Causes of the Sharp Decline in Migration to Major Metropolitan Areas in the 1970s

(Revised on December 15, 2024)

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Causes of the Sharp Decline in Migration to Major Metropolitan Areas in the 1970s [1]

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Abstract

Japan's rapid growth in the 1960s was accompanied by a massive migration from rural to urban areas. However, immediately after 1970, migration declined sharply, and at the same time, the rate of economic growth plummeted.

To explain this decline in urban-bound migration, we estimated the urban-bound migration function.

The estimation reveals that in the 1970s, the largest factor contributing to the decline in this migration was the relative increase in per capita income in rural areas. The second most important factor was narrowing regional disparities in the job-to-application ratio. In addition, the relative increase in the stock of social capital in the local regions also contributed. However, the population change in the rural areas had negligible effects on urban-bound migration in the 1970s.

This paper also demonstrates that the relative increase in per capita income in rural areas is largely due to policy-based regional redistribution, implying that the large-scale redistribution of the fruits of rapid economic growth to rural areas halted urban-bound migration and reduced the growth rate. This suggests that for developing countries experiencing high growth, curbing the political pressure to redistribute to rural areas may be important to sustain the growth.

Keywords: Geographic Labor Mobility, regional migration, growth rate, income redistribution to rural areas

JEL classification: R110 J610

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Introduction.

Massive migration from rural areas to large cities in China and many other countries accompanied rapid economic growth. However, as migration declined, the economic growth rate dropped conspicuously in some of these countries.

Japan, which experienced rapid economic growth in the 1960s, had experienced a similar trend: the economic growth rate plummeted in the 1970s, and in parallel, migration from rural to urban areas declined sharply, with net migration reaching almost zero in 1976. Meanwhile, Japan's economic growth rate, around 10% in 1970, became negative in 1974.[5]

Two explanations have been given for the mechanism under which changes in the speed of migration had a strong impact on the country's growth rate as a whole.

The first focuses on the Keynesian effect of demand expansion. The high level of migration in the 1960s increased the number of households in Japan as a whole, expanding the demand for home appliances and other products purchased by new households, triggering a rapid growth. On the other hand, in the 1970s, this migration declined, resulting in a decrease in demand and low growth. This explanation was advocated by Yoshikawa (1997, pp124-125).

The second focuses on the increase in productivity of the country as a whole brought about by migration. The wage gap reflecting the productivity gap between rural and urban areas in the 1960s led to a massive migration. Since this shifted of labor resources from low productivity to high productivity areas, it led to a high economic growth rate of the country as a whole. In the 1970s, however, this migration declined sharply due to a narrowing of the wage gap between regions, and as a result, Japan's economic growth rate precipitated. Tabuchi (1988, p. 224), Hatta (1992), and Masuda (2002) pointed out that the narrowing of the wage gap during this period was caused by redistribution from urban to rural areas through public investment and other means throughout high economic growth.

Both of these two strands of literature attribute the sharp decline in the economic growth rate in Japan to the decrease in urban-bound migration in the early 1970s. This implies that to find how Japan could have sustained growth, we need to understand the causes of Japan's population influx to large cities in the 1970s. This paper aims to shed light on the causes of the decline in migration to large cities in Japan during the 1970s.

Possible cause for the population shift to urban areas include ① a decrease in the population of rural areas, ② a narrowing of the income gap between urban and rural areas, and ③ a narrowing of the gap in living conditions other than monetary income.

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[5] The economic growth rate recovered somewhat after 1975, but the average growth rate from 1975 to 1990, before the bubble burst, was only 4%. For example, during the period 1960-2000, the correlation coefficient between economic growth rate and net population migration was 0.82.

In the 1960s, when migration to large urban areas increased rapidly, econometric analyses of the gross interregional migration were actively conducted. Among them, the "Urban Center Model" by Oishi, Nakamura, and Okano (1964) analyzed the effect of factor ② and obtained a high coefficient of determination in a regression equation that explained the gross migration by real income differences among regions. (In this model, the income of each region is ultimately determined by government spending in the region as the main factor.) Next, Fukuchi (1966) obtained high explanatory power with a gross migration function that included the primary industry working population in rural areas as an explanatory variable. In other words, he analyzed the effect of factor ①. However, income inequality between regions, i.e., factor ③, was not included in this equation, either directly or indirectly. Fukuchi (1968) further demonstrated that interregional income inequality (②)[6] and interregional differences in per capita life infrastructure social capital stock (a type of ③) had a significant effect on migration to urban areas. However, the migration function in this model does not include the rural population. Thus, none of these representative migration functions included all of the above three factors simultaneously. Hence, we cannot compare the relative contributions of these factors.

The above studies in the 1960s of the migration function focused on gross migration. In the 1970s, however, migration from urban to rural areas, which had been consistently growing until then, began to decline, and the economic growth rate fell sharply.

As a result, the study of rural migration and economic growth saw a resurgence in the 1980s. But the study in this period was concerned with the "net" and "gross" urban-bound migration.

First, Yoshikawa (1997, p. 119) argued that the depletion of the surplus population in the rural area caused the decline in migration in the early 1970s, based on Lewis's (1954) turning point theory.[7]

Second, Tabuchi (1988) analyzed that the rapid narrowing of income inequality in the first half of the 1970s led to a sharp decline in net migration. Tabuchi empirically showed that during Japan's rapid economic growth, the wide income gap between urban and rural areas increased the net migration to large cities, and that the high growth rate ended due to the reduction in the urban-bound migration brought about by the narrowing income gap. In particular, he showed the narrowing of income inequality caused a reduction in migration, not vice versa.

Furthermore, Hatta (1992a, p. 107; 1992c, pp. 97-98) pointed out that the policy of redistribution from Tokyo to the rural areas, called policy of "balanced development of national land," suppressed migration to Tokyo and resulted in inefficient resource allocation. Masuda (2002), using data from the National Land Report, showed that the tilted allocation of public investment to the rural areas led to a decline in income inequality among regions in the early 1970s.

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[6] However, this variable has an indirect effect through the per capita consumption ratio, which is directly in the migration function.

[7] Yoshikawa (1997, p. 119) explains the decline in migration at the end of high growth as a slowdown in migration and household growth as the rural "excess population" was absorbed entirely by the urban industrial sector.

Third, the gap in non-monetary living environments between urban and rural areas has also narrowed considerably. Hatta (1992 pp.92-96, 1992a) showed that building regulations in cities inefficiently suppressed urban population size, and Yoshino and Nakano (1994) showed that the marginal productivity of social capital stock was higher in urban areas than in rural areas in the 1980s. Furthermore, Masuda (2002, p. 146; 2004) pointed out that the over-allocation of life infrastructure social capital stock to rural areas due to the "balanced national land development" policy reduced the net migration to urban areas in the early 1970s.

This paper aims to quantitatively determine the relative magnitude of various factors (including the aforementioned variables) explaining the number of urban-bound migrants to help determine the causes of Japan's economic growth rate decline in the 1970s. Our estimation method is a fully modified OLS (FMOLS) of Phillips and Hansen (1990) respecting a cointegration relation between dependent and independent variables possibly following unit-root dynamics individually.

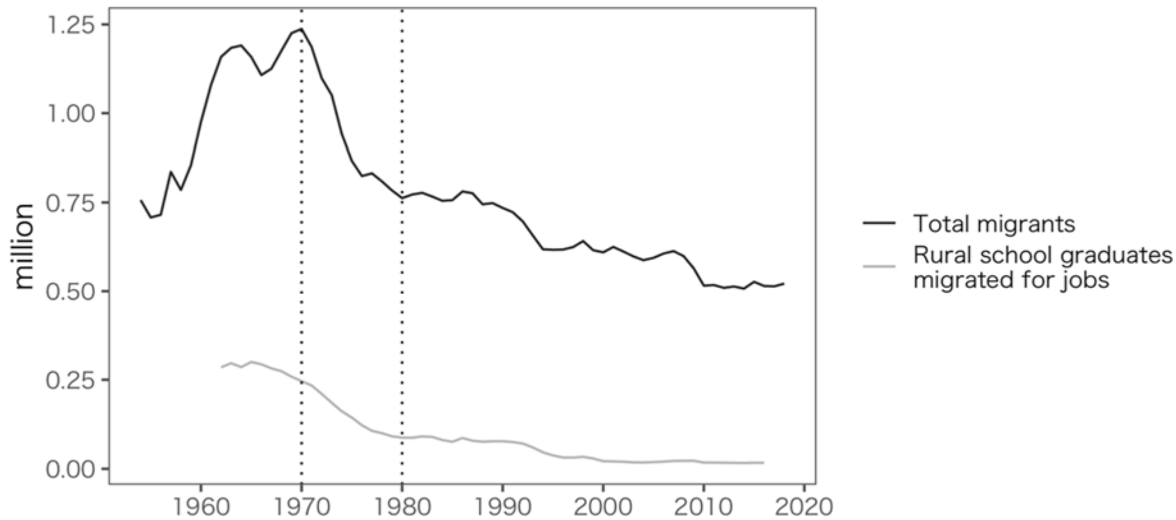
In this study, the analysis focuses on the "gross" urban-bound migration and not the "net" urban-bound migration since the rural population has a stronger influence on the gross migration from rural areas.

A simulation analysis using the estimated equation reveals the relative magnitude of each explanatory factor's contribution.

1. Population Migration Model to Large Urban Areas

Figure 1 depicts the number of people moving from rural areas to urban areas. As this figure shows, the number of migrants moving shows a significant decrease (about 475,000) between 1970 and 1980. The rate of decline is -38.4%. (For reference, the figure also shows the number of graduates of middle schools and high schools in rural areas who moved to urban areas for employment.)

Figure 1. Number of Rough Migrants from Rural Areas to Urban areas and New Graduate Job Migrants



Source: MIC, "Annual report on the internal migration in Japan from the basic resident registration" and MEXT, "Basic School Survey."

The following factors have been cited as contributing to the sharp decline in migration to large cities in the early 1970s

① Depletion of the rural area population

② Reduction of rural income disparities

③ Reduction of regional disparities in living conditions

Let us analyze how these factors affect migration from rural areas to urban areas by using a simple demand-supply model.

Figure 2. Supply-demand equilibrium point for population (gross) migration from rural areas to urban areas

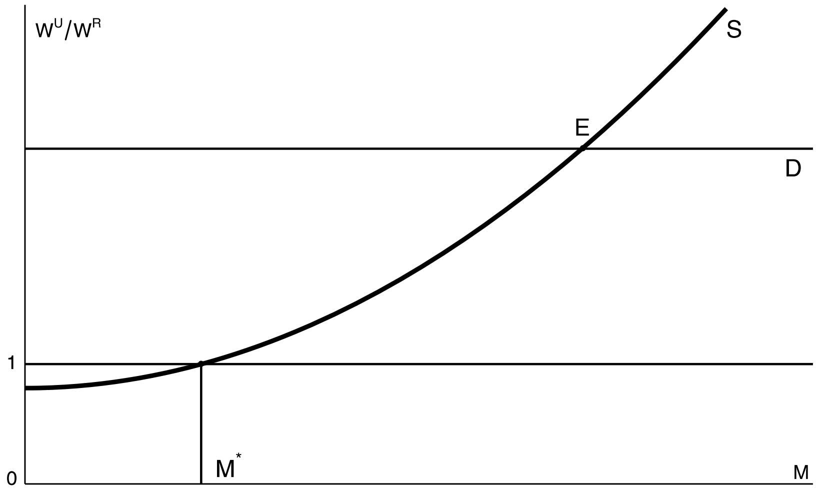


Figure 2 shows the level of migration on the horizontal axis and the wage ratio in the two areas on the vertical axis. When the wage ratio on the vertical axis is one, wages in the two areas are equal.

The upward-sloping curve in Figure 2 is the supply curve of migration from rural to urban areas. Migration level 0M* on the horizontal axis corresponding to 1 on the vertical axis occurs not for employment based on wage differentials but for such factors as marriage or higher education. However, when the wage ratio rises above 1, migration for employment and receiving higher education in preparation for future employment in urban areas increases. Thus, the supply curve of migration is upward-sloping.

On the other hand, we assume that the elasticity of demand for migration from the urban side is infinite. The horizontal line D in this figure is the demand curve. This means that "the immigration into large cities neither increases nor decreases the urban/rural gap in wage rate.

Our model determines equilibrium migration to the urban areas at the intersection *E* of the two curves.

The decline in migration throughout the 1970s means that the equilibrium moved to the left of point *E* during this period.

What kind of shift in the demand or supply curve caused this movement of the equilibrium in the 1970s? Figure 3 depicts the cases where the demand and supply curve in Figure 2 shift.

The first possibility is a case in which the supply curve shifts to the left, from the solid line S to the chain line S' in Figure 3. In this case, the equilibrium point moves from point *E* to point *A*, and migration decreases. The following factors could have caused shifts in the supply curve to the left.

①Declining population in rural areas. Arthur Lewis' tipping point theory is the case. The tipping point theory states, "In many developing countries, rapid growth occurred as surplus labor from rural areas moved out to large cities. However, as the surplus population in rural areas was depleted, migration to large cities declined, and the country's overall growth rate slowed."[8]

②Relative improvements in the non-monetary living environment in rural areas. For example, social capital such as sewage systems, parks, and living roads is improved in rural areas.

③The rising cost of job search and job change is due to the relative decline in large cities' job-to-application (JA) ratio,[9] in a situation of "ultra full employment" at the end of the 1960s, not only was it easier for workers to find work in large cities because of the relatively high JAR, but also because companies in large cities provided housing subsidies and subsidies to prepare for work, The cost of changing jobs was unusually low. After 1970, however, the cost of job search and job change increased as the JAR in large cities declined relative to that in small cities.

The second possibility is the case where the demand curve shifts downward from$D$ to the dotted line D'. In this case, the equilibrium point moves from point *E to* point *B,* and the number of immigrants decreases. The demand curve can shift downward if local industrial promotion measures or subsidies cause local wages to rise and the wage ratio observed in the market to fall. In this case, the attractiveness of the standard of living in the urban areas will relatively decrease, so the demand curve shifts downward to D' as shown in Figure 3.

Whichever of the above two possibilities occurs, equilibrium migration to large cities will decline.

However, both supply and demand curves may have shifted simultaneously. In that case, the new equilibrium can be observed, for example, at point *C*. Then, the shift from point *E* to point *C* could be caused by a decrease in the rural population or by a relative increase in the rural standard of living due to the deterioration of living conditions in large cities or income redistribution to the rural area. The relative magnitudes of the effects of these shifts in demand and supply curves can be compared quantitatively. We aim for that analysis in Section 4 and the rest of this paper.

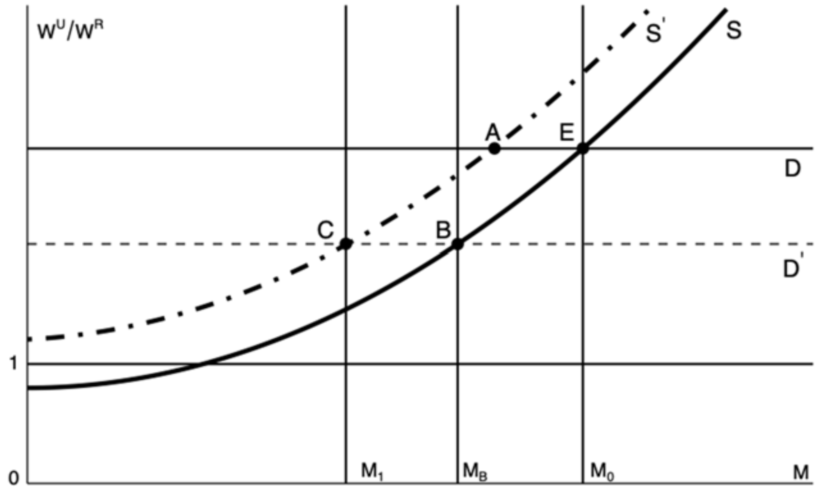
Suppose that a simultaneous shift in the supply and demand curves causes the equilibrium point to move from point E to point C, and the number of immigrants to the rural areas decreases from M_0 to M_1 in Figure 3. If only the change in relative wages had occurred, the new equilibrium would have been point B, and migration would have been at the level of M_B . Thus, we can say that M_0 to M_B shows the effect of the relative wage change, and the change from M_B to M_1 shows the effect of such factors as

[8] In Lewis 's model, the supply curve is horizontal under the survival level rural wages, but this is only in the medium to long term; since countless migration cannot occur in one year, the year-to-year short-term supply curve is rightward as shown. It can be assumed that this rightward curve shifted to the left as the rural population declined. However, if we assume that the annual supply curve starts from a level corresponding to the "survival level" in any year, it is consistent with the Lewis model.

[9] From Statistics Bureau of the Ministry of Internal Affairs and Communications (2020e). the unemployment rate was 1.2 for the four years from 1967 to 1970, a period during which there was not only a shortage of labor but also a sharp increase in bankruptcies because of it. it was called "super-full employment" because the degree of labor shortage was completely different from the early 60's. The number of bankruptcies was also increasing.

the decline in the rural population or the increase in the urban JAR. Section 6 of this paper will quantitatively compare the effects of those different factors based on the regression analysis in Section 4.

Figure 3. Change in Equilibrium Amount of Population Migration to Urban areas



2. Factors causing migration to large urban areas

Let us explore the relative importance of the factors responsible for the large decline in the number of gross migrants from rural areas to urban areas in the 1970s, as indicated by Figure 1, by applying the theoretical model of the previous section to actual data.

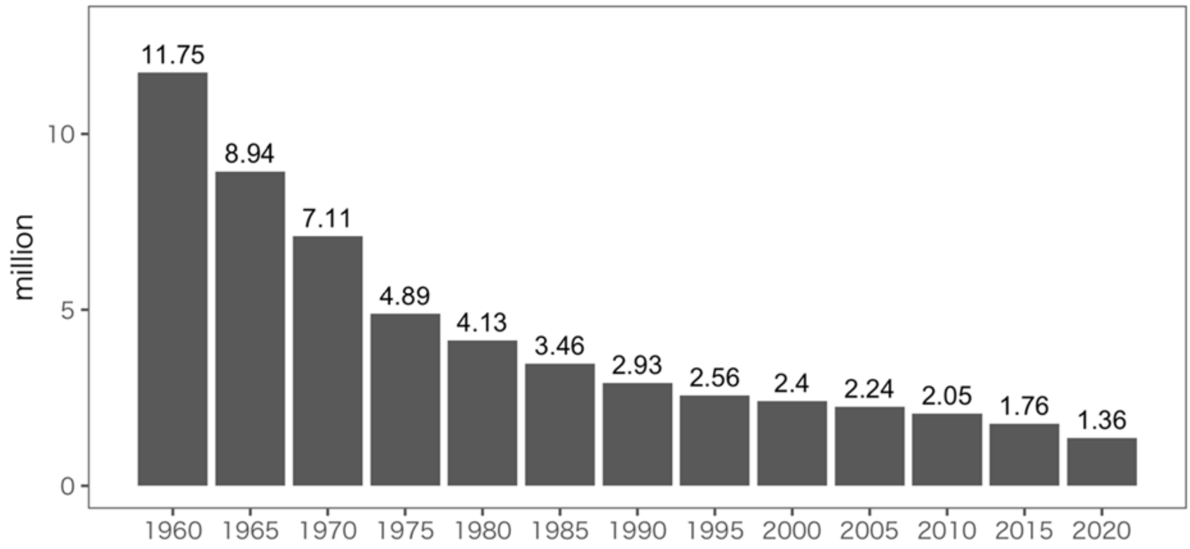
A. Population decline in rural areas

Lewis' tipping point theory maintains that when the surplus population in rural areas is depleted as a result of migration to the cities, growth of the country as a whole comes to a halt. Does this theory explain the end of growth around 1970?

Depletion of the agricultural population?

The number of farmers in Japan, which was 11.75 million in 1960, decreased by about 60% to 7.11 million in 1970. However, as Figure 4 shows, the number of farmers continued to decline after 1970, reaching 2.05 million in 2010. This is 29% of the number of agricultural workers in 1970. Therefore, it cannot be said that "the surplus labor force had already been depleted from agriculture as of 1970." The depletion of the agricultural population is not a factor explaining the sharp decline in migration in the 1970s.

Figure 4. Number of farmers[10]



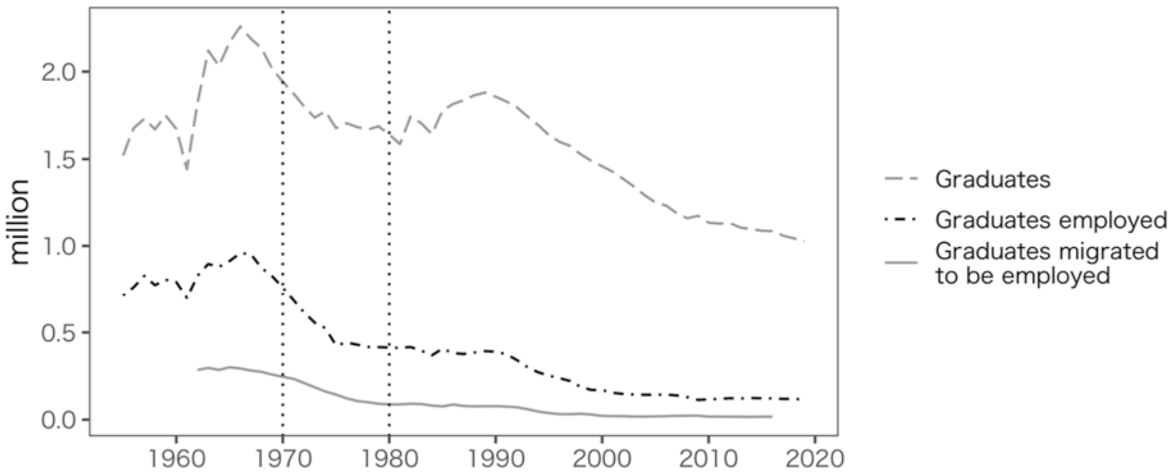
Source: MAFF, "Number of Core Agricultural Workers by Age"

[10] Agricultural workers refer to the number of household members of the agricultural working population who were engaged in self-employed farming as their usual work.

The decrease in the number of new graduates in rural areas

The number of graduates, the sum of the number of middle and high school graduates, in the rural areas decreased by 15.6% between 1970 and 1980 (from 1,941,000 to 1,638,000), as shown by the broken line in Figure 5.

Figure 5. Number of graduates in rural areas and number of new graduates moving to urban areas for employment.



* Source: MEXT, "Basic School Survey."
* Notes: The "graduates" includes those who have found employment while continuing their education, as well as those who have taken up employment in their own family business or as self-employed workers.

On the other hand, the solid line in Figure 5 shows that the number of graduates moving from rural areas to urban areas decreased by about 10,000 people, or about 64.2%, during the 1970-80 period. In other words, the "number of new graduates moving to large cities" declined at a much higher rate than the "number of new graduates" in rural areas.

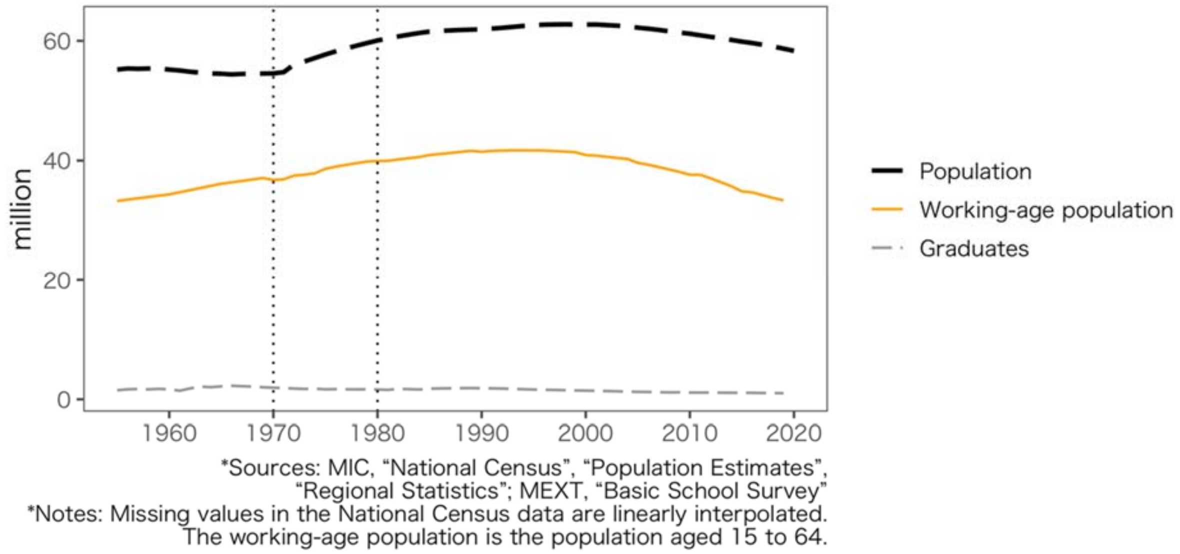
This implies that the decline in the number of new graduates moving to urban areas in the 1970s was due more to factors such as the increase in the rate of advancement to higher education and the improvement in local employment preferences than to the decline in the number of new graduates, the population number. Therefore, it cannot be said that the decline in the number of new graduates from rural areas was the main cause of the sharp drop in the number of new graduates moving to urban areas for employment between 1970 and 1980.

Change in the regional population

As we saw above, a significant share of the migrants from rural areas to large cities were non-graduate job movers: in 1970, the number of migrants to urban areas (1,237,000) was about five times greater than the number of new graduates (260,000) who moved to the cities, as Figure 1 shows. Thus, the gross movers in the 1970s included large numbers of the population in the age groups above fresh graduates.

However, the decline in migration to large cities from 1970 to 1980 cannot be explained by a decline in the population of rural areas. First, as Figure 1 shows, both the total population and the working-age population of rural areas increased during the 1970s.

Figure 6. Total Population and Working Age Population in Rural Areas



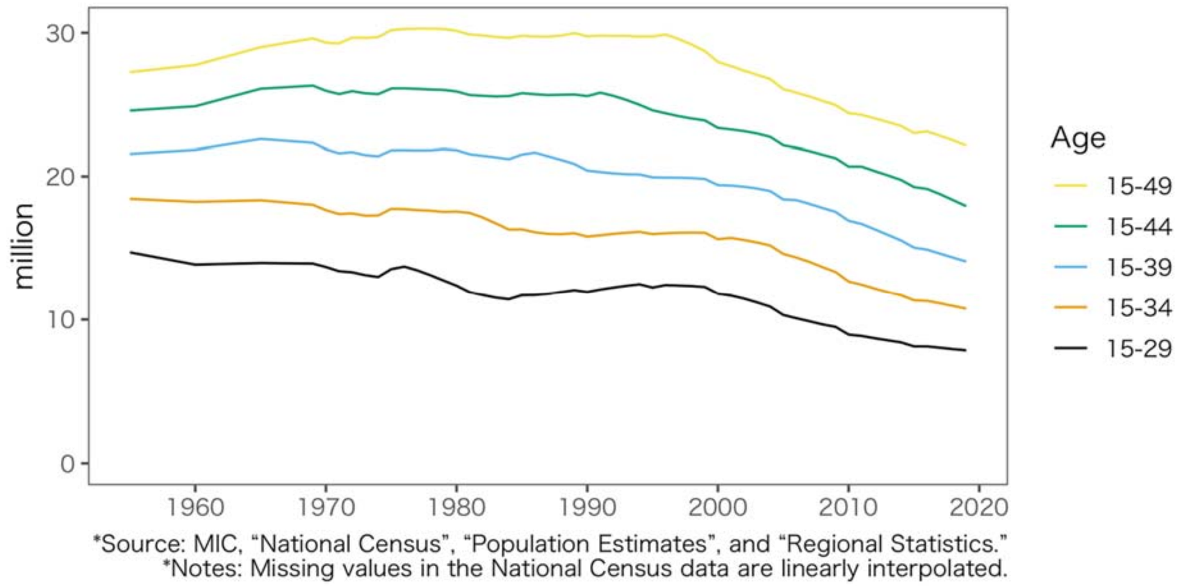
We now consider five age groups listed in Table 1 as candidates for the population base of migrants from rural areas.

Table 1. Five Age Groups Examined

Group # (*i*)	Age group
1	15 to 49
2	15 to 44
3	15 to 39
4	15 to 34
5	15 to 29

Figure 7, which depicts the transition of the population of each age group, shows that even the 15-29 age group declined by only 14%, while the 15-29 age group declined by only 3%. Thus, these observations suggest that the bulk of the 39% decline in overall migration to large cities from 1970 to 1980 cannot be explained by a decrease in population in any age group of the source of movement in the rural areas.

Figure 7. Number of people up to 30, 40, and 50 years old in rural areas



B. Narrowing of rural income disparity

Thus, it cannot be said that "population depletion in rural areas caused the decline in the number of people moving to large cities" for both new and earlier graduates, and the cause of the decline in the number of people moving to large cities must be sought in other than population depletion in rural areas.

The first of these candidates is the wage gap between urban and rural areas.

Since prefectural wage data are only available since the 1980s[11] , we use the ratio of per capita income of the two areas as a proxy variable to represent the level of wage inequality. Figure 8 shows that the income ratio peaked in the early 1960s and then declined until just before 1980, indicating that per capita income of the two areas has become more equalized.

On the other hand, Figure 2 shows that the gross urban-bound migration was increasing throughout the 1960s, against the moving direction of the income ratio shown in Figure 8. They moved in the same direction only after 1970.

Since the narrowing of interregional income inequality thus preceded the narrowing of population migration, the narrowing of wage inequality was the determinant of the narrowing of population migration. [12]

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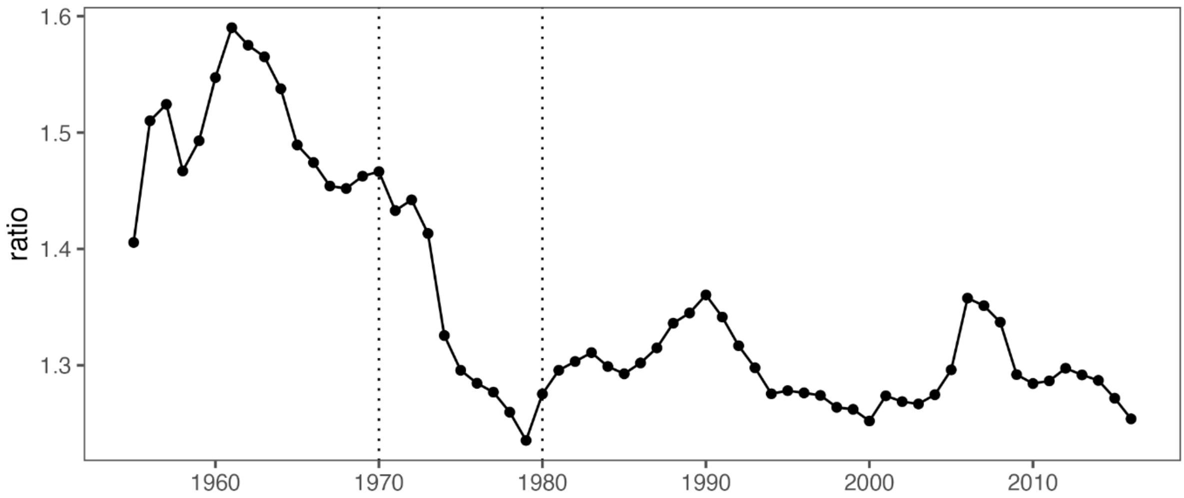
[11] Various wage data by prefecture since the 1980s are available from the Basic Survey on Wage Structure.

[12] Tabuchi (1988) demonstrated, not by comparing figures, but by demonstrating that the narrowing of the wage gap is the determinant of the reduction in net population migration.

Figure 8. Ratio of per capita income between the two regions (urban/ rural)



Source: Cabinet Office, “SNA” and MIC, “National Census” and “Population Estimates.”
Note: The ratio was calculated using the formula:
Prefectural income per capita in urban areas / Prefectural income per capita in rural areas.

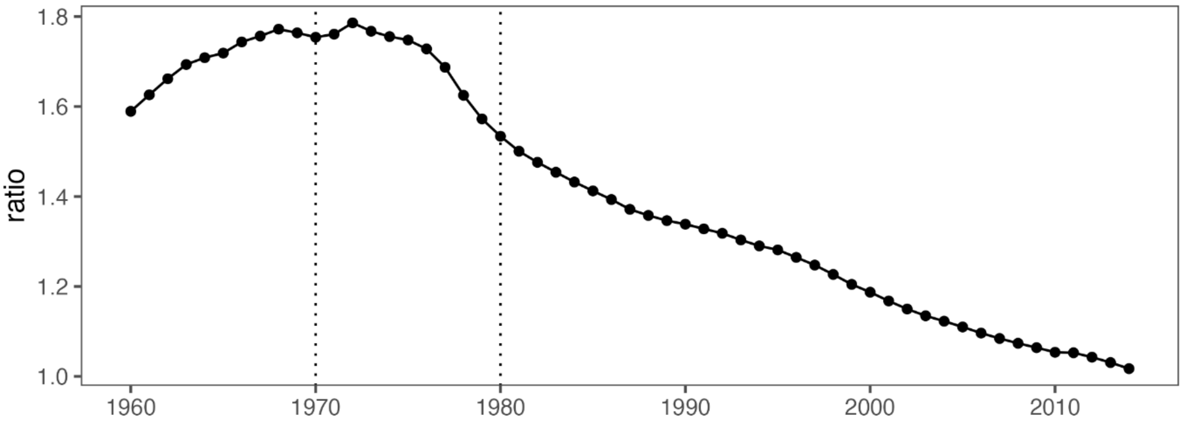
This suggests that migration is not determined solely by contemporaneous or recent income ratios, but is also influenced by relative changes in past incomes as a living conditions that reflect the accumulation of past experience over some period.

C. Reduction of social capital disparity

One of the factors that brought about the change in living environment disparities other than income is the decline in the ratio of life infrastructure social capital stock (LISCS) per capita in urban areas to that in rural areas. This is the result of a lack of investment in LISCS in large cities and ample investment in LISCS in rural areas, based on national land policy. Figure 9 reveals[13] that the relative dominance of large cities in this ratio improved during the 1960s, but has consistently declined since the early 1970s. The changes in social capital inequality during the 1960s and 1970s is consistent with the change in gross movers to urban areas shown in Figure 1.

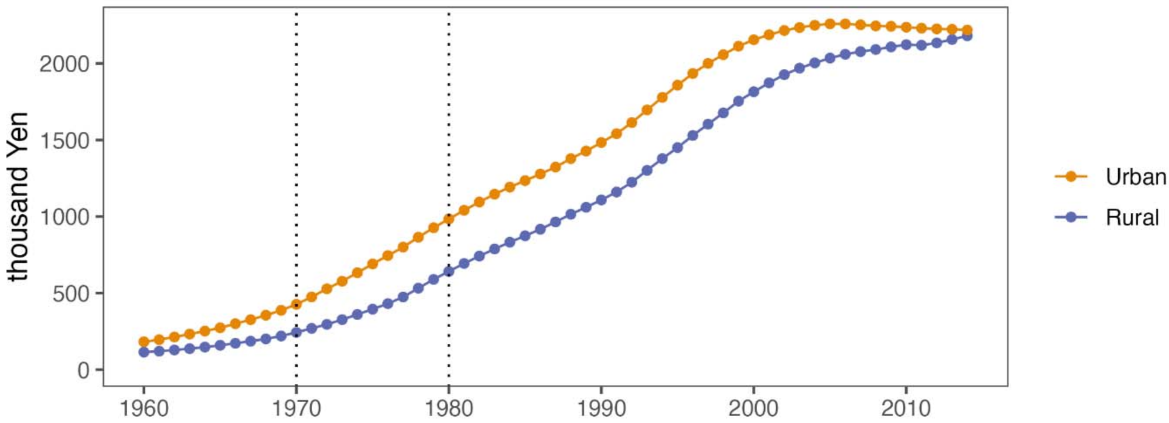
[13] Data representing the social capital stock that directly affected migration are based on the "Social Capital Stock for Living Infrastructure" prepared by Hatta, Tamura, and Hoshina (2024) from the Cabinet Office, Social Capital Stock Estimates Data/Prefecture Data/Productive Capital Stock (calendar year).

Figure 9. Per capita life-infrastructure social capital stock ratio (urban areas / rural areas)



Source: Cabinet Office, "Social Capital Stock Estimates/Prefecture-by-Prefecture Data/ Productive Capital Stock (calendar year)."
Notes: The categories of social infrastructure stock added as "life infrastructure" are educational facilities, beaches, government buildings, public rental housing, sewage systems, waste disposal, water supply, and urban parks. Okinawa Prefecture is excluded before 1975.

Figure 10. Per capita life-infrastructure social capital stock by area



Source: Cabinet Office, "Social Capital Stock Estimates/Prefecture-by-Prefecture Data/ Productive Capital Stock (calendar year)."
Notes: The categories of social infrastructure stock added as "life infrastructure" are educational facilities, beaches, government buildings, public rental housing, sewage systems, waste disposal, water supply, and urban parks. Okinawa Prefecture is excluded before 1975.

D. Jobs-to-application ratio

An increase in the jobs-to-application ratio (JAR) in the urban areas will decrease the cost of job search there, thus encouraging migration from rural areas. This will cause the supply curve in Figure 2 to shift to the right. For this reason, the ratio of JAR in urban areas to those in rural areas is employed as a variable of the migration function.[14]

[14] The annual data for the ratio of job openings to job seekers in each region were obtained from the Ministry of Health, Labour and Welfare (2021) by summing the monthly and prefectural figures for the number of job openings and job seekers, respectively, for each year, then summing these figures for urban and rural areas, and

Figure 11 shows the change in the JAR in each region. Figure 12 shows the ratio of JAR in the two regions.

Figure 11. Jobs-to-application ratio (Rural and Urban areas)

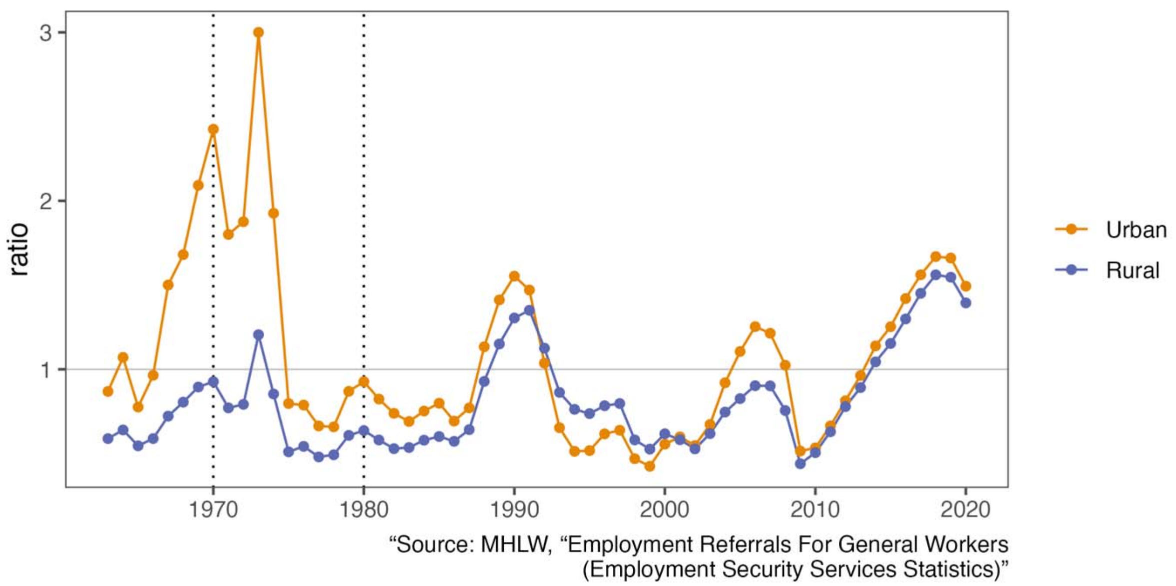


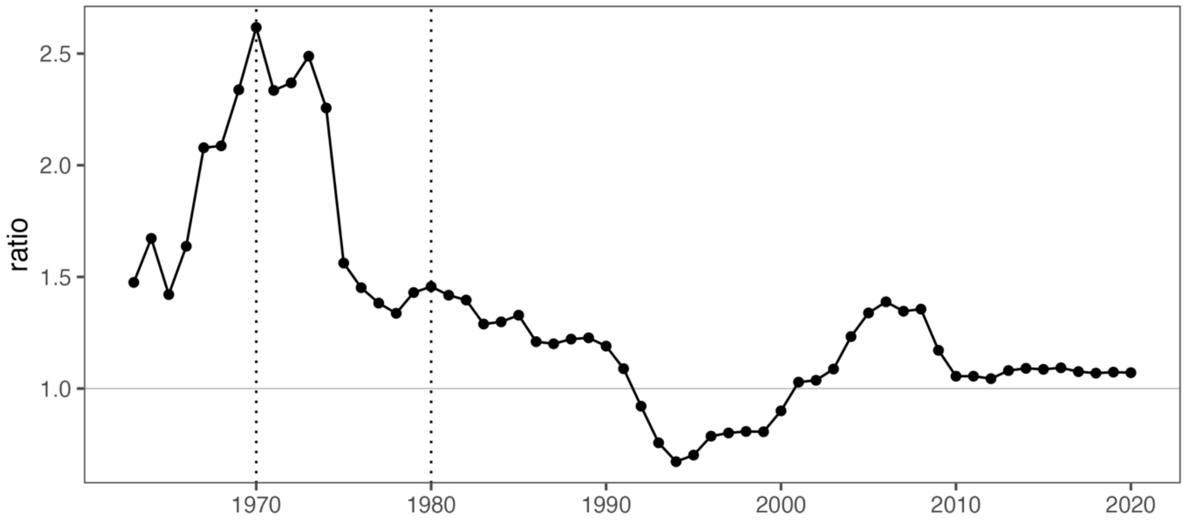
Figure 11 shows that the JAR increased in both urban and rural areas until 1970, but the growth in the JAR ratio in urban areas was more pronounced than that in rural areas during this period. On the other hand, with the end of the *Izanagi* economic boom in 1970, the JAR declined in both regions, but at a greater rate in the urban areas than in the rural areas compared to the peak. Later, when the Kakuei Tanaka Cabinet took office in 1972, the JAR temporarily increased in both urban and rural areas. However, with the oil shock at the end of 1973, both urban and rural areas experienced a sharp decline. The decline was much larger in urban areas than in rural areas.

Figure 12 showing the ratio of JAR between the two regions, reveals even more clearly the difference between urban and rural areas: while the growth of the urban job openings was relatively greater until 1970, thereafter the urban job openings relative to rural areas continued to trend downward until the mid-1990s. Conversely, the effective job growth rate in rural areas relative to urban areas continued to increase.

dividing the annual number of job openings by the annual number of job seekers. The ratio of the ratio of job openings to job seekers was then calculated for each metropolitan/rural area (see Figure 10). The ratio of job openings to total employment is shown in Figure 11.) The unemployment rate can serve the same explanatory function instead of the effective job openings ratio, but the former has data by prefecture, while the latter has only national data.

Thus, the relative increase in JAR in large cities during the 1960s, as depicted by the red line in Figure 1, is consistent with the increase in the number of people moving to large cities during this period.[15]

Figure 12. Ratio of Jobs-to-application ratio by Region (Urban / Rural Areas)



"Source: MHLW, "Employment Referrals For General Workers (Employment Security Services Statistics)"

[15] The oil shock of the fall of 1973 is often cited as the reason for the sharp decline in migration since 1970, but if the oil shock did lower migration, it can be seen as either a narrowing of the income gap between urban and rural areas or through a decline in the relative ratio of effective job offers. However, the sharp decline in migration had already begun in 1970, and the decline in the rate of economic growth in 1969. Furthermore, the price of oil in yen later fell and returned to half its 1976 level in 1986. Although the oil shock can be said to have spurred the decline in growth after 1974, it cannot be said to have been the cause of Japan's low growth over the long term. Therefore, this factor is omitted from the analysis in this paper. The fact that oil prices fell again after the oil shock is noted by Yoshikawa (1997) and Hatta (2006, p. 7).

3. Quantitative Analysis of the Factors of Migration to Urban Areas

This section aims to quantitatively analyze the factors of migration from rural to urban areas. The data used in this analysis covers the period from 1963 to 2014, corresponding to the availability of data on the ratio of job offers to applicants. The model of migration analyzed in this section is called the "Total Migration Model."

A. Total Migration Model

We analyze the factors behind the urban-bound migration by estimating the migration functions. The variables used in the functions are tabulated in Table 2, where *t* and *i* stand for the year *t* and the age group *i*, respectively.

Table 2. Variables used in the model

Symbol	Definition
M_t^i	Number of urban-bound immigrants of age group *i* in year *t*.
N_t^i	Number of the rural population of age group *i* in year *t*.
M_t	Number of total urban-bound migrants in year *t*.
N_t	Number of the rural population of the migration-suited age group in year *t*.

Using these variables, the urban-bound migration of age group *i* is formulated as follows:

$$M_t^i = (\alpha + \boldsymbol{\beta} \boldsymbol{X}_t) N_t^i$$

The amount in the parentheses, which depends on the variable vector $\boldsymbol{X}_t$, is the proportion of the number of urban-bound migrants M_t^i out of the rural population N_t^i of age group *i* in year *t*. We will suppress the dependence of $\alpha, \boldsymbol{\beta}$ on *i* for ease of simpler notations. Because of the lack of data on M_t^i, we cannot estimate the above formula directly. Instead, we will use the total number of urban-bound migrants M_t as a common dependent variable for various i:

$$M_t = (\alpha + \boldsymbol{\beta} \boldsymbol{X}_t) N_t^i,$$

and call the age group with the best fit of this estimation the **"migration-suited age group"** of the source population. Unless otherwise noted, we write the corresponding N_t^i as N_t and call it the "rural population" as the source of urban-bound migrants. Thus, we will focus on the formula

$$M_t = (\alpha + \boldsymbol{\beta} \boldsymbol{X_t}) N_t \tag{1}$$

In practice, we will estimate the following equation obtained by dividing both sides of equation (1) by N_t to avoid the issue of heteroskedasticity, i.e.,[16]

$$m_t = \alpha + \boldsymbol{\beta X_t}, \quad (2)$$

$$\text{where } m_t = M_t/N_t, \quad (3)$$

The variable explained in equation (2) represents the fraction of urban-bound migrants out of the rural population.

B. Explanatory variables for the total migration model

Let us define the explanatory variables in $\boldsymbol{X_t}$ for this model. Subsequently, the superscripts R and U stand for rural and urban, respectively.

First, the number of migrants is affected by the relative magnitude of the per capita incomes of the places of origin and destination. The lower the per capita rural income and the higher the per capita urban income, the greater the motivation for the rural residents to migrate to urban areas. Therefore, we add the ratio of income per capita between regions in the previous year as an explanatory variable, which is defined as follows:

$$y_{t-1} = y_{t-1}^U / y_{t-1}^R \quad (4)$$

in which y_{t-1}^U and y_{t-1}^R are the per capita income of the urban and rural areas, respectively.

Next, as mentioned in Section 2.C, the number of migrants is affected by the ratio of per capita social capital stocks. For this reason, we add the inter-regional ratio of the per capita social capital stock in the previous year, c_{t-1}, as an explanatory variable[17] [18], which is defined as follows.

$$c_{t-1} = c_{t-1}^U / c_{t-1}^R,$$

where c_{t-1}^U and c_{t-1}^R are the per capita social capital stock for the urban and rural areas, respectively.

Furthermore, the ease of finding a job in each region is a factor that affects migration. As explained in Section 2.D, workers have the motivation to migrate from areas with a low JAR to areas with a high JAR. Therefore, we add the ratio j_t of the JARs in the two regions as an explanatory variable[19], which is defined as follows.

$$j_t = j_t^U / j_t^R$$

where j_t^U and j_t^R are the JAR of the urban and rural areas, respectively. Hereafter, we will call j_t as the "Relative JAR," and write it as the RJAR. In practice, we use j_t^3 rather than j_t or j_t^2 for a better fit on

[16] In this paper, when taking the ratio between regions of data, all calculations are done using "urban area / rural area."

[17] The data for social capital stock was obtained from the Cabinet Office (2017) and used the "productive capital stock." The figures for all sectors were used for the estimates.

[18] The symbol c is taken from the initial letter of the word "capital."

[19] The symbol j is taken from the initial letter of the word "job-applicant ratio."

the basis of a preliminary analysis. Such a better fit is obtained perhaps because the increase in the RJAR (j_t) impacts on mobility at an accelerated pace.

Finally, we use the dummy variable D as an explanatory variable for the following reasons. The year 1973, not yet hit by the oil shock, was a year of abnormal economic overheating. As Figure 12 shows, the JAR increased steeply in urban areas but not in rural ones. This might motivate some rural residents to emigrate. However, only a limited number of rural residents could migrate on such a short notice. Furthermore, the land price in the Tokyo urban area was 140-150% in 1972. Thus, a sudden increase in the urban land price made people hesitate to migrate due to a lack of housing for migrants. In order to take these into account, we have included a dummy variable for 1973.

Formula (2) can be expressed in terms of these variables as follows:

$$m_t = \alpha + \beta_1 y_{t-1} + \beta_2 c_{t-1} + \beta_3 j_t^3 + \beta_4 D + \varepsilon \qquad (5)$$

From here on, we will call (5) the "**total migration model**."

Table 3 tabulates the definitions of the variables used in this model.

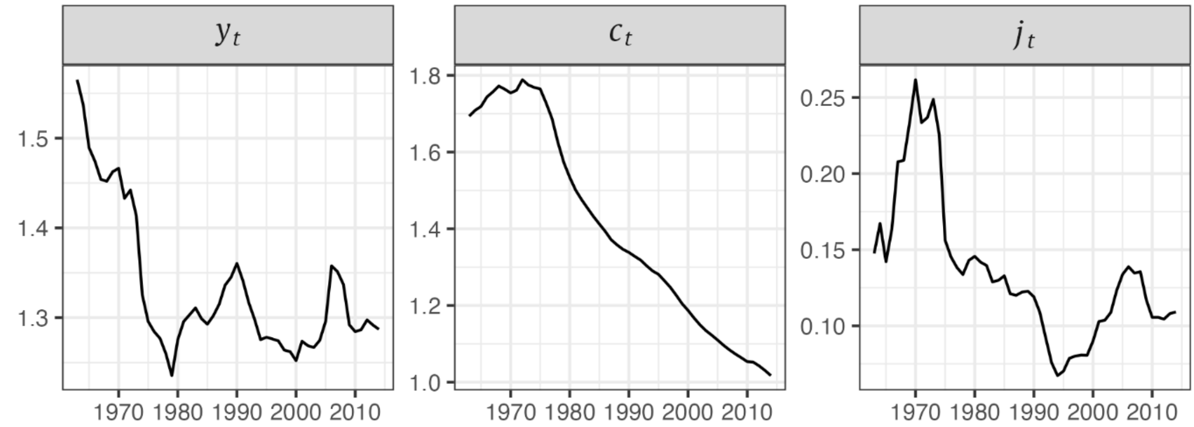
Table 3. Meaning of the variables in the total population migration model

Symbol	Definition
m_t	Number of people moving from rural areas to urban areas in year *t* / Number of rural people of age group *i* in year *t*.
y_{t-1}	The ratio of per capita income between urban and rural areas in year t-1.
c_{t-1}	The ratio of social capital stock per capita between urban and rural areas in year t-1.
j_t	RJAR in year t.[20]
D	Dummy variable for the year 1973

Figure 13 shows how the explanatory variables in the model have changed since the 1960s.

[20] In the regression analysis, this ratio is divided by 10 to make it consistent with the other variables.

Figure 13. Changes in the data used as explanatory variables in the total population migration model[21]



C. Identification of the "migration-suited age group"

As we pointed out earlier, the migration-suited age group is chosen as the age group that gives the best fit for the estimation of equation (1) or its estimable counterpart (5) using the dependent variable $m_t^i = M_t/N_t^i$, which corresponds to the equation (3).

Among the results of regression analysis of (5) for all five *i*'s in Table 1, the best fit was obtained for $i = 3$, i.e., the age group 15 to 39 corresponding to the main population source for urban-bound migration.[22] Thus, we select this age group as the "**migration-suited age group**" subsequently, and let N_t represent $N_t^{i=3}$ as the migration-suited rural population.

D. Estimation of the total migration model

The estimation results of (5) for the dependent variable $m_t = M_t/N_t$, $N_t = N_t^{i=3}$, is given in Table 4.[23]

[21] Any variable in this graph,t data plotted for the year.

[22] If there existed data on the number of migrants by each age group, we would directly find out the main age group of the rural population who migrated to the urban areas. Since no such data exists, we have to indirectly identify the "migration-suited age group."

[23] Note that N_t^i is defined in Table 3 and $i = 3$ is defined in Table 1.

Table 4. Estimated results of the total population migration model for m_t.

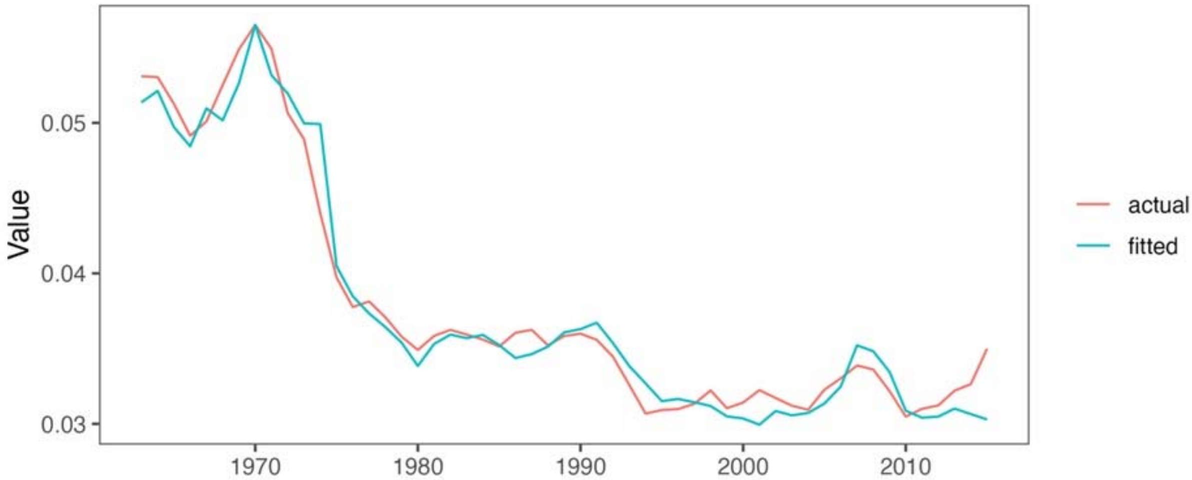
	Total Migration Model	
	OLS	FMOLS
(Intercept)	-0.044	-0.043
	(-10.597)	(-8.400)
y_{t-1}	0.051	0.049
	(15.1129)	(12.227)
c_{t-1}	0.008	0.001
	(7.1179)	(8.287)
j_t^3	0.621	0.001
	(7.815)	(8.251)
D	-0.005	-0.004
	(-2.869)	(-2.666)
Num.Obs.	53	50
R2	0.966	0.966
R2 Adj.	0.963	0.963

The numbers in parentheses below each coefficient are all t statistics.
For FMOLS, the standard errors are based on the long-run covariance matrix estimated nonparametrically using the quadratic spectral kernel and Andrews's automatic bandwidth selection rule.

One concern about time-series OLS regression analysis of this kind is a spurious regression phenomenon, a statistical artifact of seemingly a good fit when a unit-root process is regressed on another set of unit-root processes. In fact, Ng-Perron's (2001) unit root tests suggest the presence of a unit root for all of m_t, y_{t-1}, c_{t-1}, and j_t^3. To deal with this possibility, we interpret (5) as a cointegration relation and estimate it by the fully modified OLS (FMOLS) method of Phillips and Hansen (1990)[24]. The results are summarized in the last column of Table 4. The estimated coefficients are qualitatively similar to those of the OLS method, except for j_t^3. We obtain similar results by other estimation methods respecting a cointegration relation, such as canonical cointegration regression (CCR) or dynamic OLS (DOLS) of a range of leads and lags. The actual and fitted values for M_t based on FMOLS results are shown in Figure 14.

[24] See Appendix for a detailed description of the estimation process.

Figure 14. Actual and fitted values for $\boldsymbol{m_t^i}$ in the total migration model (i = *15–39*).



From the estimated value of m_t, we can estimate the value of M_t using definition (3). Table 5 compares the actual and fitted values of M_t for 1970 and 1980, corresponding to the two graphs in Figure 14. This table shows the high explanatory power of regression equation (2) during the period 1970-1980. For example, column [A] gives the actual and fitted values of M_{1970}, which implies that the fitted value is almost 100% of the actual value, as is shown in row [3], column [4]. Column [B] shows that the actual and fitted values of M_{1980} are also very close and that the fitted value explains 103.1% of the actual value. Row [1], column [c] in Table 5 gives the difference in actual values of 1970 and 1980, while row [2], column [c] cell gives the corresponding difference for the theoretical values. Row [3], column [c] cell of the table shows that the difference in the fitted values between 1970 and 1980 is 95.4% of the difference in the actual values between the same period.

Table 5. Comparison of actual and theoretical values of M_t^R for 1970 and 1980.

	Actual and Estimated Results	[A] 1970	[B] 1980	[C] Difference (1980 - 1970)
[1]	Actual value	1237383	762334	−475049
[2]	Predicted value	1237342	739189	−498153
[3]	$\frac{[1]}{[2]} \times 100$	100.0%	103.1%	95.4%

E. New Graduate Migration Model

We have data on new graduates in rural areas and data on the number of urban-bound migration for employment urban-bound of new graduates for employment. In this section, we use these data to test the hypothesis that "the decrease in the number of the rural new graduates is the main cause of the decrease in the migration of new graduates for employment."

We will analyze the factors that affect the number of urban-bound new graduates moving from rural areas for employment by estimating a migration function. To this end, we define a few new variables, as in the following table.

Table 6. New variables used in the model

Variable	Meaning
Mg_t	Number of new graduates who moved from rural areas to urban areas in year t[25]
Ng_t	Total number of new graduates in rural areas in year t.
mg_t	Mg_t/Ng_t the number of urban-bound migrants of new graduates divided by the number of new graduates in rural areas.

Based on these variables, we estimate the following equation for the new graduates, which corresponds to (5)[26].

$$mg_t = \alpha + \beta_1 y_{(t-1)} + \beta_2 c_{(t-1)} + \beta_3 j_t^3 + \beta_4 D + \varepsilon \quad (6)$$

The estimation results are given in Table 7 and Figure 15. As previously, the OLS and FMOLS methods produce qualitatively similar coefficients and fitted figures, so we show only the figure based on the FMOLS method.

[25] g is the initial letter of graduates.

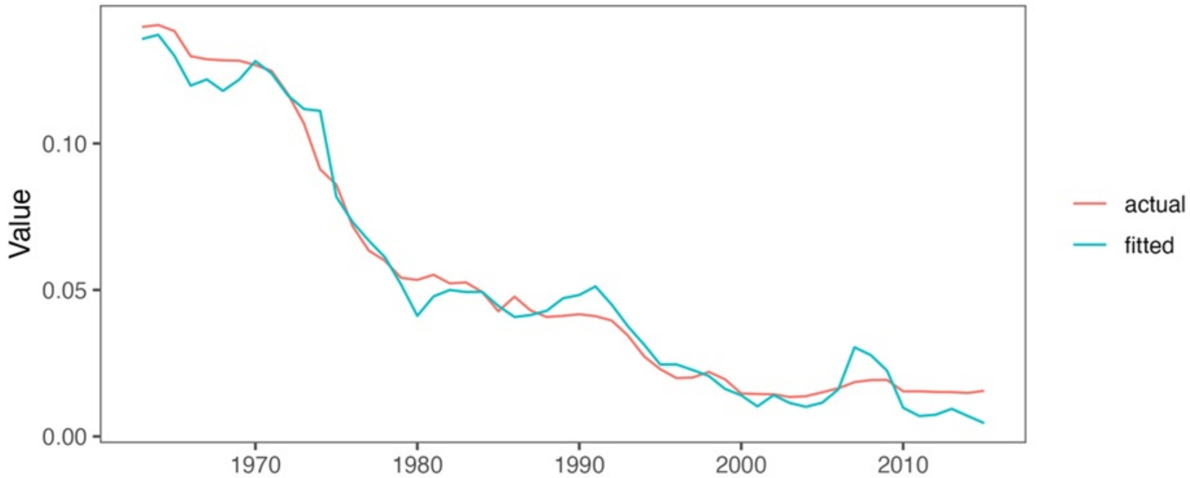
[26] We estimate m_{gt} rather than M_{gt} to avoid the issue of heteroscedasticity.

Table 7. Estimated results of the new graduate model using mg_t^R as the dependent variable.

	New Graduate Model	
	OLS	FMOLS
(Intercept)	-0.419	-0.413
	(-24.159)	(-15.591)
y_{t-1}	0.259	0.255
	(18.374)	(12.174)
c_{t-1}	0.088	0.087
	(18.287)	(15.637)
j_t^3	0.697	0.001
	(2.099)	(1.985)
D	-0.017	-0.011
	(-2.320)	(-1.394)
Num.Obs.	53	50
R2	0.979	0.976
R2 Adj.	0.978	0.973

The numbers in parentheses below each coefficient are all t statistics.
For FMOLS, the standard errors are based on the long-run covariance matrix estimated nonparametrically using the quadratic spectral kernel and Andrews's automatic bandwidth selection rule.

Figure 15. The estimated (fitted) and actual values of the new graduate model mg_t^R.

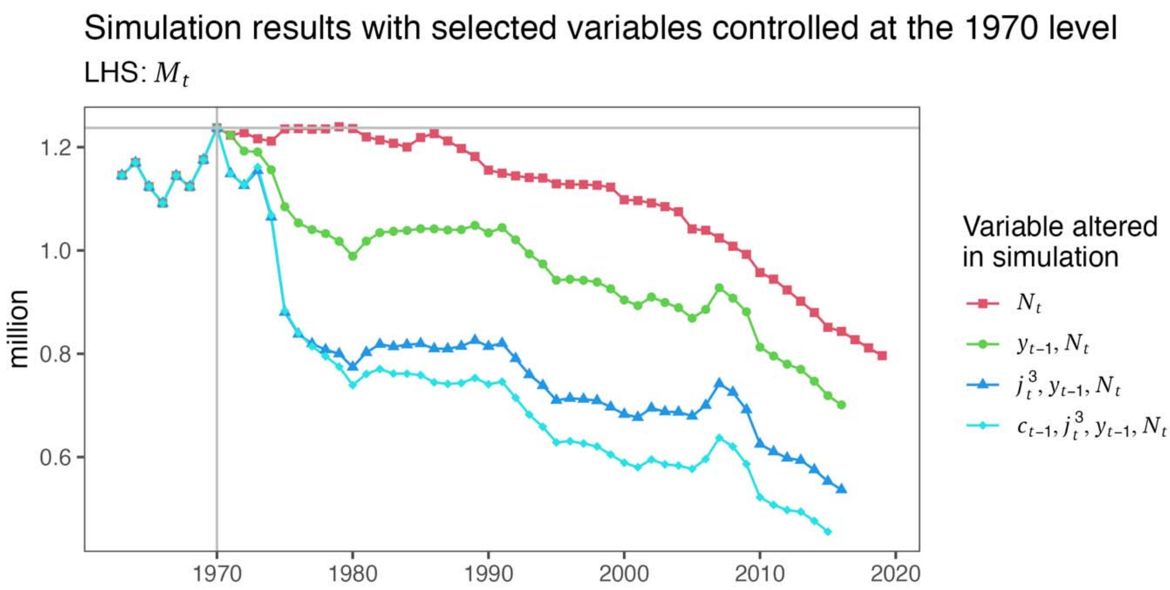


4. Simulation by model

A. General Population Migration Model

Next, we analyze the contributions of the changes in population, income ratio, RJAR, and social capital stock ratio to the charge in M_t between 1970 and any later year. To do this, we will conduct simulation for formula (5) by substituting selected variable(s) with actual values for each year, while keeping other variables fixed at their 1970 levels. The results are shown in Figure 16.

Figure 16 . Change M_t^R in under the General Population Model from 1970 onward, when each variable is gradually modified



The lowest ◆ line in the figure indicates the theoretical values of M_t when all the explanatory variable are changed in formula (5), and therefore is identical to the fitted blue line in Figure 1.

The thin horizontal line at the M_{1970} level could be interpreted as the theoretical values of M_t in each year t derived from formula (5) when all the explanatory variables and N_t (the population of 15 to 39-year-olds in rural areas) are fixed at their 1970 levels, where N_t is the denominator of the RHS of definition (3) of the dependent variable m_t. The vertical distance between the thin horizontal line and the ◆ line at the bottom of Figure 16 in each year represents the "**total variation**" for that year relative to 1970.

The three lines between the thin horizontal line and the ◆ line at the bottom each show the theoretical values of M_t, when only the variable indicated to the right of the table are adjusted, while all other variables are controlled at the 1970 level.

For example, the top ■ line in Figure 16 indicates the transition of M_t when only N_t takes the actual value, with other variables maintained at the 1970 level, and, the ● line shows the transition of M_t when both N_t and the income ratio y_{t-1} take actual values, with other variables held constant at the 1970 level. Lastly, altering all variables results in the ◆ line.

Therefore, the vertical distance between each of these lines and the line directly above at a year represents the "**contribution**" of the respective variable to the change in M_t from 1970 till that year. This contribution for 1980 is shown in column [b] of Table 8[27].

Table 8. Contribution of Each Variable to the Decline in Population Migration (1970, 1980)

	Additional variable	Contribution to the change of M_t	Contribution rate	Variables altered in simulation	1980
ID	[a]	[b]	[c]	[d]	[e]
[1]	N_t	1351 ①	0.27 %	N_t	1235991 ⑤
[2]	y_{t-1}	247081 ②	49.6 %	$y_{t-1} + N_t$	988910 ⑥
[3]	j_t^3	214796 ③	43.12 %	$j_t^3 + y_{t-1} + N_t$	774115 ⑦
[4]	c_{t-1}	34925 ④	7.01 %	$c_{t-1} + j_t^3 + y_{t-1} + N_t$	739190 ⑧

The percentage share of each variable's contribution to the total variation is termed the "**contribution rate**". The contribution rates 1980 for all explanatory variables in 1980 are tabulated in column [c] of Table 8. This represents the extent to which each variable contributed to the total variation in M_t (1037342) from 1970 to 1980.

[27] Note that the level of "contribution" is "path-dependent." In other words, it depends on how other variables change over the same period. The basic method of evaluation is to fix all variables other than the target variable at the 1970 level and apply the actual value only to the target variable, as shown in cell ① of Table 8 for N_t. We call the contribution under the definition as the "**basic contribution.**" However, the sum of the "basic contributions" for all variables does not equal the total variation.

On the other hand, the sum of each variable's contribution equals the total variation. if we determine "contributions" by adding each variable at a time, as shown in column [b] of Table 8. However, this approach introduces a new issue, as the size of each variable's "contribution" depends on the order in which the variables are added.

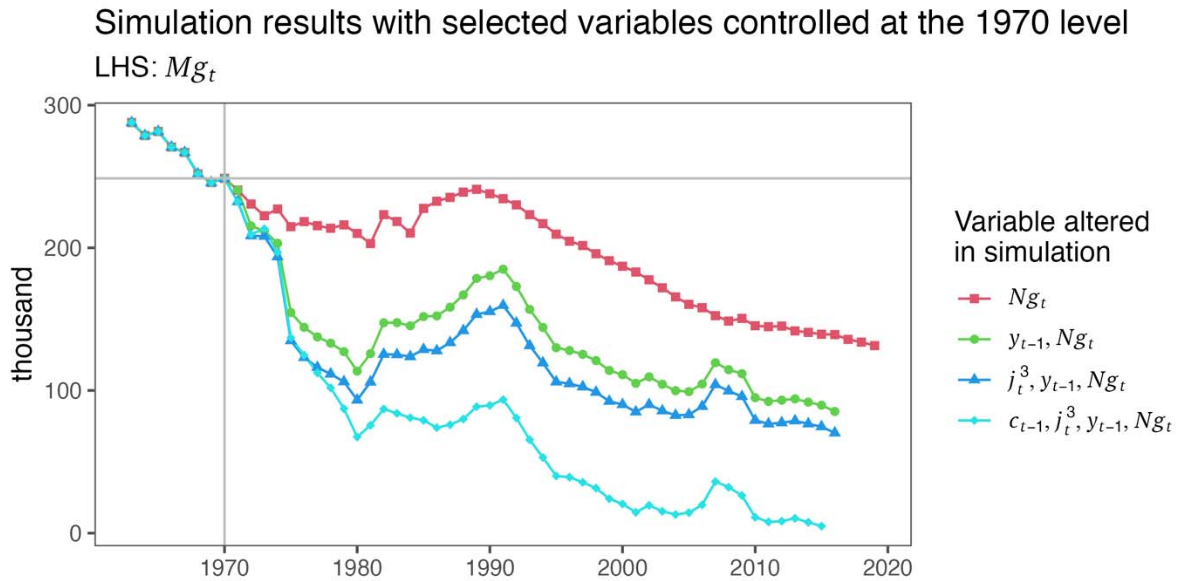
In Table 8, N_t is varied first. Since it is a part of the variables on the left side of equation (3). Subsequently, the remaining variables are varied in the order of descending "basic contribution" size as of 1980. The order of variable variation used in Table 8 will also be followed in Table 9 for new graduates.

As shown in column [c], the contribution rate of rural population change is only 0.27%. Because the rural population changes in the 1970s were minimal, substituting the actual values of population change on the right side of formula (5) and formula (3) had little impact on the theoretical value of M_t in 1980. The factor with the highest contribution rate, at 49.6%, is the income ratio y_{t-1}, followed closely by the RJAR at 43.12%. Lastly, the contribution of the social capital ratio change is 7.01%, which is quite small if not negligible.

B. New Graduate Migration Model

Next, let us analyze the contributions of population, income ratio, RJAR, and social capital stock ratio to the trend the changes in Mg_t, the number of new graduate migrants. To do this, we conduct a simulation for formula (5), assigning the actual value of selected variable(s) for each year while keeping other variables fixed at their 1970 levels. The results are shown in Figure 17.

Figure 17 . Mg_t change in under the New Graduate Model from 1970 onward, when each variable is gradually modified



The vertical distance between each line in the figure and the line directly above again represents the "contribution" to the change in Mg_t of the change of the variable corresponding to the line for the period from 1970 to the chosen time.

Columns [b] and [c] of Table , respectively, tabulate the contribution and the contribution rate for each variable in 1980.

Table 9. Contribution of Each Variable to the Decline in New Graduate Migration (1970, 1980)

	Additional variable	Contribution to the change of Mg_t	Contribution rate	Variables altered in simulation	1980
ID	[a]	[b]	[c]	[d]	[e]
[1]	Ng_t	38620 ①	21.31 %	Ng_t	210073 ⑤
[2]	y_{t-1}	96508 ②	53.24 %	$y_{t-1} + Ng_t$	113565 ⑥
[3]	j_t^3	20271 ③	11.19 %	$j_t^3 + y_{t-1} + Ng_t$	93294 ⑦
[4]	c_{t-1}	25852 ④	14.26 %	$c_{t-1} + j_t^3 + y_{t-1} + Ng_t$	67442 ⑧

According to Table , the factor with the highest contribution rate, 53.24%, is the reduction in income disparity (y_{t-1}) between urban and rural regions. The contribution rate of the number of rural new graduates gave the next highest contribution rate in 1980 at 21.3%. In the new graduate migration model, the variable for RJAR (j_t^3) only contributed 11.19% compared to the total population migration model. This reveals that compared to older age groups, new graduates are less influenced by short-term factors like the RJAR. This is consistent with the fact that the contribution rate of income ratio, a long-term factor, is higher for new graduates than for the general population.

5. Factors contributing to the narrowing of income inequality

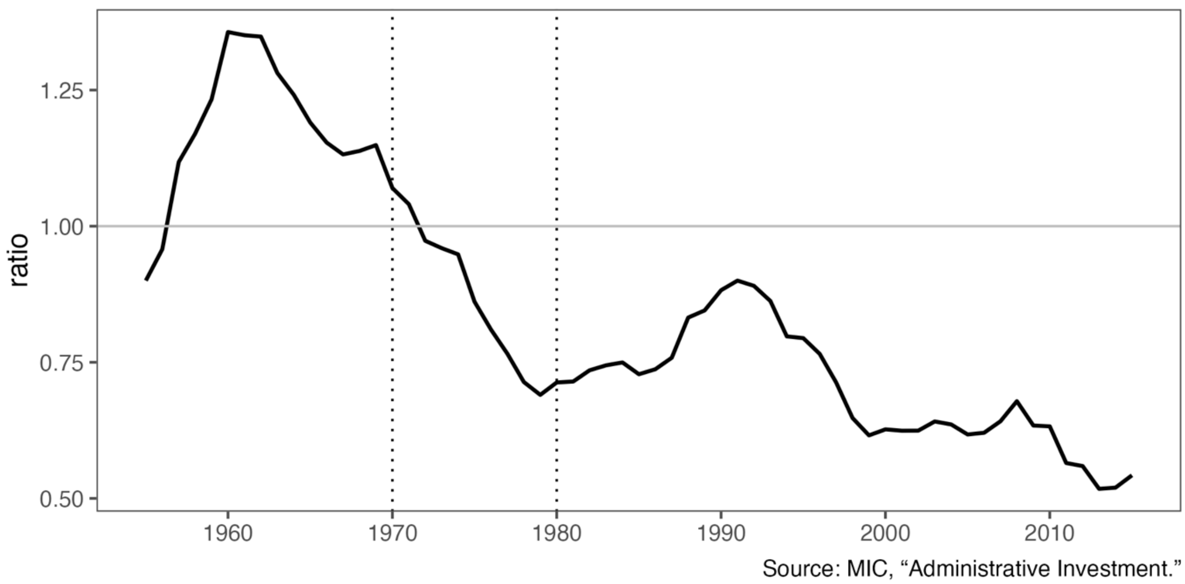
As the above analysis reveals, a major factor in the sharp decline in migration from rural areas to urban areas in the early 1970s was the narrowing of income inequality (see Figure 16).

One of the reasons for the narrowing of income inequality from the early 1960s to the 1970s, as shown in Figure 8, is the existence of various local preferential policies (later called "balanced national land development policies") that have been implemented since the period of rapid economic growth. Tabuchi (1988, p. 224), Hatta (1992), and Masuda (2002) point out that the redistribution of income to rural areas through public investment and other measures implemented throughout the period of rapid economic growth was responsible for the narrowing of the wage gap that occurred during this period.

Kyogoku (1986) points out that such scattering policies began during the Ikeda cabinet, and Masuda (2009) points out that such scattering to the regions grew dramatically with Kakuei Tanaka's success as a representative of the Diet.

As Masuda (2004) pointed out, this narrowing of income inequality moves very closely with the rapid increase in the allocation of administrative investment, a flow variable, to rural areas. This has created public works jobs in rural areas and directly expanded labor demand for farmers.

Figure 168. Ratio of government investment per capita, urban vs. rural areas



To see this policy variable's effect on income inequality changes, we adopt the ratio of government investment per capita, urban areas versus rural areas (to be called Public Investment Ratio, and denoted I_t) as the explanatory variable. Figure 18 depicts the level of this ratio for each year on the horizontal axis.

Public investment in rural areas raises the wage rate in rural areas, lowering the relative wage rate in urban areas, and hence the income ratio ($y_t = y_t^U / y_t^R$). Hence, we estimate the income ratio equation with I_t as the explanatory variable. Table 10 shows the estimated result of this equation.

Table 10. Estimated results of the income ratio equation on public investment ratios[28]

	y_t
intercept	1.034
	(54.293)
I_t	0.375
	(16.901)
Num.Obs.	56
R^2	0.841
R^2 Adj.	0.838
F	285.631

* Note: I_t represents the investment ratio (urban/rural area) in year t.
The numbers in parentheses below the coefficients indicate t-statistics.

The coefficient of determination in Table 10 indicates that the change in I_t explains 84.1% of the change in y_t. On the other hand, Table 8 shows that the change in y_t accounts for 49.6% of the change in M_t during the 70s. This implies that the change in I_t explains 41.7% (=49.6% { 84.1%) of the change in M_t during the 70s. Consequently, the relative increase in public investment in rural areas accounts for over 40% of urban-bound migration during the 70s.

[28] The administrative investment (investment ratio) variable in this regression analysis is the same year as the county income ratio.

6. Summary

Japan experienced rapid growth in the 1960s, accompanied by a massive population shift from rural to urban areas. Around 1970, however, urban-bound migration declined rapidly, and the growth rate was lowered sharply. Not only did the decline in migration greatly reduce demand for consumer electronics and housing in urban areas, but it also reduced the relocation of resources from less productive to more productive areas, halting the growth of the nation's productivity.

This paper investigated the causes of the decline in Japan's (gross) migration to urban areas in the 1970s.

First, we found that rural population reduction had not caused this decline since 1970, when the rural population of the relevant age group stayed consistent between 1970 and 1980. Note that the number of new graduates of middle and high schools dropped significantly after the mid-1960s. However, the percentage of new graduates among the urban-bound migrants in 1970 was only 20%. Also, the number of urban-bound migrants dropped by 60% during the 70s, while the number of new graduates migrating dropped by only 16% during this period.

In addition, the decline in the number of new graduates moving to urban areas seen in the 1970s was probably due more to factors such as higher rates of higher education and greater preference for local employment than to the decline in the number of new graduates, which had a larger effect than the decline in the number of new graduates in the regions themselves.

Second, according to the regression analysis in this paper, the largest factor contributing to the decline in population mobility in the migration-suited age group during the 1970s was the relative increase in incomes in rural areas. The next largest factor was the narrowing of the differences in JAR. In addition, the relative increase in the stock of social capital in the regions also contributed.

On the other hand, when this regression analysis is limited to new middle and high school graduates, narrowing the gap in the JAR, a short-term factor, is not significant. For new graduates, the relative improvements in per capita income and social capital stock in rural areas are the main determinants of migration.

Third, the redistribution policy to rural areas during rapid economic growth, based on the so-called "balanced national development" policy, has relatively increased incomes in rural areas throughout the 1960s. This directly reduced the incentive of rural residents to emigrate for employment. Moreover, the increase in incomes in rural areas indirectly reduced the urban-bound migration of new graduates for employment by boosting the percentage of new graduates from rural areas going on to higher education.

The resulting decline in migration suppressed income growth in large cities by reducing the growth in demand for consumer goods such as housing and consumer electronics and reducing the effective job growth rate. This had the effect of further restraining migration.

In other words, the policy of income redistribution to rural areas can be considered to have contributed to the sharp decline in migration in the first half of the 1970s, both directly and indirectly through the increase in the rate of higher education in rural areas and the decline in the JAR in urban areas.

This conclusion suggests that in Asian countries experiencing rapid growth, it is important to contain the political pressures for redistribution to rural areas that will result.

Appendix:

The Time Series Econometrics in Estimation in Section 3

A1. The unit root testing of individual variables

Suppose we regressed one unit-root process on another set of independent unit-root processes. In that case, we might have a spurious regression phenomenon, such as the significance of coefficients and a high R squared. Therefore, checking whether individual variables in the regression model have unit roots is a crucial first step to avoid this statistical fallacy. We will use Ng and Perron's (2001) test of the null hypothesis that the variable under consideration has a unit root. We can reject this hypothesis at a particular statistical level if a test statistic MZa takes a more enormous negative value than the corresponding critical value. Here is the summary of the result for each variable.

H0: the variable has a unit root	m	y	v	j3	mg	1% cv	5% cv	10% cv
MZa: with constant	-1.748	-1.379	-0.834	-1.684	-0.587	-13.8	-8.1	-5.7
MZa: with constant and trend	-11.928	-6.417	-1.322	-3.487	-6.861	-23.8	-17.3	-14.2

Included observations are 52.

The numbers below each variable names are the values of MZa test statistics.

Critical values (cvs) are based on Ng-Perron (2001, Table 1).

Table A. Results of the Ng-Perron unit root test.

All the test statistics cannot exceed the 10% critical values. Therefore, we cannot reject the null hypothesis of the unit root for each variable.

A2. Regression with cointegration

We can often eliminate the unit-root non-stationarity of individual processes by forming their linear combination (cointegration relation). We performed Johansen's (1988) test of the number of cointegration relations, but it implied a range of numbers of such relations up to 4. Four cointegration relations for four variables are especially dubious as it means that all variables are stationary, and therefore, it contradicts the previous result of the unit root tests. Subsequently, we will assume a single cointegration relation between m and y, c, j3. We consider the dummy variable D for 1973 as an exogenous variable. The equation of our interest is the following "total migration model" introduced in Section 3B:

$$m_t = \alpha + \beta_1 y_{t-1} + \beta_2 c_{t-1} + \beta_3 j_t^3 + \beta_4 D_t + \varepsilon_t$$

Suppose the error term for m correlates with those for [y, c, j3]. In that case, the estimated coefficient vector is subject to non-standard nuisance components in the covariance matrix of its asymptotic error distribution. However, we can eliminate such components using dynamic techniques. The Fully Modified OLS (FMOLS) of Phillips and Hansen (1990) uses an estimator of the long-run covariance matrix of these error terms to modify the data and to correct a bias so that the asymptotic error distribution has the covariance matrix of a block diagonal structure. Canonical Correlation Regression (CCR) of Park (1992) uses stationary transformations of the data to avoid the long-run dependence between these errors. Dynamic OLS (DOLS) of Stock and Watson (1993) estimates the above model with additional leads and lags of the first-order differences of [y, c, j3] so that their error terms have no long-run correlation with that form. All of these methods permit asymptotically valid and standard inference procedures and are nowadays implemented in Eviews.

The following table summarizes the results of estimating the total migration model using these asymptotically valid methods. We adopted symmetric numbers of leads and lags for DOLS from 1 to 5. We call these results "cointegrating regression results" to contrast with a static OLS method, as recorded in Table 4 of Section 3.D.

Variables (LHS: m)	FMOLS		CCR		DOLS (1,1)		DOLS(2,2)		DOLS(3,3)		DOLS(4,4)		DOLS(5,5)
Ly	**0.0490**	a	**0.0493**	a	**0.0441**	a	**0.0317**	b	0.0151		-0.0349		-0.0288
	12.2270		14.9047		4.6938		2.7368		1.0439		-1.5824		-0.2074
Lc	**0.0088**	a	**0.0089**	a	**0.0084**	a	**0.0090**	a	**0.0119**	a	**0.0184**	a	0.0187
	8.2869		8.1193		6.2203		5.5699		5.5784		6.6001		2.3110
J3	**0.0007**	a	**0.0006**	a	**0.0008**	a	**0.0009**	a	**0.0011**	a	**0.0012**	a	0.0012
	8.2506		7.8487		15.3240		7.4140		6.3190		5.2095		1.2200
constant	**-0.0426**	a	**-0.0431**	a	**-0.0360**	a	-0.0205		-0.0015		**0.0583**	c	0.0503
	-8.4002		-10.3058		-3.1945		-1.4384		-0.0868		2.1452		0.2860
D1973	**-0.0041**	b	**-0.0041**	b	**-0.0034**	a	**-0.0032**	c	0.0016		-0.0020		0.0151
	-2.6661		-2.2076		-6.1505		-1.7751		0.3612		-0.2600		1.1846
Included observations	50		50		48		46		44		42		40
Andrews Bandwidth	2.0635		2.0635		3.8951		2.4917		3.5984		1.5630		2.0651
R-squared	0.9662		0.9665		0.9914		0.9935		0.9958		0.9984		0.9998
Adjusted R-squared	0.9632		0.9635		0.9881		0.9888		0.9899		0.9936		0.9952
S.E. of regression	0.0015		0.0014		0.0008		0.0008		0.0007		0.0005		0.0004

Long-run covariance estimation adopts a Quadratic-Spectral kernel with Andrews automatic bandwidth selection.
The numbers in each row with a variable name are estimated coefficients, and those in the next row are their t-values.
The estimated coefficients followed by "a", "b" and "c" are significant at 1, 5 and 10% significance levels, respectively.
DOLS(p,q) means the inclusion of p leads and q lags, but all DOLS results assume p = q.

Table B: The cointegrating regression results for the total migration model.

The cointegrating regression results are similar to their simple OLS counterparts in Table 4 of Section 3.D, except that the magnitudes and significance of estimated coefficients on j3 and the year 1973 dummy are smaller. For DOLS, including too many leads and lags makes many coefficient estimates insignificant, perhaps due to the loss of too many sample observations. Because of the similarity among

FMOLS, CCR, and DOLS (with a decent number of leads and lags), we will report only FMOLS results in Table 4 as a leading case.

Another model of our interest is the "new graduate migration model" as follows:

$$mg_t = \alpha + \beta_1 y_{t-1} + \beta_2 c_{t-1} + \beta_3 j_t^3 + \beta_4 D_t + \varepsilon_t$$

i.e., the same model as the total migration model for another dependent variable mg. The following table collects the cointegrating regression results for this model.

Variables (LHS: mg)	FMOLS	CCR	DOLS(1,1)	DOLS(2,2)	DOLS(3,3)	DOLS(4,4)	DOLS(5,5)
Ly	**0.2551** a	**0.2582** a	**0.2321** a	**0.2321** a	**0.2256** a	**0.2551** a	0.2505
	12.1742	14.9062	6.0633	6.0633	4.4902	3.4364	1.1158
Lc	**0.0869** a	**0.0871** a	**0.0767** a	**0.0767** a	**0.0784** a	**0.0805** a	**0.0904** b
	15.6365	15.0654	9.4697	9.4697	11.6955	9.7766	6.5958
J3	**0.0008** c	**0.0007** c	**0.0021** a	**0.0021** a	**0.0026** a	**0.0019** b	-0.0010
	1.9846	1.6850	5.5857	5.5857	5.5041	2.9954	-0.6408
constant	**-0.4133** a	**-0.4172** a	**-0.3771** a	**-0.3771** a	**-0.3717** a	**-0.4134** a	-0.4198
	-15.5909	-18.9593	-8.5788	-8.5788	-6.1642	-4.5334	-1.4838
D1973	-0.0112	-0.0099	**-0.0150** c	**-0.0150** c	0.0110	0.0161	0.0352
	-1.3937	-1.0374	-1.9345	-1.9345	0.6487	0.8216	1.7844
Included observations	50	50	48	46	44	42	40
Andrews bandwidth	2.0635	2.0635	5.8345	1.7101	2.4311	1.4024	2.0134
R-squared	0.9756	0.9755	0.9964	0.9964	0.9986	0.9995	1.0000
Adjusted R-squared	0.9734	0.9733	0.9937	0.9937	0.9966	0.9980	0.9996
S.E. of regression	0.0065	0.0066	0.0029	0.0029	0.0021	0.0015	0.0006

Long-run covariance estimation adopts a Quadratic-Spectral kernel with Andrews automatic bandwidth selection.
The numbers in each row with a variable name are estimated coefficients, and those in the next row are their t-values.
The estimated coefficients followed by "a", "b" and "c" are significant at 1, 5 and 10% significance levels, respectively.
DOLS(p,q) means the inclusion of p leads and q lags, but all DOLS results assume p = q.

Table C: The cointegrating regression results for the new graduate migration model.

The static OLS and cointegrating regression results are in Table 7 of Section 3. E and Table C. They follow the same pattern as those in Table 4 of Section 3.D and Table B do, i.e., most coefficient estimates are of similar magnitudes and significance, but j3 and 1973 dummy carry coefficients of smaller magnitudes and significance in the cointegrating regression results than in their OLS counterparts. Because of the similarity among FMOLS, CCR, and DOLS (with a decent number of leads and lags), we will report only FMOLS results in Table 7 as a leading case.

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