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COVID-19, Telework Patterns Within a City, and Changes in Urban Structure – Preliminary Findings

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Abstract: *With the coronavirus disease (COVID-19, the spread of teleworking means that people do not necessarily have to live near their place of work. Will the role of cities change in this case? Teleworking patterns within a city matter. According to data from the Tokyo metropolitan area, people who live in a particular part of the city or work in the city centre are more likely to telework. Areas with a higher proportion of managers and professionals have higher rates of telework. Those who can telework may move from central Tokyo to other parts of the country, but the destination is mainly the outskirts of Tokyo. In the suburban areas, there was a positive correlation between the rate of increase in the number of migrants from the 23 wards of Tokyo and the teleworking rate. It is reasonable to assume that areas offering a good living environment are unevenly distributed, that the telework rate is high in these areas, and that the number of migrants is increasing in these areas. The government's story that more people will move to rural areas as a result of widespread telework may not be so simple.*

Keywords: Teleworking, Urban structure, Migration

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1. Introduction

Cities are the basis for sustainable economic growth and development, while they also create problems and strains. In the case of the new coronavirus disease (COVID-19), the spread of the disease was driven by the movement of people within large cities. This is one of the vulnerabilities of large cities. COVID-19 has made people, businesses, and governments realise that it is becoming increasingly difficult to continue living and working in the way we have been. The widespread use of remote working and various measures to avoid densification have given people room to reconsider where they live and where their companies operate.

With COVID-19, the spread of teleworking and business practices that do not require face-to-face contact will mean that people do not necessarily have to live near their place of work. Will the role of cities change in response? Will the influx of households to the largest cities decrease or increase? Could the urban structure within the capital or largest economic city change, and if so, how? How will the pandemic affect governments trying to prevent an excessive influx of people into the largest economic centres and improve people's lives?

Changes are already taking place. For example, Tokyo's population has fallen as out-migration has exceeded in-migration since the effects of COVID-19 became apparent. The Basic Policy on Economic and Fiscal Management and Reform 2021, approved by the Japanese Cabinet on 18 June 2021, declares that, in light of changes such as the growing interest in rural areas triggered by infectious diseases, the expansion of telework, and digitalisation, policies should support these changes to create a large flow of people to rural areas and regional cities, and to address the problem of excessive concentration of Tokyo's population.

What is the actual situation? Using available data from the Tokyo metropolitan area, this paper describes how telework has been undertaken and how migration patterns have changed since the pandemic, discusses implications for other countries, and makes policy recommendations.

2. What Urban Economics Has Told Us

The changes in the economic environment caused by COVID-19 may alter the long-running urban economics debate on the economies of agglomeration and the development of information and communication technology (ICT). The debate on how ICT and telework affect cities was taking place in response to the expansion of ICT even before COVID-19 and has become more active since the pandemic.

One of the main arguments for ICT reducing the need for urban agglomerations is the 'death of distance' (Cairncross, 1997). As ICT allows for the free exchange of information, and as the economy shifts towards an information-based economy, the need for urban agglomerations will diminish. It is likely that distance will become less important.

On the other hand, some economists, such as Moretti (2012), have argued that ICT developments have accelerated agglomeration in the light of experience. For example, the economy-wide shift towards an innovation society means that access to key players such as innovators and venture capitalists becomes more important. Glaeser (2011) argued that face-to-face communication is still paramount in today's internet age. Kabo et al. (2015) found that researchers working in the same academic building, and sharing common spaces such as lifts, corridors, and toilets, contributed to both the propensity to form new collaborations and the propensity to obtain grants for collaborative research. This shows the importance of incidental small talk and chit-chat in the creation of new knowledge, which cannot be completely replaced by meeting tools such as Zoom.

Moreover, the factors of agglomeration cannot be expected to be eliminated by ICT. Duranton and Puga (2013) identified the following sources of agglomeration: (i) the sharing of infrastructure, facilities, suppliers and consumers, and labour; (ii) the matching of suppliers, consumers, and labour; (iii) learning, represented by knowledge externalities and other factors; and (iv) the existence of amenities that cities possess

The development of ICT has led to the creation of new services, some of which are based on the existence of urban agglomerations. App-based food delivery services (e.g. Uber Eats, GoFood, and GrabFood), for example, use ICT to link clusters of restaurants, drivers, and users, which would not be possible if there were

no concentrations of people. As more services like Uber Eats make it possible to use real services more conveniently through apps, ICT will increase the transmission of information and the movement of goods and people at the same time. The presence of more useful apps in cities will further increase the attractiveness of cities.

As shown above, many urban economists are sceptical about the disappearance of urban agglomerations. While it seems that the importance of cities will decline when people can live and work anywhere, the need for cities will not disappear, and ICT can make cities even more attractive. As discussed in the Comprehensive Asian Development Plan (CADP) 3.0 of the Economic Research Institute for ASEAN and East Asia (ERIA, forthcoming), the unbundling of individual tasks based on the evolution of communication technologies and urban agglomeration is progressing in parallel, and there is no contradiction between the increasing exchange of ideas and technologies between individuals, overcoming distances and borders, and the continued concentration of people in cities.

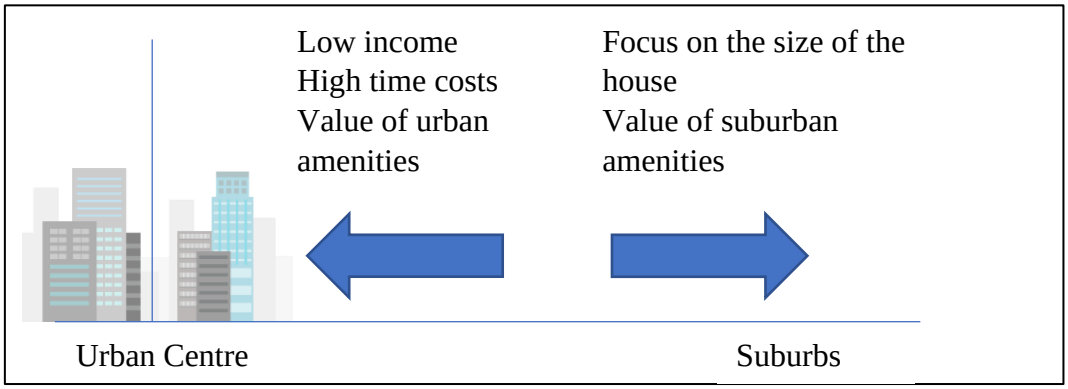
In the meantime, remote working has the potential to change the shape of cities and living patterns within the cities. Companies enjoy knowledge spillovers and seek proximity to handle day-to-day business communication. Knowledge spillovers include both explicit and tacit ones. These generate externalities. Firms will form a city and cluster in the central business district (CBD) if the external economy is strong, commuting costs are low, or both. Conversely, when commuting costs are high or spatial externalities are weak, the result is either multiple cities[1] or a mix of workers and firms with no concentration of firms (Fujita and Ogawa, 1982; Fujita and Thisse, 2002; Heikkila and Wang, 2009). Following this argument, if the spread of teleworking lowers commuting costs for workers, more firms will locate in urban centres and more workers can be accommodated in a single urban employment area, which may result in the areal expansion of large cities such as Tokyo and Jakarta.

[1] Fujita, Krugman, and Venables (1999) explained the interpretation of Fujita and Ogawa (1982) as multipolarity within one city, rather than multiple cities.

One important point that has become clear after COVID-19 is that telework is not uniformly available to people. The ease of teleworking depends on the type of job, with telework-friendly jobs clustered in large cities (Althoff et al., 2020; OECD, 2020). What might happen within a city? In a single-centre city model, where firms are assumed to be concentrated in the CBD, we consider the possible consequences of the spread of teleworking on the structure of the city by assuming different groups of workers with different characteristics (Alonso, 1964; Brueckner, 2011).

In a simple monocentric city model, workers belonging to the low-income group live closer to the city centre, while those belonging to the high-income group live farther from the city in the suburbs (Figure 1). This is because for the low-income group the impact of the increased commuting costs of living away from the city centre is larger. Workers in the low-income group accept to live in very small houses.

Figure 1: Determinants of Residential Patterns



Source: Authors.

On the other hand, the results can change if the two groups are given different attributes. The group with the highest time cost dislikes long commuting times and lives close to the city centre. The group that prefers city centre amenities such as speciality shops, restaurants, theatres, and museums also lives closer to the city centre. Conversely, groups that value suburban amenities such as large parks and large shopping malls live in the suburbs, away from the city centre. Groups that

value the size of their homes, such as those with a large number of family members, also choose to live in the suburbs.

Households may have several separate attributes and areas may not be homogeneous, with high-income housing areas and single-person housing areas located next to each other within a similar distance of the city centre. This means that not all high-income groups will live in the suburbs as in the simple model, but rather there will be a mix of high- and low-income groups in each area.

Given this mix of housing patterns, what happens if teleworking causes commuting costs to fall only for the higher income groups? Some workers in the higher income groups, who were living near the city centre because of its amenities and time costs, would choose to live in larger homes in the suburbs as commuting costs fell. Overall, the fall in commuting costs would move the boundaries of the city farther away and more people would live within the city than before.

3. Analysis

From the model of urban economics, we can obtain two hypotheses:

a) Similar to the fact that teleworking is more likely to take place in large cities, the ease of teleworking within large cities is higher for those who live in a particular part of the city and for those who work in the city centre, where most headquarters functions are concentrated.

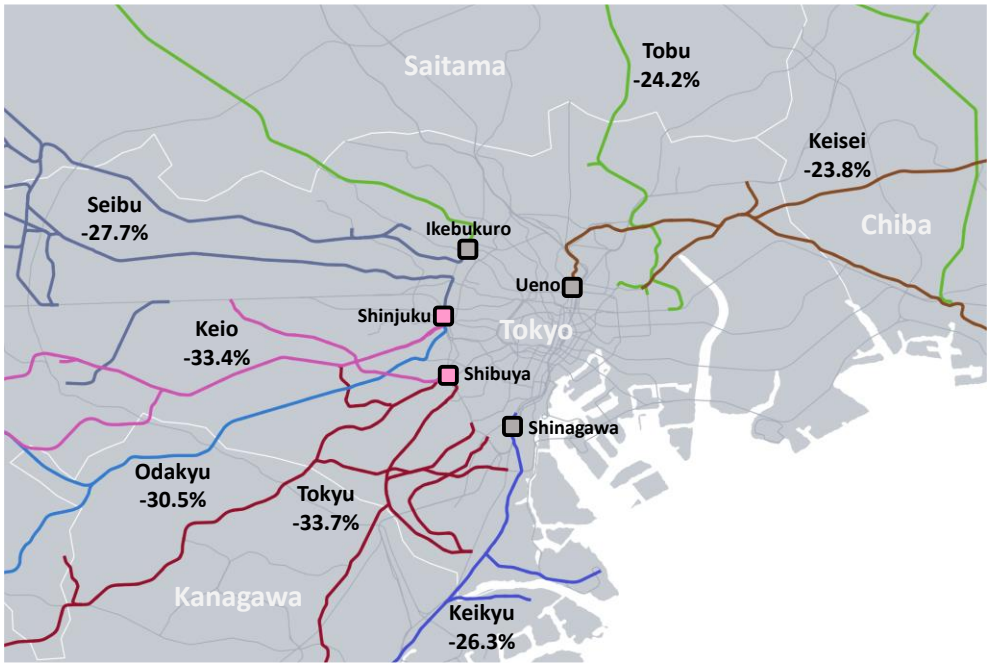
b) According to urban economic theory, the development of teleworking means lower commuting costs, and those who can telework will migrate from the city centre to other areas. Even for those who can telework, the cost of commuting is not zero and most of them have to commute from time to time. As a result, the ‘other areas’ mentioned above will mainly be the suburbs of large cities, not rural areas as stated by the Government of Japan in its basic policy statement.

Sections 3.1 and 3.2 present data to test these hypotheses.

3.1. Telework Patterns

Figure 2 shows the decline in the number of commuter pass users in 2020 in the Tokyo metropolitan area, by major private railway company. The Tokyo metropolitan area comprises the 23 wards of Tokyo and the municipalities of the surrounding prefectures that are commuting areas. Tokyo's major terminal stations – Shinjuku, Shibuya, Shinagawa, Ueno, and Ikebukuro – are shown on the city centre side. The figure shows that lines to the south and west (Tokyo, suburbs, and Kanagawa Prefecture), such as Tokyu, Odakyu, and Keio, have seen a high rate of decline since 2019, while lines to the northwest, north, and east (Saitama and Chiba prefectures), such as Tobu, Seibu, and Keisei, have seen a relatively small decline. While some no longer commuted to work in 2020 due to unemployment, this shows that the group of people who are no longer required to commute to the city centre every weekday, i.e. those who can use remote working to some extent, varies depending on the railway company used. The area to the southwest of Shinjuku and Shibuya is home to a relatively affluent population, and many of the professionals and employees of large companies who are expected to work remotely live in this area. In addition, Toyo Keizai Online (2021) pointed out that many information technology (IT) companies are located near Shinjuku and Shibuya, and that IT companies have a higher rate of remote work than other industries, so many of them may have stopped using the commuter pass. This confirms that the rate of remote working was higher on routes to areas where rents were relatively high where many remote work-friendly industries, such as the IT industry, are located in central terminal stations.

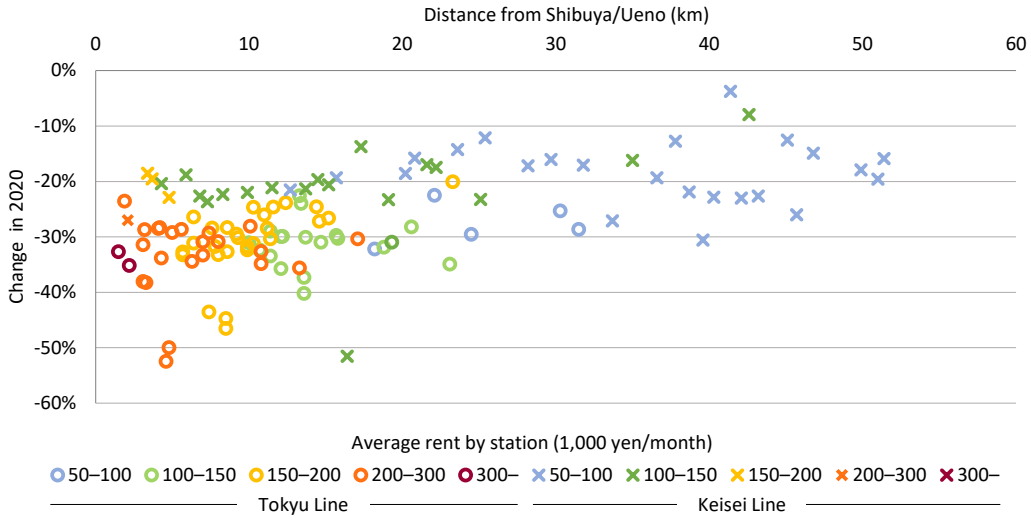
Figure 2: Decline in the Number of Commuter Pass Users on Major Private Railways in Metropolitan Tokyo (2020)



Note: Each colour corresponds to a private railway company.
Source: Authors, based on Toyo Keizai Online (2021).

Figure 3 shows the distance from the terminal station, the rate of decline in the number of commuter pass users, and the average rent at each station. The stations selected are those on the Tokyu Line, where the rate of decline in commuter pass use was high, and those on the Keisei Line, where the rate of decline in commuter pass users was low. The circles represent the Tokyu Line, and the crosses represent the Keisei Line. Each station is colour-coded according to its average rent. The Keisei Line is restricted to stations in cities belonging to the Tokyo Urban Employment Area. For all stations for which data were available, the number of commuter ticket users was lower than in 2019. The Tokyu Line generally experienced a larger decline in commuter pass users than the Keisei Line. This shows that the results in Figure 2 also apply to the stations of both lines.

Figure 3: Decrease in Commuter Passengers at Tokyu and Keisei Stations (2020)



km = kilometre.
Note: Rental housing (2-bedroom with living space or 3-bedroom without living space). Excludes data for the Setagaya Line, Kodomonokuni Line, Ueno, and Shibuya.
Sources: Websites of Tokyu and Keisei rail companies. Average rents for each station were obtained from the LIFULL HOME website (https://www.homes.co.jp/chintai/tokyo/line/price/), accessed 21 June 2021.

Overall, and for the Tokyu and Keisei lines alone, there is a trend between the distance from the terminal station and the rate of decline in the number of commuter pass users. In other words, the rate of decline in the number of commuter pass users is higher in areas that are close to the city than areas that are farther from the city. If each worker's wages, time costs, and the monetary value of commuting fatigue were the same, workers farther from the city centre would normally be more willing to work remotely. However, the trend is the opposite: the farther from the city centre, the smaller the decline in the number of commuters, i.e. the less remote the work. This shows that telework rates vary according to the average rent range and the average wage implied by that rent range.

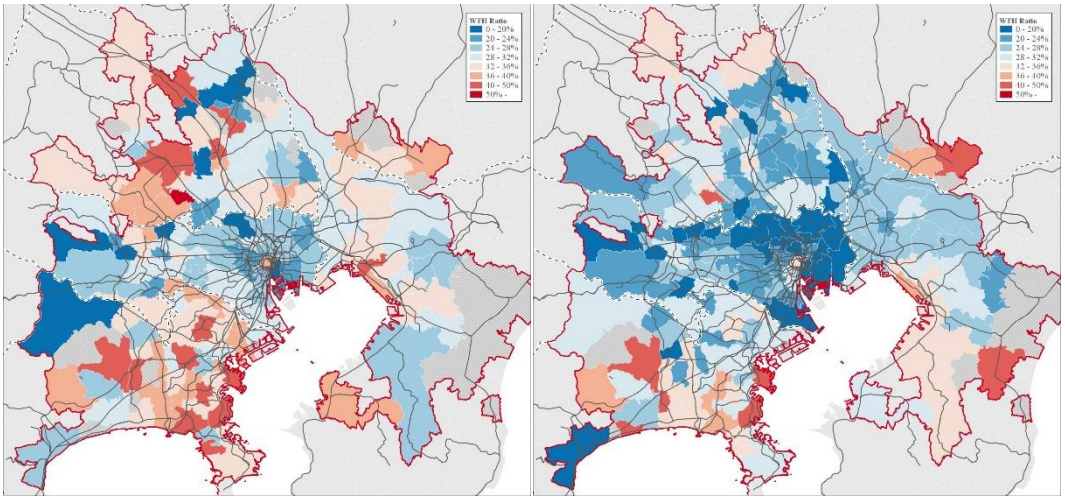
Even at similar distances from the terminal stations of Shibuya and Ueno, the rents that correspond to the Tokyu and Keisei lines are different, and the number of commuter pass users is lower on the Tokyu line. This is because different areas have different living environments and different average household incomes, even when they are the same distance from the city centre.

Furthermore, when comparing rents in the same range (e.g. ¥100,000–¥150,000) between Tokyu and Keisei, the rate of decline was smaller for commuter pass users in Keisei, despite its relative proximity to the terminal station. This suggests that the rate of remote working is different between Tokyu and Keisei even when comparing stations in the same rent range, although living costs other than rent may be different. This supports the possibility that not only wages but also the composition of jobs themselves differ between the terminal stations near Shibuya and Ueno.

In Figure 4, we estimate the telework rate by place of residence in the Tokyo metropolitan employment area based on the estimated and aggregated location of home and work based on mobile phone GPS information, and how much the proportion commuting to the five central wards of Tokyo or the 23 wards of Tokyo decreased in 2021 compared with 2019.[2] Two features of intra-city teleworking can be observed here. The first is that telework rates are higher in certain parts of the city. The high rate of teleworking in the southwest of Tokyo, where many of the relatively affluent live, is consistent with the discussion in Figures 2 and 3. The other finding is that the telework rate is higher when the denominator is people who work in the five central wards of Tokyo, compared with people who work in the 23 wards of Tokyo. This indicates a concentration of industries and occupations in central Tokyo that are more likely to be teleworked, such as head office functions. In the same way that telework rates differ between cities and municipalities, we can reconfirm the importance of the spatial distribution of teleworkers and workplaces within cities.

[2] As in Figure 2, it should be noted that this figure includes those who no longer commute due to unemployment.

Figure 4: Estimated Telework Rate



Workplace: Five central wards of Tokyo Workplace: 23 wards of Tokyo

Source: Authors, based on congestion statistics by Zenrin DataCom (https://www.zenrin-datacom.net/solution/congestion), data purchased 7 December 2021.

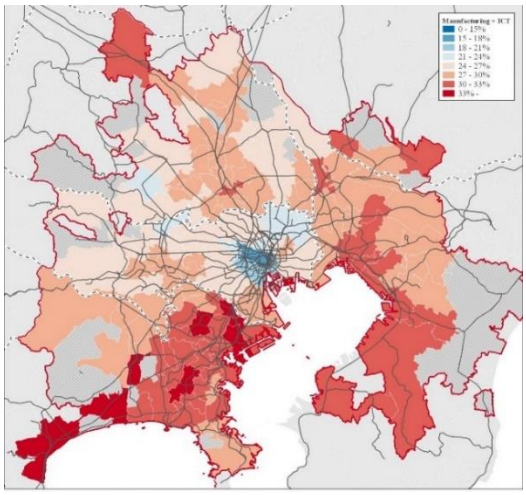
The teleworking rate is higher in municipalities with a higher proportion of workers in the manufacturing and ICT industries, as well as in professional and managerial positions (Table 1). Figure 5 shows the share of workers in the manufacturing and ICT industries in the five central wards of Tokyo by place of residence. The manufacturing and ICT industries are based on the Japan Standard Industrial Classification, and therefore include workers at the head office.

Table 1: Preliminary Estimation Result of Telework Ratio

Independent Variable	Commute to 5 wards				Commute to 23 wards			
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Professionals and managers	3.548*** [0.986]	4.249*** [0.935]			4.336*** [0.650]	5.596*** [0.586]		
ICT and manufacturing			3.952*** [0.742]	3.936*** [0.813]			4.002*** [0.730]	3.769*** [0.761]
Time to commute		0.179** [0.070]		0.008 [0.082]		0.322*** [0.057]		0.120* [0.068]
Number of observations	344	344	344	344	344	344	344	344
R-squared	0.4037	0.4151	0.4263	0.4247	0.4629	0.5141	0.4705	0.4768

ICT = information and communication technology, OLS = ordinary least squares.
Notes: The dependent variable is a logit transformed teleworking rate. We use OLS with White heteroskedasticity consistent standard errors in brackets. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. In all specifications, we include a dummy variable for the year 2021.
Source: Authors' calculations.

Figure 5: Share of Manufacturing and ICT Industry Working in the Five Wards of Tokyo



Source: 2015 Population Census. (https://www.e-stat.go.jp/en/stat-search/files?page=1&toukei=00200521&tstat=000001080615), accessed 1 February 2022.

Unlike Figures 2 and 3, the telework rate for workers living in the 23 wards of Tokyo tends to be low. This is because this analysis is limited to workers who work in the five central wards or the 23 wards of Tokyo. Many essential workers, such as cleaners and shop assistants, live close to their place of work, and essential workers who live in the 23 wards and work in the city centre reduce the telework rate. Essential workers who live and work in the suburbs are not included in the denominator of Figure 4, so unlike Figures 2 and 3, the telework rates are relatively higher in suburban areas.

When restricted to those working in the city centre, telework rates tend to be higher where commuting by train is relatively inconvenient. This implies that some workers can choose whether to telework. In an economic model where commuting costs are high, but there are other benefits to coming to work compared with teleworking, and workers can decide whether to telework, workers farther from their place of work are more likely to choose to telework. This result is therefore consistent with the model.

In summary, we find that telework rates vary widely not only between cities but also within cities: in the 23 wards of Tokyo, some workers telework but many essential workers live there and telework rates are relatively low. In certain

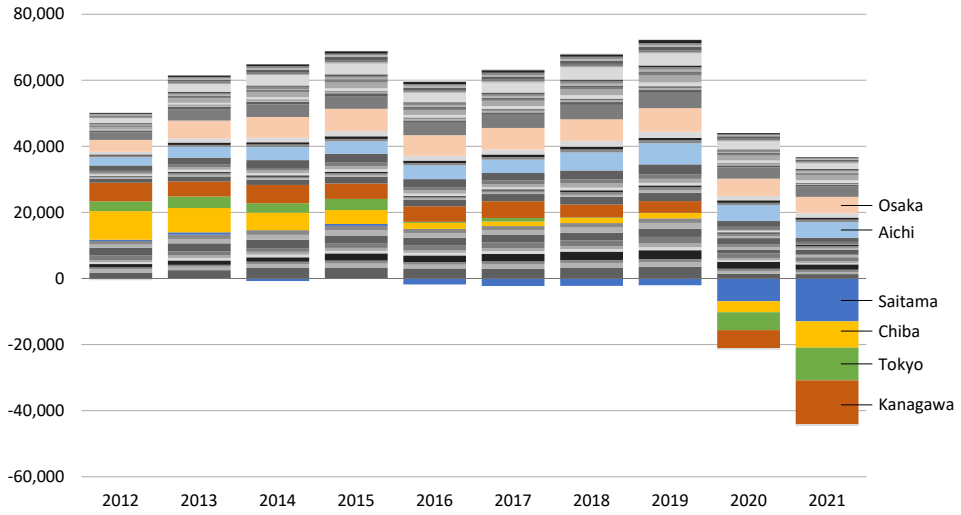
suburban areas, teleworking rates were higher. Following the implications of the economic model, it is possible that some telework-capable workers living near central Tokyo may move elsewhere in search of a larger home. Is this happening? Where are they moving?

3.2. Migration Patterns After COVID-19

Changes in migration patterns can be ascertained to some extent through the annual report on internal migration in Japan derived from the basic resident registration.[3] Figure 6 shows the number of net migrants in the 23 wards of Tokyo by prefecture. A negative figure indicates that net out-migration to the 23 wards of Tokyo has exceeded net in-migration. In 2020 and 2021, unlike earlier years, we observe migration from the 23 wards of Tokyo to prefectures around Tokyo, i.e. Tokyo outside the 23 wards, Saitama, Chiba, and Kanagawa. For prefectures outside the Tokyo metropolitan area, the number of people moving to the 23 wards of Tokyo exceeds the number moving out. While the population of Tokyo's 23 wards has started to decline since the middle of 2020, the population of the Tokyo metropolitan area, including the surrounding prefectures, has been increasing. Therefore, the main relocations from Tokyo's 23 wards will be to the suburbs of Tokyo, not to the countryside.

[3] https://www.stat.go.jp/english/data/idou/3.html, accessed 30 March 2022.

Figure 6: Net Migration in Tokyo's 23 Wards

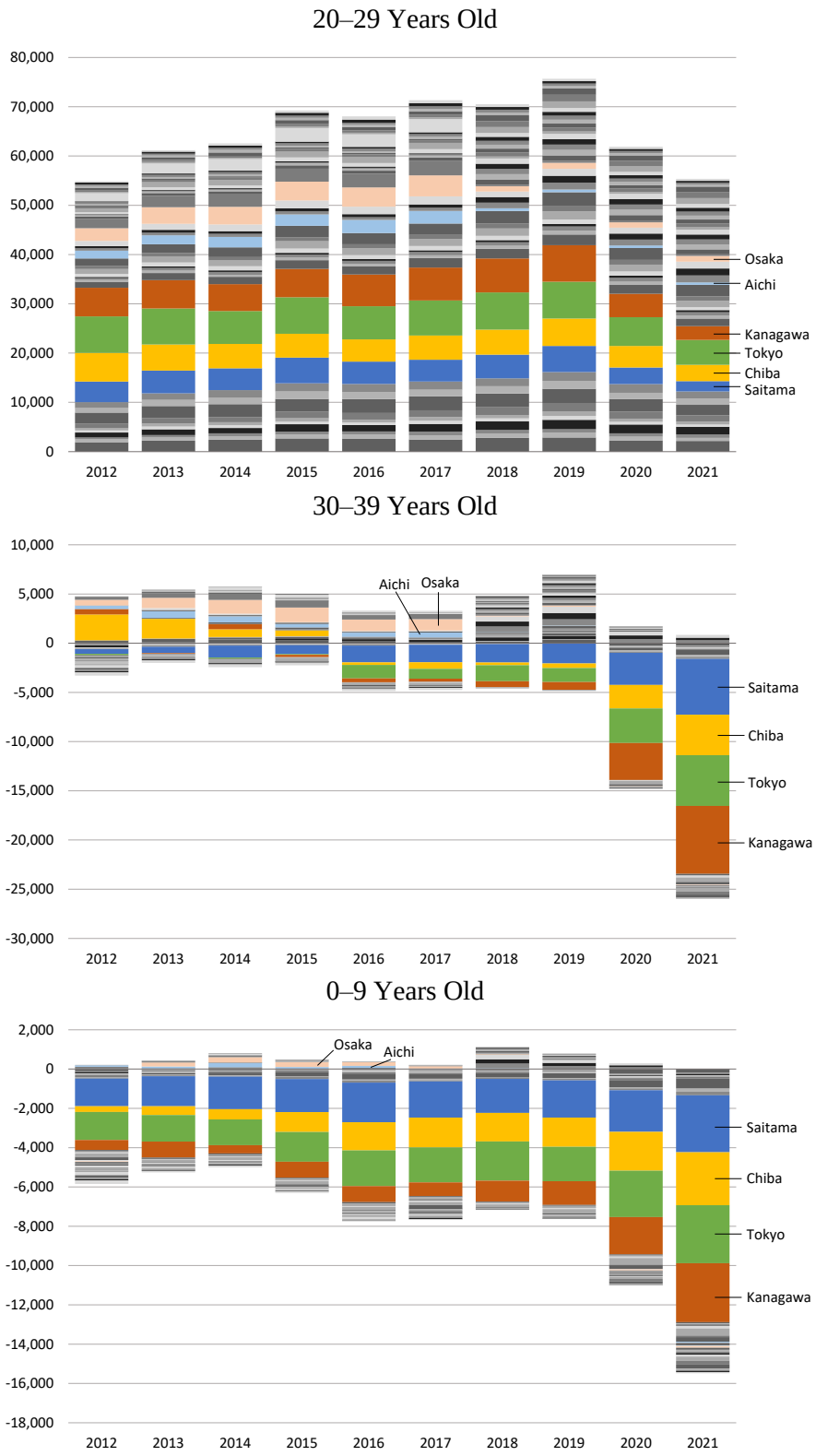


Note: Tokyo(*): Tokyo outside the 23 wards.
Source: Annual report on internal migration in Japan derived from the basic resident registration.[4]

Figure 7 shows the number of net migrants in Tokyo's 23 wards by age group: while those in their twenties continue to move into Tokyo, those in their thirties and above are increasingly moving out to other prefectures, particularly from 2020. For the 0–9 age group, the trend of moving out to prefectures around Tokyo has been observed in the past, becoming even higher in 2020 and 2021. This suggests that more of the child-rearing generation is moving from the 23 wards of Tokyo to the surrounding prefectures. Following the urban economics model, it is clear that after 2020, more child-rearing generations are choosing to live in the suburbs due to changing circumstances.

[4] Ibid.

Figure 7: Net Migration in Tokyo's 23 Wards, By Age Group



Source: Annual report on internal migration in Japan derived from the basic resident registration.[5]

[5] Ibid.

The figure for the 0–9 age group shows that there has always been an excess of out-migration to areas outside the Tokyo metropolitan area, and that this trend has accelerated since 2020. As far as the child-rearing generation is concerned, migration from the 23 wards to other prefectures outside the Tokyo metropolitan area is also increasing.

In the Tokyo metropolitan area, which areas are chosen as destinations for migration? For municipalities in the Tokyo metropolitan employment area, there is a positive correlation between the rate of increase in the number of migrants from the 23 wards of Tokyo and the estimated teleworking rate among those working in the five central wards of Tokyo. In addition, the municipalities with an increase in the number of migrants tended to have higher numbers of managerial and professional/technical workers. In this case, the high rate of teleworking and the high number of managerial professionals are not the determining factors for migration. It is reasonable to assume that there is an uneven distribution of areas that provide a comfortable living environment for teleworkers and their families, that many teleworkers live in these areas and the telework rate is high, and that the number of migrants from the 23 wards of Tokyo is increasing in these areas. If this is correct, then the government's narrative as in the basic policy statement that the spread of telework will accelerate migration to rural areas is not easily supported.

4. Policy Recommendations

We summarise the implications of this analysis and policy recommendations that could be adapted to other countries.

- In the post-COVID-19 economic environment, more teleworkers may prefer to live in large houses in the suburbs rather than in areas close to city centres. The private sector has already responded to this trend, and the government's policy should be to develop new residential areas in the suburbs targeting middle- and high-income families with children, and to improve the internet connectivity.
- Even for those who can telework, it is not always possible to telework at all hours. If they are required to commute to work on occasion, they are likely to choose suburban areas where travel to the city centre is relatively convenient.

In other words, the importance of improving the convenience of commuting to the city centre as a matter of policy is not diminished.

- Occupational groups that value the diversity of amenities in the city centre will continue to live close to the city centre. Therefore, migration to the suburbs should be considered to be limited to a few middle- and high-income groups.
- While policies to reduce the concentration of the population in large cities may continue, it is premature to assume that COVID-19 will increase migration to rural areas. The analysis of Tokyo shows a trend towards greater out-migration of the child-rearing generation to the rest of the metropolitan area, but in aggregate, households continue to move into Tokyo. Trends should be monitored closely and urban policies should be made carefully, taking into account the possibility of further geographical expansion of the metropolis.

As this analysis is based on Tokyo, the characteristics of Tokyo and Japan need to be taken into account. Japan is known to have a lower rate of telework after the spread of COVID-19 than Europe and the US. This may be due to the face-to-face nature of the Japanese business environment. If there were more jobs that allowed a 100% teleworking workforce, there could be more migration to other metropolitan areas or resort areas. Another influence is the presence of special amenities that exist only in Tokyo due to the city's unipolar concentration. Unlike in Europe and the United States, Japan does not have several large cities with different costs of living, which again limits workers' options. In Japan, the stage of rapid urbanisation has long since ended, and even for families raising children, their hometown is often already in the Tokyo metropolitan area. In this case, there is no option to return to the particular region or other city where the family home is located.

In the future, there will be a need for a more precise analysis of which areas are the best places for so-called white-collar workers to live. We need to look at the educational environment, the specific amenities of the area, and the supply of housing for white-collar workers. In Japan, differences in internet access do not

vary much by location, but in some developing countries, the availability of stable internet access could be a determining factor.

Althoff et al. (2020) argued that essential workers near city centres in the United States have been most affected by the implementation of telework. Similar points have been made in developing countries, with media reports suggesting that many returned to the countryside during the spread of the disease, but the actual situation is unclear due to lack of data[6]. In this analysis of Tokyo, it is likely that cases of temporary return to the countryside are not reflected in the basic resident registration.

As a longer-term impact, there is a concern that teleworking will reduce the frequency of visits to the city centre by higher income groups, making it more difficult for the restaurants and shops that are components of the city centre's amenities to operate, and reducing the importance of the city (Glaeser, 2022). It is necessary to proceed from the acquisition of data on these issues.

[6] According to data from Thai telecoms operators, 1.6 million people moved out of major cities and popular tourist destinations to their hometowns between December 2019 and April 2021. Yuda, M. (2021), 'Thailand's COVID crisis exposes the reality of '2% unemployment', 17 August, Nikkei Asia, https://asia.nikkei.com/Spotlight/Asia-Insight/Thailand-s-COVID-crisis-exposes-the-reality-of-2-unemployment, accessed 30 March 2022.

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