THE PROJECTED IMPACT OF DEMOGRAPHIC CHANGES ON HOUSEHOLD SIZE AND HOUSING STOCK IN SAINT LUCIA: 2015-2030

SINOVIA CONSTANCE MOONIE

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Sinovia Constance Moonie
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Sir Arthur Lewis Institute of Social and Economic Studies
Faculty of Social Sciences
St. Augustine Campus

ABSTRACT

The Projected Impact of Demographic Changes on household size and housing stock in Saint Lucia: 2015-2030

Sinovia Constance Moonie

Between 1960 and 2010, the average household size in Saint Lucia decreased from 4.22 persons to 2.81 persons. During that period, two parallel trends contributed to the decline: a significant increase in the number of households and a drastic growth in one–person households.

This paper traces the major trends in household formation since 1960 and develops a set of nationally representative household projections that could help determine future housing demand. It begins with an examination of the existing extrapolative methodologies for developing household projections and provides an outline of the household membership rate procedure as a suitable methodology for deriving robust projections of future household numbers and the distribution of households by size for Saint Lucia. Using census data from the last four decades, household projections are then produced for the years 2015 to 2030 in five-year intervals.

Keywords: household projection, household size, headship rate, housing stock, household formation.

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Any errors or omissions remain the sole responsibility of the author.

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Chapter 1

Introduction

The household and the family are two of the most basic social units in a society. They act collectively to influence the key processes of fertility, migration and mortality as well as "socio-demographic processes including the destabilization of traditional patterns of marriage, cohabitation and divorce; the growing fluidity of ties of kin and friendship; and increasingly complex transitions through life course" (Buzar, Ogden and Hall 2005, 413). Notwithstanding their interrelatedness, most demographic research has been limited to just one component: the family and the characteristics of the individuals and relationships among those that constitute that unit. However, of equal or even greater importance are the dynamics of households, particularly trends in the number, type, structure, size and composition of households.

As households function as key economic and social units within the society, changes in their characteristics, number and size have enormous implications and therefore cannot be overlooked. For instance, Jacobsen, Mather and Dupuis (2012) contend that:

> Household structure plays an important role in the economic and social well-being of families and individuals as the number and characteristics of household members affect the types of relationships and the pool of economic resources available within the household. (12)

Further, trends in household composition, formation, development and dissolution are, on the one hand indicators of social change, and on the other, key determinants of both current and future housing demand. Consequently, analyses of the demographic characteristics of households are important for use by planners and policymakers, since "changes at the household level have repercussions at the country level" (Ayad *et al* 1994, 1).

Given the pivotal role of the household as a unit of consumption, production, ownership and residence, discerning both past and projected trends in the evolution of household structure, including its number, size and composition is crucial for understanding the combined impact of social, economic and demographic factors on household dynamics. Historical trends in household formation and dissolution are important not only for understanding the extent to which households have evolved over time, but even more so, they provide a very critical baseline for projecting future households. According to Holmans (2002), household projections provide a means for generating estimates of numbers of households in future years using estimates of the future population. Consequently, projections make it possible to "anticipate the changes in number, size type and composition of households" (Jiang and O'Neill 2007, 2).

Household projections are extremely important for decision-making and forward-planning in diverse policy areas including housing, education, elderly and child care. Additionally, as households are the main consumers of a goods and services, projections help with determining potential demand for various home-related services such as water, electricity and other durable goods (Zeng *et al*

2010). Household projections also meet the needs of a range of users, chief among those are government departments with responsibility for physical planning, housing and development; and governmental and private agencies that plan the development of public utilities, and the production and distribution of consumer durables (United Nations 1973).

The importance of long- or short-term household projections is therefore self-evident. In addition, the need to project the number of households (and by extension, families) is well recognized as an integral part of economic and social planning. Notwithstanding that, household projections that would enable forward planning are typically not produced by developing countries because of the paucity of data to undertake such analyses or the lack of statistical capacity to produce those projections.

Preliminary research on the evolution of households in selected Caribbean countries over the period 1970 – 2001 reveal a trend towards smaller household sizes. Accompanying that trend have been continuous increases in the number of households. Of the Caribbean countries assessed in this preliminary research, the dramatic decline in household size was most apparent for Saint Lucia, where the average number of persons per household declined from 4.59 persons in 1980 to 2.81 in 2010. Over that same period, the proportion of family[1] households fell from 83 per cent to 65 per cent while the number of households increased significantly from 24,733 to 58,891. This decline in average household size

[1] In this context, family households refer to two types of families: nuclear and extended. Therefore the proportions reflect the ratio of family households

coupled with the increase in the number of households is reflective of a complicated set of demographic and social processes that warrant attention.

The trends in household formation in Saint Lucia, and by extension, the Caribbean subregion, supports the observations of United Nations (1973) that "in most of the world the rate of the growth of households and families has been more rapid than the population in recent years, and therefore their future trends will be different from those of the total population" (United Nations 1973, 1). These findings give even further credence to the declining trends observed by Bongaarts (2001) in several developing[2] countries. This evolution of households which has been characterized by a trend towards smaller household sizes while the number of households increase suggests that more housing units will be needed to accommodate the same or slightly larger population. Those trends therefore underscore the need for more targeted research on the demographic characteristics of households. In particular, it justifies more detailed analysis of issues related to household demography including changes in household size and composition, as well as the development of a set of household projections that will enable some determination of future housing stock.

[2] This study focused on 49 developing countries in four continents namely: Asia, Latin America, North East/ North Africa and Sub-Saharan Africa. Caribbean countries were not included in this research.

I. Statement of the Problem

Households are critical units of analysis for research on social, demographic and economic processes. Consequently, data on households are ubiquitous, particularly from large statistical exercises such as the population and housing census, for which the household is the main unit of enumeration. Notwithstanding that, detailed analyses of household demographic characteristics such as the size, structure and composition of households as well as headship of households are not readily undertaken and lacking for many developing countries despite emerging trends in household formation and composition. In Saint Lucia, the subject of this research paper, analyses of household characteristics obtained through population housing censuses and surveys are limited to "aspects of the building used for purposes of the household - its type, tenure, material used for outer walls, date of construction and size; also amenities available to the household such as water supply, toilet facilities, lighting and cooking fuel" (Saint Lucia 1980 Census Report, xii).

In the last four decades, the number, size and structure of households in Saint Lucia have undergone dramatic changes. An analysis of household trends for the period 1980 to 2010 indicated that the average household size in Saint Lucia decreased from 4.59 persons to 2.81 persons. This decline in average household size implies that relatively more housing units are required per capita to fulfill the housing needs. As a consequence, the number of private households increased more than two fold and the proportion of the population who were household heads increased from 44 to 49 per 100 persons. At that rate, the growth

in new households has outpaced population growth in each intercensal period across that forty year time span. Such changes in the number, size and composition of households are suggestive of "changes in attitudes regarding family size or ways of living or indicate that there are forces already at work to produce that change" (United States Bureau of the Census 1979, 83). More importantly, as households are the basic units of demand for housing, changes in the rate of household formation affect the number of dwellings required as well as the demand for consumer goods and services.

Understanding changes in household demography, particularly emerging trends such as declines in household size even when the population growth continues to increase (albeit at a lower rate), are important since they impact on future social, economic and environmental development. Furthermore, household transitions do not only underscore the need for analysis of past trends and characteristics of households particularly their number, size and structure but also justify the development of household projections as a means of predicting future trends in household formation. Moreover, the projections of household growth and size would also be crucial information for development planning as well as inputs for the enhancement of the existing national housing policy. In particular, these household projections will help fill a data gap and therefore address a data deficiency and need articulated in the National Report for Housing and Resettlement for "an accurate projection of Saint Lucia's housing deficits" (Ministry of Housing, Urban Renewal and Local Government 2008, 8). As noted by Riche (2003), "households are a better predictor of changes in housing demand

than population", consequently, those projections would serve as indicators of projected housing demand and therefore be useful inputs for determining future housing stock for the country. In the long run, such information would help avert any mismatch between housing demand and supply and therefore reduce the possibility of unplanned development or the urban sprawl especially in the highly populous urban areas such as Castries and Gros Islet.

II. Research Aims

Given the paucity of research on the historical trends on household formation and the limited attempts at deriving household projections (be it on a periodic or ad hoc basis) in Saint Lucia, the purpose of this research paper will be to develop a set of national household projections. These projections are expected to provide some estimates of future housing need as well as the demand for goods and services by households. Consequently, they would help address a major data deficiency noted in the existing national housing policy. Moreover, as the proposed research goes beyond the traditional assessment of population-related factors including population growth, distribution and structure as the most relevant demographic variables for planning and policy development, it is expected to provide critical information that would have implications on national development and quality of life.

Specifically, the study will focus on three primary aims:

(i) To assess historical trends in household formation in Saint Lucia over the period 1960 to 2010;

(ii) To develop a nationally representative model for projecting household size and determining future housing stock for the period 2015-2030;

(iii) To analyze the expected changes in the number and structure of households based on the projections.

III. Definition of key terms

For the purpose of the census, the United Nations defines a household as "the arrangement made by persons, individually or in groups, for providing themselves with food and the other essentials for living" (United Nations 2007, 114). This definition emphasizes on the dimensions of common residence and common housekeeping arrangement so as to distinguish it from the concept of a family which refers to "members of a household who are related to a specified degree, through blood, adoption or marriage" (United Nations 1973, 6). In spite of this recommendation, the way in which the household concept is operationalized by data collecting agencies is by no means standard and therefore differs across and within countries.

The Government of Saint Lucia Statistics Department, which is the principal body with responsibility for conducting social and demographic surveys, defines a private household as "one or more persons living together (i.e. sleeping most nights of a week 4 out of 7) and sharing at least one daily meal" (Saint Lucia

Government Statistics Department 2010, 5). This definition has been used consistently across censuses (1960 – 2010), except for minor changes in wording. The notion of a private household is used to distinguish it from shared households or institutions which include prisons, hospitals, nursing homes etc. Further, the concept of the private household emphasizes the two elements prescribed by the United Nations i.e. co-residence and common housekeeping. Based on this conception, the definition of a private household embodies different types of household composition, and therefore tends to be synonymous with family except that a private household can consist of just one person whereas a family cannot.

The household population is defined as "all persons who reside in private households in Saint Lucia" (Saint Lucia Government Statistics Department, 5). Consequently, it accounts for the segment of the population living in private households and is therefore computed as the total population of the country, minus persons living in institutional households.

With respect to the measurement, one of the key indicators relating to the structure of households is average household size. This refers to the number of persons residing in a private household and is therefore regarded as one of the most basic demographic characteristics of a household (Bongaarts 2001). Computationally, average household size is derived as the ratio of the total population in households to the number of households in an area.

A very important factor which is often overlooked in the studies of households is housing stock (Faust 2008). According to Pozdena (1988), housing

stock refers to the actual structures or housing assets themselves and is therefore measured as the number of housing units available at a point in time. It is important to give due consideration to the role of housing stock when examining trends in household formation as it can impact on the rate of growth or decline in the number of households. Fundamentally, the rate of household formation is determined by the affordability and availability of appropriate housing. Thus, if there is a lack of appropriate housing, new households will not be formed. Conversely, if housing is both available and affordable then, there is likely to be an increase in the number of households.

One very significant variable used in the analysis is the head of the household, which refers to the person recognized as the principal person (male or female) "who carries the main responsibility in the affairs of the household and/or is the chief breadwinner" (Saint Lucia National Census Report 1980). The identification of the head is one of the first requirements for any household survey including the population and housing census. The principle reason for identifying the household reference person or household head at the outset is to determine the relationship or position of each member of the household with respect to the head of the household or main reference person, for example, the spouse of the head, the child of the head, parents.

IV. Significance of this research

As household formation and projections of household size are not areas that are well researched or studied, this paper will contribute in two key ways. Firstly, it

will provide to an overview of the evolution of Saint Lucian households over time and enable an understanding of the past trends in household formation. This information will hopefully provoke interest in issues of household demography that have remained virtually under-researched in the Caribbean. More importantly, it is hoped that the findings and outcomes of this research will be the impetus for producing regular household projections for Saint Lucia.

Secondly, the projections will provide a long term view of the number and size of households in Saint Lucia. These projections in combination with the existing data on household size, structure and formation in Saint Lucia will help trace transitions in household size and serve as significant inputs for the planning purposes with respect to housing/building and the development of public utilities. In addition, as households are the main consumers of goods and services, the findings will be useful to private industries that produce and distribute consumer durables including electrical appliances and automobiles (United Nations 1973).

The findings of this research also have policy relevance and have a general application in the areas of social policy concerned with the household. Given the importance of shelter as a basic human need as well as a measure of standard of living, the provision of adequate housing particularly to "core need" households including the indigent and vulnerable groups is a key priority for the Government of Saint Lucia (Ministry of Housing, Urban Renewal and Local Government 2008). As household projections are indicative of future housing need, the results of this research will be a useful input for planning. It could also potentially provide the data needed to enhance the Ministry's existing housing policy.

V. Organization of the paper

This paper is organized so that the initial chapters provide a concise assessment of the key trends and issues related to household formation in Saint Lucia. Chapter 2 presents a review of the existing literature on household formation and the main approaches for developing household projections. Next, an analysis of the past trends in household formation for Saint Lucia is provided in chapter 3. The analysis provides the critical trends upon which the household projections were based. In chapter 4, an outline of the main extrapolative methods for producing household projections is presented. Based on the existing methods and the purpose of the research paper, the household membership rate method is then proposed for the development of a set of household projections for Saint Lucia for 2015-2030. The main results are then presented in chapter 5. The final chapter presents a synopsis of the key findings and a brief discussion of the main research questions.

Chapter 2

Literature Review

I. Introduction

This chapter presents a synthesis of earlier work done on household demography, with specific examination of the literature related to household formation and methodologies that have been developed for projecting households. It proceeds by first looking at the literature on the various determinants of household formation since household formation is the key underlying factor that drives the demand for housing. Of greatest relevance to this paper however are the previous studies on models and methodologies for developing household projections.

There is a substantial amount of research on changes in household structure and transitions in household formation for developed countries including Australia, Britain, Northern Ireland, the United Kingdom and the United States (Barry *et al* 2005; Carliner 1991; Holmans 2012; Leiwen and O'Neill 2007; Richer 2003). In addition, those developed countries have embarked on the periodic publication of household projections in the last few decades (Shyrock, Siegel and Associates 1980) and (United Nations 1973). This is however not the case for developing countries, for which projections of housing stock are hardly attempted on account of the lack of or limited availability of data on households (Shyrock, Siegel and Associates 1980). Not only are projections seldom produced for developing countries, there is also a dearth of research on household demographic

characteristics. This was underscored by Bongaarts (2001) in his study of household size and composition in developing countries as a major shortcoming and area for development. He noted, in particular, that "demographers have neglected the quantitative dimensions of the size, composition and change in household and their consequences" (Bongaarts 2001, 3).

II. Determinants of household size and formation

Many of the studies on household formation highlight that the dominant pattern over time has been a fall in household size (Lesthaeghe and Moors 2000; Leiwen and O'Neill 2007). As noted by Lesthaeghe and Moors (2000), these transitions can largely be attributed to the second demographic transition (SDT) which has been characterized by significant fertility declines as a result of the adoption of efficient contraception at early ages and the overall postponement of parenthood. The net effect of this sub-replacement fertility became apparent in the second half of the 1960s, and was compounded by the rise in divorce rates and age at first marriage. Although Lesthaeghe and Moors (2000) identified the postponement of parenthood as the hallmark of the second demographic transition, they also noted the emergence of a "sexual revolution" which was characterized by a decline in the age at first sexual intercourse, for both sexes, as another defining feature. This increase in prenuptial intercourse accounted for high teenage fertility rates and high teenage pregnancy rates; the consequence of which was an elevated incidence of "young single mothers either living on their own or in their own parental household (three generations) and the proportions of children currently being

raised in single parent households headed by women younger than 25" (Lesthaeghe and Moors 2000, 125).

To examine the relationship between the secondary demographic transition and household formation empirically, Bongaarts (2001) analyzed household surveys of 43 developing countries in Asia, Latin America, North East/ North Africa and Sub-Saharan Africa. This study focused on the key aspects of household size and composition and entailed an examination of the main determinants of household formation. His findings supported the research done by Lesthaeghe and Moors (2000) and further underscored the impact of three determinants: declining fertility schedules, the mean age at marriage and marital disruption on household size. He further noted that household size was positively associated with the level of fertility and mean age at marriage but inversely associated with the level of marital disruption (Bongaarts 2001).

Changes in household size and structure have been assessed within the framework of an ageing population, and fertility and mortality decline (Kobrin 1976) and (Riche 2003). In her examination of the impact of current and projected changes in the United States in the twenty first century, Riche (2003) noted that the most significant demographic change that would reshape the country's residential landscape would be age-driven population changes. Based on those factors and the ageing of the baby boomers, it was projected that by 2025 the number of households would increase significantly because of the ageing population and changing population composition.

Despite the vast amount of literature that associates the change in household structure with the demographic transition, there is well-documented research on other drivers of household formation which cannot be overlooked. There is, for instance, a significant amount of previous studies on household formation among young adults which have been clustered around the non-demographic determinants including economic conditions, labour market, business cycles, and housing costs. Some authors have examined the rate of household formation from economic lenses and have identified socioeconomic factors that affect both household formation and size. Kochanowski (1995) argues that economic conditions and growth play a major role in cohabitation and headship rates and, as such, may be better indicators of household formation. This perspective is supported and illustrated by Dunne (2012) in his commentary which assessed the impact of the Great Recession on the rate of household formation in the United States of America. In his comparison of household projections against actual data for the 2008 - 2011, Dunne (2012) noted that over that period there had been shortfall in household formation among young adults aged 18 to 34 years because of the weak economy. He posited that while demographic factors such as population ageing would invariably impact on the rate of household formation, economic factors could not be overlooked as recessionary forces would undoubtedly reduce household formation. He also observed that for persons in the younger cohort, changes in the employment-to-population ratio and the growth in house prices were positively correlated with the rate of household formation. Labour market conditions, housing prices, rent and the cost of living independently have also been identified as determinants of the rate of household

formation, particularly among young adults[3] (Di, Yang and Lui 2002, Hendershott and Smith 1994; Paciorek 2013).

Previous studies also distinguish between the type of impact that demographic and non-demographic factors have on household formation. The Joint Centre for Housing Studies of Havard University (2013) identified economic conditions as the main drivers of household growth in the short run, while the size and age structure of the adult population were deemed as more critical factors in the long run. As a consequence, headship rates (the rate at which people formed independent households) have been and are projected to continue to increase among persons aged 65 and over as the majority of the baby boomer generations continue to enter retirement.

III. Measuring household formation

A significant amount of the literature on household formation has focused on age-specific headship rates (Kobrin 1976; Hendershott and Smith 1994; Paciorek 2013). As defined previously, the headship rate refers to the rate at which people formed independent households and therefore the number of persons who are counted as heads of households. By extension, the age-specific headship rate refers to the "rate at which the population in a specific age category forms into households; it is the ratio of the number of household heads in an age category to the people in that category" (Hendershott and Smith 1994, 2).

[3] In the literature, the group "young adults" refers to persons aged 25-34 years. This is typically the share of the population that are most likely to form new households.

The literature highlights headship rates as one of the main demographic drivers of household growth, since one's propensity to form a new household is largely determined by his/her age and is therefore a factor of the size and age composition of the population. Further, age-sex specific headship rates in developed countries are known to typically take on an inverted U-shape as the rates are usually lower among persons in younger age groups and among persons over 65 years. Studies by Crone and Mills (1991) and Kochanowski (1995) provide evidence that headship rates serve as a link between population and housing stock. Further, changing age distribution of the population impacts on headship rates, therefore they are not constant over time.

Analyses of the headship rate have been used to illustrate the differences in the rates of household formation by age and are deemed to be predictors of prospective change in the number of households. With respect to the latter, headship rates form the basis of many of the models and methodologies used by countries for making household projections and will be elaborated further in the ensuing section.

IV. Methods for projecting household: different approaches

Various methods have been devised and applied for projecting household stock and size by countries institutions and individuals, each differing by the type of data available and the purpose of the projections (United Nations 1973). The crudest

method of projection estimates future housing stock by assuming that the rate of growth of households would be equivalent to rate of growth of the population (Shyrock, Siegel and Associates 1980; United Nations 1973). There is therefore a clear assumption that the average size of the household would remain constant over the projection period. This approach has been viable in instances when the paucity of census or survey data on household heads limits the capacity of countries to produce more detailed or elaborate projections. However, the approach is obviously deficient as it fails to take into account the demographic and non-demographic factors that could potentially impact on the growth in the number of households. Moreover, the trends highlighted in the previous section point to considerable differences in the growth rates of population and households, and therefore challenge the validity of the basic assumptions underlying this method.

An alternative and more refined approach that takes into account the characteristics of the population, such as its composition by age and sex, is the headship rate method. This method is the classic approach used by many countries for future household formation and the approach recommended by the United Nations because it is the least demanding in terms of data and assumptions (United Nations 1973; United Nations 1989; Zeng Vaupel and Wang 1998). It is based on a methodology that assigns probabilities to individuals of being the household head. As such, it is classified as a ratio method since it relies on the projection of the total population by certain demographic characteristics such as age and sex (United Nations 1973).

The headship rate method is also regarded as a type of "propensity modeling" (Hendershott and Smith 1984) and (Carliner 1991). Hendershott and Smith (1984) posit that while trends in household formation are typically driven by economic conditions and the capacity of persons to form new households, there are two key underlying factors that need to be considered, namely: the age structure of the population and the age-specific headship rates. The age structure of the population is a determining factor since it influences one's propensity to form a new household or become a household head. The age-specific headship rate, on the other hand, is an indicator or measure of the propensity of persons in each age group to establish their own households and thus derived as the number of household heads in an age and sex category expressed as a proportion of total population in that category.

The rationale for the extensive use of the headship rate method by both developed and developing countries has been the simplicity of the methodology and the minimal data requirements (Ediev 2007; United Nations 1973, Zeng *et al* 2012; Zeng, Vaupel and Zhenglian 1998). The procedure for estimating future number of households involves applying the age-specific headship rates to the population, projected by the age and sex. Thus, at a minimum, the method provides the "projected numbers of household by age and sex of household, average household size and other relevant indicators" (United Nations 1989, 189).

Despite its widespread use, the headship rate suffers a number of shortcomings that are both definitional and computational. The first issue relates to the definition of the head of the household. While identifying the head of

household is one of the first requirements for any household survey including the population and housing census, as noted by Bruce and Lloyd (1992) the process is in itself subjective as the "head is not usually defined by objective criteria" and instead is so designated by members of the household based on their own subjective view. This arbitrary designation of the head of household therefore has implications for the rates and consequently poses a challenge for the resulting projections. Secondly, the headship rate method assumes constancy of rates of household formation and therefore does not take into account changes in the propensity of persons to form new households. As cited previously, household formation is not constant and can vary because of demographic and non-demographic factors (Zeng *et al* 1998). The third shortcoming relates to the mechanical nature of the method. In addition, it is severely limited in the type of distributions and details it can produce. For instance, the method cannot produce projections of the distribution of households by the number of household members or type of household (United Nations 1989). Owing to these shortcomings, a number of extensions of the headship rate method have been developed to allow for greater flexibility and enable the generation of a wider range of distributions (Ediev 2007; Zeng *et al* 1998).

The extended cohort component method or Profamy method developed by Zeng *et al* (1998) and which is based on a cohort approach has been advanced as a methodological alternative to the headship rate method. This method which is deemed as an extension of the conventional cohort-component population projection model, projects households and living arrangements by taking into

account changes in demographic components such as marriage/union formation and dissolution, fertility, leaving parental home and mortality (Zeng Vaupel and Wang 1998). According to the United Nations (1973), the cohort method which underpins this approach involves tracing persons or groups of persons who are born in a particular period of time in order to ascertain the proportion who have certain relevant characteristics such as school enrolment, household headship etc.

While the cohort approach clearly meets the need for detailed projections of household sizes, types and living arrangements, it is not always easy to apply because of the huge data requirements.

Chapter 3

Trends in household formation in Saint Lucia

(1960 – 2010)

This chapter presents a detailed analysis of the number, size and key characteristics of households in Saint Lucia over the period 1960 to 2010. The tabulations and figures presented therein are based on the results of the population and housing censuses for that period. Key trends that are likely to impact on future household growth are identified and discussed.

The number of households has grown significantly

In 2010 there were 58,891 households in Saint Lucia, an increase of 20,209 or 191% since 1960. This amounts to an average annual intercensal growth rate[4] of 2.13% for households. Table 1 presents a more detailed summary of the absolute numbers of households and intercensal changes for the period 1960 to 2010. For all intercensal periods except 2001 to 2010, the number of households has doubled. Between 2001 and 2010, the rate of increase was not as consistent and appeared a bit stunted.

[4] Based on exponential growth rate.

Table 1:
Summary of changes in household stock, 1960 - 2010

Census Year	Households	Intercensal Increase (absolute numbers)	
		Total Increase	Average Annual Increase[a]
1960	20,209		
1970	21,753	1,544	154
1980	24,733	2,980	295
1991	33,079	8,346	759
2001	47,541	14,462	1442
2010	58,891	11,350	1266

Source: Reports and Monographs of the Population and Housing Census 1960-2010.

Note: [a]The exact intervals between census dates were: 1960-1970 = 10.0 years; 1970 -1980 = 10.096 years; 1980-1991 = 11.0 years; 1991- 2001 = 10.027 years; 2001-2010 = 8.967 years.

The number of households increased at a faster rate than the total population

Between 1960 and 2010, the total count of the household population for Saint Lucia increased from 85,153 to 165,595. This increase represents an average annual growth rate of 1.33 per cent since 1960. At that rate, average annual intercensal increases in population have been much lower compared to the rate of increase in households. Table 2 provides the exponential annual growth rates of households and population for each intercensal period.

Table 2
Annual growth rates of households and population, 1960-2010

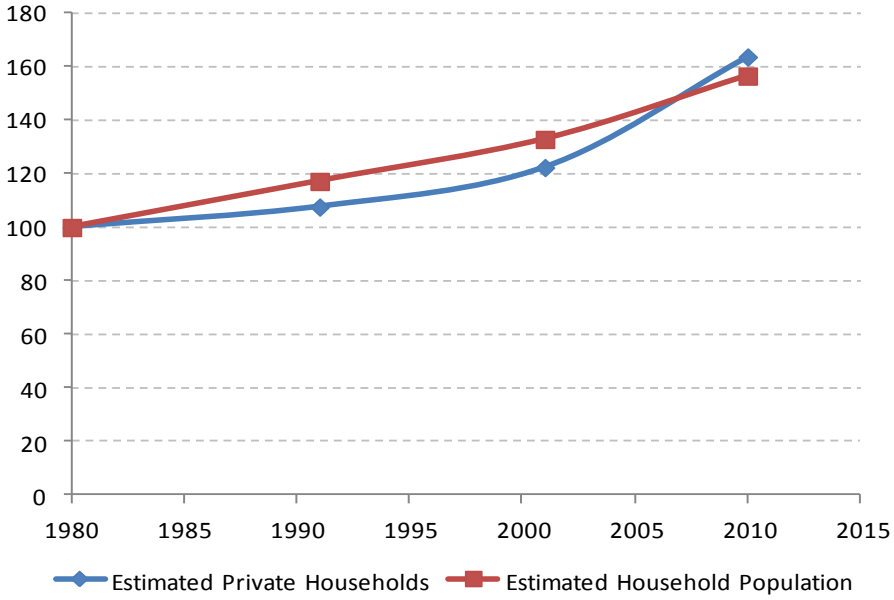
Census Year	Estimated Private Households	Estimated Household Population	Annual growth rate (%)	
			Households	Population
1960	20,209	85,153		
1970	21,753	99,806	0.736	1.588
1980	24,733	113,174	1.272	1.245
1991	33,079	133,308	2.643	1.489
2001	47,541	157,775	3.617	1.681
2010	58,891	165,595	2.388	0.539

Source: Author on the basis of published results of the Population and Housing Census 1960-2010.

A comparison of the annual growth rates for each intercensal period revealed that from 1970 onwards, the rate of growth of household stock outpaced population growth. Further between 1970 and 2001, the annual growth rate of household population changed only negligibly. However over that same period, the number of households increased by at least 1 percentage point for each successive intercensal period.

To further illustrate the variation in the growth rates of the population and households, trend lines indexed on 100 for base year 1960 were plotted on one pair of axes. The resulting trajectories for each times series are shown in Figure 1. While the population growth rates appear fairly linear, the number of households grew at exponential rate, such that by 2010, the rate of increase in households was far higher than that of household population.

Figure 1
Trends in household population and households, 1960- 2010



Source: Author on the basis of published results of the Population and Housing Census 1960-2010.

Household size has declined

While upward trends were recorded for total population and the housing stock, the patterns in household size have tended in the opposite direction. Changes in the average household size between 1960 and 2010 are given in Table 3.

Table 3
Average household size, 1960-2010

Census year	1960	1970	1980	1991	2001	2010
Household size	4.22	4.56	4.58	4.03	3.32	2.81

Source: Reports and Monographs of the Population and Housing Census 1960-2010.

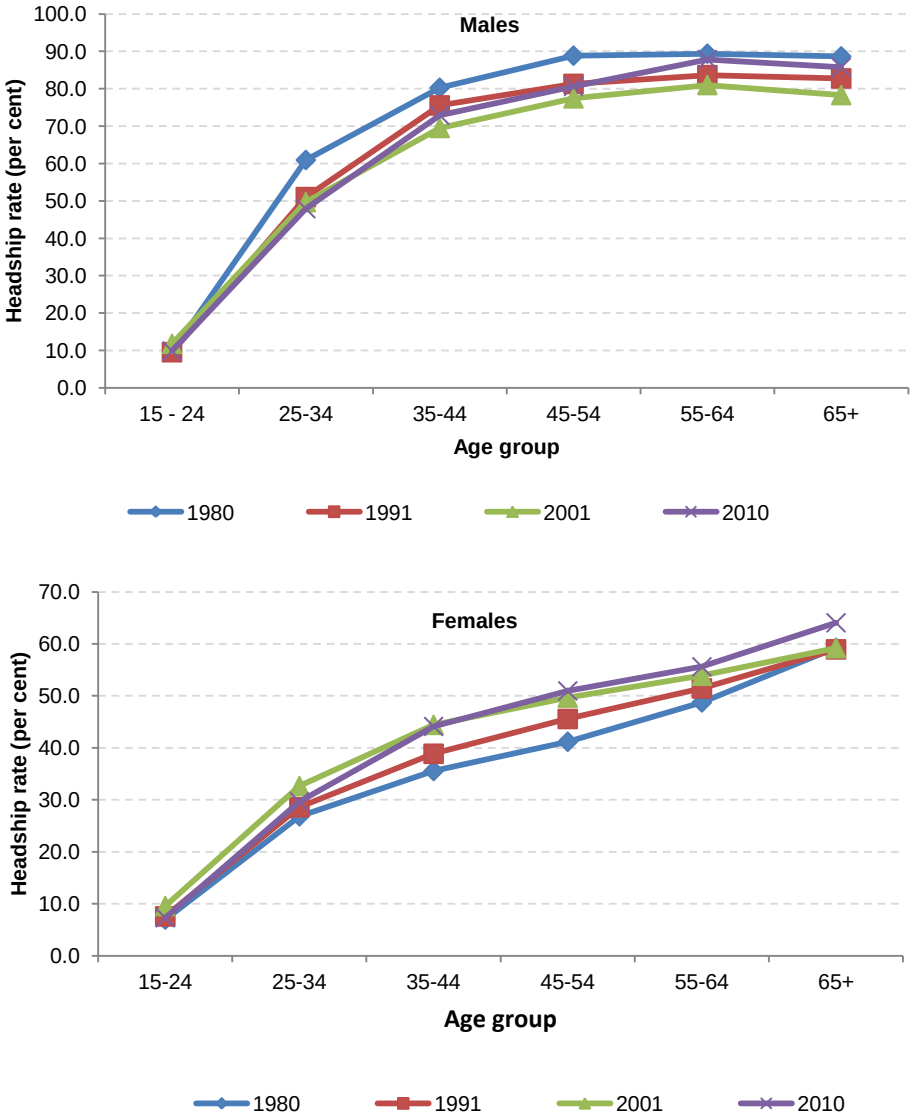
Between 1960 and 1980, the average household size increased nominally from 4.22 to 4.59 persons per household. However, since then average household size has been on the decline and decreased substantially from 4.59 persons per household in 1980 to 2.81 persons per household in 2010.

Headship rates have remained relatively stable

Headship rates by sex displayed in Figure 2 revealed that compared to females, a considerably higher proportion of males are household heads. In addition, for both males and females, headship rates were higher for older age groups than for the younger ones. Over time, those rates continued to increase, albeit marginally. A related observation is that a fairly high proportion of households continue to be headed by the elderly i.e. persons aged 65 years and older. The relatively high headship rates among the elderly may be linked to the stage of the country in the demographic transition. Saint Lucia experienced a major demographic change which was characterized by a transition from high fertility and mortality rates in

the 1960s to low fertility and mortality rates by the 1990s. As a consequence, the growth in the number of households relative to total adult population supported by the high headship rates among the elderly is reflective of an aging population and possibly a higher number of older persons living alone.

Figure 2
Headship rates for males and females, 1980 – 2010



Source: Author based on published results of the Population and Housing Census 1980-2010.

Relatively low headship rates ranging from 9 – 12 per cent for males and 7 – 10 per cent for females were recorded for young persons aged 15- 24 years. In addition, over time, the proportion of households that were headed by young persons have been declining such that, the proportion headed by males aged 15- 24 years decreased from 4.5 per cent in 1980 to 2.5 per cent in 2010. Similar trends were observed among females in that age group.

Headship rates peaked for males in their forties but for females in their sixties. In addition, there were large disparities in the headship rates across sex and age group. Most notably, the headship rates for women aged 25 – 64 years were substantially lower than those for men. On average, headship rates for female-headed households were half as high as those recorded for males.

It is worth noting that while characteristics of the head of the household are typically used in analyses of household formation as well as household projections, there are some inherent limitations with the designation of head of household that bias the male population and therefore cannot be overlooked. This bias is reflected in the disproportionately higher proportions of male-headed households compared to female-headed households. As indicated in the introduction, identification of the head of the household (the main breadwinner or person responsible for managing the affairs of the household) is a basic requirement of all surveys and censuses. Despite the existence of established criteria for determining the household head, the norm in most households is to designate the oldest male as the head even if he may not be the principal person with financial or other responsibility for the household. In addition, given that the

current surveys do not have room for assigning a joint head, the male invariably gets assigned that role, even if the female shares the same or greater responsibility. Bearing that in mind, the differences in the distribution of heads of households by sex or age should be treated with some caution.

A comparison of the headship rates against the age structure of the population gives credence to the association highlighted by Hendershott and Smith (1984) between age structure of the population and household formation. The data clearly shows that as the age structure of the population shifted, the number of households for a given age group changed since the propensity to form households was a factor of one's age.

The number of single family households has risen

Analysis of the distribution of private households by size revealed a sharp increase in the share of one-person households. This pattern, shown in Table 4, was one of the most notable developments for the period 1960 – 2010. Intercensal increases in the proportion of single person households have been more drastic than another type of household. In addition, there has been a notable decline in the proportion of households with 6 or more members. Between 1960 and 2010, the proportion of large households (6+ persons) declined from about 27% to less than 10 per cent.

Table 4
Percentage distribution of population and households by size of household, 1960 - 2010

Household Size	1960	1970	1980	1991	2001	2010
1 Person	16.0	17.3	16.6	17.7	22.6	27.3
2 Persons	17.5	15.1	14.7	15.8	18.9	21.7
3 Persons	15.1	12.8	12.8	14.8	18.5	18.3
4 Persons	13.1	11.2	11.9	14.8	14.7	14.8
5 Persons	10.4	10.0	10.9	12.0	10.2	8.6
6 Persons	8.3	8.4	9.1	8.8	6.8	4.4
7 Persons	6.3	7.3	7.0	6.2	3.7	2.2
8 Persons	4.6	5.6	5.1	3.9	2.1	1.2
9 Persons	3.2	4.2	4.0	2.4	1.2	0.6
10+ Persons	5.5	8.2	7.9	3.6	1.3	0.8
Total (=100%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Reports and Monographs of the Population and Housing Census 1960-2010.

Chapter 4

Methodology for developing household projections

I. Introduction

This chapter presents an overview of membership rate methodology that was used for developing household projections for Saint Lucia for the period 2015 to 2030. It builds on the some of the discussions presented in the literature review by providing more detailed information on the proposed approach including the main assumptions, the method of calculation and strengths and weaknesses. It will also include a discussion on the application of those methodologies by statistical offices for the production of national and sub-national household projections. In presenting the rationale for selection of the membership rate model for developing the household projections for this paper, reference will also be made to the other approaches that have been used by national statistical offices and research organizations.

Since the publication of the initial set of household projections in the 1930s, a number of different approaches have been advanced for the development of national and sub-national projections. These methods or models are typically classified according to two main categories: static and dynamic. Static methods allow for a comparison of the distribution of the population at discrete points in time. Dynamic methods, on the other hand, trace the behavior of individuals or cohorts over time. Thus, compared to static models, dynamic models examine the transition between household states or positions by taking into account the impact

of demographic factors on the household composition, formation, dissolution and growth. Static models however, distribute the population according to household and use the resulting rates or proportions to project future household numbers.

Dynamic and static methods can be further differentiated by the level of analysis i.e. micro- or macro- simulation. For macro-simulation models or the macro-analytic approach, the unit of analysis is the population as a whole, thus little consideration is given to the characteristics of the individual. However, with micro-simulation, modeling is done at the level of the individual. The choice of method i.e. dynamic or static model, depends on a number of factors including the type of data available (level of detail), the purpose of the projections and the needs of the user.

Among the available methods, the headship rate method has been most widely used by countries. It is an example of a static macro-simulation method and is typically a first choice for countries because of its modest data and computational requirements. However, conceptual and definitional issues related to the assignment of the head of household challenge the internal consistency and accuracy of this method. The headship rate method also suffers from other limitations. For instance, it cannot yield projections of the distribution of households by the number of household members (United Nations 1973).

The headship rate dates back to the 1940s and the post World War II reconstruction period when it was used by the United States Statistics Bureau for projecting household formation and determining future housing needs for civilians.

Since then, a number of new methods have been advanced that were either extensions of the headship rate method or dynamic models such as the extended cohort component method and PROFAMY (Ediev 2007; Zeng *et al* 2010). Some examples of the methods that are deemed to be extensions of the headship rate include the membership rate method and the propensity model (Linke 1988; McDonald and Kippen 1998).

An alternative methodology which overcomes some of the problems of the headship rate method is the household propensity rate (McDonald and Kippen 1998). This methodology projects the number of households as well as the distribution of households by type or living arrangement. Since its development, the propensity model has been used by the Australia Bureau of Statistics, New Zealand and a number of other statistical offices and agencies. Household propensity methods are built on determining the propensity of persons of different age groups belonging to different types of households or living arrangements. As such, it is often deemed to be an extension of the headship rate method since it takes into account characteristics of other members of the household aside from the head of household.

While the propensity model is an improvement over the traditional headship rate method, it is not always the most applicable, particularly if the requirement is for detailed information on distribution of the households by size. The household membership rate proposed by Linke (1988) and Leiwen and O'Neill (2004, 2009) derives household projections by using household membership probabilities disaggregated by age, sex and household size. Like the

household propensity model, it is deemed as an extension of the headship rate but is based on household membership rather than headship rates. The main difference lies in the categories for disaggregation of the population. This model has been used in Northern Ireland for developing household projections, as well as projections of households by size and tenure.

II. Household membership rate method for projecting household size and number

The methodology for developing household projections for Saint Lucia was based on the household membership rate method which was developed by Linke (1988) with refinements by Leiwen and O'Neill (2004). The membership rate is the approach used by Northern Ireland Statistics Research Agency (NISRA) for developing national and sub-national household project. With that approach, household projections are calculated by first deriving estimates of the membership probabilities for persons residing in four household types by age and sex group. These probabilities are then applied to the age/ sex disaggregated population projections. The methodology employed by NISRA distributes the population according to the following categories: (i) single person households; (ii) other households with dependent children; (iii) lone adult households with dependent children; and (iv) other households with dependent children (Barry *et al* 2005, 12). However, as the objective of this paper is to provide not only aggregated household projections but also projections of households by size, the four household type categories were not suitable. Instead, the categories used were household sizes ranging from 1-person to 7+ person households. Thus the

methodology presented here includes a slight modification of the NISRA household membership model.

The household membership rate model assumes that two key factors influence the projected number of households. These include:

(i) The projected non-institutional population by age and sex

(ii) The projected probabilities of persons of different age/ sex groups to reside in the different types of households.

Based on those assumptions, the two major inputs used for developing the household projections were the population projections for 2015 – 2030 and the past membership probabilities for the period 1980 to 2010. The latter was computed using the data for the past four censuses (1980, 1991, 2001 and 2010). The following six steps summarize the procedure used for deriving household projections.

Step 1: Obtain population projections for 2015-2030 by sex and 5-year age group

The projected non-institutional population of Saint Lucia for the period 2015 to 2030 was one of the two main inputs for deriving projections under this model. In the absence of official population projections from the Statistics Department of Saint Lucia, a set of population projections was produced by the author using the cohort component population projection model. The projections were based on the data from the 2010 population and housing census. A detailed account of the methodology, assumptions and results is included in Appendix 1. While four sets of future projections that reflect likely demographic developments based on

constant, low, medium and high variants were produced, only the medium variant was used in the analysis as the basis of the household projections. The projected population by sex and 5-year age group for the projection horizon 2015 – 2030 is given in Table A5.

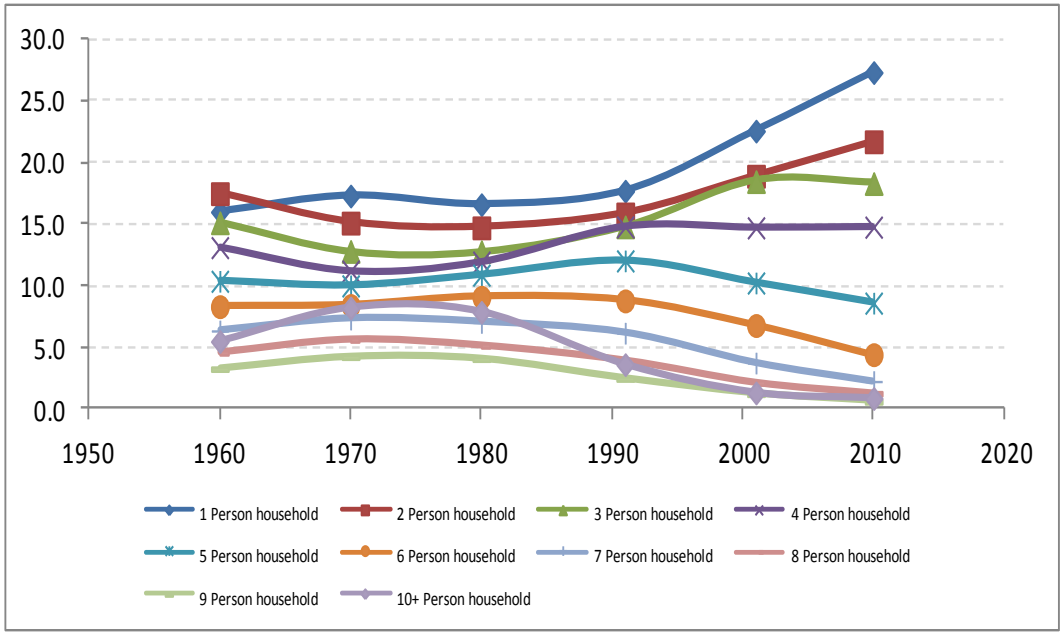
Step 2: Calculate the historic household membership probabilities by age and sex

Before computing the household propensities by age and sex, it was important to determine the categories to would be used in the analysis. As noted earlier, the four household type categories set out by Barry *et al* (2005) in their methodology was not appropriate for this analysis. Instead, seven categories that disaggregated the population according to household size were used. The specific categories were: single or 1- person households, 2 person household, 3 person households, 4 person households, 5 person households, six person households and 7+ person households. The last category of 7+ person households was determined after an examination of trends in the distribution of households according to household size over the period 1960 to 2010 shown in Figure 3.

The figure shows gradual increases in the proportion of 1 person, 2 person, 3 person and 4 person households. The proportion of 4-person households attained a plateau at about 15 per cent from 1991. Downward trends are however noted for households of size 5 and larger from as early as 1980. Further, over time the proportion of larger households plummetted at a faster rate. The rate of change appears to be equivalent for households with 5, 6 and 7 persons. Downward trends

in proportion of households of size 7 and larger started from 1980 and continued until 2010. Based on those observed trends, the open ended category of 7+ households was therefore selected.

Figure 3
Trends in the distribution of population by household size, 1960 – 2010.



Using the counts of the censuses from 1980 – 2010, the population was then classified by age group and sex for each household size. The age groups used were: 0 – 14, 15 – 24, 25 – 34, 35 – 44, 45 – 54, 55 – 64, 65 – 74 and 75+. The probabilities or proportions of persons residing in each type of household for each of the four census years was then computed by dividing the total number of persons in each age/sex/ household size category by the total number of persons for that age/ sex group. As an example, the probability of females aged 35 – 44 living in single or 1-person households is calculated by dividing the number of females in that category by the total number of females aged 35 – 44 years.

The household membership probabilities for each of the four census year are given in Appendix 2. Once the proportions were obtained, two checks were done: (i) the probability for any category must range between 0 and 1; and (ii) the total of all probabilities for all age/sex groups and household types must sum to 1.

Step 3: Derive projected household propensities for 2015 – 2030

Quinquennial propensities for the period 2015 to 2030 were computed based on the historic probabilities obtained in step 2. Three different sets of assumptions were made regarding the rate of change in probability so as to arrive at the projected probabilities.

Series I: In the first scenario, projected probabilities were held constant. The probabilities for 2010 were therefore applied for each 5-year period to 2030.

Series II: The second scenario was based on the assumption that probabilities for 1980 to 2010 followed a linear trend. Linear regression was used to fit a straight line and obtain the "goodness" of fit. The "goodness" of fit or R-squared value indicates the amount of variance that is accounted for by the model. The rule of thumb, which has been used by the Australia Bureau of Statistics for evaluating the R-squared values and "goodness of fit" was applied in this analysis. This condition specifies that if the fitted line produced an R-squared value of 0.2 or less, then it was assumed that there was no change in propensity and as such the 2010 propensity for that category would be held constant for all successive years. In a few cases, the household membership rates declined rapidly with time and, as

such, negative probabilities were obtained after fitting a downward linear trend line. However, as the household membership probabilities represent proportions of the population residing in a household of a given size, negative values were not allowed. In instances when the trend line projected negative a negative probability that value was set to zero.

Series III: The third scenario assumed that the probabilities for 1980 to 2010 changed exponentially. As with scenario II, the validity of the probabilities obtained with the exponential function was evaluated by assessing the size of the R-squared value and the observed trend. In cases where the model provided a poor fit for the data, the probability as set to zero.

Once the probabilities were obtained, a final check was performed to ensure that the sum of all probabilities across each age group equaled 1. If the total exceeded or was less than 1, the probabilities were rescaled so that they summed to 1. This step was critical for ensuring that the total projected population equaled the household population derived in step 4.

Step 4: Produce household population projections by household size

Household population projections for each output year were obtained by multiplying the projected household membership rate by the corresponding population projections. Three sets of household projections were produced by combining the medium population projections with the constant, linear and exponential household membership rates.

Step 5: Produce the household projections

To obtain household projections from the population, a weighting factor had to be applied to the aggregated household projections. The weights used varied according to the household size and are provided in Table 5.

Table 5
Weights applied to household population projections

Household size	Weight
Single or 1- Person Household	1
2 Person Household	0.500
3 Person Household	0.333
4 Person Household	0.250
5 Person Household	0.200
6 Person Household	0.167
7+ Person Household	0.137

The average household size was computed using the projected household population and the projected number of households.

Chapter 5

Main Results

I. Population Projections

The first output of this research paper was a set of population projections based on the 2010 census. The projections were generated for the 2015-2030 period based upon four sets of assumptions relating to the components of population change namely fertility, mortality and migration. Of the four variants generated, only the medium-variant projections were used and formed the basis for this paper. The rationale for this decision is stated in the research limitations.

According to those projections, Saint Lucia's household or non-institutional population will continue to increase over the period through to 2030. Under the medium variant, the population is projected to increase by 10.02 per cent between 2010 and 2030. In absolute terms, this is equivalent to an increase of 16,586 people. The distribution of the projected population by broad age groups is provided in Table 6. Further details about the methodology can be found in Appendix 1.

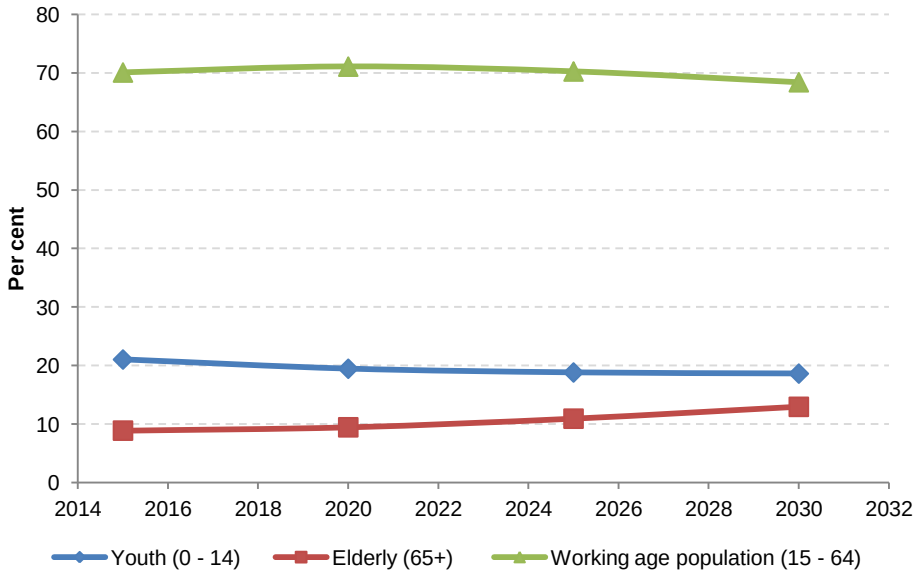
With respect to the changes in population composition, the major pattern is the projected steady increase in the elderly population (65 years and over). As the fertility level under the medium assumption is projected to remain below replacement level, the proportion of persons under 14 years will continue to dwindle to 2030.

Table 6
Population Projections by broad age groups: Medium Variant (2015- 2030)

Age Group	2015		2020		2025		2030	
	Male	Female	Male	Female	Male	Female	Male	Female
0 - 14	18205	17518	17402	16539	17385	16258	17545	16405
15 - 24	15531	15202	14052	13859	12510	12251	11429	11008
25 - 34	13162	13538	14622	14548	15284	15079	13844	13757
35 - 44	11884	12334	12309	12662	12777	13368	14222	14388
45 - 54	11205	11440	11398	12160	11324	12013	11762	12365
55 - 64	7182	7485	9008	9319	10175	10754	10376	11469
65 - 74	4115	4612	4616	5216	5730	6456	7219	8089
75+	2621	3755	2689	3985	2946	4413	3292	5013
Total	83905	85884	86097	88287	88132	90593	89689	92493

The size of the adult population 15-64 years will remain fairly constant over the projection period. Figure 4 shows the growth patterns for three broad age groups under the medium variant.

Figure 4
Projected proportions of children, adults and elderly, 2015 – 2030

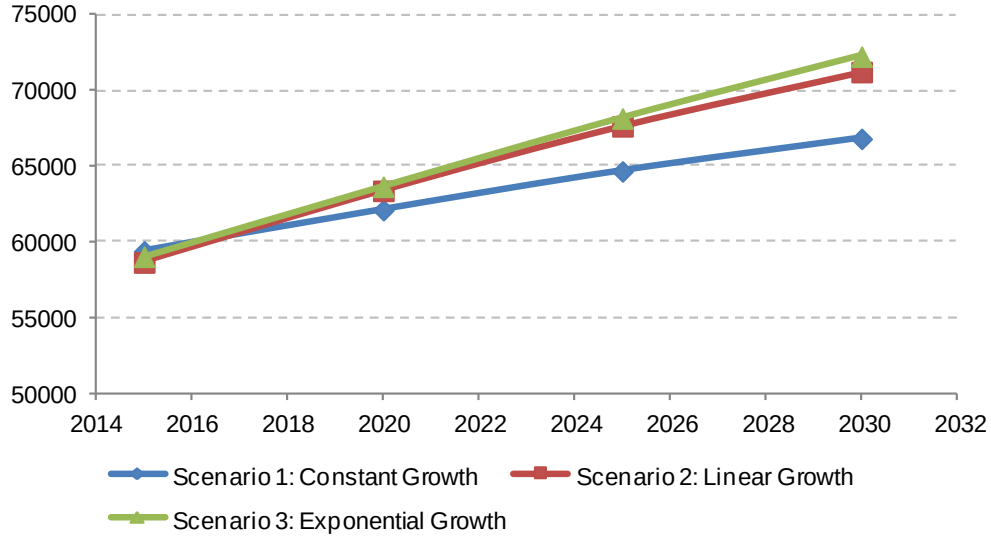


Using the household membership rate method, the projected population for Saint Lucia for 2015 to 2030 was then converted into number of households. A distribution of the projected household population by size of household was also obtained.

II. Household Projections

Three variants of the 2010-based household projections were developed using the household membership rate methodology. Figure 5 shows the projected growth trajectories for 2015 to 2030 under those three scenarios. Each scenario is based on different assumptions about the rate of change of the household membership probabilities over the projection period. Thus, the differences in future household membership probabilities would account for the differences in between each set of projections.

Figure 5
Household projections based on three growth scenarios, 2015 – 2030



As can be surmised from Figure 6, the linear and exponential growth scenarios (Scenarios II and III) yielded similar households projections. Thus, they could be interpreted as the high variants while scenario I could be the low variant.

Number of households and average household

Under all three scenarios, the number of households in Saint Lucia is expected to continue to increase. Under scenarios II and III respectively, there will be 12,589 and 13,233 more households in Saint Lucia in 2030 than in 2010. For scenario I, which is based on a constant growth pattern, the increase in household stock will be more modest and approximate 8,176.

The rate of household formation and average household size based on the household projections is given in Table 7. The figures indicate that there were variable rates of increase in the number of households for each scenario. All scenarios point to sharp increases in the number of household to 2020, but between 2020 and 2030, the rate of growth will begin to decline. In addition, the average household size will continue to decline at a rather modest rate. Between 2015 and 2030, average household size is expected to decline from approximately 2.9 persons per household to as low as 2.52 persons per household.

Table 7
Projected increase in the rate of household formation under Scenarios I, II and III

	2015	2020	2025	2030
Projected Household Population	169789	174384	178725	182181
Scenario I: Constant growth				
Projected Household	59366	62088	64647	66799
Average household size	2.86	2.81	2.76	2.73
Rate of increase	1.27	4.59	4.12	3.33
Scenario II: Linear Growth				
Projected Household	58633	63366	67630	71212
Average Household Size	2.90	2.75	2.64	2.56
Rate of increase	0.02	8.07	6.73	5.30
Scenario III: Exponential Growth				
Projected Household	59007	63634	68143	72230
Average Household size	2.88	2.74	2.62	2.52
Rate of increase	0.66	7.84	7.09	6.00

Number of households by size

The dominant pattern will be the rapid growth in the number of 1-person households. According to the projections, the proportion of one-person households will increase at such a rate that by 2030, approximately one in every three households will be one-person households. The projected number of households disaggregated by household size is given in Table 8.

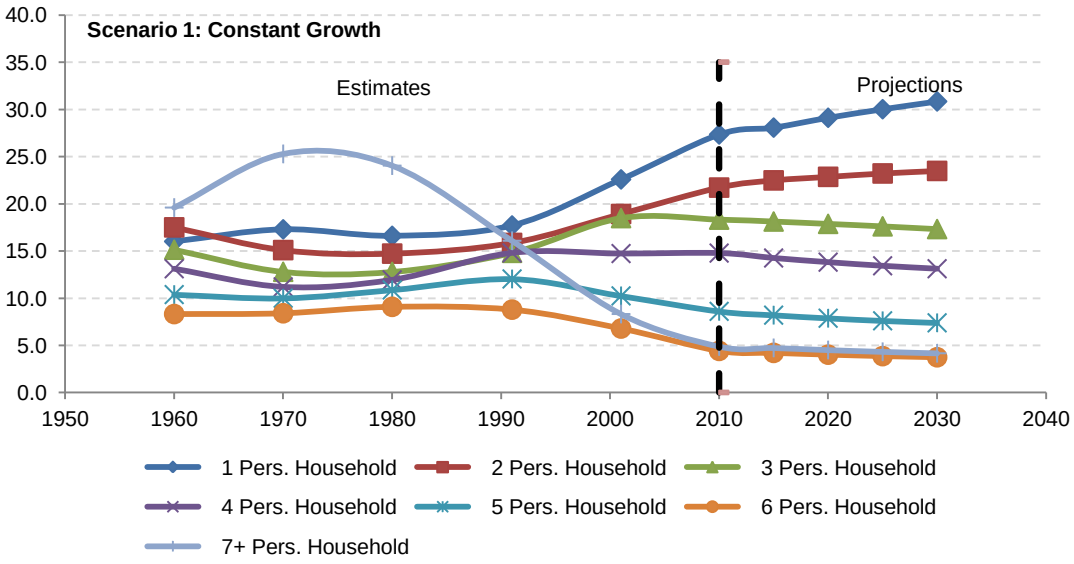
Table 8
Projected number of households by size, under scenarios I, II and III (2015 – 2030)

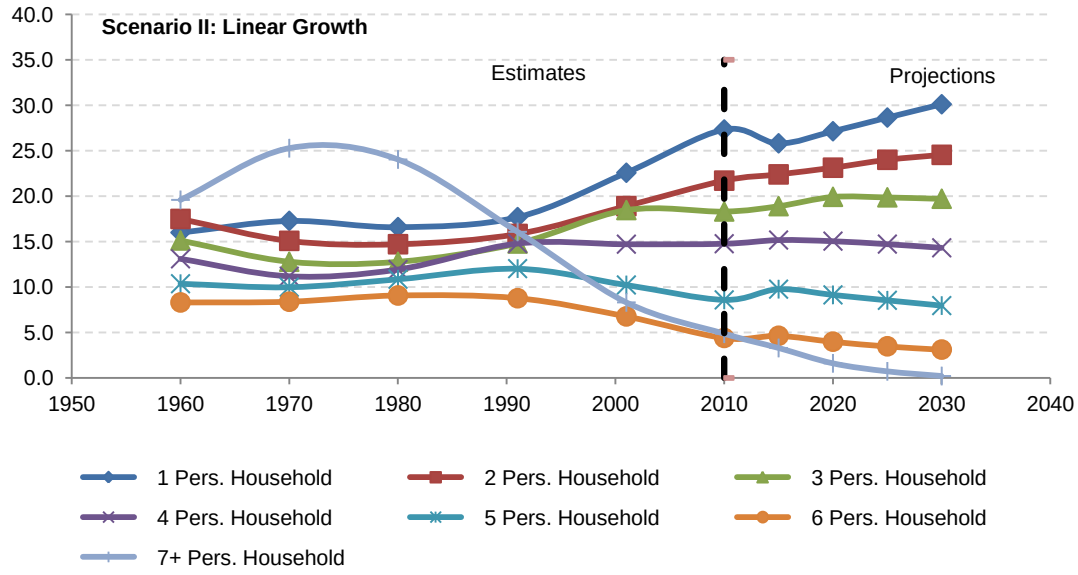
	Scenario I- Constant				Scenario II- Linear Growth				Scenario II- Exponential Growth			
	2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
Household size	*Non-institutional households (Absolute Number)*											
1 person	16659	18072	19401	20597	15135	17199	19373	21443	15859	18199	20622	23030
2 persons	13339	14185	15001	15680	13130	14656	16231	17478	12049	13656	15301	16767
3 persons	10753	11092	11380	11565	11085	12628	13441	14043	12432	13524	14472	15265
4 persons	8458	8572	8677	8759	8897	9537	9958	10199	9154	9603	9903	10105
5 persons	4863	4885	4910	4930	5728	5793	5777	5670	5504	5344	5128	4870
6 persons	2490	2489	2491	2492	2722	2532	2357	2226	1170	1135	1065	956
7+ persons	2803	2793	2787	2775	1936	1021	492	153	2840	2172	1652	1237
All Households	**59366**	**62088**	**64647**	**66799**	**58633**	**63366**	**67630**	**71212**	**59007**	**63634**	**68143**	**72230**
Household size	*Non-institutional households (Proportions)*											
1 person	28.1	29.1	30.0	30.8	25.8	27.1	28.6	30.1	26.9	28.6	30.3	31.9
2 persons	22.5	22.8	23.2	23.5	22.4	23.1	24.0	24.5	20.4	21.5	22.5	23.2
3 persons	18.1	17.9	17.6	17.3	18.9	19.9	19.9	19.7	21.1	21.3	21.2	21.1
4 persons	14.2	13.8	13.4	13.1	15.2	15.1	14.7	14.3	15.5	15.1	14.5	14.0
5 persons	8.2	7.9	7.6	7.4	9.8	9.1	8.5	8.0	9.3	8.4	7.5	6.7
6 persons	4.2	4.0	3.9	3.7	4.6	4.0	3.5	3.1	2.0	1.8	1.6	1.3
7+ persons	4.7	4.5	4.3	4.2	3.3	1.6	0.7	0.2	4.8	3.4	2.4	1.7
All Households	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

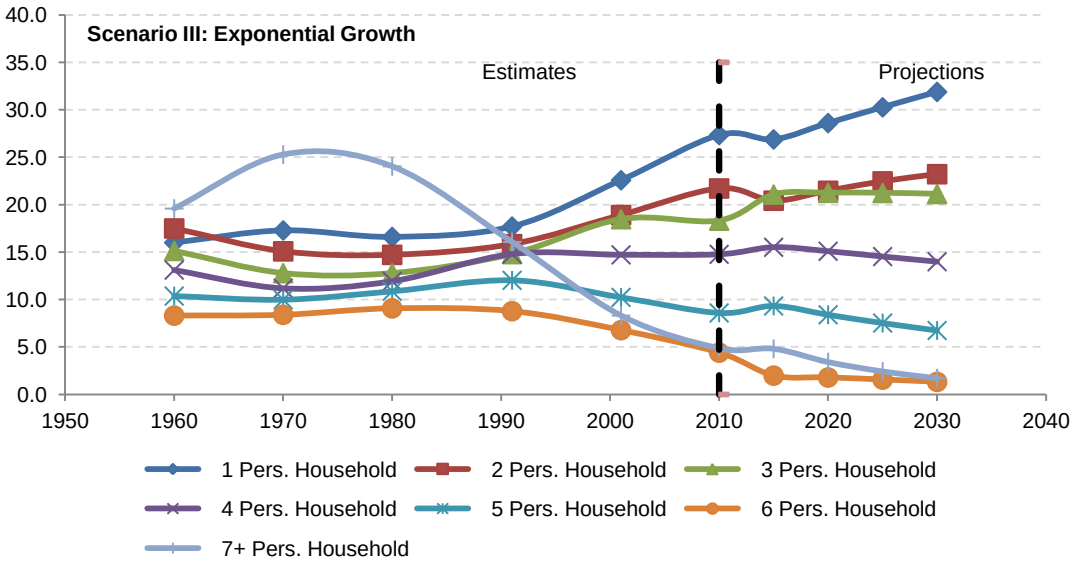
Over the projection period, there will be marginal increases in the number and proportion of 2-person and 3-person households. At the same time, households with 4 or more persons are likely decrease. Based on those rates, about 60 percent of the projected household population will belong to households of 3 or less persons. In addition, large households comprising 5 or more persons will account for less than 20 per cent of all households.

Figure 6 provides a clearer illustration of the changing distribution of households over time, by tracing the shares of households by size from 1960 to the end of the projection period.

Figure 6
Estimated and projected distribution of households in Saint Lucia by size under scenarios I, II and III (1960 – 2030)




Scenario II: Linear Growth
Estimates
Projections
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
1 Pers. Household
2 Pers. Household
3 Pers. Household
4 Pers. Household
5 Pers. Household
6 Pers. Household
7+ Pers. Household


Scenario III: Exponential Growth
Estimates
Projections
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
1 Pers. Household
2 Pers. Household
3 Pers. Household
4 Pers. Household
5 Pers. Household
6 Pers. Household
7+ Pers. Household

Chapter 6

Discussion and Conclusions

This chapter presents the final conclusions of this research paper. It summarizes the main research findings and discussions and provides a response to the main aims of this paper.

I. Historical trends in household formation

In this paper, we assessed historical trends in household formation in Saint Lucia over the period 1960 to 2010 and then used a trend-based methodology for projecting the number of households for the period 2015 – 2030. The analysis showed that there had been a substantial increase in the number of households since 1960. The rate of growth in households exceeded population. Much of this increase was attributable to the growth in the number of one person households, such that in 1960 they accounted for only 16 per cent of all private households but by 2010 the proportion grew to 27 per cent. One consequence of those changes was the decline in average household size from 4.22 persons per household in 1960 to 2.82 persons per household in 2010.

A review of the literature on patterns in household formation indicates that the observed trends for Saint Lucia are consistent with reported trends for both developed and developing countries. More specifically, the transition in household size from large to small appears to be the most pronounced pattern across most countries. Researchers have linked that, for the most part, to the main components of the demographic transition, namely fertility and mortality decline.

In addition, favourable conditions such as the availability and affordability of housing units have influenced the rate of household formation.

II. Method for projecting household size and determining future housing stock (2015-2030)

The development of household projections is not a common practice for many countries. In fact, countries are more likely to produce population projections than household projections. This is due to issues of data unavailability as well as the high level of uncertainty associated with household projections. Thus unlike population projections that are based on core set of assumptions related to the major components of population change, projections of the number and composition of households could be influenced by a broader range of social, economic and demographic factors. As a result, there is no standard methodology for developing household projections. Instead, a plethora of methodologies or models that based on varying assumptions have been developed and used by countries and research organizations. These range from simple static methods such as the headship rate to more complex models that are based on dynamic micro simulation. In light of that, due consideration had to be given to a number of factors before determining which was best suited for deriving national projections for Saint Lucia.

III. Rationale for selection of household membership rate method

Given that purpose of this paper was to derive a set of household projections by household size and obtain and estimate of the projected household

stock, a static method such as the headship rate or one of its extensions was most viable. In order to determine the best suited approach/ method, due consideration had to be given firstly to the type of outputs required and the available data sources. With respect to data, the decennial population and housing census and the quarterly labour force survey (LFS) were the two most viable sources. Although the LFS was conducted regularly and met some of the data requirements, it was by nature a small sample survey and, as such, its ability to produce reliable trends was questionable. The population and housing census provided a better count of the non-institutional population and was therefore more appropriate. In addition, a longer historical series of published information on the counts and attributes of the population and households from 1960 to 2010 was available along with the micro data for census years 1980, 1991, 2001 and 2010. For those reasons, as well as others, the population and housing census provided the base data for this paper.

A second factor that influenced the choice of model was the research goal of this research paper. The principal aim was to derive a set of robust household projections for Saint Lucia, however, a desirable by-product of this research was also the preparation of detailed projections on the distribution of households by size. On that basis, the household membership rate method was most suitable for obtaining projections according to that type of disaggregation.

IV. Implications of household and household stock projections

The main aim of this paper was to develop a set of household projections for Saint Lucia for the period 2015 – 2030. Those projections indicate that the number of households will continue to increase, even while the rate of population growth remains quite low at just about 10%. Further, based on the high variant household projections, by 2030 the total number of households is expected to increase by 23% from 2010. This implies that rate of household formation will be twice as high as population growth. It is also projected that there will be a substantial increase in the number of one person households, to the extent that those households will account for nearly one third of all households in the country. Households with 5 and more households will decline and account for less than 20% of all projected households. In addition, the average household size is also projected to continue to decline, albeit at a modest rate.

The projected decline household size coupled with substantial increases in the numbers of households is both indicative of increased rates of household formation. Given that the rate of household formation drives the demand for additions to the housing stock, the projections imply that the current housing stock will be enlarged by about 23%. There is therefore a need for policy-makers and planners to put systems in place that would ensure that adequate and affordable housing is available. Moreover, as this indicative figure points to new households that have to be accommodated, there is a need for forward planning, in order to ensure that new housing units are developed in an orderly manner. In addition a potential increase in housing demand, a further implication of the projected

increase in households would be the increased demands for services such as utilities, road, schools etc.

While the projected increase in households impacts on the availability of housing on the one hand, related trends such as the decline in household size is another important consideration. This factor would inform the size of the housing units that would be required. Thus, as the average household size is projected to decline to as low as 2.5 persons per household, then smaller units will be required to accommodate the household population.

V. Research Limitations

Household projections provide a long-term outlook of the expected number and type of households at a future time point, and are therefore, by nature, based on conjecture. These projections reflect future trends based on some implicit and explicit assumptions about expected trends pertaining to the components of population change. Consequently, there is a large element of uncertainty associated with the derived projections. This stems from two sources: (i) the methodology used to develop the household projections; and (ii) the estimates of population size based on population projection methodologies. In addition, while it is possible to find published research or tools that evaluate the accuracy of national population projections, similar methodologies on the evaluation of household projections is not as readily available.

The household projections developed and presented in this paper are possible scenarios that are intended to provide information on likely future

household stock and housing demand. They are based on historic trends on household formation and assumptions about population growth and the probability of forming households. In particular, they indicate what could potentially happen if the patterns and rate of household formation continued into the future and the mid-range population projections were fixed. Given that the underlying assumptions for the household membership model are limited and do not take into account other social and economic factors that can influence the rate of household formation, then users of these projections should exercise caution in their interpretation and application.

There are also limitations associated with the use of secondary data, in particular the results of population and housing censuses. Censuses are invaluable data sources based on strengths which include comprehensiveness and comparability across time. Consequently, census data are best suited for use in this analysis and for developing projections. Notwithstanding that, no estimate of the population or households is fully accurate as invariably there will be some level of non-response, or to a lesser extent, double counting during the data collection exercise. As such, the reported figures for household and population estimates are derived by adjusting the counts for undercounting. Typically, countries conduct post-enumeration surveys that help with determining the accuracy of the enumeration exercise as well as the magnitude of the coverage error (over count or under count) and content error. However, since such a survey is not conducted for Saint Lucia, it is not possible to make any determination of the accuracy of the data on households.

The final limitation relates to the quality of the population projections used for this paper. As discussed in the preceding sections, population projections are one of the main inputs for developing household projections. As such, their quality impacts significantly on the final output. Owing to the unavailability of the official population projections, a set of projections was developed specifically for this paper. Challenges with obtaining reliable net migration rates for males and females affected the assumptions made about the migration component of the projections. Consequently, a number of inferences had to be made based on available data and that in turn impacted on the quality of the resulting population projections. On that basis, only the medium projections were used for developing the household projections. As it would have been ideal to produce variant household projections that were based on the four variant population projections in combination with the low, medium and high household membership rates, the use of only mid-range population projections limited the scope of the analysis.

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APPENDIX 1

Saint Lucia Population Projections: 2015 – 2030

Introduction

The population projections for Saint Lucia project the size and structure of the population into the future based in assumptions about variations in the components of population change i.e. fertility, mortality and international migration. Given that changes in levels of fertility, mortality and migration cannot be predicted with any level of certainty, four sets of future projections that reflect likely demographic developments based on constant, low, medium and high variants were generated for the 20 year projection horizon. The projections start with base year 2010 and continue 5-year steps for a 20 year time horizon.

The method for computing the projections was the cohort component method which involves "calculating the future size of cohorts, taking into account the effects of fertility, mortality and migration" (Rowland 2006, 439). Under this method, the future size, age and sex characteristics of the population are projected based on assumptions about the probable direction of change in the three major components of population change, namely fertility, mortality and migration. The scenarios and assumptions for each component were developed by examining historical trends for each component for the period 2000-2010 and earlier, findings of intercensal surveys as well as government policy documents and research papers.

Base Data for population projections

The base data for the projections are the counts of the national 2010 Population and Housing census which has a temporal reference day of 10 May 2010 (i.e. census night) and covers the total resident population living in Saint Lucia at that time. The estimated population residing in private households at the time of census taking was 165,595 which comprised 82,926 males and 83,600 females. The population composition by age group and sex is given in Table A1.

Table A1
Base Population for 2010 by sex and 5-year age groups

Age	Male	Female	Total
0 - 4 years	5,979	5,831	11,810
5 -9 years	6,678	6,472	13,150
10 – 14 years	7,479	7,439	14,918
15 – 19 years	8,116	7,805	15,921
20 – 24 years	6,744	6,876	13,620
25 – 29 years	6,553	6,736	13,289
30 – 34 years	6,150	6,103	12,253
35 – 39 years	5,952	6,333	12,285
40 – 44 years	6,043	6,175	12,218
45 – 45 years	5,496	5,467	10,963
50 – 54 years	4,447	4,479	8,926
55 – 59 years	3,177	3,313	6,490
60 – 64 years	2,687	2,797	5,484
65 – 69 years	2,087	2,293	4,380
70 – 74 years	1,722	1,869	3,591
75 – 79 years	1,145	1,420	2,565
80 – 84 years	796	1,108	1,904
85+ years	668	1,159	1,827
TOTAL	81,919	83,675	**165,594**

Source: Saint Lucia 2010 Population and Housing Census Report.

Assessment of data quality

Given the importance of the input data used as the starting point for both population and household projections in determining the overall reliability of the projections, an initial assessment of data quality was conducted as a preliminary step. The quality of data on the age-sex structure of the population is one of the most important indicators for measuring general quality of census data. The Age-Sex Accuracy Index developed by the United Nations is one of the key indexes for measuring the accuracy of age structure by sex and 5-year age groups. Standards for quality of sex and 5-year age group distribution are given in Table A2.

Table A2
United Nations Age/ Sex Accuracy Index

Index	Interpretation
Less than 20	Accurate
20 – 40	Inaccurate
Greater than 40	Highly Inaccurate

Source: Hobbs, Frank.

The resulting age-sex accuracy index for Saint Lucia was 17.6. According to the standards set for interpreting this index, the census data for 2010 can be considered as "accurate".

Demographic Assumptions: Population Projections 2010-2030

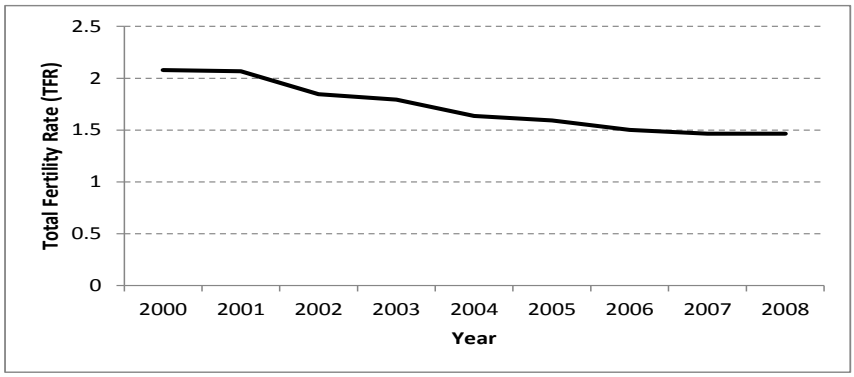
Saint Lucia's population is expected to continue to grow through to 2030, albeit at a very moderate pace. Under all of the scenarios, population growth will be driven primarily by fertility in combination with declining mortality. Migration will have a very nominal impact on growth

Fertility Assumptions

The period fertility perspective was applied in formulating assumptions about future fertility rates. The assumptions for fertility were based on a time series analysis of historical data spanning 2000 to 2008 in combination with fertility data dating to the 1960's. The assumptions also reflect an analysis of the main (proximate) determinants of fertility that affect a woman's risk of becoming pregnant which included: contraception, nuptiality and sexual intercourse.

Between 1960 and 2010, Saint Lucia's fertility level has been on the decline. Data for that period reveal that this trend was characterized by a drop from high fertility rates of 6.7 in the early 1960's to 1.9 in 2009 (Rodriguez *et al*. 2012). Thus, currently the fertility rate is below replacement level. The drop in fertility has been attributed to factors such as the advent of family planning programmes, increased participation of women in the labour force, delays in the start of childbearing, intensification of the pursuit of higher educational qualifications among women and increased socioeconomic status (St. Bernard 2001; Rodriguez 2012).

Figure 1:
Trends in total fertility rate (TFR) for the period 2000 – 2008



Source: Vital Statistics Reports 2000 – 2006 and Statistical Digest 2001 - 2011.

The significant downward trend in fertility is manifested in the declines in the population of children 15 years and under. This trend is apparent both in terms of the absolute number of children and proportional share of children to total population. Data for the period 1970 to 2010 indicates that the population of children 15 years and under decreased from 49,527 (49.62%) in 1970 to 39878 (24.08%) in 2010. Owing to the sustained low fertility levels, the population of this age group will continue to decline and expected to fall below 20,000 by 2030. The rate of decline will vary based on the scenario.

With respect to contraceptive use, data from 1998 suggests that contraceptive prevalence rate (% of women aged 15-49 years) stood at 47 per cent. In addition, the number of teen births had decreased significantly over time. Thus, the level of teenage pregnancy remains relatively high and continues to pose a challenge. The adolescent fertility rate dipped from 60 births per 1000 women in 2008 to 58 in 2012.

High Fertility Assumption
Under the high variant, fertility was projected to increase only slightly but remain below replacement level of 2.1 children per woman by 2030.

Medium Fertility Assumption
Under the medium variant, fertility was projected to remain fairly low but small increases would be recorded over the period, so that by 2030, the TFR would be 1.75 children per woman.

Constant Fertility Assumption
Under the constant variant, fertility was projected to remain fixed at the level of 1.465 children per woman throughout the period.

Low Fertility Assumption
Under the low variant, fertility was projected to decline to 1.25 children per woman by 2030.

Table A.3
Projected age-specific fertility rates (ASFRs): low, medium and high variants.

Age group	2005	Low	Medium	High
15-19 years	0.045	0.038	0.061	0.065
20-24 years	0.080	0.057	0.081	0.094
25-29 years	0.080	0.061	0.077	0.098
30-34 years	0.061	0.049	0.074	0.085
35-39 years	0.040	0.033	0.042	0.051
40-44 years	0.011	0.011	0.014	0.016
45-49 years	0.002	0.0002	0.001	0.001
Projected TFR	**1.594**	**1.25**	**1.75**	**2.05**

The age-specific birth rates which would correspond to the TFRs at the end of the period for each scenario are given in Table A.3.

Mortality Assumptions

The assumptions for mortality to the end of the projection period were based on the survival rates in the abridged life tables for 2005. The age specific survival rates were applied to the base year to project the number of survivors to the end of the projection period. An examination of trends in life expectancy at birth for both males and females for the period 1985 to 2006 point to a very nominal increase between the start and end year. Life expectancy changed continually over the period and followed a fluctuating pattern. This has been attributed in part to the variable and relatively high rates of infant mortality and high incidence of noncommunicable diseases (NCDs) on the one hand and improvements in medical care on the other. There has been some progress towards reducing the incidence of infectious diseases, however chronic/ life style diseases including diabetes, heart disease and cancer continue to dominate and remain the top causes of mortality. Gains in life expectancy continue to be relatively higher for females than males. In 2006, the life expectancy for males stood at 69.8 years and for females 75.7. The scenarios depict similar patterns with women outliving males in all cases.

HIV/AIDS continues to contribute to the mortality levels among adults aged 25 – 49 years, particularly among high-risk groups such as men who have Sex with men (MSM), men who have Sex with men and women (MSMW), intravenous drug users and commercial sex workers. According to the 2010 Country Progress Report for the United National General Assembly Special Session on HIV/AIDS (UNGASS), as of 31 December 2009 a total of 760 HIV cases had been reported, of which 314 (41.3%) had died. Trends in the number of new HIV cases have declined however there has been an increase in the number of AIDS cases and deaths. Consequently, the HIV/AIDS epidemic will impact on mortality levels for both HIV and AIDS have been higher in males than females.

High Assumptions:

Under the high variant, life expectancy would increase significantly for both males and females. Male expectancy would start at 71.26 and rise to 75.25 by end of the period. For females, life expectancy would increase from 77.07years to 80.79 years.

Medium Assumptions:

Under the medium variant, moderate increases of 1.74 and 1.93 years would be recorded for males and females respectively.

Low Assumptions:

Under the low assumption, changes in life expectancy would be less dramatic. For males life expectancy would increase by 1.09 years to 72.35. A similar increase of 1.18 years would be recorded for females.

International Migration Assumptions

Migration patterns for Saint Lucia, like most other Caribbean countries is characterized by high levels of emigration, particularly among the young, skilled, working-age population and persons aged 15 – 39 years. The data for the period 2000-2010 displayed in Figure 3 point to fluctuations throughout the period as well as declining levels in overall rate of emigration.

Table A4:
Net Migration rates (per 1000 population), 2001-2010

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Net migration	-4.67	-4.15	3.64	3.15	2.67	1.73	1.28	4.53	4.14	3.93

Source: Index Mundi, http://www.indexmundi.com/g/g.aspx?c=st&v=27.

In the absence of sex and age disaggregated migration data for Saint Lucia, net migration was computed indirectly using the Forward Reverse Survival Method. This method estimates net migration by applying 10-year life table survival ratios to census counts and projecting survivors at past and future time points. The estimate of net migrants is then derived as the residual, which is the difference between the enumerated population and the projected survivors under natural increase. On the basis of the results of this residual, the following emigration scenarios were developed.

High Assumptions:
Under the high variant, international migration flows will be dominated by high levels of emigration particularly among persons of working age. The pace will however increase at a moderate/ slower rate because of the global economic climate. Towards the end of the projection period the rate is projected to reach about -2.0.

Medium Assumptions:
Under the medium variant, international migration flows will be dominated by fairly high levels of emigration particularly among persons of working age.

Low Assumptions:
Under the low scenario, there is likely to be no significant change in the migration pattern with the primary emigrant being those within the 15 – 59 age groups. The proportion of female migrants will continue to remain slightly above that for males. On average net external movements would be approximately -1000.

Table A5
Population Projections: Medium Variant (2015- 2030)

Age Group	2015		2020		2025		2030	
	Males	Females	Males	Females	Males	Females	Males	Females
0 - 4	5608	5225	5900	5497	5953	5547	5761	5371
5- 9	5946	5823	5579	5219	5874	5492	5929	5543
10 - 14	6651	6469	5923	5822	5559	5219	5855	5491
15 - 19	7455	7425	6632	6458	5907	5813	5545	5211
20 - 24	8076	7778	7421	7401	6603	6439	5884	5797
25 - 29	6691	6841	8011	7743	7365	7371	6558	6415
30 - 34	6471	6697	6612	6805	7919	7708	7286	7341
35 – 39	6050	6060	6372	6654	6517	6766	7813	7669
40 - 44	5833	6274	5937	6008	6260	6602	6410	6718
45 - 49	5892	6089	5694	6192	5803	5936	6127	6530
50 - 54	5313	5351	5704	5967	5521	6077	5635	5834
55 – 59	4235	4335	5069	5188	5450	5797	5284	5914
60 - 64	2947	3150	3939	4131	4725	4957	5091	5554
65 - 69	2386	2584	2628	2920	3527	3846	4244	4632
70 - 74	1730	2028	1989	2296	2204	2610	2975	3456
75 - 79	1287	1541	1302	1683	1508	1921	1684	2203
80 – 84	732	1049	829	1149	846	1270	988	1465
85+	602	1166	557	1152	592	1222	620	1346
Total	**83905**	**85884**	**86097**	**88287**	**88132**	**90593**	**89689**	**92493**

APPENDIX 2
Household Membership Probabilities 1980 – 2010

Table B1: Household membership probabilities for 1980

	Single person household	2 person household	3 person household	4 person household	5 person household	6 person household	7+ person household	Total
Male 0 - 14 years	0.00000	0.01620	0.05550	0.09501	0.12346	0.13777	0.57205	1.00000
Male 15 - 24 years	0.02854	0.05933	0.08261	0.09080	0.09528	0.10425	0.53919	1.00000
Male 25 - 34 years	0.08774	0.10913	0.13574	0.14820	0.13590	0.11199	0.27130	1.00000
Male 35 - 44 years	0.08272	0.08979	0.09503	0.10733	0.12120	0.11283	0.39110	1.00000
Male 45 - 54 years	0.12274	0.11337	0.08818	0.08107	0.08786	0.07849	0.42829	1.00000
Male 55 - 64 years	0.14808	0.15576	0.09982	0.09616	0.09031	0.08629	0.32358	1.00000
Male 65 - 74 years	0.19012	0.19467	0.13053	0.09591	0.08173	0.08343	0.22361	1.00000
Male 75+ years	0.22631	0.20986	0.10928	0.09961	0.08511	0.07447	0.19536	1.00000
ALL MALES	**0.04603**	**0.06238**	**0.08018**	**0.10013**	**0.11296**	**0.11728**	**0.48105**	**1.000**
Female 0 - 14 years	0.00008	0.01530	0.05608	0.09494	0.12847	0.13275	0.57238	1.00000
Female 15 - 24 years	0.01097	0.05848	0.09382	0.10966	0.11453	0.11209	0.50045	1.00000
Female 25 - 34 years	0.02398	0.08304	0.11175	0.14062	0.15275	0.13706	0.35080	1.00000
Female 35 - 44 years	0.02456	0.06990	0.09290	0.10808	0.12059	0.11903	0.46494	1.00000
Female 45 - 54 years	0.04437	0.10898	0.10612	0.10483	0.10327	0.10716	0.42527	1.00000
Female 55 - 64 years	0.09173	0.18750	0.14148	0.12127	0.10572	0.08955	0.26275	1.00000
Female 65 - 74 years	0.16467	0.23155	0.15360	0.11162	0.09271	0.07426	0.17159	1.00000
Female 75+ years	0.21062	0.22489	0.12785	0.10445	0.09989	0.05365	0.17865	1.00000
ALL FEMALES	**0.02709**	**0.06579**	**0.08671**	**0.10719**	**0.12271**	**0.11939**	**0.47112**	**1.000**

Table B2: Household membership probabilities for 1991

	Single person household	2 person household	3 person household	4 person household	5 person household	6 person household	7+ person household	Total
Male 0 - 14 years	0.00000	0.02126	0.08288	0.15063	0.17644	0.15551	0.41327	1.00000
Male 15 - 24 years	0.03183	0.06264	0.09425	0.12374	0.13084	0.13245	0.42426	1.00000
Male 25 - 34 years	0.10809	0.12383	0.14865	0.16817	0.13261	0.10012	0.21853	1.00000
Male 35 - 44 years	0.11339	0.09482	0.10818	0.16048	0.15591	0.12773	0.23949	1.00000
Male 45 - 54 years	0.12986	0.11316	0.11092	0.13061	0.12512	0.11191	0.27841	1.00000
Male 55 - 64 years	0.15478	0.16974	0.12313	0.10852	0.09948	0.09043	0.25391	1.00000
Male 65 - 74 years	0.20152	0.22470	0.13533	0.09612	0.08052	0.07799	0.18381	1.00000
Male 75+ years	0.22327	0.22543	0.14595	0.11561	0.06792	0.07731	0.14451	1.00000
ALL MALES	**0.06098**	**0.07666**	**0.10445**	**0.14267**	**0.14577**	**0.12949**	**0.33998**	**1.00000**
Female 0 - 14 years	0.00000	0.02093	0.08244	0.15121	0.17397	0.15801	0.41344	1.00000
Female 15 - 24 years	0.00889	0.06673	0.11632	0.13318	0.13695	0.12962	0.40830	1.00000
Female 25 - 34 years	0.02410	0.09797	0.14308	0.19268	0.16839	0.12356	0.25021	1.00000
Female 35 - 44 years	0.02398	0.08919	0.12462	0.15913	0.17013	0.13806	0.29490	1.00000
Female 45 - 54 years	0.03949	0.13467	0.13627	0.14449	0.12714	0.11002	0.30792	1.00000
Female 55 - 64 years	0.07542	0.19344	0.14191	0.13558	0.12090	0.08780	0.24496	1.00000
Female 65 - 74 years	0.16125	0.24103	0.16795	0.12102	0.08213	0.06671	0.15991	1.00000
Female 75+ years	0.23309	0.23463	0.16957	0.09887	0.06916	0.06711	0.12756	1.00000
ALL FEMALES	**0.02783**	**0.08045**	**0.11549**	**0.15072**	**0.15251**	**0.13176**	**0.34123**	**1.00000**

Table B4: Household membership probabilities for 2001

	Single person household	2 person household	3 person household	4 person household	5 person household	6 person household	7+ person household	Total
Male 0 - 14 years	0.00000	0.03758	0.13467	0.19401	0.18764	0.15977	0.28619	1.00000
Male 15 - 24 years	0.04560	0.08708	0.14512	0.16845	0.16373	0.13667	0.25334	1.00000
Male 25 - 34 years	0.13762	0.15257	0.20684	0.16744	0.11845	0.08095	0.13597	1.00000
Male 35 - 44 years	0.16618	0.13020	0.16599	0.17875	0.13678	0.09899	0.12302	1.00000
Male 45 - 54 years	0.16879	0.12409	0.15606	0.15956	0.14731	0.09975	0.14429	1.00000
Male 55 - 64 years	0.19414	0.20649	0.15323	0.14403	0.09513	0.07601	0.13072	1.00000
Male 65 - 74 years	0.21027	0.29070	0.16182	0.10917	0.07171	0.05459	0.10142	1.00000
Male 75+ years	0.23414	0.24337	0.17609	0.11457	0.07651	0.05498	0.09996	1.00000
ALL MALES	**0.09314**	**0.11096**	**0.15747**	**0.17120**	**0.14865**	**0.11761**	**0.20091**	**1.00000**
Female 0 - 14 years	0.00000	0.03406	0.13732	0.18987	0.18759	0.15950	0.29162	1.00000
Female 15 - 24 years	0.01838	0.08748	0.16140	0.17306	0.16845	0.14354	0.24763	1.00000
Female 25 - 34 years	0.03818	0.13720	0.22063	0.19991	0.14558	0.10453	0.15397	1.00000
Female 35 - 44 years	0.03527	0.11699	0.18602	0.20295	0.16345	0.12602	0.16928	1.00000
Female 45 - 54 years	0.06231	0.16035	0.19515	0.17853	0.15025	0.10441	0.14901	1.00000
Female 55 - 64 years	0.10899	0.25322	0.19647	0.14553	0.10361	0.06965	0.12296	1.00000
Female 65 - 74 years	0.17069	0.28132	0.18017	0.12471	0.08103	0.06408	0.09770	1.00000
Female 75+ years	0.22286	0.25194	0.17391	0.11114	0.08120	0.06104	0.09819	1.00000
ALL FEMALES	**0.04275**	**0.11490**	**0.17330**	**0.18030**	**0.15686**	**0.12511**	**0.20678**	**0.04275**

Table B4: Household membership probabilities for 2010

	Single person household	2 person household	3 person household	4 person household	5 person household	6 person household	7+ person household	Total
Male 0 - 14 years	0.00000	0.05720	0.17444	0.25048	0.20254	0.12824	0.18634	1.00000
Male 15 - 24 years	0.04430	0.11109	0.16620	0.20625	0.17478	0.11805	0.18005	1.00000
Male 25 - 34 years	0.16279	0.18389	0.20349	0.16967	0.11356	0.06543	0.10218	1.00000
Male 35 - 44 years	0.19802	0.15520	0.19307	0.20221	0.11807	0.06369	0.07148	1.00000
Male 45 - 54 years	0.23315	0.16191	0.16970	0.17790	0.11779	0.06355	0.07488	1.00000
Male 55 - 64 years	0.24126	0.21885	0.17419	0.14561	0.09120	0.05629	0.07238	1.00000
Male 65 - 74 years	0.25316	0.31837	0.15760	0.10454	0.06916	0.03907	0.05728	1.00000
Male 75+ years	0.26558	0.32537	0.14946	0.10041	0.05710	0.04177	0.05480	1.00000
ALL MALES	**0.12813**	**0.14600**	**0.17801**	**0.19494**	**0.14221**	**0.08728**	**0.12343**	**1.00000**
Female 0 - 14 years	0.00000	0.05374	0.17622	0.24908	0.19844	0.12862	0.19311	1.00000
Female 15 - 24 years	0.01863	0.11239	0.18145	0.21388	0.17441	0.12032	0.17938	1.00000
Female 25 - 34 years	0.05118	0.17581	0.23564	0.20710	0.13429	0.07760	0.11754	1.00000
Female 35 - 44 years	0.05166	0.15595	0.22026	0.24057	0.15345	0.08543	0.09252	1.00000
Female 45 - 54 years	0.07171	0.20805	0.22770	0.19691	0.12824	0.07283	0.09521	1.00000
Female 55 - 64 years	0.13550	0.27347	0.20910	0.15217	0.09704	0.05644	0.07773	1.00000
Female 65 - 74 years	0.19972	0.34698	0.17434	0.10736	0.06940	0.04062	0.06214	1.00000
Female 75+ years	0.27229	0.29769	0.16277	0.11389	0.06773	0.03687	0.04998	1.00000
ALL FEMALES	**0.05942**	**0.15811**	**0.20074**	**0.20877**	**0.14956**	**0.09243**	**0.13096**	**1.00000**