Dutch Census 2011

Analysis and Methodology

Statistics Netherlands

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Explanation of symbols

.	Data not available
*	Provisional figure
**	Revised provisional figure (but not definite)
x	Publication prohibited (confidential figure)
–	Nil
–	(Between two figures) inclusive
0	(0.0) Less than half of unit concerned
empty cell	Not applicable
2013–2014	2013 to 2014 inclusive
2013/2014	Average for 2013 to 2014 inclusive
2013/'14	Crop year, financial year, school year, etc., beginning in 2013 and ending in 2014
2011/'12–2013/'14	Crop year, financial year, etc., 2011/'12 to 2013/'14 inclusive

Due to rounding, some totals may not correspond to the sum of the separate figures.

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Foreword

Population censuses have a long tradition in the countries of the European Union, and today they provide important input for EU policymaking and monitoring. As national censuses are of greater value if their results can be compared between member states, in the last decades steps have been taken to harmonise census output. One of the results of this is the EU Census Hub, with direct links to standardised census tables of all member states, which are available to everybody, free of charge.

Census methods still differ across Europe. While many countries still use individual census questionnaires successfully, in the Netherlands the last complete enumeration was in 1971. Statistics Netherlands now conducts a register-based census. Not only does this use data already available to Statistics Netherlands, thus placing no burden on individuals, it is also a lot cheaper. The results are comparable with earlier Dutch censuses, and with the census results of other countries in the 2011 European Census Round. For the 2011 Census, Statistics Netherlands' census experts compiled the required census tables by combining existing register data with sample survey data.

This book highlights a number of results of the Dutch 2011 Census, placing some of them in a broader perspective: European immigrants in the Netherlands versus Dutch people living elsewhere in Europe, and an interesting comparison of the islands of the Caribbean Netherlands with similar regions in the Netherlands. Some key figures are also compared with those from past censuses. The last two chapters address the methodology used, examining the new weighting approach used for the sample-based Labour Force Survey data and an additional estimation technique for detailed cells of the census tables that could not be estimated with repeated weighting.

A PDF version of this book is available on the website of Statistics Netherlands. The book is intended for researchers and policymakers, but also the interested general public. I hope it will also be of interest for statistical institutes in other countries. Lastly, I would like to thank the editors Eric Schulte Nordholt and Jantien van Zeijl and the language editor Lieneke Hoeksma.

Director General of Statistics Netherlands
Dr T.B.P.M. Tjin-A-Tsoi

The Hague/Heerlen, November 2014

Contents

1. Introduction to the Dutch Census 2011

Author
Eric Schulte Nordholt

Statistics Netherlands produced the tables for the Dutch Census 2011 by combining existing register and sample survey data. Since the last census based on a complete enumeration was held, in 1971, the willingness of the population to participate has fallen sharply. Statistics Netherlands no longer uses census questionnaires and has found an alternative in the register-based census, using only existing data. The register-based census is cheaper and more socially acceptable. The table results of the Netherlands are not only comparable with earlier Dutch censuses, but also with those of the other countries in the 2011 European Census Round.

The first part of this book consists of analyses of the results, focusing on the following topics: key figures and a global historical comparison with earlier Dutch censuses (chapter 2), a global comparison of the results of the 2011 Census in the Netherlands with results in other European countries (chapter 3), foreigners in the Netherlands and Dutch people in Europe (chapter 4), and the Caribbean Netherlands compared with the Frisian Islands (chapter 5). The second part addresses the methodology; it examines the new weighting approach in which microdata of the Labour Force Survey are reused in the 2011 Census (chapter 6) and an additional estimation technique for detailed cells of the census hypercubes that could not be estimated with repeated weighting (chapter 7).

1.1 The Dutch Population and Housing Census 2011

The European Census Round

The 2011 Census Round was coordinated by Eurostat for all European Union (EU) and European Free Trade Association (EFTA) member states.[1)] The EU population and housing censuses have a broad basis: they are covered by four Regulations (European Commission, 2008, 2009, 2010a and 2010b), which have served to harmonise population definitions, census variables and categories, census hypercubes and metadata within the EU. Moreover, they specify the technical format (SDMX) for data delivery. All EU member states were required to conduct a

1) More information on which countries are part of the EU and EFTA can be found in chapter 4.

census for 2011. For most national statistical institutes this was a major operation involving a lot of work and high costs. Each country had to collect census data and validate and protect its census output in the hypercubes. All data had to be transformed to SDMX format and put in the so-called Census Hub. Lastly, in addition to sixty mandatory hypercubes, all countries had to produce a number of quality hypercubes and a metadata file describing the methodology used.

Census experts at Statistics Netherlands started preparations for the 2011 Population and Housing Census in 2008. In 2009 they started work on the data collection procedures required to collect the census information about the 16,655,799 people living in the Netherlands on 1 January 2011.

16,655,799
inhabitants on 1 January 2011

The 2011 Census in the Netherlands resulted in sixty high-dimensional tables, so-called hypercubes (European Commission, 2010a). Five relate to the Netherlands as a whole, forty contain data at provincial level (NUTS 2), ten at COROP level (NUTS 3) and five at municipal level (LAU 2). The sixty hypercubes fall into three different groups: five are about housing, four relate to commuting and the remainder are demographic tables, concerning economic activity, occupation and level of education, for example.

A register-based census

Data from different sources were combined to produce the 2011 Census tables. These data were not obtained by interviewing inhabitants in a complete enumeration, as in traditional censuses in most other countries, but by using data from registers and sample surveys that are already available at Statistics Netherlands. This approach has a number of advantages and disadvantages.

One of the advantages of this innovative approach is a much lower census bill for Dutch tax payers. A traditional census in the Netherlands would cost a few hundred million euros, while with this method it costs 'only' around 1.4 million

euros. This bill includes the costs for all preparatory work, such as extending the methodology and updating and developing accompanying software, as well as the analyses of the results. It does not include the costs of the registers, as these are not kept for censuses but primarily for other purposes. Also, under Dutch law, Statistics Netherlands may access government registers free of charge. This low-cost census approach is only possible for countries with sufficient register information. By way of example, let us compare the costs of the Dutch register-based census with those of the traditional census held in the United Kingdom in 2011. In the United Kingdom the census cost approximately 565 million euros. In terms of PPP per capita (in 2011 US dollars), the census cost 11.82 in the UK, compared with 0.10 in the Netherlands (United Nations, 2014). A register-based census costing less than 1 percent of a traditional census is not exceptional. Today, the huge costs of traditional censuses are often justified by pointing out the enormous implications of the census results for regional funding distribution. But a register-based census would be impossible in the UK anyway, because of the lack of sufficient register data and access restrictions.

Apart from the financial aspect, there are also other important differences between a traditional census and the register-based census conducted in the Netherlands. A well-known problem with traditional censuses is that participation is limited and selective. In spite of the mandatory character of a traditional census, part of the population will not participate at all (unit non-response) and those who do will not answer all questions (item non-response). Although correcting for non-response by weighting and imputation techniques is worth trying, traditional correction methods are inadequate to obtain reliable results. The last traditional census in the Netherlands, in 1971, met with many privacy objections against the collection of integral information about the population living in the Netherlands. This increased the non-response problem, and non-response was expected to be even higher if another traditional census were to be held in the Netherlands (Corbey, 1994). There are almost no objections to a register-based census in the Netherlands and the non-response problem only plays a role when survey microdata are reused.

Another advantage of the register-based census is the short production time. The register-based census in the Netherlands got off to a later start than traditional censuses in other countries. It would have been pointless to start the production phase of the 2011 census project before all sources were available, and some registers became available relatively late. In spite of this delay, Statistics Netherlands compiled its census tables faster than most other countries in the 2011 European Census Round. In fact, the Netherlands had one of the shortest production times for the complete set of tables required by Eurostat. Statistics Netherlands had the advantage that no incoming census forms had to be checked and corrected.

A disadvantage of the Dutch census is that for some variables only sample information is available, which meant it was impossible to meet the level of detail required in some census hypercubes. At the moment, however, the Netherlands perceives the advantages of the register-based census in terms of cost and non-response problems to amply outweigh the loss of some detail compared with a traditional census.

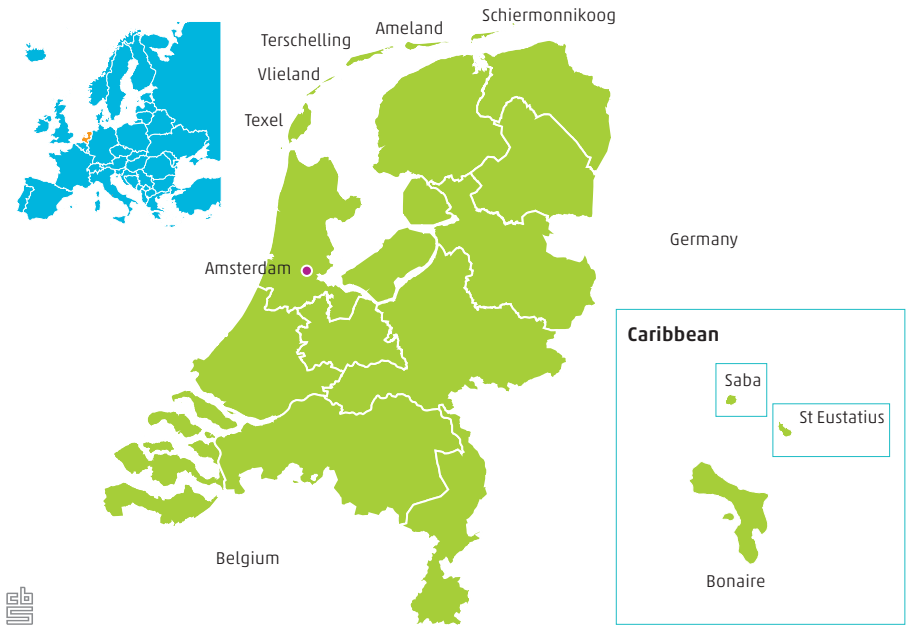
Statistics Netherlands is not the only country that uses registers to produce census information. Four Nordic countries (Denmark, Finland, Norway and Sweden), Austria and Slovenia have more variables available in registers than the Netherlands, and the problem of insufficient detail in the outcome does not play a major role there. Most of the other register-based countries are in a similar position to the Netherlands: not all variables relevant for the census can be found in registers. They are therefore very interested in the Dutch approach of combining registers and existing sample surveys and using modern statistical techniques and accompanying software to compile the hypercubes. Obviously, it is essential that statistical bureaus are permitted to make use of registers that are relevant for the census. For Statistics Netherlands this is laid down in the statistical law that came into force in 2004. Nevertheless, Statistics Netherlands will have to maintain the good contact it has established with register holders over the last 25 years. Timely deliveries with relevant variables for Statistics Netherlands are crucial for official statistics production.

The Netherlands

The Kingdom of the Netherlands includes the Netherlands in Europe and six islands in the Caribbean. The Kingdom consists of four constituent countries: the Netherlands (consisting of twelve provinces), Aruba, Curaçao and St Maarten. The latter three islands have an independent status as a country within the Kingdom of the Netherlands. The other three Caribbean islands (Bonaire, Saba and St Eustatius) are part of the Netherlands and have had the status of 'special municipality' since 10 October 2010. All four countries produce their own official statistics. Statistics Netherlands has a regional office in the Caribbean responsible for statistics on Bonaire, Saba and St Eustatius (the Caribbean Netherlands). Although the Caribbean Netherlands is part of the Netherlands, statistics on the Netherlands do not include the Caribbean Netherlands. All statistics concerning the Caribbean Netherlands are published separately. The results of the Dutch 2011 Census therefore relate only to the European part of the Netherlands. However, chapter 5 of this book compares some figures for the Caribbean Netherlands with those for the European part of the Netherlands. As no census was held in the Caribbean Netherlands in the 2011 Census Round, other sources were used for

statistics on Bonaire, Saba and St Eustatius. Some key results of the 2011 Census in the European part of the Netherlands as well as a brief historical comparison can be found in chapter 2, while chapter 3 compares key results of the Netherlands with those of other European countries. Chapter 4 presents more information about people living in the Netherlands but born in other EU and EFTA countries, and people born in the Netherlands but living in other EU and EFTA countries.

1.1.1 The Netherlands in Europe and in the Caribbean



1.2 Census methods in the UNECE region

Census practices in the 2010 Census Round

As mentioned in the previous section, a number of countries conduct register-based censuses. As it is interesting to know how other countries conduct their censuses, in 2013 the United Nations Economic Commission for Europe (UNECE) conducted an online survey among its members to collect information about national census practices in the 2010 Census Round, and about plans for the 2020

round. All EU and EFTA countries are also members of the UNECE, which also includes Canada, the Russian Federation and the United States, among others. Response to the UNECE questionnaire was high and the results of fifty countries on important methodological issues were analysed (UNECE Task Force on Census Methodology, 2013).

Most countries participating in the online survey had conducted a census in the 2010 Round. Four – Bosnia-Herzegovina, Georgia, Republic of Moldova and Ukraine – had not yet done so, but were still planning to conduct a traditional census during this round. The traditional census in the Former Yugoslav Republic of Macedonia was cancelled in 2011, and there are as yet no firm plans to take another one. This country has therefore been excluded from the following analyses.

As expected the countries used different methods, and some countries reported a different method for the population than for the housing census, often connected with the availability of registers for these domains. Using registers to produce official statistics reduces costs and bypasses the problem of declining survey response rates. Three main types of census method can be distinguished: the traditional census, the combined census, and the register-based census.

Traditional censuses

The traditional census approach collects basic characteristics from all individuals and housing units (full enumeration) for a specific point in time. More detailed characteristics can be collected either from the whole population or on a sample basis. Collection modes include personal interviews, self-completed paper questionnaires, and data collection by telephone and the internet. Across the world, this is still the most common approach to census-taking. Most UNECE countries with a traditional census use personal face-to-face interviews with paper questionnaires as their main approach. However, in the Czech Republic, France, Ireland, Italy, Luxembourg, Slovakia, the United Kingdom and the United States, the main method is self-completion of paper questionnaires by respondents. In Canada most respondents participate online (CAWI), while in Portugal self-completed paper questionnaires and online response were equally popular.

Just as in the census round of 2000, full field enumeration without register information (traditional census) is still the most popular method in the UNECE region in this census round. Almost two-thirds of countries collected data using 'traditional' methods. But although it is still the most common general approach in the region, it is less so than in the 2000 round, when four-fifths of countries used

this approach. A substantial minority (33 percent) of the full field enumeration countries used information from registers only as a frame of control. The United States was alone in using traditional enumeration with yearly updates of characteristics on a sample basis. Another alternative approach to the traditional model was used by France: the rolling census. This is a cumulative continuous survey covering the whole country over a period of time rather than on one particular day.

Combined censuses

Four countries (Estonia, Latvia, Liechtenstein and Lithuania) used a combination of register data with complete field data collection for selected population census variables, and six countries (Germany, Israel, Poland, Spain, Switzerland and Turkey) used a combination of register data with ad-hoc sample data collection for selected population census variables.

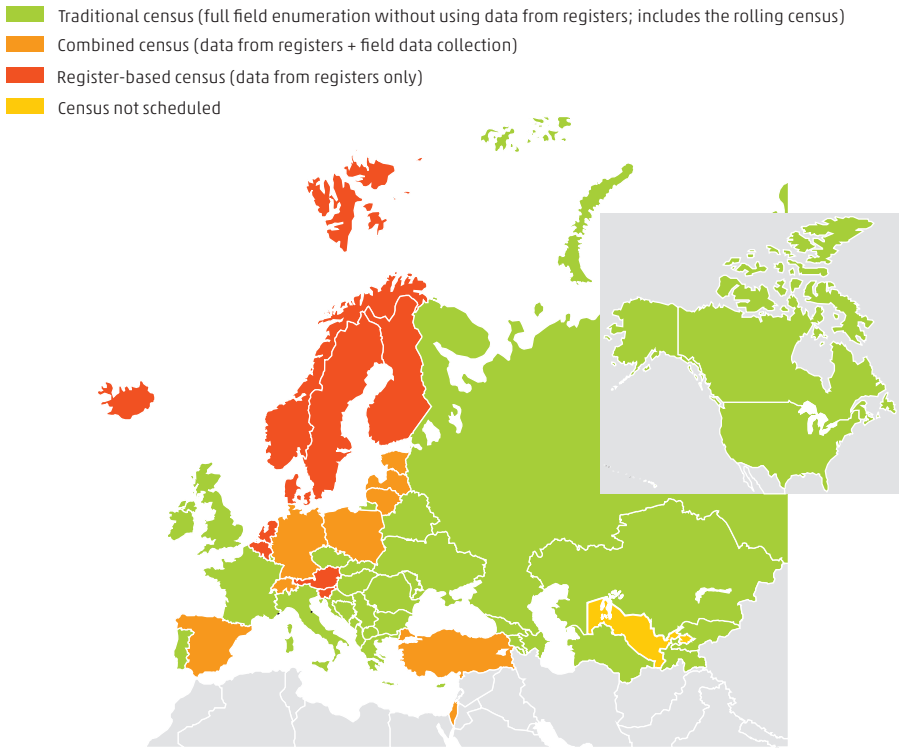
Register-based censuses

A growing number of EU and EFTA countries have switched to methods without field data collection, relying on registers for their 2011 population and housing censuses, and skipping census questionnaires completely. Some of these countries 'recycled' information from their labour force surveys, combining it with register data (Belgium, Iceland and the Netherlands). Lastly, some countries used registers only in this census round (Austria, Denmark, Finland, Norway, Slovenia and Sweden). All nine register-based countries collected census information relating to housing entirely from these registers.

Overview

The map of the UNECE area reveals interesting east-west and north-south tendencies in census method (see figure 1.2.1). Three main categories are distinguished on the map: traditional (31 countries), combined (10 countries) and register-based (9 countries). Register-based censuses are becoming increasingly popular in northern Europe, combined censuses are more often found in central Europe. Traditional censuses continue to be more popular in English-speaking and Commonwealth of Independent States (CIS) countries. All UNECE countries outside Europe conduct traditional censuses. Only Uzbekistan did not conduct a census in this round, and had no plans to do so.

1.2.1 Census methods in UNECE countries



Source: UNECE Task Force on Census Methodology (2013).

1.3 Compilation methods in the Netherlands

The current census results in the Netherlands refer to 2011. The backbone of the Dutch census is the central population register (PR), which combines all the municipal population registers. PR data for 1 January 2011 were used as the basis for the set of hypercubes. The hypercubes focus on frequency counts, not on quantitative information. Data not available or derivable from the PR were taken from other registers. All register variables are now available from Statistics Netherlands' System of social statistical datasets (SSD), and their quality has been improved by applying micro-integration techniques. Micro-integration entails

checking the data and adjusting those that are incorrect. It is widely assumed that micro-integrated data provide more reliable results, as they are based on a maximum amount of information. They also provide better coverage of subpopulations: if data are missing in one source, another source can be used.

In the 2011 Census, only two variables were not taken from a register: 'occupation' and 'educational attainment'. Records from the Labour Force Survey (LFS) in a three year period around the enumeration date (1 January 2011) were used to estimate values for these two variables, which are included in 23 of the 60 hypercubes. Table consistency was guaranteed by using repeated weighting for these 23 hypercubes. The method of repeated weighting, described extensively in Houbiers et al. (2003), is based on the repeated application of the regression estimator, generating a new set of weights for each table estimated. The weights of the records in the microdata are adjusted in such a way that a new table estimate is consistent with all earlier table estimates.

We used the latest version of VRD software developed by Statistics Netherlands for this repeated weighting. VRD stands for *Vullen* (= Filling) Reference Database, and the aim of the application is to fill and manage the reference database. The main functions of VRD are estimating tables via repeated weighting, adding these to the reference database, and withdrawing aggregates from the database. Under the condition of small, independent samples, variances of table values can also be estimated. Such estimated variances were used to set publication rules for cells and to calculate variation coefficients for the quality hypercubes, which serve as a quality assessment of the census hypercubes.

To maximise accuracy, all estimates are based on the largest possible number of records. Tables containing only register variables are counted from the registers. Tables with at least one variable from the LFS are estimated from the largest possible combination of register and survey data. Initial weights have to be available for these estimations. Chapter 6 describes the weights used for the 2011 Census and how they were calculated, as well as how the new panel character of the LFS was used: data from different waves were available and the data closest to 1 January 2011 (Census Day) were used to compile the tables. As not all detailed cells could be estimated through repeated weighting only, an additional technique was required. Chapter 7 describes this technique and how it was applied in the reconciliation of hypercubes for the 2011 Census.

As part of the 2011 Census was compiled on the basis of sample data, margins of inaccuracy have to be taken into account for some results. A rule of thumb was applied for cell values based on a sample from the census population: only estimated table cells based on at least five persons are published. In addition, rare categories have been made confidential to prevent disclosure of individual information.

1.4 Conclusions

The register-based census has proven to be a successful concept in the Netherlands. It has many advantages compared with traditional censuses: costs are considerably lower, problems with non-response only play a role when survey microdata are reused, and the production time is much shorter. These advantages more than make up for the loss of some detail in tables based on survey variables. The 2011 Census provides data on the Netherlands that can be compared to results of earlier Dutch censuses and to results of other countries taking part in the 2011 Census Round.

Although most countries in the world still conduct traditional censuses, the Netherlands is not the only country with a register-based census. A number of countries in Europe have switched to combined and register-based censuses. The 2011 Census was the fourth that the Netherlands conducted without census questionnaires.

Just as in the 2001 Census, the repeated weighting technique was used successfully to produce a consistent set of tables for the 2011 Census. A new additional method was introduced for the 23 hypercubes to be estimated. All tables that had to be estimated were based on the largest number of records possible and the resulting hypercubes are mutually consistent. It is important to apply micro-integration of the different sources in the SSD before compiling tables using the estimation techniques. The use of micro-integration and the applied estimation techniques guarantee the consistency between table results from different hypercubes. There is thus no confusion for users of census information, as there is one figure on each socio-economic phenomenon, instead of several figures depending on which sources are used.

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Part 1.
Analysis

2. Key results of the Dutch Census 2011 and comparisons with earlier Dutch censuses

Author
Eric Schulte Nordholt

The Dutch Census 2011 cannot be considered in isolation from its predecessors. This new census builds on a rich tradition of traditional population censuses carried out in the period 1795–1971. These enumerations contain very detailed data about specific categories, which is why historians are so interested in all current and previous census data. For the European Union censuses of 1981 and 1991, Statistics Netherlands provided alternative census data consisting of a combination of register and survey data, but without numerical consistency and without detailed information about regions and specific categories. This combined data provision was continued for the censuses of 2001 and 2011, by which time it was possible to compile consistent data at a very detailed level. In this way the two most recent censuses are a continuation of the traditional census. The 2011 Census data are even more detailed than those of 2001, and include the hypercubes that are mandatory for all EU countries under the 2008 European Census Act. This chapter looks at some historical aspects of the traditional population census: goals, population concept, use of census data for analysis, and presents key results of the Dutch Census 2011 and last but not least some comparisons of 2011 Census data with those from earlier censuses.

2.1 Introduction

The first census in the Netherlands was held in 1795 for the purpose of establishing voting constituencies. At that time the united provinces of the Netherlands still constituted a republic, and its borders differed from those of today. Following the withdrawal of Napoleon, the Netherlands became a kingdom and a census was held once every ten years. The first census of the Kingdom of the Netherlands was taken in 1829. Before the official institution of a central bureau of statistics, the Ministry of the Interior organised another six censuses (in 1839, 1849, 1859, 1869, 1879 and 1889). In 1899 the Central Bureau of Statistics (Statistics Netherlands) was established, and was put directly in charge of the eighth census. Six more traditional censuses were carried out in the twentieth century: in 1909, 1920, 1930, 1947, 1960 and 1971. The four most recent censuses (1981, 1991, 2001 and 2011) were not based on a complete enumeration but on registers and surveys available for Statistics Netherlands. Until now 18 censuses have been held in the Kingdom of the Netherlands.

The Dutch data compiled for 1981 and 1991 were much less detailed than the sets of tables compiled for the 2001 and 2011 Censuses. Moreover, they were largely based on a register count of the population in combination with the then existing

surveys on labour force and housing conditions. The amount of information that has become available in the 2011 Census is again larger than that of the 2001 results. This is mainly the result of the introduction of so-called hypercubes (high dimensional tables): more variables have now been cross-classified than ever before.

18 **censuses have been held in the Kingdom of the Netherlands**

In 1991 the Census Act was rescinded, officially terminating Statistics Netherlands' obligation to conduct a census every ten years (Corbey, 1994). For the 2001 Census there was no obligation to produce census data, but Statistics Netherlands compiled a set of tables based on a gentlemen's agreement between the European Union and its member states at that time. The 2011 Census has its legal basis in the 2008 European Census Act (European Commission, 2008). Eurostat has a coordinating role in collecting harmonised data on the EU and a duty to make international comparisons of the outcomes.

Originally, censuses had two aims. First, to correct errors in the municipal population registers. And second, to obtain extra information about socio-economic phenomena in the country. As the Netherlands conducts a register-based census, the first aim no longer exists. Also, the quality of the central population register (PR), which unites all municipality population registers, has improved considerably: as central government funding is allocated on the basis of population size, it is in the municipalities' own interest to keep their population registers up-to-date. Another reason for the improvement is that it is extremely difficult to function in Dutch society if you are not in the PR. Both municipalities and citizens, therefore, have enough incentive to maintain a high quality PR. The second aim is still valid and many census results are published in a historical or international context. At present, census data are also popular for comparisons between countries.

Section 2.2 presents some key results of the 2011 Census. As different variable and category definitions and classifications are used, historical comparisons are not always that easy. Where possible and relevant, comparisons are made with the

results of the Dutch 2001 Census. These comparisons are largely based on Schulte Nordholt (2004). Section 2.3 comprises a few comparisons over a longer period. The time series presented are extended versions of those previously presented in Schulte Nordholt and Van Maarseveen (2007). Section 2.4 completes this chapter with some conclusions.

2.2 Some key results of the 2011 Census compared with 2001

Population by age, household type and sex

Table 2.2.1 presents the population of the Netherlands by age and sex. At the start of 2011, over 16.6 million people were living in the Netherlands, 8.2 million of them male and 8.4 million female. In age categories up to and including 60–64 years, there were more men than women, but in older age categories women outnumbered men. In the age categories beyond 80 years there were almost twice as many women as men, for the over-90s this rises to over three times as many, among Dutch centenarians women outnumbered men sixfold.

There have been some remarkable changes compared with the situation according to the 2001 Census. The percentage of females remained stable at 50.5 percent. The percentage of people under 15 years decreased from 18.6 to 17.5 percent of the population. The percentage of people aged 75 years and older rose from 6.1 to 7.0 percent. For women aged 75 years and older the percentage rose from 7.8 to 8.6 percent and for men in this age group it rose from 4.3 to 5.4 percent.

Most people live in private households. Just as in 2001, more than 0.2 million people lived in institutional households in 2011, such as care homes and homes for the elderly. Men account for around 41 percent of this group, women for 59 percent. In 2001 these shares were 36 percent and 64 percent respectively. Table 2.2.2 gives more information about the population by type of household and sex.

2.2.1 Population by age and sex, 2011

	Total	Male	Female
Total	16,655,799	8,243,482	8,412,317
0–4 yrs	923,106	472,308	450,798
5–9 yrs	985,229	503,882	481,347
10–14 yrs	998,740	510,974	487,766
15–19 yrs	1,006,744	514,830	491,914
20–24 yrs	1,034,729	522,667	512,062
25–29 yrs	1,001,538	504,117	497,421
30–34 yrs	1,004,764	503,323	501,441
35–39 yrs	1,121,568	560,289	561,279
40–44 yrs	1,295,925	653,664	642,261
45–49 yrs	1,298,292	655,302	642,990
50–54 yrs	1,196,319	601,040	595,279
55–59 yrs	1,090,247	546,952	543,295
60–64 yrs	1,103,652	553,446	550,206
65–69 yrs	790,560	390,725	399,835
70–74 yrs	637,518	302,542	334,976
75–79 yrs	499,321	219,108	280,213
80–84 yrs	360,828	139,348	221,480
85–89 yrs	212,056	66,949	145,107
90–94 yrs	76,191	18,812	57,379
95–99 yrs	16,668	2,961	13,707
100 yrs and older	1,804	243	1,561

Source: Statistics Netherlands.

2.2.2 Population by type of household and sex, 2011

	Total	Male	Female
Total	16,655,799	8,243,482	8,412,317
persons living in a private household	16,436,484	8,153,076	8,283,408
persons in an institutional household	219,315	90,406	128,909

Source: Statistics Netherlands.

Population by economic activity and sex

At the beginning of 2011, just over half of people in the Netherlands were in the economically active population (labour force). In 2001 the share of economically active persons was still 47 percent. The increase in the active population was caused by growth of both the employed and the unemployed population. The employed labour force included 8.2 million people in 2011: 7.2 million

employees, 0.6 million employers and 0.3 million self-employed. The unemployed labour force comprised just over 0.6 million people.[1)]

Men accounted for 54 percent of the economically active population, while in the economically inactive population 55 percent were women. In the 2001 Census, both these percentages were 58 percent. The economically inactive include people under the age of 15 years, people living on income from pension and capital, students who are not economically active, and homemakers and others. The latter category – homemakers and others – comprises more than twice as many women as men. Table 2.2.3 gives the figures for the population by economic activity and sex.

2.2.3 Population by economic activity and sex, 2011

	Total	Male	Female
Total	16,655,799	8,243,482	8,412,317
Economically active population	8,813,362	4,731,079	4,082,283
employed	8,175,971	4,407,130	3,768,841
employees	7,203,796	3,816,283	3,387,513
employers	635,862	437,485	198,377
self-employed	336,313	153,362	182,951
unemployed	637,391	323,949	313,442
Economically inactive population	7,842,437	3,512,403	4,330,034
younger than 15 yrs	2,907,075	1,487,164	1,419,911
pension or capital income recipients	2,768,813	1,207,136	1,561,677
students (not economically active)	679,924	355,203	324,721
homemakers and others	1,486,625	462,900	1,023,725

Source: Statistics Netherlands.

Working population by branch of economic activity, occupation and sex

The 8.2 million people in the working population can be broken down by branch of economic activity based on the NACE code (*Nomenclature statistique des Activités économiques dans la Communauté Européenne*)[2)]: 0.2 million people

[1)] In the organisational set-up of the census, employees, employers and self-employed (own account workers) are mutually exclusive categories. Employers and self-employed who also work for a wage for a number of hours a week are counted as employees. A person in the employed labour force cannot be unemployed at the same time. The number of unemployed in the Dutch Census 2011 is derived with the help of social benefit registers.

[2)] For employees with more than one job the characteristics of their main job were taken. In the context of the Dutch Census 2011, a person's main job is defined as the job yielding the highest wage in 2010.

in the Netherlands were working in agriculture and fishing in 2011, 1.3 million in manufacturing and construction, and 6.5 million in services.[3] At the beginning of 2001 these numbers were 0.2 million, 1.5 million and 5.7 million respectively. In the services sector, 3.9 million people worked in commercial services and 2.6 million in non-commercial services. In 2001 these numbers were lower: 3.5 million and 2.1 million respectively.

The International Standard Classification of Occupations (ISCO) can be used to classify workers by occupation. For men the most common occupation categories in the 2011 Census were:

1. professionals;
2. craft and related trades workers;
3. technicians and associate professionals.

'Professionals' was also the most common occupation category for men in the 2001 Census. For women the most common occupations in the 2011 Census were:

1. service and sales workers;
2. professionals;
3. technicians and associate professionals.

In 2001 the most common occupation category for women was 'technicians and associate professionals'.

Population by level of education and sex

Education levels of the Dutch population can be classified by means of the International Standard Classification of Education (ISCED).[4] The most common level of educational attainment is upper secondary (ISCED level 3), accounting for 2.4 million men and 2.4 million women in the Netherlands. More women than men have primary or lower secondary education (ISCED levels 1 and 2) as their highest completed level of education. Men dominate the higher levels (ISCED levels 4, 5 and 6), and most prominently the second stage of tertiary education: ISCED level 6 is completed by more than twice as many men as women (45 thousand versus 20 thousand).

[3] For 0.2 million employed persons no branch of economic activity was stated in 2011.

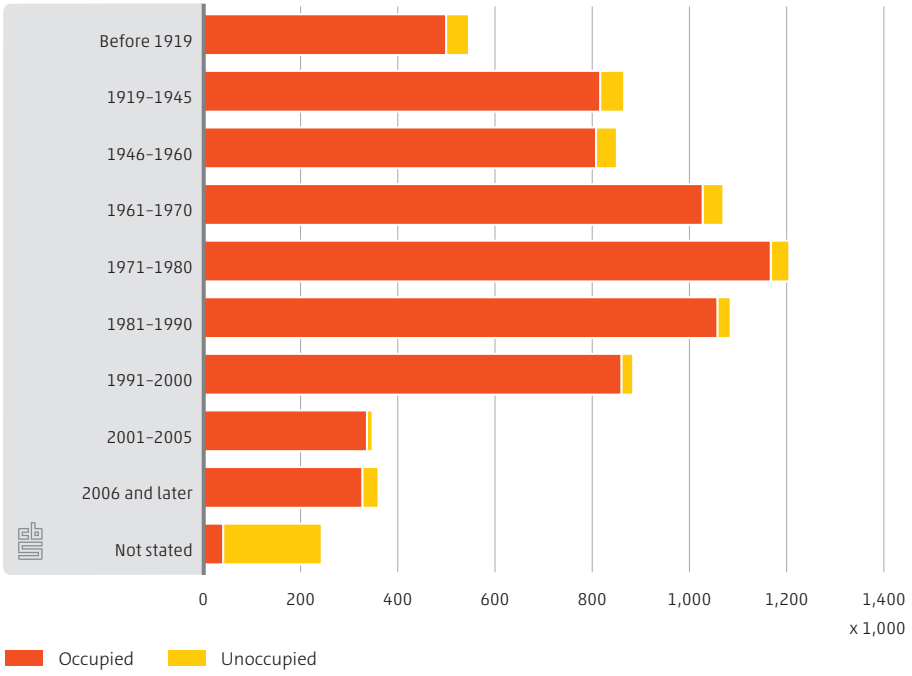
[4] The highest level of education completed determines the category in which a person is classified according to the ISCED. For persons younger than 15 years, this variable was considered not applicable in the 2011 Census (European Commission, 2009).

500,000
unoccupied dwellings

Housing characteristics

According to the 2011 Census, the Netherlands had almost 7.5 million conventional dwellings: more than 6.9 million occupied and 0.5 million unoccupied. These dwellings can be classified by period of construction. Although 7 percent of all conventional dwellings were unoccupied, this percentage falls considerably if dwellings whose period of construction is not stated are excluded from the analysis: to 4.4 percent. The oldest and the newest dwellings had the highest unoccupancy rates: 8.6 percent of homes built before 1919, and 9.3 percent of those built in 2006 or later were unoccupied (see figure 2.2.4).

2.2.4 Conventional dwellings by period of construction and occupancy status, 2011



2.3 Census 2011 outcomes compared with previous census results

Population by age group 1829-2011

Using figures from all 18 censuses, table 2.3.1 gives a rough age breakdown of the population in the period 1829–2011. Remarkable developments include the large growth and, especially in the period after the Second World War, the ageing of the Dutch population.

2.3.1 Population by age group and census year

Census year	All ages	0–19 yrs	20–64 yrs	65 yrs and older
	× 1,000	% of total population		
1829	2,613.3	44	50	5
1839	2,861.6	45	50	5
1849	3,056.9	43	53	5
1859	3,309.1	42	53	5
1869	3,579.5	43	52	6
1879	4,012.7	44	50	5
1889	4,511.4	45	49	6
1899	5,104.1	44	50	6
1909	5,858.2	44	50	6
1920	6,865.3	42	52	6
1930	7,935.6	40	54	6
1947	9,625.5	38	55	7
1960	11,462.0	39	53	9
1971	13,060.1	36	54	10
1981	14,216.9	31	57	12
1991	15,070.0	25	62	13
2001	15,985.5	24	62	14
2011	16,655.8	23	61	16

Source: Statistics Netherlands.

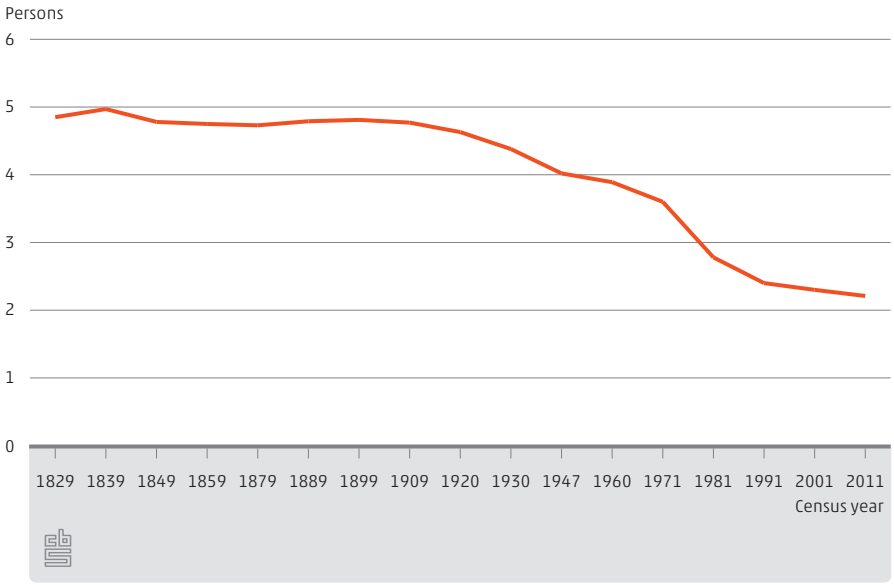
Household size 1829-2011

The average private household size in the Netherlands has decreased since the beginning of the twentieth century. Together with the growth in prosperity in the post-war period, the average size diminished rapidly. Not only has the number

2.2 persons per household

of children per couple decreased since the 1960s, but children are leaving home earlier and live alone longer than half a century ago. From 4.8 persons in 1899 the average private household size has dropped to 2.2 in 2011. Specifically worth mentioning is the decrease since 1947, when the average size was still 4.0 persons. Figure 2.3.2 illustrates the fall in average household size.

2.3.2 Average household size by census year



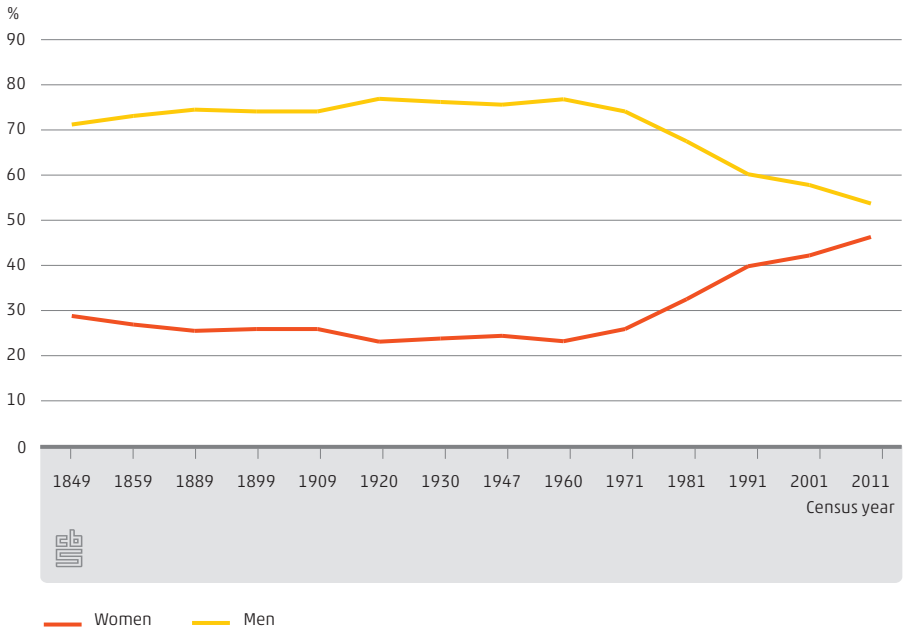
Economically active population 1849-2011

The census of 1849 was the first to include questions on occupation, although there was as yet no sharp distinction between the economically active and non-active labour force. It was up to the respondents themselves to decide whether they did

or did not belong to the labour force. According to the earliest explanatory notes, the labour force consisted of persons who provided for themselves or others. Until 1947 the population was divided into two parts: the labour force and the remaining population. Since the 1947 census, the primary division of the labour force was between the active and the temporarily not active labour force.

There was a striking increase in the participation of women in economic activities after 1960. Until the early 1960s, women in the civil service were dismissed when they got married under existing legislation at the time. This was also often the case in the private sector, and as a consequence relatively few women were employed. As legislation changed, female labour force participation gradually increased: in the period 1849–1971, women accounted for about a quarter of the economically active population; by 2011 this share had increased to 46 percent. One reason the law on married female civil servants was revoked was the shortage of labour in the 1960s. Another reason was the emergence of new ideas about marriage, family life and childcare. Figure 2.3.3 clearly shows the narrowing gap between the percentages of women and men in the economically active population since 1971.

2.3.3 Economically active population by census year



2.4 Conclusions

Population censuses are the most important sources for describing long-term developments in social population structures (Van Maarseveen, 2004). Historical comparisons are sometimes hampered by differences in methods (e.g. definitions, classifications, observation periods) and changes in how data are processed and published. However, this chapter has outlined a few aspects using comparable data for the period 1829–2011. Some remarkable results of these comparisons are:

- the huge growth of the population from 2.6 million inhabitants in 1829 to 16.7 million in 2011;
- the ageing of the population: 5 percent over-65s in 1829 and 16 percent in 2011;
- the decrease in average household size, especially in the post-war period;
- the increase of women in the economically active population since 1960.

The outline can of course be filled in in much more detail. Both the hypercubes and the microdata of the 2011 Census can be used for such more detailed analyses. The integral data of the censuses make many kinds of small-area analyses possible, which can add nuance to the picture sketched above.

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3. Key results of the Dutch Census 2011 and comparison with other European countries

Authors
Frank Linder
Jantien van Zeijl

The 2011 EU Census Round aims at easy access to detailed and comparable census data by disseminating sixty predefined high dimensional tables (so-called hypercubes) of all 32 countries in the European Union and the European Free Trade Association in the European Census Hub. This is an innovative dissemination tool in which users can define datasets of interest and receive those data simultaneously from different national statistical institutes, who keep their census data in systems at their own premises. This chapter sets some key results of the 2011 Census in the Netherlands alongside those for other European countries. It gives an overall impression of the wealth of statistical information available in the Census Hub, such as population structure, employment rates, educational attainment, types of households, and housing characteristics.

32 European countries present their census data in the European Census Hub

3.1 Introduction

The comprehensive series of tables in the Census Hub offer a detailed insight into demographic and socio-economic aspects and housing in all participating European countries. Most tables are available for the statistical unit 'persons', but there are also tables with data on 'households and families' and 'dwellings'. This chapter presents some key results from the Dutch Census 2011 and compares them with results from other member states of the European Union (EU) and European Free Trade Association (EFTA).[1)]

Section 3.2 compares population sizes of European countries and describes the demographic structure of the population in terms of sex and age. It also addresses employment rates and examines differences in the percentages of men and women with higher education levels. Section 3.3 discusses different types of private households in the population; section 3.4 focuses on housing characteristics. Section 3.5 completes the chapter with a number of conclusions.

[1)] More information on which countries are part of the EU and EFTA can be found in chapter 4.

The data in this chapter are provisional. Eurostat may revise the data and tables published in the Census Hub in accordance with the latest information it receives from the countries concerned. The data in this chapter were extracted from the Census Hub on 1 September 2014.

3.2 Population characteristics compared with other European countries

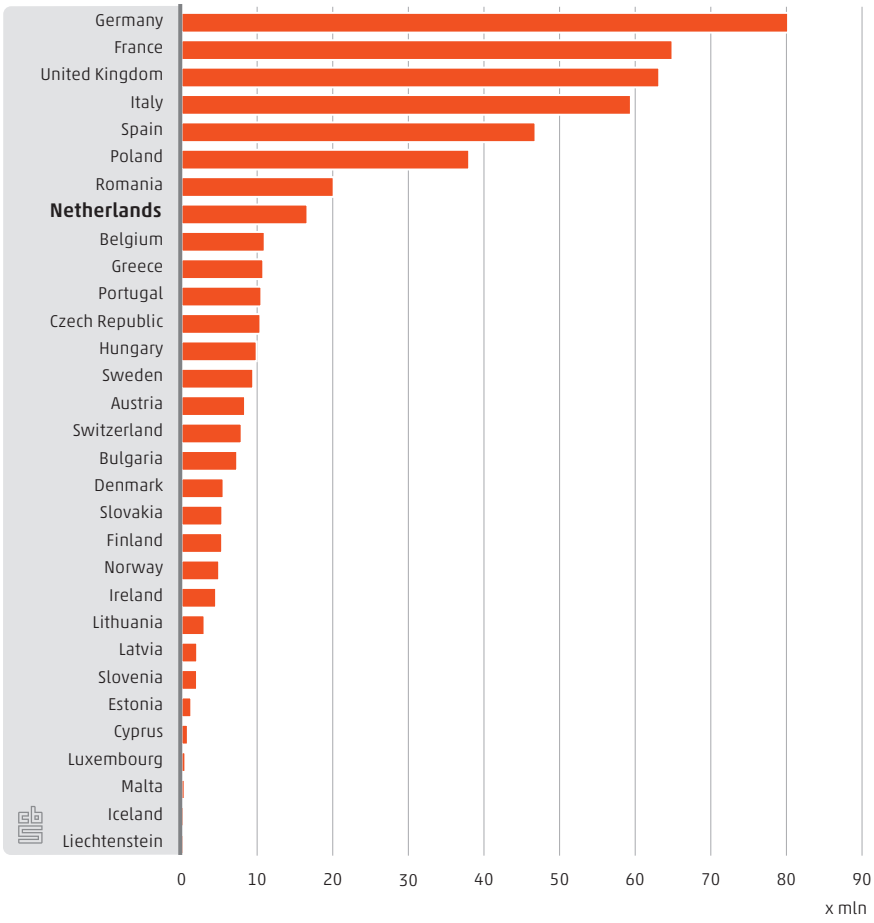
Demographic structure

More than 500 million people lived in the countries of the EU and EFTA in 2011. Germany had most inhabitants, 80 million, and France, the United Kingdom, Italy, Spain, Poland and Romania also all had more inhabitants than the Netherlands. Four countries (Belgium, Greece, Portugal and Czech Republic) had fewer inhabitants than the Netherlands, but still more than 10 million people. Five countries had fewer than 1 million inhabitants: Cyprus, Luxembourg, Malta, Iceland and Liechtenstein. Figure 3.2.1 presents the population sizes in European countries in 2011.

On 1 January 2011, the Netherlands had a population of 16.7 million people, 49.5 percent of whom were male and 50.5 percent female. Like the Netherlands, almost all other EU and EFTA countries in the Census Hub have an overall sex balance in favour of women. Exceptions are Iceland and Norway, which have slightly more men.

Figure 3.2.2 illustrates the sex ratios for a number of age groups, with blue colours denoting more males, and orange colours more females. Overall in Europe, the sex ratio (i.e. the number of males divided by number of females) for younger ages is higher than 1. This is not surprising, as slightly more boys than girls are born. In almost every country, the sex ratio remains higher than 1 for age groups up to 29 years, and in two-thirds of the countries even up to 49 years. Ireland is the only country with more women than men in the population aged 15–29. While in most countries the sex ratio is below 1 in age groups from 50–64 years onwards, in the Netherlands this turning point is from age 65 years.

3.2.1 Population in EU and EFTA countries, 2011[1)]

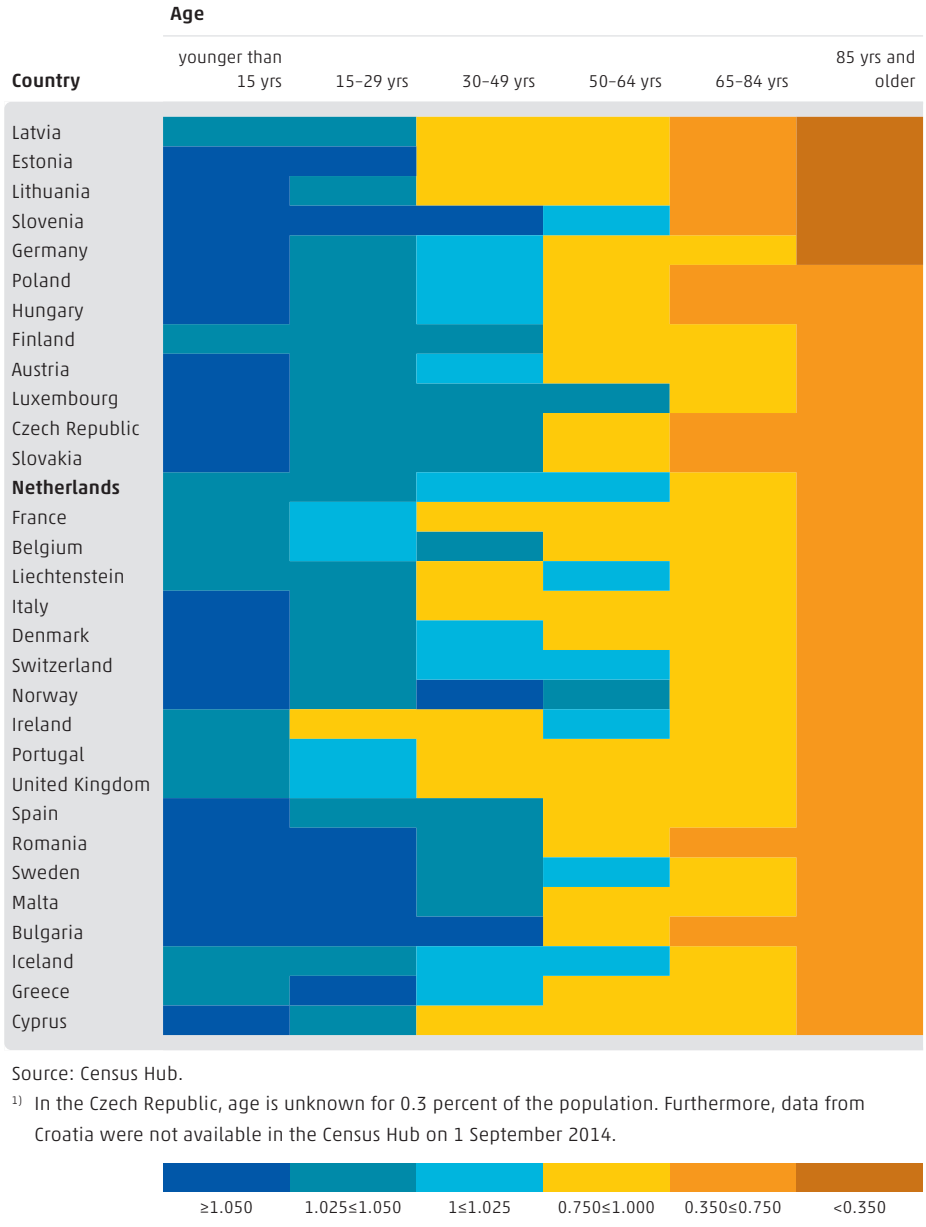


Source: Census Hub.
[1)] Data for Croatia were not available in the Census Hub on 1 September 2014.

As the orange colours in figure 3.2.2 confirm, older women tend to survive their male peers: from the age group 65–84 years women outnumber men everywhere in Europe. Most east European countries, for example, Bulgaria, the Czech Republic, Hungary and Poland, show sex ratios of between 0.35 and 0.75 for ages 65–84 years. In other words, for every 100 women in these countries there are between 35 and 75 men. In the Baltic states Estonia, Latvia and Lithuania the sex ratios are exceptionally low, just over half. In most countries at least two out of every three over-85s are women (sex ratio below 0.50). In the three Baltic states this age group even comprises about four women for every man. The sex ratio for Dutch people aged 85 and older does not differ much from most other European countries. One reason for these extremely low sex ratios at higher ages

in eastern Europe is the high mortality of men as a result of a less healthy lifestyle. Furthermore, the Second World War and the period of Stalinist repression also claimed many male victims in the Baltic states. The common pattern in almost all EU and EFTA countries is that the female dominance at higher ages more than compensates for the male dominance in the lower and middle age groups, so that in the end the overall sex ratio is lower than 1 for the complete population.

3.2.2 Sex ratios for different age groups in EU and EFTA countries, 2011[1)]

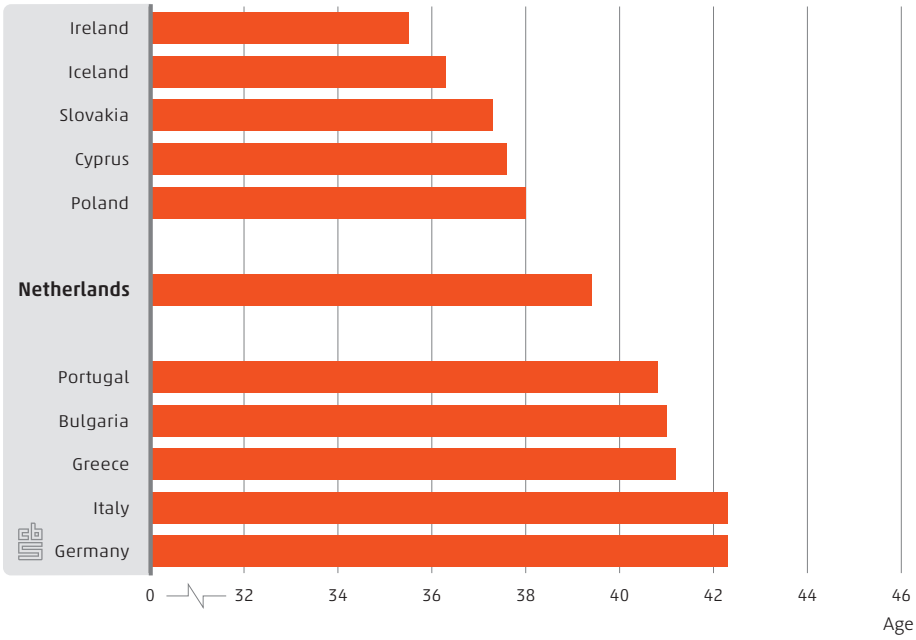


Source: Census Hub.

[1)] In the Czech Republic, age is unknown for 0.3 percent of the population. Furthermore, data from Croatia were not available in the Census Hub on 1 September 2014.

The average age[2)] of the population in the Netherlands is 40.3 years; for men it is 39.4 years and for women 41.3 years. This places the Netherlands in the middle of the European list for men, while it is ninth youngest with respect to women. Figure 3.2.3 presents the average male age in the Netherlands and in the five European countries with the highest and the lowest average ages respectively. Figure 3.2.4 does the same for women. Ireland is indisputably the youngest nation for both sexes. The average male age is 35.5 years, the average female age 36.7 years. Iceland, too, has a very young population: men there are 36.3 years on average, women 37.6 years. Italy has the oldest population, although for men it shares its top position with Germany. The average age of Italian and German men is 42.3 years, for Italian and German women it is 45.2 and 45.1 years respectively.

3.2.3 Average age of men in the Netherlands and top 5 and bottom 5 of EU and EFTA countries, 2011[1)]

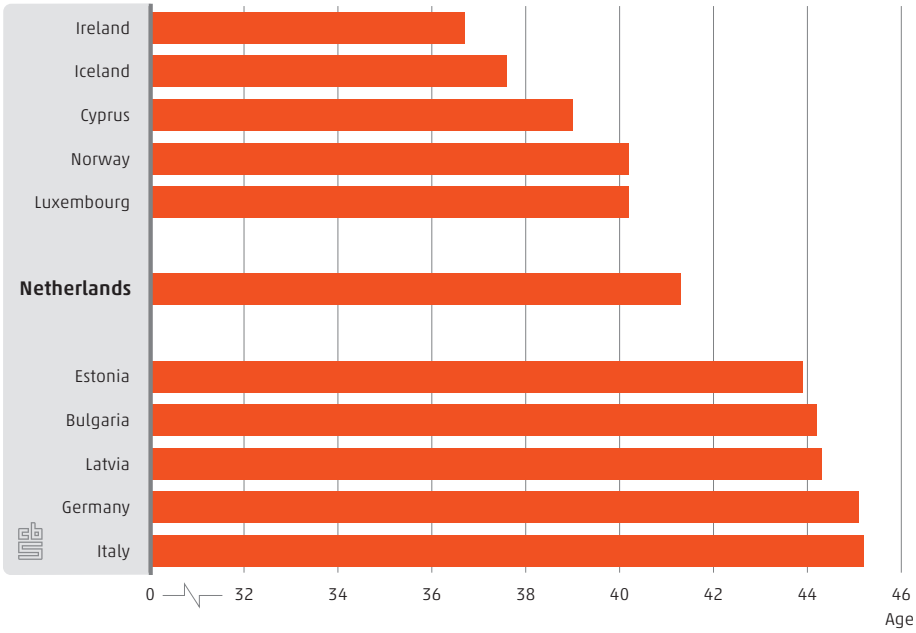


Source: Census Hub.

[1)] Data for Croatia were not available in the Census Hub on 1 September 2014.

[2)] The average age was calculated as a weighted average of the number of persons n_i of a certain single age i multiplied with the factor (i + 0.5). For persons aged 100 years and older, 101 was taken instead of 100.5 as a factor. For Latvia, because of lack of information on single ages, calculation of the average age was only possible on the basis of 5-year age classes.

3.2.4 Average age of women in the Netherlands and top 5 and bottom 5 of EU and EFTA countries, 2011[1)]



Source: Census Hub.

[1)] Data for Croatia were not available in the Census Hub on 1 September 2014.

To get an impression of the age distribution of males and females, figure 3.2.5 shows a standardised population pyramid for the Netherlands and by way of reference for the countries with the youngest and the oldest average ages, Ireland and Italy respectively. The shape of Ireland's population pyramid clearly differs from those of the other two countries, while the Netherlands and Italy show more similarity.

The youngest age group, boys and girls younger than 5 years, accounts for 8 percent of the total population in Ireland, while in the Netherlands and Italy its share is between 4 and 6 percent. One important reason for this is the higher fertility rate in Ireland (Eurostat Population Database, 2014). The share for Ireland remains higher until age 35–39 years, which means that for any age group under 40 years, Ireland has relatively more people in this age group than the Netherlands and Italy. From the intersection point (age group 40–44 years) onwards the percentages are lower than those in the Netherlands and Italy and remain so until the oldest ages. So, for ages over 40 years the Netherlands and Italy have relatively more people in their population than Ireland. The life expectancy for Dutch and Italian citizens is known to be higher than for the Irish (Eurostat Population

Database, 2014). In all three countries, after age 70 the percentage of women exceeds the percentage of men. As remarked above, older women tend to survive their male peers.

3.2.5 Population of the Netherlands, Ireland and Italy by age and sex, 2011

Source: Census Hub.

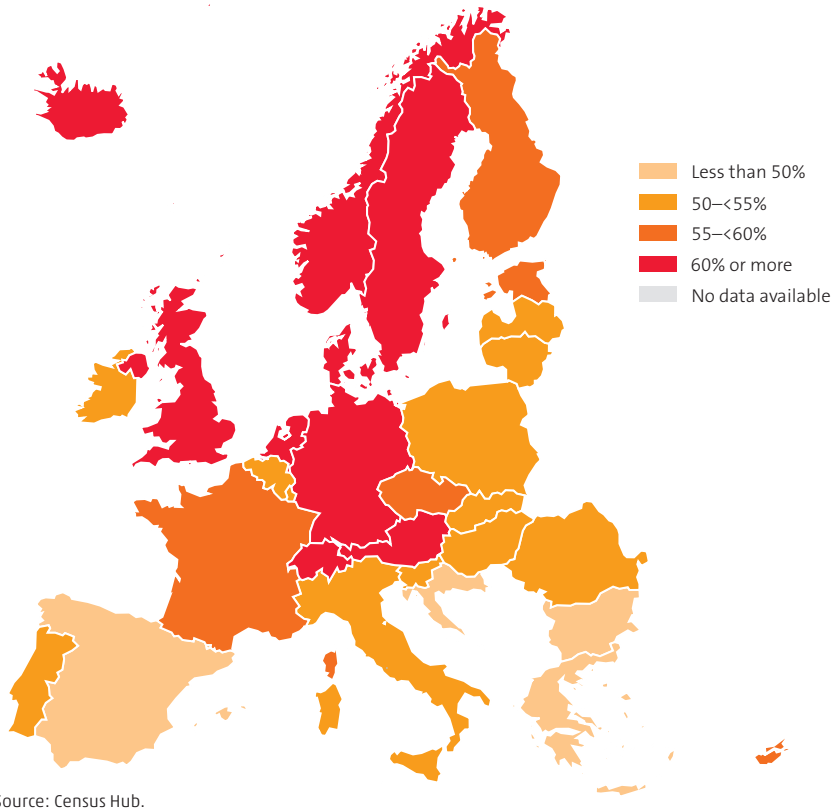
Employment rate

In the Netherlands, 65 percent of the population between 15 and 74 years old have a job.[3)] For men this is 70 percent and for women 60 percent. Compared with other EU and EFTA countries the Dutch have quite a high employment rate (percentage of employed persons), ranking fourth overall in Europe: fourth

[3)] In the Dutch Census 2011, the age group 15–74 years is considered as the 'potential' labour force. People in younger and older age groups are by definition never employed.

for men (range 50–74 percent) and sixth for women (range 37–70 percent). Iceland, Norway and Switzerland have the largest employed labour force in the ages 15–74 years, with employment rates of 72, 69 and 68 percent respectively. In Greece, Croatia, Bulgaria and Spain, less than half of the population aged 15–74 are employed. Figure 3.2.6 presents employment rates (in classes) for all EU and EFTA countries.

3.2.6 Employment rates of population 15-74 years in EU and EFTA countries, 2011[1)]



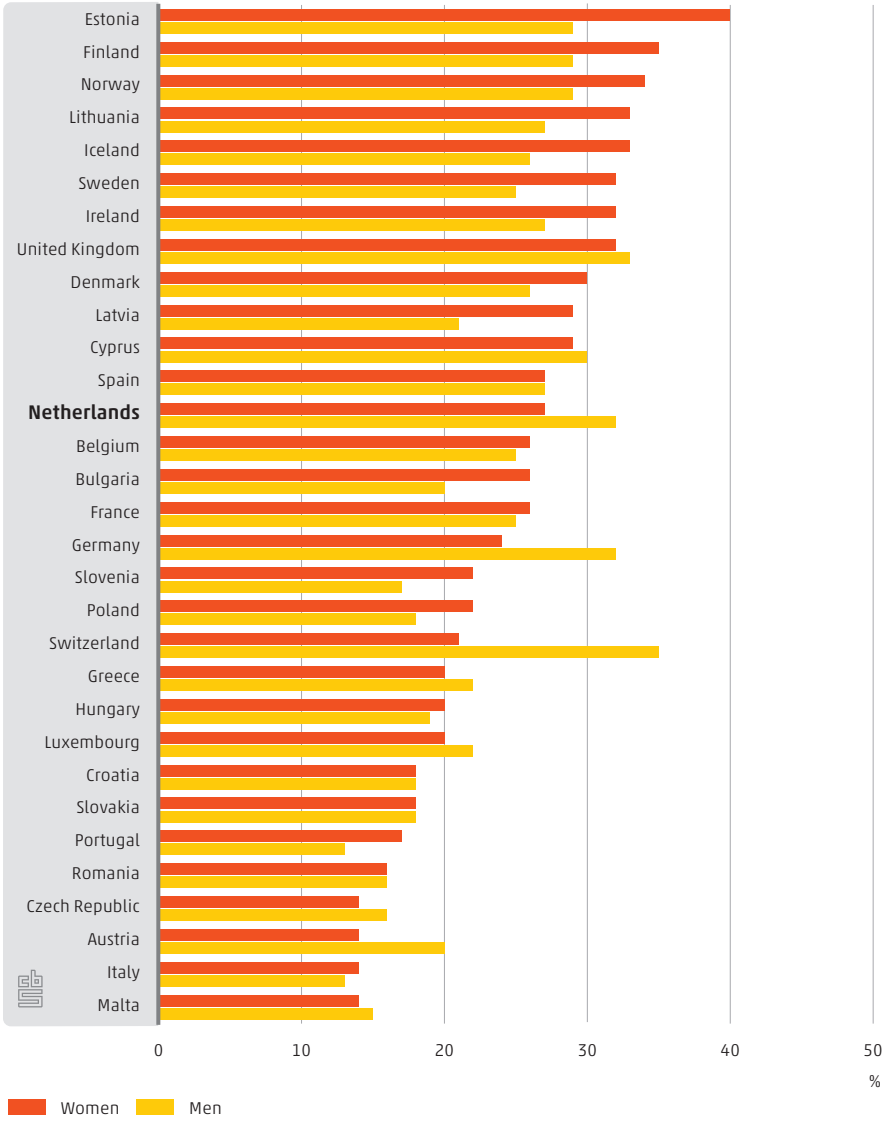
Source: Census Hub.
[1)] Data from Liechtenstein were not available for age 15–74 in the Census Hub on 1 September 2014.

Higher educational levels

In the Netherlands 29 percent of the population of 25 years and older have completed tertiary education.[4)] For men this is 32 percent, for women 27 percent (see figure 3.2.7).

[4)] Tertiary education is the equivalent of ISCED-5 (bachelor, master or equivalent) and ISCED-6 (PhD or equivalent) level.

3.2.7 Population over 25 with tertiary education in EU and EFTA countries by sex, 2011[1)]



Source: Census Hub.

[1)] Data from Liechtenstein were not available in the Census Hub for age 25 years and older on 1 September 2014. Data from France on ISCED level 6 in the European Census are claimed to have low reliability.

2/3 of EU and EFTA countries have relatively more higher educated women than men

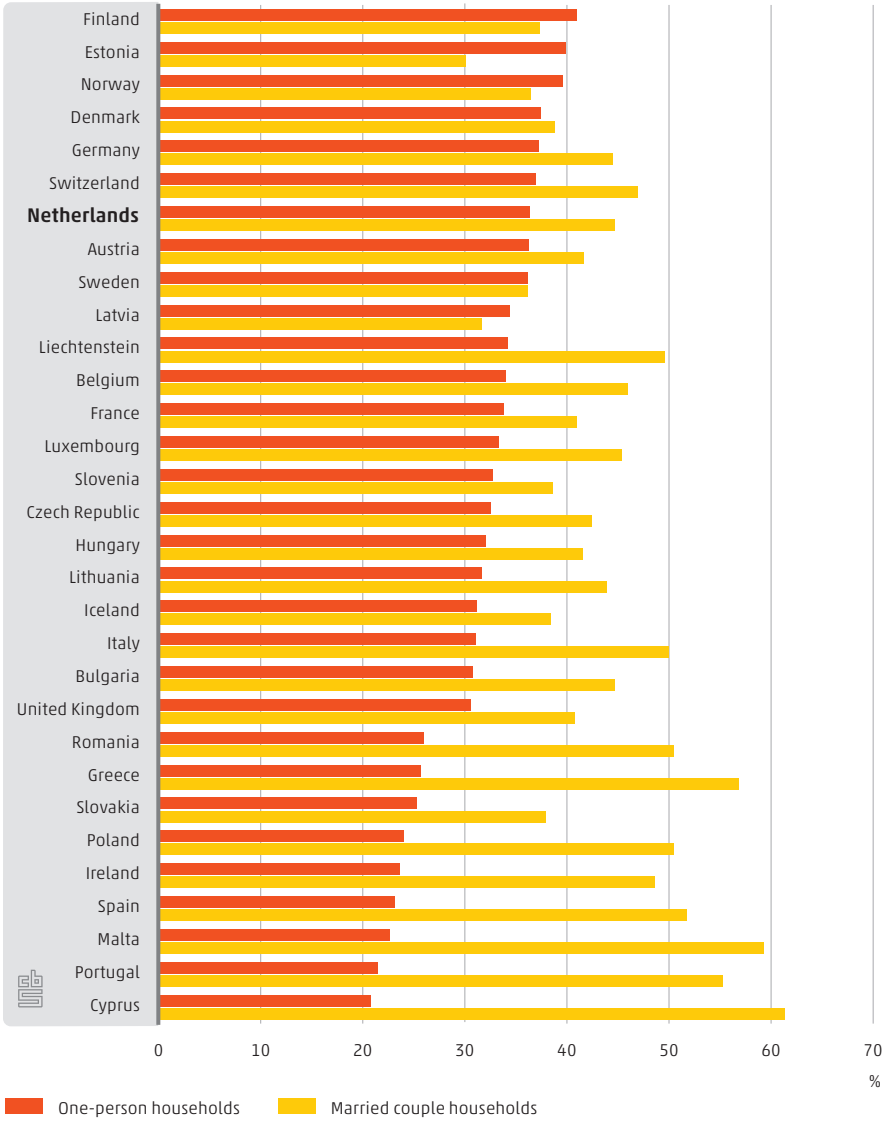
In many countries it was not common practice in the past for women to continue their studies after completing secondary school. Following a substantial catch-up effort, two-thirds of EU and EFTA countries in the Census Hub now have relatively more women than men with a higher educational level. Estonia is the unrivalled champion: no fewer than 40 percent of Estonian women have a degree in higher education. Interestingly, the ten countries with the largest proportion of higher educated women, such as the three Baltic states, Norway and Iceland, are all located in northern Europe. The Czech Republic, Austria, Italy and Malta rank at the bottom of the list, all with only 14 percent of women having completed tertiary education. The Netherlands is one of eleven European countries in which men still have a lead over women in this respect. In fact the Dutch rank third on the male list. In countries such as Switzerland and Estonia, and to a lesser extent Latvia and Germany, the gap between the male and female proportions of higher educated is quite wide. In Switzerland (14 percent gap) and Germany (8 percent) men definitely show higher percentages. In Estonia (–11 percent gap) and Latvia (–8 percent) it is the women who clearly have the lead.

3.3 Household characteristics compared with other European countries

There were more than 7.4 million private households in the Netherlands on 1 January 2011: 36 percent of them were one-person households, 45 percent married couples[5)] with or without resident children, 12 percent cohabiting couples with or without resident children and 7 percent single-parent households. The percentages of one-person and married couple households in all EU and EFTA countries are presented in figure 3.3.1.

5) Including registered partnership households (0.7 percent).

3.3.1 One-person and married couple households in EU and EFTA countries, 2011 [1)]



Source: Census Hub.

[1)] Percentages do not add up to 100%; other categories of 'type of private households' are 'cohabiting couples with or without resident children', 'single-parent households', 'multi-person non-family households' and 'two-or-more family households'. 'Two-or-more family' households are not distinguished in the Netherlands and Liechtenstein.
Data from Croatia were not available in the Census Hub on 1 September 2014.

More one-person households often go together with fewer married couples, for example Finland, Estonia and Norway. Countries with a relatively high percentage of married couples often have fewer one-person households, for example Cyprus, Portugal, Malta and Spain. One in every 8.5 private households in the Netherlands is a cohabiting couple. There are only a few other countries with higher rates: Norway, Finland, France and Estonia, but with 16 percent, Sweden is the unrivalled leader in this respect.

3.4 Housing characteristics compared with other European countries

The 16.7 million people living in the Netherlands in 2011 occupied 7.0 million homes, a ratio of one home per 2.4 persons. Most people lived in conventional dwellings, a small percentage in collective homes, and a very small fraction in a different type of housing[6] (see table 3.4.1). Conventional dwellings were the most common housing type in all EU and EFTA countries, accounting for more than 95 percent in each country.

3.4.1 Housing types and occupant ratios in the Netherlands, 2011

	Number of occupants	%	Number of dwellings	%	Occupant ratio
Total	16,655,799	100.0	7,030,917	100.0	2.4
conventional dwellings	16,275,214	97.7	6,939,487	98.7	2.3
collective dwellings	280,234	1.7	54,225	0.8	5.2
other housing	76,457	0.5	27,619	0.4	2.8
not stated	23,894	0.1	9,586	0.1	2.5

Source: Statistics Netherlands.

[6] Conventional dwellings are defined as separately constructed and independent premises at fixed locations, designed for permanent human habitation. Collective homes are premises designed for habitation by large groups of individuals or several households. Other housing types include huts, cabins, houseboats, caves, or any other shelter used for human habitation, irrespective of whether they are designed for human habitation (European Commission, 2009).

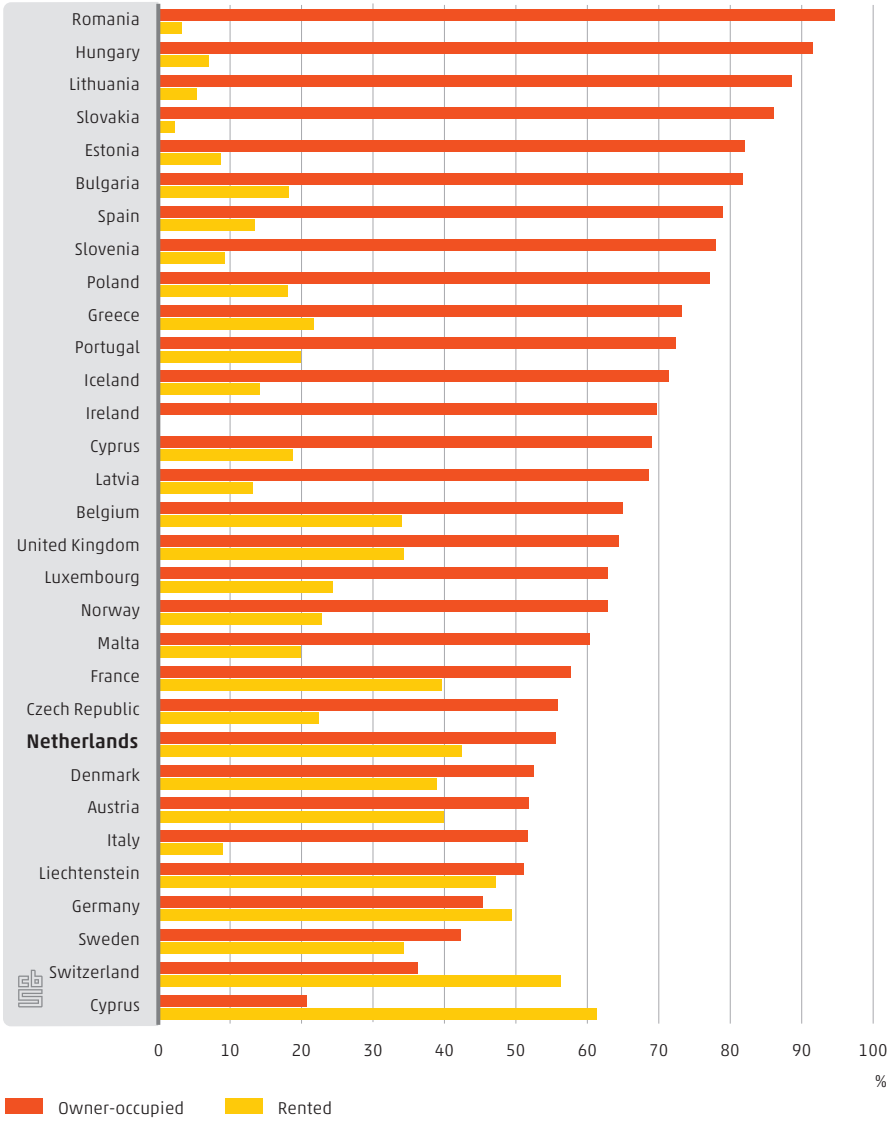
2.3 average number of occupants in a Dutch conventional dwelling

Seven percent of conventional homes in the Netherlands were unoccupied, compared with 17 percent on average in the EU and EFTA countries. In Cyprus, Bulgaria, Malta, Portugal and Greece more than 30 percent of dwellings were unoccupied. More than 37 million dwellings in Europe are unoccupied, with highest numbers in Spain and Italy (both more than 7 million).

Most conventional dwellings in the Netherlands (56 percent) were owner-occupied, 42 percent were rented, and for the remaining 2 percent, the ownership status was 'not stated'. Across Europe, too, most conventional dwellings were owner-occupied (on average 62 percent). In Hungary and Romania even more than 90 percent of homes were owner-occupied. On average, 29 percent of occupied conventional dwellings in Europe were rented. The rental sector was most common in Switzerland, Germany and Liechtenstein. Switzerland and Germany even had higher percentages of rented than owner-occupied dwellings. Another, less common, type of ownership is cooperative ownership[7)] (on average 2 percent in EU and EFTA-countries). This type of ownership does not exist in the Netherlands, but in Sweden 21 percent of occupied conventional dwellings were cooperatively owned; in Norway this was 14 percent. Malta and Italy had relatively high percentages of other types of ownership (20 and 39 percent respectively), but these types are not specified in the census data. Figure 3.4.2 shows the percentages of owner-occupied and rented conventional dwellings for all EU and EFTA countries in the Census Hub.

7) Cooperative ownership refers to ownership within the framework of a housing cooperative (European Commission, 2009).

3.4.2 Owner-occupied en rented conventional dwellings in EU and EFTA countries, 2011[1)]



Source: Census Hub.

1) Percentages do not add up to 100%; other categories of 'type of ownership' are 'dwellings in cooperative ownership', 'dwellings in other types of ownership', and 'not stated'. The number of rented conventional dwellings in Ireland was not available in the Census Hub on 1 September 2014 and no data were available for Croatia and Finland.

3.5 Conclusions

Resulting in a wide range of information about a country's population, its households and its housing, censuses provide important input for policymaking and monitoring. For the 2011 EU Census Round, a number of regulations (European Commission, 2008 and 2009) have harmonised definitions, variables and categories for the data to be delivered to Eurostat from Population and Housing Censuses in EU and EFTA countries. As all the data are now also available from a central system (the Census Hub) they can be easily compared and placed in an international context.

In this chapter, a number of key results of the Dutch Census 2011 are compared with those from other European countries. This comparison shows that men in the Netherlands outnumber women up to older ages than in the Baltic states, for example, and that employment rates are relatively higher in the Netherlands than in most other countries in Europe. The share of one-person households in the Netherlands is also relatively high. The share of owner-occupied dwellings, on the other hand, is lower than overall in Europe. These are just some of the interesting results emerging from the 2011 Census. Through the Census Hub, a wealth of information becomes available about persons, households and housing in 32 European countries. Although census methods differ between the countries, the census results are comparable and the Census Hub makes it easy to place them alongside each other.

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4.

European foreigners in the Netherlands and Dutch foreigners in Europe

Authors
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Some 1.9 million people living in the Netherlands on 1 January 2011 were born elsewhere. Most of them were born outside Europe, but nearly half a million were born in another European country. On the other hand, close to half a million people born in the Netherlands were living elsewhere in Europe, mostly in Belgium and Germany. While migration flows from outside Europe have a longer history, some of them going back to the period immediately after the Second World War, migration flows from within Europe (especially from central and east European countries) are much more recent and more dynamic: after the Germans, Polish migrants are now the second largest group of Europeans in the Netherlands.

4.1 Introduction

This chapter focuses on the origin and destination of European Union (EU) and European Free Trade Association (EFTA) citizens in the Netherlands on the one hand, and Dutch-born people living in other EU/EFTA countries on the other. Section 4.2 describes the legal framework of free movement of people within Europe and labour market options and restrictions. Section 4.3 gives a brief overview of Dutch immigration since the Second World War, distinguishing between immigration of EU and non-EU citizens. Section 4.4 focuses on citizens from other EU/EFTA countries living in the Netherlands, whereas section 4.5 shows the opposite: Dutch-born people living in other EU/EFTA countries. Section 4.6 comprises some conclusions on origin and destination of European migrants.

The data in this chapter are provisional. Eurostat may revise the data and tables published in the Census Hub in accordance with the latest information it receives from the countries concerned. The data in this chapter were extracted from the Census Hub on 1 September 2014.[1)]

[1)] Because of confidentiality regulations, the data for the Netherlands in this chapter are not derived from the Census Hub but from national sources. The data for the Netherlands cannot be reproduced via the Census Hub.

4.2 European Union and European Free Trade Association

Since Croatia joined on 1 July 2013, the European Union (EU) consists of 28 countries.[2] Other countries are knocking on the EU's door, indeed some have been for quite a long time: Iceland, Montenegro, Serbia, the former Yugoslav Republic of Macedonia and Turkey. Alongside the EU, Iceland, Liechtenstein, Norway and Switzerland make up the European Free Trade Association (EFTA). These four countries also participated in the 2011 Census Round.

Several EU treaties have addressed migration and asylum policy in the region. The *Treaty of Amsterdam* for instance, which came into force on 1 May 1999, placed a greater emphasis on citizenship and the rights of individuals, a communal area of freedom, security and justice, and the beginnings of a common foreign and security policy. It also meant that more and more decisions, for instance in the field of migration and asylum, could be taken at supranational level. The *Treaty of Lisbon*, in effect since 1 December 2009, was intended to complete the process started by the Treaty of Amsterdam. It introduced a High Representative of the Union for Foreign Affairs and Security Policy.

The formation and expansion of the EU and the institution of the *Schengen Agreement* have made it easier and easier for EU citizens to move around within the Union, as border controls and visa requirements have been removed (open borders). Free movement of persons (labour) is one of the four economic freedoms applying to all EU citizens, the others being free movement of goods, capital and services. For most Europeans, free movement of labour is the most practical benefit of the EU: it allows EU citizens to live and work in other member states. An important step towards free movement of persons in general, and workers in particular, was taken in the Schengen Agreement. This Agreement, named after the small Luxembourg town in which it was concluded, was established in 1985. Its main purpose was to abolish internal border controls and visa requirements, making it easier to travel between the member countries, while at the same time maintaining and strengthening external border controls. The Schengen Agreement (1985) and the Schengen Convention (1990) were eventually fully implemented

[2] Austria (joined the EU in 1995), Belgium (1958), Bulgaria (2007), Croatia (2013), Cyprus (2004), Czech Republic (2004), Denmark (1973), Estonia (2004), Finland (1995), France (1958), Germany (1958), Greece (1981), Hungary (2004), Ireland (1973), Italy (1958), Latvia (2004), Lithuania (2004), Luxembourg (1958), Malta (2004), the Netherlands (1958), Poland (2004), Portugal (1986), Romania (2007), Slovakia (2004), Slovenia (2004), Spain (1986), Sweden (1995) and the United Kingdom (1973).

in 1995. The Convention created a common area of free travel that since its implementation has been known as the *Schengen Area*. Together, the agreements and associated regulation concerning Schengen are also known as the *Schengen Acquis*, which forms a fundamental part of the European legislation concerning the European internal market. Since the agreements were implemented, in 1995, the number of member states has increased. The Schengen Acquis has been accepted by all EU member states except Bulgaria, Croatia, Cyprus, Ireland, Romania and the United Kingdom. On the other hand, all members of the EFTA region are members of the Schengen Area, which thus now consists of 26 countries.

Although the agreement established free movement of persons, some ratifying countries introduced restrictions with respect to labour immigration. In the Netherlands, until 1 May 2007 immigrants from countries that joined the EU in 2004 required a working permit to work here. Or more precisely: employers had to have a working permit to employ them. Bulgarians and Romanians have only been allowed to work in the Netherlands without a permit since 1 January 2014. Immigrants from Croatia require a working permit until 1 July 2020 at the latest, seven years after their entry into the EU.

4.3 Dutch migration

As a result of the free movement of persons within the EU/EFTA region, migration from other EU countries to the Netherlands has increased substantially. In 2003, one year before ten central and east European countries joined the EU, migration from other EU/EFTA countries to the Netherlands accounted for slightly more than 25 percent of the total inflow of foreign-born people. By 2007, this share had risen to just over 45 percent, and since 2011 more than half of foreign-born immigrants come from other EU and EFTA countries.[3)]

Migration flows are reflected in the number of immigrants living in the Netherlands.[4)] Tables 4.3.1 and 4.3.2 show the number of immigrants from non-EU/EFTA and EU/EFTA countries living in the Netherlands on 1 January 2011. About 11 percent of the total population in the Netherlands (nearly 1.9 million people)

[3)] Statistics Netherlands, StatLine (External migration).
[4)] In this chapter descent or origin is defined slightly differently from the usual definitions used by Statistics Netherlands. Normally, in the Netherlands descent is defined by parents' country of birth. The census data provide information on the person's own country of birth.

were born abroad. The majority of them (1.4 million) were born in non-EU/EFTA countries, while almost 0.5 million were born in one of the other EU/EFTA countries.

Table 4.3.1 shows that a large majority of immigrants from non-EU/EFTA countries have quite a long migration history. Almost three-quarters stayed in the Netherlands for more than 10 years, and nearly half for longer than 20 years. This share is close to 90 percent for immigrants from the former Dutch colonies (Indonesia and Suriname), most of whom have been living in the Netherlands for more than 20 years. Immigration from Indonesia rose sharply after the Second World War, peaking to almost 70 thousand in 1946, shortly after Japanese occupation had come to an end. After the transfer of sovereignty, relatively large numbers of migrants left for the Netherlands in 1950 and 1951 (56 thousand and 44 thousand respectively). Suriname was granted independence in 1975, resulting in a remarkable peak in immigration to the Netherlands: some 40 thousand Surinamese people came to live in the Netherlands in that year. A second wave arrived in 1979 and 1980, the last years in which Surinamese people could automatically obtain Dutch nationality. In the first decade of the present millennium, immigration from Indonesia and Suriname has been stable at a level of 1 thousand (Indonesia) to 2 thousand (Suriname) persons yearly.

4.3.1 Top 10 immigrant groups from non-EU/EFTA countries by duration of stay, 2011

		Duration of stay in the Netherlands			
Country of birth	**Total**	less than 5 yrs	5–9 yrs	10–19 yrs	20 yrs or longer
	x 1,000	**%**			
Turkey	197.4	8.5	9.8	21.9	59.8
Suriname	186.2	7.6	7.6	17.7	67.1
Morocco	167.7	7.1	10.6	23.1	59.1
Indonesia	137.8	3.8	3.5	6.6	86.1
Netherlands Antilles	74.4	19.1	13.8	31.5	35.6
China	54.9	30.3	18.4	20.9	30.4
Iraq	41.0	27.2	12.8	57.0	2.9
Afghanistan	31.8	13.2	17.2	67.8	1.7
Iran	26.2	18.1	12.4	49.7	19.9
Bosnia and Herzegovina	25.5	5.2	5.9	76.2	12.7
Total	1,400.5	15.9	12.2	26.2	45.7

Source: Statistics Netherlands.

In addition to these colonially driven migration flows, many labour migrants arrived in the Netherlands from Mediterranean countries in the 1960s, especially

from Turkey and Morocco. Later, in the 1970s and 1980s, relatives of these labour migrants came to join them. Many of these so-called 'guest workers' and their families still live in the Netherlands, as is reflected in the high percentages of these groups who have lived in the Netherlands for more than 20 years. More recently, relatively large shares (some 30 percent) of Chinese and Iraqi immigrants have been in the Netherlands for less than five years. Many of these immigrants came to the Netherlands as students or asylum seekers.

For EU/EFTA immigrants, the picture is totally different. As table 4.3.2 shows, migration within the EU is much more dynamic. One in three EU/EFTA immigrants had been living in the Netherlands for less than five years, compared with one in six non-EU/EFTA immigrants. A clear distinction can be made between the 'old' western EU countries (e.g. Belgium, Germany and the United Kingdom) and the 'new' central and east European countries Bulgaria, Poland and Romania. Many immigrants from the latter region came to the Netherlands soon after their countries joined the EU in 2004 (Poland) and 2007 (Bulgaria and Romania).

4.3.2 Top 10 immigrant groups from EU/EFTA countries by duration of stay, 2011

		Duration of stay in the Netherlands			
Country of birth	**Total**	less than 5 yrs	5–9 yrs	10–19 yrs	20 yrs or longer
	x 1,000	**%**			
Germany	122.3	20.9	9.8	17.0	52.3
Poland	66.6	60.3	19.0	11.2	9.6
Belgium	50.0	17.5	13.0	18.7	50.8
United Kingdom	47.2	25.3	14.7	21.6	38.4
France	23.4	33.1	14.1	19.5	33.3
Italy	20.8	30.2	12.0	15.8	42.0
Spain	20.4	30.1	12.0	14.0	44.0
Bulgaria	15.0	82.0	8.1	6.8	3.2
Portugal	14.7	34.8	15.6	16.3	33.3
Romania	12.3	53.9	15.4	18.6	12.2
Total	468.1	33.6	13.2	16.8	36.3

Source: Statistics Netherlands.

The development in Polish immigration to the Netherlands is interesting and quite remarkable. Before Poland joined the EU, the majority of immigrants from this country to the Netherlands consisted of so-called 'Polish brides': women looking for a man, often a native Dutch man, to marry or cohabit with. After the accession of Poland to the EU in May 2004, Polish immigration to the Netherlands changed from predominantly women seeking a partner to men seeking work. Although

it would be three more years before Polish migrants were completely free to work in the Netherlands (1 May 2007), more and more men came to the Netherlands to find a job: male immigrants have dominated Polish migration flows to the Netherlands since 2004. More than six years after Poland joined the EU, immigration from this country to the Netherlands was still rising. Despite the relatively prosperous economy in Poland, migrants from this country still benefit from leaving home and working elsewhere in Europe; not only in the Netherlands but even more often in Germany (with 2.7 million Polish immigrants) and the United Kingdom (0.7 million), according to their 2011 Census data. Many of these newly arrived immigrants, not only those from Poland but from Bulgaria and Romania as well, have already returned or plan to return home. Nicolaas (2011) found that more than half of Polish immigrants who came to the Netherlands between 2000 and 2009 had returned to Poland by the end of 2009.

The 2011 Census allows us to present a uniform and standardised picture of the migration dynamics for the 32 countries involved. The following two sections highlight migration flows from EU/EFTA countries to the Netherlands and vice versa.

4.4 People from EU/EFTA countries in the Netherlands

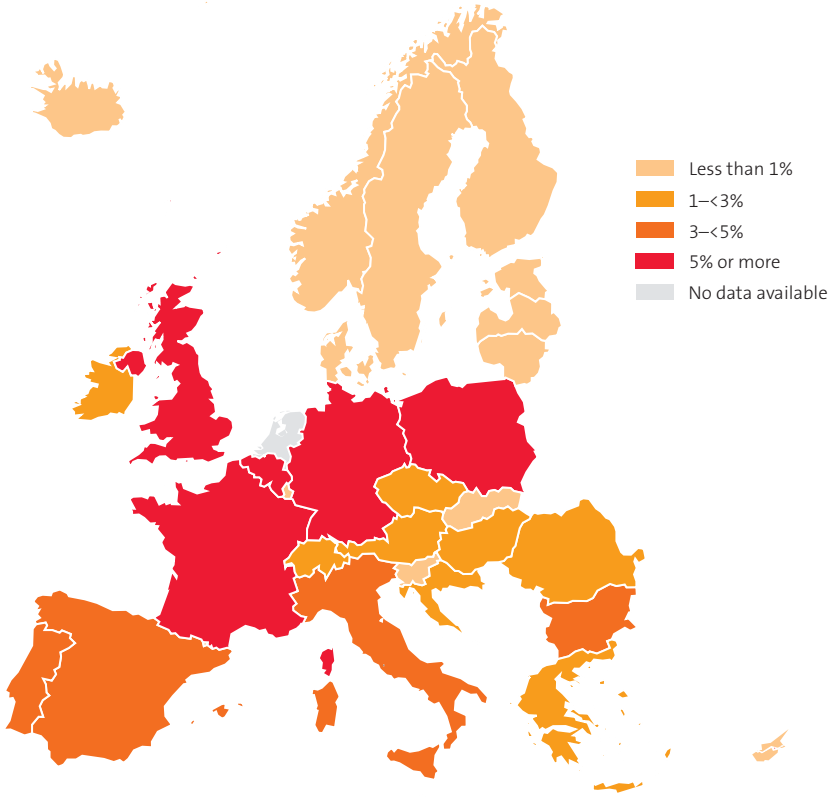
On 1 January 2011, almost half a million people living in the Netherlands were born in another EU/EFTA country; as expected, many of them in neighbouring countries Germany (26 percent) and Belgium (11 percent). A substantial share of these German and Belgian migrants are labour migrants who live in the Netherlands (close to the German and Belgian border) but work in Germany or Belgium.

26% of Europeans living in the Netherlands are German

Despite their rather short migration history, Polish immigrants are the second largest group in the Netherlands. With 14 percent their share is even larger than that of Belgians. Figure 4.4.1 shows the shares of the countries of birth of EU/EFTA-born people in the Netherlands.

Sex and age distributions differ considerably between European immigrant groups. While 65 percent of Italian-born people living in the Netherlands are male, this is the case for only 30 percent of people from Finland. Women also account for large percentages of east Europeans in the Netherlands, such as immigrants from Latvia, Romania, Czech Republic, Lithuania and Estonia.

4.4.1 Country of origin of EU/EFTA born people in the Netherlands, 2011[1)]

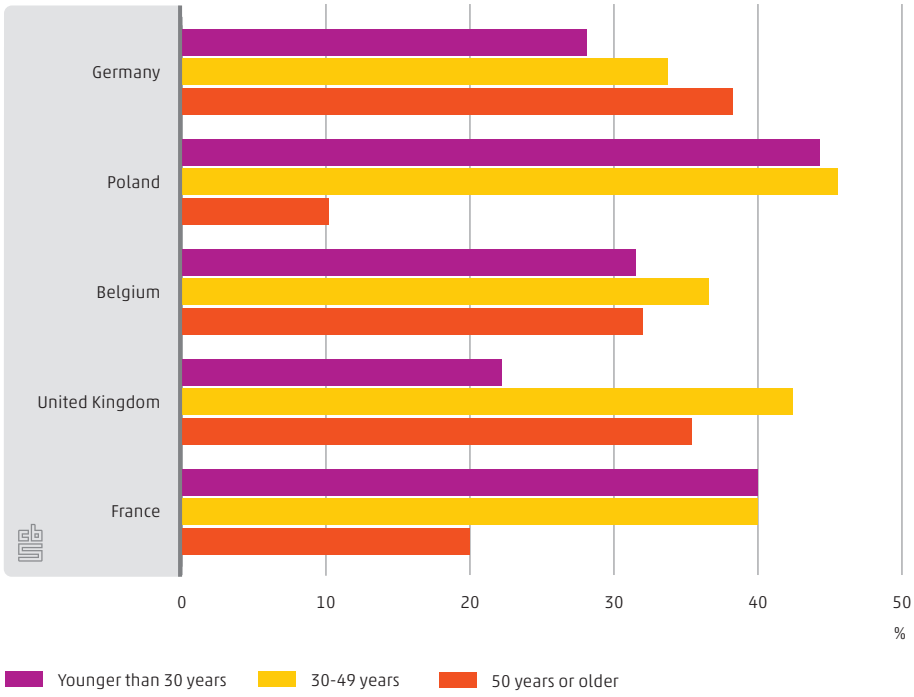


[1)] Percentage of total number of people born in EU/EFTA countries.

Figure 4.4.2 shows the age distribution of males born in the five European countries with the largest immigrant groups in the Netherlands. People born in

Germany are relatively older than people born in the other countries. The Polish, in particular, show the opposite of the Germans: only 10 percent of them are older than 50 years. As described above, many people from Poland came to the Netherlands to work when Poland joined the EU in 2004, but before that many Polish women came to the Netherland in search of a husband. As a result the sex balance of Polish-born people in the Netherlands is fairly even. Moreover both Polish groups are relatively young.

4.4.2 Male immigrants in the Netherlands born in some EU/EFTA countries by age, 2011

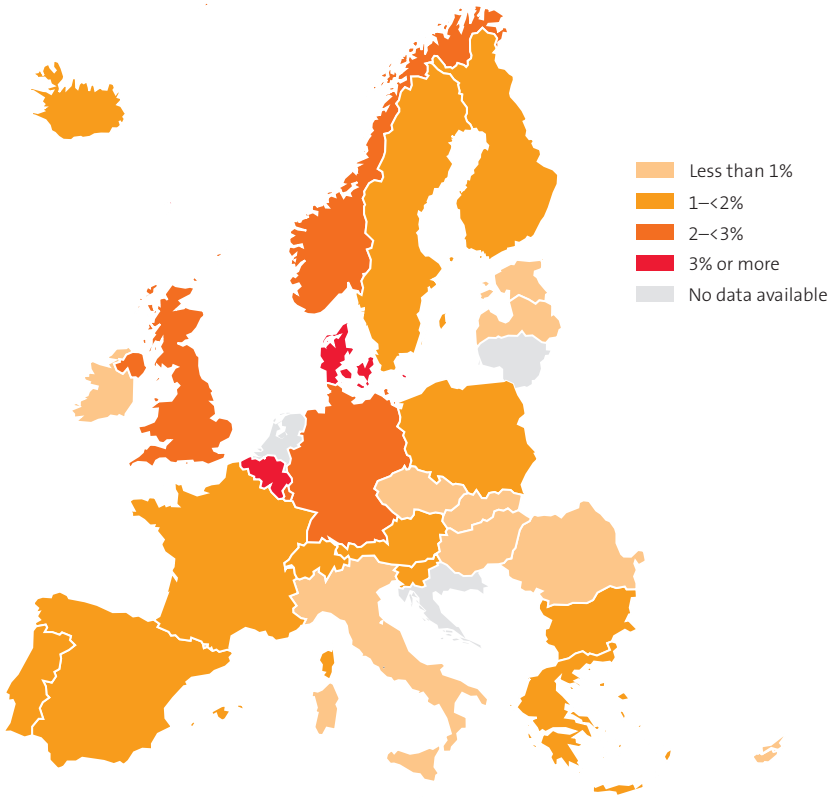


4.5 Dutch people in EU/EFTA countries

On 1 January 2011, about 470 thousand Dutch-born people were living in one of the other EU/EFTA countries. The largest Dutch communities can be found in neighbouring countries Belgium (126 thousand) and Germany (112 thousand). In relative terms, the largest share of Dutch-born people lives in Belgium: over 16 percent of the non-Belgian EU/EFTA population in this country are of Dutch

descent. Denmark has the second largest share of Dutch-born people: nearly 4 percent of the EU/EFTA population in Denmark were born in the Netherlands. Although some 40 thousand Dutch-born people leave the Netherlands every year, the Dutch diaspora in the EU/EFTA is quite modest. One of the reasons for this is that over half of these Dutch emigrants return to the Netherlands sooner or later (Nicolaas, 2004). Figure 4.5.1 shows the shares of Dutch-born people living in other EU/EFTA countries.

4.5.1 Dutch-born people living in EU/EFTA countries, 2011[1)]



Source: Census Hub.

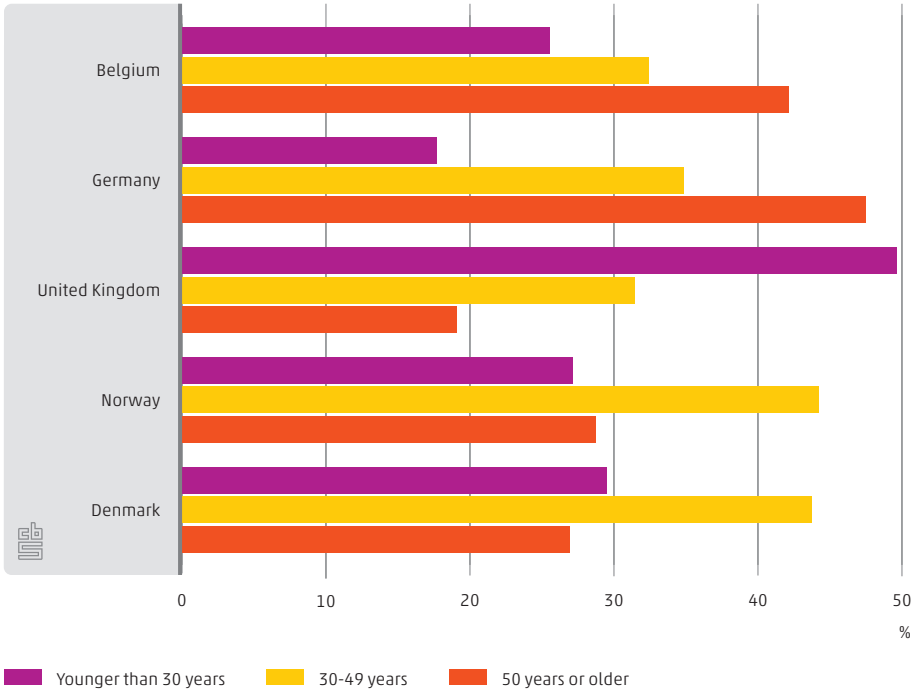
[1)] Percentage of total EU/EFTA immigrants; Data from Croatia, Liechtenstein and Lithuania were not available for age 15–74 in the Census Hub on 1 September 2014.

Overall, a very slight majority (50.1 percent) of the 470 thousand Dutch-born people living in other EU/EFTA countries are female, varying from 20 and 25 percent in Estonia and Latvia to almost 65 percent in Greece and Italy. In neighbouring countries Belgium and Germany, 50.4 and 48.7 percent respectively of Dutch-born

people are female. In terms of age, one quarter of Dutch-born people living in EU/EFTA countries are younger than 30 years, one third are between 30 and 50 years of age, and some 40 percent are 50 years or older.

However, the age distributions of the Dutch differ considerably between the EU/EFTA countries. Figure 4.5.2 shows the age distribution of Dutch-born males in the five countries with the highest numbers of Dutch-born people. Neighbours Belgium and Germany more or less resemble the overall EU/EFTA-pattern, Denmark and Norway show relatively high shares of 30–49 year olds, while in the United Kingdom, almost half of Dutch-born males are children and young adults (many of them students), twice as many as the percentage for the EU/EFTA. The female age distribution is very similar, although with a larger percentage in the group aged 50 years or older, and a smaller percentage in the 30–49 years group.

4.5.2 Dutch-born males in some EU/EFTA countries by age, 2011



4.6 Conclusions

For centuries now, the Netherlands has been a country of migrants. As globalisation has reduced perceived distances between countries, and EU treaties have eliminated political borders, migration flows have changed through the years. As a result, nearly 1.9 million people in the Netherlands – 11 percent of the population on 1 January 2011 – were born elsewhere. Some 1.4 million of them were born outside the EU/EFTA region and have generally lived in the Netherlands for a long time. The half a million people born in other EU and EFTA countries, however, show a more dynamic pattern. They move around Europe, but tend to stay in a certain country for shorter periods. People born in Germany, Belgium and the United Kingdom are traditionally well represented in the Netherlands, but more recently the Polish have become the second largest group of European immigrants. Compared with other immigrant groups, the Polish are relatively young.

Dutch-born migrants are also more dynamic. Almost half a million people born in the Netherlands live in other EU or EFTA countries, especially in Belgium and Denmark they represent a high percentage of all people born in other EU or EFTA countries. With on-going globalisation, the growing size and influence of the European Union and an increasing demand for international trade treaties, mobility between countries is expected to increase in the near future. As migration will then become even more dynamic and less permanent, it will be very important to monitor migration flows. The 2011 Census provides a standardised instrument to compare migration between the EU and EFTA countries. This valuable instrument gives the opportunity to monitor and compare these flows now and in the future.

References

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Nicolaas, H. (2011). More than half of the Polish immigrants return home. *Bevolkingstrends*, 2011-1, pp. 32–36. [in Dutch]

5.

The Caribbean Netherlands compared with the Frisian Islands

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Following the dissolution of the Netherlands Antilles, the islands Bonaire, St Eustatius and Saba have had the status of special municipalities of the Netherlands since 10 October 2010. Although these Caribbean islands are classified as overseas countries and territories of the European Union (EU), they do not constitute part of EU territory. This is one of the reasons why the islands were not included in the 2011 EU Census Round. To find out how the population characteristics of the three islands of the Caribbean Netherlands compare with those from the 'European' Netherlands, this chapter compares some key figures for the islands with results from the Dutch Census 2011. The Frisian Islands (in the North Sea to the north of mainland Netherlands) were chosen as reference regions, because of similarities in both geographical characteristics and population size.

5.1 Introduction

The three islands making up the Caribbean Netherlands – Bonaire, St Eustatius and Saba – are located in the Caribbean, more than seven thousand kilometres away from the 'European' Netherlands (referred to further below as the Netherlands). St Eustatius and Saba are located close to each other, but at quite a distance from Bonaire (about 800 kilometres; see also figure 1.1.1 in Chapter 1). The islands are all small in terms of both area and population: Bonaire is the largest with 290 km^2 and 16 thousand inhabitants (Statistics Netherlands, 2013). Because the islands are so small, figures on the Caribbean Netherlands may easily be subject to disproportionate scale effects. For example, the establishment of a school of medicine on Saba with around 400 students has had an enormous impact on the demographic structure and economic activity on the island.

13 km^2 Saba is the smallest island of the Caribbean Netherlands

To place the Caribbean Netherlands in a regional perspective with the Netherlands, Dutch municipalities were selected with geographical characteristics and

population sizes similar to those of the Caribbean islands. These are the Dutch Frisian or Wadden Sea Islands, which – apart from being islands – have in common with the Caribbean Netherlands that tourism is an important branch of economic activity. The largest Frisian Island, Texel, can be compared with Bonaire; two smaller islands – Terschelling and Ameland – are good references for St Eustatius; and lastly, the smallest islands Vlieland and Schiermonnikoog were selected for comparison with Saba (see table 5.1.1). Totals for the Netherlands (NL) used for reference purposes do not include the population in the Caribbean Netherlands.

5.1.1 Geographical characteristics and population size of the Caribbean Netherlands and the Frisian Islands, 2011

	Population	Area
	inhabitants	km²
Caribbean Netherlands		
Bonaire	15,823	288
St Eustatius	3,689	21
Saba	1,833	13
Frisian Islands		
Texel	13,728	163
Terschelling	4,721	87
Ameland	3,503	59
Vlieland	1,151	37
Schiermonnikoog	957	44

Source: Statistics Netherlands.

As no census data are available for the Caribbean Netherlands, the data are taken from the population register and from the 2012 Labour Force Survey conducted on the islands.[1)] The results for the Frisian Islands are from the 2011 Census.

The following three sections examine demographic aspects of the islands. Section 5.2 describes the population structure in terms of sex and age group. Section 5.3 examines country of birth and nationality, and section 5.4 goes into marital statuses within the population. Section 5.5 focuses on socio-economic aspects, such as employment status and branches of economic activity in which people work. Section 5.6 completes the chapter with some concluding remarks.

1) The sources of the data on the Caribbean Netherlands do not necessarily comply with the European Census regulations. There are slight differences in some definitions used for comparisons with reference groups in the Netherlands.

5.2 Population by sex and age

There are fewer women than men in all age groups in the Caribbean Netherlands, except for the over-65s on Saba (see table 5.2.1). In the Netherlands, women outnumber men in older age groups (see table 2.2.1 in chapter 2). The effect of women surviving their male peers is an overall sex ratio (i.e. number of males divided by number of females) of lower than 1 in all reference regions except the island of Terschelling.

5.2.1 Female population in the Caribbean Netherlands and the Frisian Islands by age, 2011

	Total	0–14 yrs	15–64 yrs	65 yrs or older
	% per age group			
Caribbean Netherlands				
Bonaire	46.9	48.1	46.2	49.8
St Eustatius	45.7	48.2	44.8	47.8
Saba	47.2	48.7	46.3	51.8
Frisian Islands				
Texel	50.4	51.0	49.6	52.9
Terschelling	47.3	47.7	45.3	54.2
Ameland	50.0	51.3	48.8	53.2
Vlieland	50.0	49.5	48.7	55.3
Schiermonnikoog	50.8	46.9	49.1	58.1
Netherlands	50.5	48.8	49.7	56.0

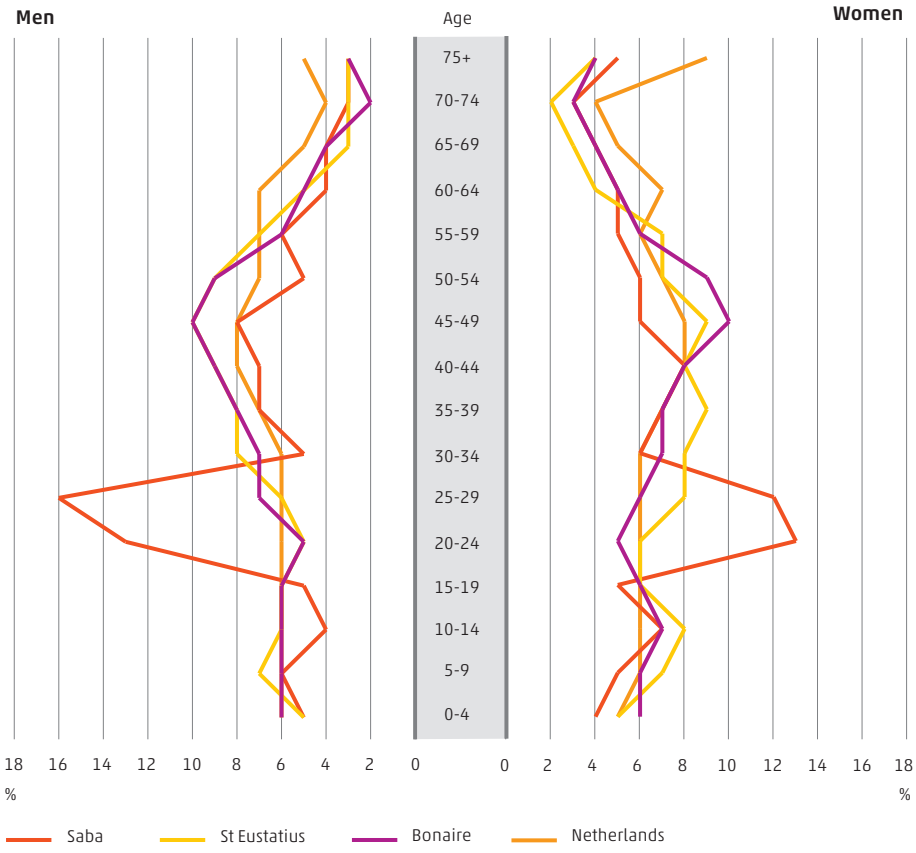
Source: Statistics Netherlands.

Figure 5.2.2 shows a standardised graph of the populations of the islands of the Caribbean Netherlands and the Netherlands as a reference. The male and female populations on Bonaire, St Eustatius and Saba show younger age structures. Several factors contribute to this: the slightly higher birth rate in the Caribbean Netherlands (Statistics Netherlands, 2010), and the influx of young and middle-aged workers in construction, hotels and restaurants, health care and other sectors on the islands.

For the youngest age groups – up to 14 years – the pattern in figure 5.2.2 is somewhat diffuse. The middle ages – roughly 15–50 years – generally show higher percentages for the Caribbean Netherlands. For Saba the graph shows an unusual bulge for age groups 20–24 and 25–29 years, slightly larger for men than for women. The main reason for this bulge is the presence of about 400 bachelor students from the United States and Canada doing a follow-up programme at Saba

University School of Medicine. This group of students has a tremendous impact on the demography of this small island.[2)] The process of population ageing is clearly slower on the islands of the Caribbean Netherlands than in the Netherlands. For all groups over 60 years proportions of both men and women are smaller in the Caribbean than in the Netherlands. One reason for this could be that the post-war baby boom hardly affected the Caribbean region.

5.2.2 Population of the Caribbean Netherlands and the Netherlands by age and sex, 2011



Source: Census Hub.

[2)] The figures may be slightly upwardly biased because of delayed withdrawal from the population register of North American students returning to their native country.

5.3 Country of birth and nationality

A remarkably large percentage of people in the Caribbean Netherlands were not born there[3]: society on these islands with people from many different countries can be considered as a veritable melting pot. Figure 5.3.1 shows that the shares of foreign-born people on Bonaire, St Eustatius and Saba are exceptionally high compared with the Frisian Islands and the Netherlands as a whole. There are fewer people with a foreign background on the Frisian Islands than on average in the Netherlands, and certainly fewer than on the three islands in the Caribbean. On St Eustatius, more than half of the population were born in another country.

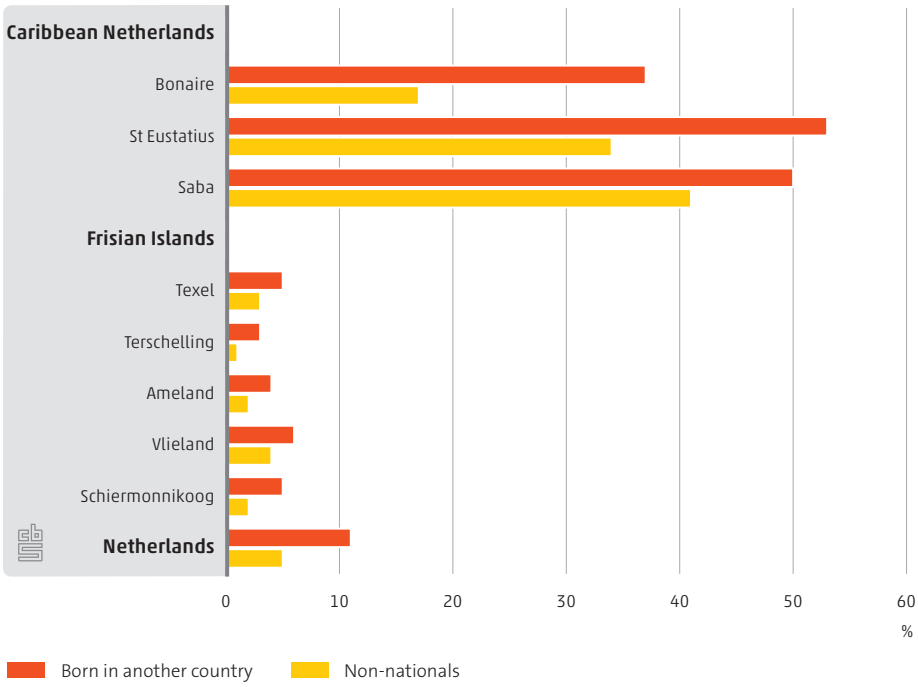
53% of the population of St Eustatius have their roots elsewhere

In terms of nationality, the picture is different. The number of people with the nationality of the country where they live very often outnumbers the number of people who were actually born there. Percentages of non-nationals[4] in the Caribbean Netherlands are in double digits, while the average in the Netherlands is less than 5 percent. On Saba these percentages are mainly pushed up by the presence of the medical school with foreign students and staff.

[3] Before 10 October 2010, Bonaire, St Eustatius and Saba were part of the Netherlands Antilles. As no figures are available on country of birth for the separate islands, foreign-born people on the three islands are defined as being born outside the borders of the former Netherlands Antilles (including Aruba). For example, if someone on Saba was born on Aruba, Curaçao, St Maarten, Bonaire or St Eustatius, he or she is not considered to be foreign-born.

[4] Note that Bonaire, St Eustatius and Saba do not have their own nationalities. Most locals on these Caribbean islands and on Aruba, Curaçao and St Maarten have Dutch nationality. A non-national is therefore someone with a non-Dutch nationality.

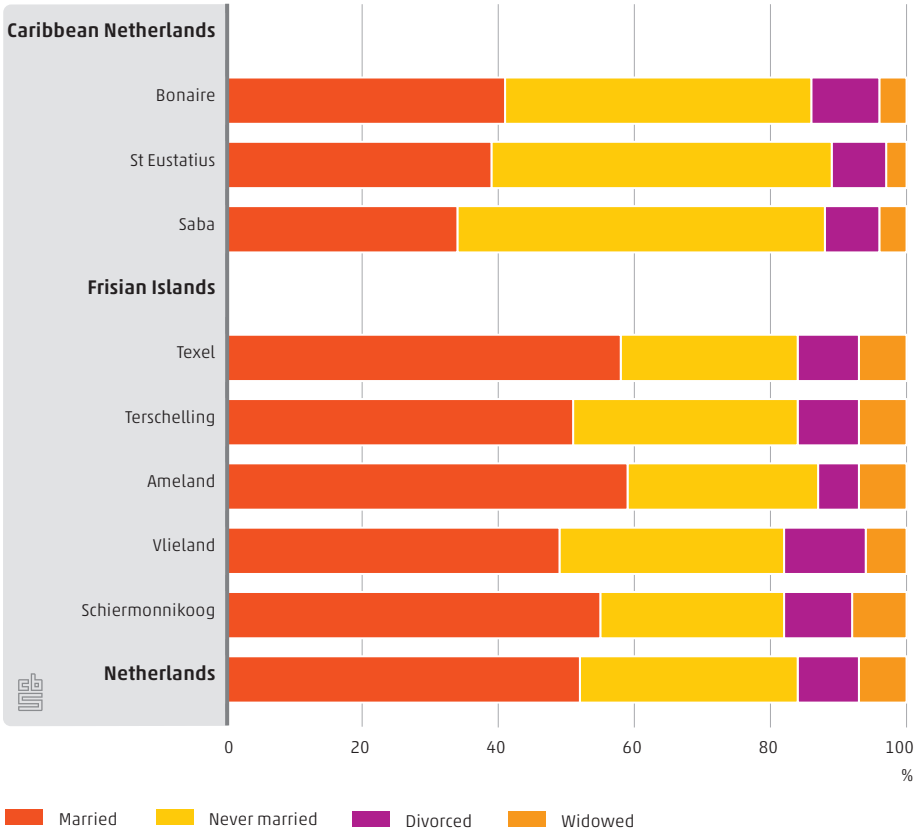
5.3.1 Foreign-born people and non-nationals in the Caribbean Netherlands and the Frisian Islands, 2011



5.4 Marital status

Figure 5.4.1 shows the marital status of the population aged 18 years and older in the Caribbean Netherlands compared with the Frisian Islands. In the Netherlands, partners in a relationship can choose between three legal living arrangements: they can marry, enter into a registered partnership, or sign a cohabitation agreement. Of course, they can also choose to live together without a formal agreement. In figure 5.4.1 the first two options are included in the category 'married', the last two in 'never married'; people who terminate their marriage or registered partnership are all included in the category 'divorced'. Just over half of over-18s in the Netherlands are married (51 percent) or in a registered partnership (1 percent). The number of registered partnerships in the Caribbean Netherlands is negligible, as this is not yet an official option on the islands.

5.4.1 Marital status of the population (18 years and older) of the Caribbean Netherlands and the Frisian Islands, 2011[1)]



1) Persons with a registered partnership are included in the category 'married'.

Relatively fewer people in the Caribbean Netherlands than on the Frisian Islands are married. Among other things this is an effect of the younger age structure of the population and the higher incidence of single motherhood in this region (Distelbrink and Hooghiemstra, 2006). The share of married persons is highest on Bonaire and lowest on Saba. The latter is probably related to the fact that this island is home to relatively many people in the age group 20–29 years attending Saba University School of Medicine. There is not much difference between the Caribbean Netherlands and the Frisian Islands in the percentages of persons who have terminated their marriage (or registered partnership), although Ameland has a quite a low divorce rate. The smaller shares of widows and widowers on the Caribbean islands are again the effect of the younger populations there.

5.5 Employment

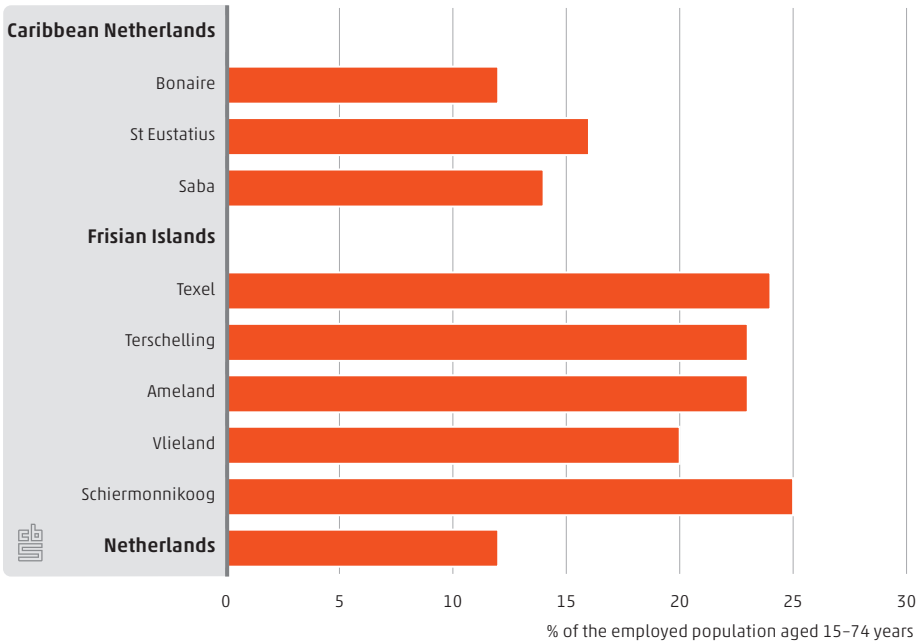
Data from the 2012 Labour Force Survey (LFS) on the Caribbean Netherlands are a good basis to compare employment in this region with that on the Frisian Islands, although they refer to the year after the census year. The Dutch census data on the employed population are taken from registers with complete coverage, while the LFS for the Caribbean Netherlands is a sample survey. The latter presents employed persons in terms of 'net labour participation' in accordance with international standards; this includes all paid work of at least one hour a week and therefore is more or less identical to the definition of employment in the Dutch Census 2011.

Employment rates for the age group 15–74 years on Bonaire (69 percent) and St Eustatius (70 percent) are higher than on average in the Netherlands (65 percent), and comparable or slightly higher than on the Frisian Islands (64–71 percent). Saba (63 percent) is an exception to this; probably mainly because of the students at the school of medicine, who account for roughly one quarter of the population aged 15–74 years there. The employed population is analysed for two aspects: self-employment and economic activity.

Self-employed people

In the Caribbean Netherlands the share of the employed population aged 15–74 years that is self-employed is a few percentage points higher than on average in the Netherlands (see figure 5.5.1). It is highest on St Eustatius, followed by Saba, while Bonaire has a share similar to that in the Netherlands. On all the Frisian Islands, proportions of self-employed are much larger. These differences are related to the substantial tourism sector: relatively more people run a hotel or restaurant compared with other regions of the Netherlands.

5.5.1 Self-employed people aged 15-74 years in the Caribbean Netherlands and the Frisian Islands, 2011[1)]



[1)] Data of the Caribbean Netherlands concern 2012.

Branch of economic activity

It is interesting to compare the branches of economic activity of the employed population in the Caribbean Netherlands with those on the Frisian Islands (NACE classification), as both areas are known as tourist regions. 'Accommodation and food service activities' is certainly an important branch of economic activity on the Caribbean islands, but the branch does not provide as many jobs there as on the Frisian Islands (see table 5.5.2). The accommodation and food services industry accounts for most employed people on the Frisian Islands, while this is not the case in the Caribbean Netherlands.

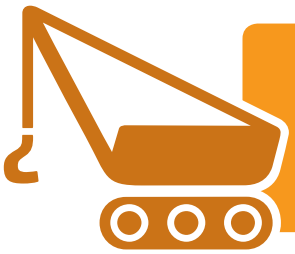
5.5.2 Some important branches of economic activity in the Caribbean Netherlands and the Frisian Islands, 2011[1)]

	Accommodation and food service activities	Public administration and defence; compulsory social security	Construction	Transportation and storage	Professional, scientific, technical, administrative and support service activities	Education	Manufacturing, mining and quarrying, and other industry
	% of the employed population aged 15–74 yrs						
Caribbean Netherlands							
Bonaire	10.8	10.5	15.4	5.9	7.5	4.2	6.1
St Eustatius	7.0	13.0	12.5	22.1	4.6	9.1	4.8
Saba	9.4	15.3	10.8	2.8	6.2	15.5	3.5
Frisian Islands							
Texel	15.0	6.4	6.0	4.4	12.3	3.3	7.6
Terschelling	22.1	8.9	8.0	8.8	10.3	3.7	3.4
Ameland	25.7	9.1	9.2	7.0	8.5	2.5	4.4
Vlieland	29.8	12.3	5.3	10.1	11.7	1.0	2.7
Schiermonnikoog	28.5	9.1	4.2	6.0	14.1	3.5	1.5
Netherlands	4.0	6.1	5.6	4.6	15.3	6.2	10.1

Source: Statistics Netherlands.

[1)] Data of the Caribbean Netherlands concern 2012. Percentages do not add up to 100 percent.

The government is quite an important employer for the workforce in the Caribbean Netherlands and to a lesser extent also for the Frisian Islands, judging from the category 'public administration and defence; compulsory social security'. These are mostly requisite services, and because of the small size and the isolated location of the islands there are fewer possibilities to gain from economies of scale. Compared with the Netherlands, relatively more people on Bonaire, St Eustatius and Saba work in the construction industry, mainly housing and office construction. A very large share of the employed population on St Eustatius works in 'transportation and storage', most of them for Statia Oil Terminals of the American company NuStar.



15% of employed persons on Bonaire work in construction

'Professional, scientific, technical, administrative and support services' is a minor branch of employment in the Caribbean Netherlands, but is quite substantial on the Frisian Islands. On Saba, a relatively large number of people are involved in teaching, roughly a quarter of them at Saba University School of Medicine. Employment in 'manufacturing, mining and quarrying, and other industry' is not substantial in the Caribbean Netherlands or on the Frisian Islands; it is larger for the Netherlands as a whole because of higher percentages in other parts of the country.

5.6 Conclusions

Although Bonaire, St Eustatius and Saba are officially three (special) municipalities of the Netherlands, they were not included in the Dutch Census 2011. The main reason for this was that they are not part of the European territory and therefore not covered by the Regulations concerning the EU 2011 Census Round. A more practical reason is that the statistical infrastructure on the islands is still very different from that in the Netherlands. It is not yet possible to conduct a census for the Netherlands including the Caribbean region on the basis of registers and sample surveys. However, the Dutch Ministry of the Interior and the local island authorities are carrying out a project to check and improve the quality of the local population registers. Once the quality of these registers is sufficient, the islands of the Caribbean Netherlands will become part of the Dutch population statistics and be included in future Dutch population and housing censuses.

To overcome these obstacles and compare the three islands of Caribbean Netherlands with the rest of the Netherlands, other data sources containing population characteristics were selected and set alongside data from the 2011 Census data for the five Frisian Islands. This comparison shows that the population in the Caribbean Netherlands differs from that on the Frisian Islands: they are younger and a much larger share was born outside the country. There are also substantial differences in sectors of employment between the two regions.
It would be good if the quality of the statistical sources in the Caribbean Netherlands can be improved in the near future, so that these islands can be included in the register-based Dutch Census 2021. This will increase comparability and the 2021 Census will present a picture of all municipalities in the Netherlands.

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Part 2.
Methodology

6.

Weighting Labour Force Survey sample data for the 2011 Census

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Tables in the Dutch 2011 Census on educational attainment and occupation contain estimated values. As information on education and occupation is not available in registers, it was obtained from Labour Force Survey sample data, from which population totals were estimated using census-specific weights and weighting techniques. This chapter sets out the two processes of selecting suitable sample survey data and of weighting these data so that they comply with the requirements of the 2011 Census.

6.1 Introduction

In the Dutch 2011 Census two variables were not available from registers. Information on educational attainment and occupation of the population aged 15 years and older was based on data from the Dutch Labour Force Survey (LFS). For individuals younger than 15 years this information was imputed as 'not applicable', in accordance with the EU Census Regulations (European Commission, 2009).

Before performing the estimation procedures for population totals, as described in chapter 7, several decisions had to be made about how to use the underlying LFS data and how to assign representative weights. Section 6.2 describes the selection of LFS data for the 2011 Census. After selection, a two-stage strategy was used to adjust the survey data to comply with the 2011 Census, i.e. weights were constructed to render the LFS data representative for the census population. The first stage of this strategy is outlined in section 6.3, the second in section 6.4. Section 6.5 completes the chapter with some conclusions.

6.2 Labour Force Survey data in the 2011 Census

The LFS is a continuous sample survey among residents of the Netherlands. The survey population does not include the institutional population, i.e. persons

living in homes and institutions such as prisons and homes for the elderly.[1)] The survey has a stratified two-stage design: municipalities are selected in the first stage, addresses in the second. It is designed as a rotating panel survey, comprising five waves of interviews per respondent. The first wave is a face-to-face interview in which respondents are asked to participate in four additional telephone interview waves every three months. If one address houses more than one household, a maximum of four households may be interviewed. In each household, a maximum of eight individuals are allowed to take part in the survey, irrespective of age. Every month, new addresses are approached for the first wave of interviews. The sample consists of about 170 thousand addresses per year. Usually, households at some 53 thousand addresses will respond (Statistics Netherlands, 2013).

Because of the limited number of LFS data per interview month, the response for one particular month cannot supply the required level of detailed occupation and education data for the 2011 Census. Therefore, responses of more than one survey month were combined. To obtain enough mass for the detailed census tables, three years of LFS data were used: interviews in the 18 months before and 18 months after 1 January 2011. This amounted to a total of 36 symmetrically placed interview months around the enumeration date, resulting in the combination of LFS responses from July 2009 to June 2012, irrespective of waves, as questions on education and occupation are asked in all five waves. The data thus assembled consisted of 1.2 million responses (for the exact number of responses, see table 6.2.1).

6.2.1 Population sizes in the LFS data selection process

	Units	Size
LFS data from 36 interview months	**responses**	1,230,467
LFS data limited to 1 response per person	**persons**	427,234
LFS data linked to Census population	**persons**	415,188
Census-LFS data after 15+ age selection	**persons**	331,968

Source: Statistics Netherlands.

The design of the LFS makes it possible for participants to respond more than once in the period of one calendar year. In effect, a person could respond up to five times in the course of the 36 selected interview months. One response had to be selected and because the census tables present a snapshot view of the population

[1)] The exclusion of the institutional population from the LFS means that no information about 'educational attainment' and 'occupation' of this subpopulation was available for the 2011 Census. Census tables with one or both of these variables therefore contain estimations based on available LFS data on the non-institutional population.

on 1 January 2011 (Census Day), the response with the shortest distance to that date was chosen. Having completed this procedure, the data comprised the response of 427 thousand persons (see table 6.2.1).

To produce the Census 2011 tables, the 427 thousand LFS responses with information on education and occupation were linked to register data from Statistics Netherlands' System of social statistical datasets (SSD). Micro-linkage took place through a combination of personal identifiers (sex, date of birth, postal code and house number). The central population register in the SSD formed the backbone of the 2011 Census and the LFS data provided characteristics on occupation and level of education. In the data selection process, first the LFS respondents who were included in the census population were determined, followed by the age selection (15 years and older).

As 12 thousand of the 427 thousand responses could not be linked to the population on 1 January 2011 (Census Day), the number of responses to be used for the 2011 Census was reduced to 415 thousand (see table 6.2.1). One of the reasons for this reduction is the survey's sample design: the LFS is a household survey and addresses are selected randomly. Every household member at every selected address is interviewed, by proxy if necessary. It is therefore conceivable that two or more respondents in the LFS turn out to be the same person in the SSD. Furthermore, the census describes the population of the Netherlands on a specific date, while the LFS population should be interpreted as a yearly average. Of the 415 thousand responses left, 83 thousand did not meet the age criterion of 15 years or older on Census Day.[2)] People younger than 15 years are considered not to have an occupation, and their level of education is also imputed as 'not applicable'. The LFS data that were used in the 2011 Census thus contain 332 thousand persons (see table 6.2.1).

Regular LFS data weights were not useable for calculating representative census population totals as the LFS data used here span a period of three years in four different calendar years, making it impossible to give a meaningful interpretation of the LFS weights they contain. A two-tier weighting procedure was therefore proposed to render the LFS data representative with respect to the census population. The first-tier procedure (described in section 6.3) was applied when the survey data were entirely composed of LFS respondents who had been confirmed to be part of the census population (Census-LFS data). The purpose of this tier was to determine weights to make the survey data representative

[2)] Although the statistics on labour market participation and employment – for which the LFS is the source – refer only to the population aged 15 to 64 years, the LFS itself comprises information on people of all ages, including children.

for the LFS population on 1 January 2011. These weights 'harmonise' the survey data and make the responses from 36 different interview months appear as one single wave of LFS responses. It should be noted this does not yet contain the age restriction. The second-tier procedure (see section 6.4) was applied after the 15+ age selection. The purpose was to make the data representative for the census population aged 15 years and older.

6.3 First-tier weighting of LFS data

The first-tier weighting was applied to the Census-LFS data containing only LFS respondents who were part of the census population. The weighting should render the Census-LFS data representative with respect to LFS population totals on 1 January 2011, using a suitable weighting model yet to be specified. Given the origins of the Census-LFS data, the LFS weighting model was taken as the starting point for the development of the new weighting model. Usually, quarterly LFS data are weighted using the Linear Weighting method in combination with an elaborate weighting model relying on register data available at Statistics Netherlands[3)]; weights per quarter are combined to yield weights on a yearly basis. The resulting weights make the survey data representative with respect to the LFS population totals for each of the additive terms in the weighting model. This weighting model is geared towards enforcing consistency between quarterly and yearly employment statistics. As this consistency was not required for the 2011 Census, the new weighting model was adapted accordingly. This reduced LFS weighting model was accepted as the weighting model for the Census-LFS data.

It is beyond the scope of this chapter to present an in-depth explanation of the LFS weighting model used at Statistics Netherlands. Here it is only mentioned that the weighting model includes socio-economic, geographical and demographic register variables. The proposed weighting model for the Census-LFS data consists of 11 additive terms, each a single categorical variable or the cross product of two or three categorical variables. To enable the weighting of the Census-LFS data,

3) At Statistics Netherlands, the weighting of sample survey data in general – and the method of Linear Weighting in particular (Bethlehem, 2009) – is a widely used technique for producing statistics. It relies on categorical register data and a specified weighting model. The technique produces weights that can be used to estimate absolute or relative distributions of single categorical survey variables or cross products of categorical survey variables. Through the application of the weights, the survey data become representative with respect to the population totals for every additive term of the weighting model. Weighting of the LFS data is now standard practice at Statistics Netherlands, and as a result a well-established (linear) weighting model exists.

LFS population totals for the population on 1 January 2011 were drawn up for each of the terms in the weighting model. The LFS population of the Netherlands was about 16.4 million (compared with the almost 16.7 million according to the population register).

The weighting of the Census-LFS data was successful, i.e. the numerical algorithm converged to produce new weights with positive values.[4] The algorithm yielded the so-called *Census-LFS publication weights*, which make the Census-LFS data representative with respect to the LFS population total on 1 January 2011 for each additive term in the weighting model. In order to assess the quality of the Census-LFS publication weights, a selection of characteristic values is presented in table 6.3.1.[5] The weights range from just under 4 to just under 535. Furthermore, an average value of around 39 together with a first quartile of just over 26, and a third quartile of over 43 indicate a non-symmetrical distribution of the publication weights.

6.3.1 Characteristic values of Census-LFS publication weights determined in first-tier weighting

	Census-LFS publication weight
Minimum value	3.9692
Maximum value	534.6764
Average value	39.4451
Median	34.4241
1st quartile	26.1678
3rd quartile	43.5015
Standard deviation	26.2979
Estimated population size	16,377,117

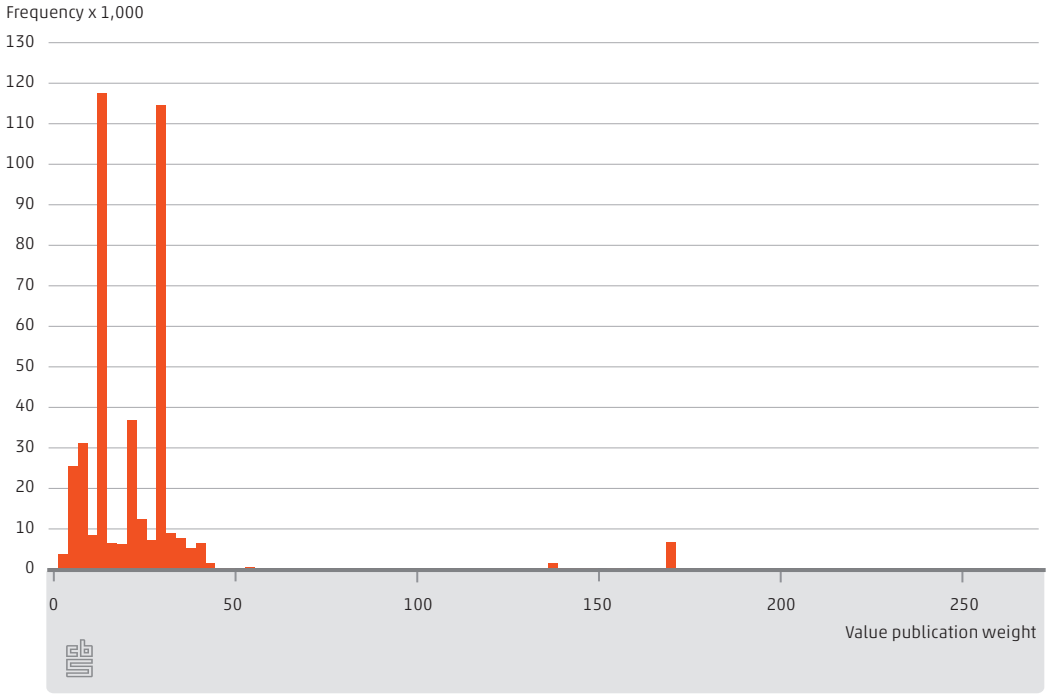
Source: Statistics Netherlands.

The wide range in values and the asymmetrical distribution of the Census-LFS publication weights are in line with the properties of the original LFS weights from which they were derived. Figure 6.3.2 illustrates these original weights (scaled to add up to the population total), revealing an irregular distribution with minimum and maximum values positioned widely apart.

[4] The Bascula module of Statistics Netherlands' Blaise software package facilitates weighting of sample survey data using the method of Linear Weighting. This programme uses sample survey data, weighting models and population totals and comprises fine-tuning mechanisms to prevent numerical problems.

[5] A minor mismatch between the LFS population and the Census 2011 population excluding the institutional population is responsible for the small difference in population size (16,377,117 for the LFS vs. 16,436,484 for the Census 2011).

6.3.2 Original LFS weights

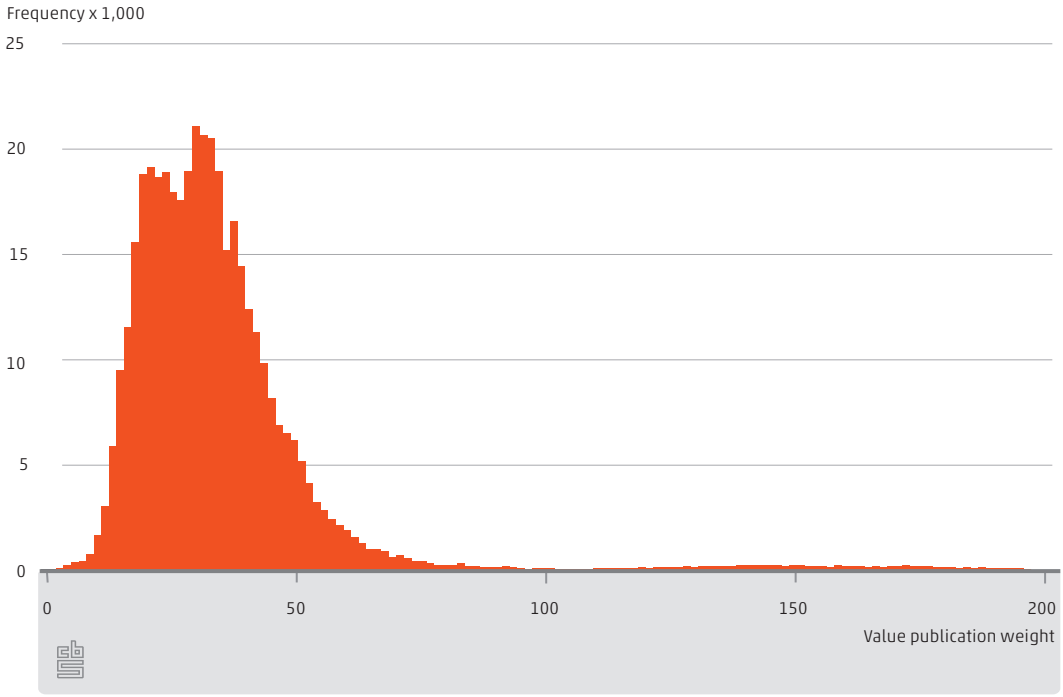


For a further quality analysis of the Census-LFS publication weights, the histogram of a cut-out of weights is shown in figure 6.3.3. The cut-out consists of all weights with a value of less than 200, thereby representing 99.6 percent of all publication weights. The graph features a tapered tail on its right-hand side. The position of the main body of the histogram is the area located on the horizontal axis below value 100. This body is bell-shaped with a broad base topped off by two narrow peaks. Furthermore, the bell shape is asymmetrical with a decreasing slope less steep than its increasing slope. Overall, the curvature is smooth with no disrupting features. It suggests an unbroken variation of weight values which, in turn, confirms the quality of the result of the first-tier weighting process.

To sum up, the original LFS weights of the Census-LFS data had an irregular distribution ranging widely in value. Weighting the Census-LFS data, using Linear Weighting and a weighting model as close as possible to the original LFS weighting model, yielded Census-LFS publication weights with positive values. A histogram of these publication weights, showing outliers and a smoothly curved, bell-shaped main body, is perfectly acceptable. Furthermore, the Census-LFS publication weights meet the purpose of the design: they render the Census-LFS data representative for the LFS population totals on 1 January 2011 for the respective terms of the

weighting model, thereby making the LFS responses from 36 interview months appear as one single wave of survey data.

6.3.3 A 99.6 percent cut-out of Census-LFS publication weights determined in first-tier weighting



6.4 Second-tier weighting of LFS data

After completion of the first-tier weighting and before the start of the second-tier weighting, the 15+ age selection was applied to the Census-LFS data. Thus, the second-tier weighting was applied to the Census-LFS 15+ data, starting out from the Census-LFS publication weights determined in the first-tier weighting. The aim of the second-tier weighting was to make the Census-LFS 15+ data representative with respect to the 15+ census population. This required a new weighting model. The following seven register-based (non-LFS) variables were

considered for this weighting model because they feature in one of the most important hypercubes of the 2011 Census.[6)]

1. age
2. current activity status
3. geographical area
4. household status
5. legal marital status
6. country of birth
7. sex

These seven variables are available in full for the entire census population. Furthermore, variables 1, 3, 4, 5 and 7 not only have a counterpart in the LFS but are also included in the first-tier weighting model. More precisely, in the first-tier weighting model the variables 'age' and 'sex' are crossed to yield an independent additive term. The same is true for 'age' and 'geographical area', and 'age' and 'current activity status', and the cross product of 'household status' and 'legal marital status'. Taking all these considerations into account, it was decided to use a weighting model with five additive terms for the second-tier weighting:

(age × sex) + country of birth + (household status × legal marital status) + (geographical area × sex) + (age × current activity status).

Determination of the population totals for each of the additive terms in the weighting model facilitates the weighting of the Census-LFS 15+ data in accordance with the proposed weighting model.

13,748,724

people make up the Dutch population aged 15 years or older

6) This 'hypercube 6' is considered to be one of the most important of the 60 hypercubes, as it is one of the largest in terms of number of cells and was therefore used as a key test in the 2011 Census Round.

The second-tier weighting of the Census-LFS 15+ data using Linear Weighting and the new weighting model was applied without any difficulties, resulting in publication weights that will be referred to as the *Census-LFS 15+ publication weights*. Once these weights are applied, the Census-LFS 15+ data are representative for the census population aged 15 and older on 1 January 2011.

Table 6.4.1 presents the characteristic values used to analyse the Census-LFS 15+ publication weights. On 1 January 2011, 13,748,724 people were 15 years or older. The Census-LFS 15+ publication weight ranges from just below 4 to around 767. This range overlaps the range of the Census-LFS publication weights presented in table 6.3.1. The median, and first and third quartiles more or less match those of the first-tier weighting.

6.4.1 Characteristic values of the Census-LFS 15+ publication weights determined in second-tier weighting

	Census-LFS 15+ publication weight
Minimum value	3.7172
Maximum value	766.7984
Average value	41.4158
Median	33.9283
1st quartile	25.5383
3rd quartile	45.0859
Standard deviation	31.9717
Estimated population size	13,748,724

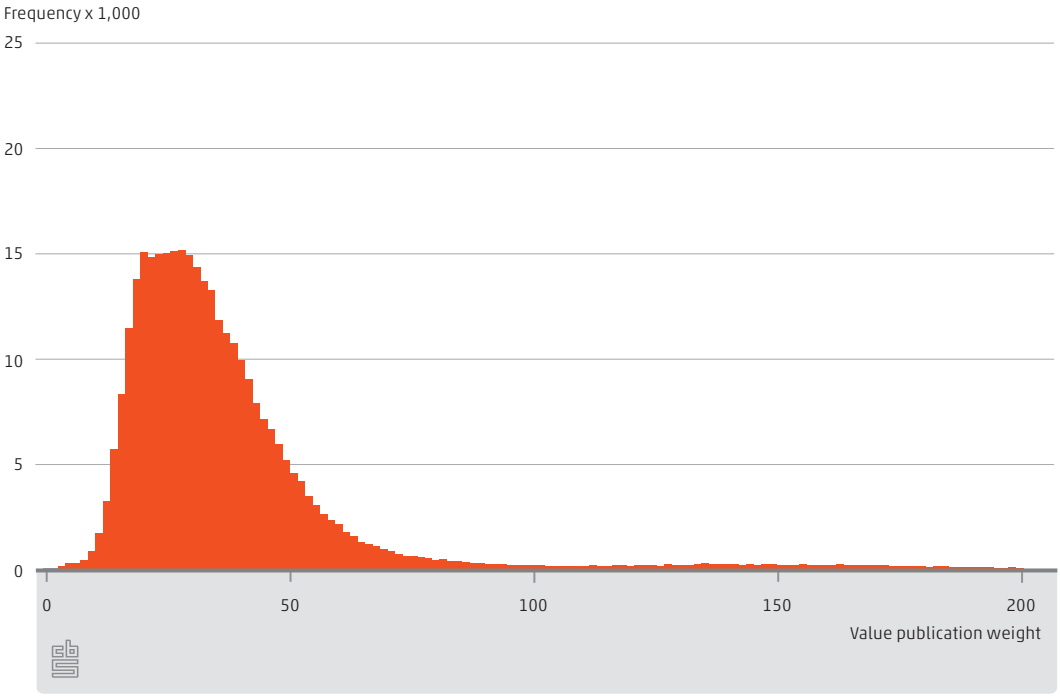
Source: Statistics Netherlands.

Just as for the quality analysis of the results of the first-tier weighting, a histogram was drawn up for a suitable cut-out from the Census-LFS 15+ publication weight (see figure 6.4.2). This histogram is constructed in the same way and based on the same cut-out from the publications weights as figure 6.3.3. This time, the cut-out of the Census-LFS 15+ publication weight encompasses 99.3 percent of all publication weight values.

Some properties of the histogram in figure 6.4.2 were also seen in figure 6.3.3: the tapering off to the right for instance. The main body of the histogram in figure 6.4.2 is located in the same region as that in figure 6.3.3: below value 100. Lastly, both graphs share a noticeable asymmetry in their bell-shaped main bodies. Apart from the similarities, there are also differences between the two graphs. The top half of the main body of the graph in figure 6.4.2 is narrower than that in figure 6.3.3.

In addition, the two distinctive peaks in figure 6.3.3 are lacking; indeed, the top of the histogram's main body is flat in figure 6.4.2. Lastly, the descending slope is smoother in figure 6.4.2 than in figure 6.3.3. In conclusion, the main body of the histogram of the Census-LFS 15+ publication weight determined in the second-tier weighting is smooth and has no disrupting features. Again, it indicates a good quality of results.

6.4.2 A 99.3 percent cut-out of Census-LFS 15+ publication weights determined in second-tier weighting



To sum up, weighting the Census-LFS 15+ data, using Linear Weighting and a new weighting model based on important census register information, yielded Census-LFS 15+ publication weights with positive values. Again, the histogram of these publication weights was perfectly acceptable and the weights meet the purpose of the design. The second-tier weighting process renders the Census-LFS 15+ data representative with respect to the relevant population totals on 1 January 2011 for the respective terms of the weighting model.

6.5 Conclusions

Weighting the Census-LFS 15+ data with the Census-LFS publication weights as starting point – which in turn used the original LFS publication weights as their starting point – yielded positively valued Census-LFS 15+ publication weights. The weighting was based on Linear Weighting in combination with a newly designed weighting model. Analysis of the Census-LFS 15+ publication weights demonstrated its distribution to be in line with that of the Census-LFS publication weights produced in the first-tier weighting. As the weighting model fulfilled the aim of the weighting – i.e. the publication weights make the Census-LFS 15+ data representative with respect to the 15+ census population totals on 1 January 2011 for each term of the weighting model – the procedure can be considered to have been successful. The Dutch Census 2011 made successful use of the selected sample survey data from the LFS for information on level of education and occupation for people aged 15 years or older. Combining records from three years of LFS data made it possible to produce detailed Census 2011 tables.

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7.

Beyond repeated weighting

Author
Jacco Daalmans

This chapter describes the methodological aspects of estimating the 2011 Census tables in the Netherlands. Because of a number of estimation problems, the repeated weighting method used in the 2001 Census could not be directly applied to the 2011 tables. The chapter presents some examples of these estimation problems and describes the solutions implemented for the Dutch 2011 Census.

7.1 Introduction

According to the European Census Regulations (European Commission, 2008 and 2010), Statistics Netherlands was required to compile sixty high dimensional tables for the Dutch 2011 Census. These tables display the number of times combinations of characteristics occur in the population; for example, the frequency distribution of the Dutch population by age, sex, marital status, occupation, country of birth and nationality. As the tables are very detailed, comprising five, six, sometimes seven, and even nine dimensions, they are also known as 'hypercubes'. An example of a cell in one of the hypercubes: the number of 36 year-old male widowed managers, born in Portugal with the Polish nationality. The total number of cells in all the tables was more than one hundred million, far more than the number of people living in the Netherlands, which is below 16.7 million. It is no wonder then that most of the cells in the set of tables are zero-valued.

One of the most important requirements of the 2011 Census Regulations is numerical consistency, i.e. common marginal totals in different tables have to correspond. For example, in all tables containing the variables 'occupation' and 'sex', the total number of male managers must be identical. This consistency is automatically present in censuses based on complete enumeration, but if multiple data sources are used there is a risk of inconsistent results. As Statistics Netherlands conducts a census based on several registers as well as a sample survey, numerical consistency is a very important issue.

Statistics Netherlands has developed the method of repeated weighting for the consistent estimation of multiple frequency tables from sample surveys and registers. This method was applied in the Dutch Census 2001. The application of the method was not without its problems, but appropriate solutions were found for the estimation problems experienced at that time. A frequently occurring problem is the 'zero cell problem', i.e. the problem that the occurrence of certain categories of variables cannot be estimated as sample surveys do not always cover all categories

in the population (e.g. 83 year-old married men may not be covered by a sample). Another problem is the so-called 'edit rules', which require relationships between different variables that are not automatically satisfied. An example of this is the relationship between the variables 'economic activity' and 'occupation': only people who work have an occupation.[1)] A third problem is the many consistency constraints. At some point in the estimation it may become impossible to satisfy all constraints simultaneously. As the 2011 Census tables are much more detailed than those in the 2001 Census, the estimation problems have a much deeper impact. Therefore, the solutions implemented for the 2001 Census, described in Gouweleeuw and Hartgers (2004), are not sufficient for the 2011 Census, and additional approaches had to be developed. The specific aim of this chapter is to demonstrate that repeated weighting has been successfully applied to the difficult estimation problems of the Dutch Census 2011 tables.

Although the focus of this chapter will be on the Dutch Census 2011 and its specific estimation problems, references are provided for readers interested in the details of the repeated weighting method. Section 7.2 explains the method of repeated weighting, while section 7.3 describes the problems posed by the method and the solutions implemented to compile the 2011 Census tables. Lastly, section 7.4 summarises some conclusions.

7.2 Repeated weighting

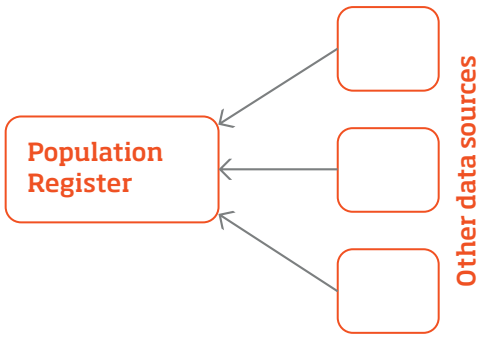
In the 2011 Census, repeated weighting was applied to the tables with socio-economic and demographic variables based on several registers and a sample survey. Tables on housing characteristics were produced by a different process, as they could be based on available registers only. This section gives a brief description of the method of repeated weighting; a more extensive description of this method can be found in Houbiers (2004). Basically, repeated weighting consists of three preparation steps and the subsequent application of the method in order to estimate multiple frequency tables consistently.

[1)] This is how Statistics Netherlands operationalizes these concepts in the 2011 Census, based on the information in available registers and surveys. The European Regulation (2009) allows an occupation for people that are unemployed at the Census reference day or period, but that have been in employment before.

Data linkage

The first step of the preparation is data linkage. In this step all data sources are linked at the unit (= person) level. The population register is the 'backbone': all other data sources – both registers and sample survey – are linked to it (Bakker, Van Rooijen & Van Toor, 2014). Figure 7.2.1 sketches the central role of the population register in the data linkage process.

7.2.1 Data linkage



Micro-integration

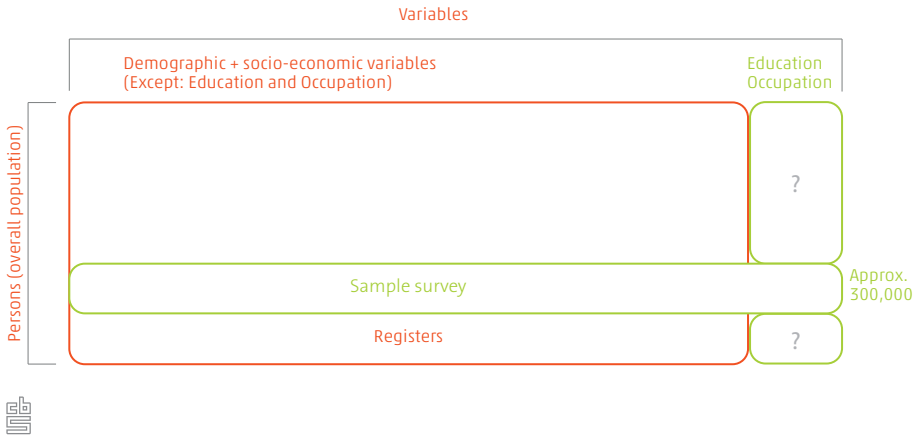
The second step is micro-integration, a process aimed at reducing inconsistencies at the unit level. If a person's age is 24 according to the population register, and 25 according to another register, a decision has to be made about which data source is correct. A number of predefined decision rules are used for this purpose, see for example Bakker (2011).

331,968 observations
underlie the 2011 Census estimations

Compiling data blocks

After micro-integration, the third step is to compile so-called 'data blocks'. Each data block contains all records that have a certain maximum set of variables in common. Two main data blocks were used in the Dutch 2011 Census: a 'register block', based on combined registers, and a 'sample survey block', derived from the Labour Force Survey (LFS). The register block covers the full population (over 16.6 million persons) and includes all relevant variables except 'educational attainment' and 'occupation', which are not derived from registers but from the LFS. For the sample survey block this is the other way around: it covers all relevant variables, but it is available for a subset of persons only, i.e. the relevant LFS sample: 331,968 persons in a three-year period around Census Day (1 January 2011). Figure 7.2.2 presents a schematic view of the data blocks.

7.2.2 Schematic view of the data blocks



Applying repeated weighting

All tables containing 'educational attainment' or 'occupation' were estimated using repeating weighting. All other tables were directly obtained by counting from the register block. Applying the technique of repeated weighting basically means that sampling weights are repeatedly adjusted. A sampling weight is available for each person in the LFS. Among other things, these weights are based on the inverse of the inclusion probability. For example, a weight of 12 means that a certain person

in the sample represents 12 persons, of whom 11 are not included in the sample).[2] Based on these sample survey weights, so-called starting weights were derived for each person in the sample survey block (see chapter 6). Aggregating these starting weights results in a first or initial table estimate. The initial table estimates are not necessarily consistent with the registers; for example, the sum of the starting weights of all 83 year-old men may differ from the register count of these men. By applying the technique of repeated weighting consistency between table estimates and register counts is achieved.

The basic principle of repeated weighting is that the tables are estimated in sequence. Each table is estimated consistently with all previously estimated tables and with the available registers. In other words, each table is estimated in such a way that the marginal totals it has in common with all already estimated tables will have the same value as in those earlier tables (see figure 7.2.3). In this process the starting weights are adjusted. Mathematically this implies that the calibration properties of the regression estimator (Särndal, Swensson and Wretman, 1992) are applied. Let us consider a fictitious population, consisting of 1,000 men and 1,000 women for whom the sums of starting weights are 800 and 1,200 respectively. As a result of calibration, the starting weights of men are corrected by a factor 1,000/800 and those of women by a factor 1,000/1,200. In this simple example there is one marginal total of one dimension. In reality the problem is more complicated, as the estimated tables need to correspond with multiple marginal totals, each of which may consist of more than one variable, for example the marginal 'occupation by sex'.

A key property of repeated weighting is that categories of variables that do not occur in a sample survey will by definition have a zero value in all table estimates based on that survey. On the one hand this is a very desirable property, as it precludes the possibility of non-zero counts for categories that cannot exist in practice, for example 5 year-old professors. On the other hand, as will be shown in the following section, it is also the source of a number of estimation problems.

[2] In practice weights are not integers.

7.2.3 Simple example of repeated weighting

Table 1

Education x Nationality	Not NL	NL	Total
$Education_{Lo}$	20	29	49
$Education_{Hi}$	9	42	51
Total	29	71	100

Common marginal total: Education

Table 2

Education x Age	<65 years	>-65 years	Total
$Education_{Lo}$	36	13	49
$Education_{Hi}$	39	12	51
Total	75	25	100

Table 3

7.3 Problems with repeated weighting

Empty cell problem

The empty cell problem occurs when estimates have to be made without underlying data. It is caused by sampling effects: a characteristic known to exist in the population is not covered by the sample survey from which the table estimates are made. A fictitious example of this is the estimation of a table comprising population by geographic area, branch of economic activity and educational attainment. The first two variables – geographic area and branch – are taken from a register, which shows that 34 persons live in the geographic area North Holland and work in the mining industry. However, information on level of education is only available from a sample survey that does not cover any of these 34 people. Consequently, education levels of 'miners' from North Holland cannot be estimated. The basic variant of repeated weighting cannot be used in this simple example. In the 2001 Census this was resolved by estimating less detailed tables: omitting one or more of the variables from the original tables and considering variables at a lower level of detail, for example age in 10-year classes instead of 5-year classes. This was not feasible for the 2011 Census. Firstly, as the required tables are much more detailed than those for the 2001 Census, the zero-cell problem occurs much more often; as table 7.3.1 illustrates, at least one of the 2011 Census

tables contains more empty than non-empty cells. Secondly, aggregating classes of variables is not allowed because of the loss of results, which hinders comparison with other countries.

7.3.1 Cell coverage of a census table[1)]

Observations	Occurrence (%)
0	79.5
1	3.1
2–5	5.1
6–10	2.8
>10	9.4

Source: Statistics Netherlands.

[1)] Based on a randomly chosen census subhypercube (13.1: geographic location × sex × education × current activity status × age).

The so-called epsilon method (Houbiers, 2004) was applied to solve the empty cell problem: zero-valued estimates in an initial table were replaced by small, artificial, non-zero 'ghost' values, which were set to 1 for all empty cells in the 2011 Census tables. In other words, it was assumed a priori that each empty cell is populated by one fictitious person, but the microdata were not adjusted. In the estimated tables the results of these cells normally differ from 1. The epsilon method is basically a technical solution for the estimation problem. An important drawback is that it may lead to implausible results: non-zero counts may be obtained for categories that do not appear in the population (e.g. 15 year-old professors). To prevent this 'side effect', so-called auxiliary tables were estimated for the 2011 Census. These tables are not very detailed, typically with one or two dimensions (e.g. education by sex, education by age). The auxiliary tables are estimated before all other tables and do not use the epsilon method. As all target tables have to be estimated consistently with the auxiliary tables, there will be no deviation from the data sources at the low dimensional level of the auxiliary tables. Moreover, the problem of implausible zero values will not occur for cells covered by an auxiliary table. For example, an auxiliary table of education by age will not contain any 15 year-old professors, as these do not appear in the data sources. In addition, the use of the auxiliary table prevents the occurrence of 15 year-old professors in all target tables, as these target tables have to be estimated consistently with all auxiliary tables. Another measure taken to prevent the occurrence of unreliable results is the publication strategy: Statistics Netherlands only publishes cell estimates that are based on a minimum number of observations; in the 2011 Census the rule was adopted that sample survey estimates based on fewer than five observations are not be published.

Edit rules

Repeated weighting does not take into account adjustments to comply with consistency rules for different variables in different tables (so-called 'edit rules'). An example of such a rule is that the number of people who have never resided abroad cannot exceed the number of people born in the country concerned. The reason underlying this rule is that a person who has never lived abroad was by definition born in the country concerned. And this rule not only applies to the overall population, but also to all possible sub-populations (e.g. 23 year-old married men). As different tables can be estimated from different sources, edits of variables in different tables are not automatically satisfied. Renssen, Kroese and Willebroordse (2001) solve this problem by extending all tables containing a variable that requires a certain edit rule with all other variables appearing in that edit rule. In our example, country of birth is added to all tables that include the variable 'ever/never resided abroad'. Thus, all variables subject to the same edit rule are estimated within the same table or tables. Because all tables are estimated from one data source, and it is assumed that all edit rules are satisfied within that data source, this will prevent the violation of edit rules.

Conflicting marginal totals

Another problem arising in the estimation process is that of 'conflicting marginal totals'. Each table estimated imposes certain consistency constraints on all subsequently estimated tables. When a certain number of tables have been estimated, it may become impossible to estimate a new one consistently with all previously estimated ones. There is an especially high risk of estimation problems in the case of two (or more) tables with a large number of common variables, as these have a large number of common marginal totals. Although it may be possible to estimate each table in isolation, it may not be possible to estimate them in sequence, because of the many consistency constraints they impose on each other. The only way to tackle this problem is to prevent it, and one way to prevent it is to estimate the tables in a different order. The order chosen for the 2011 Census was based on a plan produced by trial and error. Another way to prevent estimation problems is to merge tables with a large number of common marginal totals. Instead of estimating several tables with partly similar variables (e.g. tables A, B and C), one large table is estimated (e.g. table D) that contains the union of variables in the original tables (tables A, B and C). The constraints for consistency between the three separate tables A, B and C do not apply to the combined table D that is estimated as a whole. Thus, estimation problems can be avoided. A drawback of merging is that it results in more detailed tables that may

be more difficult to estimate. Technical problems may also occur, for example out-of-memory problems, slow computation, et cetera. Therefore, merging should not be applied too often. In the 2011 Census, merging was applied twice: two high dimensional tables were estimated. One of these consisted of crossings between geographic location, sex, age, year of arrival, current activity status, household status and level of education, a combination that appears in many census tables.

7.4 Conclusions

Statistics Netherlands estimated sixty detailed census tables from a combination of registers and a sample survey. The repeated weighting method was used to estimate these tables consistently. Consistent estimation was a challenge because of the level of detail in the Census 2011 tables, which was much higher than in the tables of the Census 2001. Because the tables were so detailed, estimation problems were frequent and the solutions implemented in 2001 were inadequate for the 2011 Census. However, by developing and applying additional solutions, all 2011 Census tables were estimated consistently.

A more general message is that repeated weighting can be applied to very complex estimation problems. It may also be useful for other applications requiring optimal use of multiple data sources. Repeated weighting applications may encounter obstacles, however. The method is generally not suitable in the presence of consistency rules between different variables ('edit rules'). Moreover, the solutions for the estimation problems described in this chapter are not a simple recipe for success: they require extensive preparation and are therefore labour intensive. For example, estimation problems may be solved by estimating tables in a different order, but it is not always easy to determine a feasible order. For the 2011 Census a useable estimation order was produced only after a long period of trial and error. Furthermore, it is important to take into account that the repeated weighting results are order-dependent: estimating tables in a different order leads to different estimates. Although repeated weighting can be a powerful method, it may also be worthwile to consider alternative methods (e.g. imputation). De Waal (2014) presents a comprehensive overview of different methods and their features.

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