Rural-Urban-Migration and Business Cycle†

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The purposes of this paper are: 1) to present a model that integrates the classical rural-urban migration hypothesis into the utility differential model and 2) to analyze the structure of the recent rural-urban migration.

As is well known the size and the direction of the migration between rural areas and the urban used to coincide with the business fluctuations of the whole economy since the nineteenth century in the western countries¹⁾, which may conveniently be called the classical migration. This phenomenon was also observed in the postwar Japan, at least up to the late 1950's²⁾. A massive one-way inflow of the rural population into the metropolitan areas since then³⁾ however, seems to have led most regional economists to formulations of a variety of hypotheses explaining this urbanization that could be well summarised as the 'utility differential hypothesis'⁴⁾. In this process the relationship between the migration and the business cycle came to escape the attention of the students in this field.

In the following we will revisit this long-dismissed relationship and evaluate the legitimacy of the so-called 'U-turn' or 'J-turn' proposition⁵⁾. Section I presents simple data analyses and Section II the model. The final section shows some simulation results and findings.

I. Data Analyses

Let us classify all the prefectures, except for Okinawa, into two regions: the urban, consisting of prefectures of the centers of local block economies (Tokyo, Saitama, Chiba, Kanagawa, Miyagi, Shizuoka, Aichi, Osaka, Hyogo, Okayama, Hiroshima and Fukuoka), on one hand, and the rural, consisting of the rest. The first region is further dichotomised, specifically for this section, into the Tokyo metropolitan area consisting of the first four and the suburbs consisting of the others, and these two areas and the second region are labelled as (1), (2), and (3), respectively.

Figure 1 shows the size of net migration from region (3) to others. As is evident from the charts the ups and downs of the rural-urban migration coincide with the business cycles in the period of 1955-75, though the amplitude varies from cycle to cycle; during the upswing of the business cycle it keeps increasing and, toward the end of the downswing, it

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1) See Samuelson (8).

2) Tachi (6) analyses interregional migration in the postwar Japan from a variety of view points.

3) Among abundant documents on the urbanization, Tachi (7) provides a compact reference.

4) The essence of the pioneering work by prof. Takao Fukuchi is neatly described in Fukuchi and Nobukuni (2). Development of the theory since then is reviewed in Nobukuni (4).

5) For the original U-turn hypothesis, see Kuroda (3). An example of the followers can be seen in Okada (5).

Fig. 1 Net Out-Migration from the Rural Region

approaches the respective trough. It is noticeable that the net migration from (3) to (2) followed the pattern of even the short small recession in 1962-63. The behavior of the rural-urban migration toward the end of 1960's and thereafter, however, seems to be different in nature. It starts declining before another recession comes in, unlike the preceding periods. The magnitude of the decline is also distinct. The so-called 'U- or J-turn hypothesis' (UJH) argues that this shift in the u-r migration pattern be attributed to structural changes in the migration behavior, instead to temporary changes in economic environments. A hypothesis that can explain the decline as well as the cyclical and upward trend preceding it will negate the UJH.

The absolute out-migration from the rural area, depicted together with the indices of the degree of production operation (R_j and R_r/R_u)—for the national economy and for the regions, in a relative term, respectively—in figure 2 tells us that it reaches the peak in 1970 when R_r/R_u just started rising. The simple classical hypothesis (SCH) seems to be

Fig. 2 Rate of Out-Migration and Business Cycles

supported by the evidence of the simultaneous down-swing of the gross migration and the R_j since 1973. The reversed movement during the period of 70-73, however, seems to contradict the SCH.

We are naturally led, therefore, to a more sophisticated hypothesis: The rural-urban migration is determined by the differential regional business cycle as well as by the overall trade fluctuation, which we will call the regionalised classical hypothesis (RCH). In order to see the validity of this hypothesis gross interregional migration was regressed on R_j and R_r/R_u where R_i s are taken to be proxies of the business fluctuations. The result is:

$$\ln N_{ji} = 13.9 + 1.39321 \ln(R_j/R_i) + .8796 \ln R_j \quad RR = .575, S = .1029$$

(5.12) (3.09)

We see that both variables are statistically highly significant. The explanatory power of these variables are, however, not satisfactory in terms of the coefficient of determination. A further development will be presented in Section 11.

II. Characteristics of the Model

Our behavioral hypothesis regarding the interregional migration is that in the long-run its direction and magnitude will be determined by the interregional utility differential while in the short-run by the business cycles, overall and regional. For convenience of presentation we will here restate the utility differential hypothesis as follows.

(UDH). Assuming that representative residents in any region have a common utility function that is log-linear, interregional migration between region i and j , N_{ij} , will be a

monotonically increasing function of this differential ;

$$(i) \quad N_{ij} = f(\mu_{ij}), f' > 0, \text{ where } \mu_{ij} = u_j/u_i.$$

By log-transformation of N_{ij} we will have a log-linear function in the arguments of the utility function, X_k . In our model let X 's to be regional real per capita income, y_i , and also per capita endowment of the social overhead capital, SOC_i .

Thus we have, combining the UDH and RCH, the following migration function :

$$(ii) \quad N_{ij} = N_{ij}(y_i/y_j, SOC_i/SOC_j; R_j, R_i, R_j).$$

Since some of the independent variables are interrelated with the migration we need develop a consistent model in order to fully understand the behavior of the migration. Firstly let us introduce regional labor market by industrial sector.

In the primary sector the demand for and supply of labor are simultaneously determined by the farmers. New entry to agriculture may be limited due to a variety of institutional settings, but farmers are free to turn to other sectors. Therefore we assume that the behavior of the employment here is set to be a convergence process to the long-run equilibrium determined by its relative productivities with respect to both that of the same region as a whole and that of the primary sector in Japan. Thus we have :

$$(iii) \quad E_{lj} = E_{lj}(y_{li}/y_i, y_{lj}/y_j, E_{li}-1)$$

Regarding the secondary and the tertiary sector let us assume either partial or instantaneous clearance of the market. As a source of supply we have two groups : the previous residents in the same region, N_{i-1} , and net immigration, $(N_{oi}-N_{io})$, for region i , where suffix o stands for the other region. On the other hand we have R_i and/or expected production level determined by the product in the previous year, Y_{si-1} , as demand-shift parameters. If the market is only partially cleared we will have E_{si-1} as an explanatory variable in addition to the above-mentioned parameters, where suffix s stands for the sector. The reduced form for the sectoral employment is :

$$(iv) \quad E_{si} = E_{si}(N_{i-1}, (N_{ji}-N_{ij}), (R_i \text{ and/or } Y_{si-1}), (E_{si}-1))$$

The resultant structures show that the tertiary sector labor market is instantaneous while the secondary partial with the speed of clearance being twenty-four percent per annum.

By adding necessary equations we can close the model. The details of the model is spelled out in the Appendix. Brief notes on the variables related to the public sector will help clarify some of the structure. Among items of public capital formation, that do not add up to the total, GIT, because of exclusion of some items, the agricultural investment is treated as exogenous on account of its political nature in regional allocation.

III. Some Findings

The final test shows that the model can trace the actual behavior of the migration very closely, as is seen in Table 1. Since the utility differential indicated by the arguments has been steadily decreasing the cyclical pattern of the migration cannot be well explained by the UDH. On the other hand, as is seen in Section I, neither SCH nor RCH can explain the decrease in the migration in the late 1960's. We may be able to conclude, therefore, that none of the SCH, RCH, or UDH can consistently explain the behavior of the migrants

Table 1 Simulation Results of Main Variables

a) Migration (unit : one thousand persons)

— Nur —					— Nru —			
Time	Actual	F. Test	Case 1	Case 2	Actual	F. Test	Case 1	Case 2
66	749	726	758	793	1150	1143	1094	1144
67	766	757	811	840	1166	1155	1079	1116
68	803	801	862	872	1214	1167	1085	1098
69	852	852	922	895	1255	1211	1118	1085
70	887	890	958	911	1270	1219	1131	1075
71	932	894	946	922	1235	1161	1096	1069
72	941	915	955	931	1152	1141	1091	1063
73	996	979	1003	937	1123	1163	1134	1059
74	961	960	960	941	1018	1079	1077	1055
75	911	918	899	945	947	983	1002	1052
76	891	898	871	948	980	937	964	1049
77	891	890	852	950	872	899	933	1047
78	863	895	840	952	861	866	922	1044

b) Employment (unit : one thousand persons)

— Eu —					— Er —			
Time	Actual	F. Test	Case 1	Case 2	Actual	F. Test	Case 1	Case 2
66	24855	25027	24852	24986	23656	23868	24078	24170
67	25358	25694	25381	25458	24073	24166	24521	24550
68	25863	26093	25701	25721	24489	24375	24805	24792
69	26366	26523	26028	25941	24906	24520	25064	24970
70	26871	26814	26276	26153	25324	24635	25214	25108
71	27094	26931	26418	26375	25254	24706	25245	25219
72	27319	27166	26683	26619	25185	24857	25364	25316
73	27544	27497	27084	26893	25115	25142	25567	25408
74	27769	27539	27238	27195	25046	25205	25508	25499
75	27995	27598	27417	27533	24978	25292	25471	25593
76	28296	27819	27729	27915	25189	25448	25539	25701
77	28598	28081	28099	28348	25401	25651	25633	25834
78	28901	28389	28544	28845	25613	25941	25780	26011

c) Income (unit : 100 milion yen at '70 prices)

— Yu —					— Yr —			
Time	Actual	F. Test	Case 1	Case 2	Actual	F. Test	Case 1	Case 2
66	231827	259752	258107	259509	147230	159546	161077	161810
67	265395	285234	281824	283493	167091	172277	175517	176458
68	301168	311302	306684	307760	186122	186403	190891	191507
69	345048	339112	333104	332552	204941	201598	207582	207221
70	334175	366934	360187	358302	225260	217887	224838	223639
71	405717	393089	386640	385234	239085	234859	241856	240966
72	458900	421084	415182	413537	268396	253393	260272	259248
73	523652	451954	447351	443268	310837	274826	280932	278309
74	498256	479777	477367	474722	311146	295419	299952	298288
75	508066	507348	507533	508300	321752	316334	319013	319638
76	543248	538270	540825	544280	340719	339448	340407	342811
77	557301	571628	577043	583124	355230	365580	364406	368555
78	584117	607088	616257	624934	375962	394541	390391	396283

Table 2 Simulation Results for Other Variables

Variable	Actual	Final Test	Case 1	Case 2	Variable	Actual	Final Test	Case 1	Case 2
45 ('70)	54866	53980	53275	53290	45 ('70)	77764	72819	75203	74828
Ni 49 ('74)	59380	57453	56386	56384	Y2r 49 ('74)	104932	99222	100818	99835
53 ('79)	62171	60581	59679	59711	53 ('79)	124919	127337	126450	128462
45 ('70)	49797	50623	51333	51318	45 ('70)	204977	199813	194891	193558
Nr 49 ('74)	51192	52037	53104	53107	Y3u 49 ('74)	291951	274723	272598	271261
53 ('79)	53000	54355	55257	55224	53 ('79)	355501	368126	374057	380144
45 ('70)	2449	2687	2689	2685	45 ('70)	119170	115826	120388	119573
Elu 49 ('74)	2003	2057	2056	2058	Y3r 49 ('74)	173912	165134	168071	167388
53 ('70)	1688	1544	1536	1538	53 ('79)	218904	233461	230720	234594
45 ('70)	7626	7114	7116	7111	45 ('70)	347440	350519	345260	342988
Elr 49 ('74)	5894	6076	6076	6076	Ku 49 ('74)	470195	453269	448646	445264
53 ('79)	4890	5069	5061	5064	53 ('79)	558955	549660	550763	558975
45 ('70)	10806	10581	10322	10277	45 ('70)	186262	183704	191058	188633
E2u 49 ('74)	10603	10673	10497	10463	Kr 49 ('74)	261833	248536	254438	251377
53 ('79)	10542	10450	10487	10608	53 ('79)	317332	318129	318139	326160
45 ('70)	7021	6981	7269	7225	45 ('70)	10075	9801	9806	9796
E2r 49 ('74)	7439	7513	7694	7672	E1J 49 ('74)	7897	8133	8132	8135
53 ('79)	7868	7872	7819	7920	53 ('79)	6578	6613	6598	6602
45 ('70)	13616	13547	13265	13120	45 ('70)	17827	17562	17591	17502
E3u 49 ('74)	15163	14809	14685	14674	E2J 49 ('74)	18042	18186	18192	18135
53 ('70)	16671	16394	16521	16699	53 ('79)	18410	18322	18306	18528
45 ('70)	10677	10539	10830	10773	45 ('70)	24293	24086	24094	23964
E3r 49 ('74)	11713	11617	11739	11752	E3J 49 ('74)	26876	26426	26423	26426
53 ('79)	12855	13000	12901	13028	53 ('79)	29526	29394	29422	29727
45 ('70)	10906	11017	11021	11013	45 ('70)	39232	40260	40267	40251
Y1u 49 ('74)	9439	11094	11092	11013	Y1J 49 ('74)	41791	42157	42155	42160
53 ('79)	10988	11070	11050	11053	53 ('79)	43126	44313	44271	44281
45 ('70)	28326	29242	29246	29238	45 ('70)	246055	223923	229478	228559
Y1r 49 ('74)	32302	31063	31063	31065	Y2J 49 ('74)	301749	293183	294494	292200
53 ('79)	32138	33243	33221	33228	53 ('79)	342548	355728	357601	362199
45 ('70)	168291	156104	154275	153731	45 ('70)	324147	315639	315280	313131
Y2u 49 ('74)	196817	193960	193676	192365	Y3J 49 ('74)	465863	439857	440669	438650
53 ('79)	217629	227391	231151	233737	53 ('79)	574405	601588	604777	614738

in the last one and a half decades. Our hypothesis that the combination of RCH and UDH is a comprehensive theory of the interregional migration, that is verified by the good performance of the model, negates structural changes claimed in hypotheses such as UJH, on the other hand.

We did not introduce any particular treatment of the oil embargo so as to improve the fitness. Instead we saw how well the model can trace the reality even after the embargo.

The performance surpassed our expectation. It will be quite easy to reduce the average percentage to less than five percent, say, by means of a dummy variable, which we did not want to so that we could maintain maximum possible coherence.

Actually the net migration from the rural to the urbanised region reversed in 1976 (compare Nur and Nru in the first column of (a), Table 1) or, according to our model, in 1977. This we suspect might not have taken place if there had been no difference in the degree of regional economic stagnation or no nation-wide depression. To analyse the impact on the migration of these factors simulation runs were carried out under two sets of conditions. In the first case Ru and Rr were set equal to RJ to which the actual values were given (Case 1). In the second another condition was added that RJ be a given constant of 0.9 (Case 2). The results are shown in the last two columns of the same table. We can see from these outcomes that the gross migration in both directions reached a peak at the same time in 1973 in Case 1. The net migration, however, did not reverse the direction, though it kept decreasing after the peak. In Case 2 urbanisation still keeps going on at the rate of one hundred thousand persons per year.

Looking into variations in other variables we can evaluate the value of migrating. The national income in 1978 increased by 502 billion yen at the '70 prices. Dividing this amount by the total number of migrants in the same year (316 thousand persons) we obtain 1.6 million yen as the per head contribution of migrating. Since the total employment decreased by five thousand real contribution must be higher than this. Of course the employment in the urban region increases and that in the rural decreases. Full-fledged evaluation requires much longer run because: a) the impact arises through time due to the dynamic nature of the model and, b) the average life span extends to two or three decades ahead. The above evaluation is, therefore, just a rough approximation.

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Appendix. The Rural-Urban Migration Model

1) Population :

$$N_i - (N_{oi} - N_{io}) = -863.4 + 1.02777N_4 - 1 \quad RR = .988, S = 44.96$$

(45.9)

2) Interregional Migration :

$$\ln(N_{io} * 1000) = 4.624 + .33851 \ln(R_o/R_i) + .5234 \ln R_J - .04074$$

(2.8) (5.8) (-1.4)

$$* \ln(GLi/N_i)/(GLJ/GLJ) * (Y_i/E_i)/(YJ/EJ) - 1$$

$$+ .6691 \ln(N_{io} - 1 * 1000) \quad RR = .969, S = .0277$$

(7.1)

3) Employment in the Primary Sector :

$$E_{li} = -24.05 + .9788E_{li} - 1 + 558.3((Y_{li}/E_{li})/(Y_{IJ}/E_{IJ})) - 1$$

(116.7) (1.6)

$$- 232.3((YJ/EJ)/(Y_{IJ}/E_{IJ})) - 1 \quad RR = .998, S = 95.8$$

(-3.3)

4) Employment in the Secondary Sector :

$$E_{2i} - E_{2i} - 1 = 861.4 + 518.3D_1 + .013702N_i + .4555(N_{oi} - N_{io})$$

(4.7) (1.04) (2.97)

$$500.85R_i - .24996E_{2i} - 1 \quad RR = .772, S = 56.7$$

(1.88)

5) Employment in the Tertiary Sector :

$$E_{3i} - E_{3i} - 1 = 4545.3 + 762.5D_1 + .067703N_i - 1 + .9221(N_{oi} - N_{io})$$

(2.6) (.975) (2.1)

$$.018338Y_{3i} - 1 + 1023.5R_i \quad RR = .992, S = 185.8$$

(6.5) (1.5)

6) Private Fixed Capital in the Secondary Sector :

$$K_{2i} - K_{2i} - 1 = -21320 + 17864D_1 + 31092R_i + .1448Y_i - 1 - .1748K_{2i} - 1$$

(4.7) (2.2) (3.2) (-3.1)

$$+ .2376GITJ \quad RR = .837, S = 3151$$

(1.9)

7) Value Added in the Primary Sector :

$$\ln(Y_{li}/E_{li}) = .3257 + .1009D_1 + .6079 \ln(GA_i/E_{li}) \quad RR = .937, S(9) .0627$$

(4.1) (18.4)

8) Value Added in the Secondary Sector :

$$\ln(Y_{2i}/E_{2i}) = .1998 + .2181D1 + .5409\ln(K_{2i}/E_{2i}) + .4669\ln(GK_i/N_i) \quad (4.1) \quad (3.1) \quad (2.1)$$

$$RR = .938, S = +0.709$$

9) Value Added in the Tertiary Sector :

$$\ln(Y_{3i}/E_{3i}) = -6.861 + .1820\ln(GK_i - 1/E_{3i}) + .6640\ln(Y_{1i} + Y_{2i}) \quad (1.4) \quad (13.2)$$

$$+ .01683T \quad (2.2)$$

$$RR = .990, S = .0276$$

10) Total Government Investment :

$$\lnGIT = -.9286 + .5184\ln YJ + .4332\ln(GIY - 1) \quad (1.5) \quad (1.4)$$

$$RR = .859, S = .118$$

11) Economic Overhead Capital :

$$\ln GK_i = .3703 - .5921D1 + .9139\ln(GK_i - 1) + .06937\ln GIT \quad (-3.1) \quad (97.9) \quad (9.5)$$

$$+ .1377\ln((Y_i/E_i)/(Y_L/E_J)) - 1 \quad (2.9)$$

$$RR = .999, S = .00540$$

12) Social Overhead Capital :

$$\ln(GL_i - GL_i - 1) = 3.7524 + .9208\ln GIT + .4739\ln(Y_i/N_i) - 1 \quad (7.7) \quad (3.9)$$

$$- .4482\ln(N_{io} - 1 \cdot 1000) \quad (-2.7)$$

$$RR = .961, S = .0884$$

13) Regional Employment :

$$E_i = E_{1i} + E_{2i} + E_{3i}$$

14) Regional Product :

$$Y_i = Y_{1i} + Y_{2i} + Y_{3i}$$

15) National Population :

$$NJ = N_u + N_r$$

16) National Employment in the Primary Sector :

$$E1J = E_{1u} + E_{1r}$$

17) National Employment in the Secondary Sector :

$$E2J = E_{2u} + E_{2r}$$

18) National Employment in the Tertiary Sector :

$$E3J = E_{3u} + E_{3r}$$

19) Total Employment :

$$EJ = Eu + Er$$

- 20) National Economic Overhead Capital :

$$GKJ = GK_u + GK_r$$

- 21) National Social Overhead Capital :

$$GLJ = GL_u + GL_r$$

- 22) National Product :

$$YL = Y_u + Y_r$$

- 23) National Product in the Primary Sector :

$$Y1J = Y1_u + Y1_r$$

- 24) National Product in the Secondary Sector :

$$Y2J = Y2_u + Y2_r$$

- 25) National Product in the Tertiary Sector :

$$Y3J = Y3_u + Y3_r$$

Notations. Numerical suffixes refer to the industrial sector, and i ($=u$ or r) to the respective region. Figures in parentheses show the t -value, RR the coefficient of determination after adjustment by the degree of freedom, and S the estimated standard deviation.

Endogenous variables are indicated by the headings of the equations. Exogenous are : GAI , public agricultural capital stock ; R_i , indices of business cycle ; T , time trend, and $D1$, regional dummy ($=1$ for region u and $=0$ otherwise). The unit of measurement is one thousand persons, for the variables related to population or employment, and one hundred million yen at 1970 prices for values.

The sample is annual observations on the two regions for 1966-1973. The estimator is OLS as a first approximation to the structure ; judging from the model structure some consistent estimator may be desirable. The model performance in the final test is, however, rather excellent, as is shown below.

average % error	regional variables
0—5	Nu Nr Nur Nru Elr E2u E2r E3u E3r Y1u Y1r Y3r Ku Kr GKu GKr GLu GLr Yr
5—10	Elu Y2u Y2r Y3u Yu
10 or more	GIT

Those variables whose average errors exceed five percent drastically deviated from the actual right after the first Oil Embargo but soon returned to the neighborhood of the observation.