Migration behaviors leaving metropolitan areas: assessing the impacts of health risks and teleworking in the COVID-19 context

Xue PENG

Asian Growth Research Institute

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ARTICLE

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Xue Peng [1]✉

An increase in the number of people leaving metropolitan areas (MAs) was observed in various countries in the early years of the COVID-19 pandemic. While considerable attention has been paid to the impacts of health risks and teleworking, two prominent topics related to health-crisis-led migration, empirical evidence remains inadequate. This study aims to empirically investigate the impacts and temporal changes of these two factors on migration leaving MAs (LMA migration). It utilizes survey data from the Japanese government and employs fixed effects logit models. (1) By using infection rates in a more accurate measurement than previous studies, this study confirms the health-risk-aversion motives in LMA migration. (2) Teleworking's influence on LMA migration is found to be insignificant over the long term. Nevertheless, it increases the likelihood of formal employees staying in MAs and strengthens the tendency of the self-employed to leave for *local areas*. (3) Temporally, the significant impact of lower COVID-19 infection rates attracting metropolitan residents persisted beyond the pandemic stringency and continued for several months afterward, though it eventually reversed. Teleworking shows a positive influence on LMA migration only in the later stage of COVID-19. These findings suggest a tendency of 'deferred decisions' in LMA migration due to people's unfamiliarity with an unprecedented health crisis. However, the negative impact of infection risks emerges sooner than the significant effect of teleworking, indicating that safety is a pressing priority for LMA migration in the early stages of a major health crisis. (4) Self-employed individuals, homeworkers, and the unemployed are more likely to engage in LMA migration, while employees (whether formal or informal) are less likely, highlighting the role of opportunity costs. Policy implications suggest that local governments should focus on attracting the self-employed from MAs during health crises and on enhancing the teleworking environment for the long term.

[1] Asian Growth Research Institute, Kitakyushu, Japan. ✉email: peng@agi.or.jp

Introduction

The global COVID-19 pandemic has once again revealed the imperfections and threats of living in metropolitan areas (MAs), just as past pandemics have done (Malatzky et al. 2020; Rowe et al. 2023). Changes in residence choices and subsequent movements have been observed globally, illustrated by an increase in the number of people leaving large cities in various countries such as Spain (González-Leonardo et al. 2022), the United Kingdom (Rowe et al. 2023), Germany (Stawarz et al. 2022), Sweden (Vogiazides and Kawalerowicz, 2023), Norway (Tønnessen, 2021), Australia (Perales and Bernard, 2023) and Japan (Fielding and Ishikawa, 2021). Although the pandemic has subsided, MAs still face a higher probability of encountering future health risks compared to local areas. Hence, understanding the mechanism of migration leaving the MAs (LMA migration) is paramount, as it provides crucial insights into how people adapt to health crises.

Despite a growing collection of studies on domestic migration following the onset of the COVID-19 pandemic, most focus on changes in migration patterns, including directions and intensities. Several studies attempting to explain LMA migration emphasize economic factors, including income level, home ownership, living costs, and prospective job opportunities in settlements outside MAs (Anastasiou, 2020; Tønnessen, 2021; González-Leonardo et al. 2022; Vogiazides and Kawalerowicz., 2023). Other factors include individuals' birthplace, indicating the impact of social ties (Tønnessen, 2021), and place attributes such as rural areas' proximity to cities and the high prevalence of second homes (González-Leonardo et al. 2022).

In addition to these factors, considerable attention has been paid to the impacts of health risks and teleworking, two prominent topics related to the COVID-19 pandemic. However, much of the discussion on these two aspects remains narrative, with few studies providing empirical evidence. For instance, existing research on LMA migration infers that people are leaving MAs to avoid heightened health risks, primarily based on indirect indicators like population densities (Brandén et al. 2020; Aradhya et al. 2021; Rowe et al. 2023) or vague terms like 'health reasons' (Van Leeuwen and Venhorst, 2021). One exception, the study by Peng and Dai (2024), finds a significantly negative impact of infection rates on LMA migration but does not examine its temporal changes.

Meanwhile, the LMA migration discussions related to teleworking are far from reaching a consensus, and the strand that addresses crisis-led LMA migration often considers teleworking a facilitator but provides only narrative explanations rather than direct evidence (Rietveld and Vickerman, 2003; Fielding and Ishikawa, 2021; Rowe et al. 2023; Perales and Bernard, 2023). A few studies that have directly examined teleworking, utilize data on teleworking frequency either at the city level (Haslag and Weagley, 2024) or the occupation level (Tønnessen, 2021; Vogiazides and Kawalerowicz, 2023), resulting in inaccurate measurement at the individual level. The rare study that examines individual-level teleworking reports its insignificant impact on LMA migration (Peng and Dai, 2024). However, whether teleworking's impact changes over time and whether it varies across different occupations or employment statuses, remains unstudied.

As a result, existing research on whether and how health risks and teleworking have affected LMA migration behaviors in the COVID-19 context remains insufficient. This study aims to shed new light on the impacts of health risks and teleworking underpinning LMA migration behaviors by addressing two sets of questions: (1) Have health risks affected LMA migration? Are there temporal changes in their impacts during the pandemic? (2) Has teleworking affected LMA migration? Are there

temporal changes? Does occupation matter? Does employment status matter?

To answer these questions, I choose Japan as the research area, where there are essentially no restrictions on domestic migration. More importantly, Japan stands out as a case of high mobility even during the stringent periods of the pandemic. Unlike many other countries, Japan did not enforce compulsory lockdown containment zones during the COVID-19 pandemic. Furthermore, the Japanese government has conducted six waves of *Surveys on Changes in Attitudes and Behaviors in Daily Life under the Influence of Novel Coronavirus Infection* (CABC surveys) (COJ, n.d.), with four waves (the third to sixth) specifically inquiring about LMA migration behaviors. Data from these four CABC surveys comprise the panel dataset used in this study. They enable a more in-depth examination of the mechanism of LMA migration in the context of the COVID-19 pandemic, focusing particularly on two focal variables: the infection rates in an individual's resident prefecture and the individual's teleworking frequency. Entity- and time-fixed effects logit models are adopted for estimation.

The remainder of the paper is structured as follows: Section 'Literature review' reviews the existing literature on the increasing LMA migration following the onset of the COVID-19 pandemic, the impact of health risks, and the impact of teleworking. Section 'Data and methods' introduces LMA migration trends in Japan, presents the data from the CABC surveys, and specifies the estimation methods. The section 'Results and discussions' discusses the results from the empirical analyses. Section 'Concluding remarks' concludes this paper with the contributions, implications, and limitations.

Literature review

The increasing LMA migration following the onset of the COVID-19 pandemic. The outbreak of COVID-19 has reshaped people's preference for residence choice. Extant research finds evidence of an increasing outflow of migrants from MAs in multiple countries. For example, in Japan, the outflow from the Tokyo Metropolitan Area (Tokyo MA) increased by 5.0% in 2020 compared to 2019. Although it still has a positive net migrant inflow, the 'one-point concentration' of Tokyo has been weakened by the pandemic (Fielding and Ishikawa, 2021). In Spain, migration leaving core cities increased by 6.0% in 2020 (González-Leonardo et al. 2022). In Britain, a study using Meta-Facebook user data to examine changes in population density suggests that large cities experienced significant migration outflows during periods of stringent COVID-19 containment measures (Rowe et al. 2023). Significant losses in net migration are also found in large cities like Berlin and Hamburg in Germany (Stawarz et al. 2022), Swedish inner cities, particularly the inner city of Stockholm (Vogiazides and Kawalerowicz, 2023), and some capital cities of Australia such as the Melbourne MA (Perales and Bernard, 2023) in 2020.

Although some researchers argue that changes in domestic migration brought on by crises—including the COVID-19 pandemic (Perales and Bernard, 2023; Rowe et al. 2023)—are likely to be short-lived (Glaeser, 2020), it remains crucial to study LMA migration behaviors in this context. Future health crises could occur, and MAs are still likely to be the most affected. By understanding the mechanism of migration behaviors during major health crises, governments can better anticipate and respond to potential movements of residents in future crises.

LMA migration, which partially overlaps with 'counter-urbanization migration' or 'migration down the urban hierarchy,' is often observed among affluent families with children, couples

at the onset of childrearing (Smith and Higley, 2012; Champion and Atkins, 2000), and older or pre-retirement individuals (Lowe and Speakman, 2006; Stockdale and Macleod, 2013; Ishikawa, 2016), reflecting the process of gentrification in areas outside MAs (Little, 1987). These migrations are mainly driven by the desire for better amenities and lower living costs outside MAs, addressing needs at specific life stages.

During crises, a trend in contrast to the gentrification process is observed, with younger and unemployed individuals showing a high potential for counter-urbanization migration, as seen during the Greek economic crisis in 2013 (Remoundou et al. 2016). Pull factors, including job opportunities in rural areas—like those in tourism and agriculture—are identified, in addition to lower living costs (Anastasiou, 2020). Regarding migration during the COVID-19 pandemic, public sector workers, including healthcare workers, teachers, and police officers, are found to be more likely to make counter-urbanization moves (Tønnessen, 2021; Vogia-zides and Kawalerowicz, 2023). Possible explanations include evenly distributed job markets for these occupations and lower living costs in new locations (Tønnessen, 2021). Other significant factors mentioned in previous studies include place attributes of rural areas such as proximity to cities and the high prevalence of second homes (González-Leonardo et al. 2022), personal attributes such as birthplace, certain occupations (craft and related trade workers, and others, compared to managers), home ownership, and income level (Tønnessen, 2021). Economic factors seem to be most emphasized, ranging from current income level and home ownership, to living costs and prospective job opportunities in settlements outside MAs.

Besides the above-mentioned factors, health risks and tele-working are often mentioned as facilitators for LMA migration in health crises. For example, a study focusing on LMA migration intentions highlights significant factors such as concerns about COVID-19 infections, teleworking, in addition to income changes (Teng, 2022). Nevertheless, empirical evidence regarding these two aspects in studies of LMA migration movements is not yet adequate.

The impact of health risks. It is natural to assume that people are more likely to consider migration when they perceive risks in their living environment (Mori and Taniguchi, 2014; Xu et al. 2020). During the peak of the COVID-19 pandemic, living in large cities was found to have been extremely dangerous due to the mortality rates being alarmingly disproportionate (95% of COVID-19 deaths) in those areas (Pomeroy and Chainey, 2020). Higher population density at both the neighborhood and housing levels was correlated with increased mortality from the disease (Brandén et al. 2020; Aradhya et al. 2021). Researchers also find that residents of MAs in Germany (Schweda et al. 2021), as well as in Japan (Okubo et al. 2021), tend to feel higher pressure from the COVID-19 pandemic, which might cause them to move out from MAs. Health risk aversion appears to be an essential driving force for LMA migration during a major health crisis.

While similarly focusing on health issues, most existing studies explain LMA migration during the COVID-19 pandemic using amenity migration theory. This theory focuses on migrants who are moving from urban to rural areas primarily seeking natural environment and associated experiences (e.g., outdoor recreation and leisure) (McGranahan, 1999; Moss, 2006). A natural amenity-rich environment coincides with one that is beneficial for health during a pandemic, and these amenities tend to hold higher value in rural areas or small cities compared to larger cities. Amenities identified in COVID-19 migration studies include natural resources and low population density (Kotsubo and Nakaya, 2022), green spaces and having a personal garden

(Dolls and Mehles, 2021), and larger indoor spaces (Kotsubo and Nakaya, 2022), among others. As a result, health-risk-aversion motives are often obscured by amenity-driven explanations.

Only a few studies have directly examined whether the LMA migration is driven by health risk aversion. For example, Peng and Dai (2024) find a significant and negative impact of infection rates in the current residence on LMA migration in Japan. Their study provides direct empirical evidence that LMA migrants tend to choose destinations with lower infection rates. However, such research is still in its infancy. Peng and Dai's (2024) study relies solely on cross-sectional data from the fifth CABC survey and does not address possible temporal changes. Additionally, their indicator of health risks—represented by infection rates—is cumulative, encompassing all newly confirmed infection cases in the residence prefecture from the onset of the COVID-19 pandemic in January 2020 to the survey time in early June 2022. Meanwhile, the LMA migration examined occurred during the 6 months before the survey time. Therefore, the timing of migration behaviors and infection rates do not align exactly.

To address the shortcomings of previous studies and confirm whether health-crisis-led LMA migration is driven by health-risk-aversion motives, it is necessary to utilize panel data to determine if the results persist across the pandemic period. Additionally, infection rates need to be measured in alignment with the timing of LMA migration.

The impact of teleworking. Existing studies have not yet reached a consensus regarding the impact of teleworking on migration, LMA migration included.

Teleworking as a cause of a decrease in migration. Zelinsky (1971) conjectures that improvements in information and communication technologies (ICTs) could provide potential migrants with a substitute for domestic migration, and this trend would lead to a decline in migration. For example, empirical studies indicate that the utilization of ICTs reduces both residential mobility and interregional migration in Northern Ireland (Cooke and Shuttleworth, 2018), and decreases interstate migration in the United States (Cooke and Shuttleworth, 2017). Teleworking, supported by ICTs, may facilitate alternative forms of mobility, and cause a decrease in migration in the same way. For instance, findings from Australia suggest that teleworking contributed to a 1–4% decline in domestic migration from 2001 to 2016 (Kalemba et al. 2020). Teleworking is also believed to have contributed to the decline in employment-related migration post-COVID-19 in Australia (Haslag and Weagley, 2024).

Previous research proposes several possible explanations. The fundamental explanation is rooted in the endowment effect theory, which posits that people have a 'loss aversion,' where losses are weighted substantially more than objectively commensurate gains (Kahneman and Tversky, 1979; Thaler, 1980). Individuals often place a high value on their current lifestyle and residence, making them reluctant to move. For this reason, advancements in communication technology empower individuals to maintain professional and personal connections remotely while continuing to live in the same residence. This phenomenon is observed as an increased place elasticity (Barcus and Brunn, 2010) or enhanced residential rootedness and attachment to place (Cooke and Shuttleworth, 2018; Cooke et al. 2018).

Another relevant theory is the cumulative inertia theory, suggesting that the strength of location-specific social ties tends to increase with the duration of stay (Thomas et al. 2016), creating resistance to moving (Huff and Clark, 1978).

In either context, the role of ICTs involves enhancing the knowledge about alternative locations, thereby improving the

quality of initial residence decisions (Kaplan and Schulhofer-Wohl, 2017; Cooke and Shuttleworth, 2018; Cooke et al. 2018). While teleworking enables individuals to choose their preferred place of residence, it may also be closely associated with a reduction in exploratory migration (Kaplan and Schulhofer-Wohl, 2017) as well as onward and return migration (Cooke et al. 2018), largely due to increased residential satisfaction.

Teleworking has an insignificant effect on migration. In contrast to the previous perspective, Kalemba et al. (2022) contend that teleworking does not contribute to a decline in migration. Analyzing survey data from Australia between 2002 and 2018, they demonstrate that teleworking shows no significant impact on migration for any motivations, and this insignificant effect has remained consistent over time. Additionally, their findings indicate a decline in migration across all motivations, including employment-related migration. They argue that this decline in employment-related migration is not attributable to an increase in alternative forms of mobility, such as teleworking, nor to shifts in inter-industry or occupation mobility.

A study in Japan using the fifth CABC survey data reveals that, while teleworking stimulates the intention for LMA migration, it is not significantly related to actual LMA migration behavior (Peng and Dai, 2024). Another study utilizing survey data conducted in the Tokyo MA in February 2021, finds that teleworking has a limited effect on young adults' migration intention of leaving the Tokyo MA for local areas, despite its significantly positive impact on the within-Tokyo-MA-migration intention (Teng, 2022). Similarly, previous studies in the Netherlands indicate that teleworking is not a significant factor influencing people's relocation intentions (Muhammad et al. 2007; Ettema, 2010).

Teleworking as a potential facilitator for LMA migration during health crises. Another perspective is that teleworking might facilitate LMA migration, particularly during a major health crisis. The COVID-19 pandemic, for instance, unleashed great potential for teleworking (OECD, 2021), providing people with greater flexibility and freedom in their choice of residence. Meanwhile, a suitable teleworking environment necessitates more space at home (Kotsubo and Nakaya, 2022) to keep demarcations between work and personal life, which often requires at least one dedicated room for home-based telework (Rymaniak et al. 2020). Consequently, this heightened demand for space may lead individuals to migrate away from MAs, where housing prices are typically higher, to regions that offer more affordable housing with larger spaces.

Supporting this notion, a study conducted in France finds that teleworkers, driven by the pandemic, need appropriate teleworking conditions at home. This aspect emerges as one of the most influential factors affecting employees' work adjustment, although migration choices are not addressed (Carillo et al. 2020).

Nevertheless, direct empirical evidence for telework facilitating health-crisis-led LMA migration remains insufficient. More importantly, the assumption that residents relocate primarily for a better teleworking environment might be obscuring the issue. During health crises, it can be challenging to determine whether people are driven more by health considerations or by the search for a better teleworking environment. Therefore, it is essential to evaluate the impact of teleworking while controlling for health risks—an aspect that previous research has not adequately addressed.

From the previous discussion, it is evident that health-crisis-led LMA migration remains largely underexplored in the existing literature. A major gap is the absence of empirical evidence regarding the impact of health-risk-aversion motives—essentially,

safety considerations—which are often obscured by amenity migration theory. This inadequate examination of safety considerations also clouds the understanding of teleworking's effect, leaving the two aspects conflated. Moreover, the temporal changes in the impacts of these two focal factors in a pandemic context—infection rates and teleworking frequency—are yet unstudied. This study aims to enrich the theoretical framework of health-crisis-led LMA migration by examining these two factors and addressing the existing gaps.

Data and methods
This study seeks to investigate the impacts of health risks and teleworking on LMA migration in the context of a major health crisis. The COVID-19 pandemic serves as an appropriate context for this examination, given the widespread and profound health, social, and economic challenges it has engendered.

Migration from metropolitan to local areas in Japan in the COVID-19 context. Each country has encountered a distinct pandemic situation, encompassing the spread of the pandemic, governmental measures, and responses from organizations and populations (Carillo et al. 2020). Unlike some other countries, Japan has not implemented compulsory lockdown measures such as containment zones or business shutdowns during the COVID-19 pandemic. In areas announced to be in a public health emergency, residents were requested to refrain from going out, and restaurants were required to shorten operating hours. However, none of these measures placed mandatory restrictions on people's mobility. This makes Japan a suitable case for investigating the autonomy choice of migration behaviors and revealing the impacts of health risks and teleworking.

The COVID-19 pandemic is generally associated with a decline in the intensity of migration (Fielding and Ishikawa, 2021; Stawarz et al. 2021). In terms of LMA migration, initially, the number of migrants leaving any of the three major MAs (Tokyo MA, Osaka MA, and Nagoya MA) in Japan declined in 2020 (458,043 persons in total) compared to 2019 (460,520 persons). However, the number quickly rebounded, surpassing the 2019 level in 2021 (467,903 persons), and continued to increase in 2022 (478,563 persons) (Fig. 1). Examining the changes in the out-migrants across the three major MAs, only Tokyo MA saw an increase in out-migrants in 2020, whereas all three MAs showed an increase in 2022 (Fig. 2). Overall, the COVID-19 pandemic appears to have temporarily slowed the rise of LMA migration. However, the annual average number of out-migrants from the three main MAs has increased from an average of 429,652 in the seven years before the pandemic (2013–2019) to 468,170 during the 3 years after its outbreak (2020–2022), marking a 9.0% increase. It should be noted that the statistics in this subsection only include migrants who moved out of any of the three major MAs. They do not encompass residents who moved within each of the three major MAs, those who moved within areas outside the three major MAs, or any intra-prefecture migrants.

Data and variables. This study utilizes microdata from the third to sixth CABC surveys for empirical analysis. These surveys were conducted to investigate the attitudes and behaviors in daily life under the influence of the COVID-19 pandemic. LMA migration and teleworking were inquired about in the surveys. The surveys were conducted during the following periods respectively: April 30 to May 11, 2021 (the third wave); September 28 to October 5, 2021 (the fourth wave); June 1 to June 9, 2022 (the fifth wave); March 2 to March 11, 2023 (the sixth wave). In each survey wave, the stratified random sampling method was used, and the population was divided into smaller subgroups based on
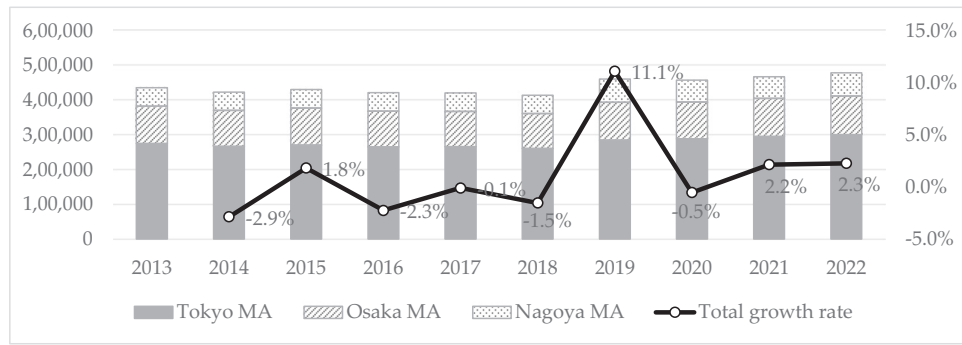
Fig. 1 Number and change rate of migrants leaving the three major metropolitan areas. *Sources*: Statistics of Japan (2019, 2021, 2023). *Notes*: The Tokyo MA contains the prefectures of Tokyo, Kanagawa, Saitama, and Chiba. The Osaka MA consists of the prefectures of Osaka, Kyoto, Hyogo, and Nara. The Nagoya MA comprises the prefectures of Aichi, Gifu, and Mie.
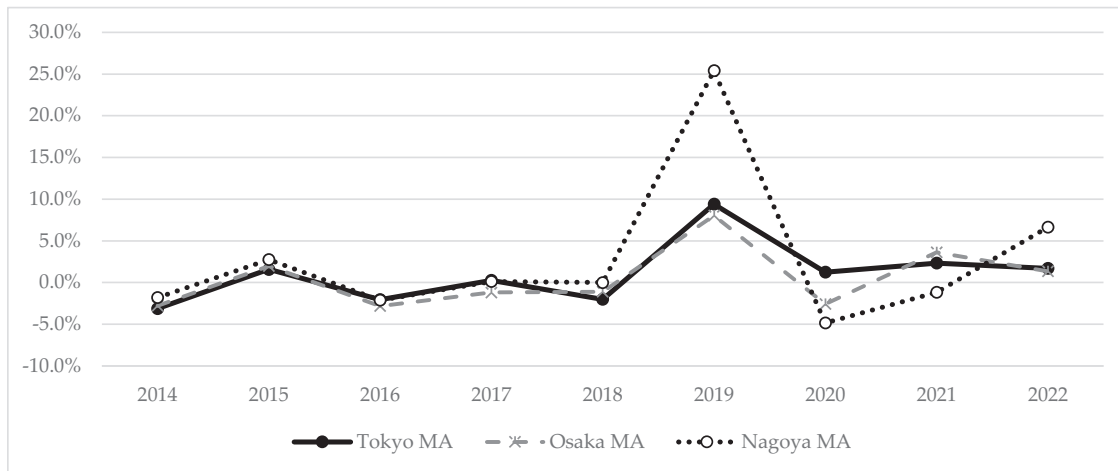
Fig. 2 Change rate in the number of migrants leaving the three major metropolitan areas. *Sources*: Statistics of Japan (2019, 2021, 2023).

residence, gender, and age.[1] A random sample was drawn from each subgroup to compose the final sample pool. Over 10,000 valid responses were collected in each survey wave. Thus, the survey samples are highly representative of Japanese residents. Student samples were excluded according to the research purpose of this study, and 37,170 observations were finally used for analysis.

In each survey wave, more than 60% of the observations overlap with those from the previous survey, and 34% of the individuals have participated in all four surveys. The survey data thus forms an unbalanced panel dataset. I proceed with the unbalanced panel data to retain as much information as possible. Since the reasons that some samples dropped out of the survey are not endogenous, an unbalanced approach is satisfactory.

The definitions and descriptions of the variables are presented in Table A1 in the appendix. The summary statistics of the variables are reported in Table 1.

The dependent variable *Migration* is derived from the question: 'Have you engaged in any specific behaviors related to moving from metropolitan to *local areas* within the last 6 months?' In the survey, the term *local areas* is annotated to encompass MAs smaller in population than major metropolises, as well as non-MA areas. Therefore, the term *local areas* used hereafter are relative concepts rather than absolute geographic definitions. The LMA migration behavior discussed in the following analysis reflects a move from MAs to less populated areas. For respondents who chose the answer 'Having migrated', the binary variable *Migration* receives a value of 1 and 0 otherwise. Of all the

observations, 1430 (3.85%) have migrated, while 35,740 (96.15%) have not (Table 2).

My first focal variable is the logarithm of the COVID-19 infection rate (scaled by 10,000) in an individual's residence prefecture at the survey time (*COVID*). This infection rate is calculated as the ratio of newly confirmed infection cases in the past 6 months preceding the survey to the population of the prefecture. The COVID-19 infection rates range from approximately 3.0759 to 1,550.7050 cases per 10,000 people, with logarithmic values (of infection rates scaled by 10,000) ranging from 1.1236 to 7.3465.

The other variable of interest is the frequency level of teleworking (*Telework*). Of the total observations, 3.74% work remotely almost all the time, 4.33% primarily work remotely (over half of the work time), 6.35% primarily commute to work and regularly telework, and 8.21% primarily commute to work and occasionally telework. In total, 22.63% of the observations engage in some form of telework, while 77.37% do not telework in any capacity.

It is worth noting that the variables of *COVID* and *Telework* correspond to the 6 months preceding the survey start date and represent the conditions at the outcome locations of the LMA migration choices. These conditions apply equally to both those who have moved and those who have not. Although the dataset does not capture changes before and after migration decisions, it can still reflect the mechanism of migration decision-making through the characteristics of the chosen residence and the behavior patterns observed post-decision.

Table 1 Summary statistics.

Variable		Obs	Mean	Std. dev.	Min	Max
Migration		37,170	0.0385	0.1923	0	1
COVID		37,170	5.3009	1.4785	1.1236	7.3465
Telework		37,170	0.4886	1.0420	0	4
Occupation	ITprofessional	37,170	0.0334	0.1798	0	1
	OfficeWorker	37,170	0.1392	0.3462	0	1
	HealthWorker	37,170	0.0765	0.2659	0	1
	ManuAndConstru	37,170	0.0772	0.2669	0	1
	ServiceAtStore	37,170	0.0599	0.2373	0	1
	ServiceNotAtStore	37,170	0.1016	0.3022	0	1
EmploymentStatus	FormalEmployee	37,170	0.4482	0.4973	0	1
	InformalEmployee	37,170	0.2037	0.4028	0	1
	Manager	37,170	0.0166	0.1278	0	1
	Self-employed	37,170	0.0560	0.2300	0	1
	HomeWorker	37,170	0.0073	0.0849	0	1
	Unemployed	37,170	0.2682	0.4430	0	1
UnemploymentRate		37,170	2.6532	0.5300	0.8	3.8
Female		37,170	0.5016	0.5000	0	1
HouseholdIncome		37,170	3.2104	1.5071	1	6
University		37,170	0.4712	0.4992	0	1
AgeLevel		37,170	7.0276	3.2446	1	14
Married		37,170	0.5957	0.4908	0	1
ChildUnder15		37,170	0.1701	0.3757	0	1

Table 2 Summary of migration behaviors.

Survey Wave	Number of observations having migrated	Number of observations having not migrated	Total	Percentage of observations having migrated (%)
3rd	273	9048	9321	2.93
4th	336	8963	9299	3.61
5th	392	8937	9329	4.20
6th	429	8792	9221	4.65
Total	1430	35,740	37,170	3.85

I include controls for a set of well-established sociodemographic correlates of migration, including gender, age, marital status, educational attainment, employment status, and occupation. Of all observations, 50.16% are female. The average age level is 7.02, with age level 7 corresponding to the age range of 45–49. On average, 59.57% are married and 47.12% have a university education or higher (including currently enrolled). 17.01% have at least one child at or below middle school age. Regarding the employment status of the observations, 44.82% are formal employees, 20.37% are informal employees, 1.66% are in managerial roles, 5.60% are self-employed,[2] 0.73% are homeworkers,[3] and 26.82% are unemployed. This study also examines several types of occupations of the observations. Of the sample population, 3.34% are IT professionals, 13.92% are office workers, 7.65% are healthcare workers, 7.72% are manufacturing engineering, construction, and mechanical technical professionals, 5.99% are store-based service personnel, and 10.16% are non-store-based service personnel. Together, these occupations account for 48.78% of all observations.

Additionally, I control for the regional attribute of the unemployment rate in a respondent's residence prefecture at the survey time, which ranges from 0.8% to 3.8%, with an average of 2.65%.

Model specification. The logit model is a well-established method for studying discrete choice and is widely adopted in migration studies utilizing microdata. Since panel data is utilized, this study controls for entity- and time-invariant unobserved heterogeneity and employs fixed effects logit models for analysis.

The first model is specified as follows:

$$ln\left[\frac{prob(Migration_{i,t}=1)}{1-prob(Migration_{i,t}=1)}\right] = \beta \cdot COVID_{i,t} + \gamma \cdot Telework_{i,t} \qquad (1)$$
$$+ X_{i,t} \cdot \delta' + \theta_t + \alpha_i + \varepsilon_{i,t}$$

In Model (1), $Migration_{i,t}$ represents whether individual i has migrated from metropolitan to *local areas* during the last 6 months preceding survey wave t ($t = \{3,4,5,6\}$). $COVID_{i,t}$ represents the COVID-19 infection rates during the last 6 months preceding the survey for the prefecture where the individual i resided at the survey time. $Telework_{i,t}$ represents the teleworking frequency of individual i at survey wave t. $X_{i,t}$ represents the vector of control variables corresponding to the individual i at survey wave t, including *Female, HouseholdIncome, University, AgeLevel, Married, ChildUnder15*, and *UnemploymentRate*. θ_t is the unknown coefficient for the time regressor t. α_i is the unobserved time-invariant individual effect. β and γ represent the coefficients for corresponding variables. δ is the vector of coefficients. $\varepsilon_{i,t}$ is the overall error term.

To examine the temporal changes of the coefficients, for every survey wave t, I estimate the following entity-fixed effects model separately:

$$ln\left[\frac{prob(Migration_i=1)}{1-prob(Migration_i=1)}\right] = \beta \cdot COVID_{i,t} + \gamma \cdot Telework_{i,t} + X_{i,t} \cdot \delta' + \alpha_i + \varepsilon_i$$

$$(2)$$

I also examine the moderating effect of occupation and employment status by setting the following entity- and time-fixed

effects models. First, for a certain employment status m, the benchmark model is specified as follows:

$$ln\left[\frac{prob(Migration_{i,t}=1)}{1-prob(Migration_{i,t}=1)}\right] = \beta \cdot COVID_{i,t} + \mu \cdot Group_{i,t,m} \\ + X_{i,t} \cdot \delta' + \theta_t + \alpha_i + \varepsilon_{i,t} \quad (3)$$

Here $Group$ represents $EmploymentStatus$. Next, the moderating effect model is as follows:

$$ln\left[\frac{prob(Migration_{i,t}=1)}{1-prob(Migration_{i,t}=1)}\right] = \beta \cdot COVID_{i,t} + \mu_1 \cdot Group_{i,t,m} \\ + \mu_2 \cdot Group_{i,t,m} \cdot Telework_{i,t} \\ + \gamma \cdot Telework_{i,t} + X_{i,t} \cdot \delta' + \theta_t + \alpha_i + \varepsilon_{i,t} \quad (4)$$

A significant result of μ in Model (3) indicates a significant impact of employment status m on LMA migration behavior. Based on this premise, if μ_2 in Model (4) is also significant, it indicates that there is a moderating effect of teleworking on the relationship between employment status m and LMA migration.

The models for examining the effects of occupations are specified similarly, by using $Group$ to represent $Occupation$.

Results and discussions

In the results, odds ratios are reported instead of coefficients. A significant odds ratio greater than one indicates a positive association, while a significant odds ratio below one indicates a negative association.

COVID-19 infection rate. Table 3 reports the results from the entity- and time- fixed effects logit regression of Model (1). The findings suggest that the COVID-19 infection rate of one's residence prefecture is significantly and negatively associated with one's LMA migration behavior. This implies that metropolitan residents indeed gravitate to *local areas* with lower health risks. For every unit increase in the variable *COVID*—meaning the COVID-19 infection rate in an individual's prefecture increases to approximately 2.718 times (i.e., the Euler's number)—the residents are about 37% less likely to have been an LMA migrant during the same period.

Next, I estimate the impact of the COVID-19 infection rates in each survey wave with Model (2), and the results are presented in Table 4. The results show that the variable *COVID* is significantly associated with LMA migration behaviors across four survey waves. This association is negative in the third to fifth waves but becomes positive in the sixth wave. Specifically, for every increase in an individual's prefecture's COVID-19 infection rate to approximately 2.718 times, the residents are about 41% to 57% less likely to have been LMA migrants in the third to fifth waves. However, in the sixth wave, the same increase in the COVID-19 infection rate makes an individual 3.82 times more likely to have conducted LMA migration and moved to their current residence. Regarding the relationship between the survey waves and public health emergencies (Fig. 1), the third wave was conducted during a public health emergency, and the fourth wave was conducted

### Table 3 Results of the entity- and time- fixed effects logit regression.

Dependent Variable: *Migration*		Model (1)
COVID		0.6344***
Telework		1.0485
Female		0.7204***
HouseholdIncome		0.8713***
University		1.3215***
AgeLevel		0.9064***
Married		1.1337
ChildUnder15		1.1083
UnemploymentRate		0.5725***
EmploymentStatus	FormalEmployee	(ref)
	InformalEmployee	1.1028
	Manager	1.2769
	Self-employed	1.8859***
	HomeWorker	2.8981***
	Unemployed	2.1717***
Entity- and time-fixed effects		YES
Number of individuals		19,306
Number of observations		37,170

Notes: (1) Odds ratios are reported.
(2) *** denotes significance at the 0.1% level.

Table 4 Results of the logit regression by survey waves.

Dependent Variable: *Migration*		Model (2c)	Model (2d)	Model (2e)	Model (2f)
Survey wave		Third	Fourth	Fifth	Sixth
COVID		0.5743***	0.4126***	0.4601***	4.8157***
Telework		1.0867	1.1504*	1.0123	1.0157
EmploymentStatus	FormalEmployee	(ref)	(ref)	(ref)	(ref)
	InformalEmployee	1.6222*	1.3000	0.9102	0.9671
	Manager	0.8908	1.5731	1.3101	1.3967
	Self-employed	1.7242	2.5371***	1.7375*	1.6687*
	HomeWorker	0.7719	3.1965*	4.6272***	1.6941
	Unemployed	3.0683***	2.5286***	1.9026***	1.8457***
UnemploymentRate		0.7399	0.9958	0.7080*	0.6031***
Female		0.5436***	0.7296*	0.7789*	0.7965*
HouseholdIncome		0.8589**	0.8895*	0.8805**	0.8766**
University		1.6346***	1.3758*	1.3095*	1.1967
AgeLevel		0.8584***	0.9333**	0.8919***	0.9309***
Married		1.6093**	1.0270	1.1476	0.9710
ChildUnder15		0.9265	1.3432	1.287	0.9252
Entity-fixed effects		YES	YES	YES	YES
Number of observations		9321	9299	9329	9221

Notes: (1) Odds ratios are reported.
(2) *, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively.
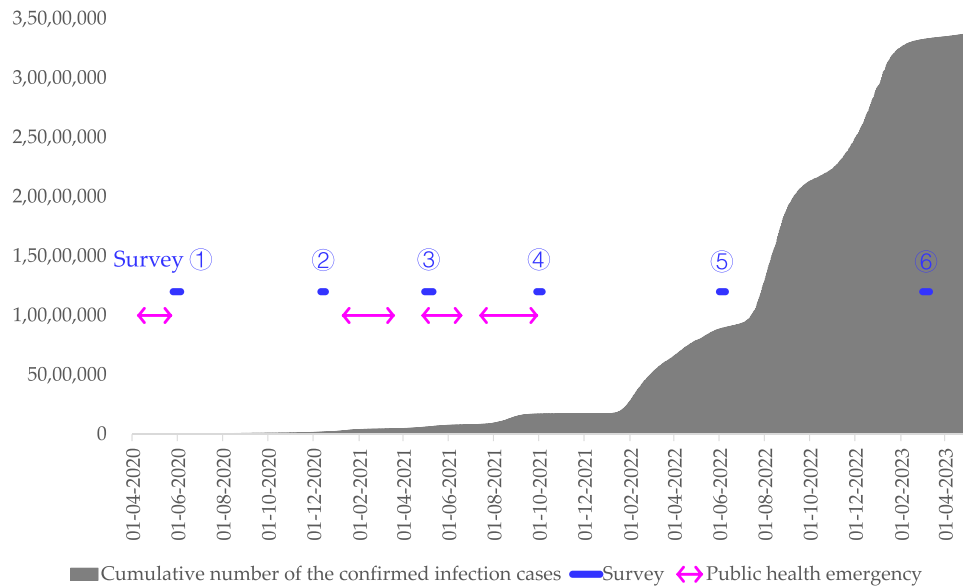
Fig. 3 Time of CABC survey waves and public health emergencies in the context of COVID-19. *Sources*: Information on public health emergencies is from Nippon Hoso Kyokai (n.d.). Data on the confirmed infection cases are from the Ministry of Health, Labour and Welfare of Japan (n.d.). *Notes*: The public health states of emergency lasted from April 7 to May 25 in 2020, January 8 to May 21 in 2021, April 25 to June 20, and July 12 to September 30 in 2021, respectively.

right after one. The fifth and sixth waves were conducted 8 months and 17 months after the last public health emergency was lifted, respectively.

The above results demonstrate that during a stringent period of the COVID-19 crisis, individuals tended to leave MAs to reduce their risk of infection. This trend persisted for several months after the public health emergency had been lifted, and even reversed eventually. The turning point occurred between 8 and 17 months after the last public health emergency was lifted, which took place at the end of September 2021. Since then, no new emergency status has been announced, despite the increasing number of infection cases (Fig. 2). Owing to the widespread use of vaccines, the public's better knowledge of COVID-19, and the decreasing virulence of the virus, people's perceived threat of the pandemic decreased during the recovery time. Eventually, individuals began to prefer areas with more prosperity and dynamism, despite the higher infection risks.

Why does the negative impact of infection rates persist for several months after the last public health emergency? A possible explanation is that the COVID-19 pandemic, as an unprecedented type of health risk, was previously unknown to society, leaving people uncertain about its potential duration and cessation. The virus continues to infect people, although it is not severe enough to trigger another public health emergency. Nevertheless, people remain unsure whether another public health emergency will occur. Therefore, a trend of 'deferred decisions' appears, and LMA migration continues to be drawn to regions with lower infection risks for several months.

Teleworking and its moderating effects
The impact of teleworking. In the results of the pooled logit regression, no significant association is found between individuals' teleworking and their LMA migration (Table 3). Such a result is in line with Kalemba et al.'s (2022) findings that teleworking has no significant effect on domestic migration in Australia over the long term. It also echoes the viewpoint that there are non-substitutable advantages of face-to-face communication, and teleworking might not be able to dramatically change the way

people live (Yahagi et al. 2020; Peng and Dai, 2024). Since infection risks are controlled for in my model, any impact of teleworking on LMA migration must be attributed to factors other than health concerns—most likely, the pursuit of a better teleworking environment. However, the insignificant result suggests that this pursuit alone does not significantly influence LMA migration.

In the results of the separate analysis for each survey wave, all four odds ratios for *Telework* are above one, but only the one for the fourth survey wave is significant (Table 4). Teleworking potentially serves as a facilitator driving people to leave MAs, but its effect becomes significant only in the later stage of a health crisis—right after the fourth public health emergency (Fig. 3). This may also be explained by the 'deferred decisions' of LMA migration, due to people's unfamiliarity with the COVID-19 pandemic, including its possible severity, treatment or precaution, trend, and duration. Initially, people tend to 'wait and see' what will happen. After experiencing several public health emergencies—in this case, three—those who can telework after LMA migration eventually take action to move. However, this effect becomes insignificant after the last public health emergency status has ceased.

The impacts of employment statuses on LMA migration and teleworking's moderating effects. Teleworking may have different impacts on individuals with varying employment statuses. In that case, whether teleworking has any moderating effects on the association between certain employment status and LMA migration requires further study. A series of moderating effects analyses are therefore conducted, and the results are reported in Table 5.

First, regarding the relationship between one's employment status and LMA migration, the variable of interest is *Group*. The results show that the formal employees (Model 3a) and informal employees (Model 3b) are less likely to engage in LMA migration behaviors. These results may be caused by the opportunity costs related to one's job. People with employment opportunities, whether formal or informal, are facing some opportunity costs if they resettle. Therefore, instead of leaving MAs for *local areas*,

Table 5 Moderating effect analysis results of teleworking on the relationship between employment status and LMA migration.

Dependent Variable: Migration	FormalEmployee		InformalEmployee		Manager		Self-employed		HomeWorker		Unemployed	
	Model (3a)	Model (4a)	Model (3b)	Model (4b)	Model (3c)	Model (4c)	Model (3d)	Model (4d)	Model (3e)	Model (4e)	Model (3f)	Model (4f)
COVID	0.6390***	0.6393***	0.6458***	0.6438***	0.6444***	0.6422***	0.6441***	0.6444***	0.6444***	0.6441***	0.6401***	0.6330***
Group	0.6298***	0.6335***	0.7263***	0.7279***	1.0096	0.8255	1.4131*	1.1794	2.3130***	2.1261*	1.8163***	1.8997***
Group * c_Telework		0.8436*		1.0176		1.2851		1.3887***		1.0423		1
Telework		1.1227**		1.0215		1.0171		0.9498		1.0021		1.0845*
Entity- and time-fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of individuals	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306
Number of observations	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170

Notes: (1) Odds ratios are reported.
(2) Group represents the dummy of each subgroup in the column headers. c_Telework represents the centered value of the variable Telework.
(3) Control variables include: Female, HouseholdIncome, University, AgeLevel, Married, ChildUnder15, UnemploymentRate.
(4) *, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively.

they either remain in their original residence or move into MAs to secure their job in the economic deterioration caused by the pandemic. This appears to entail a trade-off between economic and safety considerations, and the findings suggest that employees in MAs tend to prioritize economic considerations.

Contrastingly, self-employed individuals (Model 3d), homeworkers (Model 3e), and the unemployed (Model 3f) are found to be more likely to engage in LMA migration. The result for the unemployed is in line with the well-established argument that unemployed individuals tend to show higher levels of internal migration (Greenwood, 1997; Bernard and Bell, 2018), because they are out of work at their previous locations and they must relocate for new job opportunities. In a previous study on migration in 2013 during the Greek economic crisis, unemployed and younger individuals are found to be highly likely to engage in counter-urbanization migration (Remoundou et al. 2016). However, when juxtaposing similar results for the self-employed and homeworkers in our study, a more general reason for individuals in these three employment statuses leaving MAs may be the lower or absence of employment opportunity costs, rather than the pursuit of new job opportunities.

Additionally, the above results show that unemployed individuals, who have the highest resource constraints, are more likely to engage in LMA migration, and the employees are less likely to do so, revealing that the determining factors for LMA migration in Japan lie in aspects other than resources. These results invalidate the entrapment theory, which suggests that some socio-economic groups might be stuck in places due to resource constraints (Fielding, 2012). This could be because migration costs in Japan are not prohibitively high, thanks to the well-developed transportation and relocation services.

For further analysis of teleworking's moderating effects, the variable of interest is the interaction term Group * c_Telework when the coefficient for Group is significant. It is found that teleworking strengthens the negative relationship between formal employees and LMA migration, as shown in Model 4a (odds ratio: 0.8436*). For every level up in the teleworking frequency, a formal employee is about 16% less likely to conduct LMA migration. In comparison, teleworking is found to strengthen the positive relationship between the self-employed and LMA migration, as shown in Model 4d (odds ratio: 1.3887***). For every level up in the teleworking frequency, a self-employed individual is about 39% more likely to conduct LMA migration.

The impacts of occupations on LMA migration and teleworking's moderating effects. Next, I test the impacts of different occupations on LMA migration and whether teleworking has any moderating effects on their relationships. The variable of interest is Group in Table 6. The results show that office workers (Model 5b) and manufacturing engineering, construction, and mechanical technical professionals (Model 5d) are less likely to engage in LMA migration. No significant associations are found for other occupations, such as IT professionals, healthcare workers, and service workers (whether store-based or not).

Meanwhile, the results for all interaction terms (Group*c_Telework) are insignificant (Table 6). Teleworking does not significantly moderate the relationship between any of the occupations specified in this study and LMA migration.

The insignificant results of IT professionals are intriguing. Although it was intuitively guessed that knowledge-intensive or white-collar occupations, typically represented by IT professionals, would like to leave MAs (Kotsubo and Nakaya, 2022), there is no significant evidence that individuals are turning this possibility into actual movements. The reason may be largely because IT professionals view teleworking only as a temporary measure and believe that face-to-face communication is

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Table 6 Moderating effect analysis results of teleworking on the relationship between occupation and LMA migration.

Dependent Variable: *Migration*	ITprofessional		OfficeWorker		HealthWorker		ManuAndConstru		ServiceAtStore		ServiceNotAtStore	
	Model (5a)	Model (6a)	Model (5b)	Model (6b)	Model (5c)	Model (6c)	Model (5d)	Model (6d)	Model (5e)	Model (6e)	Model (5f)	Model (6f)
COVID	0.6454***	0.6428***	0.6431***	0.6392***	0.6441***	0.6422***	0.6435***	0.6417***	0.6447***	0.6430***	0.6446***	0.6430***
Group	0.812	0.579	0.5053***	0.5025***	0.9215	0.9467	0.7527*	0.7462*	0.8496	0.8987	0.9351	0.9364
Group * c_Telework		1.1727		0.9770		1.0880		0.8651		1.2365		1.2113*
Telework		1.0263		1.0474		1.0206		1.0291		1.0178		1.0022
Entity- and time-fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of individuals	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306	19,306
Number of observations	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170	37,170

Notes: (1) These results are estimated by logit models. Odds ratios are reported.
(2) *Group* represents the dummy of each subgroup in the column headers. c_*Telework* represents the centered value of the variable *Telework*.
(3) Control variables include: *Female, HouseholdIncome, University, AgeLevel, Married, ChildUnder15, UnemploymentRate*.
(4) * and *** denote significance at the 5% and 0.1% levels, respectively.

irreplaceable. However, further investigation is necessary to reach a solid conclusion.

Control variables

Unemployment rate. The results in Table 3 show that the odds ratio for the unemployment rate (*UnemploymentRate*) in one's residence prefecture is significant and below one, indicating a negative association with their LMA migration behaviors. This finding echoes earlier research in Finland, which shows that interregional migration is influenced by regional differences in unemployment and available work opportunities for unemployed workers (Laamanen, 2014). However, in the analyses for each survey wave, the results show that the unemployment rates are not significant for LMA migration during the pandemic, only becoming negatively associated after the COVID-19 health emergency has been lifted (Table 4). This reflects that metropolitan residents prioritize safety over economic factors during the stringency of the pandemic.

Personal attributes. Table 3 shows that females, age level, and household income level are significantly and negatively related to LMA migration, while the results for marital status and children at or below middle school age are insignificant. These findings are consistent across all four survey waves (Table 4). Overall, older people are less likely to leave MAs. This may be attributed to the high mobility of young people during the first decade after university graduation, when major life events such as entering the job market and getting married may occur. Individuals whose household incomes are higher might be requested to stay in MAs because of job requirements and be less likely to leave. Taking together the findings regarding age, the unemployed, household income, and children, it appears that the gentrification process is not evident during the COVID-19 pandemic in Japan.

A positive and significant association is found between one's university educational background and LMA migration in most survey waves (Tables 3 and 4). Individuals with a tertiary education are more likely to leave MAs, *ceteris paribus*. A previous study of 56 countries has proved that the positive impact of tertiary education on migration is a near-universal empirical regularity (Bernard and Bell, 2018). Some other studies specified the spatial direction by arguing that educational attainment positively affects migration from rural to urban areas (Amuakwa-Mensah et al. 2016; Ginsburg et al. 2016). The rationale is that the more educated individuals are usually more informed about employment opportunities and living conditions in other regions and have more sophisticated ways of estimating net migration gains (Greenwood, 1997; Greenwood and Hunt, 2003). Under normal circumstances, economic considerations would be the priority in their migration decisions. However, during a major health crisis, health-risk-aversion motives (i.e., safety considerations) may become equally important, or even more so. Therefore, highly educated individuals may use their advantages to collect information on regional infection situations and job opportunities, and eventually migrate in the opposite direction–moving out of MAs.

Concluding remarks

Utilizing the third to sixth waves of nationally representative data from Japan's CABC survey, this study delves into LMA migration behaviors in a pandemic context. It enriches the theoretical framework of health-crisis-led LMA migration by examining the impacts of two focal factors—health risks and teleworking—and their temporal changes. Significant findings have been yielded.

First, this study contributes to migration research by confirming the trend of health-risk-aversion LMA migration during

the pandemic. It enhances the existing studies, particularly that of Peng and Dai (2024), by incorporating infection rates in a more accurate measurement, which aligns with the timing of the LMA migration behaviors. The results confirm that LMA migration is indeed significantly attracted to regions with lower infection rates during the stringent period of COVID-19. This study is, therefore, among the first to empirically support the numerous speculations and narratives suggesting that urban residents are moving out due to health-risk-aversion (i.e., safety) concerns. By directly linking health-crisis-led residential movements to safety considerations, it expands the discussion beyond the scope of amenity migration theory. Notably, such a significant impact on infection rates is found in the context where no compulsory lockdowns had been implemented. The Japanese government had provided appropriate and timely information about the pandemic, including daily updates on infection numbers. This information not only prompted individuals to modify their stay-at-home habits (Watanabe and Yabu, 2021) but also influenced their LMA migration patterns, despite the absence of strict, legally binding anti-COVID-19 measures.

Second, this study is among the first to empirically examine the impact of teleworking while controlling for infection rates. The teleworking measurement used in this study is at the individual level, improved on previous studies that relied on occupation-level (Tønnessen; 2021; Vogiazides and Kawalerowicz., 2023) or city-level data (Haslag and Weagley, 2024). The results show that, overall, teleworking itself has no significant impact on facilitating or reducing LMA migration, *ceteris paribus*, including infection risks. This suggests that the pursuit of a better teleworking environment does not significantly drive LMA migration flows, considering the overall pandemic period.

However, teleworking does exert a differentiated influence based on employment status. Specifically, it increases the likelihood of formal employees staying in MAs and strengthens the tendency of the self-employed to leave for *local areas*. Formal employees tend to be compelled to stay in MAs, to avoid job losses and the corresponding opportunity costs, indicating that they prioritize economic considerations over health risk aversion. In contrast, self-employed individuals who have the flexibility to choose their workplace without jeopardizing their employment prospects and face lower or no opportunity costs, tend to prioritize safety considerations. Overall, these findings underscore that teleworking intensifies the trade-off between economic opportunity costs and health risks—or, put differently, economic and safety considerations.

Third, this study reveals the temporal characteristics of health-risk-led LMA migration. The effects of teleworking and the cessation of the impact of infection risks exhibit a lag effect. During public health emergencies and the intervals between them, *local areas* with lower infection rates are found to significantly attract LMA migration. This trend persisted beyond the pandemic stringency and continued for several months after its cessation, indicating a tendency of 'deferred decisions' in LMA migration, though it eventually reversed. Similarly, this tendency of 'deferred decisions' is also evident in the impact of teleworking. Over the long term, teleworking's impact on LMA migration is insignificant, but in the later stage of a health crisis—right after the fourth public health emergency in the case of COVID-19—those who can telework after LMA migration eventually take action to move. These findings may be explained by people's unfamiliarity with the new type of pandemic. When an unprecedented type of health crisis emerges, people know little about its possible severity, treatment, precautions, trends, duration, or cessation, and tend to 'wait and see,' making migration choices only after the situation becomes clearer.

Regarding the emergence of the negative impact of infection risks, it is unclear whether it involves a lag due to the lack of data.

However, it does occur sooner than the effects of teleworking. The time difference is likely because the impact of infection risks is more critical, prompting a more in-time response. When safety is critically threatened, the migration choice mechanism of individuals differs—they prioritize safety and leave MAs promptly. In contrast, teleworking and the cessation of the impact of infection risks are not as fatal, leading individuals to make more 'deferred decisions' about migration.

Fourth, the findings that self-employed individuals, home-workers and the unemployed are more likely to engage in LMA migration during the pandemic point to a possible reason: their low opportunity costs in employment in MAs may facilitate this movement. In other words, not having formal employment in MAs facilitates their LMA migration as a way to avoid health risks. Contrastingly, employees (whether formal or informal) are found to be less likely to conduct LMA migration, which can be explained by their high opportunity costs. These findings are important because they provide a fresh perspective on how economic factors influence LMA mobility, highlighting the role of opportunity costs. This new perspective complements established research on crisis-led LMA migration, which typically focuses on potential job opportunities outside MAs (Anastasiou, 2020; Tønnessen, 2021).

Overall, this study finds no significant evidence of gentrification in areas outside MAs among the affluent class, nor entrapment in high-risk MAs among the economically disadvantaged. Instead, it demonstrates that safety is a pressing priority in LMA migration during a major health crisis. This finding is anchored in Maslow's hierarchy of needs theory, which positions safety as the second-level fundamental need, only after basic survival needs such as food, water, and shelter (Maslow, 1943). When safety threats become non-fatal, the effects of teleworking and the cessation of the impact of infection risks exhibit a lag effect, leading to 'deferred decisions' regarding LMA migration. Given the heightened emphasis on safety, lower economic opportunity costs facilitate residents in pursuing LMA migration for lower health risks. Furthermore, Telework intensifies the trade-off between economic opportunity costs and health risks.

The findings on such LMA mobilities have important implications for regional policy and planning, as they can help formulate effective policies and facilitate migration from MAs to *local areas*. During pandemics, special focus should be given to attracting the self-employed and encouraging entrepreneurship. Enhancing internet infrastructure and teleworking environments can help local governments attract this type of in-migrants during a health crisis, view and this should be viewed as a long-term strategy. Post-pandemic, *local areas* can still capitalize on residents' heightened focus on safety by highlighting their lower infection risks during the stringency of the pandemic, positioning themselves as safer alternatives in the face of future potential pandemics.

This research also has limitations. While it is evident that health-risk-aversion motives stimulate LMA migration, it has not ruled out the potential drive of lower living costs outside MAs. Due to the lack of monthly housing prices corresponding to the survey waves, this study has not controlled for living costs. Further work is needed to extend the discussion of living-cost-driven motives widely acknowledged in LMA studies.

Data availability

The data from the *Surveys on Changes in Attitudes and Behaviors in Daily Life under the Influence of Novel Coronavirus Infection*

(CABC surveys) that support the findings of this study are available from the Cabinet Office of Japan (COJ). Data are available at https://www5.cao.go.jp/keizai2/wellbeing/covid/index.html with the permission of the COJ.

Notes

1 The sample size for each subgroup in the seven regions of Japan is proportionate to its population. The respondents are evenly distributed across six age groups, with each group representing a 10-year interval except for the oldest group, and the gender ratio is controlled at 1:1 within each age group.
2 Self-employed indicates individuals who do not work for an employer but have their own business or find work for themselves. This category includes owners of small enterprises, freelancers, and so on.
3 Homeworkers are individuals who perform their job duties at home rather than in an office or factory. This category typically includes housewives, part-time workers working from home, and so on. However, it does not encompass freelancers working from home.

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Author contributions

Competing interests

Ethical approval

Informed consent

Additional information