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The Role of Housing in Sustainable European Long-Term Care Systems

Valerija Rogelj [1], David Bogataj [1,2,3,*], Marija Bogataj [1], Francisco Campuzano-Bolarín [3] and Eneja Drobež [1]

[1] CERRISK, Institute INRISK, 8210 Trebnje, Slovenia
[2] Systems Engineering & Economics, Alma Mater Europaea—ECM, 2000 Maribor, Slovenia
[3] Grupo de Simulación Numérica en Ingeniería Industrial, Universidad Politécnica de Cartagena, 30202 Cartagena, Spain
* Correspondence: david.bogataj@almamater.si

Abstract: There is evidence of benefits from the national health insurance systems in the EU Member States in the case of better-adjustment of housing units to the functional capacities of older adults. Still, the systematic approach to evaluating the social value (SV) of investments in specialised housing and other types of built environment is not yet developed. This paper aims to show how these benefits can be quantified if we evaluate the actuarial present value (APV) of reducing public expenditures in Long-term care (LTC), including Health care (HC) in these systems, after the development of specialised housing units which can accommodate the declined functional capacities of seniors. The paper presents steps to measure the SV as the impact of investments in the properly built age-friendly public housing stock, creating positive externalities for HC expenditures and LTC systems achieved for the Health Insurance Institute of Slovenia, thereby decreasing expenditures for this body. We developed a new model to forecast the SV of investments in specialised social housing as savings for national health and care systems, particularly the Central-European health and care insurance systems. We were forecasting the different demands for different specialised housing as part of the social infrastructure for insured older adults, which mitigates public expenditure on HC and LTC services. The multistate transitions are described based on projections and probability-weighted cashflows (actuarial present value, APV) are calculated. Unfortunately, there are no documents by the European Commission yet, although the Commission stresses the need to develop such a model.

Keywords: specialised housing; social gerontology; multiple decrements; actuarial present value; social value; long-term care; public expenditure; social infrastructure

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1. Introduction

1.1. The Challenges of Ageing in Europe

In September 2022, the European Commission (EC) published a European Care Strategy. The Commission's data indicates that public expenditure for long-term care (LTC) in the EU is expected to double in the next 30 years, as in Slovenia (from 1% of GDP to 1.9%). A strong contingency was found between poor and inadequate housing and increasing health problems that increase health insurance expenditure. There is also a strong contingency between the dispersion of housing units and logistics in LTC. Still, no documents consider healthcare (HC) and LTC expenditures dependent on the built environment and seniors' housing dispersion. According to the research of the European Commission, 90% of EU residents prefer ageing and receiving care in their own homes [1]. Currently, the stock of dwellings in the European Union is not suitable to support a change from institutional care to community care–home-based living. Around 75% of housing units in the United Kingdom and 90% in Germany are unsuitable for home-based independent living in old age due to accessibility barriers for people with functional disabilities and chronic and developing diseases [2]. These facts raise the likelihood of exposure to the risks of falls and

other events that raise the cost of health care. According to the European Care Strategy [3], challenges faced by politicians and experts in charge of Long-Term Care (LTC) are:

(a). The share of 65+ seniors will increase rapidly, generating significant growth in the demand for LTC (in Slovenia, from 20% in 2019 to 30.9% in 2050).

(b). The growing cohort of older people who depend on the care of others will have higher expectations than previous generations of receiving appropriate LTC, following their wishes.

(c). The percentage of very old residents (80+) is growing exceptionally (in Slovenia, from 5.4% in 2019 to 11.2%), changing its nature and increasing the scale of dependence on LTC for age-specific conditions.

(d). The availability of potential caregivers will be reduced.

(e). Increased public liability requirements for older adults, increased spending requirements and better care spending for LTC.

(f). Governments face growing difficulties in offering sufficient public housing provision for LTC needs within national budgets as the demand increases, and the supply of informal caregivers is reducing, especially after the prolonged retirement age of potential caregivers (mostly daughters of seniors aged 80+).

There is a contingency among housing, access to community health and social services and independent living, autonomy and quality of life of residents since different living arrangements mitigate differential disability risks [4]. Therefore, housing and services that offer older adults more autonomy within the community to which they belong and enable them to age more independently and safely are universally valued [5]. Housing and public space in the vicinity where people live are essential determinants for the residents' safety, health and wellbeing, reducing health care (HC) expenditures. Our recent interviews (January–April 2022) among more than 500 Slovenian inhabitants, led by homecare caregivers, based on a simple random sampling (1KA ARNES tool was used (available at https://1ka.arnes.si/index.php?lang_id=2) (accessed on 19 October 2022). show that more than 50% of older adults wish to stay at home under homecare or to be dislocated less than 5 km from their home (Figure 1). Only 37% are willing to move to a nursing home, even if it is not close to their home. Nursing homes are too expensive and too far for the majority. However, at home, they are more exposed to the risk of falls and other hazards: 44% of citizens need better adaptations of stairs, 33% require installation of an elevator in their building, and 21% need thermal isolation (to make their house more heat and cold proof) or waterproofing. Only 20% of those included in interviews are satisfied with their housing and think they can be well-supplied and safe enough in their family home.

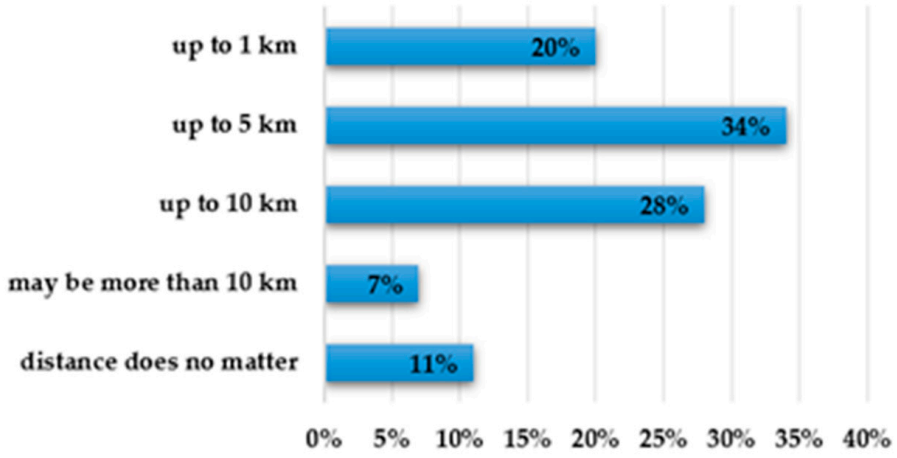

Figure 1. Maximum distance acceptable to move to LTC facilities for persons in our interviews. Source: Authors' analysis of interviews.

Therefore, sustainable development and investments in an age-friendly environment should be evaluated from these aspects. Some experts have moved away from the current approach to sustainable development and suggested a concept in which eldercare becomes central [6]. In *Sustainability*, there are many attempts to evaluate these concepts using multicriteria functions [7,8]. Still, the social value (SV) of specialised housing with proper solutions for the surrounding public space needs assessment. In this paper, we will evaluate the SV as the reduction of the expenditure of the n Health Insurance Institute of Slovenia, due to a better housing solution. Therefore, we suggest evaluating an increase in the actuarial present values (APV) with better housing for older adults, which could also influence better insurance products. We aim to develop a model to evaluate the SV of investments in specialised social housing as a novelty in this field and apply it to Slovenian development programs. The model is applicable in the European Member States, wherein healthcare is covered by national budgets or based on nationally organised health insurance schemes. This helps clear up the dilemma of paying more for health and LTC costs or investing in specialized housing for older adults as a part of the social infrastructure.

1.2. Disability and Social Sustainability

Social sustainability is "a process for creating sustainable, successful environments that promote wellbeing, which can be achieved by understanding what people need from the places where they live and work" [9]. It integrates the design of the built-in space with the characteristics of the social environment and systems for citizen engagement [10], fostering everlasting conditions for wellbeing, for the most vulnerable, disabled older adults too [11].

The disability of older adults is a social process. This process is influenced by an older adult's housing and other aspects of the built environment, where the household context and the built environments are crucial components [12]. Living arrangements and support from the community influence access to resources. [6,7] and Feng et al. [8] are among the few authors who explicitly focus on the role of living arrangements for disabled older adults. However, the exposure to risk in a given environment has rarely been assessed. Disability means difficulty performing daily activities, including household management, chores, self-care, hobbies, recreation, socializing, caregiving, errands and travel [12,13]. The manifestation of the decline in functional capacities depends on the indoor and outdoor environment of the older adult with disability when they experience a mismatch between their physical and cognitive functional capabilities and environment. Functional decline is often also experienced by older adults living in single households, exposed to increased risk of loneliness and solitude that affect their health [14–18]. There is also a strong contingency between the dispersion of housing units and costs of logistics in LTC (transport of materials, travel of caregivers and patients).

1.3. Development of Specialised Housing

The construction of specialised housing stock to accommodate the needs of ageing residents has a long tradition [19]. Terms used for retirement housing (RH) vary worldwide [20]. A variety of names such as "sheltered housing", "supported housing", "integrated care", "assisted living", "retirement village", "independent living unit(s)/villas", "serviced unit(s)/apartment(s)", "lifestyle village(s)", "residential park", "self-care unit(s)", "independent living village(s)", "retirement community/communities" and "continuing care retirement community" describe housing developments for seniors [20–22]. Seniors are usually defined as persons aged 55 and over [23]. Currently, there is a shortage of retirement housing in the UK and the EU Member States [24] due to a substantial lack of supply in the context of a rapidly growing cohort of seniors who cannot afford their own spending for accommodation and housing. Assurance of proper housing provision has recently become a subject of parliamentary debate in the House of Commons in the UK, where the supply of such housing units is much under demand [25]. Still, initial investments seem to be a constraint.

Recent studies in the UK have shown that proper, barrier-free housing arrangements decrease incidences of falls and related HC costs of accidents by half [25]. Losekoot and Theresa [26] have investigated the development of retirement villages in New Zealand, offering many residents accommodation, food, facilities, recreation activities and medical care. In Australia and the USA, the ageing population influences the provision of housing services [27,28] that range from independent living to intensive care facilities [29,30]. In the USA, a 20-year-old literature has identified two primary housing models for seniors needing others' help: Continuing care retirement communities (CCRCs) and assisted living facilities. CCRCs have started to develop since the middle of the last century and contain independent living housing units, assisted living housing units, memory care and nursing home (NH). Older adults can move into independent living in housing units if fit. Changes in care needs are accommodated within the CCRC. In such arrangements, residents can move from independent living housing units to an assisted living housing unit or memory care on-site under the same insurance contract. For those who need intensive care, a nursing home is also available [22]. In Australia and USA, a retirement village is a possible, acceptable living arrangement for seniors [31,32], encouraging social interaction, enhancing life quality and promoting independence [32].

Appropriate and adequate housing constitutes the core of housing rights. By losing their functional capacities, older persons can find living in their current home challenging. Moreover, by leaving their home and substituting it with institutional care, some critical dimensions of housing rights, such as integrity and independence, are lost [33]. Therefore, common facilities between the old home and the nursing home should be available where housing rights are protected. Several international human rights instruments acknowledge and preserve the right to housing. For instance, in Article 25 of the Universal Declaration of Human Rights [34], the right to housing is recognised as a significant part of the right to an "adequate" standard of living [35]. A similar provision is included in Article 11 (1) of the International Covenant on Economic, Social and Cultural Rights [36]. Furthermore, the right to adequate housing is regarded as a freestanding right, according to General Comment no. 4 on Adequate Housing [37].

Further, according to Article 25 of the European Charter of Fundamental Rights [38], the Union recognises the rights of seniors to lead a life of dignity and independence. This respects their wish to participate in social and cultural life. Therefore, it can be argued that international and European sources of law oblige EU Countries to conduct deinstitutionalisation and develop community care which could enhance the chances of seniors to choose their lifestyle freely and lead independent lives. Special consideration should be made for older adults with declining functional capacities, who depend on the help of others when their human rights are at stake and also in the context of the right to appropriate housing. For example, Article 78 of the Constitution of the Republic of Slovenia [39] states that the government shall create a legal environment and institutions that enable citizens to obtain an adequate home. This right forms a part of constitutional social rights, but does not operate by well-known, universally recognised minimum standards. Therefore, vagueness and flexibility could affect their effectiveness. However, due to the higher vulnerability of very old persons with declining functional ability, unsuitable housing could also result in a breach of older persons' rights (civil), from personality to privacy. The absence of proper actions by states could result in the violation of constitutional commitments [33].

In this fast-ageing society, which brings new challenges, new legal rules should be created to organise the lives of older adults. These requirements include the laws governing the financing of older adults, their health services, proper housing and other facilities, and assistance. In the debates on policies for older adults, new questions arise regarding the individual's freedom, autonomy and equality. This is why comprehensive constitutional protection of the rights of older adults was born, stemming from the fundamental right to dignity. Dignity is the most important quality for older adults [40,41], and housing rights are essential for protecting it. Moreover, the issue of the legally protected right to adequate housing for older people has become necessary in some European countries

after the recommendation of the Council that the Member States should commence the process of deinstitutionalisation. The development of community care and a better-adapted housing stock structure is needed for such a process.

In Section 2, we will focus on an overview of social infrastructure and services for the housing and care of older people in ten EU Member States. We will examine how social infrastructure for older adults' health and social care is developed across some EU countries. We looked at the social infrastructure arrangements for housing and care for older adults in 10 EU Member States: the Netherlands, France, Spain, Germany, Italy, Austria, Finland, Denmark, Croatia and the Czech Republic. The countries were selected to achieve the best possible geographical coverage of the European Union's different parts and include as many different arrangements as possible. In the context of social infrastructure for the accommodation and care of older adults, we have considered all residential facilities where social care services are provided and which include some form of public funding. In Section 3, the model for evaluation of the social value of housing is presented. The case study for Slovenia is shown as a numerical example in Section 4. From Section 4, the conclusions are derived in Section 5.

2. Adapting Living Facilities to Older Adults in Some EU Member States

2.1. Some Statistics and Demographic Projections

The EU Member States are now planning to improve the housing structure parallel to shifting LTC from institutional to home care (see details in the *Recommendations on the National Reform Programme for Slovenia* and the opinion of the Council of the European Union on the Stability Programme of Slovenia for the period 2012–2016 in [42]).

However, the activities are too slow in all EU Member States. Reaching deinstitutionalisation will not be enough to retain older citizens in the previous home environment. It also requires the development of integrated community care and the adaptation of homes through the construction of universal housing in lifetime neighbourhoods that can accommodate older adults, or replace these homes with more appropriate homes. The housing market and the legislation, especially the legislative and executive branches, must respond to this challenge. Many national acts in the developed world define and enact at least four accessibility features to be included in new homes and which significantly impact accessibility for people with declining functional abilities and, consequently, the wider community.

According to the Memorandum of Understanding [43], the right home environment is adaptable to heat, safe, accessible for older adults and visitors, and residents have access to support services and the help of others in general.

The comparative table (Table 1), derived from the Aging report data [44], shows that Croatia has the highest proportion of its population in need of assistance, at almost 10%. Spain has the lowest share of people needing assistance, at 4.3%. The difference may also be due to how people eligible for assistance are recorded and other factors (such as the effects of war and the associated higher number of war invalids in Croatia). On the other hand, Croatia has a relatively low percentage of people living in institutional care (0.8%) and the lowest percentage of people receiving state-subsidised home care (only 0.4%). In comparison, only 2.7% receive cash benefits. This means that only 3.9% of persons in Croatia, or approximately 40% of all EU citizens in need of assistance, are provided with long-term care, at least in some form. On the other hand, in the Netherlands, where 6.5% of the total population is dependent on assistance, everyone in need receives at least some form of long-term care (23% of all those in need receive institutional care, 81% receive home care and 7% receive cash benefits). The same is true for Italy (where 17% of those in need of assistance receive institutional care, 21% home care and 59% receive cash benefits) and Austria (9% of those in need receive institutional care, 11% home care and 78% cash benefits). A high proportion of those in need, 83%, receive some form of long-term care in the Czech Republic (17% of those in need benefit from institutional care, 15% from home care and 51% from cash benefits). In Finland, however, those in need of care receive

several types of long-term care in more than 50% of cases (7% are in institutional care, 50% receive home care and 71% cash benefits). Long-term demographic projections point to a marked trend of ageing of the European population in the coming decades. As a result, the EU's total population is projected to decline in the long term, and the population's age structure is set to change significantly in the coming decades. According to Eurostat, the total population will decrease by 5% (424 million) between 2019 (447 million) and 2070. The working-age population (20–64 years) will decline even more sharply, from 265 million in 2019 to 217 million in 2070, driven by fertility, life expectancy and migration dynamics. According to Eurostat demographic projections, life expectancy at birth in the EU is projected to increase by 7.4 years for males and 6.1 years for females, with the most significant increases in the Member States that currently have the lowest life expectancy.

Table 1. Data on the number of older people needing long-term care and the pathways to long-term care for the 10 EU Member States in 2019.

	People in Need of the Help of Others		**Institutional Care**		**Home Care**		**Cash Allowances**	
Country	**in 1000**	**%**	**in 1000**	**%**	**in 1000**	**%**	**in 1000**	**%**
Austria	781	8.80%	70	0.79%	94	1.06%	466	5.25%
Czech Rep.	707	6.62%	123	1.16%	105	0.99%	366	3.43%
Denmark	379	6.52%	58	1.00%	195	3.36%	0	0.00%
Finland	384	6.96%	27	0.49%	195	3.53%	276	5.00%
France	6185	9.22%	1150	1.71%	1286	1.92%	446	0.66%
Croatia	395	9.72%	32	0.80%	17	0.42%	108	2.66%
Italy	3395	5.63%	645	1.07%	721	1.20%	2006	3.33%
Germany	5795	6.97%	858	1.03%	754	0.91%	2388	2.87%
Netherlands	1130	6.51%	263	1.52%	921	5.31%	90	0.52%
Spain	2007	4.26%	153	0.33%	454	0.96%	606	1.29%

Source: Ageing report, 2021 [44].

Figure 2 shows the growth index of people dependent on assistance. It shows that the EU Member States will experience different dynamics in the growth of the aid-dependent population. For example, the highest increase in the aid-dependent population will be in Spain (53% in 2060 compared to the base year of 2019 and falling to 47% in 2070), followed by Austria (32% growth in 2060) and the Netherlands (32% growth in 2060) and Italy (29% growth in 2060). On the other hand, Croatia expects to have the lowest growth index of its assistance-dependent population (100), and falling after 2060. It is obvious that these dynamics will stabilize after 2060. Due to the various dynamics of the population's growth dependency on help from others, different countries will have different needs for developing a social infrastructure for long-term care.

Figures 3–5 show the growth projections for recipients of institutional care, home care and cash benefits, considering existing legislation.

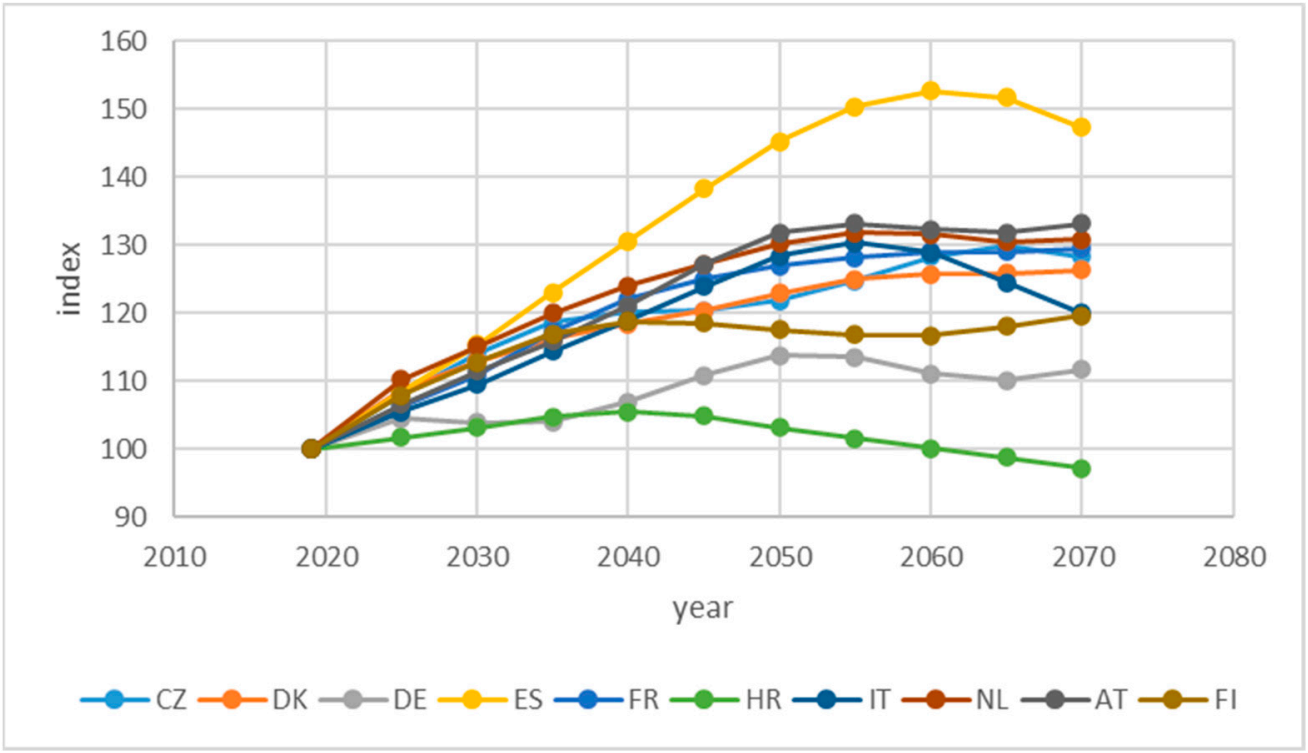

Figure 2. Index of dependent people with base year 2019 in selected EU Member States 2019–2070. Source: adapted from Ageing Report 2021 [44].

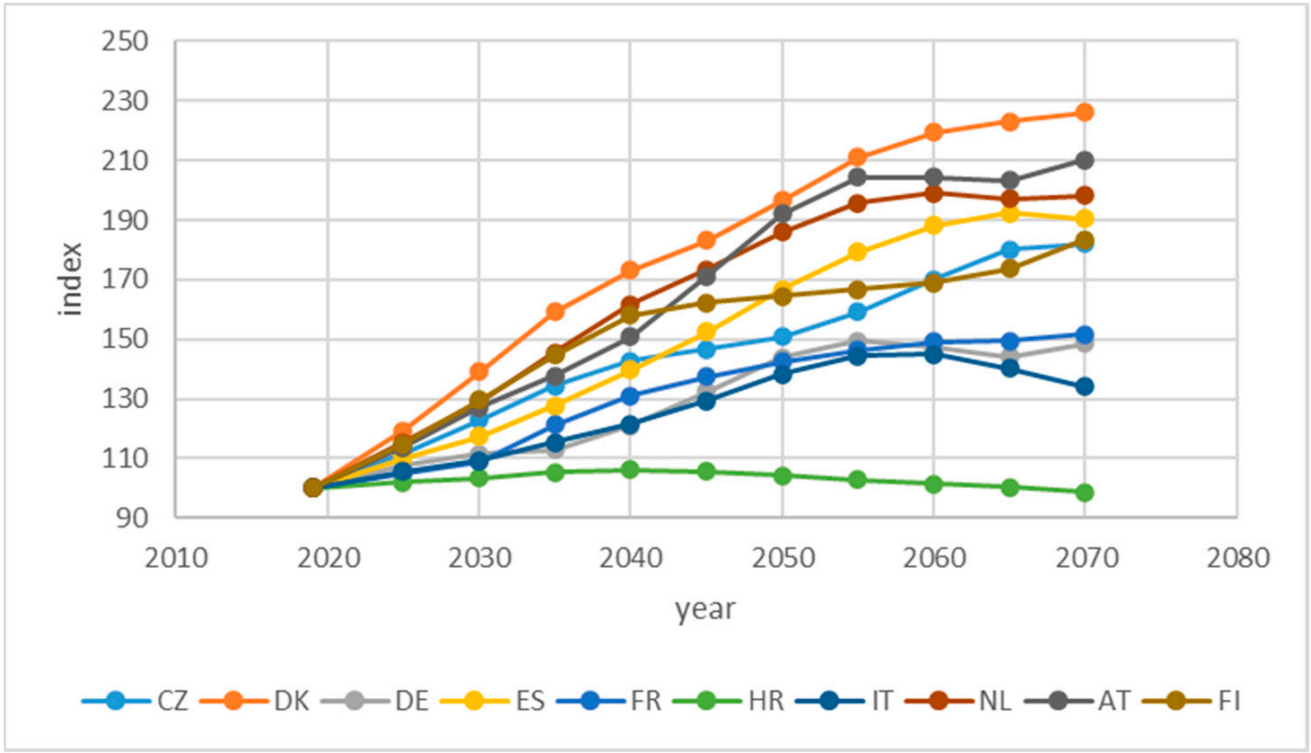

Figure 3. Index of institutional care recipients with base year 2019 in selected EU Member States 2019–2070. Source: adapted from Ageing Report 2021 [44].

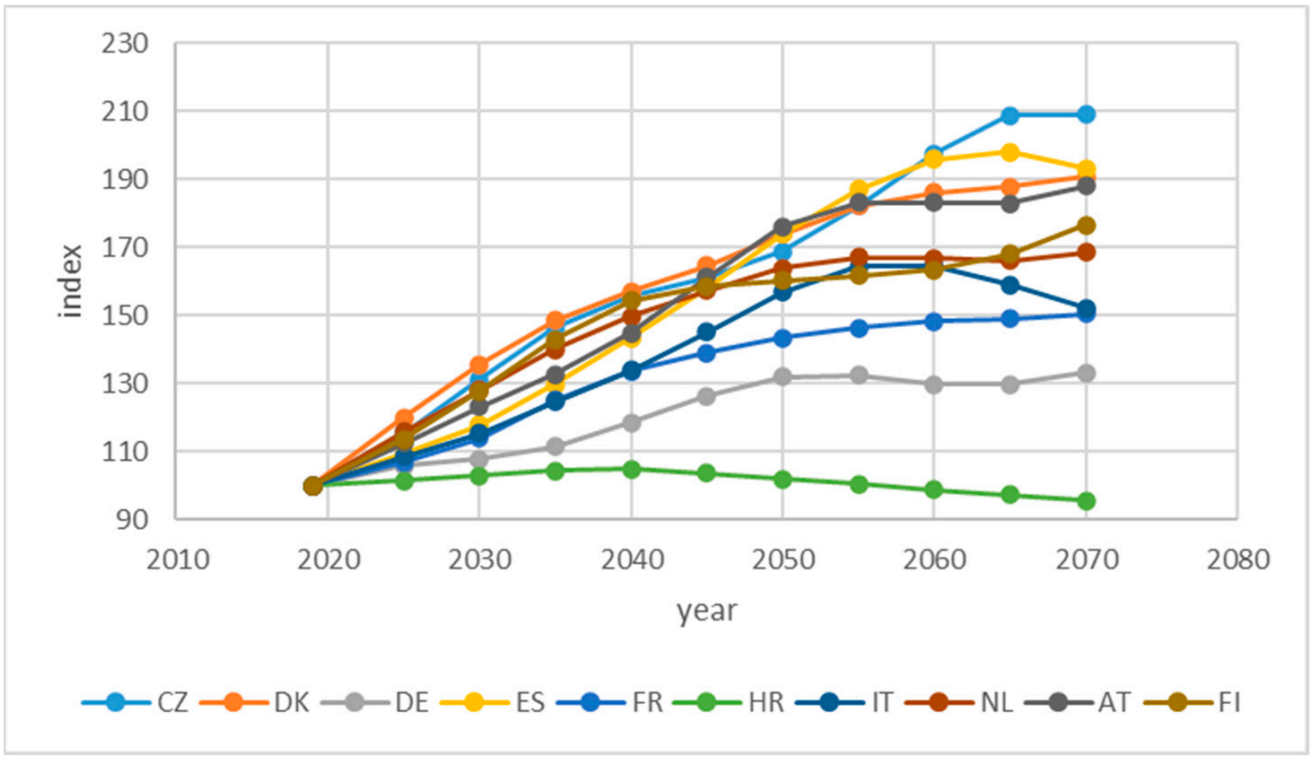

Figure 4. Index of home care recipients with base year 2019 in selected EU Member States 2019–2070. Source: adapted from Ageing Report 2021 [44].

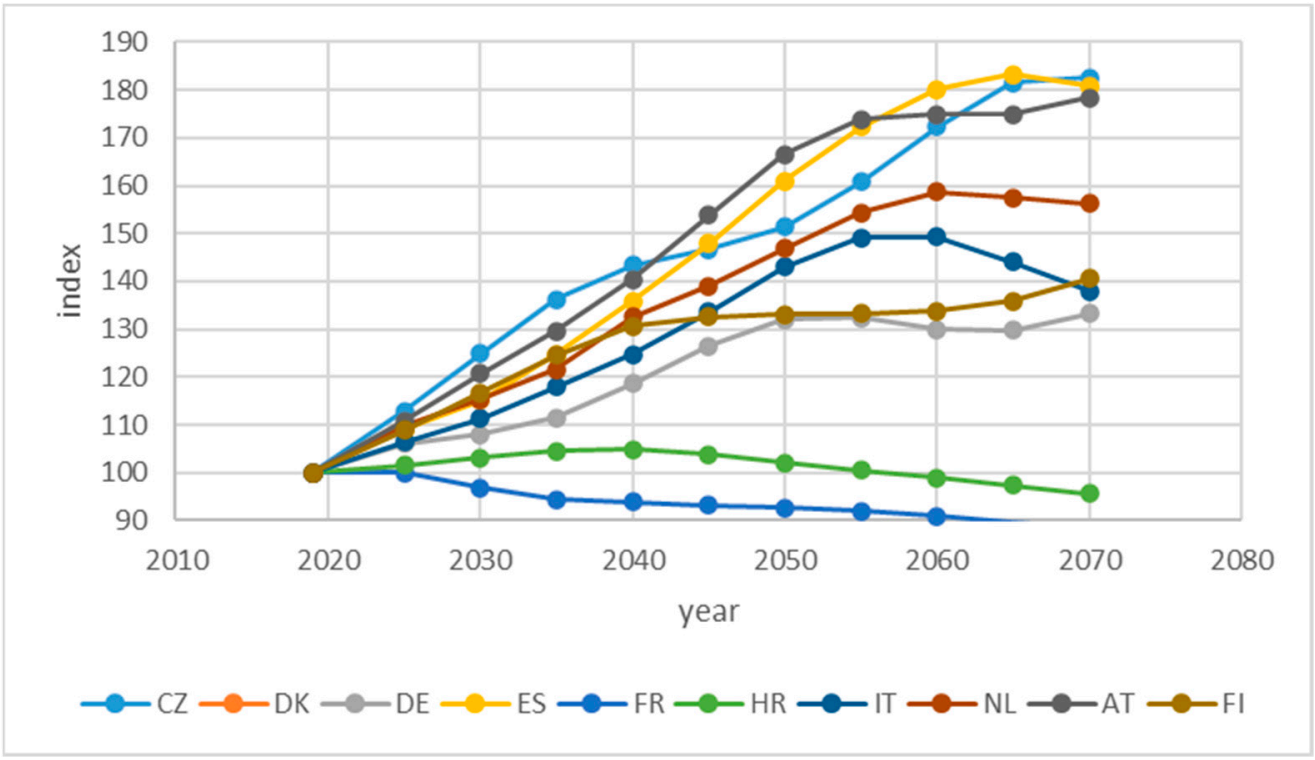

Figure 5. Index of cash benefits recipients with base year 2019 in selected EU Member States 2019–2070. Source: adapted from Ageing Report 2021 [44].

2.2. The Decline of Functional Capacities and Value of Housing Stock for Older Adults

For older adults who face physical and cognitive functional decline, choosing between staying in the current family home and moving to a retirement community with more accommodative housing units is demanding. Evaluation of the SV of such movements involves a new research method, data collection and the analysis of previously collected and tabulated data by other sources for other purposes, such as data collected from government agencies and publicly available data by third parties. Figure 6 illustrates a trajectory of functional capacity. There are thresholds when an older person needs the help of others and such needs can be characterised by the Care Dependency Scale [19], while the costs of such services are measurable. However, these costs can be influenced by housing characteristics, which could broadly expand the area of the functional capacity of individuals. People sooner or later reach the disability threshold (DT) when they need to find a more suitable living environment or intensive care. This moment is associated with higher costs of services and housing provisions. Hwang et al. [44] found a positive relationship between home improvements and ageing-in-place. Their results underscore the importance of the accommodative environment to prolong living in the community and postpone relocating to a nursing home.

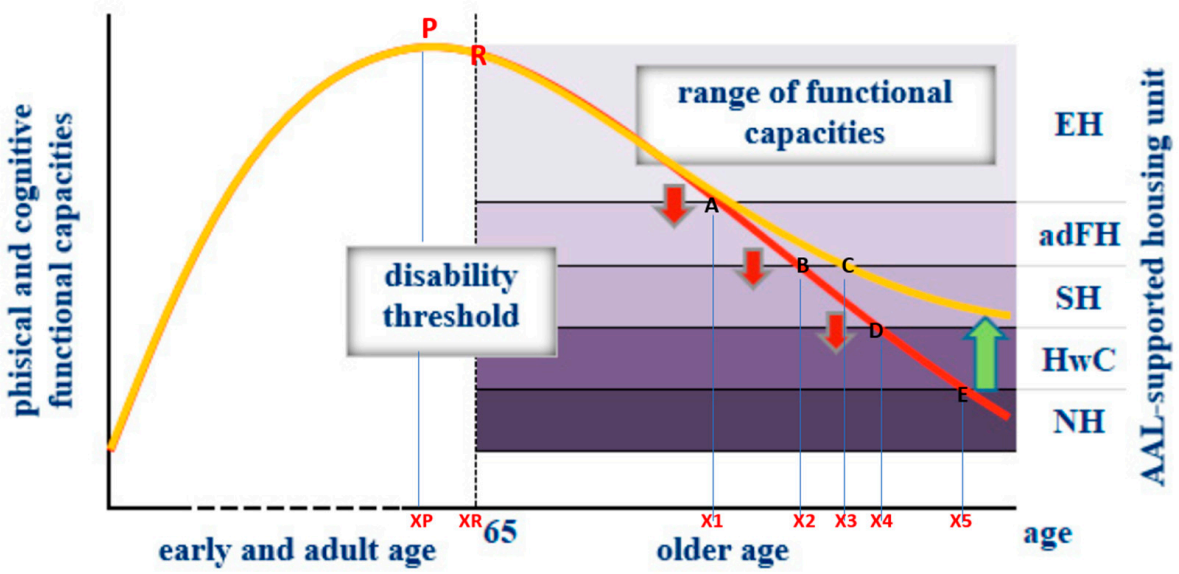

Figure 6. Evolution of functional capacity of a person from birth to old age and disability thresholds after 65. Legend: EH—existing normal family home without adaptation, adFH—adapted family homes, SH—sheltered housing, HwC—housing with care, NH—nursing home, A, B, D, E are the disability thresholds for the basic trajectory of functional capacities and C is the disability threshold in case different activities during old age improve the trajectory from the red to the yellow curve.

In Figure 6, P is the highest point of functional capabilities at age XP of a person, while R is the point of retirement at age XR. If older adults live in an unadopted environment EH, high risks from the built environment, such as fall, are present after age X1. The risk decreases if the senior moves to a more accommodative housing unit in sheltered housing: if he moves at 72 to an SH (see A), his exposure to risk decrease. He may stay at an SH without care. Due to the accommodative environment and access to services in Housing with Care (HwC), the older adult postpones relocation to a nursing home (NH). The older adult reaches the disability threshold (DT is A in case of unadopted or B in case of adapted home) when living in his dwelling is no longer safe for him. If the older adult has the option to move to a more accommodative housing unit in sheltered housing (SH) or HwC that provides a safe living space, the relocation to NH can be postponed for X5-X2 years in cases in which there is no option for HwC or X5-X4 years in cases in which in this region HwC is also an available option. The trajectory of functional capacities can be measured by

the Care Dependency Scale, while disability thresholds depend on the built environment's barriers. With a more accommodative built environment, housing and public spaces, the disability threshold moves downward. A, B, D, E are the disability thresholds for the basic trajectory of functional capacities and C is the disability threshold in cases in which different activities during old age improve the trajectory (for example rehabilitation and other physical activities). In case of improving the trajectory of functional capacities and in case SH and HwC are also available options, the person moves to NH X5-X3 years later.

In the coming decades, in Europe, at least one-fifth of the houses and apartments will have to be converted into barrier-free homes, friendlier to older adults and more suited to their needs; otherwise, the costs of care for older adults will increase significantly [25]. This transformation will require significant financial resources. Given the functional capacities of individuals and their other priorities, it is expected that the adaptation of their current homes, reconstruction and relocation of housing will take place in two directions:

(a) separation of older adults into different types of retirement communities (retirement villages, assisted-living facilities, continuous care retirement communities, sheltered housing, housing with care), which can be expected primarily in their old age [45],

(b) the adaptation of homes, construction of universal apartments and accompanying facilities in their neighbourhoods, close to their current home, that will be suitable for all generations, even for those with fewer mobility and special needs typical of older people [46], following the trends in many cities and smaller towns.

There will be a need for more considerable financial resources to which older people will contribute, and the society should be organised so that investment in an age-friendly environment and community-assisted-living facilities will be financially achievable for the community. To achieve these goals, it is not enough to improve the institutions of the social and health sectors. We also need to adjust the built environment and financial services, including the property tax of local communities and the state social infrastructure, to fulfil the growing needs of older adults.

With the rapidly growing older proportion, the development of built environments should follow guidelines set by the UN Standard Rules for the Equalisation of Disabled Persons [37]. They recommend the design of buildings in renovations and new constructions that would enable the best integration of older adults and thus offer them equal opportunities to live in the community. The UN guidelines require the following from city planners and developers:

(a) construction and installation of facilities or devices that can be equally well-used by those with reduced mobility,

(b) flexibility in use,

(c) easy to use, and understandable for older people with less experience of new technological advancements and with linguistic constraints or lower education, knowledge or concentration,

(d) quickly recognisable accompanying information for orientation in the room and for handling devices, also for those with poor vision or hearing,

(e) less exposure to the risk of an accident,

(f) efficient use of facilities,

(g) appropriate dimensions of the space for access to facilities regardless of user mobility.

These requirements are also supplemented with detailed instructions on achieving the stated objectives. They are in favor of that part of the population with reduced mobility. Thus, providing a built environment and facilities in cities and settlements of an urban character that satisfies the needs of all residents requires substantial financial resources. Some, of these funds will also need to be collected through compensation for using urban land or real estate taxes, and some older adults with low incomes will also need to contribute.

Retirement villages, scarce solutions in Europe, have been at the centre of our investigation. The construction of retirement villages significantly contributes to Australia's and Florida's economies, with stable growth over the past decades [47]. In Australia in 2013, there were over 2000 retirement villages, accommodating more than 177,000 seniors. Living

in such arrangements contributed to government HC and aged care savings estimated at over $2.16 billion annually. Residents of retirement communities enter institutional LTC later, have less frequent and shorter hospital stays and have better social wellbeing [48,49]. Such a housing stock arrangement also reduces the cost of publicly funded HC services [50]. According to [51–54], the value derived from sheltered housing is recognised as beneficial to the individual, community and taxpayers. The older adults living in dwellings adopted to seniors were found to have higher perceived autonomy, a sense of security and good quality of life. Researchers [51–54] have advised that sheltered housing should be integral to LTC policy.

The Supported Housing Review [55] acknowledges how broader benefits from supported housing which accrue to other agencies (for example, National Health System) are evident; therefore, a holistic 'whole system' approach to determining value for money is an unsolved challenge. Sheltered and extra care housing can deliver:

(a) individual flats and facilities that are accessible for people with mobility problems and easily adaptable to meet changing needs,

(b) accommodation is economical regarding heating and is of an appropriate and manageable size.

Proper sheltered housing design provides a building that is the foundation on which care and support services can be cost-effectively and efficiently delivered to meet individuals' needs as they age. While schemes vary significantly in size, scale and facilities, there are some common areas where these schemes offer added value:

(a) provide better safety and security for vulnerable seniors,
(b) support and independence,
(c) better individual physical as well as mental health,
(d) maintain and develop links with the community,
(e) increase the income of seniors and reduce poverty,
(f) facilitate downsizing to more suitable housing (freeing up larger homes),
(g) delay admission to a nursing home,
(h) reduce the frequency of hospital admissions,
(i) enable care setting after discharge from the hospital and lower incidence of re-admissions to a hospital,
(j) allow rapid recovery from periods of ill-health or planned admissions,
(k) lower care costs.

The provision of dwellings for the decreasing functional capacities of older adults could be stepwise. Therefore, we can determine the needed housing stock structure based on the multiple decrement model as developed by [56] On this skeleton, the SV of sheltered housing as reduction of LTC expenditures paid by the Health Insurance Institute of Slovenia can be modelled and evaluated using the principles of actuarial mathematics [57].

2.3. Survey os the Housing Needs of Very Old Adults in Slovenia

A survey was conducted among 198 recipients of LTC, out of whom 100 recipients were from home care (mostly not adapted housing) and 98 from nursing homes in four Slovenian municipalities. The caregivers administered the questionnaire under the guidance of responsible researchers [58]. Even though in 2018 the average pension income in Slovenia was 620 EUR per month, pension benefits of some groups of retirees, such as farmers, were lower than 300 EUR per month; therefore, they could not pay the rent for specialised housing. Among home care users, the preferential dwellings and services were as follows: 44% of seniors would have liked to stay in their old homes in any case; 40% of older adults wanted to live autonomously in ambient assisted arrangements; 13% of them insisted on living autonomously in any case till the end of their life and only 1.6% respondents were willing to spend the last hours of life in a nursing home. Based on these results, one can conclude that more than 40% of Slovenian older adults expect their municipalities will commence development of specialized housing as part of social housing. The social housing in Slovenia is now very poorly developed in comparison with Austria, France,

Netherlands or Scandinavian countries. This makes movement between homes more difficult. Older adults are ready to pay the rent or buy such units without expecting social subventions. However, we can assume that, if the rent for ambient assisted arrangements (AAL arrangements) of housing units was financially affordable (publicly subsidised) to older adults with low pension benefits, the percentage would be even higher. The awareness that rent in specialised housing is financially unaffordable for older adults with low incomes has led many to decide that they will stay in the existing home, despite barriers in its environment and the greater danger of falling or other forms of accidents.

Table 2 shows that a relatively large proportion of older adults with low pension benefits (up to 500 € per month) want to stay in their current family home in any case. From their response, it was understood that, in many cases, the answers are influenced by the awareness that the pension they receive is too low to consider anything other than staying in their existing homes or going into institutional care in a nursing home. They are mostly owners (at least partly) of their homes, but in Central Europe reverse mortgage products are not suitably developed, and the housing market in the countryside is not developed either. AAL housing was the preferred option among those with higher pension incomes. Even today, in some EU member states a large share of these older adults lives in public housing owned by the state or local government (see Figure 7).

Table 2. Number of seniors included in the survey, according to the type of desired dwelling and the monthly amount of pension benefit.

Pensions in EUR/Month	AAL + Retirement Community + Adapted Independent Home	To Stay Till the End of Life at the Family Home (No Adapted)	n
0–500	15	17	$n_1 = 32$
800+	9	4	$n_2 = 13$

Source: interviews by authors.

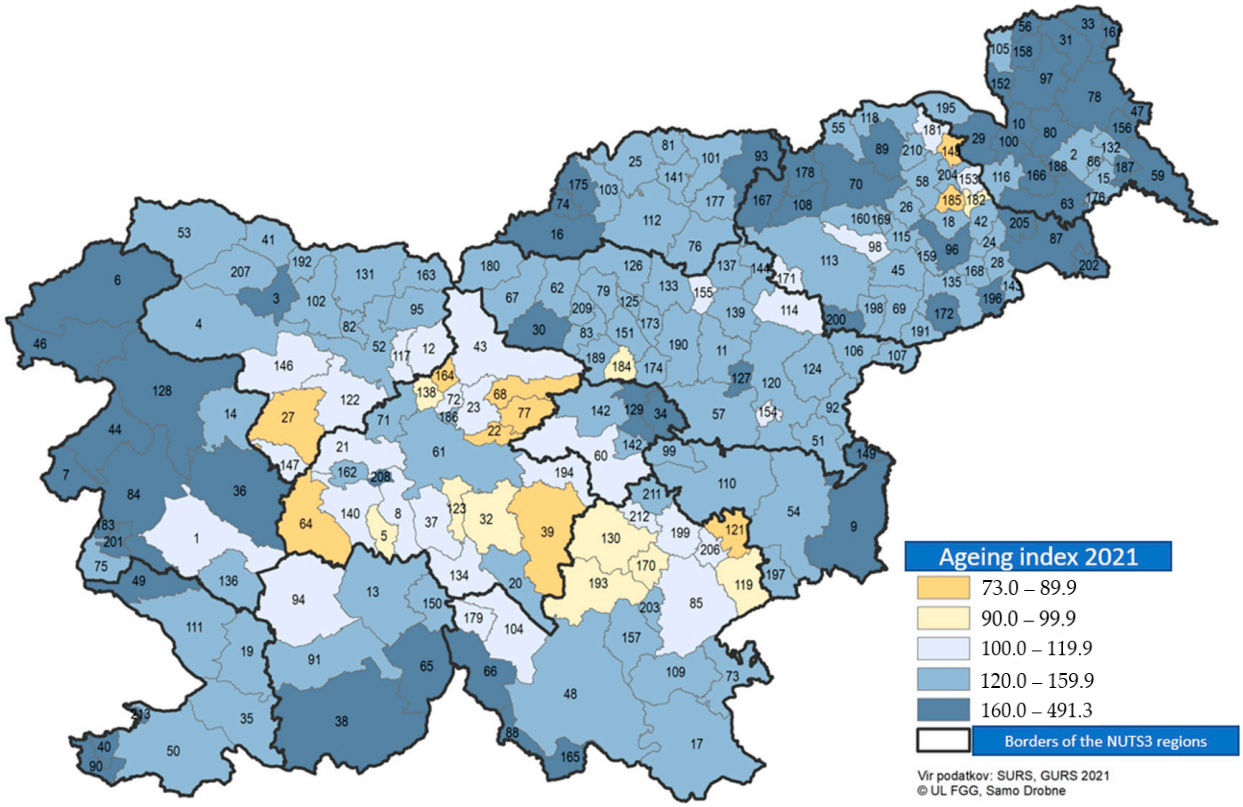

Figure 7. Ageing index in Slovenian municipalities in 2021. Source: Statistical office of the Republic Slovenia & Geodetic Administration of the Republic of Slovenia, designed by Samo Drobne.

Social housing rental stock as % of total housing stock in 2020 in EU varies a lot. It is presented in Figure 8.

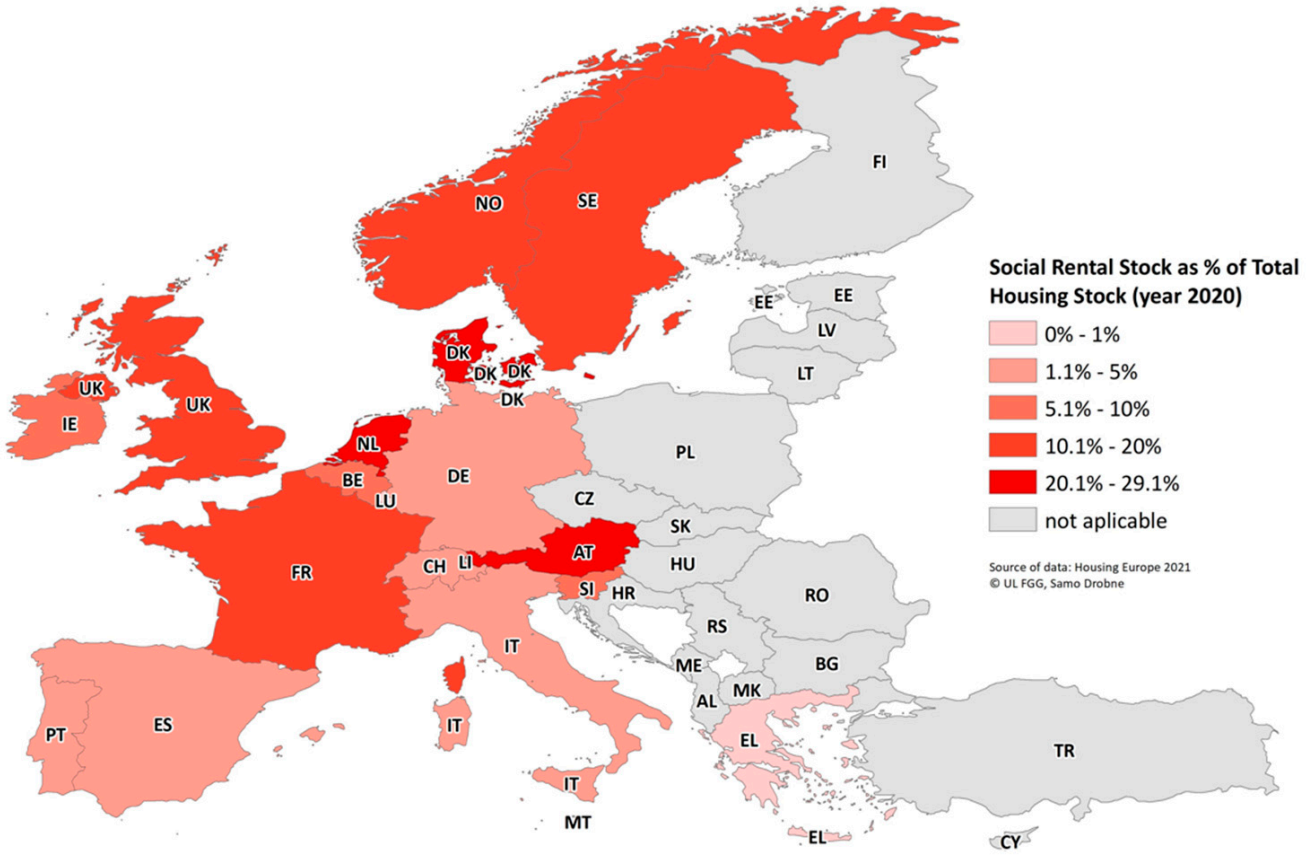

Figure 8. Social housing rental stock as % of total housing stock in 2020. Source: Based on data of Housing Europe 2021, https://www.stateofhousing.eu/#p=60 (accessed on 19 October 2022), designed by Samo Drobne).

From the table, one can prove the hypothesis that older adults in the income classes of 800+ (n_2 = 13), who can afford rent and care in specialised housing, want to stay in their family home in a smaller proportion to that of seniors with lower pension income (n_1 = 32). This finding opposes the claim of the Eurobarometer [1] that 90% of older adults want to stay at home, which is the base for European directives on deinstitutionalisation. Because of the small sample, the test was performed using the Agresti-Caffo method [59]. We have calculated the probability with a z + 4-test to compare two proportions. From Table 2, the statistics are as follows, where modified percentages $p' = p + 1$ and $q' = q + 1$ in Agresti-Caffo formula give:

$$SE = \sqrt{\frac{p'_1 q'_1}{n_1 + 2} + \frac{p'_2 q'_2}{n_2 + 2}} = 3.64;\ z_{AC} = \frac{p'_1 - p'_2}{SE} = 1648\ \rightarrow p\text{-}value = 0.05$$

Therefore, with the *p*-value = 0.05, we can confirm the hypothesis that Slovenian very old people in the income classes of 800+, who are better able to afford care in the AAL, want to stay in their current home in a smaller proportion to that of those in the lowest income brackets (up to 500 €).

Based on these conclusions, we suggest evaluating how many homes in AAL housing and similar community buildings should be constructed, on bases of [60–62], considering also [63]. Therefore, we recommend developing models, supporting decisions on optimal social programmes and financing policies and insurance schemes (social housing and reverse mortgage products) for older adults to enable them to move into AAL housing

and other community dwellings. These dwellings would be adapted for older adults. There they could remain autonomous for longer, be less dependent, and it would cost them less in terms of HC systems. Under these assumptions we will develop the model in Section 3. This is a new challenge for municipality administration and construction industry. Therefore, it is worthwhile to consider a strategy and other measures to better meet the ageing population's needs.

Demand for AAL and other specialised housing for seniors with declined functional capacities could be calculated using the multiple decrement model for social housing. Financial products for fulfilling this demand will be developed. Therefore, we can determine the needed housing stock structure based on the multiple decrements approaches that Bogataj et al. [56] developed using actuarial mathematics principles [57].

3. The Model

3.1. Multiple Decrement Model

The following is developed to evaluate the SV of investments in new, more accommodative housing stock structure, and its dynamics:

(a) extension of the basic model, where we have only family homes and nursing homes, introducing a new type of dwelling in the housing stock structure that accommodates older adults' functional capacities. Therefore, new nodes and arcs were added to the graph of transitions. Further, new probabilities of transitions are expected in the extended transition matrix.

(b) Introduction of APV of health and LTC cost as a function of the housing stock structure.

(c) Introduction of the probability distribution of 'time to failure', or when residents reach the disability threshold, which is the duration of the tenure in a dwelling of type i (see details in [55]). We have presented how this probability distribution changes if the new, more accommodative kind of dwelling is included in the housing stock available to such residents.

(d) As a novelty, we have developed a method for calculating the SV created by developing specialised social housing stock for older adults. SV is the positive externalities created for HC and LTC systems in the form of decreased expenditures. Our method evaluates the SV of investment in social housing stock as the difference between APV of HC and LTC expenditures between two housing stock structures, both with and without specialised housing for older adults. According to [25], such a model is essential for policymakers and has not yet been developed.

Based on [56], in a multi-state transition model with m dwelling options for those with reducing functional capacities, there are possibilities of $m + 1$ transitions from one type of dwelling to another. In Figure 9, we denote the initial state as state 0 and transition, which requires housing of type j with the line of the graph from this parent node to the child node j, $j = 1, 2, \ldots, m$. On this graph, we denoted the probabilities of transition from state 0 and further states to the child node (state) j or, in general, from the parent node i to the child node j at various ages. All paths to j determine the required dynamics for developing the specialised housing stock with the required number of type j units, which should be completed in a certain time τ. In the multiple decrement model, transitions between any two states from i to j, $i > j$; $i = 0, 1, 2, \ldots, m - 1$, are not possible (directed graph). This is in contrast to a multi-state transition, where we can also assume such transitions [58]. The multiple decrement model is a case of the multistate transitions where probabilities of transitions under the diagonal of matrix are equal to 0. In Slovenia it appears because rehabilitation and physiotherapy are not yet introduced into homecare.

The transitions are successive according to the functional capacities, the available category (intensity) of care and related housing, as given in Figure 9. Let us denote: i = 0: family home (FH) housing unit without special facilities for seniors and with residents without the need for care, where the residents live with functional capabilities that are autonomous;

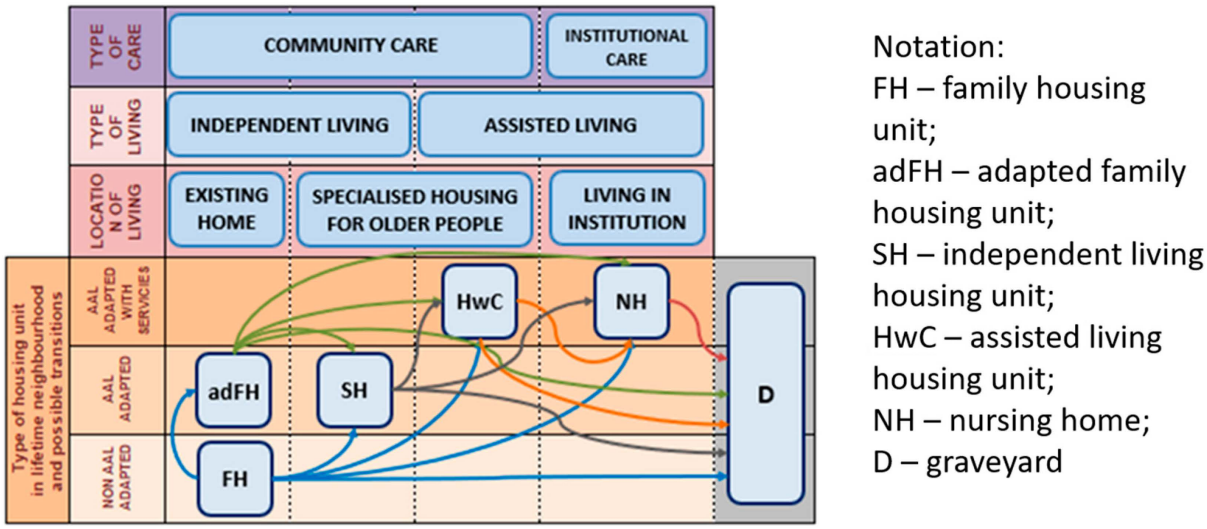

Figure 9. The graph of paths between different characteristics of homes from the existing house (EH) to the nursing home (NH).

i = 0: homecare in the nonadapted family home
i = j = 1: homecare in the adapted family home (adFH);
i = j = 2: housing unit in the independent living community (SH);
i = j = 3: housing unit in an assisted living community (HwC); and
i = j = 4: nursing home (NH);
j = 5: graveyard (D).

Let us denote by i the type of dwelling in which the older adult is currently residing (i = 0 to 4), and by j the sort of housing into which they move after reaching the disability threshold due to declining functional capacity (resettlement from the kind of dwelling i to j; j = 1 to 5). The details of the migrations can be modelled as a directed graph and simplified in Figure 10 (In Slovenia, up to now, we have had a negligable number of cases where the move from higher *i* to lower *j* is possible due to bad organization of tghe activities needed to increase the capacities of older adults. Therefore, the transitions are described with the multiple decrement model).

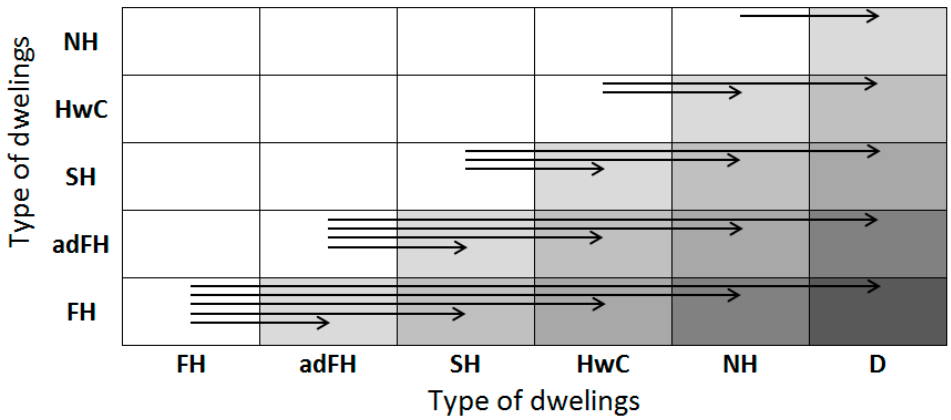

Figure 10. Admissible transitions of older adults from i-th to j-th type of housing unit. Legend: FH—family homes; adFH—adapted family homes; SH—sheltered housing; HwC—housing with care; NH—a nursing home.

Based on the data from the Social protection institute (IRSSV) [64], the Association of Social Institutions of Slovenia (SSZS) [65], Health Insurance Institute of Slovenia (ZZZS) and the Statistical Office of the Republic of Slovenia [66,67], one can derive the expected needs

of seniors at the national, regional or city/municipality level. Development of specialised housing stock can be financed from savings (decrease in expenditure) to the national HC system (from the budget or national health insurance system) and national LTC system (from the budget or national LTC insurance). To predict the various dwelling needs of seniors and the optimal structure of the housing stock, the probability distribution of $T_i(x)$, the time that a senior resident will spend in the dwelling of type i, $i \in$ H must be known.

We suppose that the resident moves to the type of housing unit that optimally suits her/his functional capacities. The model has five groups of dwellings with different services: existing family home (FH), adapted family home (adFH), independent living facilities (sheltered housing (SH), assisted living facilities), housing with care (HwC) and nursing home (NH). The model's transition probability should be calculated based on the survey results and observations of moving from one dwelling type to another if the supply is high enough. In a multiple-decrement setup, transitions between any two states, from i to j, $i > j = 1, 2, \ldots$, m, are impossible (directed graph). However, in a multi-state transition, we can also assume reverse transitions of functional capacities [59–61]. Therefore, the use of housing stock can be modelled with a multi-state transition model, which is not the case below. The probability ${q_x}^{(i,j)}$ of relocating from dwelling type i to type j due to declining functional capacity for resident x years old is shown by:

$$q_x^{(i,j)} = \frac{M_x^{(i,j)}}{S_x^{(i)}}; j = 1,\ 2,\ 3,\ 4; j > i \tag{1}$$

where ${M_x}^{(i,j)}$ is the number of older adults that move from i to j and ${S_x}^{(i)}$ is the total number of residents who previously lived in $i - 1$. Here ${p_x}^{(i)}$ is the probability of the person staying in the same home. In the year τ, the final structure of residents by type of required housing for an x age-old person in the cohort is described by the matrix (2). The basics of such a transition are described in [60,61]; however, this is not for the housing structure but only for the age–dependency structure. Here, as a novelty, the model is adapted to the given built structures:

$$P_{x,\tau} = \begin{bmatrix} p_x^{(0)} & q_x^{(0,1)} & q_x^{(0,2)} & q_x^{(0,3)} & q_x^{(0,4)} & q_x^{(0,5)} \\ 0 & p_x^{(1)} & q_x^{(1,2)} & q_x^{(1,3)} & q_x^{(1,4)} & q_x^{(1,5)} \\ 0 & 0 & p_x^{(2)} & q_x^{(2,3)} & q_x^{(2,4)} & q_x^{(2,5)} \\ 0 & 0 & 0 & p_x^{(3)} & q_x^{(3,4)} & q_x^{(3,5)} \\ 0 & 0 & 0 & 0 & p_x^{(4)} & q_x^{(4,5)} \end{bmatrix}_{\tau} \tag{2}$$

After such a transition in the year $\tau - 1$, the structure of adapted homes needed is $ZS_{x,\tau}$:

$$\mathrm{ZS_{x,\tau}} = \mathrm{S_{x-1,\tau-1}P_{x-1,\tau-1}} \tag{3}$$

To this number, the quantity and structure of net migration from other areas $\mathbf{MN}_{x,\tau}$, should be added. The data were taken from the National Statistics Office. Therefore, the total composition of needed dwellings for the cohort aged x in the year τ is

$$\begin{aligned} \mathbf{S}_{x,\tau} &= \left[S_x^{(0)}\ S_x^{(1)}\ S_x^{(2)}\ S_x^{(3)}\ S_x^{(4)} \right]_{\tau} = \mathbf{ZS}_{x,\tau} + \mathbf{MN}_{x,\tau} = \\ &= \left[ZS_x^{(0)}\ ZS_x^{(1)}\ ZS_x^{(2)}\ ZS_x^{(3)}\ ZS_x^{(4)} \right]_{\tau} + \left[MN_x^{(0)}\ MN_x^{(1)}\ MN_x^{(2)}\ MN_x^{(3)}\ MN_x^{(4)} \right]_{\tau} \end{aligned} \tag{4}$$

where the allocation of residents by type of facility in the year $\tau + 1$ (when they are $x + 1$ years old) is:

$$\begin{aligned}\left[\mathrm{S}_{\mathrm{x+1}}^{(0)}\ \mathrm{S}_{\mathrm{x+1}}^{(1)}\ \mathrm{S}_{\mathrm{x+1}}^{(2)}\ \mathrm{S}_{\mathrm{x+1}}^{(3)}\ \mathrm{S}_{\mathrm{x+1}}^{(4)}\right]_{\tau+1} &= \mathrm{ZS}_{\mathrm{x+1},\tau+1} + \mathrm{ME}_{\mathrm{x+1},\tau+1} \\ = \left[S_x^{(0)}\ S_x^{(1)}\ S_x^{(2)}\ S_x^{(3)}\ S_x^{(4)}\right]_{\tau} &\cdot \begin{bmatrix} p_x^{(0)} & q_x^{(0,1)} & q_x^{(0,2)} & q_x^{(0,3)} & q_x^{(0,4)} & q_x^{(0,5)} \\ 0 & p_x^{(1)} & q_x^{(1,2)} & q_x^{(1,3)} & q_x^{(1,4)} & q_x^{(1,5)} \\ 0 & 0 & p_x^{(2)} & q_x^{(2,3)} & q_x^{(2,4)} & q_x^{(2,5)} \\ 0 & 0 & 0 & p_x^{(3)} & q_x^{(3,4)} & q_x^{(3,5)} \\ 0 & 0 & 0 & 0 & p_x^{(4)} & q_x^{(4,5)} \end{bmatrix}_{\tau} \\ &+ \left[ME_{x+1}^{(0)}\ ME_{x+1}^{(1)}\ ME_{x+1}^{(2)}\ ME_{x+1}^{(3)}\ ME_{x+1}^{(4)}\right]_{\tau+1}\end{aligned} \quad (5)$$

The total needed housing structure is as follows:

$$\left[S^{(0)}S^{(1)}S^{(2)}S^{(3)}S^{(4)}\right]_{\tau} = \sum_x \left[S_x^{(0)}\ S_x^{(1)}\ S_x^{(2)}\ S_x^{(3)}\ S_x^{(4)}\right]_{\tau} \quad (6)$$

$\mathbf{ME}_{x,\tau}$ depends on differences in the taxation policies and subventions among areas (municipalities), as developed by [61].

3.2. Actuarial Model for the Evaluation of the Social Value of Differences in the Housing Stock Structure

From our experiences working as actuary in the biggest Slovenian mutual insurance company (VZAJEMNA) and the results of Wood [25] and Berrington [51] we may conclude that the optimal care services and the housing stock for an older adult with decreasing functional capacity depend upon the following: legal systems, fiscal systems, financial mechanisms and systems of LTC provisions and insurance.

We will use the following notation:

APV_x	The actuarial present value of lifetime expenditures for LTC services for a person x years old
${}_jp_x$	The probability that older adult x years of age will survive j years
$p_x^{ltc(i)}$	The probability that older adult x years of age is in the category of care i
c_i	Yearly expenditure on LTC services in the category of care i
ir	Interest rate; we have used an interest rate of 1.75%
$\vartheta = 1/(1+ir)$	As the discount rate
HS_1	Housing stock without specialised dwellings for older adults
HS_2	Housing stock with specialised dwellings for older adults
SV	Social value

DAV 1987 mortality rate table and the probability tables of the intensity of care have been used. The APV for covering expenditure for LTC services for a senior who is dependent on the help of others can be written in general as follows:

$$APV_x = \sum_{j=0}^{100-x} {}_jp_x \cdot \vartheta^j \cdot \left(p_{x+j}^{ltc\ I} \cdot c_1 + p_{x+j}^{ltc\ II} \cdot c_2 + p_{x+j}^{ltc\ III} \cdot c_3\right) \quad (7)$$

However, because housing stock (*HS*) most appropriate for the functional capacities of the older cohorts, is not always available, let us show the APV for lifetime LTC expenditures for a 65-year-old person (in EUR) when there are only two options of housing stock (HS_1):

$$APV_{65}(HS_1) = \sum_{j=0}^{100-65} {}_jp_{65} \cdot \vartheta^j \cdot \left(p_{65+j}^{ltc\ I}(HS_1) \cdot c_1 + p_{65+j}^{ltc\ II}(HS_1) \cdot c_2 + p_{65+j}^{ltc\ III}(HS_1) \cdot c_3\right) \quad (8)$$

The case of more options for housing stock (HS_2) is as described above:

$$APV_{65}(HS_2) = \sum_{j=0}^{100-65} {}_jp_{65} \cdot \vartheta^j \cdot \left(p_{65+j}^{ltc\ I}(HS_2) \cdot c_1 + p_{65+j}^{ltc\ II}(HS_2) \cdot c_2 + p_{65+j}^{ltc\ III}(HS_2) \cdot c_3 \right) \quad (9)$$

The literature, in many cases, states that there is no method to evaluate the SV of the construction of housing stock for sheltered housing (SH) and housing with care (HwC) [25] and that a proper information system is not available [3]. We found that the LTC expenditures are highly dependent on the housing stock availability, but in practice the housing stock and services are considered and managed separately. In all EU Member States, these two areas are regulated independently. From theoretical research and fieldwork, we learned what the social value (SV) of sheltered apartments (SH) and Serviced Apartments (HwC) is. It can be formulated as the difference between the APV of the achieved expenditure on HC and LTC in the case of a housing stock without SH and HwC (case HS_1) and housing stock with SH and HwC (case HS_2):

$$SV = APV_{65}(HS_1) - APV_{65}(HS_2) \quad (10)$$

SV is the difference between the APV in original housing stock and more accommodative housing stock as the specific housing solution for older adults with declining functional capacities. In our model, we have entered only two categories of housing stock in the structure of available housing types. These are not present in many European countries at present. In further research, the SH and HwC groups of housing stock are to be calibrated in detail. Furthermore, we must permanently follow the study of their impact on the costs of services for older adults and the costs of investing in the proper housing stock structure. Thus, we must pave the way for a more detailed picture of SV in individual types of use. The methodology does not change; only the dimension of matrices and vectors is higher.

4. Numerical Examples of the Evaluation of SV—A Case Study of Slovenia

The example is based on our research on Slovenian LTC provision. Tables 3–5 present the essential data.

Table 3. Users of HC in the period 1998–2021 in Slovenia.

End of Year	Number of Home Care Users in 10^3	Average Annual Coefficient of Dynamics
1998	3.9	
2002	4.6	1.04
2004	4.7	1.01
2007	5.6	1.06
2011	6.6	1.04
2014	6.9	1.01
2015	7.1	1.03
2021	9.8	1.06

Source: Social Protection Institute of the Republic of Slovenia [61] and authors' calculation.

Table 4. Number of LTC users and applicants (in waiting lines) age 65+, on 1 Jan 2022.

Independent Living	Home Care Users	Nursing Home Residents	Population Total	Waiting List for Nursing Home
415,843	9800	19,100	444,743	13,175
93.50%	2.20%	4.29%	100.00%	2.96%

Source: Social Protection Institute of the Republic of Slovenia—No. of homecare users [62]; No. of applicants [63]; No. of nursing home residents [64]; The population of Slovenia [65].

Table 5. The probability that a man or woman 65+ will be in a particular category of LTC.

Years Old	Independent	NH Dependence		
		Cat I	Cat II	Cat III
x		$p_x^{ltc\ I}$	$p_x^{ltc\ II}$	$p_x^{ltc\ III}$
		(**a**). Male		
65	0.9935	0.0013	0.0005	0.0046
75	0.9786	0.0052	0.0012	0.0149
85	0.9202	0.0178	0.0043	0.0577
95	0.7584	0.0604	0.0067	0.1745
		(**b**). Female		
65	0.9946	0.0008	0.0003	0.0043
75	0.9747	0.0045	0.0017	0.0191
85	0.8640	0.0291	0.0092	0.0976
95	0.5442	0.0994	0.0268	0.3297

Source: Authors' calculations from ZZZS (national Health Insurance Institute, internal data) [66].

Based on the number of users of HC services in Slovenia provided by the Slovenian Municipalities (given in Table 3), and the number of users and applicants for the institutional care of LTC in Slovenian NHs and considering their financial constraints (see Section 2.2), we can calculate the probability that an older person will be in a particular category of care in NH. We considered data for people aged 65+ (Table 4). Furthermore, we can also estimate the percentage of older adults who will need to enter the system of LTC because of their dependency on the help of others; therefore, they will need care in one of the categories (I-III) (Table 5, presented by age, gender and care category).

Table 5a presents the state probability matrix for males, and Table 5b shows the state probability matrix for females.

These probabilities are calculated based on the current relative frequency and the morbidity transitions. For example, the calculated probability is that an older man (Table 5a) or woman (Table 5b) will be in a particular care category in an NH. The probability that an older person will be dependent on the help of others and will need care in a specific category influences costs of care if there is no other option than homecare in existing family homes or institutional care in an NH. The higher the category, the higher the costs of care.

Table 5 presents the state probability matrices calculated for the case where older adults dependent on the assistance of others also have the option of moving to SH or HwC. Older adults, dependent on the support of others, would choose their new option optimally, dependent on their functional capacities.

The state probability matrix was developed based on the fieldwork described by [58,66].

Table 6 gives data on the cost of care, with different intensities of care described by categorisation from I to III.

Table 6. Costs of LTC dependent on the intensity of nursing and other daily services (Category I–III).

Category	Expenditures [€]		
	Daily	Monthly	Yearly
I	27.12	814	9763
II	35.68	1070	12,844
III	49.45	1483	17,802

Source: Association of Social Institutions of Slovenia [63]; Authors' calculations.

The details of how to evaluate the categories in points of evaluation of needed support (lower level of functional capacities gives higher number of points) are given in Table 7.

Table 7. Category of care determined on the Care Dependency Scale * with the acronym LOSS in points of evaluation.

Type of Care	LOSS	Lower Limit	Upper Limit
Care I		Minimum service	Maximum Service
Care II	LOSS II	16	32
Care III/A	LOSS III, IV	33	65
Care III/B	LOSS IV, V	66	

* The detailed Slovenian Care Dependency Scale is described in the Appendix A and [68].

The APV for lifetime LTC insurance: LTC for a 65-year-old woman or man should be calculated on the bases of actuarial mathematics:

Actuarial present values for females: $APV_{65/w}(HS_1)$ and $APV_{65/w}(HS_2)$ are

$$APV_{65/w}(HS_1) = \sum_{j=0}^{100-65} {}_jp_{65} \cdot \vartheta^j \cdot \left(p_{65+j}^{ltc\ I}(HS_1) \cdot c_1 + p_{65+j}^{ltc\ II}(HS_1) \cdot c_2 + p_{65+j}^{ltc\ III}(HS_1) \cdot c_3 \right) =$$

$$= \sum_{j=0}^{100-65} {}_jp_{65} \cdot \vartheta^j \cdot \left(p_{65+j}^{ltc\ I} \cdot 9753 + p_{65+j}^{ltc\ II} \cdot 12,844 + p_{65+j}^{ltc\ III} \cdot 17,802 \right) = 15,133.20\ €$$

In case there are more options, as described above, the APV is:

$$APV_{65/w}(HS_2) = \sum_{j=0}^{100-65} {}_jp_{65} \cdot \vartheta^j \cdot \left(p_{65+j}^{ltc\ I}(HS_2) \cdot c_1 + p_{65+j}^{ltc\ II}(HS_2) \cdot c_2 + p_{65+j}^{ltc\ III}(HS_2) \cdot c_3 \right) =$$

$$= \sum_{j=0}^{100-65} {}_jp_{65} \cdot \vartheta^j \cdot \left(p_{65+j}^{ltc\ I} \cdot 9753 + p_{65+j}^{ltc\ II} \cdot 12,844 + p_{65+j}^{ltc\ III} \cdot 17,802 \right) = 12,830.45\ €$$

Berrington [51] and Wood [25] calculated the national healthcare savings per year if the seniors lived in adapted housing and a well-organised community. The study exposes facts such as the absence of a method to evaluate the SV of the construction of SH and HwC housing stock. In this research, we realised that the SV of the SH and HwC is the difference between the APV of HC and LTC expenditures in the case of housing stock without SH and HwC and housing stock with SH and HwC:

$$SV_{65/W} = APV_{65} \cdot (HS_1) - APV_{65} \cdot (HS_2) = 15,133\ € - 12,830\ € = 2303\ €$$

In a similar way, we calculated the SV for males $SV_{65/M}$

$$SV_{65/M} = APV_{65} \cdot (HS_1) - APV_{65} \cdot (HS_2) = 6505\ € - 5565\ € = 940\ €$$

The SV for males SV_M and females SV_W was here calculated as the difference between the probability-weighted cashflows (APV) of care in case of availability of existing housing stock and a situation where more accommodated housing units are available with specialised housing solutions. This value is higher than the income value under which most people decide not to move to adopted housing units in Table 2.

5. Discussion

5.1. On the Projections, Model, and Calculations

The Ageing Report 2021 forecasts the tripling of LTC expenditures in Europe where, more than in the US and Australia, the population relies on national social systems financed from the public budget or dedicated national social insurance schemes. They also rely

more on children. Therefore, citizens believe that the national HC and LTC systems will allow them to age safely. Our findings in Slovenia (Table 1 and statistics based on these data) oppose the claim of the Eurobarometer [1] that 90% of older adults want to stay at home, which is the base for European directives on deinstitutionalisation. However, in rural areas, these homes are very dispersed, and a strong contingency was found between the dispersion of housing units and logistics in LTC [68,69]. Seniors' plans regarding LTC provision depend on their wealth and income (Section 2.2), but also, as in Spain and other Mediterranean countries, on their relations to other family members and employment of persons older than 60 years. For example, in Spain the most suitable living environment for older adults over 65+ varies depending on their circumstances. According to Fernandez-Carro [70], disadvantaged older adults (widowers, persons with low educational and financial status and those with bad self-reported health status) were more inclined to prefer co-residence in a relative's home, mainly with adult children.

In contrast, the option for institutional care or living in a community of seniors follows a different pattern, being more frequent among younger-old people and those more educated, which coincides with those aged between 65 and 69. The statistics in Spain also show how the seniors in rural areas are more often served by their children than those in urban regions. In particular, in cities, children's homes are smaller, and daughters are employed in old age, which is one of the results of pension reforms all over the EU member states. In times of crisis, when more children of older adults (80+) lost their jobs, the amount of home care increased significantly in both Spain and Slovenia.

Service development and facilities construction and management for 65+ cohorts represent the highest share of the EU Silver Economy. The demand for specialised housing and assisted living for seniors aged 80+ is expected to triple in the next five decades. Social housing is poorly developed, especially in Central and Eastern Europe. Ageing is driving the expenditures of HC and LTC provision without visible improvement in the quality of life of older adults [44,71].

Assisted living in subsidised housing in retirement communities can enable even residents with low incomes to live longer in their own dwelling in the community while mitigating increased public expenditures for HC and LTC, as adequately explained in the research published by Wood and Berrington [25,51]. Furthermore, these savings in HC, which are caused by reduced logistics because of distances between HC users, could be transferred to subsidies for community housing for seniors, which minimise nurses' travel costs. Finally, the paper shows how to calculate the upper limit of this investment amount without resorting to other public funds.

After launching the idea of deinstitutionalisation of LTC, this was adopted by many Member States. They must now update the legislation in this field to include specialised housing solutions for seniors in social housing schemes. They would also have LTC services to cope with this pressing challenge. These states seek sustainable models of community-based care that would mitigate the rise of HC and LTC-related expenditures and increase the quality of such lives.

This paper investigated the human rights issue regarding proper housing for older adults with declining functional capacities. We demonstrated how to measure the eligibility of public investment in specialised housing units for older adults. The paper suggests comparing these investments with the SV achieved. For this purpose, we defined SV as the difference in the probability-weighted cashflows before and after completed investments. In this case, reductions in public health expenditures because of risk prevention and lower logistics costs in HC could be diverted, at least partly, to new investments in custom homes in community care for older adults.

For the numerical example, we presented the survey results on how older adults in Slovenia perceive assisted living housing and where most older adults (who are already included in municipality home care programs) would want to live after a more severe decline. We also showed that their incomes significantly influence their choice. These results enable us to predict the dynamics of the expected demand for specialised housing

for seniors. The numerical example also shows how the multiple decrement model can predict demand dynamics when developing the silver economy. This structure of potential users depends on the demographic structure, the necessary intensity of care and the income of older adults.

For the evaluation of SV, demographic data on age, gender and the dynamics of ageing is required. Information on care category is needed, conditional on housing quality and the built environment. Therefore, public participation in the adapted housing will influence the probabilities of transitions in a multiple decrement model and the welfare of European communities. The social value of the investments in facilities is given output through evaluating the actuarial present value of care in different environments.

5.2. Policy Recommendation—Simulation of Assisted Living Facilities Construction Dynamics

If the municipalities in Slovenia were to build 12,179 serviced apartments in smart home neighbourhoods and thus meet the demand for long-term care in the community, there would be the possibility of redistributing 4589 residents from nursing homes (NH) to serviced apartments and to AAL housing units as demonstrated in Table 8. Therefore, the nursing homes would be able to accept 4589 applicants in category III from the waiting list (WL). The remaining 7590 applicants from the waiting list (categories I and II) would become residents in the housing with care AAL-supported smart home housing units in lifetime neighbourhoods.

Table 8. Simulation of reallocation of older adults between different types of dwellings.

From (Cat, Location) To (Loc.)	Before Reallocation	HC	HWC	NH	After Reallocation
Independent 65+	396,825				396,825
Receiving home care living in the family home	11,650	11,650			11,650
Waiting list	12,179		−7590	−4589	0
Receiving home care living in housing with care (assisted living)	646		12,179		12,825
Nursing homes	19,100		−4589	4589	19,100
Population in Slovenia (65+)	440,400	0	0	0	440,400

6. Conclusions

We developed a new model to forecast the SV of investments in specialised social housing as savings for national health and care systems, particularly for the Central European health and care insurance systems. We were forecasting the different (category related) demands for different specialised housing as the social infrastructure for insured older adults, which mitigates public expenditures for HC and LTC services. Due to the adaptation of residences to the functional capabilities of the older adults, the incidence of falls is lower in sheltered housing units and housing with care units than in family dwellings, therefore the expected average category of care in the population is lower, which leads to lower costs, as calculated by Wood [25] and Berrington [51]. Multistate transitions are described based on projections and probability-weighted cashflows (actuarial present value-APV) are calculated. Unfortunately, there are no documents for the European Commission for this, although the Commission stresses the need to develop such a model. The model has been designed to support policymakers in deciding whether to increase the HC and other LTC expenditures or to invest in specialised housing for older adults as part of social infrastructure that would reduce these expenditures. In the case of Slovenia, the SV as the difference between probability-weighted cash flows achieved by the reduced public

expenditures in HC and LTC due to investments in specialised housing is calculated based on the data of the Slovenian National Health Insurance Institute.

Organising housing with care for older adults in specialised housing units in lifetime neighbourhoods mitigates the risk of falls and reduces the incidence of events leading to ill health and disability. Each country indeed has its own housing policy for the elderly, but the European Commission encourages the development of social infrastructure for community care. Member States follow this direction. In 2018, the European Commission issued Discussion Paper 074 under the title *Boosting Investment in Social Infrastructure in Europe* [71], supporting investments in social infrastructure. There is a great emphasis on the construction of affordable housing. This policy is financially supported with credit lines from the European Investment Bank, and on this basis individual European countries are developing lines for drawing on these funds. Therefore, communities by themselves or in a private-public partnership can afford to build smaller facilities close to the clients and network of nurses from the vicinity who will provide their services to older adults in those facilities. In Slovenia, the first "smart silver village" is in construction (investor: Municipality Krško, expecting lower logistics and rehabilitation costs, after a fall, if clients move to the silver village). This is how to make LTC more sustainable for communities and insurance institutes or for national budgets responsible for the LTC in many EU member states.

An inclusive social environment of lifetime neighbourhoods also reduces social exclusion and loneliness. An improved, age-friendly environment postpones the need for residents to move to a nursing home. It substantially decreases public expenditure (from health insurance or LTC insurance funds or the national budget and the budget for communities) for health care and long-term care for older adults. Knowing the housing preferences of residents with declining functional capacities who are dependent on the help of others, we can better forecast the demand for different housing units in lifetime neighbourhoods with services, facility management and care networks. When an older adult is confronted with barriers in the built environment and in public spaces and with barriers within their dwellings that they cannot negotiate, their preferences can change. The availability of a suitable specialised housing unit with services in their neighbourhood can also influence the decision on reallocation within the district instead of moving to a nursing home. The dynamics of moving from one facility to another and tenure in the community can be registered in national statistics. Results can be measured with the multiple decrement model presented in this paper.

These findings can be an essential incentive for local governments of the constitutionally defined welfare states, as defined by the EU Member States:

(a) build appropriate housing, suitable for the needs of older people with decreasing functional abilities, close to their social networks, close to their family homes,

(b) create conditions favourable for attracting private investment in LTC housing,

(c) by providing affordable housing suitable for the functional capacities of older adults; local government would also influence the reduction of HC expenditures here, recognised as an SV of reduced HCs due to better housing stock structure.

The proposed model and relevant statistics can serve as a basis for assessing the risks for investments, namely for loans from the European Investment Bank at low-interest rates, and thus provide affordable, safe and barrier-free housing stock for ageing Europeans. Furthermore, because the population aged 65+ will reach 30% or more by 2050, all states expect an excellent opportunity for foster careers focused on care for older adults, and for a sustainable silver economy [72].

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Appendix A. LOSS Care Dependency Scale

The table below shows the 15 basic human needs and the dependency of users on care. The needs are rated on a Likert scale from 1 to 5. Each item assesses whether individuals are fully dependent, almost dependent, partially dependent, almost independent or fully independent of care. In Slovenia, the LOSS Care Dependency Scale is used as an inverse Likart scale (see Table A1). High scores indicate complete dependence on care. The lower the score, the less dependent older people are on care. Thus, a score for a certain basic human need of 1 indicates a completely independent elderly person, while a score of 5 indicates a completely dependent elderly person. After all basic human needs have been scored by the nurses, a sum of 15 to 75 points is obtained.

Table A1. LOSS Scale (CDS).

CDS Ranking Points	Item Description—the User Is Able to:
Eating and drinking	Satisfy your own need for drink and food
Excretion and discharge	Controls urine and faeces excretion
Body position	Assumes the correct posture for the activity
Movement	Moves unassisted
Sleep and rest—biorhythm	Maintains a proper biorhythm without assistance
Dressing, undressing	Dress and undress without assistance
Body temperature	Adjusting your body temperature to the outside
Hygiene	Unaided care—for your own hygiene
Avoiding hazards in the environment	Take care of your own safety without help
Communication	Able to communicate
Contact with the environment	Establish, maintain and terminate contact with others appropriately
Rules and values	Follows the rules
Daily activities	Without help, arranges daily activities indoors
Employment activities	Participates unassisted in outdoor activities
Ability to learn	Unassisted, acquires knowledge, develops skills or maintains knowledge already acquired

The scoring in the Slovenian version of the CDS (LOSS scale) is as follows:

(a) 61–75 points: the person is totally dependent on another person for basic living and daily tasks;
(b) 46–60 points: the person depends on another person for most of the basic tasks of living and daily living;
(c) 31–45 points: the person is partially dependent on another person at all times to carry out basic living and daily tasks;
(d) 16–30 points: the person is occasionally dependent on help from another person to carry out basic living and daily tasks;
(e) 15 points: the person is mostly independent in carrying out all basic tasks and daily living activities and does not need help from another person.

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