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Abstract: An increase in people leaving metropolitan areas (MAs) has been observed in various countries in the first years of COVID-19, and MAs will still be most affected in potential future health crises. Therefore, it is paramount to understand the mechanism of migration leaving the MAs (LMA migration) since it provides insight into how people adjust to health crises. This empirical study aims to investigate the impact of health risks and teleworking on residents' LMA migration behaviors. It uses microdata from the third to sixth rounds of the *Survey on Changes in Attitudes and Behaviors in Daily Life under the Influence of Novel Coronavirus Infection* conducted by the Japanese government, and employs fixed effects logit models for estimation. The results demonstrate that metropolitan residents are initially attracted to local areas with lower COVID-19 infection rates. However, this impact reverses several months after the lift of the last public health emergency, and metropolitan residents move to local areas with higher COVID-19 infection rates, where they will potentially have better prosperity and more dynamic interactions. Unemployed individuals are more likely to engage in LMA migration and the employees are less likely to do so, indicating that the entrapment phenomenon is not evident in Japan. Teleworking is found to significantly facilitate LMA migration in the later stages of the health crisis, although it does not have a significant effect over the long term. Moderating effects are detected for teleworking in the sense that it enhances the trade-off between employment opportunities and health risks.

Keywords： migration behaviors; leaving metropolitan areas (LMA); health risks; teleworking; COVID-19; Japan.

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1. 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). The recognition of the increased risks in metropolitan areas during a pandemic has led to changes in residence choices and movements. An increase in people leaving large cities has been observed 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 & Kawalerowicz, 2023), Norway (Tønnessen, 2021), Australia, (Perales & Bernard, 2023) and Japan (Fielding & Ishigawa, 2021). Although the pandemic has subsided, there is still a higher probability that MAs will encounter health risks than local areas. Therefore, it is paramount to understand the mechanism of migration leaving the MAs (LMA migration) since it provides an important insight into how people adjust 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. A few studies focus on explaining LMA migration intention (Teng, 2022) and note significant factors such as teleworking, income changes, and worries about COVID-19 infections. A few studies investigate migration movement. For example, a study in Spain decomposes the inflows of migrants from urban to rural areas and unveils the influence of population nationality composition (including both internal migrants and foreign-born) and age range (across a wide age spectrum) (González-Leonardo et al., 2022). A study in Norway confirms that in 2020, certain occupations (clerical support workers, service workers, and sales workers) displayed a higher probability of migrating from Oslo, the capital city, to other regions compared to other groups (Tønnessen, 2021). That study also reveals various factors usually associated with out-migration from Oslo between 2016 and 2020. Those factors include positive aspects such as being born outside Oslo, and negative aspects like being a professional, owning a home, having a higher income, and having an immigrant background.

Immense attention has been paid to the impacts of health risks and teleworking, two of the most prominent topics related to the COVID-19 pandemic. However, most statements concerning these two aspects are anecdotal and few studies provide empirical evidence. For example, extant LMA migration research inferring people are leaving MAs to avoid high health risks is primarily based on indirect evidence such as population densities (Brandén et al., 2020; Aradhya et al., 2021; Rowe et al., 2023) or a vague term like “health reasons” (Van Leeuwen & Venhorst 2021). The few exceptions, such as Peng and Dai (2023), find a significant negative impact of infection rates on LMA migration but do not investigate its temporal changes.

Meanwhile, the LMA migration discussions related to teleworking are generally derived explanations (Rietveld & Vickerman, 2003; Rowe et al., 2023; Fielding & Ishikawa, 2021; Perales & Bernard, 2023) rather than direct evidence from the analysis of teleworking. A few studies have directly examined teleworking, utilizing data either at the city level (Haslag & Weagley, 2022) or making a broad speculation based on occupation (Tønnessen, 2021; Vogiazides & Kawalerowicz, 2023). Furthermore, the one study that examines individual-level teleworking (Peng & Dai, 2023) does not discuss temporal changes.

As a result, existing research on whether and how health risks and teleworking have affected LMA migration behaviors in the context of the COVID-19 pandemic remains insufficient. Therefore, the focus of this paper is to shed new light on the factors of health risks and teleworking underpinning LMA migration behaviors by addressing two sets of questions: (1) Have health risks affected LMA migration? What are the temporal changes during and after 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 study case, in which there are essentially no restrictions on domestic migration. More importantly, Japan serves as a case of high mobility even during the stringent period of the pandemic. Unlike many other countries, Japan did not implement compulsory lockdown containment zones during the COVID-19 pandemic. In addition, the Japanese government has organized six rounds of *Survey on Changes in Attitudes and Behaviors in Daily Life under the Influence of Novel Coronavirus Infection* (CABC survey), and four rounds have inquired about LMA migration behaviors. These survey data have made it possible to examine the mechanisms of LMA migration in the COVID-19 pandemic context and their temporal changes.

In the empirical component of this paper, I utilize the third to sixth CABC survey results to compile this study's panel data. I construct a variable measuring the infection rates in an individual's resident prefecture during the previous six months to align with one's LMA migration behavior during the same period, if such movement has taken place. A variable measuring individual-level teleworking frequency is also constructed. I further examine the interaction of teleworking and occupations, teleworking, and employment statuses. I also investigate the temporal effects of COVID and teleworking on LMA migration. These main explanatory variables, along with other control variables, are estimated in a series of entity- and time-fixed logit models.

The remainder of the paper comprises the following parts: Section 2 reviews the previous literature on increasing LMA migration after the COVID-19 pandemic, the impact of health risks, and the impact of teleworking. Section 3 introduces LMA migration trends in Japan, presents the data from the CABC surveys, and specifies the regression methods. Section 4 discusses the results from the regression analyses. Section 5 concludes this paper with the contributions, practical implications, and limitations of this study.

2. Literature review

2.1 Increasing LMA migration after the COVID-19 pandemic

The outbreak of COVID-19 has reshaped people's preference of 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 & Ishigawa, 2021). In Spain, migration from 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 found in large cities like Berlin and Hamburg in Germany (Stawarz et al., 2022), Swedish inner cities, particularly the inner city of Stockholm (Vogiazides & Kawalerowicz, 2023), and some capital cities of Australia such as the Melbourne MA (Perales & Bernard, 2023) in 2020.

Although some researchers argue that the changes in domestic migration brought on by crises—including the COVID-19 pandemic (Perales & Bernard, 2023; Rowe et al., 2023)—are likely to be short-lived (Glaeser, 2020), it remains important to study LMA migration behavior after the onset of a crisis. This is because there is a possibility of future health crises occurring, and MAs will still be the most affected. Unveiling the mechanism of migration behavior will help governments better anticipate what will happen and provide better support for residents in future times of crises. This study, conducted in the context of the COVID-19 pandemic, aims to contribute to the ongoing migration discourse by introducing two new aspects of factors particularly important in a health crisis: health risks and teleworking.

2.2 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 & 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 & 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 find that residents in 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.

Previous studies point out the value of essential amenities beneficial for health during a pandemic, such as natural resources and low population density (Kotsubo & Nakaya, 2022), green spaces and having a personal garden (Dolls & Mehles, 2021), larger indoor spaces (Kotsubo & Nakaya, 2022) and so on. However, there are only a few studies that directly examine how health issues influence migration intention after a major crisis.

One of these few studies finds that in the Netherlands, residents' willingness to move down the urban hierarchy is not affected by health reasons, while the willingness to move up the urban hierarchy is positively related (Van Leeuwen & Venhorst 2021). However, this study is discussing migration in the context of a financial crisis, and it is difficult to generalize the role of health issues in migration decisions in the context of a global health crisis. Furthermore, the mechanisms of migration intentions might differ substantially from migration actions (Peng & Dai, 2023).

Peng and Dai (2023) find a significant and negative impact of infection rates in the current residence on LMA migration in Japan. Their results suggest that LMA migrants tend to choose areas of residence with lower infection rates. The infection rates they discuss are in cumulative terms, which include all newly reported infection cases in the residence prefecture from the onset of the COVID-19 pandemic (January

2020) to the early June in 2022. It remains uncertain whether the recent infection rates affect the LMA migration and whether there are any temporal changes.

2.3 The impact of teleworking

(1) Causes 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 & Shuttleworth, 2018), and decreases interstate migration in the United States (Cooke & Shuttleworth, 2017). Teleworking, supported by ICTs, may facilitate alternative forms of mobility, and cause a decrease in migration in the same way. For example, 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 & Weagley, 2021).

Previous research proposes several possible explanations. The fundamental explanation is rooted in the endowment effect theory, which argues that people have a "loss aversion," where losses are weighted substantially more than objectively commensurate gains (Kahneman & Tversky, 1979; Thaler, 1980). People often place high value on their current lifestyle and residence, making them reluctant to move. For this reason, advancements in communications 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 & Brunn, 2010) or enhanced residential rootedness and attachment to place (Cooke & Shuttleworth, 2018; Cooke et al., 2018). A similar theory is the cumulative inertia theory, suggesting that the strength of location-specific ties tends to increase with the duration of stay (Thomas et al., 2016), creating resistance to moving (Huff & Clark, 1978).

In the above explanations, the role of ICTs involves enhancing the knowledge about alternative locations; this results in an improved quality of initial migration decision (Cooke & Shuttleworth, 2018; Cooke et al., 2018; Kaplan & Schulhofer-Wohl, 2017). While teleworking enables individuals to choose their preferred place of residence, it may be more associated with a reduction in exploratory migration (Kaplan & Schulhofer-Wohl, 2017) and onward and return migration (Cooke et al., 2018) due to residential satisfaction.

(2) An insignificant effect on migration

In contrast to the studies in the previous section, Kalemba et al. (2022) argue that teleworking does not appear to contribute to a decline in migration. By using survey data in Australia between 2002 and 2018, they reveal that teleworking has no effect on any reason for migration and such an insignificant effect has not changed with time. They further find a decline across all reasons for migration, including employment-related migration. They suggest that the decline in employment-related migration does not seem to be attributed to an increase in alternative forms of mobility—including teleworking—or to substitution with inter-industry or occupation mobility.

A study conducted in Japan using survey data from the Tokyo MA in February 2021, also finds that

teleworking has a limited effect on young adults' migration intention of leaving the Tokyo MA for local areas, despite its positive significant impact on the within-Tokyo-MA-migration intention (Teng, 2022). Similarly, previous studies in the Netherlands find that teleworking is not a significant factor in people's relocation intentions (Muhammad et al., 2007; Ettema, 2010).

(3) Potential facilitator for LMA migration during health crisis

Another perspective is that teleworking might facilitate LMA migration, particularly during a health crisis. First, in the context of the global health crisis, the COVID-19 pandemic unleashed great potential for teleworking (OECD, 2021), which increases the flexibility and freedom of people's choice of residence. A suitable teleworking environment implies the necessity for greater space at home (Kotsubo & Nakaya, 2022) to keep demarcations between work and personal life, or at least, the availability of one room dedicated to home-based telework (Rymaniak et al., 2020). This, in turn, accentuates the demand for migration away from MAs, where housing prices are often higher, to regions where more affordable housing with larger rooms is easier to secure. A study conducted in France shows that teleworkers, driven by the pandemic, need appropriate teleworking conditions at home. This aspect emerged as one of the most influential factors affecting employees' work adjustment (Carillo et al, 2020). Nevertheless, direct empirical evidence for telework facilitating migration remains insufficient.

The above literature review illustrates the fact that existing studies have not reached a consensus regarding the impact of teleworking on migration, LMA migration included.

3. Data and methods

This study aims to shed light on the impact of health risks and teleworking on LMA migration in the context of a major health crisis. The COVID-19 pandemic appeared as a particularly appropriate context to discuss this issue due to the widespread and profound health, social, and economic challenges it has engendered.

3.1 Migration from metropolitan to local areas in Japan in the COVID-19 context

Each country has encountered distinct pandemic situations, encompassing the spread of the pandemic, governmental measures, and the 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 to discuss the autonomy choice of migration behavior and the impact of health risks and teleworking.

The COVID-19 pandemic is generally associated with a decline in the intensity of migration (Fielding et al., 2021; Stawarz et al., 2021). In terms of LMA migration, initially, the number of migrants leaving any of the three main MAs (Tokyo MA, Osaka MA, and Nagoya MA) in Japan declined in 2020 (458,043

persons) 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) (Figure 1). Examining the changes in the out-migrants across the three main MAs, only Tokyo MA saw an increase in out-migrants in 2020, whereas all three MAs showed an increase in 2022 (Figure 2). Overall, the COVID-19 pandemic appears to have temporarily dampened the intensity of LMA migration. 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 three years after its outbreak (2020–2022), marking a 9.0% increase. It should be noted that the statistics in Section 3.1 only include migrants who moved out from any of the three main MAs. They do not encompass residents who moved within each of the three main MAs, those who moved within areas outside the three main MAs, or any intra-prefecture migrants.

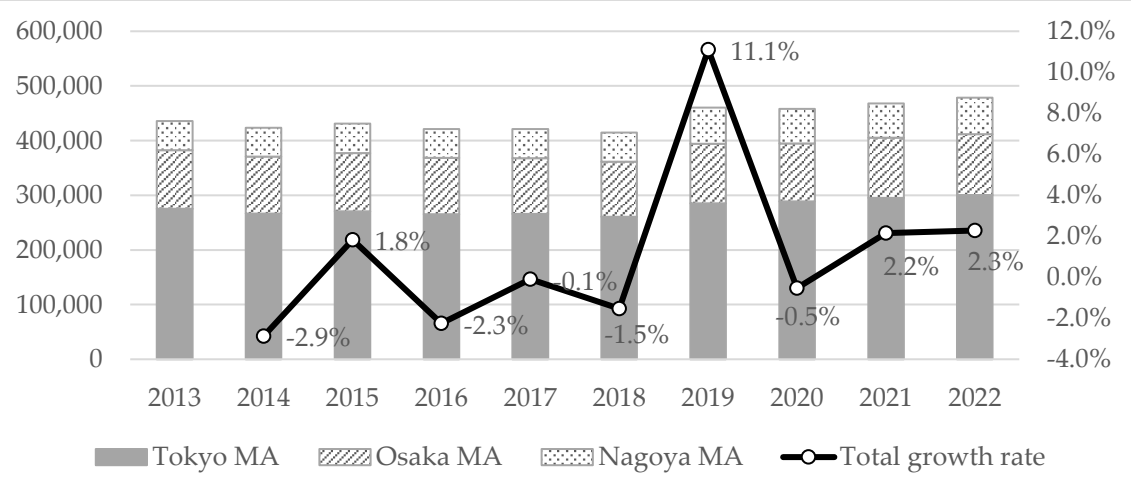

Figure 1. Number of migrants leaving the three main metropolitan areas (MAs)

Sources: Statistics of Japan (2019, 2020, 2023).

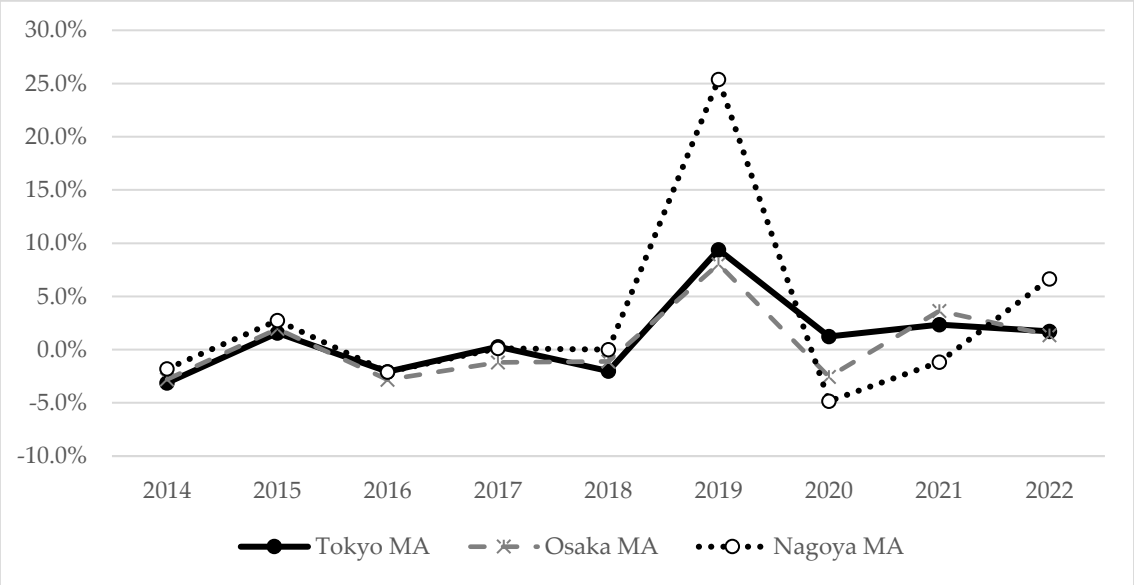

Figure 2. Ratio of change in the numbers of migrants leaving the three main metropolitan areas, to the preceding year

Sources: Statistics of Japan (2019, 2020, 2023).

3.2Data and variables

This study utilizes microdata from the third to sixth CABC surveys for empirical analysis. The surveys were conducted during the following periods respectively: April 30 to May 11, 2021 (the third round of CABC survey); September 28 to October 5, 2021 (the fourth round); June 1 to June 9, 2022 (the fifth round); March 2 to March 11, 2023 (the sixth round). In each survey round, the stratified random sampling method was used and the population was divided into smaller subgroups based on residence, gender, and age.[2] A random sample was drawn from each subgroup to compose the final sample pool. Over 10,000 valid questionnaires were collected in each survey round. 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 round, 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.

Data on the number of COVID-19 infection cases used in this study are from the Ministry of Health,

[2] 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, and the gender ratio is controlled at 1:1 within each age group.

Labour and Welfare of Japan (MHLW, n.d.). Data on unemployment rates and population numbers are from the Statistics Bureau of Japan (SBJ, n.d.; MIC, 2021a, 2021b, 2022, 2023).

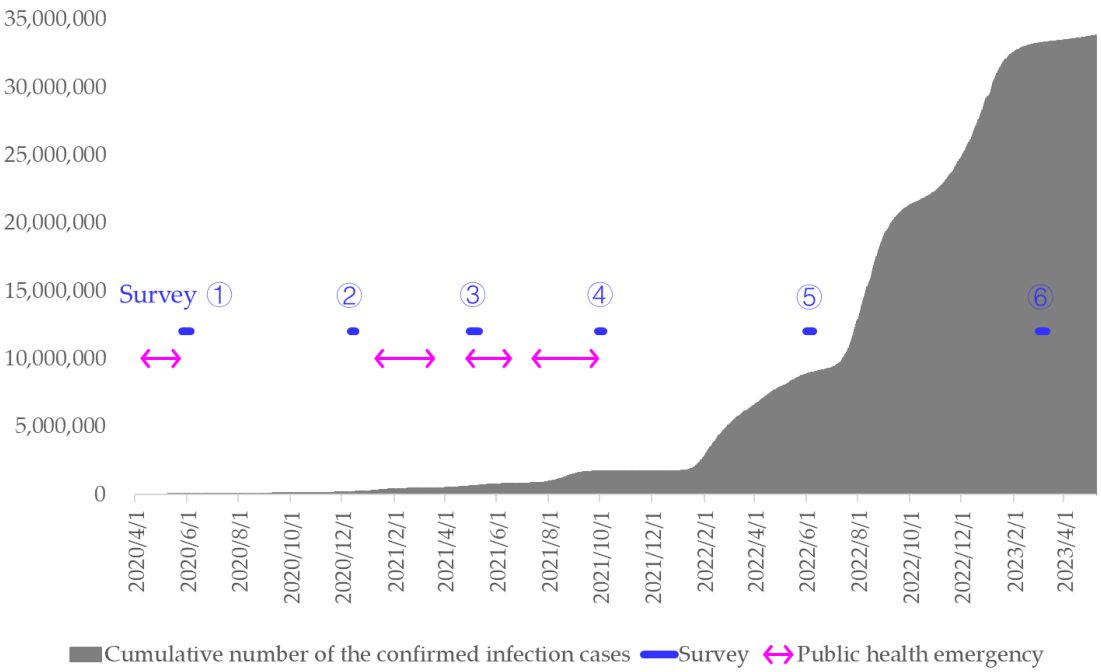

Figure 3. Time of CABC survey rounds and public health states of emergency in the context of COVID-19

Sources: Information on public health states of emergency 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.

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

Table 1. Summary statistics

	Variable	Obs	Mean	Std. dev.	Min	Max
	Migration	37170	0.0385	0.1923	0	1
	COVID	37170	5.3009	1.4785	1.1236	7.3465
	Telework	37170	0.4886	1.0420	0	4
Occupation	*ITprofessional*	37170	0.0334	0.1798	0	1
	OfficeWorker	37170	0.1392	0.3462	0	1
	HealthWorker	37170	0.0765	0.2659	0	1
	ManuAndConstru	37170	0.0772	0.2669	0	1
	ServiceAtStore	37170	0.0599	0.2373	0	1
	ServiceNotAtStore	37170	0.1016	0.3022	0	1
Employment Status	*FormalEmployee*	37170	0.4482	0.4973	0	1
	InformalEmployee	37170	0.2037	0.4028	0	1
	Manager	37170	0.0166	0.1278	0	1
	Self-employed	37170	0.0560	0.2300	0	1
	HomeWorker	37170	0.0073	0.0849	0	1
	Unemployed	37170	0.2682	0.4430	0	1
	UnemploymentRate	37170	2.6532	0.5300	0.8	3.8
	Female	37170	0.5016	0.5000	0	1
	HouseholdIncome	37170	3.2104	1.5071	1	6
	University	37170	0.4712	0.4992	0	1
	AgeLevel	37170	7.0276	3.2446	1	14
	Married	37170	0.5957	0.4908	0	1
	ChildUnder15	37170	0.1701	0.3757	0	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 six months?* In the survey, the term *local areas* was annotated to encompass MAs smaller in population than major metropolises as well. Therefore, the terms *metropolitan areas* and *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. Respondents who answered "Having migrated" are those who have finished the LMA migration movement. Of all the observations, 1,430 (3.85%) have migrated, while 35, 407 (96.15%) have not (Table 2).

Table 2. Summary of migration behavior

Survey Round	Number of observations having migrated	Number of observations having not migrated	Total	Percentage of observations having migrated
3rd	273	9,048	9,321	2.93%
4th	336	8,963	9,299	3.61%
5th	392	8,937	9,329	4.20%
6th	429	8,792	9,221	4.65%
Total	1,430	35,740	37,170	3.85%

One explanatory variable is the logarithm of the COVID-19 infection rates (*COVID*) within the last six months. The COVID-19 infection rates range from approximately 3 to 1558 cases in every 10,000 population, with the logarithm of it ranging from 1.1236 to 7.3465.

The other explanatory variable is the frequency of teleworking (*Telework*). Of the total observations, 3.74% work remotely almost all of the work time, and 4.33% primarily work remotely (over half of the work time). In comparison, 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.

The data also include personal attributes. 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 to 49. On average, 59.57% are married and 47.12% have an educational background of at least university 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, 5.6% are self-employed,[3] 0.73% are homeworkers,[4] 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 health 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, they account for 48.79% of the observations.

3.3 Model specification

Entity- and time-fixed effects logit model is used for analysis and is specified as follows:

$$U_{i,t} = ln\left[\frac{prob\left(Migration_{i,t} = 1\right)}{1 - prob\left(Migration_{i,t} = 1\right)}\right] = \beta \cdot COVID_{i,t} + \gamma \cdot Telework_{i,t}$$

[3] 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.

[4] 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.

$$+\boldsymbol{X}_{i,t} \cdot \delta' + \theta_t + \alpha_i + \varepsilon_{i,t} \quad \text{......} \quad (1)$$

where $U_{i,t}$ is the utility individual *i* obtained from LMA migration. $Migration_{i,t}$ represents whether individual *i* has migrated from metropolitan to local areas during the last six months in survey *t*. $COVID_{i,t}$ represents the COVID-19 infection rates during the last six months in the prefecture where individual *i* lived when they participated in the survey. $Telework_{i,t}$ represents the teleworking frequency of individual *i* in survey *t* (t={3,4,5,6}). $X_{i,t}$ represents the vector of control variables corresponding to individual *i* in survey *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 coefficient of each corresponding variable. δ and θ are the vectors of coefficients. $\varepsilon_{i,t}$ is the overall error term.

To examine the temporal changes of the coefficients, for every survey round *t* (t ={3, 4, 5, 6}), I estimate the following entity-fixed effects model separately:

$$U_i = ln\left[\frac{prob(Migration_i=1)}{1-prob(Migration_i=1)}\right] = \beta \cdot COVID_{i,t} + \gamma \cdot Telework_{i,t} + X_{i,t} \cdot \delta' + \alpha_i + \varepsilon_i \text{......} \quad (2)$$

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:

$$U_{i,t} = ln\left[\frac{prob(Migration_{i,t}=1)}{1-prob(Migration_{i,t}=1)}\right] = \beta \cdot COVID_{i,t} + \delta' X_{i,t} + \mu \cdot EmploymentStatus_{i,t,m} +$$

$$+X_{i,t} \cdot \delta' + \theta_t + \alpha_i + \varepsilon_{i,t} \quad \text{......} \quad (3)$$

Next, the moderating effect model is as follows:

$$U_{i,t} = ln\left[\frac{prob(Migration_{i,t}=1)}{1-prob(Migration_{i,t}=1)}\right] = \beta \cdot COVID_{i,t} + \delta' X_{i,t} + \mu_1 \cdot EmploymentStatus_{i,t,m}$$

$$+\mu_2 \cdot EmploymentStatus_{i,t,m} \cdot Telework_{i,t} + \mu_3 \cdot Telework_{i,t}$$

$$+\delta' X_{i,t} + \theta_t + \alpha_i + \varepsilon_{i,t} \quad \text{......} \quad (4)$$

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 effect of occupation can be specified similarly.

4. Results and discussions

4.1 COVID-19 infection rate

Table 3 reports the coefficients of pooled logit regressions. The findings suggest that the COVID-19 infection rate in the previous six months is negatively related to LMA migration. This implies that metropolitan residents indeed gravitate to local areas with lower health risks.

Table 3. Results of entity- and time-fixed effects logit models

Dependent Variable: *Migration*		Model (1)
COVID		−0.4551***
Telework		0.0473
Female		−0.3279***
HouseholdIncome		−0.1378***
University		0.2787***
AgeLevel		−0.0983***
Married		0.1255
ChildUnder15		0.1028
UnemploymentRate		−0.5578***
Employment Status	*Formal employee*	(ref)
	Informal employee	0.0976
	Manager	0.2442
	Self-employed	0.6345***
	Homeworker	1.0649***
	Unemployed	0.7752***
Entity- and time-fixed effects		YES
Number of individuals		19306
Number of observations		37170

Notes: 1) Coefficients are reported.

2) *, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively.

Next, I estimate the impact of the COVID-19 infection rate in each survey round with Model (2). Table 4 shows that LMA migration behavior is negatively related to infection rate in the third to fifth round, but the association turns positive and significant in the sixth round. Regarding the relationship between the survey rounds and health states of emergency (Figure 1), the third round was conducted during a public health emergency, and the fourth round was conducted right after the end of a public health emergency. The

fifth and sixth rounds were conducted 8 months and 17 months after the last public health emergency was lifted, respectively.

The above results suggest 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. A tentative explanation might be that migration usually takes several months after a decision is made as it is a complex process involving multifaceted changes in one's life, requiring time for consideration and implementation.

No emergency status was announced after October 2021, although the number of infection cases was still increasing (Figure 2). The analysis results indicate that the threat of health risks diminished during that period, and the infection rates even became positively related to LMA migration in the sixth survey round, which was conducted approximately 17 months after the last emergency status had been lifted.

The above results underscore the role of health concerns in people's migration behavior, prompting them to leave risky areas amid public health emergencies. However, during the recovery period from the COVID crisis, the threat of the pandemic significantly decreased in society owing to the widespread use of vaccines and a better understanding of the disease. Eventually, individuals exhibited preferences for places with more prosperity and dynamism, despite the higher health risks.

Table 4. Results of entity-fixed effects logit models, by survey rounds

Dependent Variable: *Migration*		Model (2c)	Model (2d)	Model (2e)	Model (2f)
Data from the survey round		Third	Fourth	Fifth	Sixth
	COVID	−0.5546***	−0.8853***	−0.7762***	1.5719***
	Telework	0.0832	0.1401*	0.0123	0.0156
Employment Status	*Formal employee*	(ref)	(ref)	(ref)	(ref)
	Informal employee	0.4838*	0.2624	−0.0941	−0.0335
	Manager	−0.1156	0.4531	0.2701	0.3341
	Self-employed	0.5448	0.9310***	0.5524*	0.5120*
	Homeworker	−0.2589	1.1621*	1.5320***	0.5271
	Unemployed	1.1211***	0.9277***	0.6432***	0.6129***
	UnemploymentRate	−0.3012	−0.0042	−0.3454*	−0.5056***
	Female	−0.6095***	−0.3152*	−0.2499*	−0.2275*
	HouseholdIncome	−0.1521**	−0.1171*	−0.1273**	−0.1317**
	University	0.4914***	0.3191*	0.2697*	0.1796
	AgeLevel	−0.1527***	−0.0690**	−0.1144***	−0.0716***
	Married	0.4758**	0.0267	0.1377	−0.0294
	ChildUnder15	−0.0763	0.2951	0.2523	−0.0778
Entity-fixed effects		YES	YES	YES	YES
Number of observations		9321	9299	9329	9221

Notes: 1) Coefficients are reported.

2) *, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively.

4.2 Telework and its moderating effects

(1) The impact of telework

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 effect on domestic migration in Australia over the long term. This 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 & Dai, 2023).

However, in the separate analyses of each survey round, all four coefficients are positive whereas one (the one for the fourth survey round) is significant (Table 4). Teleworking potentially serves as a facilitator driving people to leave MAs due to health risks, whereas its effect becomes significant only in the later stages of the health crisis.

(2) The impact of employment status on LMA migration and teleworking's moderating effects

Teleworking may have different impacts on individuals with different employment statuses. In that case, whether teleworking has any moderating effect on the association of 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, our variable of interest is *Group*. The results show that for the formal employees (Model 3a) and informal employees (Model 3b), there are negative and significant results, indicating that these people are less likely to engage in LMA migration behaviors. These results may be caused by the opportunity cost related to one's job. People with employment opportunities, no matter formal or informal, are facing some opportunity costs if they resettle. Therefore, instead of leaving MAs for local areas, they will either remain in their original residence or move upward in the urban hierarchy to secure their current job in the economic deterioration caused by the pandemic. This appears to entail a trade-off between economic reasons and health risks and our findings suggest that employees in MAs tend to prioritize economic reasons.

Contrastingly, the self-employed (Model 3d), homeworkers (Model 3e), and unemployed individuals (Model 3f) are more likely to engage in LMA migration. This is partially in line with the results of a previous study suggesting that in 2013, during the Greek economic crisis, younger and unemployed individuals were highly likely to engage in counter-urbanization migration (Remoundou et al., 2016). The reason may also be attributed to the lower or absence of employment opportunity costs they face when moving away.

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).

For further analysis of teleworking's moderating effect, our variable of interest is the interaction term

*Group * c_Telework* when the coefficient for *Group* is significant. I find that teleworking strengthens the negative relationship between formal employees and LMA migration, as shown in Model 4a, where the coefficient of the interaction term is negative and significant (−0.1701*). In comparison, teleworking is found to strengthen the positive relationship between the self-employed and LMA migration, as shown in Model 4d, where the coefficient of the interaction term is positive and significant (0.3283***).

(3) The impact of occupation on LMA migration and teleworking's moderating effects

Next, I test the impacts of different occupations on LMA migration and whether teleworking has a moderating effect on their relationships. Our 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, health workers, and service workers.

Additionally, none of the coefficients for the interaction terms (*Group * c_Telework*) indicate a significant result (Table 6). Teleworking does not demonstrate a significant moderating effect on the relationship between occupation and LMA migration, even for those suitable for remote work.

The results of IT professionals are particularly intriguing. Although scholars expect that knowledge-intensive or white-collar occupations, typically represented by IT professionals, would like to leave MAs (Kotsubo & Nakaya, 2022), there is no significant evidence that they are turning this possibility of moving into actual movement. The reasons for IT professionals may be largely because they only think of teleworking as a temporary measure and that face-to-face communication is non-substitutable. However, further investigation is necessary to reach a solid conclusion.

4.3 Other control variables

(1) Unemployment rate

The results in Table 3 show that the unemployment rate of individuals' residence prefecture is negatively related to their LMA migration behavior. However, in the analyses for each survey round, the results show that in Japan, the employment opportunities are not significant for LMA migration during the pandemic, only becoming negatively associated in the post-COVID-19 era (Table 4). This indicates that people are moving to regions with lower unemployment rates only after the COVID-19 health emergency has lifted. These significant results echo an earlier empirical study finding that in Finland, interregional migration is influenced by regional differences in unemployment and available work opportunities for unemployed workers (Laamanen, 2014). The insignificant results during the pandemic may be attributed to the complex situation caused by health considerations.

(2) Personal attributes

Table 3 shows that being female, younger, and having a higher household income are significantly negatively related to LMA migration, and these findings remain consistent across all four survey rounds (Table 4). These results suggest that females are less likely to leave MAs compared to males. In addition, when people are young, they need to get an education which is more centralized in MAs, while older generations are more likely to leave MAs for reasons such as a better parenting environment for children

and retirement migration. Individuals whose household incomes are higher might be requested to stay in MAs because of job requirements and be less likely to leave.

A positive association is found between one's university education background and LMA migration in most survey rounds (Tables 3 and 4). Individuals with a tertiary degree are more likely to leave MAs. Previous studies in Australia show that the increase in levels of educational attainment exerts an overall positive effect on migration intensities (Kalemba et al., 2022), and the odds of migrating increases among those with a university educational background (Perales & Bernard, 2023). This trend also manifests in the positive impact of university education on LMA migration during the pandemic era in Japan.

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

Dependent Variable:	*FormalEmployee*		*InformalEmployee*		*Manager*		*Self-employed*		*HomeWorker*		*Unemployed*	
Migration	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	−0.4479***	−0.4473***	−0.4372***	−0.4404***	−0.4394***	−0.4428***	−0.4399***	−0.4394***	−0.4395***	−0.4399***	−0.4462***	−0.4573***
Group	**−0.4624*** **	−0.4565***	**−0.3198*** **	−0.3175***	0.0095	−0.1918	**0.3458***	0.165	**0.8386*** **	0.7543*	**0.5968*** **	0.6417***
*Group * c_Telework*		**−0.1701***		0.0174		0.2509		**0.3283*** **		0.0414		0
Telework		0.1158**		0.0213		0.0169		−0.0515		0.0021		0.0811*
Entity- and time-fixed effect	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	19306	19306	19306	19306	19306	19306	19306	19306	19306	19306	19306	19306
Number of observations	37170	37170	37170	37170	37170	37170	37170	37170	37170	37170	37170	37170

Notes: 1) These results are estimated by logit models. Coefficients 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.

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	−0.4378***	−0.4419***	−0.4415***	−0.4475***	−0.4399***	−0.4428***	−0.4409***	−0.4437***	−0.4390***	−0.4417***	−0.4391***	−0.4415***
Group	−0.2083	−0.5465	**−0.6826*****	−0.6881***	−0.0818	−0.0548	**−0.2841***	−0.2928*	−0.163	−0.1068	−0.0671	−0.0657
*Group * c_Telework*		0.1593		−0.0232		0.0843		−0.1449		0.2122		0.1917*
Telework		0.026		0.0463		0.0204		0.0287		0.0176		0.0022
Entity- and time-fixed effect	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	19306	19306	19306	19306	19306	19306	19306	19306	19306	19306	19306	19306
Number of observations	37170	37170	37170	37170	37170	37170	37170	37170	37170	37170	37170	37170

Notes: 1) These results are estimated by logit models. Coefficients 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.

5. Concluding remarks

5.1 Contributions to research

This study contributes to the LMA stream of crisis-led migration research while unveiling the impact of health risks and teleworking.

First, it is among the first studies to provide empirical evidence that LMA migration is positively influenced by lower infection rates in local areas during the stringent period of COVID-19. This study directly tests the impact of infection rates and therefore adds to the numerous speculations and narratives suggesting that urban residents are moving out due to health considerations.

This study also contributes academically by revealing temporal changes in the impact of health risks. Initially, local areas with lower infection rates attracted LMA migration; however, over time, this trend reversed, with areas with higher infection rates attracting more LMA migration. The significant and negative effect of infection rates in local areas on LMA migration persisted beyond the pandemic stringency and for several months after its cessation. After a certain period, areas with high health risks no longer deterred people from MAs; instead, these regions began to attract individuals seeking prosperous and dynamic interactions. The turning point occurred between 8 and 17 months after the lifting of the last public health emergency.

It is particularly notable that health risks exert this kind of effect in the Japanese context where no compulsory lockdowns were implemented. It is interesting to find out that instead of strict, legally binding measures, appropriate information provided by the government, including the daily release of the infection numbers, encouraged people to not only change their stay-at-home behaviors (Watanabe & Yabu, 2021) but also their LMA migrations. This paper provides a typical case study of migration in the context of voluntary lockdowns, offering potential insights for future research in cross-cultural comparisons.

Second, this study finds that unemployed individuals are more likely to engage in LMA migration and the employees are less likely to do so. Compared to employees, unemployed individuals generally have fewer economic resources to conduct migration. However, in reality, it appears that resource conditions do not determine whether LMA migration behaviors will take place. This further indicates that the entrapment phenomenon is not evident in LMA migration in Japan.

Third, this study contributes to the existing research on teleworking and migration by identifying the enhancing effect of teleworking in the trade-off between employment opportunities and health risks. It is also among the first studies to use individual-level data on teleworking. This is a more precise measurement of telework compared to teleworking data on the occupation level (Tønnessen; 2021; Vogiazides & Kawalerowicz., 2023) or city level (Haslag & Weagley, 2022). As a result, teleworking is found to significantly facilitate LMA migration in the later stages of the health crisis, although it does not have a significant effect over the long term. However, teleworking exerts a certain influence by increasing the likelihood of formal employees staying in MAs and the likelihood of the self-employed leaving for local areas. In other words, teleworking has an indirect influence on LMA migration by enhancing the trade-off between employment opportunities and health risks. On the one hand, economic reasons tend to compel

formal employees to stay in MAs, indicating that employees prioritize economic factors in the trade-off between economic and health risks. On the other hand, self-employed individuals who have flexibility in choosing their workplace without hindering their employment opportunities, tend to prioritize health factors.

5.2 Practical implications

There are concerns about the potential disaster gentrification issues that LMA migration may bring to local areas, including shortages in healthcare resources and conflicts over the ownership of rural places (Malatzky et al., 2020). The influx of travelers or short-term dwellers during a pandemic can indeed lead to such problems. However, migration, usually coupled with an increase in the local labor force, taxpayers, and consuming base, is advantageous for local areas. Attracting migrants from MAs can help local areas alleviate the severe social and economic challenges associated with depopulation.

This study offers useful insights to local governments to effectively attract the inflow of LMA migrants in the face of a health crisis. First, maintaining low infection rates can enhance the appeal of an area to metropolitan residents during a health crisis. There is a window of opportunity for local governments to effectively capitalize on this advantage and attract residents to move in. This window extends from the during the pandemic until one and a half years after the health crisis subsides. Second, local governments can deploy effective strategies to attract individuals with low job opportunity costs to relocate. Specifically, targeting self-employed individuals, especially those who primarily work online, and enhancing telecommuting facilities and services for them will significantly amplify the impact of migration attraction policies.

5.3 Limitations

This study is not without its limitations. First, the definition of LMA migrations discussed is not entirely consistent. The term “LMA migrations” in this study generally refers to “metropolitan areas” and “local areas” in relative geographic terms. However, the term used in Section 3.1 corresponds to migration leaving the three main MAs for other regions in Japan. Comparing the former to the latter, the latter excludes migrants from a bigger MA to a smaller MA within the three main MAs, as well as from a bigger MA to a smaller MA outside the three main MAs. Nevertheless, the analysis in Section 3.1 is sufficient to provide a brief and approximate overview of LMA migration in Japan. Furthermore, findings from the rest of the study can still help in enhancing the knowledge about LMA migration behavior.

Second, the insignificant result regarding the impact of individual-level teleworking on LMA migration needs to be further tested in more studies. This insignificant result might only be applicable in countries like Japan, where society holds a relatively conservative attitude toward telework and the teleworking rate is relatively low (Peng & Dai, 2023). Comparative analyses with countries employing telework at varying levels or a follow-up investigation in future studies focused on Japan may be necessary.

Appendix

Table A1. Definitions and descriptions of the variables

	Variable	Definition and description	Nature
	Migration	Whether the respondent has migrated from metropolitan areas (MAs) to local areas within the last six months. 1 = yes; 0 = otherwise.	Dummy
	COVID	The logarithm of the number of COVID-19 infection cases in every 10,000 population[5] in the prefecture where an individual resided at the survey time. The number of COVID-19 infection cases is the number of newly confirmed cases during the 180 days preceding the survey start date.	Continuous
	Telework	An individual's current telework situation at the survey time: 4 = Work remotely and telework almost 100% of the time; 3 = Primarily work remotely (50%+) and regularly commute to the company; 2 = Primarily commute to work (50%+) and regularly telework; 1 = Primarily commute to work and occasionally telework; 0 = Others.	Ordinal
Occupation	*ITprofessional*	The occupation of an individual: IT profession. 1 = yes; 0 = otherwise.	Dummy
Occupation	*OfficeWorker*	The occupation of an individual: Administrative and office positions, including accounting, human resources, and general affairs. 1 = yes; 0 = otherwise.	Dummy
Occupation	*HealthWorker*	The occupation of an individual: Healthcare, welfare, and caregiving occupations. 1 = yes; 0 = otherwise.	Dummy
Occupation	*ManuAndConstru*	The occupation of an individual: Manufacturing engineering (including repair and inspection) or construction and mechanical technical profession. 1 = yes; 0 = otherwise.	Dummy
Occupation	*ServiceAtStore*	The occupation of an individual: Store-based roles, including sales and customer service. 1 = yes; 0 = otherwise.	Dummy
Occupation	*ServiceNotAtStore*	The occupation of an individual: Non-store-based service roles. 1 = yes; 0 = otherwise.	Dummy
Employment Status	*FormalEmployee*	The employment status of the respondent: Formal employee. 1 = yes; 0 = otherwise.	Dummy
Employment Status	*InformalEmployee*	The employment status of the respondent: Informal employee. 1 = yes; 0 = otherwise.	Dummy
Employment Status	*Manager*	The employment status of the respondent: Manager. 1 = yes; 0 = otherwise.	Dummy
Employment Status	*Self-employed*	The employment status of the respondent: Self-employed. 1 = yes; 0 = otherwise.	Dummy
Employment Status	*HomeWorker*	The employment status of the respondent: Houseworker. 1 = yes; 0 = otherwise.	Dummy
Employment Status	*Unemployed*	The employment status of the respondent: Unemployed. 1 = yes; 0 = otherwise.	Dummy
	UnemploymentRate	Unemployment rate in the prefecture of the respondent's residence	Continuous
	Female	Whether the respondent is female: 1 = yes; 0 = otherwise.	Dummy
	HouseholdIncome	The annual income level of the household (in Japanese yen): 1 = less than 2 million; 2 = 2 to 4 million; 3 = 4 to 6 million; 4 = 6 to 8 million; 5 = 8 to 10 million; 6 = above 10 million.	Ordinal
	University	Whether the respondent has a university education or higher (including currently enrolled): 1 = yes; 0 = otherwise.	Dummy
	AgeLevel	The respondent's age level: 1 = ages 15 to 19; 2 = ages 20 to 24; 3 = ages 25 to 29; 4 = ages 30 to 34; 5 = ages 35 to 39; 6 = ages 40 to 44; 7 = ages 45 to 49; 8 = ages 50 to 54; 9 = ages 55 to 59; 10 = ages 60 to 64; 11 = ages 65 to 69; 12 = ages 70 to 74; 13 = ages 75 to 79; 14 = ages ≥ 80.	Ordinal
	Married	The respondent's marital status: 1 = married; 0 = otherwise.	Dummy
	ChildUnder15	Whether the respondent has at least one child at or below middle school age: 1 = yes; 0 = otherwise.	Dummy
	Round	The survey round number.	Ordinal

[5] The population data for the third round of the survey is as of January 1, 2021 (MIC, 2021a); the fourth round is as of October 1, 2021 (MIC, 2021b); the 5th round is as of October 1, 2022 (MIC, 2022); the sixth round is as of January 1, 2023 (MIC, 2023).

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