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Aomori's Demographic Decline: Good News in Disguise?

Hidetaka KAWANO※

The National Institute of Population and Social Security Research reported this March that the demographic trend in Aomori Prefecture will be a decline by about 30 percent of the current population by the year 2040. The reaction of the general public to the report in Aomori is pessimistic about the future state of the economy. Our intuitive reaction, however, is encouraging. In this paper, we have estimated the economy-wide effects of the 30 percent decline of the current population in Aomori Prefecture, in the framework of a 13-sector applied general equilibrium model. With the use of year 2000 Aomori input-output data, the major simulation results of the 30 percent decline of the current population lead to the following conclusions: 1) the Aomori prefecture will have an increasingly higher relative wage rate; 2) all the sectors, above all, the agricultural sector,will turn out to be increasingly more capital-intensive, and the economy-wide capital-labor ratio will increase; 3) labor productivity (relative marginal product of labor) will increase with the high capital-labor ratios in all sectors; 4) per capita income will increase, although the aggregate income will decline. These simulation results also imply that the demographic outflow of the population out of Aomori prefecture will result in an increase in the per capita income of the remaining population. "Voting with your feet" may benefit not only the people leaving the prefecture, but also the people who have decided to remain there.

JEL classification：C63; C68; D00; D58; F10; F11; F16; Q11; Q12; Q17; Q18
Keywords：:General equilibrium; Factor intensities; Factor prices; Product prices; Welfare

１. Introduction

The National Institute of Population and Research reported this March that the demographic trend in Aomori Prefecture will be a decline by about 30 percent of the current population by the year 2040 (National Institute of Population and Research, 2013). The reaction of the general public in Aomori to the report is pessimistic about the future state of the economy. Our reaction, however, is more optimistic than pessimistic by comparison.

In this paper, we have estimated the economy-wide effects of the 30 percent decline of the current population in Aomori Prefecture, in the framework of a 13-sector applied general equilibrium model (AGE). With the use of year 2000 Aomori input-output data, the major simulation results of the 30 percent decline of the current population lead to the following conclusions: 1) the Aomori prefecture will have an increasingly higher relative wage rate by 50.1 %; 2) all the sectors, above all, the agricultural sector, will turn out to be increasingly more capital-intensive (the capital-labor ratio rises from 8.8 in 2000 to 13.2), and the economy-wide capital-labor ratio will

※ Aomori Public University Professor

increase by 42.9 %; 3) labor productivity (relative marginal product of labor) will increase with the high capitallabor ratios in all sectors by 50.1 %; 4) per capita income will increase by 0.9 %, although the aggregate income will decline by 29.4 %.

These simulation results also imply that the demographic outflow of the population out of Aomori prefecture will result in an increase in the per capita income of the remaining popu lation. “Voting with your feet” may benefit not only the people leaving the prefecture, but also the people who have decided to remain there.

For the empirical characterization, calibration is achieved through the use of year 2000 Aomori's 13-sector input-output data (Kikaku Seisaku Tokei Bunsekika, 2005). The model closure assumes a small open economy with free capital inflow and outflow, so that the balance of payments is balanced. In this way, the original input-output data was used without modification.

A crucial step in the empirical characterization of an AGE is calibration, defined as “the requirement that the entire model specification be capable of generating a base-year equilibrium observation as a model solution” (Shoven and Whalley, 1992). An AGE model is a very powerful framework for analysis of policy reforms that could be instituted for Pareto improvements in the current state of the economy. An important development since Scarf (1967) has been the use of observed data, such as an input-output table, in developing an AGE model.

The solution procedure for coding the model follows Shoven and Whalley (1992) by reducing the dimensionality of the solution space to the number of factors of production in this general equilibrium structure. The solution algorithm used for calibration is a fixed-point algorithm originally developed by Kimbell and Harrison (1986) and modified by Kawano (2003). In his recent paper (Kawano, 2006, 2013), seven alternative fixed point algorithms were compared. Among the seven alternatives, the modified Kimbell-Harrison approach was shown to be the best for an AGE modeling.

These experiments were programmed in C-language, and conducted on the GCC version 4.0.1 compiler (Apple Computer, Inc.). The verified reliability of the simulation results in double precision (1.0e-15). The converged equilibrium values in this benchmark model were obtained through 66 iterations over the entire model. In the full paper, Section 2 reviews the empirical structure of an AGE model. In Section 3, the calibration procedure is stated briefly. Section 4 reviews the major simulation results of the 30 percent decline of the current population in Aomori-prefecture. In section 5, policy implications are presented. The conclusion follows in section 6.

2 The Empirical Structure of the Model

2.1 The Main Features of the Model

The model was kept very simple. The supply side of a theoretical general equilibrium model is made more empirically plausible by incorporating the Leontief type input-output accounting data.

An important step in building an empirical model is to incorporate flow of intermediate goods into the model structure. The flow of intermediate goods among different sectors is built into the model as part of production activity in the economy

The model is simple and has only 13 sectors, shown by subscript $i \in I = \{0, ..., 12\}$, and two final consumption commodities $X_{i \in I}$. The use of intermediate goods in production activities shows that total output $Q_{i \in I}$ in sector

i will go partly to meet domestic household consumption demand $X_{i\in I}$, external sector consumption $ES_{i\in I}$, and also intermediate input demand q_{ij} for production of goods $j \in J = \{0, ..., 12\}$. The production activities of firms include intermediate goods $Q_{j\in J}$ supplied through output markets. The usual primary factors of production are capital $K_{i\in I}$ and labor $L_{i\in I}$. As in the Leontief system, intermediate inputs are required as a fixed proportion of the total output $Q_{i\in I}$. The input-output coefficients a_{ij} are defined as:

$$a_{ij} \equiv \frac{q_{ij}}{Q_j}, \qquad \forall \quad i \in I, j \in J, \tag{1}$$

where

a_{ij} := input-output coefficient for commodity i used as an intermediate good to produce one unit of commodity j

q_{ij} := amount of good i used as an intermediate input for production of good j ,

Q_j := output in industry j .

Table 1. Input-Output Accounting Table Flows (Yen Trillion)

	Inputs to industry 0	Input to industry 1			Domestic consumption	External sector	Total output
Industry 0	$q_{00} = a_{00} \cdot Q_0$	$q_{01} = a_{01} \cdot Q_1$	$\cdots$	q_{012}	X_0	ES_0	Q_0
Industry 1	$q_{10} = a_{10} \cdot Q_0$	$q_{11} = a_{11} \cdot Q_1$	$\cdots$	q_{112}	X_1	ES_1	Q_1
$\cdots$	$\cdots$	$\cdots$	$\cdots$				
Industry 12	$q_{120} = a_{120} \cdot Q_0$	$q_{121} = a_{121} \cdot Q_1$	$\cdots$	q_{1212}	X_{12}	ES_{12}	Q_1
Capital	K_0	K_1	$\cdots$	K_{12}	$\bar{K}$		
Labor	L_0	L_1	$\cdots$	L_{12}	$\bar{L}$		

Note: Capital is broadly defined as gross value added without labor income.

The input-output table in Table 1 can be looked at in both rows and columns. Here, the table is interpreted in rows.

In row 0 in the table, the value of the domestic production in sector 0 is Q_0 trillion yen. Sales value of q_{00} trillion yen goes to its own sector 0, the other q_{01} trillion yen through q_{012} trillion yen go to sector 1 through sector 12 respectively. X_0 trillion yen through X_{12} trillion yen for domestic consumptions for sectors 0 through 12, and the remaining ES_0 through ES_{12} trillion yen worth of net import/export from external sector.

In rows 1-12, the table is interpreted in the same way as row 0.

In row 13, the total endowment of capital is $\bar{K}$ trillion yen, of which K_0 trillion yen worth of capital is used in sector 0, K_1 trillion yen worth of capital is used in sector 1, and in the same way $K_2 - K_{12}$ trillion yen worth of capital are used in sectors 2 though 12, respectively.

In row 14, the total endowment of labor is $\bar{L}$ trillion yen, of which L_0 trillion yen worth of labor is used in sector 0, L_1 trillion yen worth of capital is used in sector 1, and in the same way $L_2 - L_{12}$ trillion yen worth of labor are used in sectors 2 though 12, respectively.

2.2 The Demand Side of the Model

The level of disposable income for a representative consumer is determined by factor endowments, factor prices, and external finance. The disposable income Y is:

$$Y = w\bar{L} + r\bar{K} + EF, \tag{2}$$

where

w := wage rate,

r := rental rate,

$\bar{L}$:= labor endowment,

$\bar{K}$:= capital endowment,

EF:= external finance.

We assume a simple Cobb-Douglas utility function $U(.)$ as a representation of consumer preference.

The function is:

$$U(X_0, ..., X_{12}) = \Pi_{i=0}^{12} X_i^{\theta_i},$$

$$\because \quad 0 < \theta_i < 1, \quad \sum_{i=0}^{12} \theta_i = 1, \quad \forall i \in I. \quad (3)$$

The final demand for commodities $X_{i \in I}$ is derived by the utility maximization for a representative consumer as:

$$X_i = \frac{\theta_i Y}{p_i}, \quad \forall i \in I, \quad (4)$$

where

$\theta_{i \in I}$:= share parameter in utility function,

p_i:= price of commodity.

2.3 The Production Side of the Model

The production function with intermediate inputs is modeled as:

$$Q_j = min\left(\frac{q_{0j}}{a_{0j}}, \frac{q_{1j}}{a_{1j}}, ..., \frac{q_{12j}}{a_{12j}}, VA_j\right), \quad \forall j \in J, \quad (5)$$

where

Q_j := commodity $j \in J$ produced,

VA_j:= value-added component of production function $j \in J$.

The value-added component $VA_{j \in J}$ of production function $j \in J$ is modeled as Cobb-Douglas which allows the substitution possibility between primary factors: capital K_j and labor L_j. The value-added component VA_j is specified as:

$$VA_j \equiv \Phi_i K_i{}^{\alpha_i} L_i{}^{1-\alpha_i}, \because 0 < \alpha_i < 1, \quad \forall i \in I, \quad (6)$$

where

$\alpha_{i \in I}$:= factor share parameter in value-added component of production function (or value added output elasticity of capital),

$\Phi_{i \in I}$:= shift parameter in value-added component of production function,

$K_{i \in I}$:= capital employed in sector $i \in I$,

$L_{i \in I}$:= labor employed in sector $i \in I$.

The conditional factor demand functions can be derived by assuming no intermediate goods are needed in the model, since a fixed proportion of the total output Q_i does not affect the first order conditions of the producers' cost minimization.

1) The per unit capital demand function is:

$$k_i = \frac{1}{\Phi_i}\left(\frac{\alpha_i}{1-\alpha_i}\right)^{1-\alpha_i}\left(\frac{w}{r}\right)^{1-\alpha_i}, \quad \forall i \in I. \quad (7)$$

2) The per unit labor demand function is:

$$l_i = \frac{1}{\Phi_i}\left(\frac{\alpha_i}{1-\alpha_i}\right)^{-\alpha_i}\left(\frac{w}{r}\right)^{-\alpha_i}, \quad \forall i \in I. \quad (8)$$

2.4 Zero Profit Conditions

Perfectly competitive behavior in producers will imply zero profit conditions. Zero profit conditions for the two producers with intermediate goods are modeled as: For the producer in sector $i \in I$,

$$p_i = \sum_{j \in J} a_{ij} p_j + rk_i + wl_i, \quad \forall i \in I, \quad (9)$$

where

k_i := capital employed for per unit production of commodity $i \in I$,

l_i := labor employed for per unit production of commodity $i \in I$.

Rewrite equations (9) in matrix as:

$$(I - A^T)P = W. \quad (10)$$

Solve for P as:

$$P = (I - A^T)^{-1}W. \quad (11)$$

2.5 Market Clearing Conditions

The total output $Q_{i\in I}$ of commodity in sector $i \in I$ is met by the total intermediate input demand $\sum_{j\in J} q_{ij}$, domestic consumption demand $X_{i\in I}$, and external consumption demand $ES_{i\in I}$ as:

$$Q_i = \sum_{j\in J} q_{ij} + X_i + ES_i, \quad \forall i \in I. \quad (12)$$

By equation (1), $q_{ij} = a_{ij}Q_j$. Rewrite equation (12) as:

$$Q_i = \sum_{j\in J} a_{ij}Q_j + X_i + ES_i, \quad \forall i \in I. \quad (13)$$

Further rewrite equation (13) in matrix as:

$$(I - A)Q = X + ES. \quad (14)$$

Solve for Q as:

$$Q = (I - A)^{-1}(X + ES). \quad (15)$$

3 Calibration Procedure

Here, we calibrated the general equilibrium model to be consistent with an actual data set. In other words, choose the model parameters to replicate the real data at hand. The calibration procedure is as follows:

Step 1: Read information from the year 2000 Aomori 13-sector input-output data file. The program uses the input-output data to calibrate parameters. The calibrated parameters are: 1) consumptionshare (preference elasticity) parameters $\theta_{i\in I}$, 2) factor-share (output elasticity) parameters $\alpha_{i\in I}$,3) input-output coefficients $a_{i\in I\, j\in J}$, and 4) shift parameters in production $\Phi_{i\in I}$. These parameters are computed in double precision.

Step 2: Generate a micro-consistent data set summarized in the social accounting matrix for the year 2000 shown in the output file in Appendix. Its zero-sum row shows that all goods and factor markets are cleared. Its zero-sum column shows that income equals expenditure in each sector.

The generated data set shows micro-consistent financial flows in all sectors of the economy. In other words, the data is consistent with the underlying general equilibrium structure of the model.

Step 3: Conduct the replication check to see if the calibrated solutions in the model are error-free in building and coding the model. The generated data is identical to the original input-output table data in the output file in Appendix. The replication check has passed, so the data is considered as an appropriate benchmark for comparative static experiments.

4 Simulation Results

We have estimated the economy-wide effects of the 30 percent decline of the current population in Aomori Prefecture, in the framework of a 13-sector applied general equilibrium model. With the use of year 2000 Aomori input-output data, the major simulation results lead to the following conclusions: 1) the Aomori prefecture will have an increasingly higher relative wage rate by 50.1%, which means that active productive labor become extremely scarce and expensive if the effect of the declining demographic trend is combined with the aging population; 2) all the sectors, above all, the agricultural sector, will turn out to be increasingly more capital-intensive (from 8.8 in 2000 to 13.2), and the economy-wide capital-labor ratio will increase by 42.9 %, which means that expensive and scarce labor is substituted for relatively inexpensive capital in the process of production in all sectors; 3) labor productivity (relative marginal product of labor) will increase with the high capital-labor ratios in all sectors by 50.1 %, which means that increasing the labor productivity with more employment of capital per unit of labor will make it possible for the wage rate to go up; 4) per capita income will increase by 0.9% (￥600,000 through ￥700,000 by CV and EV measures), although the aggregate income will decline by 29.4 %.

5 Policy Implications

In this rapid demographic outflow of the Aomori prefecture population, the local government must first consider the characteristic features that both private companies and Aomori-prefecture herself need to survive: a flexible labor market. The central government of Japan must help devise "the more flexible labor market" which would allow local governments all over Japan to act on their own initiatives to adjust to the constantly changing economic environment. If that happens, then the above simulation scenario will come true.

Once this implied flexible labor market is instituted nationwide, then it will enable workers to move easily from one prefecture to another. With this government initiative, private firms can hire and fire employees with relative ease, which is crucial for giving renewed vitality to the whole economy of Japan, and especially Aomori prefecture located at the northern tip of Japan.

Domestic local economies need to adjust themselves to the changing environment. One loses one's job in one place one day, and the following day they find another job in another place. In a world of fast changing environments, one should be prepared to move from one place to another, which is exactly what "Voting with your feet" means. The Aomori local government should not discourage people from going out of the prefecture, by all means. At the same time, private firms have more incentive to hire employees, because they can easily fire employees if they engage actively in unraveling any mismatch between employees and firms.

The ideal environment of a thriving economy in which the most private firm operates must be highly competitive, where "Schump eterian Creative Destruction" is at work in order to make the economic pie larger before distributional policies are implemented. If more flexible local labor markets are instituted nationwide by the central government, a local market like Aomori will be bound to thrive.

If, on the contrary, the labor markets in Aomori remain stagnant, and do not strive for more flexibility, this stagnation will continue to be reflected in the economy for a long time, much of which Japan has experienced for more than two decades. What is crucial for the thriving economy is the functioning of both factor and product markets. Private firms and even the central government as well as many local governments at all levels must stand on their own. Any form of government-subsidized organizations, cartels, and monopolies need to be eliminated or dismantled, which is also of paramount importance to the elimination of rent-seeking and the reduction of the enormous public debts accumulated over the years.

6 Conclusion

In this paper, we have estimated the economy-wide effects of the 30 percent decline of the current population in Aomori Prefecture, in the framework of a multi-sector AGE model. The simulation results show that the pessimistic reaction of general public in Aomori to the government agency report of a decline by about 30 percent of the current population are unwarranted. The key policy question should be how more competitive and flexible product-factor markets, especially the labor market, can be facilitated to improve the future prospect of the economy in Aomori.

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```
7======================================The output file=========PART II=======================================
 PROGRAM: aomori_13sec_2000_5-2.c
 DATE: September 15,2013
 NAME: Hidetaka Kawano
 Data: Aomori 13 sector Input_Output in 2000
 Input File: aomori_13sec_2000_2.txt
 TOPICS: Comparative static of Decreasing 30 percent of labor endowment in 2000

 /// 0. Defining the sectors in Aomori ///
     Sector  0: Agriculture
     Sector  1: Forestry
     Sector  2: Fishery
     Sector  3: Mining
     Sector  4: Manufacturing
     Sector  5: Construction
     Sector  6: Power_gas_water
     Sector  7: Commerce
     Sector  8: Finance_insurance_real estate
     Sector  9: Transport_communication_broadcast
     Sector 10: Public service
     Sector 11: Service
     Sector 12: Miscellaneous


 /// 1. Calibrated consumption share parameters: theta[]///
 (1- 1) theta[ 0]= 0.007157977136202
 (1- 2) theta[ 1]= 0.003314296199454
 (1- 3) theta[ 2]= 0.002289746213475
 (1- 4) theta[ 3]= 0.000056230943444
 (1- 5) theta[ 4]= 0.167823470351865
 (1- 6) theta[ 5]= 0.189449077331605
 (1- 7) theta[ 6]= 0.013308791486043
 (1- 8) theta[ 7]= 0.096772898756926
 (1- 9) theta[ 8]= 0.112004825502805
 (1-10) theta[ 9]= 0.041321604742340
 (1-11) theta[10]= 0.102576893965458
 (1-12) theta[11]= 0.263862777261094
 (1-13) theta[12]= 0.000061410109288
        ----------------------------
        sum_theta= 1.000000000000000


 /// 2. Calibrated production share parameters: alpha[] ///
        Capital share                       Labor share
 (2- 1) alpha[ 0]= 0.897885397003031   1-alpha[ 0]= 0.102114602996969
 (2- 2) alpha[ 1]= 0.672586015538291   1-alpha[ 1]= 0.327413984461709
 (2- 3) alpha[ 2]= 0.712575696882584   1-alpha[ 2]= 0.287424303117416
 (2- 4) alpha[ 3]= 0.616372170071784   1-alpha[ 3]= 0.383627829928216
 (2- 5) alpha[ 4]= 0.506487425924551   1-alpha[ 4]= 0.493512574075449
 (2- 6) alpha[ 5]= 0.270364564033863   1-alpha[ 5]= 0.729635435966137
 (2- 7) alpha[ 6]= 0.658591823074737   1-alpha[ 6]= 0.341408176925263
 (2- 8) alpha[ 7]= 0.305465696185470   1-alpha[ 7]= 0.694534303814530
 (2- 9) alpha[ 8]= 0.828403558934967   1-alpha[ 8]= 0.171596441065033
 (2-10) alpha[ 9]= 0.364279467148985   1-alpha[ 9]= 0.635720532851015
 (2-11) alpha[10]= 0.041146342867008   1-alpha[10]= 0.958853657132992
 (2-12) alpha[11]= 0.267907171421682   1-alpha[11]= 0.732092828578318
 (2-13) alpha[12]= 0.788954549404710   1-alpha[12]= 0.211045450595290


 /// 3. Calibrated input-output coefficients: a[][] ///
          (0)       (1)       (2)       (3)       (4)       (5)       (6)       (7)       (8)       (9)      (10)      (11)      (12)
 ( 0) 0.108382 0.002330 0.000000 0.000000 0.057905 0.002168 0.000000 0.000111 0.000000 0.000013 0.000090 0.005495 0.000000
 ( 1) 0.000220 0.173352 0.000413 0.000088 0.005306 0.000199 0.000000 0.000000 0.000000 0.000000 0.000007 0.000194 0.000000
 ( 2) 0.000000 0.000000 0.029318 0.000000 0.029151 0.000000 0.000000 0.000000 0.000000 0.000000 0.000020 0.001884 0.000000
 ( 3) 0.000000 0.000166 0.000000 0.004528 0.010015 0.010848 0.073433 0.000000 0.000000 0.000000 0.000030 0.000020 0.000113
 ( 4) 0.191796 0.039947 0.198024 0.160811 0.288393 0.276813 0.077395 0.042572 0.014302 0.060257 0.135698 0.134175 0.049935
 ( 5) 0.007957 0.002164 0.000856 0.006935 0.003687 0.002989 0.044941 0.006041 0.029614 0.009348 0.017646 0.007885 0.000000
 ( 6) 0.005873 0.002996 0.001927 0.030102 0.023299 0.007456 0.066574 0.013682 0.003715 0.016557 0.038173 0.029827 0.009271
 ( 7) 0.052012 0.015091 0.049934 0.045918 0.058601 0.065448 0.017813 0.017066 0.002566 0.013653 0.020189 0.043287 0.011328
 ( 8) 0.040503 0.011984 0.024256 0.075276 0.012935 0.018220 0.037139 0.079875 0.066025 0.052807 0.006628 0.029897 0.125373
 ( 9) 0.025662 0.029627 0.018582 0.038852 0.024865 0.042503 0.030402 0.042261 0.015164 0.104419 0.051466 0.024218 0.025531
 (10) 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.083385
 (11) 0.020371 0.020223 0.022880 0.148976 0.054995 0.092342 0.091960 0.077288 0.059691 0.096282 0.105932 0.069074 0.046525
 (12) 0.005793 0.002275 0.004756 0.013104 0.005181 0.004355 0.004945 0.005862 0.004365 0.004844 0.000752 0.002694 0.000000
      ---------------------------------------------------------------------------------------------------------------------
      0.458568 0.300155 0.350947 0.524589 0.574332 0.523340 0.444602 0.284758 0.195441 0.358182 0.376630 0.348648 0.351463
      0.541432 0.699845 0.649053 0.475411 0.425668 0.476660 0.444602 0.284758 0.195441 0.358182 0.376630 0.348648 0.351463


 /// 4. Calibrated shift parameters in production: phi[]  ///
 (4- 1) phi[ 0]= 2.568295421633889
 (4- 2) phi[ 1]= 2.689160356285795
 (4- 3) phi[ 2]= 2.806869270201006
 (4- 4) phi[ 3]= 4.093446351692414
 (4- 5) phi[ 4]= 4.698103991893418
 (4- 6) phi[ 5]= 3.760582651801370
 (4- 7) phi[ 6]= 3.421349088057585
 (4- 8) phi[ 7]= 2.587155738414556
 (4- 9) phi[ 8]= 1.965742594948587
 (4-10) phi[ 9]= 3.002038572979871
 (4-11) phi[10]= 1.904434957452518
 (4-12) phi[11]= 2.745249457654359
 (4-13) phi[12]= 2.581508842665020


 /// 5. Factor endowments  ///
  (5- 1) Capital kbar= 1.979455000000000
  (5- 2) Labor   lbar= 1.904961800000000     NOTE: Up by -30.000000 percent !


 /// 6. Numeraire  ///
  (6- 1) Wage rate  w= 1.000000000000000


 /// 7. Commodity prices: p[]///
 (7- 1) p[ 0] = 0.742665894627842   NOTE: Up by -25.733411 percent !
 (7- 2) p[ 1] = 0.771099503640840   NOTE: Up by -22.890050 percent !
 (7- 3) p[ 2] = 0.772431522915836   NOTE: Up by -22.756848 percent !
 (7- 4) p[ 3] = 0.802048399791425   NOTE: Up by -19.795160 percent !
 (7- 5) p[ 4] = 0.813406091534969   NOTE: Up by -18.659391 percent !
 (7- 6) p[ 5] = 0.860976032497351   NOTE: Up by -13.902397 percent !
 (7- 7) p[ 6] = 0.790533900811243   NOTE: Up by -20.946610 percent !
 (7- 8) p[ 7] = 0.863555111984423   NOTE: Up by -13.644489 percent !
 (7- 9) p[ 8] = 0.733521208792372   NOTE: Up by -26.647879 percent !
 (7-10) p[ 9] = 0.850596868576174   NOTE: Up by -14.940313 percent !
 (7-11) p[10] = 0.927857428721988   NOTE: Up by  -7.214257 percent !
 (7-12) p[11] = 0.871521622682594   NOTE: Up by -12.847838 percent !
 (7-13) p[12] = 0.760051747406557   NOTE: Up by -23.994825 percent !
```

```
///  8. Factor prices  ///
(8- 1) w  =  1.000000000000000
(8- 2) r  =  0.666036552337701
(8- 3) w/r=  1.501419098531652     NOTE: Up by  50.141910 percent !
(8- 4) r/w=  0.666036552337701     NOTE: Up by -33.396345 percent !


///  9. Income & expenditure  ///
(9- 1) Expenditure on X[ 0]: p[ 0]*X[ 0]=  0.027319090307530
(9- 2) Expenditure on X[ 1]: p[ 1]*X[ 1]=  0.012649321932150
(9- 3) Expenditure on X[ 2]: p[ 2]*X[ 2]=  0.008739030929684
(9- 4) Expenditure on X[ 3]: p[ 3]*X[ 3]=  0.000214610663432
(9- 5) Expenditure on X[ 4]: p[ 4]*X[ 4]=  0.640513996486182
(9- 6) Expenditure on X[ 5]: p[ 5]*X[ 5]=  0.723050151435135
(9- 7) Expenditure on X[ 6]: p[ 6]*X[ 6]=  0.050794249488788
(9- 8) Expenditure on X[ 7]: p[ 7]*X[ 7]=  0.369342833897980
(9- 9) Expenditure on X[ 8]: p[ 8]*X[ 8]=  0.427476909267366
(9-10) Expenditure on X[ 9]: p[ 9]*X[ 9]=  0.157707775552769
(9-11) Expenditure on X[10]: p[10]*X[10]=  0.391494325336031
(9-12) Expenditure on X[11]: p[11]*X[11]=  1.007057008373730
(9-13) Expenditure on X[12]: p[12]*X[12]=  0.000234377435064
                           --------------------------------------
(9-14) Total expenditure                =  3.816593681105842
(9-15) Factor income y=r*kbar+w*lbar+EF =  3.816593681105841   NOTE: Up by -29.404387 percent !
(9-16) Per capita-income y/lbar         =  2.003501425123507   NOTE: Up by   0.850876 percent !


///  10. Factor markets  ///
     --- Sectoral capital use ---
(10- 1) k[ 0]=  0.137138919452980   NOTE: Up by  -6.084671 percent !
(10- 2) k[ 1]=  0.017002022907013   NOTE: Up by   0.200512 percent !
(10- 3) k[ 2]=  0.027089747752236   NOTE: Up by -10.420463 percent !
(10- 4) k[ 3]=  0.012532109453240   NOTE: Up by  -6.441885 percent !
(10- 5) k[ 4]=  0.308236042625237   NOTE: Up by  -7.787199 percent !
(10- 6) k[ 5]=  0.157088713812408   NOTE: Up by  10.409701 percent !
(10- 7) k[ 6]=  0.064951335171514   NOTE: Up by  -9.573794 percent !
(10- 8) k[ 7]=  0.218803243868244   NOTE: Up by   9.714308 percent !
(10- 9) k[ 8]=  0.567017760742805   NOTE: Up by  -1.504697 percent !
(10-10) k[ 9]=  0.130624407964281   NOTE: Up by   6.672226 percent !
(10-11) k[10]=  0.016071782815078   NOTE: Up by  12.390090 percent !
(10-12) k[11]=  0.306592812411246   NOTE: Up by   4.129554 percent !
(10-13) k[12]=  0.016306101023717   NOTE: Up by -10.193859 percent !

     --- Total capital use and endowment ---
(10-14) Capital use= 1.979454999999999
(10-15) kbar=        1.979455000000000

     --- Sectoral labor use ---
(10-16) l[ 0]=  0.010387851491909   NOTE: Up by -37.448958 percent !
(10-17) l[ 1]=  0.005512493023642   NOTE: Up by -33.262796 percent !
(10-18) l[ 2]=  0.007277722736487   NOTE: Up by -40.336754 percent !
(10-19) l[ 3]=  0.005195045156565   NOTE: Up by -37.686876 percent !
(10-20) l[ 4]=  0.200037325179695   NOTE: Up by -38.582904 percent !
(10-21) l[ 5]=  0.282357414727047   NOTE: Up by -26.463104 percent !
(10-22) l[ 6]=  0.022425582436364   NOTE: Up by -39.772842 percent !
(10-23) l[ 7]=  0.331347024730065   NOTE: Up by -26.926261 percent !
(10-24) l[ 8]=  0.078227787413151   NOTE: Up by -34.398528 percent !
(10-25) l[ 9]=  0.151828725087630   NOTE: Up by -28.952398 percent !
(10-26) l[10]=  0.249449827168441   NOTE: Up by -25.144092 percent !
(10-27) l[11]=  0.558009826488785   NOTE: Up by -30.645911 percent !
(10-28) l[12]=  0.002905174360219   NOTE: Up by -40.185827 percent !

     --- Total labor use & endowment ---
(10-29) labor use=  1.904961800000001
(10-30) lbar=       1.904961800000000

     --- Excess demand for capital & labor ---
(10-31) rho_k= -0.000000000000001
(10-32) rho_l=  0.000000000000001

     --- Sectoral capital/labor ratio ---
(10-33) k[ 0]/l[ 0]= 13.201855991087241    NOTE: Up by  50.141910 percent !
(10-34) k[ 1]/l[ 1]=  3.084271097322647    NOTE: Up by  50.141910 percent !
(10-35) k[ 2]/l[ 2]=  3.722283567691070    NOTE: Up by  50.141910 percent !
(10-36) k[ 3]/l[ 3]=  2.412319638338907    NOTE: Up by  50.141910 percent !
(10-37) k[ 4]/l[ 4]=  1.540892642652297    NOTE: Up by  50.141910 percent !
(10-38) k[ 5]/l[ 5]=  0.556347046753722    NOTE: Up by  50.141910 percent !
(10-39) k[ 6]/l[ 6]=  2.896305384969291    NOTE: Up by  50.141910 percent !
(10-40) k[ 7]/l[ 7]=  0.660344676541139    NOTE: Up by  50.141910 percent !
(10-41) k[ 8]/l[ 8]=  7.248290914175628    NOTE: Up by  50.141910 percent !
(10-42) k[ 9]/l[ 9]=  0.860340544181539    NOTE: Up by  50.141910 percent !
(10-43) k[10]/l[10]=  0.064428919424447    NOTE: Up by  50.141910 percent !
(10-44) k[11]/l[11]=  0.549439808865817    NOTE: Up by  50.141910 percent !
(10-45) k[12]/l[12]=  5.612778787737121    NOTE: Up by  50.141910 percent !

     --- Economy-wide capital/labor ratio ---
(10-46) kbar/lbar= 1.039104826144020   NOTE: Up by  42.857143 percent !


///  11. Commodity markets  ///
     --- Domestic output ---
(11- 1) Per capita Q[ 0]= 0.142064717600135   NOTE: Up by  28.710808 percent !
(11- 2) Per capita Q[ 1]= 0.016598759883193   NOTE: Up by  25.309126 percent !
(11- 3) Per capita Q[ 2]= 0.027357497353127   NOTE: Up by  13.862267 percent !
(11- 4) Per capita Q[ 3]= 0.019209424701589   NOTE: Up by  14.359531 percent !
(11- 5) Per capita Q[ 4]= 0.614117881725627   NOTE: Up by   7.792179 percent !
(11- 6) Per capita Q[ 5]= 0.475684048993303   NOTE: Up by  17.253854 percent !
(11- 7) Per capita Q[ 6]= 0.081137526165206   NOTE: Up by  12.444202 percent !
(11- 8) Per capita Q[ 7]= 0.396429077894564   NOTE: Up by  18.189414 percent !
(11- 9) Per capita Q[ 8]= 0.416508308872497   NOTE: Up by  31.229168 percent !
(11-10) Per capita Q[ 9]= 0.226509127185184   NOTE: Up by  17.692128 percent !
(11-11) Per capita Q[10]= 0.222772261193137   NOTE: Up by   8.740281 percent !
(11-12) Per capita Q[11]= 0.684951980441638   NOTE: Up by  10.474023 percent !
(11-13) Per capita Q[12]= 0.015354188973970   NOTE: Up by  17.749227 percent !

     --- Total value of domestic output ---
(11-14) Total = 5.303245405547834


     --- Domestic demand---
(11-15) per capita X[ 0]=  0.019310187120643   NOTE: Up by  35.795755 percent !
(11-16) per capita X[ 1]=  0.008611336315917   NOTE: Up by  30.788407 percent !
(11-17) per capita X[ 2]=  0.005939050473433   NOTE: Up by  30.562869 percent !
(11-18) per capita X[ 3]=  0.000140463811605   NOTE: Up by  25.741633 percent !
(11-19) per capita X[ 4]=  0.413366171606399   NOTE: Up by  23.985887 percent !
(11-20) per capita X[ 5]=  0.440850246807970   NOTE: Up by  17.135520 percent !
```

```
(11-21) per capita X[ 6]=  0.033729334923647   NOTE: Up by  27.573119 percent !
(11-22) per capita X[ 7]=  0.224519127826473   NOTE: Up by  16.785685 percent !
(11-23) per capita X[ 8]=  0.305924116202476   NOTE: Up by  37.488698 percent !
(11-24) per capita X[ 9]=  0.097329177955062   NOTE: Up by  18.564833 percent !
(11-25) per capita X[10]=  0.221491952193137   NOTE: Up by   8.692211 percent !
(11-26) per capita X[11]=  0.606582139238766   NOTE: Up by  15.718157 percent !
(11-27) per capita X[12]=  0.000161877453601   NOTE: Up by  32.689486 percent !

     --- Total value of domestic demand ---
(11-28) Total = 3.816593681105842

     --- External sector (Net export) demand ---
(11-29) ES[ 0]=  0.127436000000008
(11-30) ES[ 1]=  0.003006000000000
(11-31) ES[ 2]=  0.002705000000000
(11-32) ES[ 3]=  0.003215000000000
(11-33) ES[ 4]= -0.590747999999972
(11-34) ES[ 5]=  0.000000000000010
(11-35) ES[ 6]= -0.032692999999995
(11-36) ES[ 7]=  0.091836000000002
(11-37) ES[ 8]= -0.023064999999985
(11-38) ES[ 9]=  0.020319999999999
(11-39) ES[10]=  0.000000000000000
(11-40) ES[11]= -0.309446999999953
(11-41) ES[12]=  0.001988000000000

     --- Total external sector demand ---
(11-42) Total ES Value = -0.593242497398216

     --- Total external finance ---
(11-43)             EF = 0.593242497398216


///  12. Individual Welfare (utility) level  ///
(12-1) u_autarky = 0.000000635496054

(12-2) u_old =   0.000000531985690
(12-3) u_new =   0.000000635496054
(12-3) u_individual =   0.000000635496054
(12-4) y_old =   0.000003663463728
(12-5) y_new =   0.000003694635249
(12-6) individual_cv=((u_new-u_old)/u_new)*y_new=601786.645951796090230
(12-7) individual_ev=((u_new-u_old)/u_old)*y_old=712813.277325085597113
```

/// 13. Input-output Accounting Matrix (in value terms) ///

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	X[i]	ES[i]	Q[i]
(0)	0.029331	0.000074	0.000000	0.000000	0.067741	0.001964	0.000000	0.000084	0.000000	0.000006	0.000038	0.007169	0.000000	0.036785	0.127436	0.270628
(1)	0.000059	0.005481	0.000022	0.000003	0.006207	0.000181	0.000000	0.000000	0.000000	0.000000	0.000003	0.000254	0.000000	0.016404	0.003006	0.031620
(2)	0.000000	0.000000	0.001528	0.000000	0.034102	0.000000	0.000000	0.000000	0.000000	0.000000	0.000008	0.002458	0.000000	0.011314	0.002705	0.052115
(3)	0.000000	0.000005	0.000000	0.000166	0.011717	0.009830	0.011350	0.000000	0.000000	0.000000	0.000013	0.000026	0.000003	0.000268	0.003215	0.036593
(4)	0.051905	0.001263	0.010320	0.005885	0.337383	0.250837	0.011962	0.032150	0.011348	0.026001	0.057586	0.175072	0.001461	0.787447	-0.590748	1.169871
(5)	0.002153	0.000068	0.000045	0.000254	0.004313	0.002709	0.006946	0.004562	0.023497	0.004034	0.007489	0.010288	0.000000	0.839803	0.000000	0.906160
(6)	0.001589	0.000095	0.000100	0.001102	0.027257	0.006757	0.010290	0.010332	0.002948	0.007144	0.016199	0.038919	0.000271	0.064253	-0.032693	0.154564
(7)	0.014076	0.000477	0.002602	0.001680	0.068556	0.059306	0.002753	0.012888	0.002036	0.005891	0.008568	0.056481	0.000331	0.427700	0.091836	0.755182
(8)	0.010961	0.000379	0.001264	0.002755	0.015132	0.016510	0.005740	0.060320	0.052386	0.022786	0.002813	0.039010	0.003667	0.582774	-0.023065	0.793432
(9)	0.006945	0.000937	0.000968	0.001422	0.029088	0.038514	0.004699	0.031915	0.012032	0.045056	0.021841	0.031599	0.000747	0.185408	0.020320	0.431491
(10)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002439	0.421934	0.000000	0.424373
(11)	0.005513	0.000639	0.001192	0.005452	0.064337	0.083677	0.014214	0.058366	0.047360	0.041545	0.044955	0.090128	0.001361	1.155516	-0.309447	1.304807
(12)	0.001568	0.000072	0.000248	0.000480	0.006061	0.003946	0.000764	0.004427	0.003463	0.002090	0.000319	0.003515	0.000000	0.000308	0.001988	0.029249
k[i]	0.137139	0.017002	0.027090	0.012532	0.308236	0.157089	0.064951	0.218803	0.567018	0.130624	0.016072	0.306593	0.016306			
l[i]	0.010388	0.005512	0.007278	0.005195	0.200037	0.282357	0.022426	0.331347	0.078228	0.151829	0.249450	0.558010	0.002905			

/// 14. Social Accounting Matrix (in value terms) ///

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(0)	0.179203	-0.000055	-0.000000	-0.000000	-0.050309	-0.001459	-0.000000	-0.000062
(1)	-0.000046	0.020155	-0.000017	-0.000002	-0.004786	-0.000139	-0.000000	-0.000000
(2)	-0.000000	-0.000000	0.039075	-0.000000	-0.026342	-0.000000	-0.000000	-0.000000
(3)	-0.000000	-0.000004	-0.000000	0.029217	-0.009397	-0.007884	-0.009103	-0.000000
(4)	-0.042220	-0.001027	-0.008394	-0.004787	0.677151	-0.204032	-0.009730	-0.026151
(5)	-0.001854	-0.000059	-0.000038	-0.000218	-0.003713	0.777850	-0.005981	-0.003928
(6)	-0.001256	-0.000075	-0.000079	-0.000871	-0.021548	-0.005341	0.114053	-0.008168
(7)	-0.012155	-0.000412	-0.002247	-0.001451	-0.059202	-0.051214	-0.002378	0.641012
(8)	-0.008040	-0.000278	-0.000927	-0.002021	-0.011100	-0.012110	-0.004211	-0.044246
(9)	-0.005907	-0.000797	-0.000824	-0.001209	-0.024743	-0.032760	-0.003997	-0.027147
(10)	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000	-0.000000
(11)	-0.004805	-0.000557	-0.001039	-0.004751	-0.056071	-0.072926	-0.012387	-0.050867
(12)	-0.001192	-0.000055	-0.000188	-0.000364	-0.004607	-0.002999	-0.000581	-0.003365
k[i]	-0.091340	-0.011324	-0.018043	-0.008347	-0.205296	-0.104627	-0.043260	-0.145731
l[i]	-0.010388	-0.005512	-0.007278	-0.005195	-0.200037	-0.282357	-0.022426	-0.331347
EF								
Csum	0.000000	0.000000	0.000000	-0.000000	0.000000	-0.000000	0.000000	0.000000

	(8)	(9)	(10)	(11)	(12)	-p[i]*X[i]	-p[i]*ES[i]	Row_sum
(0)	-0.000000	-0.000004	-0.000028	-0.005324	-0.000000	-0.027319	0.094642	0.000000
(1)	-0.000000	-0.000000	-0.000002	-0.000196	-0.000000	-0.012649	0.002318	-0.000000
(2)	-0.000000	-0.000000	-0.000006	-0.001898	-0.000000	-0.008739	0.002089	0.000000
(3)	-0.000000	-0.000000	-0.000010	-0.000021	-0.000003	-0.000215	0.002579	-0.000000
(4)	-0.009230	-0.021149	-0.046841	-0.142405	-0.001188	-0.640514	-0.480518	0.000000
(5)	-0.020230	-0.003473	-0.006447	-0.008858	-0.000000	-0.723050	0.000000	-0.000000
(6)	-0.002330	-0.005648	-0.012806	-0.030767	-0.000214	-0.050794	-0.025845	0.000000
(7)	-0.001758	-0.005087	-0.007399	-0.048774	-0.000286	-0.369343	0.079305	-0.000000
(8)	0.543573	-0.016714	-0.002063	-0.028615	-0.002690	-0.427477	-0.016919	-0.000000
(9)	-0.010234	0.328701	-0.018578	-0.026878	-0.000635	-0.157708	0.017284	-0.000000
(10)	-0.000000	-0.000000	0.393757	-0.000000	-0.002263	-0.391494	0.000000	0.000000
(11)	-0.041276	-0.036207	-0.039179	1.058619	-0.001186	-1.007057	-0.269690	0.000000
(12)	-0.002632	-0.001589	-0.000242	-0.002671	0.022231	-0.000234	0.001511	0.000000
k[i]	-0.377655	-0.087001	-0.010704	-0.204202	-0.010860	1.318389		0.000000
l[i]	-0.078228	-0.151829	-0.249450	-0.558010	-0.002905	1.904962		-0.000000
EF						0.593242	-0.593242	0.000000
Csum	0.000000	0.000000	0.000000	0.000000	0.000000	-0.000000	0.000000	

```
/// 15. #s of iterations  ///
(15- 1) Iteration for general equilibrium loop: No.= 66
(15- 2) The computational time:    0.001.

===============================The end of the output file==========================
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