

Impacts of the Formation of Industrial Clusters on the Japanese Regional Economy under Rapid Population Decline during 2010-2040: Using the Dynamic Regional Computable General Equilibrium Model

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1. Introduction

The Japanese economy has sustained low growth despite deflation for nearly 20 years. The Abe administration's policy focus has been to exit deflation and revitalize the economy, and the government is currently implementing new economic policies known as "Abenomics" that aim at "bold monetary policy," "flexible fiscal policy," and a "growth strategy that promotes private investment." The major premise for these economic policies is Japan's "depopulating society," caused by a declining birth rate and an aging population. Furthermore, the changing demographics, in which the core labor force population aged 20–64 is shrinking while the population aged 65 and over is growing, is not uniform across Japan, as inter-regional disparities exist. These population dynamics are troubling because they not only restrain the Japanese economy and impede the revitalization of regional economies, but they could also lead to increased disparities among regions. This study clarifies the types of policy measures needed to revitalize Japan's economy in a "depopulating society" without exacerbating the disparities among regional economies from the viewpoint of industrial clusters. The targets proposed in "Basic Policies for Economic and Fiscal Management and Reform—Ending Deflation and Revitalizing the Economy" (June 13, 2013, Cabinet Decision) include a nominal GDP growth rate of 3% and a real GDP growth rate of approximately 2%, on average, for the "new decade of revival" (from fiscal 2013 through fiscal 2022). This "Japan Revitalization Strategy" was amended in 2014, and the following is an extract from the revised version. "However, it is not easy to put the Japanese economy back onto a full growth path at a time when Japan's economy and society face the advent of a population fall through declining birthrate and aging population." Therefore, the strategy emphasizes that boosting productivity and strengthening "earnings capacity" is vital for the Japanese economy as a whole. Thus, this study employs the recursive-dynamic six regional computable general equilibrium (D6SCGE) model to draft a picture of the future of regional economies 30 years from now based on the depopulating society.

2. Assumptions in setting the scenario

The population forecasts frequently used in surveys and papers regarding the depopulating society are "Population Projections for Japan (January 2012 projections)" published by the National Institute of Population and Social Security Research (IPSS). These projections use data from the 2000 Population Census for Japan and the Vital Statistics of Japan and are based on three variants for the national population until 2060. According to these projections, Japan's population is expected to decline by approximately 970,000 people by around 2040, with the proportion of the elderly at approximately 36%. The IPSS has also released "Population Projections for Japan by Region" (March 2013 projections), in

which it projects the population of prefectures and municipalities by gender and age group until 2040 based on national medium-variant fertility and mortality assumptions. As can be seen from the trends for the population aged 20–64 and the population aged 65 and above by region (indexed to 2010 = 100), the former is declining in all regions and becomes more pronounced year after year. This becomes particularly noticeable in Hokkaido and Tohoku by 2040, where the population aged 20–64 is projected to decline by 40% relative to 2010. Even in Kanto, the population of this group is projected to decline by approximately 30%. On the other hand, the population aged 65 and above is projected to rise in all regions, although regional disparities are likely to exist between 2025 and 2030. The high growth rate in this segment of the population is particularly pronounced in Okinawa, and there is moderate growth in Kanto as well until 2030, which is then followed by a sharp increase. On the other hand, the population aged 65 and above in Tohoku is projected to peak around 2025 before declining while the population aged 65 and above is projected to remain virtually flat in Hokkaido. This study uses the IPSS population projections for populations through 2040 for each prefecture by gender and for five age groups spanning ages 20 to 64.

3. Structure of the dynamic six regional CGE model

The database used for the recursive-dynamic six regional computable general equilibrium (D6SCGE) model is the six inter-regional social accounting matrix (SAM), which encompasses the inter-regional Input-Output Table of competitive import model for the six regions of Hokkaido, Tohoku, Kanto (the seven prefectures of the Kanto area plus the four prefectures of Niigata, Nagano, Yamanashi, and Shizuoka), Chubu/Kinki/Chugoku/Shikoku, Kyushu, and Okinawa.

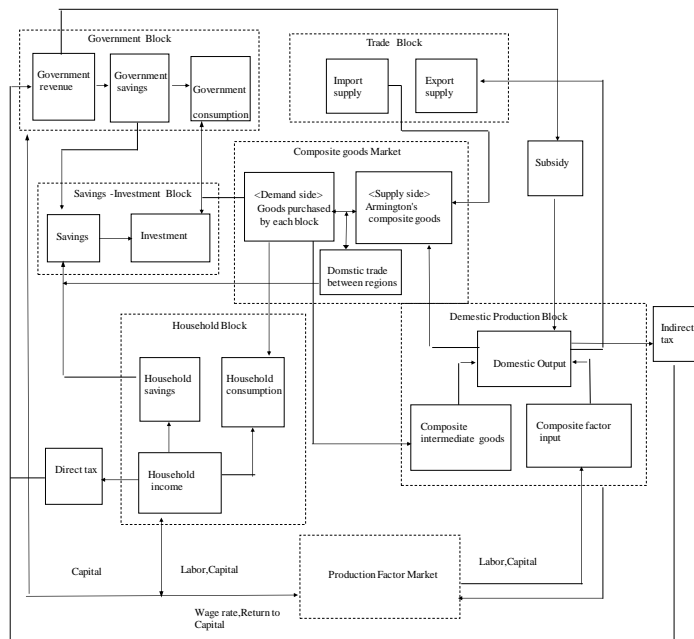


Fig.3c. Structure of the CGE Model

The data sources for this regional SAM are the 2005 Ministry of Internal Affairs and Communications' national Input-output table, the 2005 Ministry of Economy, Trade and Industry's nine inter-regional Input-output table along with its nine intra-regional Input-Output Table of competitive import model, and the Cabinet Office's fiscal 2005 Prefectural Accounts for 47 prefectures. Then we constructed the D6SCGE model, in which is the six regional computable general equilibrium (6SCGE) model with the addition of a recursive dynamic dimension.

4. Simulations and the results

4.1 Setting the simulation scenarios

In this study, our base case scenario assumes the scenario based on the rate of decline in the labor force by region, and our alternative-case scenarios call for an increasing labor participation rate due to various policies associated with economic revitalization. For the latter, we assume three scenarios: A, B1, and B2.

Table 6 Productivity of industry by Region

a) Scenario A, B1 and B2												
efficiency parameter in the firm's production function (annual rate of time period)	Crop cultivation, Lvestock and Fisheries				Foods, Beverage				Transport			
	T=1-5	T=6-10	T=11-20	T=20-30	T=1-5	T=6-10	T=11-20	T=20-30	T=1-5	T=6-10	T=11-20	T=20-30
Hokkaido	3.0%	5.0%	5.0%	5.0%	1.5%	2.5%	3.0%	3.5%	0.0%	0.0%	0.0%	0.0%
Tohoku	3.0%	5.0%	5.0%	5.0%	1.0%	2.0%	2.5%	3.0%	0.0%	0.0%	0.0%	0.0%
Kanto	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.8%	1.0%	1.5%
Chubu,Kinki,Chugoku and Shikoku	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.8%	1.0%	1.5%
Kyushu	3.0%	5.0%	5.0%	5.0%	1.0%	2.0%	2.5%	3.0%	0.0%	0.0%	0.0%	0.0%
Okinawa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	1.0%	1.5%	1.5%

b) Scenario A								
efficiency parameter in the firm's production function (annual rate of time period)	General machinery,Electrical machinery and Transportation equipment etc.				Tertiary industry excluding electricity,gas and heat-water supply,commerce and transport			
	T=1-5	T=6-10	T=11-20	T=20-30	T=1-5	T=6-10	T=11-20	T=20-30
Hokkaido	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tohoku	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kanto	0.05%	0.10%	0.15%	0.20%	0.8%	0.8%	1.0%	1.5%
Chubu,Kinki,Chugoku and Shikoku	0.05%	0.10%	0.15%	0.20%	0.8%	0.8%	1.0%	1.5%
Kyushu	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Okinawa	0.0%	0.0%	0.0%	0.0%	0.5%	1.0%	1.5%	1.5%

c) Scenario B1 and B2												
efficiency parameter in the firm's production function (annual rate of time period)	Textile products, Pupt, parer and wooden products and Chemical products etc.				Iron and steal, Non-ferrous metals and Metal products				Tertiary industry excluding electricity,gas and heat-water supply,commerce and transport			
	T=1-5	T=6-10	T=11-20	T=20-30	T=1-5	T=6-10	T=11-20	T=20-30	T=1-5	T=6-10	T=11-20	T=20-30
Hokkaido	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.5%	0.8%	1.0%
Tohoku	0.3%	0.5%	1.0%	1.5%	0.3%	0.5%	0.5%	0.5%	0.3%	0.5%	0.8%	1.0%
Kanto	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.8%	1.0%	1.5%
Chubu,Kinki,Chugoku and Shikoku	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.8%	1.0%	1.5%
Kyushu	0.3%	0.5%	1.0%	1.5%	0.3%	0.5%	0.5%	0.5%	0.3%	0.5%	0.8%	1.0%
Okinawa	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	1.0%	1.5%	1.5%

d) Scenario B1					e) Scenario B2				
efficiency parameter in the firm's production function (annual rate of time period)	General machinery,Electrical machinery and Transportation equipment etc.				efficiency parameter in the firm's production function (annual rate of time period)	General machinery,Electrical machinery and Transportation equipment etc.			
	T=1-5	T=6-10	T=11-20	T=20-30		T=1-5	T=6-10	T=11-20	T=20-30
Hokkaido	0.0%	0.0%	0.0%	0.0%	Hokkaido	0.0%	0.0%	0.0%	0.0%
Tohoku	0.30%	0.50%	1.00%	1.50%	Tohoku	0.50%	0.75%	2.00%	3.00%
Kanto	0.05%	0.10%	0.15%	0.20%	Kanto	0.05%	0.10%	0.15%	0.20%
Chubu,Kinki,Chugoku and Shikoku	0.05%	0.10%	0.15%	0.20%	Chubu,Kinki,Chugoku and Shikoku	0.05%	0.10%	0.15%	0.20%
Kyushu	0.30%	0.50%	1.00%	1.50%	Kyushu	0.50%	0.75%	2.00%	3.00%
Okinawa	0.0%	0.0%	0.0%	0.0%	Okinawa	0.0%	0.0%	0.0%	0.0%

First, the rates of change in the labor force among the six regions for the base case scenario and the other three scenarios. The base case scenario assumes that the labor force declines by 27.8% nationally

between 2010 and 2040, with declines of 34.8% for Hokkaido, 38.1% for Tohoku, 26.1% for Kanto, 27.3% for Chubu/Kinki/Chugoku/Shikoku, 28.6% for Kyushu, and 11.1% for Okinawa. In contrast, the other three scenarios assume the rates of decline will be approximately 5% to 8% less than the base case scenario. Even so, the rates of decline are projected to be approximately 30% in the northern regions, with declines of 29.6% for Hokkaido and 32.0% for Tohoku. Let us now explain the three alternative case scenarios except the base case scenario. Scenario A features increased production to meet the increased exports and domestic supply attributed to the “Japan Revitalization Strategy” mentioned above in Section 2.2. Second, we assumed an increase in industrial productivity to supply the goods and services needed to meet additional demand generated through the development of new markets, with the construction of next-generation infrastructure and growth of the so-called sixth industry, the medical and healthcare sector, and the energy sector following that same strategy. Next, we explain the scenario B1 of the improving productivity for the manufacturing sector in the regional areas of Tohoku and Kyushu, based on the scenario A. Lastly, we explain the scenario B2 of the development of broad-range industrial clusters in the regional areas of Tohoku and Kyushu, based on the scenario B1.

4.2 Simulation results

Here, we note the following three points from a comparison of real GRP, nominal GRP, and total output for the nation and the six regions for each scenario, as shown in Table 9.

Table 9 Projection of GRP and total output

(annual rate of 10 years)		Real GRP			Nominal GRP			Total Output		
		2010-2020	2020-2030	2030-2040	2010-2020	2020-2030	2030-2040	2010-2020	2020-2030	2030-2040
Whole country	Base Scenario	-0.04%	-0.02%	-0.41%	0.09%	0.07%	0.06%	-0.07%	-0.05%	-0.43%
	Scenario A	0.64%	0.80%	0.55%	0.86%	0.91%	0.88%	0.70%	0.76%	0.44%
	Scenario B1	0.68%	0.89%	0.67%	0.87%	0.93%	0.90%	0.78%	0.91%	0.63%
	Scenario B2	0.69%	0.91%	0.70%	0.77%	0.93%	0.91%	0.79%	0.93%	0.67%
Hokkaido	Base Scenario	-0.27%	-0.20%	-0.57%	0.09%	0.08%	0.08%	-0.23%	-0.17%	-0.53%
	Scenario A	0.22%	0.35%	-0.23%	0.60%	0.68%	0.73%	0.50%	0.66%	0.12%
	Scenario B1	0.43%	0.78%	0.32%	0.60%	0.67%	0.70%	0.68%	1.03%	0.58%
	Scenario B2	0.44%	0.78%	0.33%	0.53%	0.68%	0.71%	0.68%	1.02%	0.57%
Tohoku	Base Scenario	-0.43%	-0.35%	-0.56%	0.08%	0.07%	0.07%	-0.41%	-0.34%	-0.54%
	Scenario A	-0.01%	0.16%	-0.24%	0.64%	0.67%	0.73%	0.10%	0.30%	-0.04%
	Scenario B1	0.25%	0.70%	0.49%	0.70%	0.78%	0.84%	0.37%	0.83%	0.69%
	Scenario B2	0.28%	0.77%	0.61%	0.55%	0.79%	0.85%	0.53%	0.99%	0.97%
Kanto	Base Scenario	0.06%	0.02%	-0.42%	0.09%	0.06%	0.05%	0.07%	0.03%	-0.39%
	Scenario A	0.81%	0.92%	0.72%	1.04%	0.94%	0.88%	0.87%	0.88%	0.66%
	Scenario B1	0.81%	0.93%	0.73%	1.04%	0.94%	0.90%	0.87%	0.88%	0.66%
	Scenario B2	0.82%	0.94%	0.75%	0.93%	0.95%	0.90%	0.87%	0.88%	0.67%
Chubu, Kinki, Chugoku and Shikoku	Base Scenario	-0.05%	-0.01%	-0.41%	0.09%	0.08%	0.07%	-0.03%	-0.01%	-0.39%
	Scenario A	0.67%	0.86%	0.62%	0.80%	0.98%	0.94%	0.85%	0.80%	0.54%
	Scenario B1	0.67%	0.86%	0.63%	0.80%	0.98%	0.94%	0.84%	0.80%	0.55%
	Scenario B2	0.67%	0.87%	0.65%	0.70%	0.97%	0.92%	0.84%	0.80%	0.55%
Kyushu	Base Scenario	-0.18%	-0.04%	-0.27%	0.09%	0.08%	0.08%	-0.16%	-0.03%	-0.24%
	Scenario A	0.20%	0.40%	0.06%	0.51%	0.70%	0.74%	0.33%	0.54%	0.26%
	Scenario B1	0.47%	0.95%	0.77%	0.59%	0.84%	0.92%	0.61%	1.10%	1.00%
	Scenario B2	0.48%	0.99%	0.85%	0.47%	0.88%	0.98%	0.81%	1.28%	1.38%
Okinawa	Base Scenario	0.30%	0.29%	0.05%	0.10%	0.09%	0.10%	0.33%	0.30%	0.08%
	Scenario A	1.11%	1.58%	1.28%	0.99%	0.97%	1.08%	1.21%	1.60%	1.33%
	Scenario B1	1.12%	1.59%	1.30%	1.00%	0.98%	1.09%	1.21%	1.60%	1.33%
	Scenario B2	1.12%	1.60%	1.31%	0.92%	0.96%	1.04%	1.21%	1.60%	1.33%

First, the national economic growth rate is approximately zero in the base case scenario of decline in the labor force by region, declining to a rate of -0.4% per annum by 2030. In contrast, for scenario A, we found that the growth rate to be in the range of 0.6% per annum until 2020 and 0.8% in the 2020s, then slowing down to the 0.5% range in the 2030s. However, as the pushing effect of real growth rate is weak and the wider regional disparity for only this scenario A, we consider the scenario B1 of the improving productivity in the manufacturing sector and the scenario B2 of the development of broad-range industrial clusters. For scenarios B1 and B2, we found that the growth rate to be in the range of 0.7% per annum until 2020 and $0.8\text{--}0.9\%$ in the 2020s, slowing down to the 0.7% range in the 2030s. We thus found that both scenarios are effective in pushing up real economic growth rate.

Second, by region, although the regional economic growth rate for the urban areas of Kanto and Chubu/Kinki/Chugoku/Shikoku is approximately zero, then slowing down to the -0.4% in the 2030s in the base case scenario, the positive growth of $0.7\text{--}0.8\%$ in the same urban areas in the 2030s in the scenarios A, B1 and B2. On the other hand, we forecast negative growth of $0.2\text{--}0.5\%$ in the regional areas of Hokkaido, Tohoku, and Kyushu under the base case scenario and growth that is either negative or very low at $0.1\text{--}0.4\%$ under scenario A. However, the manufacturing sectors in the Tohoku and Kyushu areas under scenario B1 incorporate the impact of the improving productivity, so economic growth in Kyushu is expected to be on a par with that of urban areas in Kanto and Chubu/Kinki/Chugoku/Shikoku. In addition, although the decline in the labor force will exert downward pressure on economic growth in the Tohoku region compared to other regions from 2030 on, Tohoku will be able to maintain economic growth of close to 0.5% . As evident, the simulation results show that besides the demographic change in the labor force, the inter-regional differences between urban and regional areas will grow beyond 2030 unless the improving productivity of manufacturers. Third, in terms of the impact of industrial clusters on regional areas, the total outputs by region in scenarios A and B2 indicate that the growth rate of total output in Tohoku can become surpass that of Kanto in the 2020s, while growth would surpass 1.2% in Kyushu. This highlights the impact that industrial clusters focused on manufacturing has on revitalizing production activity in regional areas.

5. Conclusion and policy implications

This study clarified the types of policy measures needed to revitalize Japan's economy in a "depopulating society" without exacerbating the disparities among regional economies from the viewpoint of industrial clusters. The following three points were highlighted through the simulation. First, unless the productivity of production activities in a "depopulating society" improves, Japan's economic growth will be virtually zero and decline to negative growth of 0.4% by 2030. However, economic growth could reach a level of approximately $0.7\text{--}0.8\%$ if policies are taken to increase productivity and raise production subsidies to create the production volume required to meet the additional domestic and overseas demand generated by the current Abe administration's "Japan Revitalization Strategy." However, such economic growth will be supported by growth in urban areas and it will increase the disparities in

growth among regions. Consequently, the simulation results indicate that incorporating the impact of industrial clusters on regional areas yields growth that is on a par with that of urban areas. Considering this point, some form of preferential policies to support industry (e.g., policies for varying corporate taxes by region), such as in the industrial clusters focused on the manufacturing sector (as is currently evident in automotive industrial clusters in the Tohoku and Kyushu areas), would revitalize regional areas' economies and ultimately correct inter-regional economic disparities. Second, the construction of wide-range industrial clusters – those which go beyond the current automobile clusters in the regional areas of Tohoku and Kyushu to incorporate a wider range of manufacturing sectors such as general machinery and electrical machinery – will be effective in preventing the exacerbation of inter-regional economic welfare disparities during the process of fiscal consolidation. The simulations conducted in this analysis suggest that construction wide-range industrial clusters will invigorate regional economies and will lead to narrower inter-regional economic disparities. Funds will be secured by changing the allocation ratio of local allocation tax grants in favor of regional areas rather than urban areas. In order to resolve inter-regional economic disparities, it is necessary to build new infrastructure by utilizing those funds to provide production subsidies for the member industries of broad-range industrial clusters as well as to offer corporate income tax cuts to lure industries to regional areas.