Expected developments in the number and type of Italian households until 2040

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Abstract

Household projections provide crucial information for policy planning. The purpose of this work is to estimate household projections for Italy, consistently with the official population projections, annually updated by the Italian National Institute of Statistics (Istat). An approach based on the Propensity rate model met the requirements: parsimony, simplicity, replicability and quality. The method, in addition to producing the number of households by type, provides with future time series of the population by household position (child, living with a partner with or without children, lone parent, living alone, other position), age and sex. Household projections from 2020 to 2040 were released in 2021 for the first time together with population projections. The results show an increase in the number of households by one million and a decrease in their average size, which would drop from 2.3 members to 2.1 Furthermore, the results document a decrease in couples with children, an increase in those without children and of people living alone.

Keywords: Family, household, Italy, official household projections, propensity rate.

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1. Introduction

Literature has shown the importance of the family dimension in the study of many social and economic phenomena, such as housing, health, work, welfare, migration, poverty and social exclusion (Bell *et al.* 1995; Hantrais *et al*. 2006; Hays 2002; Paciorek 2013). Family formation, in fact, directly or indirectly influences most social and economic outcomes.

Since the 1960s, families in many Western countries have undergone significant changes. The extended family has almost disappeared and the traditional two-parent family has become less common, as divorce rates, remarriage and single-parenthood have increased. Families have seen more women enter the labour market, teenagers spend more time in education and older family members live longer and, increasingly, alone (Stevens et al. 2012).

Data on the number of households, their typology and the distribution on the territory, today and in the years to come, represents a central support for planning public intervention actions. Policies supporting fragile families, particularly older adults living alone, single-parent families, or large families can take advantage of this kind of information.

Household projections are also useful for urban and housing policies, as well as for estimating energy consumption. Notably, a growing number of households, linked to a reduction in their size, may have significant effects on energy use (O'Neil *et al.* 2002).

In addition, the development of predictive scenarios for population, households, and families meets a primary knowledge need for countries that, like Italy, have undergone profound demographic and social transformations over the years.

In 2020, the Italian National Institute of Statistics (Istat) started a project on household projections integrated with the established set of official population projections. The goal of the project was to find a model to estimate the number and type of households in Italy over the next 20 years, which met the following requirements: consistency with the demographic projections, parsimony (detailed and quality information versus cost), need for non-burdensome input data, timeliness, and annual reproducibility.

This paper presents the model used to project households in Italy from 2020 to 2040 and reports the main results. It is structured as follows. Section 2 gives an illustration of the most relevant household projection models available in the literature. The chosen model and strategy are presented in Section 3. The data and definitions used in this study are discussed in Section 4, followed by the step-by-step application in Section 5. Section 6 shows the results obtained. Finally, some conclusions and possible next steps are drawn up in Section 7.

2. Models in literature

There is a considerable availability of models for household projection purposes. Following the classification proposed by Gill and Keilman (1990), household forecasting models can be distinguished according to the approach followed (static or dynamic) and/or to the basic unit of analysis (micro or macro)[2].

In a static approach, projections are carried out applying proportions or rates that allow shifting from a projected population to the corresponding families and households. The best known is the "headship rate method" (United Nations 1973; Kono 1987; Linke 1988), widely applied for its reproducibility and the simplicity of the procedure. This model focusses on the characteristics of the household head, producing outcomes about the total number of households and their mean size.

These limitations (see next paragraph) are partly overcome by another static model, the propensity rate model, which offers a wider range of results, such as the distribution of households by type and population by family position (de Beer *et al*. 1999; Wilson 2013; ABS 2019).

Dynamic approaches, unlike static ones, explicitly model family events. In the dynamic method, the distribution of the population broken down by state is the outcome of transitions people make in their lives. Individuals move between states and consequently, the structure of the households change (multistate method). Therefore, dynamic models give a more accurate picture of the mechanism of social and demographic changes occurring in the real world. As a result, they are in theory better suited for integrating population projections with household projections. In addition, the study of transitions allows assessing the impact on population dynamics caused by policies or by socio-economic changes that may emerge in the society.

Depending on the basic unit used, dynamic models can be defined as macro or micro (Keilman *et al.* 1988). Macro-dynamic models proceed by groups based on different characteristics, which vary according to the application (*e.g.* age, sex, marital status, family position, etc.). Rates for demographic events and household formation and dissolution are then applied to the multi-

2 For an in-depth review on household forecasting methods, see Keilman (2019).

group population. This allows modelling transitions between states for each calendar year along the time horizon. The Lipro macro-dynamic model, for example, implements a multi-state demographic model that focusses on flows between states (*e.g*. from *living alone to living in a couple* or from being a *partner with children* to being a *single parent*) (van Imhoff *et al*. 1991). Similarly, *ProFamy* provides detailed family compositions and population group characteristics such as marital/union status. It uses socio-demographic rates as input, projecting family states of individuals grouped by age-cohort and other attributes (Zeng *et al*. 2013).

Starting from the individual's risk of experiencing a specific event, dynamic micro-based models consider the individual as the basic unit of prediction, with the aim of simulating its entire life cycle (Cannari *et al.* 1998). The dynamics of the population are derived by aggregating the forecast results according to the chosen classificatory criteria. Microsimulation modelling is a very useful tool for measuring the impact of certain changes, such as the effect of ageing on the pension system, or of policies, such as the impact of child support on female labour force participation and household income (Décarie 2012).

To overcome some limitations that emerge in the two different approaches, there have been some attempts to use the static and dynamic models in a combined way. For example, de Beer and Alders (1999) developed a probabilistic forecasting model, which first projects the population by marital status based on a multistate model and then applies propensity rates to obtain households. Similarly, Mic/Mac represents an attempt to bridge the gap between micro and macro models (Willekens *et al.* 2007), a methodology that complements conventional projections by age and sex (aggregate projections of cohorts, Mac) with projections of the way people live their lives (projections of individual cohort members, Mic). In Mic/Mac the life course is viewed as a sequence of states and events that result in transitions from one state to another. An advantage of such an approach is a better control for population heterogeneity, while traditional projections assume that members of a cohort are identical with respect to socio-demographic behaviour. Another benefit offered by Mic/Mac is the information on duration of stay, generally not available in traditional models without a life course perspective. Lastly, the projection of people's lives is taken under control as Mac can be used as a starting point for Mic (validation/calibration of Mic by using Mac).

Forecasting always involves dealing with uncertainty, since the future is inherently uncertain. Therefore, for each of the above approaches, a further distinction between probabilistic and deterministic models can be made. The former model tells us how likely it is that the number of households for a given future year will be within a certain range; the latter one predicts one result, the most likely trajectory, sometimes formulating alternative (usually low and high) scenarios (Keilman 2019).

3. The choice of the method

The main objective of the project was to find a projection model that would make it possible to jointly release official population and household projections on an annual basis. Therefore, we required a model that was consistent with demographic projections, parsimonious (with detailed, high-quality results respect to costs), and replicable every year. In this regard, an important aspect to analyse concerned the availability, but above all, the timeliness, of the data sources to be used as input for our model. The continuous working cycle, due to the current production of the official basic data (census, population dynamics and social surveys), preparatory to the construction of a forecasting model on households, requires a step-by-step process that in Istat necessarily has to be completed by the end of the following year to which the information refers. Therefore, although data availability and timeliness should not drive the choice of an optimal model, for a national statistical institute, such as Istat, this factor cannot be ignored.

The previous considerations about time constraints, along with the desire to refresh the assumptions underlying the projections on a yearly basis, limit our potential range of action on the methodological side, particularly with regard to the dynamic models and, above all, the micro-dynamic ones. Dynamic models certainly allow a more realistic representation of the population development due to demographic and social processes (birth, death, marriage, divorce, migration events, etc.). However, such an approach also presents some drawbacks from the perspective of a national statistics institute. Among them, it has to be stressed that micro-dynamic models require a huge amount of data processing, to the point that generally only a small representative sample of the population can be processed in the microsimulation procedure. Secondly, the final results are based on a collective of individual trajectories not necessarily bound to any main result at the macro level, so such an approach may require the adoption of considerable calibration measures in order to obtain consistent predictions.

As mentioned in the previous paragraph, Mic/Mac represents a valid solution for overcoming the problem of potential inconsistencies in the results at the micro level. Nevertheless, Mic/Mac has been designed to be used mainly for single countries separately. The model is substantially a uni-regional type, therefore not particularly suitable for a country like Italy, where

the multiregional dimension is essential in explaining social and demographic behaviours.

Because of the low detailed outcome, another approach not able to best represent the complexity of the Italian reality is the headship rate model. This method includes only the characteristics of the household head, which is often defined vaguely and differently across countries (Murphy 1991).

In conclusion, for the above-mentioned reasons and because of its adaptability to the Italian situation, the method that best met our requirements is the static approach based on the "Propensity rate model". This method has been used in recent years by the Australian Bureau of Statistics to project households in Australia and New Zealand (ABS 2019). It goes beyond the classical headship rate model, overcoming the concept of 'headship' and providing a more detailed set of information (McDonald *et al.* 2006; Bell *et al.* 1995; Wilson 2013; Blangiardo *et al*. 2012).

The model relies on propensity rates, defined as the proportion of people of a certain age and a specific household position in a given year. As an example, the propensity of a 30-year-old person to live in a couple with a partner is the ratio of the number of 30-year-olds living in a couple to the total 30-year-old population.

Starting from a predicted population by age, sex and region, the method develops in five steps to predict the population by household position; this allows the number and type of households to be determined. The steps, described in detail in Section 5, are the following:

Step 1. Estimating the projected population living in households.

Step 2. Calculating household propensity rates.

Step 3. Modelling the future trends of household propensity rates.

Step 4. Obtaining the projected population by household position.

Step 5. Calculating the number, type, and size of the projected households.

Generally, the propensities are extrapolated from the analysis of past trends. Different methods can be applied, such as linear or non-linear models, or even following experts' judgments. In this application, we introduced a new indicator that measures life expectancy in a specific household position, to be used for predicting future household behaviour (see Section 5).

There are several advantages of the method: it easily links to existing population projections; data inputs are not as onerous as for dynamic models; it provides detailed results. In light of this, projections can be easily updated when new input data become available.

However, there are also some drawbacks, which mainly derive from the static nature of the method. In fact, the application of propensity rates to the population may lead to inconsistencies in terms of overall results. For example, the projected number of male and female partners may differ (the two-sex problem, Keilman 1985; Schoen 1988) or the initially projected propensities will not sum to unity across living arrangements, and therefore, require ex-post adjustments (Wilson 2013).

4. Data and definitions

We integrated several data sources to carry out our analysis. Firstly, the Permanent Population and Housing Census supplied the base-population on January 1st 2020 by age, sex, region of residence, and type of residence (private or institutional household[3]). Since 2018, the new population and housing census, which replaces the previous one traditionally based on a decennial basis, releases data annually through the integration of the information available from administrative sources and that were acquired with sample surveys. The combined use of data from registers and surveys guarantees the information on the main demographic and socio-economic characteristics of the resident population in Italy. The specific objective of the permanent census, in particular, is the production of data relating to the counting of the resident population at the municipal level and its distribution by sex, age, citizenship, level of education, and professional status (Istat 2021*c*).

Secondly, information on household and family structures was achieved from the Italian multipurpose survey *Aspetti della vita quotidiana*, which provided a long time series (from 2002 to 2019). This is an annual cross-section sample survey carried out by interviewing a sample of 20,000 households (for a total of about 50,000 people) and guarantees consistent and accurate estimates at the regional level. The questionnaire includes a detailed set of questions regarding the family context of the individuals, so that the information on households is the strength of the survey, and represents the benchmark for the social statistics produced by Istat (Bagatta *et al.* 2006).

Both the Permanent Population Census and the Italian multipurpose survey are based on the population usually resident[4] in Italy. Regarding the population living in households, both sources rely on the definition of the *de facto* situation.

3 An institutional household is a group of people cohabiting for caring, military, punitive, religious or other similar reasons, and thus residing in institutions such as hospitals, barracks, prisons, nursing homes or religious buildings.

4 According to the "Regulation (EU) N. 1260/2013 of the European Parliament and of the Council on European demographic statistics", the definition 'usual residence' means the place where a person normally spends the daily period of rest, regardless of temporary absences for purposes of recreation, holidays, visits to friends and relatives, business, medical treatment or religious pilgrimage.

Regarding the institutional households, for the Multipurpose survey, they are not part of the reference population. For the Census, the population resident in institutions refers to the administrative information (Population Register).

In the model, we use the following definitions of family and household. People in a couple or a parent-child relationship usually living together (see footnote 4) form a family (or nucleus). This includes a married, civilly united (same sex) or cohabiting (both same and opposite sex) couple, with or without children, or a single parent with one or more children. Children refer to a never-married biological, step/adopted son or daughter (regardless of age), who live with at least one of the parents, and who have no partner or own children in the same house. In case of separated parents, minor children are considered part of the parent's family to whom they have been assigned by the court; if children are adults, they can decide which parent to join.

The household may consist of one person (one-person household) or a group of people. In the latter case, two conditions are required:

1. co-residence;
2. the presence of a relationship such as marriage, civil union, kinship, consensual union, friendship, adoption, guardianship, or emotional ties. Conversely, guests, servants or persons who share the dwelling for economic reasons (tenants, boarders, etc.) are not considered as members of the household.

A household may contain several families (family-households). In this case, for instance, a child who marries, if he/she continues to live with his/her parents constitutes a new family within the parents' household. Also, a daughter-in-law who lives with her in-laws forms a household, even in the absence of her husband (being linked to them by an emotional tie).

In addition, a household may consist of people who live together without forming any family, but may be related (such as two siblings or cousins, friends or parents with a divorced/widowed child): these are the so-called multi-person households.

In this research, households containing two or more families will be considered together, as they represent a small share of the total number of households (about 1.5 per cent in the last two decades). Table 4.1 shows the eight household positions and six household types considered.

Table 4.1 - Household type and household position classifications

Household type	Household position
1. One-person household	1. Lone person
2. Couple without children (a)	2. Partner in couple with children
3. Couple with children (a)	3. Partner in couple without children
4. One parent with children	4. Single parent with children
5. Multi-person household	5. Child (b)
6. Two or more family household	6. Other person in one-family households (c)
	7. Person living with others not forming a family
	8. Person in a household with 2 or more families

Source: Authors' processing
(a) Both married and unmarried couples.
(b) Children are never married biological, step/adopted son or daughter (regardless of age), living with at least one parent in a couple or with a single parent, and who have no partner or own children in the same household.
(c) Other person is a person living in a one-family household, not having a couple relationship or parent-child relationship, such as, for example, a cousin or a friend.

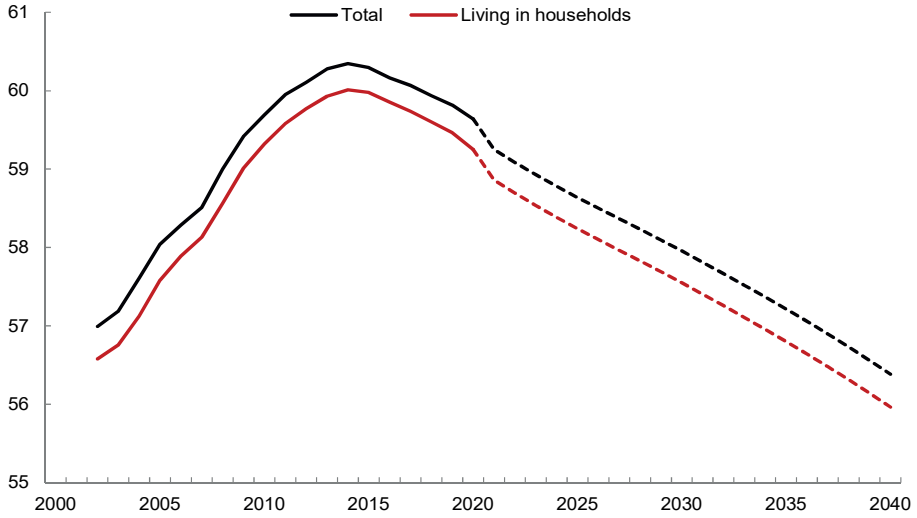
5. Application of the method

In the first step, the aim is to estimate the projected population living in private households. In fact, since the base population, as well as the projected one, represents the entire population, it is necessary to separate individuals living in private households from those living in institutions such as hospitals, barracks, prisons, nursing homes, religious buildings, etc. (see footnote 4).

The proportions of people living in institutions by gender, five-year age group and region were calculated using data from the Permanent Census (mean value observed in 2019). In general, such proportions present a substantial stability along time, despite the ongoing and strong ageing process of the country. In the period 2002-2019 the total amount of people living in institutional households ranges from about 310 thousand to about 480 thousand, thus representing from 0.5% to 0.8% of the total resident population. Given their substantial stability, the proportions of people living in institutional households by sex, age group and region have been kept constant along the time horizon. Among the motivations for assuming a constant trend for the future, we find particularly relevant the fact that older people (the prevailing component in this particular sub-population) are expected to achieve a longer healthy life in the years to come (Quattrociocchi *et al*. 2021). Moreover, family support is still very strong in Italy, where older people are often cared for by family members or, at their own home, by caregivers. We then assumed that both the improved quality of life in old age and the family support could compensate for the large increase of the older population in the future. Therefore, we chose a conservative scenario, following the current trends with a constant proportion of people living in institutional households by age, gender, and region.

Once institutional households are left out of the analysis, we obtain the population living in private households from 2020 to 2040 (Figure 5.1). The graph also shows the growth of the Italian population at the beginning of the millennium, which reached around 60 million between 2012 and 2017, and then began to decline. In fact, a sharp decline in births and an increase in deaths started in the early 1990s, leading to a negative natural balance. For example, in 2020 there were about 400,000 births and over 700,000 deaths. Since 2015, the migration balance has no longer compensated for the natural balance, resulting in a negative total balance that is leading to a continuous population decline.

Figure 5.1 - Total population and population living in households. Italy, years 2002-2040 (observed and median scenario, in millions)



Source: Authors' processing on Population Census and Population projections

The second step of the model consists in calculating the propensities to live in the household positions of interest. For each time t, a propensity rate is defined as the proportion of persons of age x and sex s with a household position i:

$$\text{Propensity Rate}_{x,i,s,t} = \frac{P_{x,i,s,t}}{P_{x,s,t}} = \text{LAP}_{x,i,s,t}$$

where x= five-year age group 0-4, 5-9, ..., 80-84, 85+,
s=sex,
i=household position,
t=time.

Hereinafter, these rates are also referred to as *Living Arrangement Propensities* (LAP). Survey data from *Aspetti della vita quotidiana* (AVQ) allows computing LAPs over the 20-year period from 2002 to 2019. These rates are used to break down the projected population by living arrangement at the regional detail. However, due to the sparseness of data in small regions, we decided to aggregate the LAPs, working first at the 'macro-region' level.

In order to identify homogeneous groups of regions, characterised by similar family structures and evolution over time, we ran a dynamic principal component analysis using the STATIS methodology (Lavit *et al*. 1994). The analysis examined the main socio-demographic variables at the regional level over the period 2002-2019, including fertility rates, mean age at childbearing, mean household size, separation and divorce rates, female employment rates, internal and international migration rates, and proportions of certain family types (singles, couples with and without children, lone parents, etc.). The procedure was optimised by eliminating co-variates with low latent variability explained by the axis. Finally, we obtained the following five clusters:

- Group 1 - North-west (Piemonte, Valle d'Aosta/V*allée d'Aoste*, Lombardia, Liguria);
- Group 2 - Eastern Adriatic (Veneto, Emilia-Romagna, Trentino-Alto Adige/*Südtirol*, Friuli-Venezia Giulia, Marche);
- Group 3 - Tyrrhenian (Toscana, Lazio);
- Group 4 - South (Campania, Puglia, Calabria, Sicilia);
- Group 5 - Central (Umbria, Sardegna, Abruzzo, Molise, Basilicata).

Such a geographical breakdown reflects both the proximity of regions and their similarity in a socio-demographic perspective. The quality of the results allowed clustering the smallest regions in an effective way.

In the third step, the aim is to model future household propensity rates. In this regard, we introduce a synthetic indicator calculated as the sum of the propensity rates by age. In particular, we use the "number of years lived" function from the life table (L_x) to weight the propensity rates, as proposed in the Sullivan's methodology (Sullivan 1971). We denote this indicator as the *Total Household Position Rate* (TPR):

$$\mathbf{TPR_{i,s,t}} = \sum_{\mathbf{x=0-4}}^{\mathbf{85+}} \mathbf{LAP_{x,i,s,t} * L_{x,s,t}} = \sum_{\mathbf{x=0-4}}^{\mathbf{85+}} \frac{\mathbf{P_{x,i,s,t}}}{\mathbf{P_{x,s,t}}} * \mathbf{100} * \mathbf{L_{x,s,t}}$$

where i=household position, s=sex, x=five-year age class, t=time from 2002 to 2019. $L_{x,s,t}$ represents the number of years lived in age group x during year t by individuals of sex s; the indicator is collected from the official Life tables in all the years from 2002 to 2019[5].

5 Source: Istat, *Life tables of the resident population*, https://demo.istat.it/app/?i=TVM&a=1974&l=en.

Under the hypothesis of independence between mortality and household position, the TPR for a given household position would represent approximately how many years on average a cohort of individuals will expect to live in that position. Such hypothesis implies that along the life course the family behaviours and the mortality conditions are experienced as observed in a given calendar year. Furthermore, because of population heterogeneity, people living in different household positions (for example living alone vs. living in couple) also present different mortality risks. However, we assume that the error made by attributing the same mortality to different family types has a limited impact. In fact, in old age, where mortality is higher, the prevailing family condition is living alone. On the contrary, in adulthood, when there is greater heterogeneity between family positions, the risk of death is low and therefore the impact of the error is rather negligible.

In conclusion, the TPR indicator, despite the limitations described above, allows the construction of forecast assumptions that make logical sense and that can be kept under control.

As shown in Table 5.1, the mean time spent as a single person has increased substantially: while in 2002, a man counted on living an average of 5.8 years as a single person (out of a total life expectancy of 77.2), in 2019 the estimated time in this state rises to 9.4 years (out of 81). In contrast, due to declining birth rates, in 2002, women expected to live 22.7 years in a couple with children (out of a total of 83), but in 2019 this expected time drops to 19.6 years (out of a total life expectancy that in the meantime has risen to 85.3 years). In addition, the time in 'child' status has increased from 30.4 to 31 years for males and from 27.7 to 28.6 for females. This is due to the typical Italian behaviour of young people prolonging their stay in the family of origin[6] (Castagnaro *et al*. 2022).

In order to model future trends of propensities, we decided for a top-down approach where we first project the TPR per household position and macro-region, then we estimate the age pattern for each projected year ($LAP_{x,i,s,t}$). In fact, one limitation of the static approach based on propensity rates is the distinct prediction of the rates by single age group, as it is difficult to control their consistency, particularly in the patterns of small regions, with the risk of obtaining unreliable results. Predicting the TPR first made it easier to translate assumptions about family behaviour and to hold together future trends in the various household positions.

6 Children are considered as such if they are never married, regardless of age.

Table 5.1 - Total household position rates by family position and sex. Italy, years 2002-2019

Household position	Men					Women				
	2002	2005	2010	2015	2019	2002	2005	2010	2015	2019
Lone person	5.8	6.1	7.5	8.5	9.4	10.7	11.1	12.0	12.5	12.9
Person in multi-person household	0.9	1.1	1.1	1.4	1.6	1.7	1.7	1.6	1.7	1.7
Partner without children	13.2	13.6	14.7	14.1	13.7	12.2	12.6	13.7	13.2	12.7
Partner with children	23.2	22.6	21.6	20.4	19.7	22.7	22.0	21.1	20.2	19.6
Lone parent	0.8	1.1	1.0	1.2	1.4	4.2	4.3	4.6	4.8	5.4
Child	30.4	30.7	30.2	30.9	31.0	27.7	28.1	27.8	28.3	28.6
Other position	0.8	0.6	0.8	0.9	0.9	1.5	1.4	1.1	0.9	1.0
Person in household with 2+ families	2.1	2.3	2.4	2.7	3.3	2.3	2.3	2.4	3.0	3.4
Total	**77.2**	**78.1**	**79.3**	**80.1**	**81.0**	**83.0**	**83.5**	**84.3**	**84.6**	**85.3**

Source: Authors' processing on "Aspetti della vita quotidiana" survey data

The total time spent in each household position ($TPR_{i,s,t}$) by macro-region is predicted using time-series analysis models based on trend extrapolation from the 2002-2019 period (Box *et al*. 2015). For each household position and sex, the predictions have been carried out applying a best ARIMA optimisation procedure as shown in Table 5.2. These models proved to be effective for all five macro-regions.

Table 5.2 - Predictive models of Total household position rates by position and sex (a)

Household position	Men	Women
Lone person	RWD || ARIMA (1,0,0)	RWD
Person in multi-person household	RWD	RWD
Partner without children	ARIMA (2,0,0)	RWD
Partner with children	RWD || ARIMA (2,1,0)	RWD || ARIMA (2,1,0)
Lone parent	RWD	RWD || ARIMA (2,0,0)
Child	RWD	RWD
Other position	RWD	ARIMA (1,0,0)
Person in household with 2+ families	ARIMA (1,1,0)	ARIMA (1,1,0)

Source: Authors' processing
(a) RWD=Random Walk with Drift model; ARIMA=Auto Regressive Integrated Moving Average model.

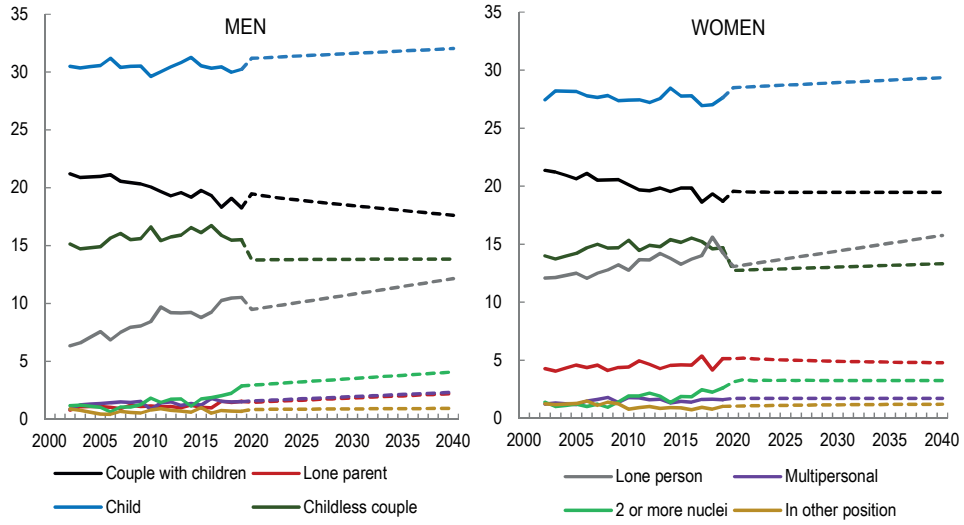
The expected changes in the time spent in different household positions over the 20-year projection period reflect the assumptions underlying our projections. In summary, they show:

- an increase in "lone persons";
- a fall in "partners with children";
- a slight growth in "partners without children";

- an increment in the "child" position;
- a small rise in "lone parents", especially fathers;
- a substantial stability of "other people" living with a nucleus;
- a slight increase in "persons in households with 2 or more families".

These trends can be observed in Figure 5.2, which shows, as an example, the results for the North-west macro-region.

Figure 5.2 - Total household position rates by position and sex. North-west area, Year 2002-2040



Source: Authors' processing on "Aspetti della vita quotidiana" survey data and Households' projections

To define the LAPs in each projection year, we keep constant the age breakdown for each household position and geographical group and equal to the mean one observed in 2017-2019. Hence, we calculated propensities as follows:

$$LAP_{x,s,i,G,t} = LAP_{x,s,i,G,2017-19} * WP_{s,i,G,t} * WL_{x,s,G,t} \qquad t = 2020, \ldots, 2040 \qquad (1)$$

where x=age groups 0-4, ... , 85+, s=sex, i=household position, G=geographical group.

In this formula, $WP_{s,i,G,t}$ is a weight that adjusts $LAP_{x,s,i,G,2017-19}$ on the basis of the future changes in the Total household Position Rates:

$$WP_{s,i,G,t} = \frac{TPR_{s,i,G,t}}{TPR_{s,i,G,2017-19}} \qquad t = 2020, \dots, 2040$$

and $WL_{x,s,G,t}$ is a weight that captures changes in mortality over time:

$$WL_{x,s,G,t} = \frac{L_{x,s,G,2017-19}}{L_{x,s,G,t}} \qquad t = 2020, \dots, 2040$$

At the end of the procedure, the sum of the LAPs by household position in each age group approximates, but does not always equal, the value 100. The problem occurred mainly at the open-aged group (85+) where, because of low absolute frequencies, the impact proved to be not significant. Therefore, some ex-post adjustments were made, which consisted of pro-rating the distributions to the value of 100.

To move from the main geographic groups to regional projections, we allow any single region to keep its own socio-demographic specificity. To that purpose, we introduce a Regional Correction Factor as the ratio between the regional TPR (r) and the macro-regional TPR (G) to which the region belongs, as observed in 2017-2019:

$$RCF_{r,i} = \frac{TPR_{2017-19,i,r}}{TPR_{2017-19,i,G}}$$

where i=household position, r=region, G=macro-region to which region r belongs.

Multiplying the projected LAPs, as from formula (1), by the regional correction factors, we obtain the series of regional LAPs from 2020 to 2040.

As an example, for "lone persons", the TPR found in Piemonte is 10.79 while in the group 1 is 10.42. The RCF is therefore 1.04. This means that since Piemonte has a higher TPR (more lone persons living there) than the North-west group, it is necessary to make an adjustment by multiplying the projected LAPs by 1.04, increasing their level slightly.

In the fourth step, regional propensities are applied to the projected population living in private households obtained in step 1. This application produces the projected population living in different household positions by sex, age group, and region. Figure 4 in Section 6 shows the age pyramids by household position in 2020 and 2040 at the national level.

In the fifth step, we obtain the number, type and size of projected households. We consider the *Household Representative Rate* (HRR), defined as the probability of a person from a specific group (based on geography, age group, sex, and type of household) being a household reference person. From the population by household position, gender and age, we have:

- each "lone person" represents 1 household (HRR=1);
- a "single parent" acts for 1 household (HRR=1);
- "partners in a couple" constitute 0.5 of a household (HRR=½);
- "children" and "other persons" do not count in the calculation of households (HRR=0).

Moreover, for multi-person households and households with two or more families, the HRR is the ratio between 1 and the average number of people in a multi-person household or in a household with two or more families, as observed from data in 2017-2019. Therefore, the multi-person households were obtained by dividing the number of people living in multi-person households by an average size of this type of household, which has remained broadly stable over time at about 2.1 members. Similarly, the households containing two or more families was derived by dividing the number of persons living in households with two or more families by the average size, which assumed values between 5 and 5.4, depending on the territorial reference group.

Finally, we can calculate household size by dividing the population living in the household by the number of households. With this method, household size can be measured for both total households and households containing at least one family.

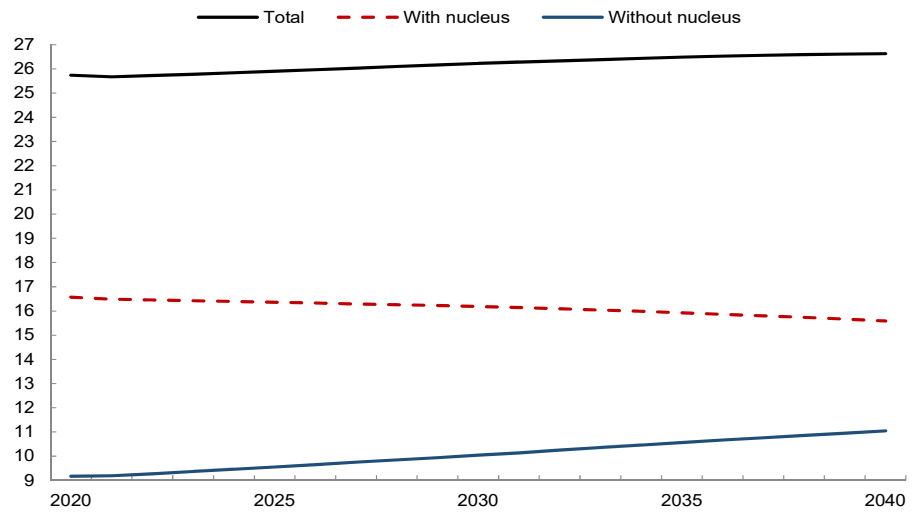
6. Main results

Number of households and size

Projections of the total number of households show an increase of almost one million additional units, following a trend that has already been underway for several years in Italy: from 25.7 million in 2020, it would grow by 3.5 per cent to 26.6 million in 2040.

Such an increase hides a peculiarity of the evolution of families: their fragmentation. Specifically, households without nucleus (non-family households) increase consistently, from 9.2 to 11 million (+20%). Households with at least one nucleus (family households) follow an opposite trend, decreasing from 16.6 to 15.6 million (-6%) (Figure 6.1). This decline is due to the consequences of long-term socio-demographic dynamics, such as the ageing of the population, an increase in marital instability, and low birth rates (Pirani *et al*. 2021). Therefore, an increased life expectancy generates more lone people; the fall in birth rates increases the number of childless people, while the growing marital instability increases the number of people living alone and lone parents.

Figure 6.1 - Projected number of households. Italy, years 2020-2040 (values in millions) (a)



Source: Authors' processing on Households' projections

(a) Data from the survey *Aspetti della vita quotidiana* are disseminated based on a two-year average. Here, however, the data refer to January 1st. As to 2020, this can give rise to differences.

A significant outcome of our predictions is that the mean household size decreases from 2.3 in 2020 to 2.1 in 2040, while the total number of households increases. For households with at least one nucleus, the mean size falls from 3 to 2.8 members over the same period.

Population structure

Past and prospective demographic dynamics in Italy entail a situation in which the number of older people is continuously growing and new generations tend to shrink, both in absolute and relative terms (Istat 2021*a* e 2021*b*). The age structure of the population today shows an imbalance in favour of the older generations and there are no factors that suggest a reversal of this trend. Demographic projections show how unlikely a turnaround in the number of future births can be, even in case of favourable assumptions about fertility (Istat 2021*b*). This is because the prospect of having to deal with a decreasing number of women in childbearing age, on the one hand, and the tendency to postpone parenthood, on the other, seem to be taking on increasing weight.

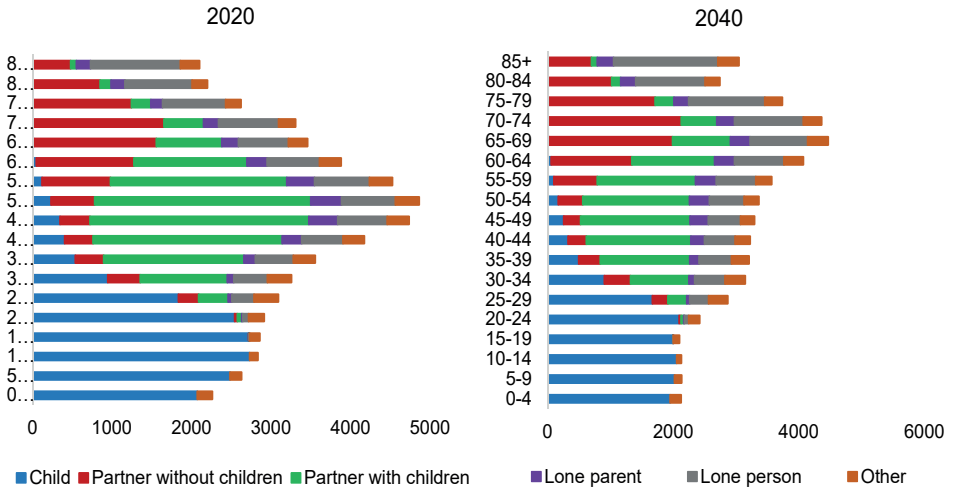
The analysis of the expected population by 2040 according to family role jointly highlights the ageing process and changes in household positions. In particular, it shows a decrease in people living in couples with children, an increase in those without children, and in people living alone, the latter especially if they are older adults (Figure 6.2). The younger age groups are getting smaller, but the "child" family position remains prevalent until the age of 30, reflecting the fact that young people stay longer in their family of origin.

Lone persons

The increase of lone people, real micro-families, is mainly responsible for the absolute growth of the total number of households.

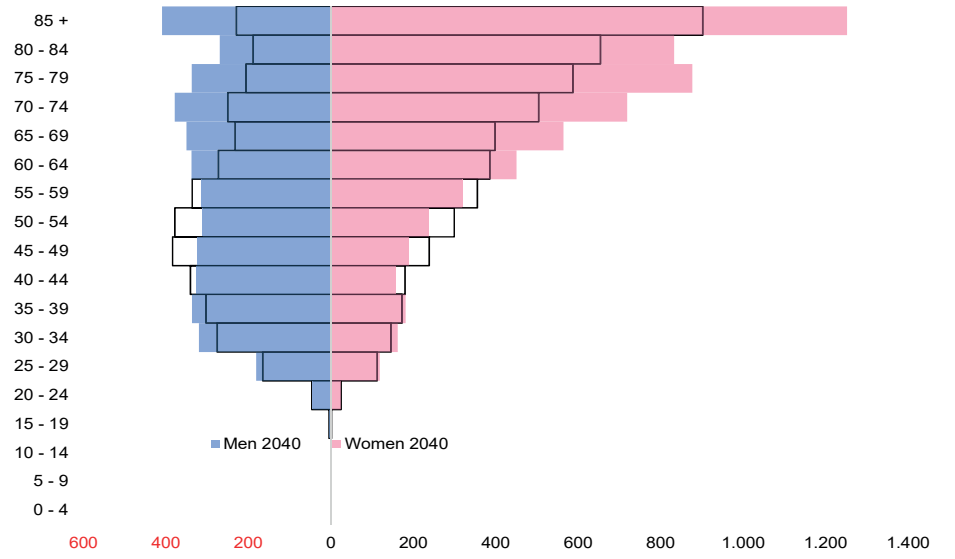
Men living alone are expected from 3.6 million in 2020 to 4.3 million in 2040 (+17%). Women living alone will pass from 5 to 6.1 million, with a 23% growth (Figure 6.3). This growth has a strong social impact, since it is especially in old age that the number of single people increases significantly.

Figure 6.2 - Population by position in the household and five-year group. Italy, years 2020 and 2040 (values in thousands)



Source: Authors' processing on Households' projections

Figure 6.3 - Lone persons by 5-year age group and sex. Italy, years 2020 and 2040 (in thousands)



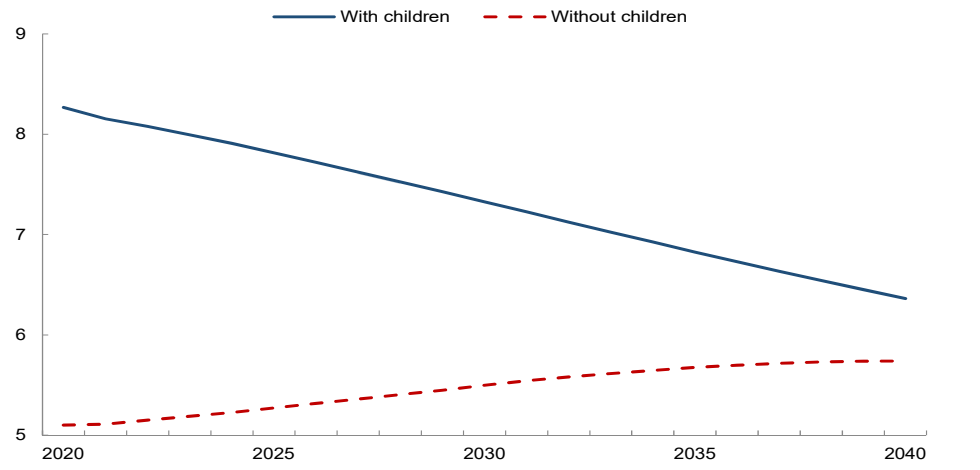
Source: Authors' processing on Households' projections

Among individuals over the age of 64, a spread to 1.2 million lone women and 640,000 lone men are expected. The longer survival of older adults and, among them, of people living alone, could lead to a greater need for care in the future.

Couples with and without children

Due to past and projected fertility levels, couples with children will decrease substantially. Between 2020 and 2040, their number would drop by 23%, from 8.3 million to 6.4 million. At the same time, childless couples are expected to grow slightly, from 5.1 million to 5.7 million, with a 13% increase (Figure 6.4). If these trends continue with the same intensity as predicted up to 2040, especially as regards the decline of couples with children, childless couples could overtake them by 2045.

Figure 6.4 - Couples with and without children. Italy, years 2020-2040 (in millions)



Source: Authors' processing on Households' projections

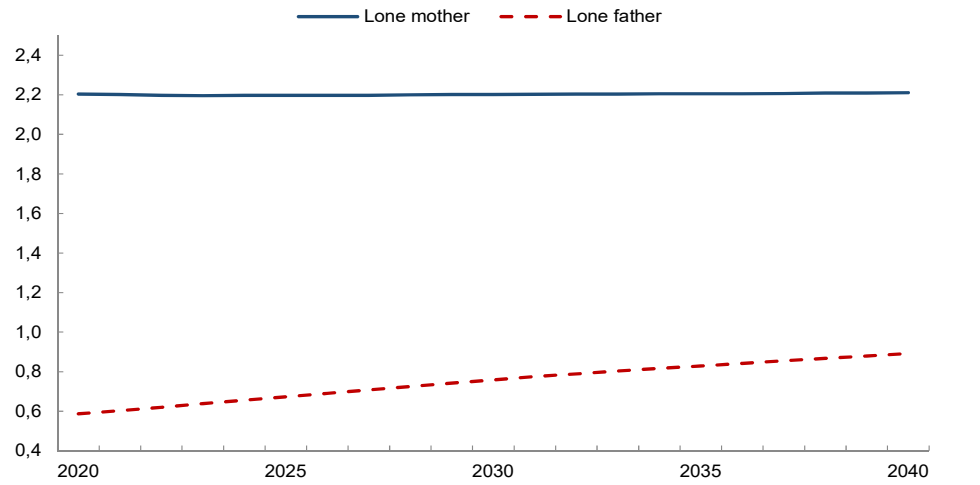
Single parents

As marital instability becomes increasingly widespread in our country, single parent families will also increase.

In 2020, there were 2.8 million lone parents, more mothers (2.2 million) than fathers (around 600 thousand) and they accounted for 8.6% and 2.3% of

total households, respectively. While in the past, after the couple's dissolution, children were generally placed with mothers, the number of fathers as guardians in separation or divorce judgments has increased in recent years[7]. As a result, lone fathers, although still much fewer than lone mothers, would reach about 900,000 (3.4% of total households) by 2040. In that year, single mothers will be numerically unchanged at 2.2 million (8.3% of the total), so that the total number of lone parents is expected to reach 3.1 million (Figure 6.5).

Figure 6.5 - Lone parents by sex. Italy, years 2020-2040 (in millions)



Source: Authors' processing on Households' projections

Geographical differences

At the territorial level, the differences between household types reflect the demographic dynamics and social behaviours typical of the different areas of the country[8].

In the North, in 2020, the share of family households is considerably lower: 62.8% compared to 67.7% in the South (Table 6.1). However, projection

7 This increase is partly due to the 2006 law on joint custody (8 February 2006, no. 54), which provides regulations on the separation of parents and the shared custody of children.

8 The specific territorial classification identified by our model has proven to be particularly effective in modelling the future family formation processes. However, it will not be used for the analysis of the results. In this section, we consider the three large traditional divisions: North, Centre and South, in line with the usual Italian data release, thus enabling a comparison of time series. The main difference between the two classifications concerns the Centre, whose regions belong to Groups 2, 3 and 5. The North roughly corresponds to Groups 1 and 2, while the South refers mostly to Groups 4 and 5.

results show a tendency for convergence between the two areas. In the South, in fact, a more consistent change in this type of household is expected, since in 2040 they could constitute 61% of the total households (a reduction of about 7 percentage points). In the North, in contrast, non-family households will see a smaller reduction, reaching 57.5% of total households in 2040.

Table 6.1 - Households by type and geographic area. Years 2020, 2030, 2040
(percentage values)

Household type	North			Centre			South			Italy		
	2020	2030	2040	2020	2030	2040	2020	2030	2040	2020	2030	2040
Lone man	14.7	15.8	17.0	15.0	15.6	16.7	12.5	13.0	13.9	14.1	14.8	16.0
Lone woman	20.3	21.5	22.9	19.9	21.7	23.4	17.3	19.6	22.4	19.2	20.9	22.8
Childless couple	21.8	22.7	23.1	18.2	19.2	19.6	17.9	19.5	20.4	19.8	21.0	21.6
Couple with children	30.0	26.2	22.8	29.7	25.7	21.9	36.9	32.0	26.9	32.1	27.9	23.9
Lone father	2.2	2.8	3.3	2.6	3.3	3.7	2.2	2.8	3.2	2.3	2.9	3.4
Lone mother	7.5	7.3	7.1	10.3	10.1	10.3	9.0	8.9	8.9	8.6	8.4	8.3
Other type	3.5	3.7	3.8	4.3	4.5	4.6	4.3	4.3	4.3	3.9	4.0	4.1
Households with nuclei	62.8	60.3	57.5	62.9	60.3	57.2	67.7	64.8	61.0	64.4	61.7	58.5
Households without nuclei	37.2	39.7	42.5	37.1	39.7	42.8	32.3	35.2	39.0	35.6	38.3	41.5

Source: Authors' processing on Households' projections

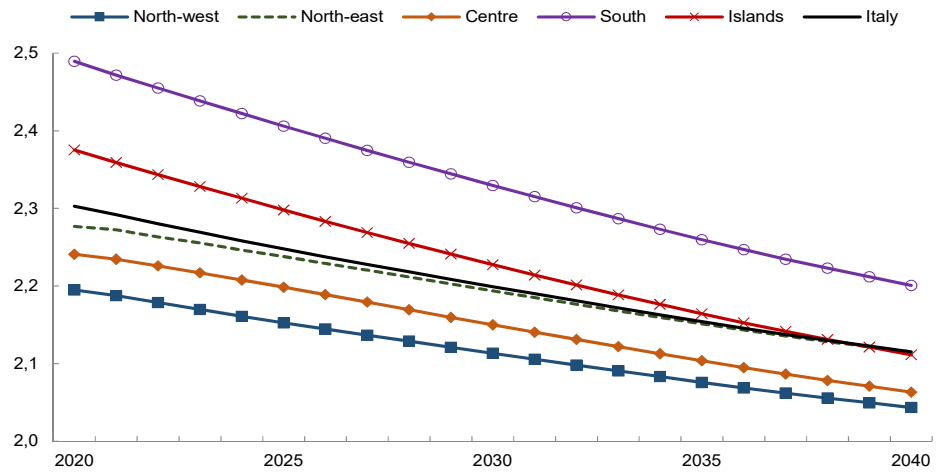
In the short term, the ageing process will be particularly intense in the South. Although this area still has a younger structural profile, its mean age will rise from 44.6 years in 2020 to 50 years in 2040, surpassing even the North, where it will reach 49.2 years (from an initial level of 46.3).

Spatial and gender gaps in survival will affect the growth of people living alone: women will increase from 20.3 to 22.9% (+2.6%) in the North and from 17.3 to 22.4 (+5.1%) in the South, leading to a convergence between the two areas. The proportion of men living alone, meanwhile, will remain at a much lower level in the South than in the North (in 2040, 13.9% vs. 17%). This result is probably due to men's greater propensity to contract second marriages or to live with other relatives in the South rather than in the North (Rettaroli 1997; Angeli *et al*. 2003; Meggiolaro *et al*. 2008; Gałęzewska et al. 2017). As already mentioned, couples with children are the household type that will undergo the greatest change over the next 20 years, falling from 32.1% to 23.9% of total households. In the South, this decrease would be more pronounced, with a drop of 10 percentage points (from 36.9% to 26.9%), due to the strong decrease in fertility rates in these regions.

Childless couples will continue to be more widespread in the North (23.1%), although with a smaller increase. In fact, the most significant change is expected in the South, where, despite a less widespread starting situation, couples without children would increase by about 3 percentage points in the next twenty years (from 17.9% to 20.4%).

All these changes in family structures will have an impact on the households' average size, which will continue to fall according to territorial specificities. The North and the Centre, with very similar current values and future trajectories, will reach an average number of members just below the national value. The South, thanks to historically higher fertility rates, has always had larger families than the North. Today, with declining reproductive levels even in the South, this primacy (2.5 members) tends to become less clear. In the future, the expectation is for a further decline to 2.2 members (Figure 6.6).

Figure 6.6 - Mean household size by geographic area. Years 2020-2040



Source: Authors' processing on Households' projections

7. Conclusions and perspectives

Household projections represent fundamental and priority information for policy planning. Despite the vast utility of knowing the family structure of the future population, official household forecasts are still not widespread. In 2020, the Italian National Statistical Institute started a project with the aim of releasing official household projections integrated with the demographic projections on an annual basis.

In this paper, we described the methodology implemented for projecting the number and type of households in our country over a 20-year time horizon. A static method based on the propensity-rate model was used. The method consists of a few simple steps. First, the projected population is broken down into persons living in private and institutional households; then, propensity rates for the entire projection period are calculated and predicted to obtain the projected population by living arrangements. Finally, predictions on the number of future households, their average size and composition are derived.

The main strengths of this method are: it easily links to existing population projections; data inputs are not burdensome and allow projections to be annually updated; it provides quite detailed results. Starting from the approach developed by the Australian Bureau of Statistics – ABS (2019), we supplemented it with some methodological refinements. These include the introduction of a synthetic indicator, the Total household position rate, regardless of age, and the territorial top-down strategy. The former made it possible to better translate the assumptions about family behaviour and to keep control on the predicted trends of the various household positions. The latter permitted to derive robust and consistent results at the regional level, considering that the release of territorial information is essential for a country like Italy, where geography is itself an interpretative key more than a classification variable.

However, we are still working on some open issues. First, the two-sex problem, that arises when males and females are modelled separately, so that the predicted number of male partners is not equal to the number of female partners. It has proven to be a rather difficult problem, because it has both conceptual and methodological aspects and there is no simple way to bring empirical data to bear on it. Although there are several interesting proposals

(Schoen 1988), we had to overlook them, as it was essential to maintain numerical consistency between the population by household position and the total predicted population by sex and age. Furthermore, we intend to provide measures of the uncertainty of the estimates, which are important for better understanding phenomena and making appropriate decisions.

The results show an expected increase by one million in the number of households together with a decrease in the mean household size that would drop from 2.3 to 2.1 persons in a 20-year time horizon. We find a reduction in the share of couples with children and a growing importance of couples without children and of persons living alone. By 2040, only one in four families will consist of a couple with children, while more than one in five will be childless. In addition, more than 10 million people will live alone in 2040, from an initial value of 8.6 million in 2020. A large proportion of these lone people will be older and this may lead to a greater need for care in the future. However, more old people in the population may also have positive implications: the increase in the number of total years lived, with many of them in good health conditions, could enable these persons to play an active role in the society. For example, as is already the case today and more likely in the future, by supporting their children's families in taking care for their grandchildren and providing them with economic support, participating in the economic cycle not only as consumers of welfare services, but also as capital investors (Istat 2020; Quattrociocchi *et al.* 2021).

Although the results are widely expected, also because they are in line with the overall picture that emerges from the general demographic trends, we believe that our analysis poses a series of useful indications for the planning of policies. In particular, we highlight the need to pay greater attention in the coming years to young families with children and to those that include very old people. Their needs may turn out to be crucial not only for themselves, but also for accompanying a sustainable development of the country system as a whole.

For the future, the outcome of the model and the feedback received from users represent a further incentive for us to refine some methodological issues that would allow better investigating the structure of the Italian household. Among them, for example, we aim at getting more information on couples with children and single parents, by identifying those with children by age group (or below a given age threshold). On the other hand, looking at the is-

sue of the progressive ageing of the population and to the growing fragility of very old people, we are interested in better understanding the family context of older adults, whether they live in couple or alone, or live with the present support of their children.

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