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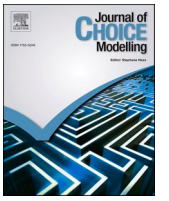

Building a life-course intertemporal discrete choice model to analyze migration biographies

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ABSTRACT

Individual migration mobilities over the life course have not been well understood in existing studies, and therefore ways to represent the underlying intertemporal dynamics and heterogeneities have remained unclear. To fill this research gap, this study investigates the domestic migration of people residing in the Capital Area of Japan, which has suffered from various issues caused by the over-concentration of population for several decades. Using a web-based questionnaire survey, workers aged 20–49 living in the Capital Area were requested to recall their five latest migration experiences (i.e., migration biography). A life-course intertemporal discrete choice model with cross-sectional and longitudinal heterogeneities was developed to represent individual migration destination biographies, by introducing quasi-hyperbolic utility and drawing on time preference theory. It was found that a considerable proportion of working people in the Capital Area (especially Tokyo) are from other regions of Japan. In the modeling analysis, the temporally-changing, intertwined and heterogeneous roles of place attachment, motives and altruism in migration decisions over the life course are empirically confirmed. Nonlinear influences of past, present and future utilities are further revealed, where the past utility grows more influential, and the importance of future utility diminishes over time. Policy implications of the derived findings for the development of megacities and local cities are discussed.

1. Introduction

Understanding population migration is crucial to regional and urban planning/policymaking (United Nations , 2016; Murillo, 2017; Sakamoto et al., 2018; Bernt, 2019; OECD, 2019; Wu et al., 2019). Owing to massive out-migration from local cities and rural areas, population concentration in three megacity regions of Japan (i.e., the Capital Area centered around Tokyo, the Chukyo Area centered around Nagoya, and the Kinki Area centered around Osaka) has been a serious problem for several decades. As shown in Fig. 1, population in the three megacity regions accounts for 60.3% of the whole population in 2019 and shows a continuing growth. In particular, the Capital Area accommodated 35.1% of Japanese population in 2019. In contrast, population in local cities and rural areas of Japan peaked in 1998 and since then, a declining trend had been a "new normal", leading the population in 2019 to decrease to the same size as the mid-1970s. Before the 1970s, population decline was not regarded as a problem by local governments. One

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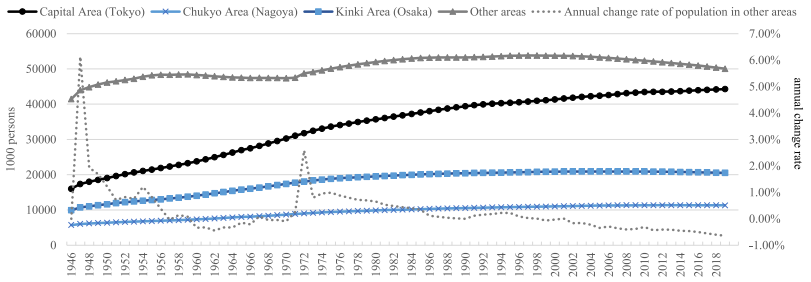


Fig. 1. Changes in the population of Japan over time (1946–2018).
(Source: Authors; based on population data from https://www.e-stat.go.jp/)

phenomenon during this period was the "employment en masse" of junior high school students. Such massive employment mobilities from rural areas to urban areas were actively promoted nationwide and contributed to the country's rapid economic growth (Katase, 2010). However, such migration mobilities caused serious problems for both local and central governments (e.g., public services have been worsened and regional community functions have been on the verge of collapse due to reduced tax revenues caused by the withdrawal of industries[1]). It is therefore important to better understand the reason and mechanism of population migration into megacity regions of Japan. This argument is also applicable to other countries troubled by similar social issues.

Migration mobility has been investigated using macrolevel, mesolevel and microlevel theories (Zhang et al., 2017). This study focuses on individual migration mobility and associated dynamics over the life course. A review of literature suggests that existing migration decision models cannot capture complicated and dynamic decision-making process over the life course. Defining time-varying utility is especially problematic. Migration is usually triggered by motives related to employment, environment as well as social relations (Lundholm et al., 2004). In this regard, people sometimes need to make a trade-off between own preferences and concerns about other family members. In other words, influences of altruism should not be underestimated in depicting individual migration decisions (Coulter et al., 2016; Burum et al., 2020). Migration may also lead to emotional transfer (Blunt et al., 2012). Namely, emotional linkage with a migration destination may be influential to migration decision-making. Place attachment is usually used to describe people's emotional connection to a place such as home, neighborhood, city, region, country or continent (Lewicka, 2011). Neighborhood is deemed as the proper scale in the research on place attachment (Lewicka, 2010); however, it is also argued that such affection could be stronger at the city level (Casakin et al., 2015). Settling down in a city and recognizing the city as hometown are intertwined (Blunt and Sheringham, 2019), suggesting that place attachment could be formed through accumulation of affection. Furthermore, influences of factors affecting migration decisions change over time and function in a complicated way (Morris et al., 2018). Roles of these factors in migration decision-making over the life course have not been adequately investigated. Filling such a research gap is important to figure out how to resolve various issues caused by the over-concentration of population in megacity regions from the perspective of individual migration decision-making.

This study aims to develop a life-course model for migration mobility, namely migration destination biography model. Biography is a set of mobilities observed over the life course (Zhang et al., 2014). Based on the migration destination biography model, three research questions will be answered.

Q1: What is the status of migration mobility between the Capital Area and other areas in Japan?
Q2: What kinds of roles do motives, place attachment and altruism play in individual migration decision-making?
Q3: How are the time-varying mechanism underlying migration biography?

Answering **Q1** helps policymakers understand temporal and spatial features of migration. In Japan, a variety of regional revitalization policies have been implemented since the 1980s, and the central government has further established a special department for regional revitalization in 2014. As evidenced in Fig. 1, effects of existing efforts are limited in the sense that population of other areas have declined at a steady rate since the 1990s. Most existing policies emphasize infrastructure development and pay insufficient attention to improving quality of life. Related to this concern, **Q2** is posited to capture the key behavioral and psychological factors affecting migration decision-making. Understanding the roles of motives, altruism and place attachment allows authorities to make local life-oriented policies. By adopting a centrally-controlled uniform development strategy, regional identity has been seriously damaged and gradually disappear in many places. Loss of regional identity undoubtedly discourages people, especially young people, to reside in local cities and rural areas. Behavior and associated factors change over the life course, motivating us to raise **Q3**. Addressing **Q3** needs **Q1** and **Q2** to be answered taking life-course changes into consideration, and then reflecting the time-varying mechanism underlying migration mobility.

Concretely speaking, this study develops a life-course intertemporal discrete choice model to depict individual migration destination biography. It is a discrete choice model with cross-sectional and longitudinal heterogeneities (DCLH model) and is further

[1] https://www.mlit.go.jp/hakusyo/mlit/h26/hakusho/h27/pdf/np101200.pdf.

improved by introducing quasi-hyperbolic utility based on time preference theory. The resulting model is called DCLH-QHDU model. In DCLH model, parameters of explanatory variables are decomposed into elements connected with different points in time. The DCLH-QHDU model is based on time preference theory (Yu et al., 2017), by distinguishing the influences of present, past and future utility on migration decision-making. Time preference theory argues that the utility of current choice includes retrospective utility (accumulated state dependence), present utility and future utility (expectations). To the best of our knowledge, this is the first attempt in the literature of migration research to incorporate both cross-sectional and longitudinal heterogeneities over the life course and apply time preference theory. These two models are applied to investigate heterogeneous dynamics of migration biography, together with influences of motives, altruism and place attachment.

- ***Motives*** related to self-interest, altruism and concerns about life (i.e., education/job and residential environment) are introduced in the two life-course models.
- ***Altruism*** is measured by how much individual own will is reflected in the migration decision (i.e., degree of own will, abbreviated as DOW). In other words, the lower the degree of own will, the higher the level of altruism. DOW is introduced to the models in two ways: as an independent explanatory variable and as a composite variable integrated with motive.
- ***Place attachment*** is represented by a measure of hometown recognition at the city level. Influence of hometown recognition on migration decision-making is assumed to vary across people (i.e., cross-sectional heterogeneity) and change over time (i.e., longitudinal heterogeneity). Thus, both cross-sectional and longitudinal heterogeneities are reflected in the life-course models.

The remainder is organized as follows: Section 2 reviews existing studies on migration behavior. Section 3 introduces a migration biography survey conducted by the authors in the Capital Area of Japan and presents descriptive analyses. Migration biography models are developed in Section 4, followed by estimation results and empirical analyses in Section 5. Conclusions are elaborated in Section 6, together with policy implications and a discussion on research limitations.

2. Literature review

2.1. Migration biography

Mobility biography is widely used to investigate dynamics in behavior (Zhang et al., 2014; Müggenburg et al., 2015). According to the definition of biography in life course theory, migration biography can be described as a sequence of interlinked migration events (Elder, 1994; Coulter and Van Ham, 2013; Coulter et al., 2016). Coulter and Van Ham (2013) claimed that it was necessary for residential mobility biography to explore individual migration behavior by allowing the incorporation of the impacts of past mobilities. Fatmi et al. (2017) investigated household residential location choice by taking into consideration the effects of both life events and interdependencies across life domains, in line with the life-oriented approach (Zhang, 2017), and concluded that life events affected household residence location choice significantly. Only a few studies can be found in the literature to quantify migration biography based on suitable modeling approaches. At best, econometric models with panel data (e.g., a panel model with attrition, e.g. Rindfuss et al., 2007), a model with fixed and random effects of time (Ricardo da Silva et al., 2014) and a panel cointegration analysis (Brucker et al., 2011) have been applied. The lack of behaviorally-oriented migration biography models is also pointed out by Zhang (2017) and Scheiner and Rau (2020), who have made extensive literature reviews.

2.2. Factors affecting migration decision

Many factors influence migration decision-making, from individual/household attributes at a micro level to opportunity structures of the regional housing and labor market at a macro level (Coulter and Van Ham, 2013).

Motives: Generally, people decide to move when they are inspired by the desire for better quality of life. Geist and McManus (2008) investigated reasons for long-distance and local migration in the USA and revealed the dominant role of quality-of-life reasons (e.g., upgraded neighborhood, commute, housing and living environment). They subsequently investigated migration for different reasons (e.g., job change, family, and quality of life) and revealed variations across gender and family status (Geist and McManus, 2012). For young people, migration was usually associated with human capital investment, such as job promotion and income growth (Bayer and Juessen, 2012). By comparing urban migrants and return migrants, De la Roca (2017) revealed that skilled, educated and productive workers are more inclined to migrate to large cities. Ahlin et al. (2018) found that high school grade and better educational background of parents encouraged individuals to start working life in urban areas. As for Japan, Taima and Asami (2020) shed light on the importance of job opportunities, educational environment and marriage with regards to migration decision-making. Migration motives and their influences may change over the life course. As noted by Coulter and Scott (2015), reasons why people move varied over the life course, and the significance of developing a biography approach in migration research was confirmed, as age and marriage status affected individual migration motives. Kley (2010) argued that young people were more likely to migrate considering their own interests, and the importance of improving family life grew after raising children. Jo et al. (2014) examined the influence of close relationships on migration over the life course.

Altruism: In the literature of migration mobility, household is usually regarded as basic unit. Many studies have explored the effect of intra-household interactions on household migration decision-making (Bailey et al., 2004; Abraham et al., 2010; Rabe and Taylor, 2010; Coulter et al., 2012). As argued by Steele et al. (2013), treating individual as basic unit is reasonable as the influence of intra-household interaction could be reflected by introducing the concept of altruism.

Place Attachment: Emotions influence individual judgment and preference (Lerner et al., 2015). Place attachment represents individual emotional ties with a place, indicating its importance to individual (Lewicka, 2011). The place-people relation is affected by characteristics of both places and people (Scanell and Gifford, 2010; Lewicka, 2011). Place attachment can be categorized based on cultures, places and entities (Song and Soopramanien, 2019; Daryanto and Song, 2021), related to place of birth and residency length (Casakin et al., 2015; Song and Soopramanien, 2019). With regards to migration mobility, Adams (2016) examined the role of place attachment and asserted the indispensability of non-economic factors. Clark et al. (2017) discussed the locality of migration behavior by adopting four measures of place attachment, including family roots, life space, community connection, and satisfaction. Blunt and Sheringham (2019) elucidated home-city geographies (including physical and imaginative geographies) and examined the correlation between urban dwelling and migration mobility. Wu et al. (2019) checked place attachment of local residents and migrants in social and functional dimensions. In the rapidly mobile age, dynamics in place attachment should be underscored (Di Masso et al., 2019). In the context of Japan, Taima and Asami (2020) revealed the push effect of place attachment on intention to migrate to non-metropolitan areas. All above studies shed light on the important role of place attachment in migration mobilities.

2.3. Positioning this study in the literature

There are two major research gaps in existing studies. The first gap is that temporal dynamics of migration decision-making have not been quantified in a satisfactory manner, and few models representing migration dynamic over the life course are found in the literature. Migration biography forms over the life course. Without quantifying life course decision-making mechanism, the effects of migration policies cannot be properly evaluated and effective migration policies cannot be proposed with scientifically sound evidence. The second gap is that though a great body of literature have studied migration mobility, the roles of motives, place attachment and altruism over the life course are still under-explored. Self-interest and altruism are human nature, and clarifying their impacts on migration mobility is essential for a better understanding of migration decision-making. All factors affecting migration may not be time-invariant, while time-varying decision-making mechanism remains unexplored. To address these research gaps, this study develops migration biography models to investigate migration mobilities and provides a case study in the Japanese context.

3. Data analysis

We designed a migration biography questionnaire survey which allows each respondent to recall a maximum of five recent migration experiences. For each migration, following information is requested: respondent's age at each migration, migration destination (at the municipality level) and hometown recognition, and migration motives and degree of individual own will in the migration decision-making process. Hometown recognition is measured by asking the question "do you perceive this destination as your hometown or not", 1 – yes and 0 – no. This dummy variable is used to represent place attachment. Degree of own will in the migration decision-making process is measured in the form of a percentage ranging from 0% to 100%, as 0% means that the migration is fully decided by other person(s) and 100% means that the decision is made fully by him/herself. Namely, a smaller percentage corresponds to a higher level of altruism. Thus, degree of own will can be used to represent altruism.

A web-based survey was conducted in December 2015. A major survey company in Japan was employed to collect respondents from the target region. Taking into consideration its continuing population growth, the Capital Area of Japan was selected, including

Table 1
Data descriptions.

Attributes	Percentage
Gender	
male	58.4%
female	41.6%
Cohort	
1960s	14.9%
1970s	41.2%
1980s	35.8%
1990s	8.1%
Education Background	
bachelor degree or above	66.0%
others	34.0%
Marriage status	
married	45.9%
unmarried	54.1%
Family size (number of members)	
1	30.3%
2	23.8%
3	21.5%
more than 3	24.4%
Number of children	
zero	66.6%
non-zero	33.4%

Tokyo's 23 wards (i.e., the central area of the capital, hereafter, Tokyo) and seven surrounding prefectures (i.e., the Capital Area beyond Tokyo, abbreviated as CABT). Because attracting workforces is crucial for regional development, the survey targeted the working population aged 20–49 years old. The online questionnaire was designed to avoid missing data and reduce the answering burden. Validity of the collected data was further guaranteed by deleting respondents who answered too quickly or who provided data with logic errors, etc. Valid data was obtained from 1000 respondents, including 500 from Tokyo and 500 from CABT. The distributions of age and gender were kept almost the same as those for the total populations in each region.

Data descriptions are provided in Table 1. It is shown that 41.4% of the respondents were from the 1970s cohort (born in the 1970s), accounting for the largest share of the sample. The second largest cohort is the 1980s (35.8%), followed by the 1960s cohort (14.9%). About two-thirds, or 66% of respondents were married, about 70% of respondents lived with other family members, and about 30% had at least one child.

3.1. Analysis of migration biography

Regarding **Q1**, 2380 migrations were recorded, involving migration biographies of 795 respondents. 80%–87% of respondents had experienced migrations (Fig. 2). The average times of migration were larger for older cohorts than young cohorts, which is not surprising as older people would be expected to have experienced more migrations. Half of the 1960s cohort have experienced three or more migrations, while the corresponding share for the 1990s cohort is 25%. Comparing the shares of respondents who experienced three or more migrations, an increase of 10 percentage points or more was observed from the 1990s cohort to the 1980s cohort, and from the 1980s cohort to the 1970s cohort, respectively.

In this study, migration destinations over the life course have three alternatives: Tokyo, CABT, and other areas (i.e., areas beyond the Capital Area). All respondents are categorized into the following eight mutually exclusive groups, also shown in Fig. 3.

- **Three groups** of *respondents to CABT* colored in blue (the first three sets of blocks from the left): 31.1% moving within CABT, 11.0% from Tokyo to CABT, and 9.2% from other areas to CABT.
- **Five groups** of *respondents to Tokyo* colored in orange (the other five sets of blocks): 23.1% moving within Tokyo, 9.4% from other areas to Tokyo, 6.6% from CABT to Tokyo, 4.8% from other areas and CABT to Tokyo, and 4.8% returning to Tokyo.

Among all respondents, moving within Tokyo (23.1%) and within CABT (31.1%) accounts for more than half of all migrations. Moving between Tokyo and CABT is the second largest group of migration (22.4%): 11.0% from Tokyo to CABT, and 11.4% for the reverse flow (i.e., 6.6% from CABT and 4.8% from both CABT and other areas). Thus, migrations within the Capital Area account for 76.6%. The share of moving from other areas to the Capital Area is 18.8%. Various regional revitalization policies were implemented during the period (1968–2015); however, it seems that they are not effective to push working people to move outside the Capital Area. This observation is consistent with Fig. 1. As shown in Fig. 3, there are obvious differences in migration patterns by age cohorts. The 1990s cohort shows the largest share of migration within and to CABT, while the 1980s cohort is most likely to migrate within and to Tokyo. As for migration from other areas to Tokyo, it is mainly observed in the 1980s and 1990s cohorts. For all cohorts, migrations within CABT and within Tokyo are the major.

3.2. Analysis of migration motives and altruism

Regarding **Q2**, the number of observations and average degree of own will are displayed in Fig. 4. It reveals that migration mobility is mainly concentrated in the age range of 19–36, and peaks at the age of 19 and 23, which correspond with high school graduation and university graduation. The degree of own will first increases sharply to 60% at the migration age 20 and then fluctuates until age 45. Afterwards, the degree of own will decreases remarkably. At the early time and mid-time of respondents' careers, many respondents could make migration decisions according to their own will to a greater extent (about 60%). The average degree of own will is 43.8%, implying that migration decisions are usually made jointly with others and involve altruism.

Respondents were asked to choose from thirty given motives and one more option "*others*" (see Table 2). Although multiple choices were permitted, around 90% of migrations were reported to be driven by only one motive. Motives are further classified into four types

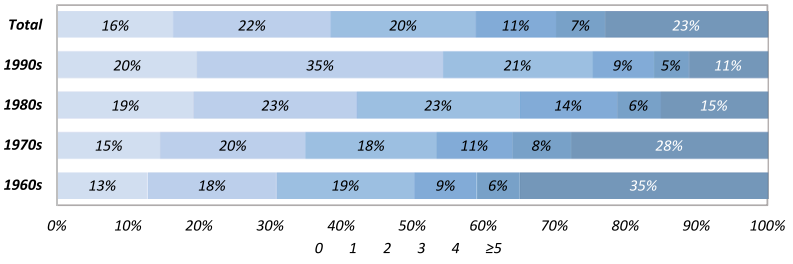


Fig. 2. Number of migrations, by cohort.

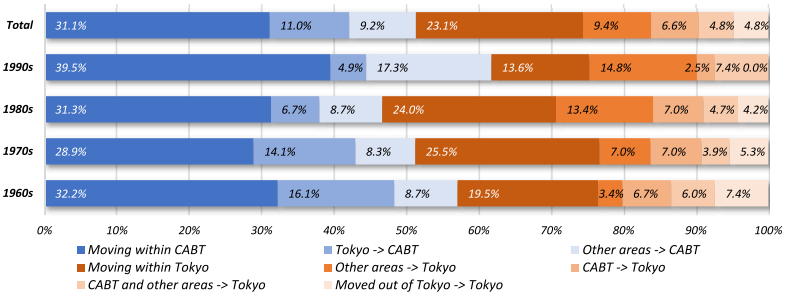


Fig. 3. Shares of groups characterized by migration biography.

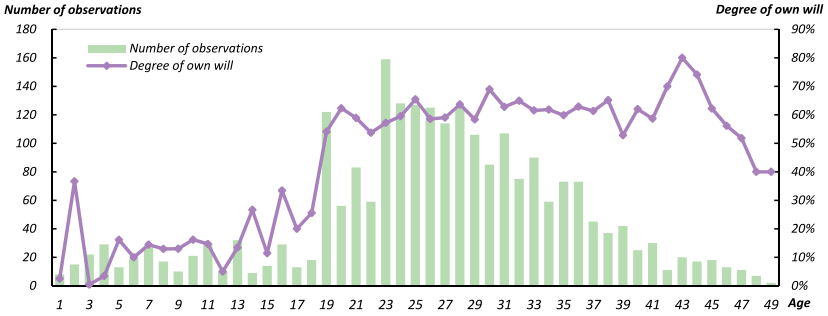


Fig. 4. Number of observations and average degree of own will, by age.

as shown in Table 2. Self-interest motive is dominant, inducing 79.2% of all migrations, and over half (54.1%) are related to changes in education and job. Motives related to altruism and residential environment are associated with 26.6% and 16.1% of all migrations, respectively.

- *Self-interest motive* (**SI**): related to own interests or self-concerned matters.
- *Motive related to altruism* (**AT**): concerned about other household members, including spouse, parents and children.
- *Motive related to education/job* (**EJ**): related to education or job, and the subject could be self, spouse and parents.
- *Motive related to residential environment* (**RE**): related to housing issues or living environment.

Fig. 5 shows the proportions of migrations related to different motives and the average degree of own will. The average degree of own will varies across motive types: 63.7% for **SI**, 27.4% for **AT**, 62.9% for **EJ**, and 63.5% for **RE**. Migrations induced by all types of motives are attached with a similar degree of own will (around 63%), except **AT**. This is because people have to compromise and sacrifice something when they have to move for the interests of other household members. Degree of own will further varied across motives within the same motive type. For instance, for **SI**, migration motivated by job change due to company's will, job location change and inheritance of family business are related to a respondent's interest but are not voluntary. Degree of own will is relatively low for migrations induced by these motives.

4. Migration destination biography model: A life-course intertemporal discrete choice model

To address **Q3**, two types of migration destination biography models are developed, based on studies by Zhang et al. (2004) and Yu et al. (2017). The utility that individual i chooses destination r at the mth migration is composed by an observed utility u_{irm}, which is a function of explanatory variable vector x_{irm} (consisting of variables x_{irmk}, where $k = 1, 2, \ldots K$) and unknown parameter vector θ_{irm} (consisting of parameters θ_{irmk}, where $k = 1, 2, \ldots K$), and an unobserved error term ε_{irm}, as shown in Equation (1).

$$U_{irm} = u_{irm} + \varepsilon_{irm} = \theta_{irm} x_{irm} + \varepsilon_{irm} \tag{1}$$

To represent cross-sectional and longitudinal heterogeneities based on observed information, observed utility u_{irm} is further divided into three parts (see Equation (2)) by decomposing time-varying parameter θ_{irm} in line with the method adopted by Zhang et al. (2004) and Yu et al. (2017). The *first* part is constant term c_r indicating an intrinsic preference for region r. The *second* part represents the independent effect of hometown recognition as h_{irm} denotes individual i's hometown recognition ($h = 1$, if yes; 0, if no) for destination r at the mth migration and β_h is corresponding parameter. The *third* part describes effects of explanatory variables, including socio-demographics, motives, degree of own will, and composites of motives and degree of own will. τ_{ia} denotes the period between

Table 2
List of migration motives.

Motives	*Self-interest motive* (SI)	*Motive related to altruism* (AT)	*Motive related to education/ job* (EJ)	*Motive related to residential environment* (RE)
respondent's schooling	▲		▲	
respondent's being-employed	▲		▲	
respondent's job changes due to own will	▲		▲	
respondent's job changes due to company's will	▲		▲	
respondent's job location change	▲		▲	
respondent's inheritance of family business	▲		▲	
respondent's start of operating a business	▲		▲	
spouse's being-employed		▲	▲	
spouse's job changes due to own will		▲	▲	
spouse's job changes due to company's will		▲	▲	
spouse's job location change		▲	▲	
spouse's inheritance of family business		▲	▲	
spouse's start of operating a business		▲	▲	
spouse's retirement		▲	▲	
children's schooling		▲		
accompanying with respondent's parents		▲		
co-living with respondent's parents		▲		
living close to respondent's parents		▲		
co-living with spouse's parents		▲		
living close to spouse's parents		▲		
co-living with children		▲		
living close to children		▲		
respondent's marriage	▲			
respondent's divorce	▲			
housing-related issues	▲			▲
related to living environment	▲			▲
respondent's convenience of commuting/schooling	▲		▲	
spouse's convenience of commuting/ schooling		▲	▲	
due to children-rearing environment		▲		
due to respondent's health	▲			
Proportions (%)	79.2	26.6	54.1	16.1

Note: "▲" indicates motive is attached to the corresponding classification.

(*a-1*)th migration and *a*th migration, and h_{ira} indicates hometown recognition at the *a*th migration. The main effect of the *k*th explanatory variable x_{irmk} is measured by β_{0k}, and the integrated effect of explanatory variable x_{irmk} and hometown recognition is captured by β_{1k}. Equation (2) is utility function of the first migration destination biography model, called a dynamic discrete choice model with cross-sectional and longitudinal heterogeneities (i.e., DCLH model). In DCLH model, parameters to be estimated include β_h for hometown recognition, β_0 (consisting of parameters β_{0k}, where $k = 1, 2, \ldots K$) for explanatory variables x_{irm}, and β_1 (consisting of parameters β_{1k}, where $k = 1, 2, \ldots K$) for the τ_{ia}-sensitive integrated effects of hometown recognition and explanatory variables x_{irm} (i.e., such integrated effects sensitive to migration experience (measured by τ_{ia}) can be captured by β_1).

$$u_{irm} = c_r + \beta_h h_{irm} + \sum_{k=1}^{K}\left(\sum_{a=1}^{m}\tau_{ia}\cdot(\beta_{0k} + \beta_{1k}h_{ira})\right)\cdot x_{irmk} \tag{2}$$

The roles of hometown recognition in migration decision-making are emphasized in DCLH model. Accordingly, hometown recognition is introduced in two manners: its own main effects and the integrated effects together with explanatory variables. The integrated effects mean that, for instance, even though an individual wants to work in a large city, if he/she is highly attached to his/her current small city, he/she may not migrate out to the large city due to place attachment. This argument may also apply to altruism, as if he/she thinks living close to or together with his/her parents is more important than going to the large city, he/she may decide to stay in the small city. Such integrated effects may change over time. Regarding above examples, even though he/she chooses to work in a large city, attracted by job found there, he/she may decide to go back to the small city after several years when his/her parents get older, motivated by taking care of parents. Such time-varying effects are considered by incorporating variables indicating the periods between migrations in the model (i.e., τ_{ia}).

Interlinked decisions within mobility biography change and correlate over time, and such temporal connections are discounted from past to present and to future (Andersen et al., 2008; Lempert and Phelps, 2016). In this regard, discounted utility theory has been used to describe intertemporal choices in the fields of psychology and economics, mainly in forms of exponential, hyperbolic and quasi-hyperbolic functions (Benhabib et al., 2010; Andersen et al., 2014). Here, to incorporate impacts of past, present and future

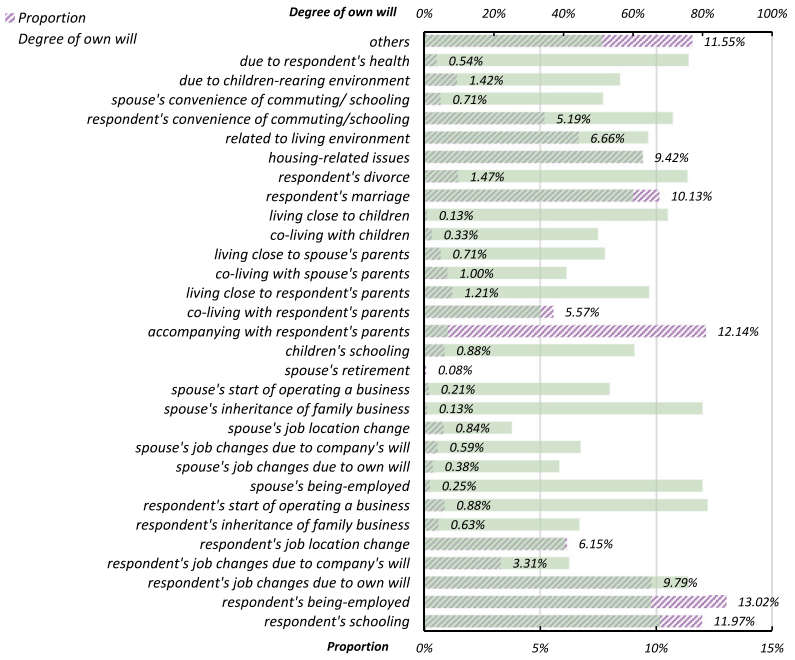


Fig. 5. Proportions of different migration motives and corresponding average shares of own will.

utility on migration decision-making, discounted utility with a quasi-hyperbolic form is adopted to improve the structure of DCLH model. This improved model is called DCLH-QHDU model, and the involved quasi-hyperbolic function (Benhabib et al., 2010; Andersen et al., 2014) shown in Equation (3), where γ is shape parameter and d is scale parameter for discounted effect.

$$D(t) = \begin{cases} 1 \\ de^{-\gamma t}, if \end{cases} \begin{matrix} t = 0 \\ t > 0 \end{matrix} \tag{3}$$

In the context of migration destination biography model, mobility age T is assumed as present (i.e., D(T) = 1). Considering that near-past and near-future utilities have greater impacts on present decision (Lempert and Phelps, 2016), past and future discounted utility functions should have diminishing property as time approaches the far ends of past and future. Thus, the discounted function for future is consistent with Equation (3) as D(t) = $d{\cdot}e^{-\gamma t}$ when t > T, while $d{\cdot}e^{\gamma t}$ is used instead of $d{\cdot}e^{-\gamma t}$ to represent the influence of past, namely D(t) = $d{\cdot}e^{\gamma t}$ when t < T. Reflecting all these arguments, the utility function that individual i chooses alternative r as the destination at mth migration at mobility age T is formulated as Equation (4) where α and γ are shape parameters for past and future utilities, and p and q are scale parameters for past and future utilities, respectively. Compared with DCLH model, there are four more unknown parameters in DCLH-QHDU model. In the parentheses of the second line of Equation (4), the first and third parts represent relative influences of past and future utility, being accordant with time preference theory (Yu et al., 2017) that provides a systematic way to capture influences of utilities at different points in time.

$$U_{irm}(T) = \int_0^{T-1} pe^{\alpha t}u_{irm}dt + u_{irm} + \int_{T+1}^{\infty} qe^{-\gamma t}u_{irm}dt + \varepsilon_{irm} = \left[\frac{p}{\alpha}\left(e^{\alpha(T-1)} - 1\right) + 1 + \frac{q}{\gamma}e^{-\gamma(T+1)}\right] \cdot u_{irm} + \varepsilon_{irm} \tag{4}$$

Assuming error term ε_{irm} follows an independent and identical Weibull distribution, likelihood functions for I individuals for above two migration destination biography models are illustrated in Equations (5) and (6), and δ_{irm} is a dummy variable, which is equal to 1 if individual i chooses region r as the destination of mth migration, and is otherwise equal to 0. Maximum likelihood estimation is implemented based on the R software package "*optimx*" (Nash and Varadhan, 2011).

$$\text{DCLH model}: L = \prod_{i=1}^{I}\prod_{m=1}^{M}\prod_{r=1}^{R}\left[\frac{\exp(u_{irm})}{\sum_{r'}\exp(u_{ir'm})}\right]^{\delta_{irm}} \tag{5}$$

DCLH-QHDU model:

$$L = \prod_{i=1}^{I}\prod_{m=1}^{M}\prod_{r=1}^{R}\left[\frac{\exp\left\{\left[p/\alpha\cdot\left(e^{\alpha(T_m-1)} - 1\right) + 1 + q/\gamma\cdot e^{-\gamma(T_m+1)}\right]\cdot u_{irm}\right\}}{\sum_{r'}\exp\left\{\left[p/\alpha\cdot\left(e^{\alpha(T_m-1)} - 1\right) + 1 + q/\gamma\cdot e^{-\gamma(T_m+1)}\right]\cdot u_{ir'm}\right\}}\right]^{\delta_{irm}} \tag{6}$$

5. Empirical results

The choice set of migration destination consists of Tokyo, CABT, and other areas. For estimating β_0 (see Equation (2)), other areas is treated as reference. As for x_{irm} (see Equation (2)), education level (Bachelor's degree or above: 1-yes, 0-no) and gender (1-male, 0-female) are introduced as socio-demographics. Four motive variables are included: "Motive_ self-interest", "Motive_ altruism", "Motive_ education/job", and "Motive_ residential environment" to represent four types of motives as shown in Table 2. To capture the influences of altruism, indicator for DOW as well as four integrated variables (i.e., "DOW × Motive_ self-interest", "DOW × Motive_ altruism", "DOW × Motive_ education/job", and "DOW × Motive_ residential environment") are adopted. Adopting integrated variables is useful to reflect the influences of observed heterogeneities and the underlying mechanism of migration decision-making. For example, even though an individual is highly motivated to migrate out because they are attracted by an improved residential environment, if his/her relative influence in migration decision is not sufficiently high, his/her out-migration may not come true.

Based on data from 795 respondents with migration experiences, estimation results of DCLH and DCLH-QHDU models are summarized in Tables 3 and 4. The goodness-of-fit indices of McFadden's rho-squared and adjusted rho-squared suggest that both models are acceptable in terms of modeling accuracy (both are larger than 0.2), where DCLH-QHDU model slightly outperforms DCLH model. The DCLH-QHDU model has a statistically significant scale parameter (p) for the past utility, meaning that migration decision-making is past-dependent. Such significance supports the applicability of time preference theory and discounted utility to represent migration

Table 3
Estimation results of the DCLH model.

Parameter	Explanatory variables of h_{irm}, x_{irm}, $x_{irm}{}^{\mathsf{T}}h_{irm}$,	Tokyo			CABT			Other areas		
	$[\beta_h\ h_{irm};\ \beta_0\ \tau_{im}\ x_{irm};\ \beta_1\ \tau_{im}\ h_{irm}\ x_{irm}]$	*est.*	*t-value*	*sig.*	*est.*	*t-value*	*sig.*	*est.*	*t-value*	*sig.*
c	Constant term	0.586	4.637	[a]	0.639	4.812	[a]			
β_0	Bachelor's degree or above (*1-yes, 0-no*)	0.000	0.030		−0.038	−3.074	[a]			
	Gender (*1-male, 0-female*)	0.033	2.766	[a]	0.037	2.931	[a]			
	Motive_ self-interest (*1-yes, 0-no*)	0.051	1.651	[c]	0.078	2.324	[b]			
	Motive_ altruism (*1-yes, 0-no*)	0.000	−0.166		0.022	2.093	[b]			
	Motive_ education/job (*1-yes, 0-no*)	−0.065	−2.124	[b]	−0.070	−2.093	[b]			
	Motive_ residential environment (*1-yes, 0-no*)	0.119	1.617		0.086	1.155				
	Degree of own will (*DOW, [0,1] with 0.1 intervals*)	0.117	3.119	[a]	0.131	3.379	[a]			
	DOW × Motive_ self-interest	−0.098	−1.719	[c]	−0.135	−2.194	[b]			
	DOW × Motive_ altruism	−0.047	−1.436		−0.080	−2.149	[b]			
	DOW × Motive_ education/job	0.012	0.259		0.025	0.470				
	DOW × Motive_ residential environment	−0.115	−1.308		−0.131	−1.424				
β_h	Place attachment (Hometown recognition)	1.463	4.273	[a]	1.219	5.852	[a]	1.516	5.577	[a]
β_1	Bachelor's degree or above (*1-yes, 0-no*)	−0.036	−2.384	[b]	0.022	2.062	[b]	−0.017	−0.981	
	Gender (*1-male, 0-female*)	−0.026	−1.684	[c]	−0.018	−1.658	[c]	0.036	2.208	[b]
	Motive_ self-interest (*1-yes, 0-no*)	0.005	0.120		0.002	0.054		−0.006	−0.113	
	Motive_ altruism (*1-yes, 0-no*)	0.030	1.441		0.019	1.044		−0.038	−1.959	[c]
	Motive_ education/job (*1-yes, 0-no*)	0.006	0.137		−0.011	−0.352		−0.092	−1.875	[c]
	Motive_ residential environment (*1-yes, 0-no*)	0.037	0.741		0.049	1.043		0.201	2.329	[b]
	Degree of own will (*DOW, [0,1] with 0.1 intervals*)	0.067	1.784	[c]	−0.009	−0.399		0.062	1.297	
	DOW × Motive_ self-interest	0.020	0.299		0.020	0.426		−0.132	−1.376	
	DOW × Motive_ altruism	−0.019	−0.393		0.015	0.415		0.024	0.449	
	DOW × Motive_ education/job	−0.035	−0.549		−0.014	−0.325		0.127	1.492	
	DOW × Motive_ residential environment	−0.077	−0.985		−0.002	−0.035		−0.237	−1.910	[c]
	Sample size	795								
	Initial log-likelihood	−2 568.56	McFadden's rho-squared	0.2261						
	Converged log-likelihood	−1987.83	Adjusted rho-squared	0.2031						

Note.
[a] 1% significance level.
[b] 5% significance level.
[c] 10% significance level.

destination biography. After reflecting time preference of past, present and future in the migration destination biography model, especially, most of the parameters (β_1) for representing the integrated effects of hometown recognition and explanatory variables x_{irm} become insignificant in the cases of Tokyo and CABT. This suggests that the model without the reflection of time preference would overestimate such integrated effects that are sensitive to the time-related migration experience. In other words, the effects of place attachment in Tokyo and CABT may be homogeneous over time across people with different objective and subjective attributes. In contrast, such integrated effects are still observed in "Other Areas", indicating that encouraging the migration into those areas should

Table 4
Estimation results of the DCLH-QHDU model.

Parameter	Explanatory variables of h_{irm}, x_{irm}, $x_{irm}{}^{c}h_{irm}$	Tokyo			CABT			Other areas		
	[$\beta_h\ h_{irm}$; $\beta_0\ \tau_{im}\ x_{irm}$; $\beta_1\ \tau_{im}\ h_{irm}\ x_{irm}$]	*est.*	*t-value*	*sig.*	*est.*	*t-value*	*sig.*	*est.*	*t-value*	*sig.*
c	Constant term	0.393	2.687	[a]	0.426	2.848	[a]			
β_0	Bachelor's degree or above (*1-yes, 0-no*)	−0.001	−0.106		−0.018	−2.060	[b]			
	Gender (*1-male, 0-female*)	0.015	1.921	[c]	0.015	1.818	[c]			
	Motive_ self-interest (*1-yes, 0-no*)	0.023	1.372		0.036	1.782	[c]			
	Motive_ altruism (*1-yes, 0-no*)	−0.000	−0.405		0.009	1.553				
	Motive_ education/job (*1-yes, 0-no*)	−0.033	−1.822	[c]	−0.036	−1.816	[c]			
	Motive_ residential environment (*1-yes, 0-no*)	0.070	1.500		0.052	1.162				
	Degree of own will (*DOW, [0,1] with 0.1 intervals*)	0.051	2.000	[b]	0.057	2.092	[b]			
	DOW × Motive_ self-interest	−0.046	−1.479		−0.065	−1.783	[c]			
	DOW × Motive_ altruism	−0.028	−1.533		−0.042	−1.836	[c]			
	DOW × Motive_ education/job	0.012	0.502		0.020	0.750				
	DOW × Motive_ residential environment	−0.064	−1.236		−0.067	−1.239				
β_h	Place attachment (Hometown recognition)	0.839	2.513	[b]	0.701	2.770	[a]	0.860	2.754	[a]
β_1	Bachelor's degree or above (*1-yes, 0-no*)	−0.017	−1.813	[c]	0.009	1.527		−0.009	−0.926	
	Gender (*1-male, 0-female*)	−0.014	−1.549		−0.008	−1.324		0.017	1.638	
	Motive_ self-interest (*1-yes, 0-no*)	−0.000	−0.022		0.000	0.010		−0.006	−0.222	
	Motive_ altruism (*1-yes, 0-no*)	0.011	0.986		0.009	0.934		−0.024	−1.878	[c]
	Motive_ education/job (*1-yes, 0-no*)	0.002	0.102		−0.006	−0.441		−0.049	−1.684	[c]
	Motive_ residential environment (*1-yes, 0-no*)	0.019	0.707		0.023	0.959		0.111	1.890	[c]
	Degree of own will (*DOW, [0,1] with 0.1 intervals*)	0.026	1.306		−0.008	−0.743		0.020	0.786	
	DOW × Motive_ self-interest	0.016	0.476		0.011	0.489		−0.058	−1.125	
	DOW × Motive_ altruism	−0.007	−0.305		0.005	0.307		0.017	0.603	
	DOW × Motive_ education/job	−0.014	−0.442		−0.005	−0.243		0.067	1.419	
	DOW × Motive_ residential environment	−0.036	−0.846		−0.004	−0.140		−0.126	−1.634	
Time-preference parameters										
Past	Discount rate (α)	0.024	1.414		Scale parameter (p)	0.023	2.095	[b]		
Future	Discount rate (γ)	0.112	1.364		Scale parameter (q)	0.189	1.018			
	Sample size	795								
	Initial log-likelihood	−2 568.56	McFadden's rho-squared	0.2308						
	Converged log-likelihood	−1975.84	Adjusted rho-squared	0.2062						

Note.
[a] 1% significance level.
[b] 5% significance level.
[c] 10% significance level.

pay attention to different people's profiles and psychological factors. As DCLH-QHDU model outperforms DCLH model in terms of modeling accuracy and decision-making mechanisms, hereafter, analyses will be mainly based on DCLH-QHDU model.

5.1. Intertemporal correlations in migration biography

According to shape and scale parameters α and p for the past, and γ and q for the future (see Table 4), temporally-changing curves of past and future weights (or relative influences) are displayed in Fig. 6. As aging, the weight of past gets larger at an accelerating rate, while the relative influence of future decreases. Assuming that the weight of present utility is equal to 1, Fig. 7 presents the proportions of past, present and future in total utility as aging. The share of past changes in the form of an S-shaped curve (i.e., increases slowly before age 8, then accelerates until age 18, and afterwards grows slowly). As for present, the share starts from 40% and peaks at age 14. The proportion of future keeps decreasing and gradually gets close to zero after age 40.

Similar with the study by Yu et al. (2017), the importance of past experience is re-confirmed by incorporating time preference. However, this study reveals that contributions of past, present and future change in different ways, especially with regards to how the changing curves intersect. Notably, there are three intersection points (Fig. 7): the first one for present and future around age 3, the second for past and future around age 13, and the third for past and present around age 30. These intersection points demonstrate changes in utility patterns of migration decision-making (i.e., composition of past, present and future). Before age 13, present and future are more important, as children have little experience and usually have to migrate with parents, and consider more about present and future regarding migration decision-making. Past accumulates and weighs more for adolescents and young people, but present is still dominant. After 30, past is major and accounts for more than half of total utility, indicating the important role of past experiences in migration decision-making of middle-aged and elderly people. Thus, the use of quasi-hyperbolic utility could reveal complicated dynamics of the effects of past, present and future on migration decision-making.

5.2. Influential variables describing migration decision-making

There are two types of variables that are introduced to describe migration decision-making: one to capture the main effect of a single variable and another measuring the integrated effect of two or more variables. Concretely speaking, integrated effects are involved with regards to the composites of hometown recognition (h_{ira}) and x_{irm} (see Equation (2), including motives, altruism, education level, and gender), and the composites of degree of own will and motives. Main effects and integrated effects are analyzed separately.

5.2.1. Main effects

Main effects of explanatory variables are captured by the parameters of "c", "β_h", and some "β_0", in Table 4.

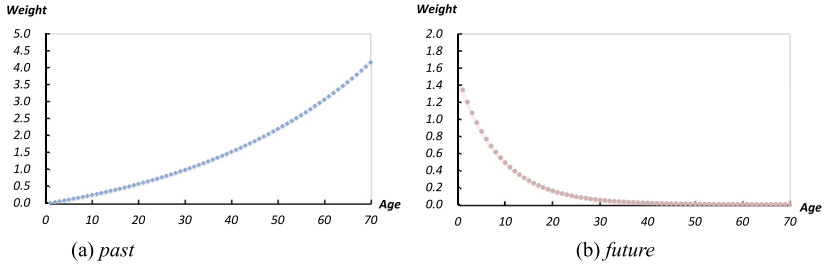
Place attachment [β_h]: The influence of hometown recognition is significantly positive for all destinations, meaning that improving place attachment is beneficial to attracting population inflow, as expected.

Motives [β_0]: Education/job motives negatively influence migration to the Capital Area (i.e., both Tokyo and CABT). This does not seem intuitive. Actually, this observation should be interpreted in this way: even though an individual is highly motivated to migrate into the Capital Area to study or work, if he/she has lived in the current place for a longer time, he/she is less likely to migrate into the Capital Area. Thus, the negative parameter value is understandable. An intuitive observation is that motives related to self interest positively affect migration to CABT. This means that if an individual is motivated by self-interest when making a migration decision, then he/she is more likely to migrate into CABT, even though he/she has already lived in the current place for a longer time.

Altruism [β_0]: DOW has statistically positive parameters for moving to Tokyo and CABT, meaning that personal will discourages people to migrate outside the Capital Area. Accordingly, policies concerning household life may encourage people to migrate to other areas, via the influence of intra-household interaction.

Individual attributes [β_0]: Gender affects migration to the Capital Area as a whole, while education level is only influential to CABT. Males are more likely to migrate to/within the Capital Area. In other words, females are more likely to migrate out of the Capital Area. Compared with other areas, CABT is less attractive to highly educated people as suggested by the positive sign of the parameter for educational attainment.

Unobserved factors [c]: The constant term is statistically significant. This finding implies that some influential factors are omitted,



(a) *past* (b) *future*

Fig. 6. Changing curves of past and future weights.

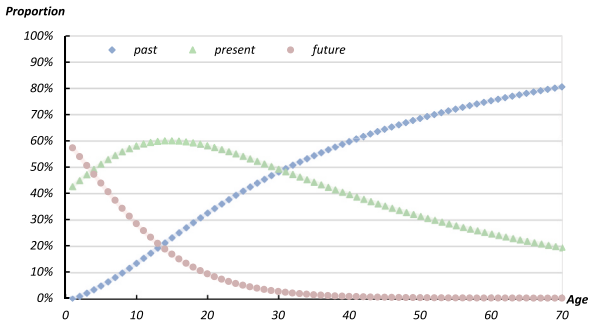


Fig. 7. Changing curves of past, present and future proportions in total utility.

suggesting that more factors should be incorporated in the survey. Because the adopted life-course survey is already complicated, future research should be done to develop more innovative life-course survey methods.

5.2.2. *Integrated effects*

Integrated effects are estimated as shown by all the β_1 parameters and the β_0 parameters of motive-related variables in Table 4.

DOW × *Motives* [β_0]: There are only two significant parameters for motives related to altruism and self interest. Altruism-related motive is influential to migration decisions via integration with DOW. Its significant and negative parameter for CABT indicates that if an individual is motivated by altruism and other persons are highly involved in the migration decision (i.e., in the case of a lower DOW value), he/she is more likely to migrate into CABT. As for migration induced by self interest, the integrated effect is negative, which is opposite to the sign of its main effect. This means that if individual migration decision is made mainly by involving other persons, the individual is more likely to migrate into CABT based on own interest. In other words, when there are conflicts between intra-household interactions and self-interest, the household may give a priority to personal will.

Place attachment × *Individual attributes* [β_1]: People with bachelor's degree do not prefer to stay in Tokyo when Tokyo is recognized as hometown. Based on aforementioned lower preference for CABT, other areas have the potential to attract highly educated people.

Place attachment × *Motives or DOW* [β_1]: Among all eight parameters, only three ones for motives related to altruism, education/job and residential environment significantly affect migration to other areas. Notably, the positive parameter related to residential environment suggests that place attachment strengthens decisions on migration to other areas when motivated by improving residential environment. Regarding motives of altruism and education/job, even though an individual recognizes other areas as his/her hometown, if the migration decision is motivated by altruism and education/job, he/she is less likely to migrate into other areas. These seemingly unintuitive observations suggest the complexities of migration decision-making, which can be better captured by the DCLH-QHDU model.

5.3. *Magnitudes of influences of variables*

As shown previously, many variables are introduced into the model in two or more ways, making the interpretation of influences of each variable difficult. To clarify the magnitudes of diverse influences of variables, the parameter equations of motives and hometown recognition are obtained based on the results in Table 2, and presented in Table 5 as functions of DOW.

- [*Par 1.1 & Par 1.2*] The parameter *Par 1.1* is about self-interest motive and *Par 1.2* is about the interaction term of self-interest motive and hometown recognition. These two parameters indicate that if only considering self-interest motive, people prefer Tokyo and CABT more than other areas, but such preference for CABT is weakened by the interaction with DOW.

Table 5
Magnitudes of the diverse influences of motives and hometown recognition interacted with DOW.

Parameters		Tokyo	CABT	Other areas
Par 1.1	**SI**	0.023 + 0.005*DOW	0.036–0.008*DOW	–
Par 1.2	**SI*hr***	0.023 + 0.047*DOW	0.036–0.011*DOW	−0.006–0.038*DOW
Par 2.1	**A**	−0.000 + 0.023*DOW	0.009 + 0.015*DOW	–
Par 2.2	**A*hr***	0.011 + 0.042*DOW	0.018 + 0.012*DOW	−0.024 + 0.037*DOW
Par 3.1	**E/J**	−0.033 + 0.063*DOW	−0.036 + 0.077*DOW	–
Par 3.2	**E/J*hr***	−0.031 + 0.075*DOW	−0.042 + 0.064*DOW	−0.049 + 0.087*DOW
Par 4.1	**RE**	0.070–0.013*DOW	0.052–0.010*DOW	–
Par 4.2	**RE*hr***	0.089–0.023*DOW	0.075–0.022*DOW	0.111–0.106*DOW

Note: Linear equations in the 2nd- 4th columns indicate the parameter equations corresponding to the variables shown the 1st column. All equations are calculated based on the estimation results of the DCLH-QHDU model, where ***hr*** means hometown recognition, and **SI**, **A**, **E/J** and **RE** are shown in Table 2.

- [*Par 2.1* & *Par 2.2*] The parameter *Par 2.1* is about altruism motive and *Par 2.2* is about the interaction term of altruism motive and hometown recognition. Only considering the influences of altruism, people are less likely to migrate into Tokyo but more likely to migrate into CABT, while the interaction with DOW increase the preference of choosing to migrate into the Capital Area. However, when the interaction between hometown recognition and altruism motive is considered, people consistently prefer the migration into the Capital Area, while positive or negative preference for other areas is determined by DOW.
- [*Par 3.1* & *Par 3.2*] The parameter *Par 3.1* is about education/job motive and *Par 3.2* is about the interaction term of education/job motive and hometown recognition. Regarding independent influence, both education/job motive and its interaction with hometown recognition discourage migration to all destinations. In contrast, integrated influences caused by DOW largely weaken such discouragement, as shown by the integrated parameter values (0.063, 0.077, 0.075, and 0.064) of DOW, which are much larger than other integrated parameters. The finding implies that DOW is much more influential when making migration decisions motivated by education or job.
- [*Par 4.1* & *Par 4.2*] The parameter *Par 4.1* is about motive related to residential environment and *Par 4.2* is about the interaction term of motive of residential environment and hometown recognition. These two parameters of motive and its interaction with hometown recognition work independently to increase the preference of choosing any destinations; however, when the interactions with DOW occur, such positive preference will be weakened.

Thus, the influences of various variables are diverse, and their magnitudes depend on the degree of own will in migration decisions.

6. Concluding remarks

Focusing on life-course choice behavior model, this study explored the underlying intertemporal dynamics and heterogeneity involved in individual decisions on migration destination biography. From a practical perspective, this study has provided scientifically sound insights into policymaking for revitalizing local areas by answering three questions **Q1**-**Q3**. To this end, a case study was conducted based on an online retrospective life history survey among the working population aged 20–49 in the Capital Area of Japan, centered around Tokyo. Valid data was sourced from 1 000 respondents who reported migration biographies between 1968 and 2015. In this section, the findings are summarized, policy implications are discussed, and future research challenges are pointed out.

6.1. Findings

From a modeling perspective, this study successfully built a life-course intertemporal discrete choice model (i.e., DCLH-QHDU model) by jointly incorporating the influences of past/present/future utility as well as cross-sectional and longitudinal heterogeneities. The past/present/future utility is represented based on time preference theory, where the discounted influence of time is reflected by adopting a quasi-hyperbolic utility function, and heterogeneities are incorporated by decomposing time-varying parameters of explanatory variables, where observed information is used to capture various heterogeneities. Modeling accuracy and performance support the applicability of DCLH-QHDU model to analyze migration destination biography. It is found that the introduction of discounted utility could mitigate the overestimation of different people's heterogeneous concerns of place attachment when making decisions on the migration to the Capital Area of Japan. A past-dependent trend of life-course migration decisions is empirically confirmed, and relative influences of past/present/future utility on migration decisions change over the life course. Past weighs more as age increases, showing a logarithm-shaped distribution. The influence of present first peaks at a certain age and then decreases over time, showing a left-skewed distribution. The weight of future declines as age increases, displaying an exponential distribution, even though the influence of future expectation is estimated to be statistically insignificant. As for influence magnitude, changing curves of past/present/future intersect with each other over the life course. Above results provide answers to the third research question **Q3**.

As for the first research question **Q1**, even though most migrations were within the Capital Area, a considerable number of observed migrations (i.e., 18.8%) were from other areas to the Capital Area. Although many regional revitalization policies have been implemented across Japan, it seems that those policies could not sufficiently stop out-migration from local cities and rural areas to megacity regions.

To answer research question **Q2**, the effects of motives, altruism, and place attachment have been extensively examined. Major findings are summarized below.

- Motives: Effects of motives on migration decision-making are diverse, due to interaction with degree of own will and place attachment (i.e., hometown recognition).
  - Self-interest motives push people to move to the Capital Area, while individual own will strengthens the preference for Tokyo but weaken the preference for CABT (i.e., the Capital Area beyond Tokyo).
  - Effects of altruism-related motives are highly dependent on degree of own will. Improving place attachment to enhance hometown recognition may be useless to attract people to other areas, if migration is motivated by altruism-related reasons.
  - Education/job-related motives discourage people from choosing the Capital Area as migration destination, while individual own will may help to weaken such preference.
  - Other areas could attract more people by considering interactions between place attachment and motives related to residential environment.
- Altruism: Though DCLH-QHDU model is built at individual level, effects of inter-personal interactions are captured by introducing degree of own will and altruism-related motives. It is found that people are more likely to choose the Capital Area (especially

Tokyo) with a high level of own will. Degree of own will discourages moving to CABT when interacting with motives related to self-interest and altruism.

- Place attachment: People are inclined to choose migration destinations recognized as hometown. As time passes, hometown recognition discourages highly educated people from choosing Tokyo as migration destination. Integrated effects of place attachment, measured by hometown recognition, and other factors on migration decisions are also revealed.

6.2. Policy implications

Findings related to motives, altruism, and place attachment provide important policy implications.

- The introduction of discounted utility could avoid misleading policy decisions related to the enhancement of place attachment in the Capital Area of Japan. The derived homogeneous responses to place attachment may be because the Capital Area already have various places with diverse features that can meet different people's needs. The enhancement of place attachment is still important, as observed in the relevant parameters; however, it could be realized by improving existing places rather than further developing new places.
- For *local cities*, three points of policy implications should be emphasized. First, significant effects of hometown recognition suggest that policies enhancing place attachment should be given a higher priority in the policymaking agenda of regional revitalization. From a short-term viewpoint, local authorities need to make more efforts to attract working population through city branding strategies by making full use of the charming points of their cities. Considering the influence of altruism, migration policies should pay more attention to family matters (e.g., spouse's job, child rearing, and children's education). In Japan, local authorities' business attraction policies have been mainly made from the perspective of employers, but not employees. Policies caring for employees and their family members should be properly designed. In this regard, cross-sectoral policymaking should be promoted, with respect to education, housing, and residential environment, etc. Such life-oriented policies are well supported by the life-oriented approach (Zhang, 2017).
- For *megacities* like Tokyo, migration policies should be made at the national level to mitigate various issues caused by the over-concentration of population. National and municipality policymakers should work together to figure out how to control population size of megacities, as a key part of activities within national, regional and urban planning. Within a megacity, for example, long-distance commuting is popular in Japan, so policies should focus on how to improve quality of life by improving spatial proximity between residence and workplace, spatial density of urban functions and quality of urban environment, as implied by the roles of residential environment and place attachment.

6.3. Future research challenges

This study should be further improved in the future. First, more individual/household-level factors affecting migration decision should be introduced. This suggests the necessity of developing a new life history survey that allows respondents to report more factors in a reliable way. Second, the influences of various objective, built environment attributes and macro-level socio-economic factors should be examined more closely, which could derive useful policy instruments for practice. Third, it is worth modeling household migration decision-making by explicitly incorporating intra-household interactions and social interactions, recognizing the difficulty of asking all household members to report their involvement in migration decisions. Again, innovative life-course survey methods should be developed. Fourth, migration decisions should be modeled together with major life choices of household members, as evidenced by Zhang et al. (2017) who investigated multiple behavioral changes related to migration decisions. In this regard, it is worth exploring the roles of more socio-psychological factors in migration decision-making affected by other life choices. Finally, effective cross-sectoral migration policies should be simulated with improved data collection and modeling methods.

Author statement

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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