goal as improving the understanding of how changes in population age structure are influencing national economies. They explain that the pattern of an increasing concentration in the working ages, observed until recently, was favourable for most countries and this remains true for some countries in Asia and most in Africa. "Elsewhere –in the West, East Asia, and Latin America– the share of the working-age population is in decline or soon will be, as the share of the elderly population grows." This has implications for among other things, "bankruptcy for publicly funded health care and pension systems, slower economic growth and possibly, decline."

This study covers, as far as data allow, ten Caribbean States – Antigua and Barbuda, Bahamas, Barbados, Belize, Grenada, Guyana, Jamaica, Saint Lucia, Saint Vincent and the Grenadines and Trinidad and Tobago. All except Belize and Guyana are islands. Geographically these countries lie within the area stretching from Guyana on the South American coast to Belize on the Central American mainland, and Bahamas in the north. All these countries share a common history of colonialism as former British colonies with a plantation experience, but for varying lengths of time and with varying degrees of intensity.

There is considerable variation in the population size of the ten countries ranging from the smallest, Antigua and Barbuda, to the largest, Jamaica, which accounts for about 45 per cent of the total population. Together, Jamaica, Guyana and Trinidad and Tobago account for nearly 80 per cent while the share for Antigua and Barbuda is 1.5 per cent.

Estimating and projecting age-related expenditures for Caribbean countries is challenging. The main source of this type of data, for the developed economies, is the system of accounts called National Transfer Accounts (NTA). The NTAs allow for the age disaggregation of the major components of national accounts as well as estimates of private transfers within households. Jamaica is the only Caribbean country identified as a member of the NTA network and only limited outputs are available. Data of the type required for fiscal projections are not normally disaggregated by age, so in most cases some assumptions have to be made with respect to age.

The United Nations World Population Prospects database 2017 is the source for the population projections to 2050. The database includes countries with populations of at least 90,000. This excludes a number of Caribbean countries and territories. Other sources of data were the databases of the United Nations Educational Scientific and Cultural Organization Institute of Statistics (UNESCO/UIS), the World Health Organization (WHO) and the Organization for Economic Cooperation and Development (OECD). Estimates of public expenditure for Caribbean countries for 2010 were obtained from national budgets and the annual reports of the national insurance schemes. Full details of the sources are outlined in Annex 2, Technical Notes.

The objective of the study is to assess the implications of population ageing for social expenditure in ten Caribbean countries by producing age-related projections of public expenditure on education, pensions and health care as a percentage of GDP. The work has been guided by the methodology of Miller, Mason and Holz (2011) that was used to project the costs of education, health care and pension programmes in ten Latin American countries. The authors calculated the increased fiscal burdens that, against a backdrop of declining mortality and fertility, countries are likely to face as a result of both demographic and policy changes. They argue that Latin American countries are set to experience both increased income (as the proportion of the population in productive ages increases), but also substantial increases in public costs (as population aging ultimately leads to increases in the demand for pensions and health care)." However, while in that exercise, 2005 was the base year for projections, in this study 2010 was used as the base year. In both cases, the projections cover the period up to 2050.

The study is presented in chapters. Chapter I is a summary of recent demographic trends in the Caribbean with special focus on the countries in the study, covering the most recent intercensal period. The analysis involves an examination of the movements in the growth components of fertility, mortality and migration and changes in the age structure. Chapter II is an analysis of the main features of the demographic transition in the study area with emphasis on the changing age structure of the population. Chapter III presents an analysis of the impact of demography and policy on current levels of government spending on education, pensions and health. This section outlines the model proposed by Miller, Mason and Holz (2011) and adopts the same approach to analyse public spending in the three areas of interest for the countries in the study area, around 2010. Comparisons are made with the countries of the OECD, with their older population structure, in order to highlight the importance of population age distributions. Each of the three areas is discussed in three separate sub-sections. Chapter IV presents the results of projections which illustrate the anticipated impact of demography and economic change on future levels of spending. There is a summary of the main findings and annexes provide details of the methodology, assumptions and procedures as well as selected output tables from the projections.

I.   Recent demographic trends

The population of the ten States as estimated by United Nations' Population Division, at midyear 2010 was 6.3 million. This represents an increase of approximately 7 per cent in the ten years since 2000, indicative of an average annual rate of growth of 0.6 per cent. In absolute numbers, the combined population of the countries rose by just under 400,000, an annual increase of approximately 39 thousand. Table 1 shows that rates of growth for the individual countries ranged from the lowest, -0.1 per cent, for Guyana, to a highest of 2.7 per cent for Belize, 4.2 times more than the average. Three other countries, Bahamas (1.9 per cent), Antigua and Barbuda (1.3 per cent) and Saint Lucia (1.0 per cent) experienced annual rates of growth in excess of the overall average of 0.6 per cent.

Table 1
Distribution of the population and changes between 2000 and 2010
(Population in thousands)

	Population		Change 2000–2010		
	2000	2010	Number	Per Cent	Average Annual Rate of Growth (per cent)
Antigua and Barbuda	83.6	94.7	11.1	13.3	1.3
Bahamas	297.9	360.8	62.9	21.1	1.9
Barbados	269.8	279.6	9.7	3.6	0.4
Belize	247.3	321.6	74.3	30.0	2.7
Grenada	101.6	104.7	3.1	3.0	0.3
Guyana	753.3	746.6	-6.7	-0.9	-0.1
Jamaica	2 656.9	2 817.2	160.3	6.0	0.6
Saint Lucia	156.9	172.6	15.6	10.0	1.0
Saint Vincent and the Grenadines	107.9	109.3	1.4	1.3	0.1
Trinidad and Tobago	1 268.0	1 328.1	60.1	4.7	0.5
Total	5 943.3	6 335.1	391.9	6.6	0.6

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

The variations in rates of growth reflect variations in levels and rates of the components of population change: fertility, mortality and migration. Table 2 present births, deaths and natural rates of increase covering the period 2000-2010. Overall, the average crude birth rate for the ten years was 18.3 per 1,000 while the average crude death rate was 7.3 per 1,000 resulting in a rate of natural increase of 11 per 1,000 for the ten countries. Natural increase was highest for Belize (21 per 1,000), almost twice the overall average. This was the consequence of a birth rate of 26.5 per 1,000, the highest of all the countries, and a death rate which was the lowest of all, 5.3 per 1,000. Only one other country saw a birth rate in excess of 20 per 1,000 during this period, Guyana, with a rate of 22.8 per 1,000. The lowest rates of natural increase were for Barbados (2.8 per 1,000) and Trinidad and Tobago (6.5 per 1,000). Birth rates for these countries were 13.0 per 1,000 and 15.1 per 1,000 respectively. It is instructive to observe that these two countries also had the highest death rates in the period (Barbados 10.2 per 1,000 and Trinidad and Tobago about 9 per 1,000), which are likely indications of the increasing number of elderly in their respective populations.

Table 2
Average annual rates of births, deaths and natural increase[a], 2000-2010
(Per thousand)

	Crude Birth Rate	Crude Death Rate	Rate of Natural Increase
Antigua and Barbuda	19.0	6.1	12.9
Bahamas	15.7	5.7	10.1
Barbados	13.0	10.2	2.8
Belize	26.5	5.3	21.2
Grenada	19.0	7.9	11.1
Guyana	22.8	7.7	15.1
Jamaica	19.2	7.1	12.1
Saint Lucia	14.8	6.9	7.9
Saint Vincent and the Grenadines	18.2	7.4	10.8
Trinidad and Tobago	15.1	8.6	6.5
Average	18.3	7.3	11.0

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] See Annexes 2 and 3 for details on sources and calculations.

Table 3
Components of population change, 2000-2010[a]
(Thousands)

	Total Growth	Natural Increase	Migration	Migration as a percentage of natural increase
Antigua and Barbuda	11.1	11.5	-0.4	-3.3
Bahamas	62.9	33.1	29.8	90.2
Barbados	9.7	7.7	2.0	25.5
Belize	74.3	59.8	14.5	24.3
Grenada	3.1	11.5	-8.4	-73.3
Guyana	-6.7	113.0	-119.7	-106.0
Jamaica	160.3	332.4	-172.0	-51.8
Saint Lucia	15.6	13.0	2.6	20.2
Saint Vincent and the Grenadines	1.4	11.7	-10.3	-87.9
Trinidad and Tobago	60.1	84.6	-24.5	-28.9
Total	391.9	678.2	-286.4	-42.2

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition[a].
[a] See Annexes 2 and 3 for details on sources and calculations.

From Table 3 it can be observed that natural increase (the difference between births and deaths) amounted to 678 thousand in the ten years but this increment was reduced by 42 per cent by international migration, which has historically played a very important role in curbing population growth in the majority of Caribbean countries. The effects of migration on population growth vary, as for some countries it has had a negative effect with a net outward movement while for some a net inward movement was dominant. Six countries experienced net outward movements over the ten years between 2000 and 2010: Guyana, Saint Vincent and the Grenadines, Grenada, Jamaica, Trinidad and Tobago and Antigua and Barbuda. The greatest impacts on growth were in Guyana and Saint Vincent and the Grenadines, with growth from natural increase in these two countries being reduced 106 per cent and 88 per cent respectively. For Grenada, the reduction was 73 per cent and Jamaica and Trinidad and Tobago saw cuts to natural increase by outward migration of 52 per cent and 29 per cent respectively. Countries showing net inflows were Bahamas, Barbados, Belize and Saint Lucia. In the case of the Bahamas, an additional 30 thousand people were added to the natural increase of 33 thousand.

II. The demographic transition and ageing

Demographic developments in the twentieth century in the Caribbean have followed the same path as in many other developing countries. These developments have seen rapid declines in mortality rates which occurred largely as a result of the improvements in health beginning in the early part of the century. Measures to improve public health, sanitation, housing and medical facilities and to control specific important diseases resulted in a decline in mortality which has continued till the present time. High rates of natural growth of up to 2 per cent per year, mainly in the 1960s, nevertheless persisted as fertility declines lagged. However, growth rates were reduced, and in some instances there was even negative growth, because of the emergence of massive migration from several countries from the 1950s onward. Average annual rates of growth for the ten countries in this study, for the period 1950-55 ranged from a low of 0.9 per cent for Saint Lucia to the highest of 3.5 per cent for Guyana.

Progress in the demographic transition can be assessed by an examination of the long term movements in the natural components of growth presented in tables 4 and 5. During 1950-55, crude death rates for the ten countries averaged about 13 per 1,000 with Saint Vincent and the Grenadines and Saint Lucia recording the highest, 17 per 1,000 and 16 per 1,000 respectively. The first reductions in mortality, appearing as early as the 1920s and accelerating over time, were among infants. During 1950-55 infant mortality rates for the ten countries combined averaged 97 per 1,000 live births, being highest in Saint Lucia (148) and Saint Vincent and the Grenadines (122). By the period 1980-85, the average had dropped to one third of its previous level, about 32 per 1,000 and for 2005-2010 was down to approximately 17 per 1,000. With these declines in mortality have come impressive increases in life expectancy. At mid-century (1950-55), average life expectancy for the ten countries was approximately 57 years. By 1980-85, this had risen to 69 years and by 2005-2010 to 72 years, an addition of 15 years in half a century. The largest increase in years was for Saint Vincent and the Grenadines which added about 21 years to life expectancy between 1950 and 2010. There has been some variation in life expectancy between countries in recent years. For 2000-2010 Antigua and Barbuda had the highest life expectancy of 75 years, 9 years more than the lowest, Guyana (66 years).

Notwithstanding the considerable declines in mortality, it is the declines in fertility which in more recent years have had the major impact on population size and age structure. It is important to note however that fertility reductions do not immediately translate into significant decreases in the numbers of births and the birth rate because of the large size of the female cohorts of reproductive age at the

beginning of the transition to lower fertility. This large cohort has itself been a result of the high fertility levels of the past which would guarantee a fairly high level of births for some time. Table 5 shows that the average crude birth rate fell from 41.1 per 1,000 for 1950-55 to 17.7 per 1,000 by 2005-2010, a fall of 57 per cent. Just as considerable has been the decline in the total fertility rate (see table 5) which fell by over half (60 per cent) from an average of 5.4 per woman in 1950-55 to 2.2 per woman in 2005-2010. By 2010, four countries, Bahamas, Barbados, Trinidad and Tobago, and Saint Lucia, saw total fertility rates below the replacement level of 2.1 per woman.

Table 4
Mortality rates for Caribbean countries, 1950-2010[a]
(Per thousand and years)

		Infant Mortality Rate per 1000 live births	Crude Death Rate per 1000 population	Life Expectancy (in years)
Antigua and Barbuda	1950-1955	93.0	10.6	58.5
	1980-1985	27.3	6.4	69.5
	2000-2005	12.2	6.2	74.1
	2005-2010	10.0	6.1	75.0
Bahamas	1950-1955	70.6	10.4	60.0
	1980-1985	22.2	5.7	69.1
	2000-2005	11.6	5.5	73.2
	2005-2010	10.0	5.8	74.3
Barbados	1950-1955	85.5	13.5	57.2
	1980-1985	24.9	10.3	69.5
	2000-2005	12.4	10.2	73.8
	2005-2010	11.0	10.2	74.6
Belize	1950-1955	100.1	13.8	55.9
	1980-1985	39.9	6.1	70.4
	2000-2005	19.7	5.7	68.5
	2005-2010	17.0	4.9	69.6
Grenada	1950-1955	107.9	14.6	56.3
	1980-1985	27.9	8.8	67.1
	2000-2005	12.0	8.1	70.9
	2005-2010	10.2	7.7	72.0
Guyana	1950-1955	72.2	11.4	58.8
	1980-1985	52.5	8.5	62.7
	2000-2005	36.5	7.7	65.3
	2005-2010	34.4	7.7	65.8
Jamaica	1950-1955	90.0	10.7	58.6
	1980-1985	30.4	6.5	72.0
	2000-2005	20.0	7.2	72.8
	2005-2010	17.9	7.0	74.2
Saint Lucia	1950-1955	148.1	16.3	58.6
	1980-1985	23.6	6.2	72.0
	2000-2005	14.2	7.2	72.8
	2005-2010	11.8	6.6	74.2
St Vincent and the Grenadines	1950-1955	122.0	16.9	51.1
	1980-1985	35.9	7.1	68.4
	2000-2005	21.2	7.5	70.7
	2005-2010	18.5	7.3	71.8
Trinidad and Tobago	1950-1955	82.6	11.6	57.9
	1980-1985	31.7	7.7	67.3
	2000-2005	28.9	8.3	68.7
	2005-2010	26.6	8.9	69.3

Table 4 (concluded)

		Infant Mortality Rate per 1000 live births	Crude Death Rate per 1000 population	Life Expectancy (in years)
Caribbean average	1950-1955	97.2	13.0	57.3
	1980-1985	31.6	7.3	68.8
	2000-2005	18.9	7.4	71.1
	2005-2010	16.7	7.2	72.1

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] See Annexes 2 and 3 for details on sources and calculations.

Table 5
Fertility rates for Caribbean countries, 1950-2010[a]

		Crude Birth Rate per 1000 population	Total Fertility Rate per woman
Antigua and Barbuda	1950-1955	36.5	4.5
	1980-1985	20.8	2.1
	2000-2005	20.0	2.3
	2005-2010	18.0	2.2
Bahamas	1950-1955	33.7	4.1
	1980-1985	27.1	3.1
	2000-2005	15.7	1.9
	2005-2010	15.8	1.9
Barbados	1950-1955	34.4	4.4
	1980-1985	17.6	1.9
	2000-2005	13.3	1.8
	2005-2010	12.7	1.8
Belize	1950-1955	51.2	6.7
	1980-1985	39.9	5.4
	2000-2005	28.5	3.4
	2005-2010	24.5	2.8
Grenada	1950-1955	39.8	5.8
	1980-1985	32.5	4.2
	2000-2005	18.8	2.4
	2005-2010	19.3	2.3
Guyana	1950-1955	44.9	6.0
	1980-1985	31.1	3.6
	2000-2005	24.2	2.9
	2005-2010	21.4	2.7
Jamaica	1950-1955	34.3	4.2
	1980-1985	28.6	3.6
	2000-2005	20.0	2.5
	2005-2010	18.5	2.3
Saint Lucia	1950-1955	47.0	6.0
	1980-1985	33.3	4.2
	2000-2005	15.9	1.9
	2005-2010	13.7	1.6
Saint Vincent and the Grenadines	1950-1955	49.5	7.3
	1980-1985	29.2	3.6
	2000-2005	18.6	2.2
	2005-2010	17.7	2.1
Trinidad and Tobago	1950-1955	39.6	5.3
	1980-1985	28.9	3.3
	2000-2005	14.9	1.8
	2005-2010	15.3	1.8

Table 5 (concluded)

		Crude Birth Rate per 1000 population	Total Fertility Rate per woman
Caribbean average	1950-1955	41.1	5.4
	1980-1985	28.9	3.5
	2000-2005	19.0	2.3
	2005-2010	17.7	2.2

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] See Annexes 2 and 3 for details on sources and calculations.

The fertility decreases over the last sixty years have had a considerable impact on the age structure as shown by the decreased proportions in the youngest age groups. From table 6, it can be observed that in 1950 more than one third, 38 per cent of the combined population of the ten countries was under 15 years old. By 2000, the proportion had declined to 31 per cent and by 2010 accounted for just over one quarter (26 per cent) of the total population. The number of persons in productive age groups on the other hand (considered here to be between the ages of 15 and 64 years) increased at a higher rate than the total population between 1950 and 2000. In 1950, the population in this age group numbered about 1.8 million. By 2000, this number had doubled to approximately 3.7 million, increasing at an average annual rate of growth of 1.5 per cent compared to the 1.3 per cent growth for the total population. The comparison in growth becomes starker in the ten years since 2000 as the rate for the 15-64 age group was 1.3 per cent compared to the much lower 0.6 per cent for the total population over the same period. The oldest age group, the 65 years and over population, increased from 126 thousand in 1950, growing by a factor of nearly four, to 491 thousand by 2010. Rates of growth for this age group have been much higher than the productive (15-64 year) age group. The average annual rate of growth between 1950 and 2000 was 2.4 per cent for the oldest age group, falling to 1.8 per cent in the most recent ten years, in keeping with reduced rates of growth for the total population.

Table 6
Age distribution of the population, 1950-2010[a]
(Thousands and percentages)

	Number (in thousands)			
	Total Population	0-14	15-64	65+
1950	3 086.9	1 173.4	1 787.6	125.8
1960	3 797.1	1 628.9	2 011.1	157.2
1990	5 502.4	1 899.0	3 248.9	354.5
2000	5 943.3	1 842.3	3 688.9	412.0
2010	6 335.1	1 653.2	4 191.1	490.8
	Percentage of Total			
	Total Population	0-14	15-64	65+
1950	100	38.0	57.9	4.1
1960	100	42.9	53.0	4.1
1990	100	34.5	59.0	6.4
2000	100	31.0	62.1	6.9
2010	100	26.1	66.2	7.7

Table 6 (concluded)

	Average annual rate of growth (per cent)			
	Total Population	0-14	15-64	65+
1950-2000	1.3	0.9	1.5	2.4
2000-2010	0.6	-1.1	1.3	1.8

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] See Annexes 2 and 3 for details on sources and calculations.

Table 7, which presents indicators of ageing –the median age, the percentages of the population aged less than 15 years and 65 years and older, the old-age dependency ratio and the ageing index– shows Barbados as the country most advanced in the process of ageing. Around 2010, the median age for Barbados was approximately 37 years, 5 years older than the next highest, 32 years for Trinidad and Tobago and 6 years higher than Bahamas. Combined with this, Barbados had the lowest percentage of the youngest age group (19.9 per cent) and was the only country with more than 10 per cent aged 65 years and older (12.5 per cent) in 2010. Siegel and Swanson (2004) describe populations with median ages of less than 20 years as "young", those with medians of 30 years and over as "old" and those with medians of 20-29 years as of "intermediate" age. On the basis of this classification, the countries which could be classified as "old" are Barbados, Trinidad and Tobago, Bahamas and Saint Lucia. All other countries may be regarded as "intermediate". The position of Belize and Guyana should be noted as the countries with the youngest populations. For both countries, the youngest population accounted for more than one third of the population (36 per cent and 33 per cent respectively) with the proportion of the oldest being less than 5 per cent in both cases. Belize had the youngest median age (22 years) of all countries. The ageing index is calculated as the number of persons 60 years old and over per 100 under 15 years old. The higher the index, the older is the population. There is a considerable variation between countries. Barbados, with the oldest population, has an index of 87 per 100 and Belize, the youngest, has an index of approximately 16 per 100.

Table 7
Indicators of ageing, 2010[a]

	Median Age in Years	Percentage of Total Under 15 Years	65+ years	Old-age Dependency Ratio	Ageing Index
Antigua and Barbuda	29.3	26.6	6.7	11.5	33.6
Bahamas	30.9	22.5	7.0	11.3	46.6
Barbados	37.0	19.9	12.5	20.5	87.0
Belize	21.9	35.7	3.8	7.7	15.9
Grenada	25.0	27.5	7.2	13.3	35.0
Guyana	24.3	32.7	4.6	8.8	22.1
Jamaica	27.6	27.0	8.5	15.5	43.1
Saint Lucia	30.3	23.2	8.7	14.9	52.0
Saint Vincent and the Grenadines	27.9	26.5	6.7	11.8	35.9
Trinidad and Tobago	31.9	20.7	8.3	13.1	60.0
Caribbean average	28.6	26.2	7.4	12.8	43.1

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] See Annexes 2 and 3 for details on sources and calculations.

Figure 1
Population pyramids for the Caribbean (ten countries), 1950 and 2010
(Thousands)
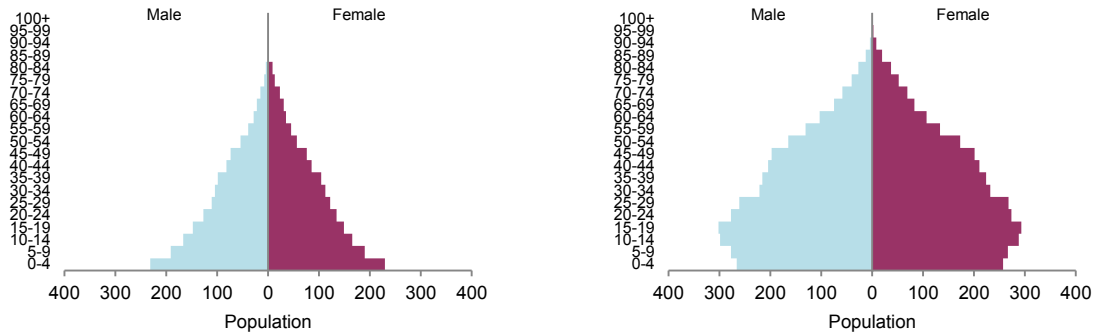
Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

Figure 1 provides graphical representations of the population in the form of population pyramids for 1950 and 2010. The pyramid for 1950 has the typical pyramid shape, a broad base with a pointed top. This depicts the structure for a young population, with a high percentage of children at the base and a very small percentage of older people at the top. The pyramid for 2010 shows a narrow base with a broader top, indicating a changing age structure with the population gradually becoming older.

It is useful to note how the ten Caribbean countries which feature in this study can be grouped into four distinct groups in respect of their demographic and economic characteristics. Figure 2 shows the ten countries on a scatter plot of GDP per worker versus the old-age dependency ratio. The countries fall into the following groups: Belize and Guyana, young populations with relatively low income; Trinidad and Tobago, Bahamas and Antigua and Barbuda, moderately advanced ageing with high income; Saint Lucia, Saint Vincent and the Grenadines and Grenada, moderately advanced ageing with moderate incomes; and finally Barbados, advanced ageing with medium income. In the results of the subsequent analysis, the within-group similarities and between-group differences among these countries will become evident in various ways.

Figure 2
Old-age dependency ratio versus GDP per worker, 2010
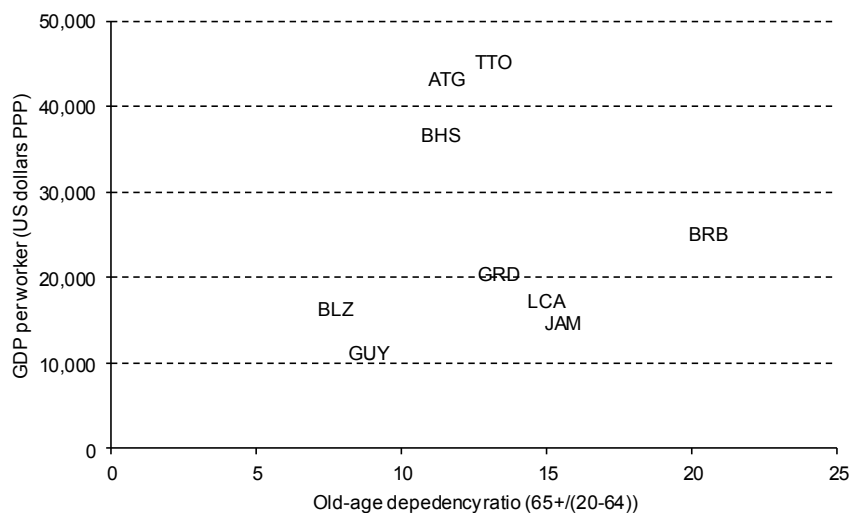
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures and United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

III. The impact of demography and policy on current levels of public expenditure on education, pensions and health

This section presents an analysis of how public expenditure on education, pensions and health care in Caribbean and OECD member countries is related to demography, specifically the age structure of the population. The analysis has been carried out using data for 2010, which is the base year for the projections of future expenditure which are presented in the subsequent section. The analysis and projections follow the model proposed by Miller, Mason and Holz (2011). As noted previously, this paper presents findings for ten Latin American countries and comparisons with OECD countries. The model provides a framework for analysing the relationship between public expenditure and the age structure of a country's population.

Public expenditure as a percentage of GDP can be expressed as the product of a benefit generosity ratio and a dependency ratio (see Annex 2). Taking the example of education, the benefit generosity ratio (BGR) would be public expenditure on education per school-age child/young person expressed as a proportion of GDP per worker. It can be thought of as the fraction of the average worker's income that is spent on education services for the average child or young person in the appropriate age range. The dependency ratio is simply the ratio of the school-age population to the working age population. In this section, this model is used to disaggregate estimates of expenditure on education, pensions and health for 2010 into these two components in order to analyse further the relationship between population age structure and public expenditure.

A. Education

Education in the Caribbean generally starts at the pre-primary level, around age 3 years, and continues up to the tertiary level at age 21 years. Compulsory education for the most part covers 12 years from about age 5 years up to 15 years (see table 8).

In 2010, public expenditure on education for the group of ten Caribbean countries averaged 4.3 per cent of GDP (see table 9). The table shows that the countries spending above this average were Belize (6.6 per cent), Jamaica (6.3 per cent), Barbados (5.9 per cent) and Saint Vincent and the Grenadines (5.1 per cent). Three countries spent just below the average, Grenada (4.0 per cent), Guyana (3.7 per cent) and Saint Lucia (3.6 per cent). At the other end of the spectrum were three countries well below the average, Trinidad and Tobago (2.9 per cent), Antigua and Barbuda (2.6 per cent) and Bahamas

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(2.3 per cent). Expenditure on primary, secondary and post-secondary non-tertiary education combined amounted to about 2 per cent or more of GDP in all countries and exceeded 3 per cent in 6 countries – Belize (5.9 per cent), Jamaica (4.7 per cent), Barbados (4.1 per cent), Saint Vincent and the Grenadines (4 per cent), Grenada (3.4 per cent) and Saint Lucia (3.3 per cent).

Table 8
Official school systems for Caribbean countries by educational level and age[a]
(Years of age)

	Pre-Primary	Primary	Secondary	Post-Secondary	Tertiary	Compulsory Education Age Group
Antigua and Barbuda	3-4	5-11	12-16	Not identified	17-21	5-15
Bahamas	3-4	5-10	11-16	Not identified	17-21	5-16
Barbados	3-4	5-10	11-15	Not identified	16-20	5-15
Belize	3-4	5-10	11-16	Not identified	17-21	5-12
Grenada	3-4	5-11	12-16	Not identified	17-21	5-16
Guyana	4-5	6-11	12-16	Not identified	17-21	6-11
Jamaica	3-5	6-11	12-16	Not identified	17-21	6-11
Saint Lucia	3-4	5-11	12-16	Not identified	17-21	5-14
Saint Vincent and the Grenadines	3-4	5-11	12-16	Not identified	17-21	5-16
Trinidad and Tobago	3-4	5-11	12-16	Not identified	17-21	6-11

Source: The United Nations Educational, Scientific and Cultural Organization (UNESCO).
[a] See Annex 2 for details on source.

Table 9
Public expenditure on education by level for Caribbean countries
and average for OECD countries, 2010[a]
(Percentages of GDP)

	Pre-Primary	Primary	Secondary	Post-Secondary	Tertiary	Expenditure on Education (% of GDP)
Antigua and Barbuda	0.0	1.1	1.2	0.1	0.2	2.6
Bahamas	0.1	0.9	0.9	0.1	0.3	2.3
Barbados	0.0	2.2	1.7	0.2	1.8	5.9
Belize	0.1	3.0	2.7	0.2	0.6	6.6
Grenada	0.1	1.6	1.6	0.2	0.6	4.0
Guyana	0.5	1.3	1.5	0.1	0.2	3.7
Jamaica	0.3	2.3	2.3	0.1	1.4	6.3
Saint Lucia	0.1	1.5	1.6	0.2	0.2	3.6
Saint Vincent and the Grenadines	0.1	1.8	1.6	0.6	0.3	5.1
Trinidad and Tobago	0.1	1.2	1.1	0.1	0.4	2.9
Caribbean average	0.1	1.7	1.6	0.2	0.6	4.3
OECD (29) average	0.5		3.6		1.1	5.3

Source: The United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Organisation for Economic Co-operation and Development (OECD) (Education at a Glance 2013).
[a] See Annex 2 for details on sources.

Expenditure on tertiary education amounted to more than 1 per cent in only two countries, Barbados (1.8 per cent) and Jamaica (1.4 per cent), while every country spent less than 1 per cent on pre-primary education. The comparison with the OECD countries shows marked differences by level of education. The OECD countries spent significantly more on pre-primary education (0.5 per cent compared to the Caribbean average of 0.1 per cent) but almost the same percentage on primary, secondary and post-secondary non-tertiary combined. The comparison for tertiary level spending shows

that expenditure by the richer countries for this level was 1.8 times more than average expenditure in the Caribbean countries.

Table 10 presents the main elements of this age-related disaggregation of expenditure on education for Caribbean and OECD countries in 2010. The expenditure per student is calculated from the expenditure on education divided by the school-age population (0 to 24 years is used as a proxy); the sector dependency ratio is the school-age population (0 to 24) as a percentage of the working-age population (20-64). The output per worker is simply the total GDP divided by the working-age population and the benefit generosity ratio (BGR) is as previously defined.

On average, the annual spending per student among the ten Caribbean countries was US$ 1,316 (PPP), far less than the average of US$ 6,599 (PPP) for the OECD countries. This is because the average GDP per worker among Caribbean countries was less than half that for OECD countries and because the Caribbean education (or school-age) dependency ratio is much higher, so expenditure is spread more thinly. Among the Caribbean countries, the variation in expenditure per student was quite considerable. Barbados (US$ 2,718) spent 6.4 times more than Guyana (US$ 424) while Trinidad and Tobago (US$ 2,237) spent 5.3 times more. The expenditure per student of US$ 969 for Belize was about 36 per cent that for Barbados (US$ 2,718).

Table 10
Education: expenditure, dependency ratios, worker output and benefit generosity, 2010[a]
(Percentages and dollars)

	Aggregate Spending (Per cent of GDP)	Expenditure per Student (US$ PPP)	Education Dependency Ratio	Worker Output (US$ PPP)	Benefit Generosity Ratio (Per cent)
Antigua and Barbuda	2.6	1 504	74.8	47 345	3.5
Bahamas	2.3	1 295	65.4	36 830	3.5
Barbados	5.9	2 718	54.8	25 261	10.8
Belize	6.6	969	112.4	16 500	5.9
Grenada	4.0	897	91.5	20 538	4.4
Guyana	3.7	425	98.8	11 333	3.7
Jamaica	6.3	1 114	83.8	14 815	7.5
Saint Lucia	3.6	887	70.8	17 439	5.1
Saint Vincent and the Grenadines	5.1	1 115	79.1	17 302	6.4
Trinidad and Tobago	2.9	2 237	58.7	45 292	4.9
Caribbean average	**4.3**	**1 316**	**79.0**	**24 865**	**5.6**
OECD average (31 countries)	**5.3**	**6 599**	**50.4**	**60 017**	**10.7**
Denmark	7.5	10 768	51.3	73 596	14.6
Australia	4.3	5 792	54.4	73 207	7.9
Italy	4.2	6 272	39.4	58 829	12.1

Source: Author's calculations and Organisation for Economic Co-operation and Development (OECD) (Education at a Glance 2013, tables B2.3 and B3.3, data relate to 2011).
[a] See Annexes 2 and 3 for details on sources, calculations and PPP conversion rates.

The table shows Belize and Guyana as the countries with the highest education dependency ratios. Belize is at one extreme with 112 persons of school-age (or university age) to every 100 workers followed by Guyana with a ratio of 99 per 100. At the other end of the spectrum are Barbados and Trinidad and Tobago with school-age (0 to 24) populations of a little more than half of the working population, yielding dependency ratios of about 55 per 100 and 59 per 100 respectively. On average, the school-age population was about four-fifths of the size of the working-age population in the Caribbean whereas in OECD countries the ratio was much lower at 50 per 100, an indication of the relatively higher level of youthfulness of the Caribbean population.

With much lower spending per person, the benefit generosity ratio for the Caribbean countries averaged 5.6 per cent of GDP per worker in 2010. This compared to 10.7 per cent among the OECD countries. Denmark stands out as the OECD member country with the highest aggregate spending on education (7.5 per cent) and a benefit generosity ratio of 14.6 per cent. The US$ 10,768 expenditure per student for Denmark was above the average for all OECD members and considerably higher than the average for the ten Caribbean countries. Australia and Italy are at the lower end of the scale in terms of aggregate spending, around 4 per cent of GDP, at the same level as the Caribbean countries. Australia has a younger population than Italy and so spending per young person is less generous. However, it has a relatively high GDP per worker and therefore education spending per student is almost as high as in Italy (US$ 5,792 versus US$ 6,272) and in both spending is much higher than in Caribbean countries.

Figure 3 shows how aggregate expenditure is the product of the benefit generosity ratio and the school-age dependency ratio for the 10 Caribbean countries and OECD member countries. The isoquant curves show the range of expenditure from 1 per cent to 9 per cent of GDP. While the difference in average aggregate spending between the two groups is only 1 percentage point of GDP, the graph illustrates the considerable difference between the Caribbean countries (high school-age dependency ratios; low per student expenditure) and the OECD countries (low school-age dependency ratios; high per student expenditure). Only Barbados, which by Caribbean standards has a relatively old population and high expenditure on education, is close to the OECD countries in respect of these measures.

Figure 3
Expenditure on education as a percentage of GDP
disaggregated by education dependency ratio and benefit generosity ratio
for Caribbean and OECD countries, 2010[a]
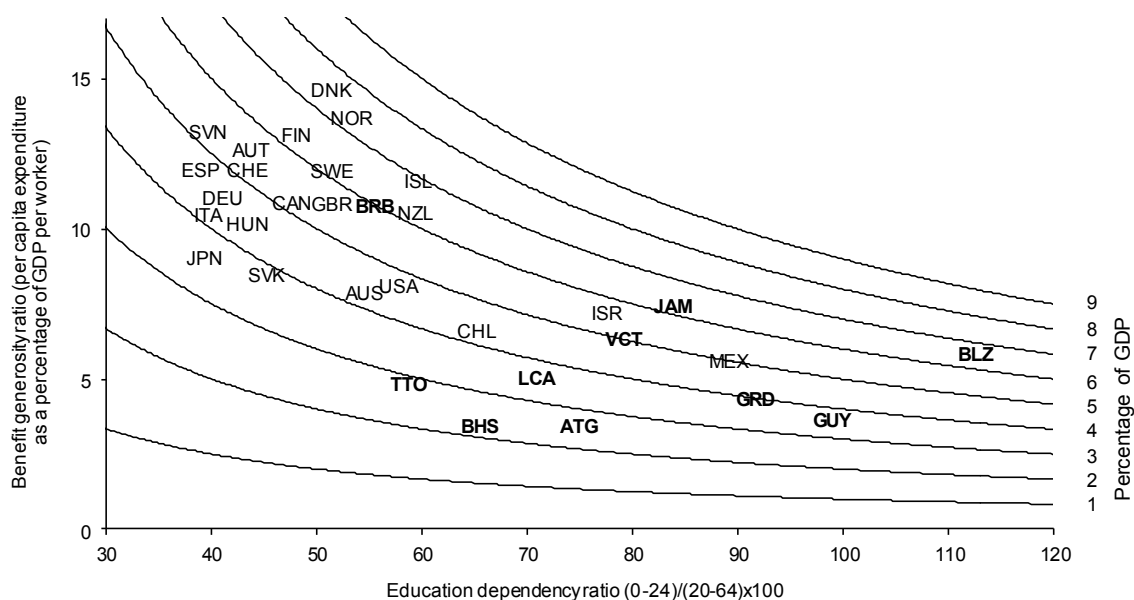
Source: Author's calculations (based on table 10).
[a] See Annex 4 for country codes.

B. Pensions

Like education, pension benefits have a clearly defined target age group. Of the three areas of expenditure under consideration, that for pensions presented the most challenges due to the relative complexity of pension systems and data limitations. There are three main forms of public pension in Caribbean countries: contributory national insurance pensions, pensions for government workers (generally non-contributory), and non-contributory or social pensions. Government pensions are paid out of the government's budget, while national insurance pensions in Caribbean countries are paid out of the

national insurance funds into which employers and employees pay contributions at fixed rates. The schemes provide a number of pensions, benefits and awards classified as long term or short term. For this study of Caribbean countries, only long term pensions (not awards or benefits) are included. Specifically the pensions considered are old age, invalidity and survivors' pensions. Employment injury benefits are excluded.

Civil service and other public sector pension schemes, which are often non-contributory, are financed directly from government budgets. The statutory pensionable age is around 62 years on average (see table 11). The pensionable age is typically defined to be the age at which people can first receive a full pension. Allowance is made for early retirement including in some cases for retirement before age 60 based on specific terms and conditions. There are small percentages of pensioners aged under 60 years receiving old age pensions. Table 12 shows that, on average, for the group of 10 countries the allocation of national budgets to pensions for civil servants and other government workers in 2010 was around 6 per cent of government expenditure. There is a clear distinction in the national budgets between payment of pensions for workers and payment of contributions to the national insurance schemes which enabled these two distinct forms of pensions to be separately identified (although often government pensioners also receive national insurance pensions).

Table 11
Pensionable ages in Caribbean countries, 2010
(Years of age)

	Statutory pensionable age		Early pensionable age	
	Men	*Women*	*Men*	*Women*
Antigua and Barbuda	60	60		
Bahamas	65	65	60	60
Barbados	66.5	66.5	62	62
Belize	65	65	60	60
Grenada	60	60		
Guyana	60	60		
Jamaica	65	62		
Saint Lucia	65	65	60	60
Saint Vincent and the Grenadines	60	60		
Trinidad and Tobago	60	60		
Average	62	62		

Source: IMF Working Paper (2016) National Insurance Scheme Reforms in the Caribbean. Some countries have no early pensionable age, some have it only for specific groups and for others there is no information.

Table 12
Expenditure on pensions and retirement benefits for Caribbean government workers around 2010[a]
(Percentages of recurrent budget)

	Expenditure on pensions and retirement benefits
Antigua and Barbuda	7.8
Bahamas	3.5
Barbados	7.1
Belize	7.0
Grenada	7.6
Guyana	6.9
Jamaica	4.8
Saint Lucia	5.8
Trinidad and Tobago	5.4
Average	6.2

Source: National budgets.
[a] See Annex 2 for details on sources.

The age distribution of pensioners presented in table 13 shows the preponderance of pensioners at age 60 years and older. Note should be taken of the more than one-fifth of recipients of survivors pensions who are less than 40 years old.

Table 14 summarises total expenditure on pensions around 2010 for nine Caribbean countries. Averages for the OECD in 2009 are also included for comparison. The table shows expenditure per older person, calculated as the expenditure on pensions divided by the population of pensionable age, the pension sector dependency ratio which is defined as the population of pensionable age as a percentage of the working-age population, the support ratio and the benefit generosity ratio. The support ratio is the inverse of the pension dependency ratio and relates the working-age population (those capable of proving economic support) to the elderly (the older people that may be dependent on the support of others). In order to maintain consistency with the OECD data, the per capita expenditure and benefit ratios shown in the table have been calculated with pensionable age deemed to be 65 years and over, notwithstanding the retirement of some people at younger ages. These ratios therefore differ from the estimates used in the calculation of the projections which are presented in the following section, which cover the entire age range in receipt of pensions. The OECD countries included in the table are the three with the highest level of aggregate spending and the three with the lowest levels.

Table 13
Age distribution of pensioners by type of pension for 9 Caribbean countries, 2010[a,b]
(Percentages; total of nine countries)

	National Insurance pensioners				Government pensioners	Total pensioners
	Old Age	*Invalidity*	*Survivors*	*Total*		
Under 40	0.0	3.9	22.4	5.1	0.2	4.1
40-44	0.0	5.4	2.1	0.8	0.4	0.7
45-49	0.0	8.9	3.8	1.3	0.6	1.2
50-54	0.0	14.3	5.0	1.8	1.0	1.7
55-59	0.0	19.3	6.2	2.4	1.3	2.2
60+	100.0	48.2	60.5	88.6	96.6	90.2
65+	78.0	15.5	50.1	68.6	73.0	69.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Annual reports of national insurance schemes, national budgets and special reports.
[a] Saint Vincent and the Grenadines excluded for lack of data.
[b] See Annexes 2 and 3 for details on sources and calculations.

Table 14
Pensions: expenditure, dependency ratios, worker output and benefit generosity, 2010[a]
(Percentages and US dollars)

	Aggregate Spending (Per cent of GDP)	Expenditure per Old Age Pensioner (US$ PPP)	Pension Dependency Ratio	Support Ratio	Worker Output (US$ PPP)	Benefit Generosity Ratio (Per Cent)
Antigua and Barbuda	4.5	16 965	11.5	8.7	43 345	39.1
Bahamas	2.4	7 710	11.3	8.8	36 830	20.9
Barbados	6.5	8 047	20.5	4.9	25 261	31.9
Belize	2.7	5 824	7.7	13.0	16 500	35.3
Grenada	3.3	5 110	13.3	7.5	20 538	24.9
Guyana	4.0	5 124	8.8	11.3	11 333	45.2
Jamaica	2.4	2 301	15.5	6.5	14 815	15.5
St Lucia	2.8	3 275	14.9	6.7	17 439	18.8
Trinidad and Tobago	4.4	15 371	13.1	7.7	45 292	33.9
Caribbean average	**3.7**	**7 747**	**12.9**	**7.3**	**25 706**	**29.5**
OECD average	**7.7**	**16 863**	**25.1**	**4.4**	**56 554**	**30.9**

Table 14 (concluded)

	Aggregate Spending (Per cent of GDP)	Expenditure per Old Age Pensioner (US$ PPP)	Pension Dependency Ratio	Support Ratio	Worker Output (US$ PPP)	Benefit Generosity Ratio (Per Cent)
Italy	15.3	25 728	33.2	3.0	55 767	46.1
France	13.2	28 225	28.7	3.5	61 303	46.0
Austria	13.1	30 432	28.4	3.5	65 879	46.2
Korea	2.0	5 348	16.4	6.1	43 709	12.2
Mexico	1.8	4 340	10.7	9.4	25 737	16.9
Iceland	1.6	5 397	20.2	5.0	68 110	7.9

Source: Author's calculations and Organisation for Economic Co-operation and Development (OECD) (Pensions at a Glance 2009).
[a] See Annexes 2 and 3 for details on sources, calculations and PPP conversion rates.

On average the elderly population is about 13 per cent of the size of the working age population in the Caribbean compared to 25 per cent in OECD countries. The pension sector dependency ratios (from the table and graphically represented in figure 4) show that at one extreme is Barbados with an elderly population of about one-fifth of the size of the working-age population. At the other extreme, Belize and Guyana have elderly populations of less than one-tenth of the size of the working age population with dependency ratios of 7.7 and 8.8 respectively. Barbados, as the demographically oldest country, has the lowest support ratio of 4.9 per cent. On average there were about 5 people of working age for every older person in Barbados in 2010. The average for the Caribbean countries was about 7 people of working-age to every older person. Belize and Guyana had the highest ratios of 13.0 per cent and 11.3 per cent respectively.

In 2010, the average share of GDP devoted to pension payments by the group of 9 Caribbean countries was 3.7 per cent. Barbados (6.5 per cent), Antigua and Barbuda (4.5 per cent) and Trinidad and Tobago (4.4 per cent) allocated the most while Bahamas, Belize, Jamaica and Saint Lucia all allocated between 2.4 and 2.8 per cent of GDP to pensions. Comparisons with the OECD average pension expenditure show that the Caribbean highest of 6.5 per cent in 2010 was a little more than one percentage point of GDP lower than the OECD average of 7.7 in 2009. While the average expenditure on pensions for the 9 Caribbean countries, 3.7 per cent of GDP, was around a quarter of the amount spent by Italy (15.3 per cent), it was significantly more than that spent by Korea (2.0 per cent), Mexico (1.8 per cent) and Iceland (1.6 per cent).

Figure 4
Expenditure on pensions as a percentage of GDP
disaggregated by old-age dependency ratio and benefit generosity ratio
for Caribbean and OECD member countries, 2010[a]
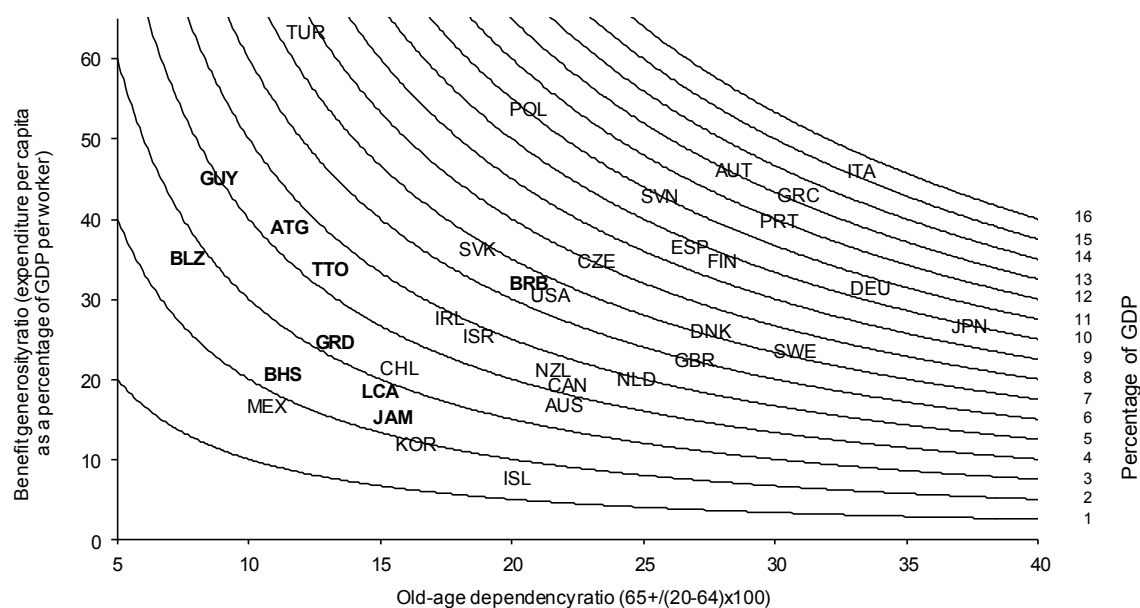
Source: Author's calculations (based on Table 14).
[a] See Annex 4 for country codes.

An examination of the benefit generosity ratios for old age pensions in table 14 shows that average public pension benefits for Caribbean pensioners, at 29.5 per cent of GDP per worker, was close to the average of 31 per cent of GDP per worker for OECD member countries. Among the Caribbean countries, the benefit generosity ratios ranged from a low of 16 per cent for Jamaica to the highest of 45 per cent for Guyana. Other countries with benefit ratios higher than the Caribbean average of 29.5 per cent were Antigua and Barbuda (39 per cent), Belize (35 per cent) and Trinidad and Tobago 34 per cent. Within the OECD group, the benefit generosity ratio ranged from a low of approximately 8 per cent for Iceland to 46 per cent for Italy, a 38 percentage point difference. This is a larger variation than among the Caribbean countries.

Figure 4 illustrates how the Caribbean countries together have much lower old-age dependency ratios than many OECD countries but that the average benefit generosity ratio for pensions is only slightly lower than for the OECD countries. Benefit generosity ratios for Caribbean countries like Guyana, Antigua and Barbuda, Belize and Trinidad and Tobago are higher than for some OECD member countries. This is in contrast to the benefit generosity ratios for education where there was a much larger difference between Caribbean and OECD countries. This could be because until now it has been relatively easier for Caribbean countries to provide slightly more generous funding of pensions than education because for a long time there were many fewer older persons compared with children. It should also be noted that OECD countries are by no means a homogenous group. The European countries tend to have more generous public pensions but this is not the case for countries such as Australia, Israel, Korea and New Zealand.

C. Health

As previously discussed, an important part of the process of demographic transition was the fall in mortality levels brought about by overall improvements in public health. This has led to what has been described as the epidemiological transition, a parallel process through which the main causes of mortality gradually change from a "predominance of acute, infectious, and parasitic diseases to a

predominance of chronic, endogenous, accident-related and self-imposed conditions" (Olshansky and others, 1977 as quoted in Siegel and Swanson, 2004). Rising average age from the demographic transition and changing lifestyles mean that people are becoming more exposed to the risk factors associated with chronic diseases. On this account, it follows that the demographic transition can be seen as changing the state of health of the population thereby impacting the demand and costs associated with medical care. Studies of expenditure on health care have therefore tended to focus on spending within the context of disease prevalence and lifestyle habits, as for example (Glassman and Zoloa, 2014).

Table 15
Estimates of near-death population, 2010
(Percentages)

	Near-death population
Antigua and Barbuda	5.9
Bahamas	5.9
Barbados	10.3
Belize	5.3
Grenada	7.5
Guyana	8.0
Jamaica	6.9
Saint Lucia	6.9
Saint Vincent and the Grenadines	7.1
Trinidad and Tobago	9.1
Average	7.3

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

Unlike education and pensions, it is more difficult to identify a specific demographic group to which health spending is directed. In the discussions on the influence of ageing on public health expenditure, researchers have introduced the concept of 'near death' and more specifically the number of people near death as a demographic measure. In this analysis, the health sector dependency ratio is defined as the number of persons close to death in the population divided by the working-age population (aged 20 to 64). The estimate of persons close to death is the annual number of deaths multiplied by 10. This is regarded as a good approximation of the number of people within 10 years of death. In support of the concept, Miller, Mason and Holz (2011) make reference to studies of OECD countries which have shown that most health costs for individuals occur in the final decade of life, and in that decade in the final year of life (Zeifel and others, 1999; McGrail and others, 2000; Miller, 2001; Lubitz and others, 2003). Most health systems devote a large percentage of their resources to curative and palliative services rather than preventive services, they conclude. With the assumption therefore that all health care spending is directed toward those in their last decade of life, the benefit generosity ratio measures the average annual expenditure on health care for these persons near to death, relative to the average GDP per worker.

The near-death population was estimated based on the average annual number of deaths for the period 2005-2015 in the United Nations World Population Prospects 2017 database. This annual average was multiplied by 10. Table 15 presents the near-death population as a percentage of the total population. Table 16 presents comparable data on public expenditure on health care for Caribbean countries and for a selection of OECD countries.

There is relatively little difference in the average health sector dependency ratios for the two groups of countries with the near-death population equivalent to about 13 per cent of the working-age population for the Caribbean compared to 14 per cent for the OECD countries. It is instructive to note that only 1 percentage point separated the average crude death rates for both groups of countries around

2010. The average crude death rate for the OECD countries was 8.5 per 1,000 compared to 7.5 per 1,000 for the 10 Caribbean countries. Barbados, the demographically oldest country is at the high end of the spectrum with a near death population which is 17 per cent of the working population. Guyana which is considered among the demographically younger populations has the second highest health dependency ratio of approximately 15 per cent. At the lowest end of the spectrum is Bahamas with a ratio of about 10 per cent. While Caribbean countries have younger populations, age-specific mortality rates are likely to be higher for a variety of reasons. This helps to explain why the average near-death dependency ratio for Caribbean countries is only slightly lower than that for OECD countries.

Table 16
Health: expenditure, dependency ratios, worker output and benefit generosity, 2010[a]
(Percentages and dollars)

	Aggregate Spending (Per cent of GDP)	Expenditure per Person US$ PPP	Health Sector Dependency Ratio	Worker Output US$ PPP	Benefit Generosity Ratio (Per Cent)
Antigua and Barbuda	4.3	18 178	10.3	43 345	41.9
Bahamas	3.5	13 441	9.6	36 830	36.5
Barbados	4.3	6 385	17.0	25 261	25.3
Belize	3.9	6 078	10.6	16 500	36.8
Grenada	2.7	4 054	13.7	20 538	19.7
Guyana	4.4	3 235	15.4	11 333	28.5
Jamaica	3.0	3 530	12.6	14 815	23.8
Saint Lucia	4.2	6 170	11.9	17 439	35.4
Saint Vincent and the Grenadines	3.9	5 396	12.5	17 302	31.2
Trinidad and Tobago	2.9	9 204	14.3	45 292	20.3
Caribbean average	**3.7**	**7 567**	**12.8**	**24 865**	**30.0**
OECD average	**6.7**	**32 538**	**13.6**	**61 018**	**51.6**
Sweden	9.9	44 756	16.6	74 856	59.8
Denmark	9.3	40 455	16.9	73 655	54.9
New Zealand	9.3	45 164	11.2	54 502	82.9
Netherlands	9.1	51 735	13.4	76 321	67.8
Korea	3.9	24 397	7.7	48 088	50.7
Mexico	3.1	11 152	8.0	28 658	38.9

Sources: Author's calculations and World Health Organization (WHO) (for OECD countries, figures relate to 2011).
[a] See Annexes 2 and 3 for details on sources, calculations and PPP conversion rates.

The relationship between the size of the 'near-death' population and health spending is less clear than was the case for education and pensions. There are relatively young countries with high levels of benefit generosity or aggregate health expenditure and there are relatively older countries that also have high health expenditure. This is partly because whereas education and health spending is directed to a specific age group, health expenditure is directed at the entire population albeit with an age profile weighted towards older persons.

Aggregate expenditure is about 1.8 times higher, and the average benefit generosity ratio 1.7 times higher in OECD countries compared with Caribbean countries, due to their greater ability to fund that expenditure. For example, Barbados has about the same dependency ratio as Denmark and Sweden but has an expenditure that is about one-half (as a percentage of GDP). In 2010, Caribbean countries spent roughly similar proportions of national income on public healthcare services, on average 3.7 per cent of GDP. Neither the relative age of populations, nor levels of GDP, appear to explain the differences in health spending observed among Caribbean countries. The variation in health spending among the ten countries ranged from the lowest, 2.7 per cent, for Grenada to the highest, 4.4 per cent, for

Guyana. Apart from Grenada, Bahamas (3.5 per cent), Jamaica (3.0 per cent) and Trinidad and Tobago (2.9 per cent) were the only other countries with allocations less than the average.

This analysis has highlighted the way that spending on education, pensions and healthcare can be analysed as a function of demography and the generosity of spending per person in the beneficiary age group. In following section, this model is extended in order to make projections of public expenditure in each of these three areas.

Figure 5
Expenditure on health as a percentage of GDP
disaggregated by health sector dependency ratio and benefit generosity ratio
for Caribbean and OECD member countries, 2010[a]
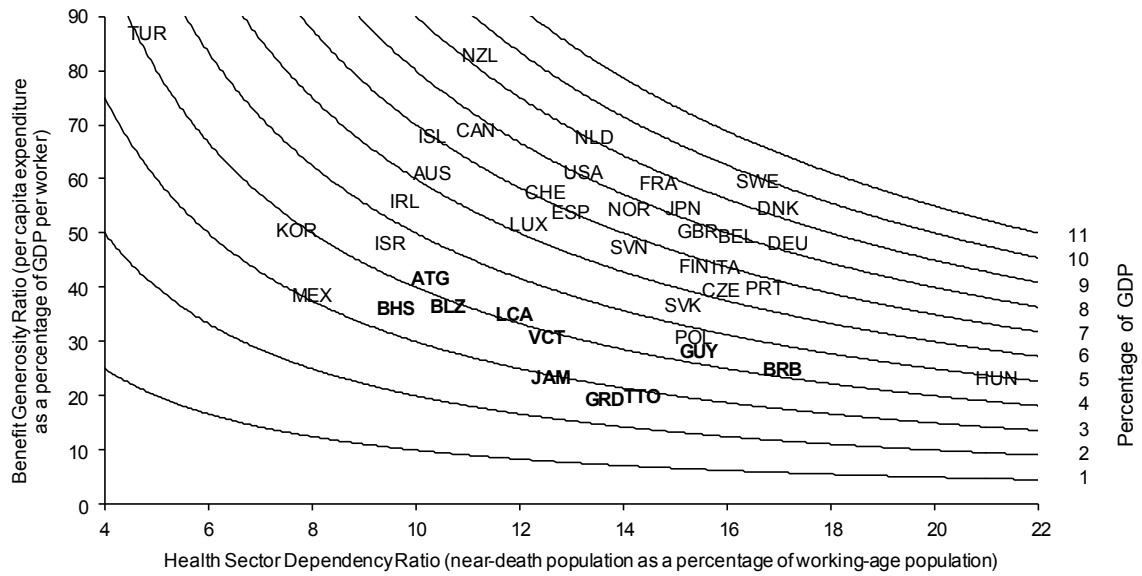
Source: Author's calculations (based on table 16).
[a] See Annex 4 for country codes.

IV. The impact of demography and economic change on future levels of public expenditure on education, pensions and health

According to the medium variant of the United Nations Population projections (2017), by 2030 all of the Caribbean countries appearing in this study with the exception of Belize and Guyana are expected to have fertility below replacement level of 2.1 children per woman. Belize will be at replacement level and Guyana will have a rate at just above (2.2 children per woman). By the end of the projection period all countries are expected to be below replacement level.

Overall, the population for the group of ten countries in this study will continue to grow over the projection period 2010-2050, albeit at a much lower average annual rate of about 0.14 per cent (see table 17). This table also shows that in the latter part of the projection period, the total population will start to decline. Variations in growth at the country level are expected, with Belize being the only country that will show a comparatively high rate of growth of 1.5 per cent over the period. Jamaica and Trinidad and Tobago will have smaller populations at 2050 than at 2010, therefore showing average annual rates of decline over the period. The populations of Barbados and Saint Vincent and the Grenadines are projected to be of the same size in 2050 as they were in 2010.

Of special significance for the economy and public expenditure are the anticipated changes in the age structure over the projection period, as can be observed from table 18 and figure 6. The most distinctive feature of the projection period is the acceleration of ageing as evidenced by the expected increase in the elderly population in the group of ten countries. The 65 years and over age group will rise by more than two and a half times from 491 thousand to 1.3 million over the projection period at an annual rate of growth of 2.5 per cent, much more than the 0.14 per cent for the total population. Simultaneous with this large increase will be a relatively small upward movement from 3,596 thousand to 3,854 thousand, at an average annual rate of growth of 0.17 per cent, among the working-age population. The result will be an increase in the old-age dependency ratio (calculated as the ratio of the population aged 65 and over per 100 population 20-64) which is expected to more than double from 13.7 per cent to 33.8 per cent in 2050 (see table 19). The age–sex pyramid, shown in figure 6, illustrates the transformation of the age structure between 2010 and 2050 and the projected increase in the proportion of older persons.

Table 17
Population change during the projection period, 2010-2050[a]
(Thousands)

	2010	2020	2030	2040	2050	Average Annual Rate of Growth (per cent) 2010-2050
Antigua and Barbuda	95	105	115	122	125	0.70
Bahamas	361	407	440	461	475	0.69
Barbados	280	288	290	287	280	0.01
Belize	322	398	473	538	592	1.54
Grenada	105	109	112	112	110	0.11
Guyana	747	791	825	835	822	0.24
Jamaica	2 817	2 913	2 933	2 858	2 704	-0.10
Saint Lucia	173	181	186	187	182	0.14
Saint Vincent and the Grenadines	109	111	112	112	109	0.00
Trinidad and Tobago	1 328	1 378	1 374	1 343	1 295	-0.06
Total	6 335	6 680	6 859	6 855	6 695	0.14

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a]See Annexes 2 and 3 for details on calculations and source.

Table 18
Age distribution of the population, 2010 and 2050[a]
(Thousands)

	2010			2050		
	0-19	20-64	65+	0-19	20-64	65+
Antigua and Barbuda	33.5	54.9	6.3	29.8	71.1	24.3
Bahamas	114.0	221.8	25.1	101.7	272.1	101.2
Barbados	74.8	169.9	34.9	64.3	144.8	71.3
Belize	149.3	160.1	12.3	167.7	364.1	60.6
Grenada	39.9	57.2	7.6	25.8	65.0	18.8
Guyana	327.1	385.4	34.0	233.2	494.0	94.7
Jamaica	1 037.8	1 541.2	238.2	577.2	1 531.5	594.8
Saint Lucia	56.9	100.6	15.0	32.3	104.4	45.6
Saint Vincent and the Grenadines	39.5	62.4	7.4	24.5	64.0	21.2
Trinidad and Tobago	375.2	842.8	110.1	280.7	743.5	270.9
Total	2 248.0	3 596.3	490.8	1 537.2	3 854.5	1 303.4

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a]See Annex 2 for details on source.

As in 2010, the country with the highest dependency ratio in 2050 will be Barbados. By the end of the projection period there will be about 5 older persons to every 10 persons of working-age in Barbados. By then, there will also be a further six countries with dependency ratios of 30 per cent or more: Saint Lucia (44 per cent), Jamaica (39 per cent), Bahamas (37 per cent), Trinidad and Tobago (36 per cent), Antigua and Barbuda (34 per cent) and Saint Vincent and the Grenadines (33 per cent). Belize will remain the country with the youngest population with a dependency ratio of 17 per 100, albeit showing a more than 100 per cent increase over 2010.

The ageing index which measures the relationship between the elderly and the youngest will rise from an average of 43 per cent to 152.5 per cent over the period as the increases among the elderly, as

described, are accompanied by a decline of over 25 per cent among the youngest (in this case those under 15 years old) from 1.7 million to 1.1 million.

Figure 6
Population pyramids for ten Caribbean countries, 2010 and 2050
(Thousands)
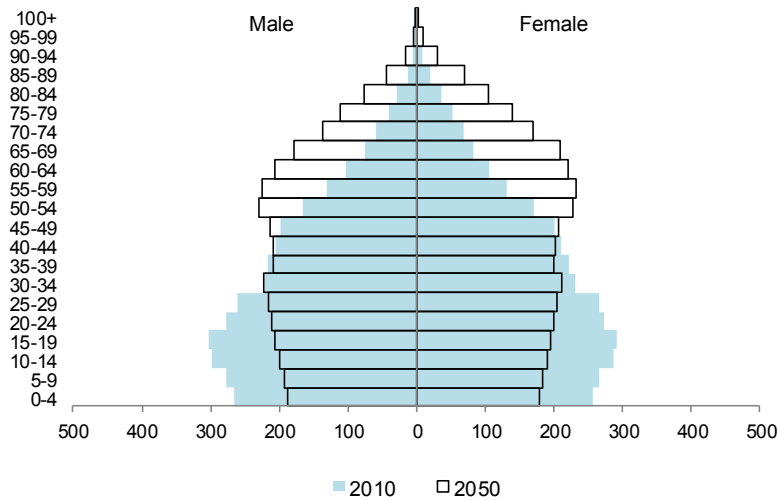
Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

Table 19
Growth rates by age over the projection period, and old-age dependency ratio and ageing index in 2050[a]

	Average Annual rate of Growth (percentage) 2010-2050 by age group			Old-age Dependency Ratio 2050	Ageing Index: 2050
	0-19	20-64	65+		
Antigua and Barbuda	-0.3	0.6	3.4	34.2	141.4
Bahamas	-0.3	0.5	3.5	37.2	174.1
Barbados	-0.4	-0.4	1.8	49.2	181.2
Belize	0.3	2.1	4.1	16.6	71.9
Grenada	-1.1	0.3	2.3	28.9	142.5
Guyana	-0.8	0.6	2.6	19.2	73.2
Jamaica	-1.5	0.0	2.3	38.8	185.7
Saint Lucia	-1.4	0.1	2.8	43.7	251.1
Saint Vincent and the Grenadines	-1.2	0.1	2.7	33.1	157.6
Trinidad and Tobago	-0.7	-0.3	2.3	36.4	175.2
Total	-0.9	0.2	2.5	33.8	152.5

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] See Annexes 2 and 3 for details on sources and calculations.

These changes in the age structure of Caribbean populations will impact public expenditure in each of the three areas under study. The remainder of this section sets out projections of future expenditure on education, health and pensions, based on an age-disaggregated version of the model

described in the previous section. The two main inputs to the projections are the benefit generosity ratios by five year age groups and dependency ratios also by five year age groups. The two sets of projections are described as 'ageing only' and 'ageing and economic change'. For the 'ageing only' projections, the assumption is that the age-disaggregated benefit generosity ratios remain constant over time and therefore the projections represent only the impact of ageing on public expenditure. In contrast, the 'ageing and economic change' projections assume that benefits will become more generous as real GDP increases.

Figure 7 compares the average benefit generosity ratios by age for Caribbean and OECD countries for education and health, and the averages for Caribbean and European Union countries for pensions. As would be expected, expenditure on education is focused mainly on persons aged 5-19, expenditure on pensions on persons aged 60 and over, and expenditure on health is distributed across all ages but with per capita expenditure on older persons significantly higher than that for other age groups. It can also be seen that the benefit generosity ratios for OECD/EU countries are higher than for Caribbean countries.

Figure 7
Benefit generosity ratio by age for education, pensions and health
for Caribbean and OECD/EU countries (averages), 2010[a,b]
(Expenditure per capita as a percentage of GDP per worker)
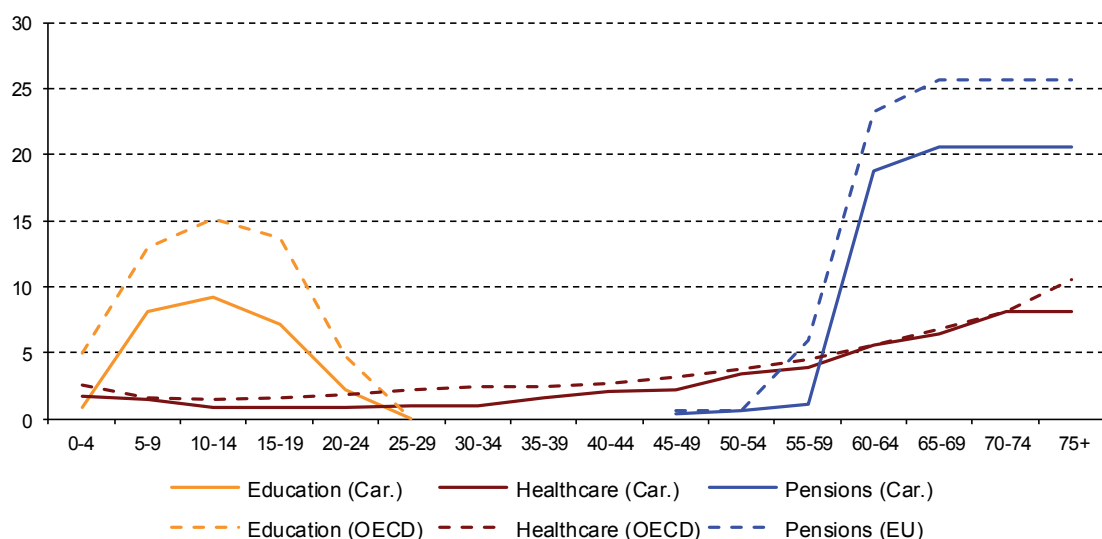
Source: Author's calculations.
[a] The very small proportion of pensions paid to persons younger than 45 are not shown.
[b] The use of pension data from EU countries, rather than OECD countries, was dictated by data availability.

Expenditure can be projected based on the assumption that the BGRs for Caribbean countries remain constant and that the only change which takes place is the evolution of the age structure of the population. The BGRs are thus combined with population projections to produce 'ageing only' projections of future expenditure on education. These 'ageing only' projections are useful in that they isolate the impact of demography on expenditure. However, they make no allowance for any change in the BGRs. It is reasonable to assume that as countries' economies grow, and they become wealthier, they will be in a position to fund more generous benefits, and BGRs would be expected to increase over time. There may also be a change in the relative generosity of spending by age group. For example, it would be reasonable to expect that as countries develop, there would be an expansion of tertiary education and therefore an increase in the BGRs for young people aged 15-19 and 20-24, compared to younger children. Therefore, a second set of 'ageing and economic change' projections have been produced which make allowance for both general and age-specific changes in the BGRs.

These 'ageing and economic change' projections make use of two additional inputs. Firstly, they make use of projections of GDP per worker up to 2050 which have been produced using ECLAC estimates for the period 2010-2016; International Monetary Fund projections for the period 2017-2022; and then the assumption of convergence towards a long term rate of growth in GDP per worker of 1.5 per cent. This convergence is assumed to take place between 2022 and 2035 after which a growth rate of 1.5 per cent is assumed for all countries. The second input is a set of estimates of BGRs for each country which instead of being held constant, evolve over time. Starting with the estimates for 2010, projected BGRs are calculated for each country on the assumption that as GDP per worker increases, BGRs become more like the BGRs in OECD/EU countries. Therefore, every increase of, say 1,000 US$ PPP in GDP per worker, results in an incremental change in the age-specific BGRs to make them more like those in wealthier countries. Further details of this methodology are set out in Annex 2.

A. Education

As the transition proceeds, the school-age population will decline and by 2050 the average school-age (or education sector) dependency ratio will fall from 78 in 2010 to 51 in 2050 (see figure 8). This would be almost equal to the average ratio observed for the OECD countries at the start of the projection period which was 50 (see table 10). Table 20 presents the school-age dependency ratios for the 10 Caribbean countries for 2010 and 2050, and shows the changes in the ratio expected over this period. Declines in this ratio are expected in all countries except Barbados where it moves up minimally by less than one percentage point. This movement for Barbados is attributable to the decline in the working-age population at an annual average rate of -0.4 per cent over the projection period, as shown in table 19. The largest expected reductions in the school-age dependency ratios are foreseen for Belize by about 54 percentage points and Grenada by approximately 41 percentage points.

Figure 8
Education dependency ratio and projected expenditure on education
for Caribbean countries (averages), 2010-2050
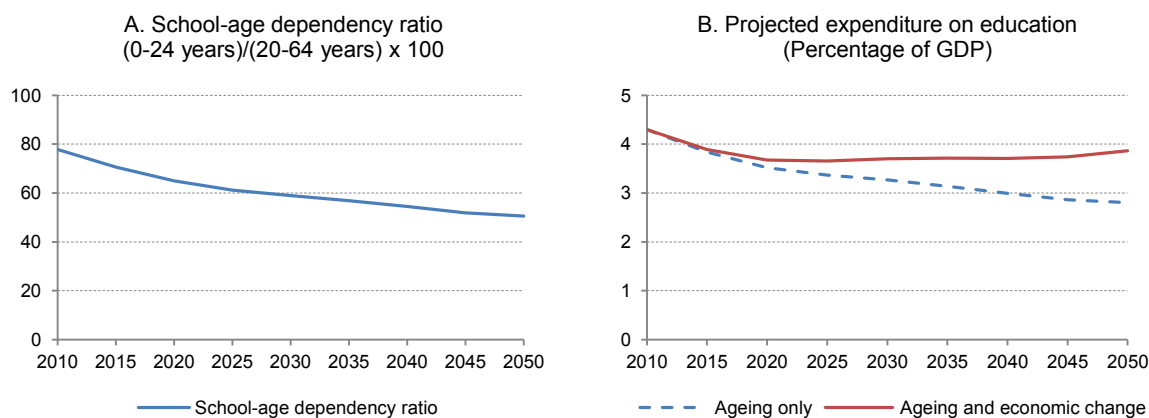
Source: Author's calculations and United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

Table 20
Education: dependency ratios and public expenditure
as a percentage of GDP, 2010 and 2050[a]
(Percentages)

| | Education Dependency Ratio | | | Expenditure on education (% of GDP) | | | | |
| | | | | | Ageing only | | Ageing and economic change | |
	2010	2050	Change	2010	2050	Change	2050	Change
Antigua and Barbuda	74.8	53.1	-21.8	2.6	1.8	-0.8	3.6	+1.0
Bahamas	65.4	47.7	-17.7	2.3	1.7	-0.6	2.6	+0.3
Barbados	54.8	55.5	0.6	5.9	5.9	0.0	7.4	+1.5
Belize	112.4	58.3	-54.0	6.6	3.3	-3.3	3.5	-3.1
Grenada	91.5	50.0	-41.5	4.0	2.3	-1.7	3.6	-0.4
Guyana	98.8	59.5	-39.3	3.7	2.1	-1.6	3.1	-0.6
Jamaica	83.8	48.1	-35.7	6.3	3.5	-2.8	4.3	-2.0
Saint Lucia	70.8	39.8	-31.0	3.6	1.9	-1.7	2.1	-1.5
Saint Vincent and the Grenadines	79.1	47.8	-31.3	5.1	3.1	-2.0	3.8	-1.3
Trinidad and Tobago	58.7	47.3	-11.5	2.9	2.5	-0.4	4.6	+1.7
Caribbean average	77.8	50.5	-27.3	4.3	2.8	-1.5	3.9	-0.4

Source: Author's calculations and United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a]See Annexes 2 and 3 for details on sources and calculations.

This decline in the share of the student population relative to the working-age population –the school-age dependency ratio– will tend to reduce education spending. The 'ageing only' projection indicates that, all other things being equal, this could be expected to reduce the average expenditure on education from 4.3 per cent to 2.8 per cent. However, since BGRs are likely to become more generous over time, it is unlikely that there would be such a reduction in spending on education, and based on the 'ageing and economic change' projections, it is estimated that average spending on education will still be 3.9 per cent in 2050. Spending is projected to fall to 3.7 per cent by 2020 before increasing gradually to 3.9 per cent. This is partly a reflection of the relatively poor economic performance of Caribbean economies in the early years of the projection period, which means that demography has a greater influence than economic growth on projected education expenditure during this period.

With no change in the benefit generosity ratios, population ageing alone would result in considerable reductions in education spending in all but one of the ten countries. Table 20 presents both the 'ageing only' and 'ageing and economic change' projections of expenditure on education as a percentage of GDP for 2010 and 2050. In respect of the 'ageing only' projections, declines are observed in all countries except Barbados for which aggregate spending is static. As would be expected, the biggest impacts on education spending are in the countries with the largest falls in the education sector dependency ratio. For example in Belize, where the dependency ratio is projected to fall by almost half from 112 to 58, this translates into a reduction in education spending from 6.6 per cent of GDP to 3.3 per cent. Other countries which will also see relatively large falls in the education sector dependency ratio are Grenada, Guyana, Jamaica and Saint Vincent and the Grenadines and Saint Lucia. These are countries which are at a relatively earlier stage of the ageing process compared to other Caribbean countries and still have relatively large child and youth populations. Antigua and Barbuda, Bahamas, Barbados and Trinidad and Tobago have older populations which have already seen falls in the education sector dependency ratio and therefore the magnitude of the projected fall is lower. For example, in Trinidad and Tobago the dependency ratio falls from 59 to 47 which (assuming no increase in the BGR) would reduce education spending from 2.9 per cent of GDP to 2.5 per cent.

For all countries, the 'ageing and economic change' projections suggest a higher level of expenditure on education in 2050 than the 'ageing only' projections because there will be at least some economic growth in all countries. However, the impact of growth, which leads to increased benefit generosity and changes in the age profile of spending, varies significantly from country to country. This is illustrated in figure 9 which shows the 'ageing only' and 'ageing and economic change' projections of

expenditure on education for Jamaica and Trinidad and Tobago. It is clear than in both countries, demographic change is a downward influence on education spending, particularly in Jamaica where demographic factors alone would reduce education spending from 6.3 to 3.5 per cent of GDP compared to a reduction of 2.9 per cent to 2.5 per cent in Trinidad and Tobago. When economic change is taken into account, the projected expenditure for Jamaica in 2050 is only slightly (0.8 percentage points) higher at 4.3 per cent while for Trinidad and Tobago, the difference between the two projections is greater with 'ageing and economic change' adding 2.1 percentage points to the 'ageing only' projection by 2050. A similar comparison could be made, for example between Belize and Barbados.

There are two reasons why economic growth is projected to increase expenditure more in some countries than in others. Partly it is because the projections of growth, particularly in the first half of the projection period are influenced by data on recent economic performance and the medium term outlook for those economics. Projected growth in GDP per worker therefore varies from country to country. However, more important is the fact that not all countries are starting from the same point. For some Caribbean countries, for example Antigua and Barbuda, Bahamas and Trinidad and Tobago, with another 30-35 years of economic growth, they will have levels of GDP per worker close to, or above, the average level of GDP per worker for OECD countries in 2010. For these Caribbean countries, the 'ageing and economic change' projections assume, with income levels having converged to OECD levels, that benefit generosity ratios will also be similar to those in OECD countries. However, this is not true for all Caribbean countries. For those countries such as Belize, Guyana, Jamaica, Saint Lucia and Saint Vincent and the Grenadines, their projected levels of GDP per worker in 2050 are still substantially below those typical of OECD countries now. As a consequence, benefit generosity ratios cannot be expected to increase to the same extent.

Figure 9
Projected expenditure on education for Jamaica and Trinidad and Tobago, 2010-2050
(Percentages of GDP)
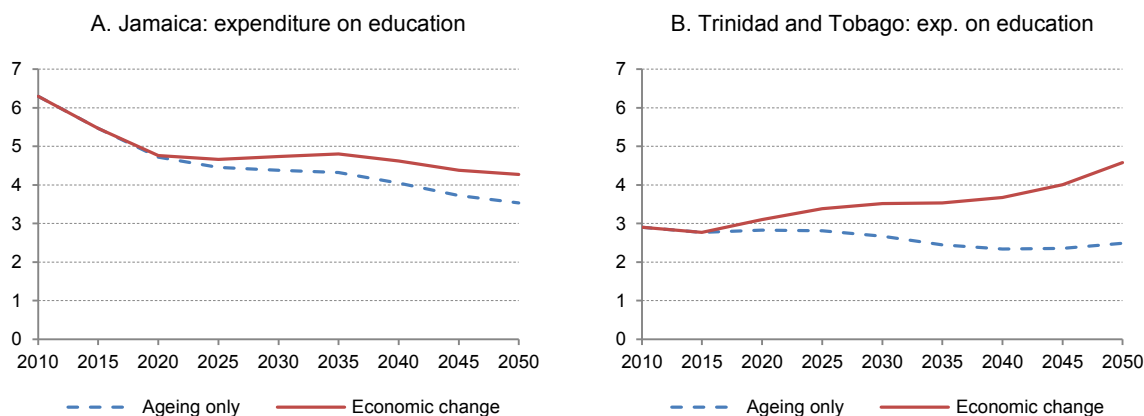
Source: Author's calculations.

B.   Pensions

The impact of demographic change on pensions works in the opposite direction with increases in the old-age dependency ratio expected to drive increases in pension expenditure. The old-age dependency ratio for nine Caribbean countries is due to increase from 13.7 in 2010 to 33.8 in 2050 (see figure 10) (Saint Vincent and the Grenadines was excluded from the analysis of pensions due to the unavailability of data). At current (2010) levels of benefit generosity, average government expenditure would increase from 3.7 to 8.4 per cent by 2050. Expenditure on national insurance pensions is expected to increase from 1.7 per cent to 3.9 per cent of GDP, expenditure on non-contributory pensions from 0.3 per cent to

0.7 per cent and government pensions from 1.6 per cent to 3.8 per cent. The 'ageing and economic change' projections see total expenditure on pensions increase from 3.7 per cent to 9.8 per cent. Based on these projections, more than three quarters of the increase in pension spending is due to ageing and less than one quarter due to economic change.

Old-age dependency ratios will more than double in all countries. For Bahamas the ratio will more than triple from 11 per cent to 37 per cent and for Antigua and Barbuda the increase will be from 11.5 per cent to 34 per cent. Barbados and Jamaica begin with ratios above the average and are expected to maintain that position at the end of the period. The reverse is true for Belize and Guyana which begin with lower ratios and despite increases of over 100 per cent will see dependency ratios which will remain below the Caribbean average in 2050.

The data in table 21 illustrates how increasing old-age dependency ratios will result in increased expenditure on pensions in each country. The main factors which influence the projections are: the increase in the old-age dependency ratio and the level of the benefit generosity ratios in 2010 (which determine the ageing only projection); and the extent to which countries growth trajectory takes them close to OECD levels of income by 2050 (which is incorporated in the 'ageing and economic change' projections). The highest projected increases in pension expenditure ('ageing and economic change' projections) are in Antigua and Barbuda (+10.0 per cent) and Trinidad and Tobago (9.4 per cent) where all of these three factors combine to increase pension spending. The smallest increase is observed in Belize (2.9 per cent), which is at an earlier stage in the ageing process and therefore the increase in the old-age dependency ratio is lower. In addition, the current BGR is low, and economic growth will only lead to a relatively small increase in the BGR. For other countries these three factors combine in different ways, for example in Barbados, the old-age dependency ratio does not increase as much as in some other countries (but for the opposite reason to Belize, because it is already a relatively aged population). However, Barbados has high current pension spending which economic growth will increase further.

Figure 10
Old-age dependency ratio and projected expenditure on pensions
for Caribbean countries (averages), 2010-2050
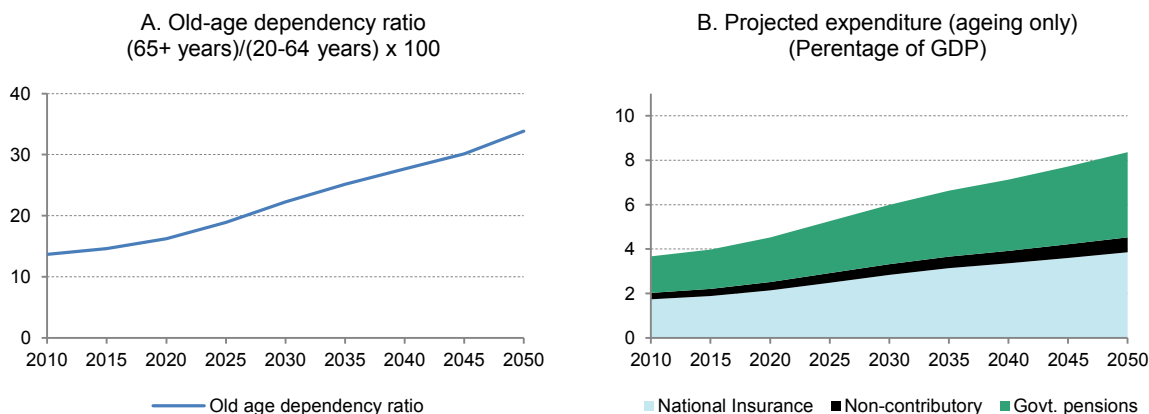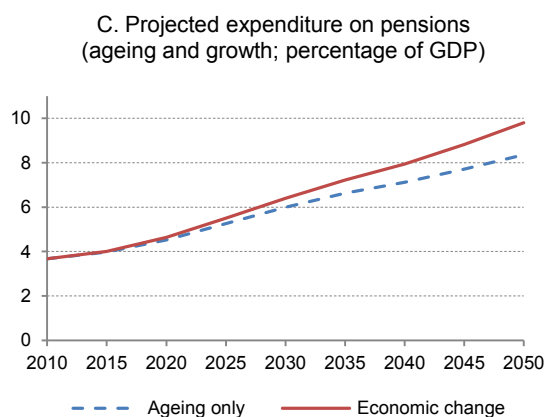
A. Old-age dependency ratio
(65+ years)/(20-64 years) x 100

B. Projected expenditure (ageing only)
(Perentage of GDP)

C. Projected expenditure on pensions
(ageing and growth; percentage of GDP)

Source: Author's calculations and United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

Table 21
Pensions: old-age dependency ratios and public expenditure
as a percentage of GDP, 2010 and 2050[a]
(Percentages)

| | | | | Expenditure on pensions (% of GDP) | | | | |
| | Old-age dependency ratios | | | | Ageing only | | Ageing and economic change | |
	2010	2050	Change	2010	2050	Change	2050	Change
Antigua and Barbuda	11.5	34.2	197.5	4.5	12.3	+7.8	14.5	+10.0
Bahamas	11.3	37.2	228.8	2.4	6.1	+3.8	7.6	+5.2
Barbados	20.5	49.2	140.0	6.5	13.1	+6.6	15.3	+8.7
Belize	7.7	16.6	116.8	2.7	5.5	+2.7	5.6	+2.9
Grenada	13.3	28.8	117.5	3.3	7.4	+4.1	9.1	+5.8
Guyana	8.8	19.2	117.3	4.0	7.1	+3.1	7.9	+3.9
Jamaica	15.5	38.8	151.3	2.4	5.7	+3.3	6.8	+4.4
Saint Lucia	14.9	43.7	192.2	2.8	7.1	+4.3	7.5	+4.7
Trinidad and Tobago	13.1	36.4	178.9	4.4	10.8	+6.4	13.9	+9.4
Caribbean average	13.7	33.8	147.2	3.7	8.4	+4.7	9.8	+6.1

Source: Author's calculations and United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a]See Annexes 2 and 3 for details on sources and calculations.

In Saint Lucia, the old-age dependency ratio will increase by a factor of nearly three but current pension spending is low and economic growth is not projected to significantly increase benefit generosity, and therefore the projected increase in pension expenditure is a relatively moderate +4.7 per cent.

C.   Health

As previously explained, the health dependency ratio, the main demographic driver of expenditure in this sector, is calculated on the basis of the population near death, regarded as the high-cost users of health care services. Changes in the health care dependency ratio between 2010 and 2050 are presented in Table 22. As the demographic transition proceeds, the age structure of the population shifts substantially towards older persons and the population near death begins to increase relative to the working-age population. At some point the population near death will grow more quickly than the

working-age population. The near-death population will grow on average 1.2 per cent annually over the projection period (not shown in table), at a much higher rate than the 0.2 per cent average for the working-age population (see table 19). The near death dependency ratio will grow by approximately 7 percentage points over the projection period (2010-2050) for the group of 10 countries. Highest growth will come from Trinidad and Tobago and Barbados 11 percentage points in each case, well above the approximately 7 percentage point average. Belize (1 per cent), Grenada (3 per cent) and Guyana (4 per cent) are the countries which will see the lowest growth.

Figure 11 illustrates the increase in the relative size of the 'near death' population and its projected impact on public expenditure on healthcare services in the 10 Caribbean countries. The impact on health expenditures is less than on pension expenditures mainly because whereas pension expenditures (with the exception of invalidity and survivors benefits) are directed overwhelmingly to older persons, expenditures on health, although weighted heavily to older personas, are nevertheless distributed across the entire age range. Therefore a shift in the age structure of the population towards older persons would be expected to have a greater effect on pension expenditures. Demographic change increases average public expenditure on health from 3.7 per cent of GDP in 2010 to 5.4 per cent of GDP in 2050. When increased benefit generosity ratios are allowed for, this becomes 6.1 per cent. Comparing the increase in health costs with the increase in pension costs, demographic factors increase health spending by a factor of almost 1.5 and increase pension costs by a factor of 2.3. Allowing for 'ageing and economic change' sees health costs increase by a factor of 1.6 compared with 2.6 for pension costs.

Figure 11
Near-death dependency ratio and projected expenditure on health
for Caribbean countries (averages), 2010-2050
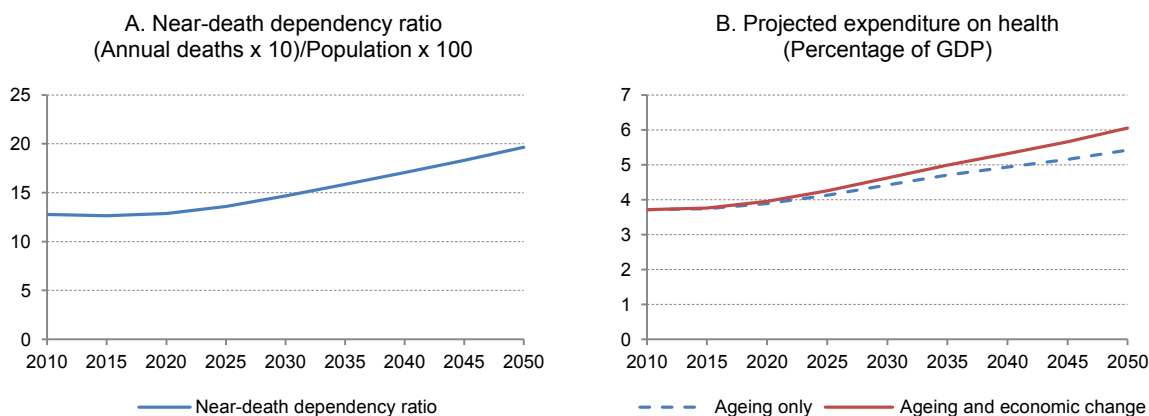
A. Near-death dependency ratio
(Annual deaths x 10)/Population x 100

B. Projected expenditure on health
(Percentage of GDP)

Source: Author's calculations and United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] The near-death dependency ratio is calculated as the annual number of deaths multiplied by ten divided by the working age population (20-64).

Demographic change has a greater impact on health expenditure in Barbados, Bahamas, Antigua and Barbuda, Saint Lucia and Saint Vincent and the Grenadines where the ageing process is a little more advanced (see table 22). In Belize and Guyana, the ageing process is less advanced and therefore the increase in older persons which drives increasing health costs is also delayed relative to other countries. In Jamaica and Grenada, health expenditure will increase, albeit from a relatively low level in 2010. The 'ageing and economic change' projections indicate that the largest increases in expenditure, of +3.0 per cent of GDP or more, will be in Antigua and Barbuda, Barbados and Trinidad and Tobago, where it is anticipated that economic growth will lead to significantly higher spending. Saint Lucia is also projected to have relatively high expenditure on health in 2050 (7.1 per cent of GDP) although this is due to relatively high public expenditure on health in 2010 (4.2 per cent) and rapid population ageing with economic growth having little impact. The projected increases in health expenditure are lowest in Belize

(3.9 to 4.6 per cent) and (Guyana 4.4 to 5.5 per cent) where population ageing is least advanced and where economic growth has less impact on the projections.

Table 22
Health: near-death dependency ratios and public expenditure
as a percentage of GDP, 2010 and 2050[a]
(Percentages)

| | Near-death dependency ratios[b] | | | Expenditure on health (% of GDP) | | | | | |
| | | | | | Ageing only | | Ageing and economic change | |
	2010	2050	Change	2010	2050	Change	2050	Change
Antigua and Barbuda	10.3	16.9	+6.6	4.3	6.6	+2.3	7.7	+3.4
Bahamas	9.6	18.3	+8.7	3.5	5.7	+2.2	6.4	+2.9
Barbados	17.0	27.6	+10.6	4.3	6.6	+2.3	7.6	+3.3
Belize	10.6	12.0	+1.4	3.9	4.5	+0.6	4.6	+0.7
Grenada	13.7	17.1	+3.5	2.7	3.8	+1.1	4.5	+1.8
Guyana	15.4	19.3	+3.8	4.4	5.1	+0.7	5.5	+1.1
Jamaica	12.6	19.4	+6.9	3.0	4.5	+1.5	5.0	+2.0
Saint Lucia	11.9	20.4	+8.5	4.2	7.0	+2.8	7.1	+2.9
Saint Vincent and the Grenadines	12.5	20.5	+8.0	3.9	5.8	+1.9	6.3	+2.4
Trinidad and Tobago	14.3	25.1	+10.8	2.9	4.6	+1.7	5.9	+3.0
Caribbean average	12.8	19.7	+6.9	3.7	5.4	+1.7	6.1	+2.3

Source: Author's calculations and United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.
[a] See Annexes 2 and 3 for details on sources and calculations.
[b] The near-death dependency ratio is calculated as the annual number of deaths multiplied by ten divided by the working age population (20-64).

V. Summary and conclusions

The main objective of this study as outlined in the introduction was to examine the implications of population ageing for social expenditure in the Caribbean based on available data for ten Caribbean countries, by producing age-related projections of public expenditure on education, pensions and healthcare. Two versions of the projections have been produced: 'ageing only' projections which illustrate the impact of demographic change in isolation and 'ageing and economic change' which show the impact of both changing age structures and increases in benefit generosity (as well as changes in its age profile) which are associated with economic growth.

As one of the most basic demographic variables, age and the age structure of populations is a very crucial determinant of the allocation of resources in general and social services in particular. Understanding the changing age structure which accompanies the global demographic transition is therefore an important first step in the process of long term fiscal planning.

The dramatic changes in age structure which have characterized the demographic landscape of many countries in the twentieth century have also been evident among Caribbean countries and will continue in the coming decades. The elderly (65 years and over) population for the ten countries in the study is projected to rise over two and a half times from 491 thousand to 1.3 million, and will represent a 19 per cent share of the total population in 2050. The changes in the relationship to the population of the working age group are expected to be even more dramatic. At the beginning of the projection period there was one elderly person for every 10 persons of working age. By 2050, the ratio is expected to be 3 elderly to every 10 working-age people. The change for Barbados, currently the demographically oldest country, over the same period will be from 2 to every 10 to around 5 to every 10.

Figure 12 summarises the anticipated impact of these changes on total public expenditure on education, pensions and health care services. It shows how demographic changes alone would increase average public spending in these three areas from 11.7 per cent of GDP to 16.6 per cent. Taking into account economic changes, it is projected that the total expenditure will be 19.7 per cent of GDP by 2050. The largest contributor to the projected increase is from pensions which will increase by 6.1 percentage points of GDP, from 3.7 per cent to 9.8 per cent ('ageing and economic change'). Projections for health care expenditure as a percentage of GDP show a smaller increase from 3.7 to 6.1 per cent. Average expenditure on education will fall from 4.3 to 3.9 per cent with the effect of falling school rolls counteracted by increasing expenditure per child.

Table 23 presents a summary of public expenditure in the areas covered by this study for the ten Caribbean countries. In all countries, total expenditure is expected to increase although the magnitude of that increase compared with 2010 varies significantly from an increase of just 0.6 percentage points of GDP for Belize up to an increase of 14.3 percentage points for Antigua and Barbuda. This variation is due to the complex way in which the projections reflect three factors: expenditure in 2010; demographic effects; and economic growth. These three factors combine together in different ways in different countries. For example, in Belize, Guyana and Jamaica, falling school rolls are expected to lead to significant reductions in education spending. In these countries, the projected increases in pension and health costs will be lower than in other countries, such as Barbados, Antigua and Barbuda and Saint Lucia, because ageing is less advanced.

Figure 12
Projected expenditure on education, pensions and health
for Caribbean countries (averages), 2010-2050
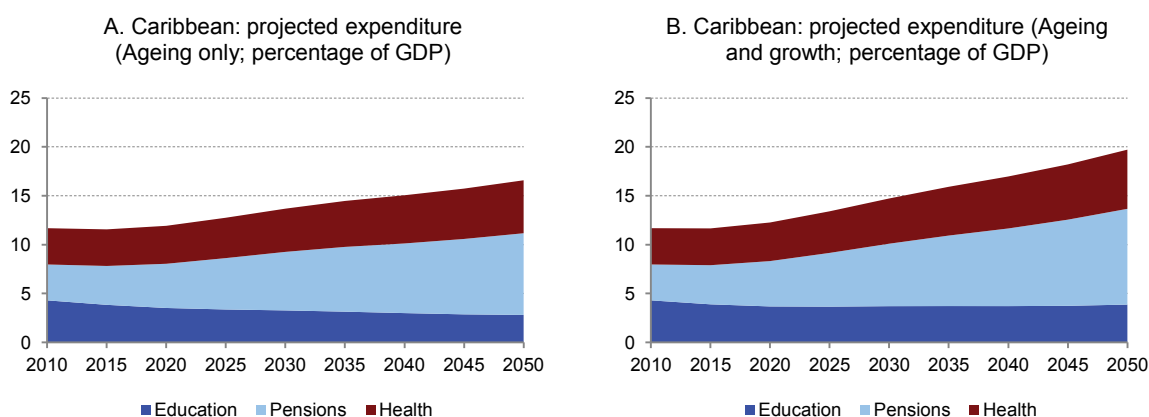
Source: Author's calculations.

Figure 13 shows the 'ageing and economic change' projections for two countries, Antigua and Barbuda and Belize, for which the projections have very different implications. For Antigua and Barbuda, total expenditure on education, pensions and health is projected to increase from 11.4 per cent of GDP in 2010 to 25.7 per cent of GDP in 2050. In contrast, in Belize, expenditure is projected to increase from 13.2 to 13.8 per cent. Antigua and Barbuda is at a later stage in the ageing process with much of the fall in the child dependency rate already having taken place and the old-age dependency ratio increasing significantly in the coming decades, contributing to increased pension and health costs. However, with Antigua and Barbuda achieving a level of income similar to many OECD countries within the projection period, it will at least have greater resources with which to fund these demands.

Figure 13
Projected expenditure on education, pensions and health
for Antigua and Barbuda and Belize, 2010-2050

A. Antigua and Barbuda: projected
expenditure (Ageing and growth; percentage
of GDP)

B. Belize: projected expenditure
(Ageing and growth; percentage of GDP)
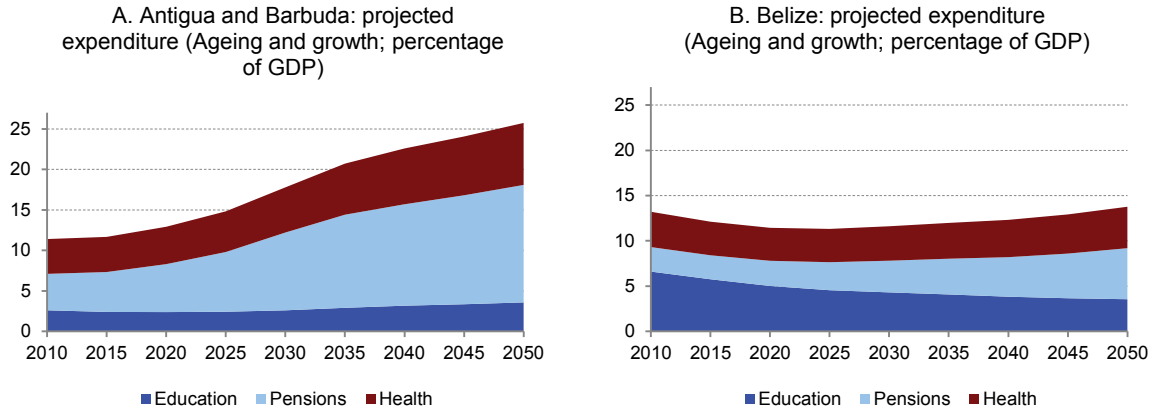
Source: Author's calculations.

Table 23
Expenditure on education, pensions and health, 2010 and 2050
(Percentages of GDP)

		Ageing only			Ageing and economic growth	
		2010	2050	Change	2050	Change
Antigua and Barbuda	Education	2.6	1.8	-0.8	3.6	+1.0
	Pensions	4.5	12.3	+7.8	14.5	+10.0
	Health	4.3	6.6	+2.3	7.7	+3.4
	Total	11.4	20.7	9.3	25.7	14.3
Bahamas	Education	2.3	1.7	-0.6	2.6	+0.3
	Pensions	2.4	6.1	+3.8	7.6	+5.2
	Health	3.5	5.7	+2.2	6.4	+2.9
	Total	8.2	13.5	5.4	16.6	8.4
Barbados	Education	5.9	5.9	+0.0	7.4	+1.5
	Pensions	6.5	13.1	+6.6	15.3	+8.7
	Health	4.3	6.6	+2.3	7.6	+3.3
	Total	16.7	25.7	9.0	30.3	13.6
Belize	Education	6.6	3.3	-3.3	3.5	-3.1
	Pensions	2.7	5.5	+2.7	5.6	+2.9
	Health	3.9	4.5	+0.6	4.6	+0.7
	Total	13.2	13.3	0.0	13.8	0.6
Grenada	Education	4.0	2.3	-1.7	3.6	-0.4
	Pensions	3.3	7.4	+4.1	9.1	+5.8
	Health	2.7	3.8	+1.1	4.5	+1.8
	Total	10.0	13.5	3.5	17.3	7.3
Guyana	Education	3.7	2.1	-1.6	3.1	-0.6
	Pensions	4.0	7.1	+3.1	7.9	+3.9
	Health	4.4	5.1	+0.7	5.5	+1.1
	Total	12.1	14.2	2.1	16.5	4.4
Jamaica	Education	6.3	3.5	-2.8	4.3	-2.0
	Pensions	2.4	5.7	+3.3	6.8	+4.4
	Health	3.0	4.5	+1.5	5.0	+2.0
	Total	11.7	13.8	2.1	16.1	4.4
Saint Lucia	Education	3.6	1.9	-1.7	2.1	-1.5
	Pensions	2.8	7.1	+4.3	7.5	+4.7

Table 23 (concluded)

		Ageing only			Ageing and economic growth	
		2010	2050	Change	2050	Change
	Health	4.2	7.0	+2.8	7.1	+2.9
	Total	10.6	16.0	5.4	16.7	6.1
Saint Vincent and the Grenadines	Education	5.1	3.1	-2.0	3.8	-1.3
	Pensions	..	..	..	..	..
	Health	3.9	5.8	+1.9	6.3	+2.4
	Total	..	..	..	..	..
Trinidad and Tobago	Education	2.9	2.5	-0.4	4.6	+1.7
	Pensions	4.4	10.8	+6.4	13.9	+9.4
	Health	2.9	4.6	+1.7	5.9	+3.0
	Total	10.2	17.9	7.7	24.3	14.1
Caribbean (average)	Education	4.3	2.8	-1.5	3.9	-0.4
	Pensions[a]	3.7	8.4	+4.7	9.8	+6.1
	Health	3.7	5.4	+1.7	6.1	+2.3
	Total	11.7	16.6	4.9	19.7	8.0

Source: Author's calculations.
[a] Average of 9 countries.

In contrast, Belize is at an earlier stage in the ageing process, with child dependency still falling, and consequently large falls in expenditure on education are forecast. While old-age dependency is increasing, it is increasing from a low level and so the projected increases in pension and health spending are lower than in other Caribbean countries. The fact that Belize is not projected to reach even close to OECD levels of income by 2050 means that benefit generosity ratios will remain closer to their current levels.

Comparing the average projected expenditure in the Caribbean in 2050 ('ageing and economic change' projections) with that in OECD countries around 2010, the level of spending on education is expected to remain below the OECD level (3.9 per cent versus 5.3 per cent of GDP). The projected level of expenditure on health will also be below the current OECD level (6.1 per cent versus 6.7 per cent of GDP). The projected expenditure on pensions will be higher than the OECD average (9.8 per cent versus 7.7 per cent) although it is much closer to the current European Union average of 9.2 per cent.

The projections have been developed using a simple model based on assumptions about how changing age structures and economic growth with affect public budgets. They are based on the assumption of either constant benefit generosity ratios, or benefit generosity ratios which increase as economic growth increases. The projections make no allowances for policy responses motivated by the need to constrain future costs. These are likely to be most necessary in the area of pensions, the area in which the projected increases in expenditure are the largest. Policies such as increasing retirement ages and merging public sector and national insurance pension schemes in order to control future government pension costs are actively being considered and in some cases implemented. These projections reinforce that for many countries, pension funding and pension reform are of great importance.

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Annexes

Annex 1
Projections of public expenditure

Education

Table A.1
Projected public expenditure on education (ageing only), 2010-2050
(Percentages of GDP)

	Base Year 2010	Projections							
		2015	2020	2025	2030	2035	2040	2045	2050
Antigua and Barbuda	2.6	2.3	2.1	2.0	2.0	2.0	2.0	1.9	1.8
Bahamas	2.3	2.0	1.9	1.9	1.9	1.8	1.8	1.7	1.7
Barbados	5.9	5.8	5.8	5.8	5.9	5.9	5.9	5.9	5.9
Belize	6.6	5.8	5.0	4.5	4.3	4.1	3.8	3.5	3.3
Grenada	4.0	3.5	3.3	3.3	3.1	2.8	2.4	2.3	2.3
Guyana	3.7	3.3	2.9	2.7	2.6	2.5	2.4	2.2	2.1
Jamaica	6.3	5.5	4.7	4.5	4.4	4.3	4.0	3.7	3.5
St Lucia	3.6	2.9	2.4	2.2	2.1	2.1	2.0	1.9	1.9
St Vincent and the Grenadines	5.1	4.6	4.2	3.9	3.7	3.5	3.3	3.1	3.1
Trinidad and Tobago	2.9	2.8	2.8	2.8	2.7	2.5	2.3	2.4	2.5
Caribbean average	4.3	3.8	3.5	3.4	3.3	3.1	3.0	2.9	2.8

Table A.2
Projected public expenditure on education (ageing and economic change), 2010-2050
(Percentages of GDP)

	Base Year 2010	Projections							
		2015	2020	2025	2030	2035	2040	2045	2050
Antigua and Barbuda	2.6	2.4	2.4	2.4	2.6	2.9	3.2	3.3	3.6
Bahamas	2.3	2.0	1.9	1.9	2.0	2.2	2.3	2.4	2.6
Barbados	5.9	5.8	6.0	6.2	6.5	6.7	7.0	7.2	7.4
Belize	6.6	5.8	5.0	4.5	4.3	4.1	3.8	3.7	3.5
Grenada	4.0	3.7	3.7	3.9	4.0	3.7	3.5	3.5	3.6
Guyana	3.7	3.5	3.3	3.2	3.3	3.3	3.2	3.2	3.1
Jamaica	6.3	5.5	4.8	4.7	4.7	4.8	4.6	4.4	4.3
St Lucia	3.6	2.9	2.4	2.2	2.1	2.1	2.0	2.0	2.1
St Vincent and the Grenadines	5.1	4.6	4.2	4.1	4.0	3.8	3.8	3.7	3.8
Trinidad and Tobago	2.9	2.8	3.1	3.4	3.5	3.5	3.7	4.0	4.6
Caribbean average	4.3	3.9	3.7	3.7	3.7	3.7	3.7	3.7	3.9

Table A.3
Benefit generosity ratios for education by age, 2010
(Expenditure per person as a percentage of GDP per worker)

	Age group					Total
	0-4	5-9	10-14	15-19	20-24	
Antigua and Barbuda	0.0	5.0	6.7	4.3	0.7	3.5
Bahamas	0.6	5.9	6.0	4.1	1.2	3.5
Barbados	0.2	13.9	14.9	16.7	7.3	10.8
Belize	0.4	8.8	10.6	7.1	1.6	5.9
Grenada	0.7	7.2	7.8	5.4	1.3	4.4
Guyana	2.7	4.5	5.7	3.8	1.0	3.7
Jamaica	1.7	10.1	11.2	9.9	3.5	7.5

Table A.3 (concluded)

	Age group					Total
	0-4	5-9	10-14	15-19	20-24	
St Lucia	0.6	8.4	9.0	5.2	1.1	5.1
St Vincent and the Grenadines	0.7	10.0	10.3	8.1	2.6	6.4
Trinidad and Tobago	0.8	7.7	9.6	6.5	1.5	4.9
Caribbean average	0.8	8.2	9.2	7.1	2.2	5.6
OECD average	5.0	13.0	15.2	13.7	4.8	..

Pensions

Table A.4
Projected public expenditure on pensions (ageing only), 2010-2050
(Percentages of GDP)

	Base Year 2010	Projections							
		2015	2020	2025	2030	2035	2040	2045	2050
Antigua and Barbuda	4.5	4.9	5.8	7.1	9.1	10.6	11.3	11.8	12.3
Bahamas	2.4	2.7	3.2	3.9	4.4	4.9	5.2	5.7	6.1
Barbados	6.5	7.5	8.8	10.1	11.2	12.1	12.6	13.0	13.1
Belize	2.7	2.6	2.8	3.1	3.5	3.9	4.4	4.8	5.5
Grenada	3.3	3.3	3.6	4.2	4.5	4.7	5.1	6.0	7.4
Guyana	4.0	4.3	4.7	5.3	6.0	6.5	7.0	7.2	7.1
Jamaica	2.4	2.5	2.8	3.2	3.7	4.1	4.5	5.0	5.7
St Lucia	2.8	2.9	3.1	3.6	4.3	5.0	5.6	6.4	7.1
Trinidad and Tobago	4.4	5.0	5.9	6.8	7.3	7.7	8.4	9.6	10.8
Caribbean average	3.7	4.0	4.5	5.3	6.0	6.6	7.1	7.7	8.4

Table A.5
Projected public expenditure on pensions (ageing and economic change), 2010-2050
(Percentages of GDP)

	Base Year 2010	Projections							
		2015	2020	2025	2030	2035	2040	2045	2050
Antigua and Barbuda	4.5	4.9	5.9	7.4	9.6	11.5	12.5	13.5	14.5
Bahamas	2.4	2.7	3.2	3.9	4.6	5.3	5.9	6.7	7.6
Barbados	6.5	7.5	9.0	10.6	12.0	13.2	14.0	14.7	15.3
Belize	2.7	2.6	2.8	3.1	3.5	3.9	4.4	4.9	5.6
Grenada	3.3	3.4	3.8	4.6	5.0	5.4	6.1	7.4	9.1
Guyana	4.0	4.3	4.9	5.6	6.3	7.0	7.6	7.8	7.9
Jamaica	2.4	2.5	2.8	3.4	4.0	4.6	5.2	5.9	6.8
St Lucia	2.8	2.9	3.1	3.6	4.3	5.0	5.7	6.5	7.5
Trinidad and Tobago	4.4	5.0	6.1	7.4	8.2	9.0	10.1	12.0	13.9
Caribbean average	3.7	4.0	4.6	5.5	6.4	7.2	7.9	8.8	9.8

Table A.6
Benefit generosity ratios for pensions by age, 2010
(Expenditure per person as a percentage of GDP per worker)

	Age group							Total
	Under 40	40-44	45-49	50-54	55-59	60+	65+	
Antigua and Barbuda	0.1	0.1	0.2	0.5	1.3	27.4	24.2	2.6
Bahamas	0.2	0.2	0.2	0.4	0.6	12.1	15.7	1.5
Barbados	0.1	0.3	0.5	1.1	2.0	21.0	26.5	4.0
Belize	0.1	0.2	0.3	0.6	0.8	20.9	28.7	1.3
Grenada	0.1	0.3	0.4	0.6	1.6	16.6	14.0	1.8

Table A.6 (concluded)

	Age group							Total
	Under 40	40-44	45-49	50-54	55-59	60+	65+	
Guyana	0.0	0.3	0.7	1.2	1.4	25.9	30.7	2.1
Jamaica	0.0	0.1	0.1	0.1	0.2	11.1	12.2	1.3
St Lucia	0.1	0.2	0.3	0.5	1.2	12.1	11.3	1.6
Trinidad and Tobago	0.1	0.1	0.2	0.4	0.8	21.4	21.9	2.8
Caribbean average	0.1	0.2	0.3	0.6	1.1	18.7	20.6	2.1
EU average	0.6	0.6	0.6	0.6	5.9	23.3	25.7	..

Health

Table A.7
Projected public expenditure on health (ageing only), 2010-2050
(Percentages of GDP)

	Base Year 2010	Projections							
		2015	2020	2025	2030	2035	2040	2045	2050
Antigua and Barbuda	4.3	4.3	4.5	4.9	5.3	5.9	6.3	6.4	6.6
Bahamas	3.5	3.6	3.9	4.3	4.6	5.0	5.2	5.4	5.7
Barbados	4.3	4.6	5.0	5.4	5.9	6.2	6.4	6.5	6.6
Belize	3.9	3.7	3.6	3.7	3.8	4.0	4.1	4.3	4.5
Grenada	2.7	2.7	2.7	2.9	3.0	3.1	3.2	3.4	3.8
Guyana	4.4	4.3	4.3	4.4	4.6	4.8	4.9	5.0	5.1
Jamaica	3.0	3.0	3.0	3.2	3.5	3.8	4.0	4.2	4.5
St Lucia	4.2	4.2	4.2	4.5	5.0	5.5	5.9	6.4	7.0
St Vincent and the Grenadines	3.9	4.0	4.1	4.4	4.8	5.0	5.3	5.5	5.8
Trinidad and Tobago	2.9	3.1	3.3	3.5	3.7	3.9	4.0	4.2	4.6
Caribbean average	3.7	3.7	3.9	4.1	4.4	4.7	4.9	5.2	5.4

Table A.8
Projected public expenditure on health (ageing and economic change), 2010-2050
(Percentages of GDP)

	Base Year 2010	Projections							
		2015	2020	2025	2030	2035	2040	2045	2050
Antigua and Barbuda	4.3	4.3	4.6	5.0	5.6	6.3	6.9	7.3	7.7
Bahamas	3.5	3.6	3.9	4.3	4.7	5.1	5.6	5.9	6.4
Barbados	4.3	4.6	5.1	5.7	6.2	6.7	7.0	7.3	7.6
Belize	3.9	3.7	3.6	3.7	3.8	4.0	4.1	4.3	4.6
Grenada	2.7	2.7	2.9	3.1	3.4	3.5	3.7	4.0	4.5
Guyana	4.4	4.4	4.5	4.6	4.9	5.1	5.3	5.4	5.5
Jamaica	3.0	3.0	3.1	3.3	3.6	4.0	4.3	4.6	5.0
St Lucia	4.2	4.2	4.2	4.5	5.0	5.5	6.0	6.5	7.1
St Vincent and the Grenadines	3.9	4.0	4.2	4.5	4.9	5.2	5.6	5.9	6.3
Trinidad and Tobago	2.9	3.1	3.4	3.8	4.2	4.5	4.8	5.2	5.9
Caribbean average	3.7	3.8	4.0	4.3	4.6	5.0	5.3	5.7	6.1

Table A.9
Benefit generosity ratios for health by age, 2010

(Expenditure per person as a percentage of GDP per worker)

Age	Antigua and Barbuda	Bahamas	Barbados	Belize	Grenada	Guyana	Jamaica	Saint Lucia	Saint Vincent and the Grenadines	Trinidad and Tobago	Caribbean average	OECD average
0-4	2.08	1.73	1.71	1.93	1.28	2.08	1.31	1.91	1.87	1.40	1.73	2.56
5-9	1.71	1.42	1.40	1.58	1.05	1.71	1.08	1.57	1.54	1.15	1.42	1.59
10-14	1.06	0.88	0.87	0.98	0.65	1.07	0.67	0.98	0.96	0.71	0.88	1.53
15-19	1.05	0.88	0.87	0.98	0.65	1.06	0.67	0.97	0.95	0.71	0.88	1.65
20-24	1.02	0.84	0.83	0.94	0.62	1.02	0.64	0.94	0.92	0.68	0.85	1.86
25-29	1.20	1.00	0.99	1.11	0.74	1.20	0.76	1.11	1.08	0.81	1.00	2.15
30-34	1.16	0.96	0.95	1.07	0.71	1.16	0.73	1.06	1.04	0.78	0.96	2.40
35-39	1.94	1.61	1.59	1.80	1.19	1.94	1.22	1.79	1.75	1.30	1.61	2.44
40-44	2.50	2.07	2.05	2.31	1.53	2.50	1.57	2.30	2.25	1.68	2.08	2.66
45-49	2.59	2.15	2.12	2.40	1.59	2.59	1.63	2.38	2.33	1.74	2.15	3.12
50-54	4.07	3.37	3.34	3.77	2.50	4.08	2.56	3.74	3.66	2.73	3.38	3.77
55-59	4.62	3.83	3.79	4.28	2.84	4.63	2.91	4.25	4.16	3.10	3.84	4.54
60-64	6.75	5.60	5.54	6.25	4.15	6.76	4.26	6.21	6.07	4.53	5.61	5.59
65-69	7.76	6.44	6.37	7.19	4.77	7.78	4.90	7.14	6.99	5.22	6.46	6.83
70-74	9.70	8.05	7.96	8.99	5.96	9.72	6.12	8.93	8.74	6.52	8.07	8.16
75+	9.75	8.09	8.00	9.04	5.99	9.77	6.15	8.97	8.78	6.55	8.11	10.53
Total	2.49	2.15	2.61	1.94	1.48	2.27	1.64	2.45	2.23	1.84	2.11	..

Annex 2
Technical notes

References to the technical notes have been made in the previous sections. The purpose of this annex is:

- to describe the model and equations used to analyse and project public expenditures;

- identify the data sources and any data quality limitations; and

- describe the procedures for calculating the input data required for the projections.

Projection Methodology

The analysis and projection methodology used in this study follows closely that set out in Miller, Mason and Holz (2011). Public spending on education, pensions and health care can be decomposed into the product of two factors: the 'benefit generosity ratio' and the 'sector dependency ratio'. The benefit generosity ratio measures the generosity of the benefit in each country relative to the average productivity of the working-age population (GDP/working-age population). It can be thought of as the fraction of the average worker's income that is consumed by the average person who is in the appropriate age range for consuming education, health care or pension benefits. The influence of demography on aggregate spending is reflected in the sector dependency ratio, defined as the ratio of the population 'at risk' of receiving the benefit (education, pensions or health care) relative to the working-age population. More formally:

Expenditure/GDP = benefit generosity ratio × sector dependency ratio, or

$$E/Y = [(E/B)/(Y/W)] \times [B/W]$$

where E = aggregate expenditures, Y = GDP, W = working-age population (aged 20–64), and B = population at risk of benefit (for example, the student-age population). This is the approach used to analyse current public expenditure in Caribbean and OECD countries and its relationship with population age structures.

Projections of public expenditure are produced using an age-disaggregated version of the equation. In the original paper, expenditure was disaggregated by single year of age whereas in this study, five year age groups were used. The age disaggregated version is:

$$E(t)/GDP(t) = \sum_x \{b(x,t) \times P(x,t)/P(20-64,t)\}$$

where

$$b(x,t) = [E(x,t)/P(x,t)]/[GDP(t)/P(20-64,t)],$$

and where $E(t)$ = expenditure in year t on education, health care or pensions; $P(x,t)$ = population in age group x in year t; $b(x,t)$ is the benefit generosity ratio disaggregated by age group x in year t; and $P(x,t)/P(20-64,t)$ is the dependency ratio disaggregated by age group x in year t.

Projections of $E(t)/GDP(t)$ can therefore be seen to depend on the future benefit generosity ratios $b(x,t)$ and the projected populations $P(x,t)$ and $P(20-64,t)$ for age groups x. An 'ageing only' set of projections were calculated for five year time intervals $t = 2015, ..., 2050$ on the assumption that the age-specific benefit generosity ratios remain constant over the projection period. A second set of projections, 'ageing and economic change' were calculated using age-specific benefit generosity ratios which increase as the GDP per worker of each country increases. The increase in the benefit generosity ratios is calculated based on a comparison of average age-specific benefit generosity ratios for Caribbean countries with the corresponding averages for OECD/EU countries (see figure 7).

As GDP per worker of Caribbean countries increases, becoming closer to that in the wealthier countries, so it is reasonable to expect that their benefit generosity ratios will also become more similar. In some Caribbean countries, there have been real falls in GDP per worker, or such falls are projected in the early part of the projection period. Where GDP per worker is projected to fall, benefit generosity ratios are assumed to remain constant until GDP per worker has surpassed its previous highest value. Furthermore, there was an upper limit on the increase applied to the benefit generosity ratios which was determined by the difference between the average age-specific benefit generosity ratios for Caribbean and OECD countries. However, in most cases this limit was not reached.

Data items and sources for Caribbean countries

Total GDP for base year 2010

The per capita figures in USD and PPP for all countries with the exception of Guyana, were obtained from the CEPAL database. There was no PPP figure for Guyana. The total GDP in USD for all countries was also obtained from the CEPAL database. The conversion factors for all countries with the exception of Guyana were derived using the ratio of GDP per capita (USD) to GDP per capita (PPP). The conversion rate for Guyana was derived using data from the IMF and World Bank. The conversion rates derived from per capita GDP were applied to the total GDP to obtain PPP figures for total GDP.

Table A.10
Conversion factors for US dollars PPP
(US Dollars and US dollars PPP)

	GDP per capita		Conversion Rate	Total GDP (millions)	
	USD	PPP		USD	PPP
Antigua and Barbuda	13 159.5	27 274.0	0.482492	1 147.9	2 379.1
Bahamas	21 920.5	22 639.0	0.968263	7 909.6	8 168.9
Barbados	15 902.0	15 354.0	1.035691	4 445.7	4 292.5
Belize	4 344.1	8 212.0	0.528994	1 397.1	2 641.0
Grenada	7 365.7	11 221.0	0.656421	771.0	1 174.6
Guyana	2 998.9	5 798.0	0.51723	2 259.3	4 368.1
Jamaica	4 822.6	8 329.0	0.579013	13 220.0	22 832.0
Saint Lucia	7 000.6	9 893.0	0.707632	1 241.9	1 755.0
Saint Vincent and the Grenadines	6 231.7	9 883.0	0.630547	681.2	1 080.3
Trinidad and Tobago	16 684.0	28 743.0	0.580454	22 157.9	38 173.4

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures.

Population and demographic indicators

Source: United Nations World Population Prospects: The 2017 Revision

- Volume 1: Comprehensive Tables

- Online database: https://esa.un.org/unpd/wpp/

Population files:
- File POP/1-1: Total population (both sexes combined) by major area, region and country, 1950-2100 (thousands) Estimates 1950-2015

- File POP/7-1: Total population (both sexes combined) by five year age groups by major area, region and country, 1950-2100 (thousands) Estimates 1950-2015

- File INT/3-1: Total population (both sexes combined) by single age, major area, region and country, annually for 1950-2100 (thousands) Estimates 1950-2015

- File POP/13-B: Old-age dependency ratio (65+/20-64) by major area, region and country, 1950-2100 (ratio of population 65+ per 100 population 20-64) Estimates, 1950-2015

- File POP/5 Median age by major area, region and country, 1950-2100 (years) Estimates 1950-2015

Mortality Files:
- File MORT/1-1:Infant mortality rate (both sexes combined) by major area, region and country, 1950-2100 (infant deaths per 1,000 livebirths) Estimates 1950-2015

- File MORT/2 Crude death rate by major area, region and country, 1950-2100 (deaths per 1,000 population) Estimates 1950-2015

- File MORT/4-1: Deaths (both sexes combined) by five year age group, major area, region and country, 1950-2100 (thousands) Estimates 1950-2015

- File MORT/7-1 Life Expectancy at birth (both sexes combined) by major area, region and country, 1950-2100 (deaths per 1,000 population) Estimates 1950-2015

Fertility Files:
- File FERT/1: Births (both sexes combined) by major area, region and country, 1950-2100 (thousands) Estimates 1950-2015

- File FERT/3 Crude birth rate by major area, region and country, 1950-2100 (births per 1,000 population) Estimates 1950-2015

- File FERT/4 Total fertility by major area, region and country, 1950-2100 (children per woman) Estimates 1950-2015

Expenditure on Education

All countries with the exception of Bahamas, Grenada and Trinidad and Tobago
- United Nations Educational, Scientific and Cultural Organization Institute of Statistics (UNESCO UIS)

Bahamas
- National Accounts Report, 2014, <http://www.bahamas.gov.bs/wps/portal/public/ reports%20and%20surveys/annually/economics/>

Grenada
- The Eastern Caribbean Central Bank, <http://www.eccb-centralbank.org/p/gdp-annual>

Trinidad and Tobago
- Estimates of Expenditure 2010

Expenditure on Health
- World Health Organization Global Health Observatory Repository, <http://apps.who.int/gho/ data/view.main.HEALTHEXPRATIOKOR>

Expenditure on Pensions

National Budgets
- Antigua and Barbuda: Budget Estimates 2012 (Actual 2010)

- Bahamas: Estimates of Expenditure 2011/12 (Approved 2010/11)

- Barbados: Estimates 2013-2014 (Actual 2011-2012)

- Belize: Expenditure for fiscal year 2011/12 (Approved 2010/11)

- Grenada: 2010 Budget Statement (2010 budget)

- Guyana: Estimates of the Public Sector for the year 2010 (Budget 2010)

- Jamaica: 2010/11 Jamaica Budget (Estimates 2010/11)

- Saint Lucia: Estimates 2010-11 (Estimates 2010-11)

- Trinidad and Tobago: Draft Estimates of Expenditure for the financial year 2010 (Estimates 2010)

National Insurance Reports

- Antigua and Barbuda: Social Security Board, Statistical Abstract 2012-2014

- The National Insurance Board of the Commonwealth of Bahamas, Annual Report 2010

- National Insurance Board of Barbados, Annual Report 2009

- Belize Social Security Board, Annual Report 2010

- National Insurance Board of Grenada, Annual Reports 2010 and 2012

- National Insurance Scheme of Guyana, Annual Report 2012

- Jamaica Ministry of Labour and Social Security, Annual Performance Report 2015/16

- Saint Lucia National Insurance Corporation, Annual Report 2012 and 2014

- The National Insurance Board of Trinidad and Tobago, Annual Report 2010

National Insurance Actuarial Reviews (for age distribution of pensioners)

- Bahamas: Ninth Actuarial Review of the National Insurance Fund, as of 31 December 2011

- Barbados: 14th Actuarial Review of the National Insurance, Unemployment and Severance Funds as of 31 December 2011

- Grenada: Ninth Actuarial Valuation of the National Insurance Fund as of 31 December 2009

- Jamaica: Actuarial Analysis of the Sustainability of the National Insurance Scheme (NIS) in Jamaica, February 2014

- Saint Lucia: Seventh Actuarial Review of the National Insurance Fund, as of June 30, 2000

- Trinidad and Tobago: Ninth Actuarial Review of the National Insurance System as of 30 June 2013

Other Sources

- IMF Working Paper, 2016, National Insurance Scheme Reforms in the Caribbean <https://www.imf.org/external/pubs/ft/wp/2016/wp16206.pdf>

- Inter-American Development Bank, Social Sector, Labor Markets Unit, Technical Note No. IDB-TN-767 (2015), Belize Pension System

- Draft Report of the Public Expenditure Review Commission of the Eastern Caribbean Central Bank, November 2012

- Government of Jamaica, Ministry of Finance, 2011, Green Paper: Options for Reform of the Public Sector Pension System

- Government of the Republic of Trinidad and Tobago, Ministry of Finance and the Economy, Treasury Division, 2015, Media Release: Payment to Government Pensioners

Data items and sources for OECD and EU member countries

Population Estimates

- Source: United Nations World Population Prospects: The 2017 Revision

    – Volume 1: Comprehensive Tables

    – Online database: https://esa.un.org/unpd/wpp/

Population files

- File POP/1-1: Total population (both sexes combined) by major area, region and country, 1950-2100 (thousands) Estimates 1950-2015

- File POP/7-1: Total population (both sexes combined) by five year age groups by major area, region and country, 1950-2100 (thousands) Estimates 1950-2015

- File INT/3-1: Total population (both sexes combined) by single age, major area, region and country, annually for 1950-2100 (thousands) Estimates 1950-2015

- File POP/13-B: Old-age dependency ratio (65+/20-64) by major area, region and country, 1950-2100 (ratio of population 65+ per 100 population 20-64) Estimates, 1950-2015

Mortality Files

- File MORT/4-1: Deaths (both sexes combined) by five year age group, major area, region and country, 1950-2100 (thousands) Estimates 1950-2015

Total GDP for base years 2009, 2010, 2011

- OECD Data, <http://www.oecd.org/std/na/gross-domestic-product-gdp-and-other-annual-national-accounts-statistics-oecd.htm>

Expenditure on Education

- Education at a Glance 2011, tables B2.3 and B3.3

Expenditure on Health

- World Health Organization Global Health Observatory Repository, <http://apps.who.int/gho/data/view.main.HEALTHEXPRATIOKOR>

- Public spending on health and long-term care: a new set of projections, <https://www.oecd.org/eco/growth/Health%20FINAL.pdf>

Expenditure on Pensions

- Pensions at a Glance 2009, OECD Data <https://data.oecd.org/socialexp/pension-spending.htm>

- The 2015 Ageing Report: Economic and budgetary projections for the 28 EU Member States (2013-2060) <http://ec.europa.eu/economy_finance/publications/european_economy/2015/pdf/ee3_en.pdf>

Other

- KNOEMA Data, <https://knoema.com/pjeqzh/gdp-per-capita-by-country-statistics-from-imf-1980-2022?country>

- International Monetary Fund World Economic Outlook Database, <https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/index.aspx>

- World Bank Open Data, <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD>

Assumptions and procedures for age-related projections

Education

The beneficiary population was determined to be the school age population covering ages 0 to 24 years. The following steps were used to derive expenditure by age within this age range.

Step 1: Calculate expenditure on education by level

Derived using expenditure data from UNESCO UIS database for all countries with the exception of Bahamas, Grenada and Trinidad and Tobago. The disaggregation by level of education for these countries was calculated by applying the average distribution of the other countries to the total expenditure on education for these three.

Table A.11
Public expenditure on education by level
(GDP in Millions of US dollars)

	Pre-Primary	Primary	Secondary	Post-Secondary	Tertiary	Total GDP on Education
Antigua and Barbuda	0.1	12.4	14.4	0.7	2.2	29.8
Bahamas	5.8	72.8	70.1	7.8	25.5	181.9
Barbados	1.0	96.7	77.0	8.7	78.9	262.3
Belize	1.4	42.4	37.9	2.5	8.0	92.2
Grenada	1.0	12.3	11.9	1.3	4.3	30.8
Guyana	11.8	29.9	34.4	2.1	5.4	83.6
Jamaica	32.9	302.5	304.6	11.0	181.9	832.9
Saint Lucia	0.8	18.9	20.4	2.6	2.1	44.7
Saint Vincent and the Grenadines	0.7	14.4	12.6	4.6	2.4	34.7
Trinidad and Tobago	20.4	257.2	247.7	27.4	89.9	642.6
Total	75.8	859.4	830.9	68.8	400.6	2235.5

Step 2: Redistribute the expenditure by level according to the proportions below

These proportions are guided by the official school age groups (see table 8).

Table A.12
Factors for apportionment of education spending by level to age groups

Standard Age Group	Factors
0-4	100% of pre primary
5-9	5/7 of primary
10-14	2/7 of primary; 3/5 of secondary
15-19	2/5 of secondary
	3/5 of tertiary
	3/5 of post-secondary
20-24	2/5 of tertiary
	2/5 of post-secondary

Pensions

Step 1: Determine beneficiary population

The beneficiary population is the number of beneficiaries of old age, invalidity and survivor benefits from the National Insurance Schemes and retirement benefits for former government workers.

Step 2: Estimate expenditure as a proportion of GDP for both groups of pensioners

National Insurance

Public expenditure on national insurance pensions as a percentage of GDP was calculated as payments to beneficiaries in the year/total GDP for the year. Calculations were based on GDP estimates reported in national currency in National Accounts Digest 2009-2015 Volume 1 (CARICOM, 2016).

Government Pensioners

A combination of assumptions is used for the estimation of the number of government pensioners. The number of government pensioners was calculated as a percentage applied to the total number of national insurance scheme (NIS) beneficiaries. :

- Antigua and Barbuda: % of active insured NIS beneficiaries identified as government workers

- Bahamas: % of employed labour force from 2010 census identified as government workers

- Barbados: % of active insured NIS beneficiaries identified as government workers

- Belize: % of active insured NIS beneficiaries identified as government workers

- Grenada: % of contributions identified as being from government

- Guyana: % of employed labour force from 2010 census identified as government workers

- Jamaica: Actual estimate from Ministry of Finance Green Paper

- Saint Lucia: % of employed labour force from 2010 census identified as government workers

- Trinidad and Tobago: Actual estimate from Ministry of Finance Media Release

For example, if the percentage of active insured NIS beneficiaries that are government workers, in Belize for example, is estimated at 15 per cent, then the number of government pensioners for Belize would be calculated as 15 per cent of NIS beneficiaries. The age distribution of NIS old age and invalidity beneficiaries is applied to the numbers derived for each country. The minimum age for retirement is assumed to be 35 years. Public expenditure on government pensions as a percentage of GDP was calculated using data from national budgets and estimates of GDP in national currency taken from National Accounts Digest 2009-2016 Volume 1 (CARICOM, 2016).

Table A.13
Public expenditure on pensions by type
(Percentages of GDP)

	Expenditure % of GDP			
	Contributory national insurance pensions	Non-contributory pensions	Government Pension	Total
Antigua and Barbuda	2.7	0	1.8	4.5
Bahamas	1.5	0.2	0.7	2.4
Barbados	3.6	0.2	2.7	6.5
Belize	0.8	0.2	1.8	2.7
Grenada	1.4	0	1.9	3.3
Guyana	2.0	0.6	1.4	4.0
Jamaica	1.0	0	1.4	2.4
Saint Lucia	1.3	0	1.5	2.8
Trinidad and Tobago	1.4	1.4	1.6	4.4
Total	1.7	0.3	1.6	3.7

Step 3: Allocate expenditure to age groups

To calculate the expenditure by age, the total GDP on pensions was distributed proportionately among the age groups with the assumption that an age group commands the same proportion of the total expenditure as it does of the total beneficiary population (see table A.14).

Table A.14
Age profiles of total expenditure on pensions for 9 Caribbean countries[a]

Age Group	Pension recipients (as a percentage of all pension recipients)		Pension recipients (as a percentage of all persons)		Expenditure (as a percentage of GDP)	
	NIS	Government Pensioners	NIS	Government Pensioners	NIS	Government Pensioners
Under 40 years	5.1	0.1	0.4	0.0	0.095	0.002
40-44	0.8	0.4	0.6	0.1	0.015	0.007
45-49	1.3	0.6	1.1	0.1	0.024	0.010
50-54	1.9	1.0	1.9	0.2	0.035	0.016
55-59	2.4	1.3	3.1	0.4	0.043	0.021
60+	88.6	96.7	45.3	12.0	1.646	1.590
65+	68.6	73.2	50.1	12.9	1.277	1.204
Total	100.0	100.0	5.6	3.4	1.857	1.646

[a] Expenditure on non-contributory pensions was allocated to age groups using the same age profile as for contributory pensions.

Health

Step 1: Determine beneficiary population

The beneficiary population is determined on the basis of rates of usage of public health facilities estimated from surveys of living conditions for six countries: Antigua and Barbuda, Grenada, Jamaica, St Lucia, St Vincent and the Grenadines and Trinidad and Tobago. The average (median) rate for each age group was applied to all 10 countries table (see table A.15).

Table A.15
Use of public health facilities in the previous three months by age
(Percentages)

Age Group	Utilization
0-4	4.5
5-9	3.7
10-14	2.3
15-19	2.3
20-24	2.2
25-29	2.6
30-34	2.5
35-39	4.2
40-44	5.4
45-49	5.6
50-54	8.8
55-59	10.0
60-64	14.6
65-69	16.8
70-74	21.0
75+	21.1
All persons	6.1

Source: Surveys of living conditions.

The utilization rate for an age group was applied to the total population in the age group to derive the beneficiary population.

Step 2: Allocate expenditure to age groups

To calculate the expenditure by age, the total GDP on health was distributed proportionately among the age groups with the assumption that an age group commands the same proportion of the total expenditure as it does of the total beneficiary population (table A.16).

Table A.16
Expenditure on health by age group for ten Caribbean countries (averages)
(Percentages)

Age Group	Expenditure on Health (Percentages of GDP)	Expenditure on Health (Percentages of total health expenditure)
0-4	0.3	7.1
5-9	0.2	6.0
10-14	0.1	4.0
15-19	0.1	4.0
20-24	0.1	3.5
25-29	0.1	3.9
30-34	0.1	3.3
35-39	0.2	5.5
40-44	0.2	6.7
45-49	0.2	6.6
50-54	0.3	8.5
55-59	0.3	7.4
60-64	0.3	8.1
65-69	0.3	7.0
70-74	0.3	7.4
75+	0.4	11.3
Total	3.7	100.0

Annex 3
Glossary of terms and definitions

Glossary

Ageing is the process of growing older. A population is said to be ageing when it has an increasing proportion of older persons.

Age Dependency Ratio – A ratio in which the numerator represents the total number of people not of working age (too old or too young to work and therefore 'dependent' on those who do), and the denominator represents the population of working age. It is often multiplied by 100, which yields the number of dependents per 100 persons of working age.

Crude Birth Rate – The number of live births per 1,000 population in a given year.

Crude Death Rate – The number of deaths per 1,000 population in a given year.

Average Annual Growth Rate (per cent) − Calculated as

$$r = \ln(p_n/p_o)/n$$

where: r = rate of growth, p_n = population at later date, p_o = population at earlier date and n = the length of the interval.

Life Expectancy – The average number of years of life remaining to a group of persons who reached a given age. It is calculated from a life table.

Median Age – The age at which exactly half the population is older and half is younger. The age at which the population is divided into two equally sized groups.

Natural Increase – The excess of births over deaths in a population. An excess of deaths over births is referred to as a natural decrease.

Net Migration – The difference between the number of immigrants and the number of out migrants for a given area over a given period of time.

Old Population – A population with a relatively high proportion of middle-aged and elderly persons, a high median age, and thus a lower potential for growth.

Population Change refers to change in the number of inhabitants of an area. The change may be an increase, a decrease or zero.

Rate of Change – The change of population during a given period expressed as a rate. The rate may relate to the entire period in which case the denominator is usually the initial population. Alternatively it may be an average annual rate in which case the rate may assume annual compounding, continuous compounding or some other function.

Rate of Natural Increase – The difference between the crude birth rate and the crude death rate.

Replacement Level Fertility is the level of fertility at which a cohort of women, on average, has only enough daughters to 'replace' themselves in the population. Once replacement level fertility has been reached, births will gradually reach equilibrium with deaths and, in absence of migration, a population ultimately will stop growing and become stationary.

Total fertility rate – is the average number of children that would be born alive to a woman (or group of women) during her (their) lifetime if she (they) were to pass through all the childbearing years conforming to the age specific fertility rates of a given year.

Sources:

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- Rowland, Donald T. (2003), *Demographic Methods and Concepts*, Oxford, Oxford University Press.

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Calculations

Dependency Ratios

- Education dependency ratio: school-age population (0-24)/ population 20-64 years $\times$ 100

- Pension dependency ratio: population 65+ years/ population 20-64 years $\times$ 100

- Health dependency ratio: near-death population/ population 20-64 years $\times$ 100

- Near-death population: average annual deaths $\times$ 10

- Old-age dependency ratio: population 65+years/ population 20-64 years $\times$ 100

- Support Ratio: population 20-64 years/ population 65+years

- Ageing Index: population 60+ years/ population under 15 years $\times$ 100

Per Capita Expenditure

- Expenditure per student (US$ PPP): Expenditure on education/ school-age population.

- Expenditure per pensioner (US$ PPP): Expenditure on pensions/ population 65+years

- Expenditure per person for health care (US$ PPP): Expenditure on health care/ near-death population

Annex 4
Country codes for figures 2,3,4,5

Caribbean Countries

Antigua and Barbuda	ATG
Bahamas	BHS
Barbados	BRB
Belize	BLZ
Grenada	GRD
Guyana	GUY
Jamaica	JAM
Saint Lucia	LCA
Saint Vincent and the Grenadines	VCT
Trinidad and Tobago	TTO

OECD Countries

Australia	AUS
Belgium	BEL
Canada	CAN
Chile	CHL
Czech Republic	CZE
Denmark	DNK
Estonia	EST
Finland	FIN
France	FRA
Germany	DEU
Greece	GRC
Iceland	ISL
Israel	ISR
Italy	ITA
Japan	JPN
Korea	KOR
Luxembourg	LUX
Netherlands	NLD
New Zealand	NZL
Norway	NOR
Mexico	MEX
Poland	POL
Portugal	PRT
Slovakia	SVK
Slovenia	SVN
Spain	ESP
Sweden	SWE
United Kingdom	GBR
United States of America	USA

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