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Structural Cause–Effect Network of Economic Factors in Aging-in-Place versus Institutionalization Decisions

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ABSTRACT

Population aging is increasing pressure on long-term care systems and household finances, making the decision between aging in place and institutionalization an important economic issue. However, prior studies often examine determinants in isolation and may not capture how economic factors interact within a connected system. This study applies the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method to map the cause–and–effect relationships among five economic determinants of aging in place versus institutionalization: pension and retirement income adequacy, cost of formal home care services, public long-term care subsidies and insurance coverage, informal caregiver opportunity cost, and housing wealth and property liquidity. Using purposive sampling, expert judgments were collected through a pairwise influence questionnaire and aggregated to form the direct-relation matrix, followed by normalization and computation of total relations to identify prominence and cause–and–effect roles. The findings show that public long-term care subsidies and insurance coverage is the strongest causal driver (r−c = 0.79), indicating that policy financing shapes other economic conditions in the system. Housing wealth and property liquidity (0.42) and pension and retirement income adequacy (0.22) also function as cause factors. In contrast, informal caregiver opportunity cost (−1.43) is the strongest effect factor, suggesting caregiver burden is mainly a downstream outcome shaped by broader policy and financial conditions. These results highlight the importance of upstream policy and resource factors in supporting aging in place and reducing reliance on institutional care.

1. Introduction

Population aging is accelerating worldwide, creating significant economic and social challenges for long-term care systems. As life expectancy increases and fertility rates decline, the proportion of older adults continues to rise, placing pressure on families, governments, and healthcare systems

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[19]. One of the most critical policy and household decisions in this context concerns whether older individuals remain in their homes, commonly referred to as "aging in place," or move into institutional care settings such as nursing homes. Aging in place is widely preferred by older adults because it promotes autonomy, familiarity, and quality of life. However, the ability to remain at home is not determined solely by preference. It is strongly shaped by economic conditions, policy design, and market structures.

Recent empirical research consistently shows that economic conditions play a decisive role in determining whether older adults remain at home or enter institutional care. Studies indicate that individuals with lower incomes and weaker financial security are more likely to be placed in nursing homes, even after controlling health and demographic factors [13]. At the same time, the cost of formal home care services has risen steadily due to labor shortages and increasing demand, making home-based care less affordable for many households [2,10]. Public financing mechanisms further shape these decisions. Evidence suggests that expansion of home- and community-based service subsidies increases the likelihood that older adults receive care outside institutions [14,8]. Beyond formal systems, informal caregiving also carries significant economic implications, as family members often reduce working hours or exit the labor force, creating measurable opportunity costs [9]. In addition, housing wealth represents a major financial resource in later life, and the ability to convert home equity into liquid funds directly affects long-term care financing decisions [1,7]. Together, these findings confirm that long-term care choices are deeply embedded within broader financial and policy structures rather than being driven solely by health status or personal preference.

However, a clear research gap remains. Much of the literature tests these determinants separately using regression approaches that are not designed to reveal how factors influence one another in a connected system. In practice, the determinants interact. For example, subsidy design can change the price and availability of home care, thereby shifting caregiver opportunity costs and household financial strain. Without modeling these cause–and–effect linkages, policymakers risk targeting symptoms rather than upstream drivers.

To address this gap, this study applies the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method, which maps interdependencies and separates "cause" factors from "effect" factors in complex systems [16]. Despite wide use of DEMATEL in other fields [5,22], it remains underused for analyzing economic drivers of aging-in-place decisions. Therefore, the general objective of this study is to map the structural cause–effect relationships among five economic determinants, pension and retirement income adequacy, cost of formal home care services, public long-term care subsidies and insurance coverage, informal caregiver opportunity cost, and housing wealth and property liquidity, in order to identify the most influential drivers shaping aging in place versus institutionalization decisions.

2. Literature Review

Population aging has become a major global demographic trend, creating increasing pressure on long-term care systems and public finances. As life expectancy increases and fertility rates decline, the number of older adults who require assistance with daily activities continues to grow [19]. In this context, an important policy and household decision concerns whether older adults remain in their homes, commonly known as aging in place, or move into institutional care settings such as nursing homes. Many studies show that most older adults prefer to remain in their homes because it supports independence, familiarity, and psychological well-being [20]. However, the ability to age in place is strongly influenced by economic conditions, including income, care costs, public subsidies, caregiving resources, and housing wealth.

One key economic factor influencing long-term care decisions is the adequacy of pension and retirement income. Adequate retirement income enables older adults to afford home-based services such as paid caregivers, home modifications, and assistive technologies. Conversely, limited income may reduce the ability to finance such services, increasing reliance on institutional care. Empirical studies show that individuals with lower socioeconomic status are more likely to enter nursing homes even after controlling health conditions and demographic characteristics [13]. Similarly, research on retirement security highlights that financial stability in later life is critical to maintaining independent living arrangements [12]. Therefore, retirement income adequacy can significantly influence the feasibility of aging in place.

Another important determinant is the cost of formal care services. The price of professional home care affects whether households choose home-based care or institutional care. When home care services become expensive, families may face financial constraints that limit their ability to maintain care at home. Recent national surveys show that the cost of home care services has increased due to labor shortages and rising demand for long-term care workers [2,10]. Rising wages in the caregiving sector also contributes to increasing service prices. As a result, the relative affordability of home care compared with institutional care can significantly influence care-setting decisions.

Public policy also plays a critical role through long-term care subsidies and insurance programs. Government support can reduce the financial burden on households and expand access to home-based care services. Evidence suggests that expansion of publicly funded home- and community-based services increases the likelihood that older adults receive care at home rather than in institutional settings [14]. Policy reforms in many countries have increasingly shifted long-term care financing toward community-based services to reduce institutional care costs and support aging in place [8]. These findings suggest that subsidy design serves as a key policy lever shaping long-term care choices.

In addition to formal care services, informal caregiving provided by family members remains an essential component of long-term care systems. However, caregiving often involves economic trade-offs for caregivers. Family members may reduce working hours, decline promotions, or exit the labor force to provide care for older relatives. These decisions generate opportunity costs in the form of lost wages and reduced career advancement. Recent studies estimate that unpaid caregiving imposes significant economic costs on households and affects labor force participation among working-age adults [9]. As the opportunity cost of caregiving increases, households may be more likely to consider institutional care alternatives.

Finally, housing wealth and property liquidity represent an important financial resource for older households. In many countries, a large share of older adults' household wealth is held in housing assets. These assets can potentially be used to finance long-term care through mechanisms such as home equity withdrawal or property sales. Research shows that access to housing wealth can help older adults fund home care services and delay institutionalization [1]. However, housing assets are often illiquid, making it difficult or costly to convert them into cash. This liquidity constraint can limit older adults' ability to use their housing wealth to support aging in place [7].

Although existing studies have identified these economic determinants, most research examines them separately using traditional statistical methods. Such approaches may overlook the complex interactions among financial resources, policy mechanisms, and caregiving dynamics. These factors often influence one another within an interconnected system. Understanding these structural relationships is therefore important for identifying the most influential drivers of aging-in-place decisions. This study addresses this gap by applying the DEMATEL method to analyze the cause–effect relationships among key economic determinants of aging in place versus institutionalization decisions.

3. Methodology

3.1 Research Design

This study applies the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method to examine how key economic factors influence older adults' ability to age in place versus move into institutional care. DEMATEL was originally developed by the Battelle Memorial Institute in Geneva (1972–1976) to analyze complex problems in which many elements interact [4]. Over time, it has become a widely used multi-criteria decision-making approach for mapping cause–and–effect relationships and visualizing them through impact-relation maps [16]. DEMATEL is suitable for this study because long-term care decisions are shaped by interdependent economic forces. Rather than assuming factors operate independently, DEMATEL explicitly models how one factor can influence another directly and indirectly [18,21].

DEMATEL is especially useful when a topic involves feedback and interdependence. In long-term care decisions, for example, subsidies may affect the affordability of home care, which in turn influences caregiver opportunity costs and household financial pressure. DEMATEL helps reveal these pathways and identify the strongest drivers, supporting better prioritization for policy and planning [18,21]. The method has also been widely applied in other complex decision areas, demonstrating its robustness and flexibility [5,22].

3.2 Study Factors

Based on a review of the literature on aging, long-term care, and household economics, five key economic determinants were identified for analysis:

1. Pension and Retirement Income Adequacy (F1)
2. Cost of Formal Home Care Services (F2)
3. Public Long-Term Care Subsidies and Insurance Coverage (F3)
4. Informal Caregiver Opportunity Cost (F4)
5. Housing Wealth and Property Liquidity (F5)

These factors were selected because they represent major economic constraints and incentives that influence long-term care decisions. Instead of examining these factors individually, this study treats them as a system of interacting variables, where changes in one factor may influence others.

3.3 Sampling Technique

This study used purposive sampling, also known as expert sampling, to select participants. Purposive sampling is commonly used in studies that require specialized knowledge because it enables researchers to select individuals with relevant expertise on the research topic [3,11].

In DEMATEL research, expert panels typically range between 5 and 15 participants, as this range provides sufficient diversity of viewpoints while remaining manageable for pairwise comparison analysis [6]. Following this guideline, the study engaged 10 experts to evaluate the causal relationships among the five economic factors.

To ensure balanced perspectives, the expert panel was designed to be multidisciplinary, representing different areas related to aging and economic policy. The panel included professionals from fields such as health economics, public finance, long-term care financing, labor economics, housing economics, and social protection policy. This diversity allows each factor to be evaluated from multiple viewpoints, improving the reliability of the causal assessments.

3.4 Expert Inclusion Criteria

Core inclusion criteria (applied to all experts)
Experts were included if they met all of the following conditions:

1. Work experience: Minimum 5 years of professional experience in a relevant area (e.g., aging policy, health economics/financing, long-term care, labor economics, housing economics, public finance, or social protection).
2. Role relevance: Current (or recent) role involves older populations, long-term care systems, or evaluation/design of economic and social policy affecting older adults.
3. Decision exposure: Direct involvement in at least one of the following: program planning, budgeting, financing, policy evaluation, market analysis, or service system management related to long-term care.
4. Qualification or seniority: Either (a) a postgraduate qualification (Master's/PhD) in a relevant discipline or (b) a senior professional role (e.g., principal analyst, manager, director, consultant) with demonstrated expertise.
5. Topic familiarity: Ability to explain how economic constraints and incentives influence whether older adults remain at home or enter institutional care (income, prices, subsidies, caregiving costs, and housing assets).

Based on these criteria, the expert panel included the following roles:

- Senior Health Systems Economist
- Global Aging Policy Advisor
- Public Finance and Welfare Economist
- Long-Term Care Market Analyst
- Aging and Housing Economist
- Labor Market and Demography Specialist
- International Social Protection Consultant
- Macroeconomic Aging Analyst
- Long-Term Care Financing Specialist
- Senior Social Protection Economist

This multidisciplinary composition helps ensure that the relationships among the five economic determinants are evaluated from diverse but relevant perspectives.

3.5 Research Instrument

A pairwise comparison questionnaire was used. The instrument was designed to measure the direct influence of the five economic determinants identified in the study. In the questionnaire, experts were asked to evaluate the degree to which one factor influences another. Each pair of factors were compared, resulting in a matrix of influence relationships. A five-point influence scale was used:

Table 1
5-point influence scale

Scale	Meaning
0	No influence
1	Low influence
2	Moderate influence
3	High influence
4	Very high influence

Experts completed the pairwise comparison matrix by assigning influence scores to each factor relationship. The responses were then aggregated using the arithmetic mean to construct the initial direct-relation matrix for the DEMATEL analysis [23]. A sample of the questionnaire used in this study is provided in the appendix.

4. DEMATEL Analytical Procedures

The DEMATEL analysis followed a standard multi-step process to convert expert judgments into a cause–effect structure.

Step 1: Construct the direct-relation matrix (X).
Experts provided pairwise influence scores for the five factors. The mean score for each pair was calculated to form the direct-relation matrix X [23].

Step 2: Normalize the direct-relation matrix.
To ensure comparability and keep values within a stable range, the matrix was normalized by dividing all entries by the maximum row sum (or maximum of row/column sums), producing the normalized matrix N [24]

Step 3: Compute the total-relation matrix (T).
The total-relation matrix captures both direct and indirect influences among factors. It is computed using $T=N(I-N)-1$, where I is the identity matrix [26]. This step is essential because in real systems, one factor may influence another through intermediate factors.

Step 4: Calculate prominence and relation indices.
For each factor, the sum of the rows of T is denoted as D (influence given), and the sum of the columns is denoted as R (influence received). Two important indices are then computed:

D+R (prominence), showing the overall importance of a factor in the system, and

D−R (relation), showing whether the factor is a net cause (positive) or net effect (negative) [25, 27].

Step 5: Develop the causal diagram and influence network.
A causal diagram was plotted using

D+R on the horizontal axis and

D−R on the vertical axis. This visual map helps interpret which factors drive the system and which are mainly outcomes [28,27].

To draw a clearer influence network, a threshold value was applied. Relationships in T below the threshold were removed, and only stronger relationships were displayed. This step helps focus interpretation on meaningful influences and reduces visual clutter [26].

5. Findings

Table 2
DEMATEL Cause–Effect Evaluation of Economic Determinants in Aging-in-Place versus Institutionalization Decisions

Criteria	ri	ci	ri + ci	ri – ci	Cause / Effect
Pension and Retirement Income Adequacy	8.31	8.09	16.39	0.22	Cause
Cost of Formal Home Care Services	8.22	8.22	16.45	-0.00	Effect
Public Long-Term Care Subsidies and Insurance Coverage	9.01	8.22	17.22	0.79	Cause
Informal Caregiver Opportunity Cost	7.65	9.08	16.74	-1.43	Effect
Housing Wealth and Property Liquidity	8.12	7.71	15.83	0.42	Cause

Note: Factors with R−C > 0 are classified as CAUSE (influencer); R−C < 0 are classified as EFFECT (receiver).

The table shows the DEMATEL cause–effect results using the value $r_i - c_i$. When this value is positive, the factor is a cause (it mainly influences other factors). When it is negative, the factor is an effect (it is mainly influenced by other factors). The results indicate that Public Long-Term Care Subsidies and Insurance Coverage is the strongest driving factor ($r - c = 0.79$), meaning it has the biggest overall influence on the other economic factors in the system. Housing Wealth and Property Liquidity (0.42) and Pension and Retirement Income Adequacy (0.22) are also cause factors, but their influence is more moderate. On the other hand, Informal Caregiver Opportunity Cost is the strongest effect factor (-1.43), suggesting it is mostly shaped by changes in other factors rather than shaping them. Cost of Formal Home Care Services (-0.00) is almost balanced, meaning it both influences and is influenced at similar levels. Overall, the findings suggest that policy support and household financial resources serve as the main "starting points" in the system, while caregiver burden and care costs tend to emerge more as outcomes of these upstream economic conditions.

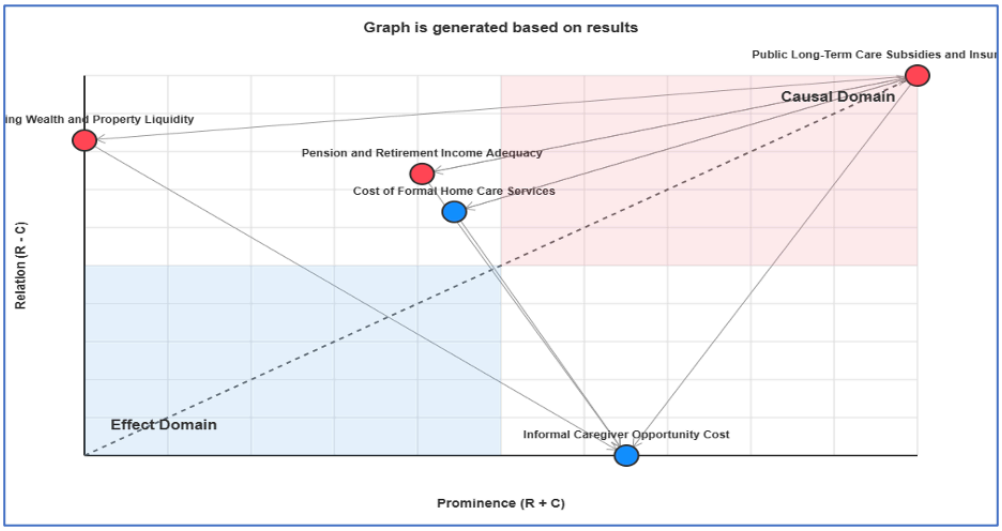

Fig. 1. Network diagram (Prominence vs Relation)

The network diagram (Figure 1) places each factor on a graph using two values. The horizontal axis, Prominence (R + C), shows how important a factor is overall because it reflects both how much the factor influences others and how much it is influenced. The vertical axis, Relation (R − C), shows whether the factor mainly acts as a driver (cause) or mainly acts as an outcome (effect). In the

diagram, Public Long-Term Care Subsidies and Insurance Coverage is in the upper-right area, which means it is highly important and strongly influences other factors, making it the main driver in the system. Housing Wealth and Property Liquidity and Pension and Retirement Income Adequacy are also in the “cause” area, but their influence is smaller, so they act as supporting economic conditions that help older adults remain at home. On the other hand, Informal Caregiver Opportunity Cost appears clearly in the “effect” area with high prominence, meaning it is important but mostly shaped by other factors rather than driving them. Cost of Formal Home Care Services sits close to the middle line, suggesting it has a mixed role, it influences some factors but is also influenced by others. Overall, the diagram suggests that policy support and financial resources are the main forces shaping the system, while caregiver burden mainly happens as a result of those upstream economic conditions.

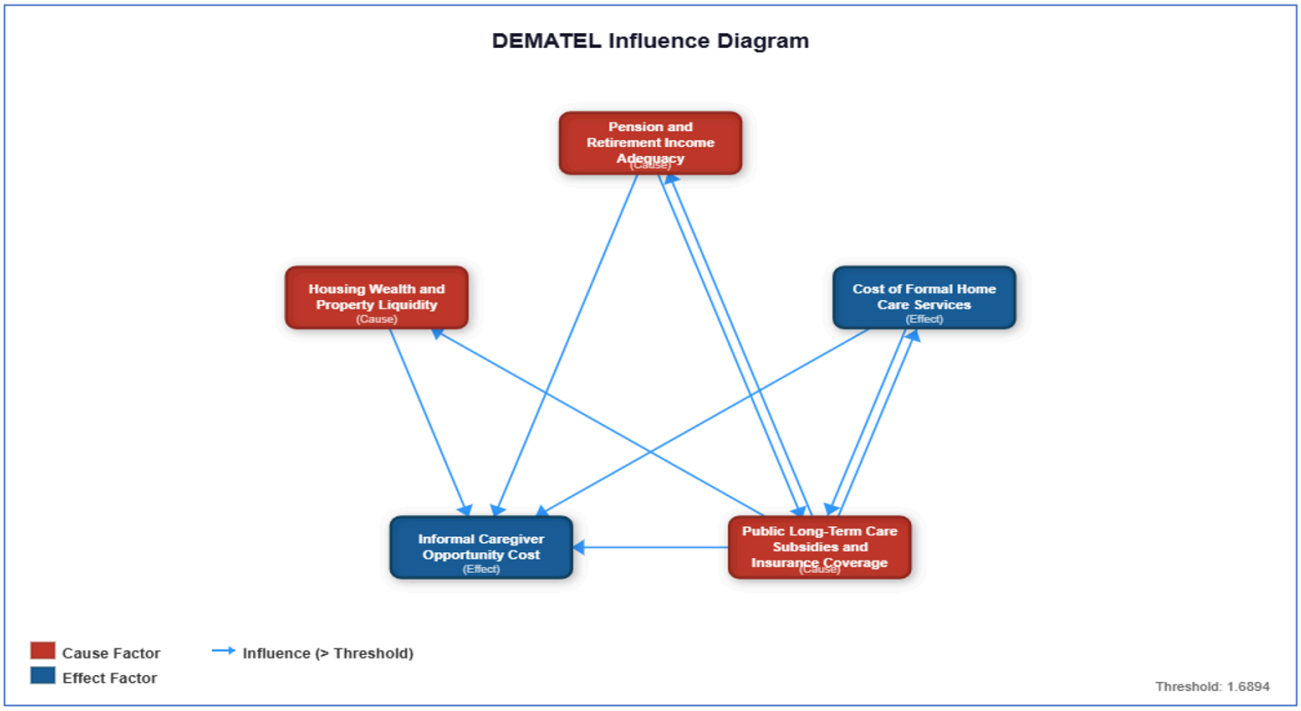

Fig. 3. Top keyword evolution over time

The DEMATEL influence diagram shows only the strong relationships (those above the threshold) between the five factors. In the diagram, red boxes represent cause factors (factors that mainly influence others), while blue boxes represent effect factors (factors that are mainly influenced by others). The results show that Public Long-Term Care Subsidies and Insurance Coverage is the most central driver in the system because it strongly affects both Pension and Retirement Income Adequacy and Informal Caregiver Opportunity Cost. This suggests that government support and insurance design can shape older adults' financial preparedness and the burden on family caregivers. Housing Wealth and Property Liquidity are also important drivers, especially because they influence caregiver opportunity costs and support other economic conditions needed for aging in place. Pension and Retirement Income Adequacy is labeled as a cause factor, but it also has two-way connections in the network, meaning it can both influence and be influenced by other factors. On the other hand, Informal Caregiver Opportunity Cost and Cost of Formal Home Care Services mainly act as effect factors, showing that they tend to increase or decrease in response to changes in policy support and household wealth. Overall, the diagram suggests that policy financing and household assets are the main starting points in the system, while caregiving burden and care costs are more

likely to appear as results that shape whether aging in place is realistic or whether institutional care becomes necessary.

6. Discussions

This study aimed to examine the structural relationships among five economic determinants influencing whether older adults remain at home (aging in place) or move into institutional care. Using the DEMATEL method, the findings indicate that these economic factors do not operate independently but interact within a connected system.

One of the most important findings of this study is that Public Long-Term Care Subsidies and Insurance Coverage emerged as the strongest causal driver in the system. This result suggests that government financial support plays a central role in shaping the entire long-term care decision environment. When governments provide stronger subsidies for home- and community-based services, older adults are more likely to receive care at home rather than in institutional settings. This finding is consistent with previous research showing that public financing programs significantly increase access to home-based care services and reduce reliance on nursing homes [8,14]. In other words, policy design can influence not only the availability of services but also the affordability of aging in place.

The results also show that Housing Wealth and Property Liquidity functions as an important cause factor. This means that housing assets play a significant role in enabling older adults to remain in their homes. Many older households hold a large portion of their wealth in housing assets, which can be used to finance home modifications, caregiving services, or daily living expenses. Previous studies have shown that access to housing wealth can help older adults maintain independence and delay institutionalization [1,7]. However, if housing assets are difficult to convert into cash, older adults may face financial barriers that limit their ability to age in place.

Another cause factor identified in this study is Pension and Retirement Income Adequacy. Although its influence is smaller compared with public subsidies, it still plays an important role in shaping care decisions. Adequate retirement income allows older adults to afford home care services, home maintenance, and assistive technologies that support independent living. On the other hand, limited retirement income may increase financial pressure and increase the likelihood of institutional care. This finding supports previous research showing that lower socioeconomic status is associated with higher rates of nursing home placement [13].

In contrast, the Informal Caregiver Opportunity Cost was identified as the strongest effect factor. This means that caregiver burden is largely shaped by other economic conditions rather than being a primary driver itself. For example, when public subsidies are limited or when formal care services are expensive, family members may need to reduce working hours or leave the labor market to provide care. This creates economic costs for caregivers in the form of lost wages and reduced career opportunities. Research has shown that unpaid caregiving can significantly affect labor force participation and financial security for families [9]. The findings of this study suggest that caregiver burden is often a consequence of broader economic conditions rather than an isolated issue.

Similarly, the cost of Formal Home Care Services appears as an effect factor with a nearly balanced relationship in the system. This indicates that care costs both influence and are influenced by other economic conditions. For example, government subsidies can reduce out-of-pocket expenses for households, while labor shortages in the caregiving workforce can increase service prices. Recent reports show that home care costs have been rising due to growing demand and workforce constraints [2,10]. Therefore, the affordability of home-based care is closely connected to policy decisions and labor market conditions.

Overall, the findings suggest that policy support and household financial resources act as the main drivers of aging-in-place decisions, while caregiving burden and care costs are largely outcomes of these broader economic conditions. This highlights the importance of designing long-term care policies that address upstream financial factors rather than focusing only on service delivery. Strengthening subsidies for home-based care, improving pension adequacy, and enabling older adults to access housing wealth could help create a more supportive environment for aging in place. From a policy perspective, the results suggest that governments should consider integrated strategies that link social protection, housing policy, and long-term care financing. Such coordinated approaches may reduce caregiver burden and improve the sustainability of long-term care systems. As populations continue to age globally, understanding the economic drivers of care-setting decisions becomes increasingly important for designing effective and equitable policies.

7. Conclusion

This study examined the structural relationships among key economic determinants influencing whether older adults remain at home (aging in place) or move into institutional care. Using the DEMATEL method, the study identified how five economic factors interact within a connected system: pension and retirement income adequacy, the cost of formal care services, public long-term care subsidies and insurance coverage, the opportunity cost of informal caregivers, and housing wealth and property liquidity. The results show that these factors do not operate independently but influence one another through a cause–and–effect structure. Public long-term care subsidies and insurance coverage emerged as the most influential driver in the system, followed by housing wealth, property liquidity, and pension and retirement income adequacy. In contrast, informal caregiver opportunity cost and the cost of formal home care services were identified mainly as outcome factors that are shaped by broader financial and policy conditions.

These findings highlight the importance of economic resources and policy design in shaping long-term care decisions. When public support systems and financial resources are stronger, older adults are more likely to remain in their homes rather than move into institutional care. This suggests that aging in place is not determined only by personal preference or health conditions, but also by the economic environment surrounding older households.

8. Implications of the Study

This study provides several important implications. First, it contributes to academic literature by offering a systems-based understanding of the economic factors influencing aging-in-place decisions. Most previous studies have examined these determinants separately using statistical models, whereas this study highlights their interactions within a network of causal relationships. By applying DEMATEL, the study demonstrates that certain upstream economic factors, particularly public subsidies and financial resources, play a central role in shaping other conditions within the system.
Second, the findings have practical implications for policymakers and long-term care planners. Since public long-term care subsidies were identified as the strongest driver, strengthening financial support for home- and community-based services may help reduce institutionalization rates. In addition, policies that improve retirement income adequacy and make it easier for older adults to access housing wealth may further support aging in place. Addressing these upstream financial conditions may also help reduce caregiver burden and improve the affordability of home-based care.

9. Limitations of the Study

Despite its contributions, this study has several limitations. First, the analysis relies on expert judgment rather than large-scale surveys or administrative data. Although expert panels are commonly used in DEMATEL studies, the results may still reflect the perspectives of the selected experts. Second, the study focuses only on five economic determinants, while other factors such as health status, social support networks, and cultural preferences may also influence long-term care decisions. Third, the findings represent a structural interpretation of relationships among factors rather than direct measurement of real-world outcomes.

10. Recommendations for Future Research

Future research could extend this study in several ways. First, researchers could incorporate additional variables, such as health conditions, family support structures, or community services, to develop a more comprehensive model of aging-in-place decisions. Second, future studies may combine DEMATEL with other analytical methods, such as Analytic Network Process (ANP) or structural equation modeling, to strengthen the analysis of complex relationships. Third, empirical data from surveys or national datasets could be used to validate the relationships identified in this study. Finally, comparative studies across different countries or policy systems may provide deeper insights into how institutional structures influence aging-in-place outcomes.

Overall, this study provides a clearer understanding of how economic conditions shape long-term care decisions. By identifying the most influential drivers within the system, the findings can help inform more effective policies that support aging in place while maintaining sustainable long-term care systems.

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