

# THE ECONOMIC AND INDUSTRIAL FORECAST OF JAPAN 2013–2030 BY REVISED MODEL JIDEA9

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## Introduction

23 years have passed since we started the construction of an INFORUM type model<sup>11</sup> JIDEA (Japan Inter-industry Dynamic Econometric Analysis). Year by year, we revised the model following the new I-O table published by the Japanese government. The government changes the base year of the I-O table every five years, then we construct a totally new model, re-organizing the industrial sectors and adding a new mechanism of calculation. The revision of 2016 demands a lot of work as the base year changed from 2005 to 2011<sup>12</sup> and the sector number increased from 73 to 85.

The model is based on observed data using I-O tables from 1995 to 2013. Estimates for future I-O tables from 2014 to 2030 are calculated using regression equations sector by sector. For both the final demand side (household consumption, private investment, exports and imports) and the value added side (wages, profits, depreciations, taxes and subsidies) we estimate each function sector by sector. All these components are summed up to macroeconomic variables. Through this model, input and output of each industry is calculated with perfect consistency, and we can analyze future economic situations from various aspects.

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<sup>11</sup> The model structure is explained in ITI web page  
(<http://www.iti.or.jp/jidea.model.pdf>).

<sup>12</sup> The publishing of I-O table was delayed and the base year was 2011 instead of 2010.

In this report, we analyzed how the Japanese economy would develop from 2014 until 2030 based on Japanese historical data from 1995 to 2013 using the JIDEA9 model.

## 1. Shrinking Japanese economy and industries

### 1.1. Introduction and assumptions of the simulation

The revised model JIDEA9<sup>13</sup> is based on the observed data expressed in 2011 prices from 1995 to 2013, and we changed total sectors from 73 to 85. The number of manufacturing industry sectors increased from 44 to 51 and of service industry sectors from 29 to 34. The model is based on I-O tables published by the Japanese Statistical Office<sup>14</sup> and Japanese National Accounts.

The sectoral employment data are based on the attached table of the System of National Accounts (SNA) published in 2017, which contains 23 sectors. The 23 sectors are spread to 85 sectors using sectoral employment data attached to the basic I-O table which is published every 5 years. The labor input coefficients are extended by the assumption that the growth rate of the labor input coefficient from 2000 to 2015 is the same as from 2016 to 2030.

For the gross fixed capital formation of the I-O table, industries expressed as selling side industries of capital goods are converted to purchasing side industries by the fixed capital matrix of 2011 (available in the basic I-O table of the same year). The fixed capital matrix is only obtained once every 5 years, so in the JIDEA9 model, we converted the investment flow from the selling side to the purchasing side only by using the table of 2011.

The main sources of the I-O table are I-O linked tables made for 2000, 2005 and 2011 with the same definition and base year<sup>15</sup>. We have complemented the missing year tables by the extended I-O tables, which are prepared separately by the Ministry of Economy, Trade and Industry. The historical database itself contains the effect of the Lehman Brothers Bankruptcy, and the North East Japan Earthquake and its recovery process. The estimated I-O table for 2014 is adjusted by macroeconomic indicators of SNA. Accordingly, the results estimated by the model are from 2015.

Baseline assumptions of the JIDEA9 model.

<sup>13</sup> The basic software of this model is developed by INFORUM (<http://www.inforum.umd.edu/>)

<sup>14</sup> The details are shown in the data source Table A1 in the Appendix.

<sup>15</sup> Refer to Table A1 in the Appendix.

- Recent year (2014) simulation results are controlled by actual or provisional data of SNA.
- The additional government investment and consumption in 2014–2015 spent for the East Japan Earthquake is included.
- The planned increase of the consumer tax in 2014 (from 5 % to 8 %) and in October 2019 (from 8 % to 10 %) is included.
- The intermediate input coefficient matrix is extended by historical trend (1995–2013) until 2030.

The main exogenous variables.

- The population forecasted by the National Institute of Population and Social Securities Research on January 2012 with medium mortality assumption.
- The labor participation rate<sup>16</sup> and labor productivity are extended by historical growth rate.
- The exchange rate is fixed by the monthly average rate of 2016; 1 dollar=108.837 yen.
- The fossil fuel price is assumed to grow by 2 % annually from 2017 to 2030.
- World import demand from Japan and Japanese import price from the world are prepared by BTM<sup>17</sup>.
- Government investment is extended by one year lagged value.

Considering the United Kingdom's exit from the EU, "America first" policy by the U.S. President Trump, and the economic stagnation of China, instability is increasing in the world economy and turning into a new stage. With OPEC's agreement to reduce oil production, world material prices are expected to spike, and with the instability of exchange rates and the stock market, the prospect of the world economy seems opaque. "Abenomics", which consists of three objects: bold monetary easing, flexible fiscal policy, and economic growth strategies to encourage private investment, started in 2013. It achieved limited results in financial and monetary aspects such as rising stock prices and weaker Yen. It has not shown evident recovery because of the delay of implementation of the policy to encourage growth.

In 2016, the Abe cabinet presented a new policy named the "Japan Revival Strategy" aiming to pull the size of Japanese GDP up to 600 trillion yen, but the detailed strategy was not announced. It is almost an abstract explanation without statistical data. On the other hand, the statistical office was planning the revision of the SNA statistical system and definitions. For example, private R & D payments are planned to be included as investment.

<sup>16</sup> The labor participation rate increases from 59.3 % in 2013 to 63.5 % in 2030. Labor participation rate is calculated as labor force divided by working age population.

<sup>17</sup> Bi-lateral Trade Model of INFORUM



**Fig. 1.** Population, 100 thousand.

As a result, the objective of increasing the size of GDP to 600 trillion yen was almost fulfilled. Nonetheless, Abe’s strategy is not included in JIDEA9.

The special procurement of the Tokyo Olympic Games in 2020 may bring such effects as a result of construction of new game venues, game management costs, and travel expenditures of foreign visitors. The total amounts of these effects should be estimated outside the model. Therefore the effects of the Tokyo Olympic Games are difficult to estimate and not included in the model.

This model is intended to forecast the economy in real terms, so the fiscal or monetary policy such as significant monetary easing by Mr. Kuroda, the Governor of Bank of Japan, is not included in the model. Even though these fiscal and monetary policy effects are thought to be included in the historical data such as in 2014 and 2015 when “Abenomics” was implemented in the Japanese economy. It is assumed that the world economy grows gradually, though the exchange rate is fixed at 108.837 per US dollar of the 2016 level. The fuel price in 2016 is 41.6 US dollars per barrel, and after 2017, the fuel price is assumed to grow by 2 % annually until 2030.

In these assumptions, the most significant effect is caused by the shrinking population. The Japanese population reached its peak in 2005 and then began to shrink. The share of the population over 65 increases and the share of the population from 15 to 65, the working age population, decreases (Fig. 1). In 2025, the baby boom generation will reach the group of elderly people, and Japan will encounter the risk of rapid increase of Medicare costs. As this model does not include the financial or fiscal sub-model, it cannot estimate the budget deficit or bankruptcy of the pension fund.

## 1.2. Decreasing GDP and consumption

GDP in real terms decreases after the peak in 2016 (Table 1). From 2015 to 2030, consumption decreases, especially household consumption, which forms 60 % of GDP. Private investment peaks out in 2015, but government investment continues to increase, and accordingly total investment peaks in 2020–2021. Exports reach a peak

Table 1

Long-term Economic Forecasts of Japan, 2011 Prices,  
Trillion Yen, 100 Thousand\*, %

Year	GDP	Consumption	Investment	Exports	Imports	Output	Wages	Inflation	Number of employees*	Growth rate GDP %
2013	471.1	385.2	101.3	72.1	87.4	934.9	255.3	0.53	633.8	0.67
2014	471.7	380.7	105.1	74.7	88.8	937.6	256.3	1.38	633.6	0.14
2015	476.6	375.7	112.8	76.8	88.8	953.6	260.6	0.26	634.6	1.02
2016	479.5	377.4	114.9	76.7	89.5	961.3	261.0	-0.87	635.0	0.61
2017	479.4	376.9	115.6	76.5	89.5	962.5	260.3	-0.05	635.0	-0.01
2018	479.3	376.6	116.0	76.2	89.6	963.4	259.4	-0.24	635.0	-0.03
2019	479.1	376.1	116.3	75.9	89.3	964.6	258.5	0.07	634.9	-0.04
2020	478.7	375.6	116.5	75.8	89.2	965.4	257.5	-0.13	634.9	-0.09
2021	478.2	375.2	116.5	75.7	89.1	966.2	256.5	-0.12	634.8	-0.10
2022	477.5	374.6	116.4	75.5	89.0	966.8	255.4	-0.09	634.8	-0.14
2023	476.8	374.0	116.2	75.5	88.9	967.4	254.3	-0.08	634.7	-0.15
2024	475.9	373.3	116.0	75.4	88.8	967.8	253.1	-0.06	634.6	-0.19
2025	474.9	372.6	115.7	75.3	88.6	968.2	251.9	-0.05	634.4	-0.20
2026	473.6	371.8	115.2	75.3	88.7	968.0	250.5	-0.02	634.3	-0.27
2027	472.2	370.9	114.6	75.2	88.6	967.5	249.2	0.01	634.1	-0.31
2028	470.6	370.0	114.0	75.1	88.5	967.0	247.8	0.03	633.8	-0.33
2029	468.9	368.9	113.4	75.1	88.5	966.4	246.4	0.05	633.6	-0.35
2030	467.1	367.8	112.7	75.0	88.4	965.7	244.9	0.07	633.4	-0.38
2013-2030										
Average	-0.05	-0.27	0.63	0.23	0.07	0.19	-0.24	n.a.	0.00	n.a.
CAGR %										

Note: Figures are all in real terms except Wages; n.a. – no value.

(Source: Forecasted by JIDEA. Hereafter the source is the same except otherwise indicated.)

in 2015 followed by imports in 2018, and afterwards both gradually decrease.

Because of the transfer of the production base of Japan to overseas countries, exports decrease more rapidly than imports, and the foreign trade deficit gradually increases (Table 2).

The number of employees and wages per employee both decrease, and the total wages (which are calculated by multiplying these two indicators) decrease. As a result, disposable income, which is estimated from total wages and the profit of small business, decreases (Table 3).

Looking at this effect from the total population perspective, total wages per capita remain flat under the condition of decreased population, and disposable income per capita slightly increases (Fig. 2).

Table 2

GDP by Expenditure Approach, 2011 Prices, Trillion Yen

	Historical data				Forecast				2000 –15 CAGR (%)	2015 –30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
GDP	476.5	489.4	500.8	461.2	476.6	478.7	474.9	467.1	–0.18	–0.13
Total expenditure	364.5	383.2	393.6	370.4	375.7	375.6	372.6	367.8	–0.13	–0.14
Outside household	19.9	18.9	16.7	15.1	12.9	11.2	9.5	7.7	–2.49	–3.39
Household	271.0	281.2	283.5	276.3	275.8	278.6	278.3	276.5	–0.13	0.02
Government	73.6	83.1	93.4	79.0	87.0	85.8	84.8	83.6	0.31	–0.26
Total investment	137.2	127.3	116.3	96.8	112.8	116.5	115.7	112.7	–0.80	–0.01
Private sector	94.4	89.8	89.5	74.7	85.6	84.7	81.5	76.6	–0.32	–0.74
Government	40.9	37.6	25.1	21.1	27.9	32.4	34.8	36.7	–1.98	1.85
Inventory change	1.9	–0.2	1.7	1.1	–0.7	–0.7	–0.7	–0.7	10.4	0.0
Export	43.1	53.8	73.5	73.1	76.8	75.8	75.3	75.0	2.4	–0.2
Import	–68.3	–74.9	–82.5	–79.2	–88.8	–89.2	–88.6	–88.4	1.1	0.0
Trade Balance	–25.2	–21.1	–9.0	–6.1	–12.0	–13.5	–13.3	–13.4	n.a.	n.a.

Note: Forecasted figures of Inventory change are fixed at 2013 level. n.a. – no value.

Table 3

Disposable Income and Saving, 2011 Prices, Trillion Yen, 100 Thousand Yen\*, %

	Historical					Forecast			2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Wages (in real terms)	269.4	271.2	258.8	243.0	248.5	245.5	238.7	230.4	-0.68	-0.50
Disposable income (in nominal terms)	301.7	300.7	290.0	287.5	304.0	303.1	300.9	297.3	-0.32	-0.15
Saving (in nominal terms)	32.5	20.7	4.2	5.7	15.0	17.5	14.6	10.4	-10.98	-2.41
Saving rate (%)	10.634	6.816	1.445	1.987	4.973	5.833	4.909	3.547	-10.58	-2.23
Household consumption (in nominal terms)	272.9	282.8	285.3	279.8	286.1	281.8	282.2	282.6	0.17	-0.08
Disposable income (in real terms)	300.9	296.9	287.4	288.9	289.2	296.8	293.8	288.0	-0.27	-0.03
Saving (in real terms)	32.4	20.4	4.1	5.7	14.2	17.1	14.2	10.1	-10.93	-2.29
Household consumption (in real terms)	271.0	281.2	283.5	276.3	275.8	278.6	278.3	276.5	0.13	0.02
Wages per employee* (in real terms)	21.3	21.2	20.1	19.0	19.6	19.8	19.8	19.8	-0.77	0.04
Disposable income per capita* (in real terms)	23.9	23.5	22.5	22.5	24.0	24.4	24.9	25.5	-0.41	0.40
Consumption per capita* (in real terms)	21.4	22.0	22.0	21.6	21.8	22.4	23.1	23.7	0.04	0.57

Note: Wages and wages per capita are converted in real terms by CPI.



**Fig. 2.** Income per capita and consumption, 2011 prices, 100 thousand Yen.

The decrease of total wages is caused by the increase of the number of non-full-time employees (or irregular employment) who are not paid the same as full-time employed workers, which leads to a labor share decrease in value added. The increase of the number of aged persons who do not work causes a decrease in income; however they withdraw savings, including pension funds, therefore household consumption holds at the same level. As a result, household consumption per capita increases slightly.

Household consumption decreases gradually from 2015 to 2030, and the decrease of tangible goods is more rapid than in services (Table 4). The consumption of chemical, petro, rubber and ceramic production goods increases because the high weighted pharmacy sector is included in the chemical sector and consumption of its products increases, but the consumption of petroleum refinery sector products, which also has a large weight, decreases. As a result, the total share of this sector slightly decreases. The transportation equipment sector in which the automobile sector occupies the largest part, is stagnant, however the weight of transportation equipment in total consumption holds almost the same.

Communication equipment, such as prevailing smart-phones, is rapidly enlarging the market. The emerging internet society causes the rapid increase of the consumption of communication and information services. On the contrary, the consumption of transportation services diminishes, though the total consumption of communication, information and transportation services holds almost at the same level. The increase of the aging population causes the expansion of consumption of medical and nursing services.



Table 4

Household Consumption, 2011 Prices, Trillion Yen

	Historical					Forecast			2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
<b>Total</b>	<b>271.0</b>	<b>281.2</b>	<b>283.5</b>	<b>276.3</b>	<b>275.8</b>	<b>278.6</b>	<b>278.3</b>	<b>276.5</b>	<b>-0.13</b>	<b>0.02</b>
Agriculture, forestry, fishery and mining	4.1	3.7	3.7	3.7	3.0	2.8	2.7	2.6	-1.53	-0.93
<b>Manufacturing total</b>	<b>73.4</b>	<b>70.0</b>	<b>67.0</b>	<b>64.5</b>	<b>61.9</b>	<b>62.9</b>	<b>62.9</b>	<b>62.4</b>	<b>-0.82</b>	<b>0.06</b>
Food and beverage	31.9	29.9	28.0	26.4	23.9	23.4	22.6	21.7	-1.49	-0.63
Textile, pulp and wooden products	7.1	6.4	4.6	3.7	3.7	3.6	3.4	3.3	-3.52	-0.87
Petroleum, chemical, rubber and ceramic production	11.4	11.9	11.4	10.7	9.3	9.2	8.9	8.6	-1.62	-0.54
Ferrous, non- ferrous and metal production	0.9	0.6	0.5	0.4	0.4	0.4	0.4	0.4	-2.92	0.45
Machinery	4.2	4.5	5.4	6.8	7.0	8.5	9.6	10.6	3.01	2.80
Transport equipment	5.8	4.7	5.5	4.8	7.0	7.0	6.9	6.8	2.68	-0.16
Other manufacturing	3.9	3.3	2.9	2.2	2.3	2.6	2.7	2.8	-2.40	1.16
Construction and civil engineering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n.a.	n.a.
Electricity, gas and water supply	8.1	8.8	8.7	9.4	8.3	8.3	8.3	8.3	-0.37	0.03
<b>Service industries total</b>	<b>193.6</b>	<b>207.5</b>	<b>212.9</b>	<b>208.1</b>	<b>211.0</b>	<b>212.8</b>	<b>212.7</b>	<b>211.5</b>	<b>0.11</b>	<b>0.02</b>
Commerce, finance and real estate	107.4	111.2	115.2	112.5	116.0	116.8	116.8	116.2	0.28	0.02
Transportation, communication and information services	19.3	22.8	23.9	26.7	25.1	25.6	25.7	25.6	0.65	0.13

	Historical					Forecast			2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Administration, education and medical services	20.9	20.4	23.6	26.2	26.6	28.0	29.0	29.7	1.80	0.72
Business services	3.3	4.3	4.0	4.6	4.0	3.9	3.9	3.8	-0.48	-0.19
Personal services	42.7	48.9	46.1	38.0	39.3	38.5	37.4	36.1	-1.44	-0.57

Note: The model estimates 85 sectors, but here we aggregate them into 15 sectors.

The sectors Construction / Civil Engineering and Electricity / Gas / Water are included in Manufacturing.

n.a. – no value.

### 1.3. Output and employment; stagnation of labor productivity

In this model, the demand side is determined first, the components of GDP expenditure such as consumption, investment, and exports are estimated at the beginning, then the total of these demand items and the intermediate demand determine output and imports. The stagnation of output is caused by the decrease of household consumption, and finally the decrease of household consumption is caused by diminution of the population and the increase of the aged population. The decrease of output is apparent in the agriculture, forestry and fishery sector. The output of the total manufacturing industry decreases but slightly increases in services (Table 5). The reduction of the manufacturing industry may be caused by the transfer of production facilities<sup>18</sup> overseas. The augmentation of the service industries is explained by the immobility of service industries, that is to say, the services are produced and consumed at the same place and are difficult to transfer overseas.

Looking at the structure of the output, we can see that from 2015 to 2030 the share of manufacturing industries diminishes from 41.2 % to 39.0 % while the share of service industries increases from 57.5 % to 59.9 %. The shift towards the service industries continues. Rapidly increasing fields such as the Internet of Things, or Big Data analysis, the enterprises based on Internet society emerge one after another and the related industries or production are expected to increase significantly.

The employed population in this model is calculated by multiplying output by the labor input coefficient (=inverse of labor productivity

<sup>18</sup> In the 2013 fiscal year the overseas production rate in the manufacturing industry reached 22.9 %, higher than the preceding year by 2.6 percentage points and the highest level historically.

Table 5

Output by Sectors, 2011 Prices, Trillion Yen

	Historical				Forecast				2000 –15 CAGR (%)	2015 –30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
<b>Total</b>	<b>936.8</b>	<b>940.9</b>	<b>972.7</b>	<b>900.0</b>	<b>953.6</b>	<b>965.4</b>	<b>968.2</b>	<b>965.7</b>	<b>0.09</b>	<b>0.08</b>
Agriculture, forestry, fishery and mining	16.3	15.4	14.2	14.0	12.2	12.0	11.6	11.0	–1.55	–0.64
<b>Manufacturing total</b>	<b>445.2</b>	<b>429.2</b>	<b>419.9</b>	<b>376.7</b>	<b>393.1</b>	<b>392.6</b>	<b>386.3</b>	<b>376.6</b>	<b>–0.58</b>	<b>–0.28</b>
Food and beverage	43.1	41.4	38.4	36.1	33.0	32.1	30.9	29.5	–1.51	–0.74
Textile, pulp and wooden products	35.6	30.2	25.0	19.9	19.4	17.9	16.5	15.2	–2.91	–1.62
Petroleum, chemical, rubber and ceramic production	74.6	76.0	74.6	69.9	69.8	70.7	70.5	69.9	–0.57	0.01
Ferrous, non-ferrous and metal production	64.1	57.2	57.2	51.8	53.1	50.9	48.2	45.2	–0.49	–1.07
Machinery	60.6	64.6	69.0	63.3	68.1	70.2	71.3	71.5	0.35	0.33
Transport equipment	40.5	41.0	54.0	51.1	50.4	49.3	48.3	47.1	1.39	–0.46
Other manufacturing	6.2	5.6	4.7	4.5	4.7	4.7	4.6	4.5	–1.22	–0.32
Construction and civil engineering	92.2	83.0	67.1	52.0	65.8	67.5	66.5	64.4	–1.54	–0.15
Electricity, gas and water supply	28.4	30.2	30.0	28.1	28.9	29.2	29.4	29.5	–0.30	0.13
<b>Service industries total</b>	<b>475.3</b>	<b>496.3</b>	<b>538.6</b>	<b>509.3</b>	<b>548.3</b>	<b>560.8</b>	<b>570.4</b>	<b>578.1</b>	<b>0.67</b>	<b>0.35</b>
Commerce, finance and real estate	189.1	186.5	203.6	193.3	200.4	203.2	204.6	205.0	0.48	0.15

	Historical				Forecast				2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Transportation, communication and information services	72.8	75.2	82.1	83.5	88.0	91.5	94.2	96.7	1.05	0.64
Administration, education and medical services	104.9	115.5	130.8	119.5	130.9	132.4	133.5	134.1	0.84	0.16
Business services	45.0	50.1	58.1	58.6	71.5	78.5	85.2	92.2	2.39	1.71
Personal services	63.4	69.0	63.9	54.3	57.5	55.3	52.8	50.0	-1.21	-0.92

coefficient). The labor productivity coefficient is difficult to estimate. It is affected by the economic cycle and by the capital equipment rate per employee. It depends on whether the industry is labor intensive or capital intensive. The most influential factor for labor productivity is technical innovation, which does not occur consecutively and expectedly. Each industry is in a different level of development – some are stagnant, while others are rapidly confronting new technical innovations. The labor productivity of each industry reflects these stages of development. Accordingly, we tried many types of productivity equations to make it endogenous, but finally we assume that the labor productivity is determined by its growth rate of the past 15 years and continues at the same rate for 15 more years (Table 6). The amount of labor force required for each industry is calculated by multiplying the labor input coefficient and output estimated in the model. Labor productivity is then re-calculated using the result of the forecast and the original definition of labor productivity (=value added / employment) and graphs express the 34 sectors aggregated from 85 sectors of the model.

Comparing the increased rate of production, manufacturing grows slower than services but labor productivity growth in manufacturing is higher than in services (Table 6). This is because services are much more labor intensive than manufacturing, and also technical innovation tends to occur much easier in manufacturing than the service industries.

Looking at changes of labor productivity by comparing the values of the index in 2010 and 2030, we see that machinery, transportation

Table 6

Index of Labor Productivity (=Value Added/Number of Employees), 2015 = 100

	Historical				Forecast				2000 –15 CAGR (%)	2015 –30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
<b>Total</b>	<b>97.4</b>	<b>102.5</b>	<b>105.1</b>	<b>98.3</b>	<b>100.0</b>	<b>99.9</b>	<b>99.9</b>	<b>99.8</b>	<b>–0.17</b>	<b>–0.01</b>
Agriculture, forestry and fishery	84.7	91.1	86.1	94.5	100.0	106.2	113.8	122.9	0.63	1.38
Mining	91.6	88.9	88.5	91.7	100.0	92.6	112.4	99.1	0.79	–0.06
<b>Total manufacturing</b>	<b>87.4</b>	<b>92.1</b>	<b>95.8</b>	<b>98.2</b>	<b>100.0</b>	<b>102.2</b>	<b>104.6</b>	<b>107.4</b>	<b>0.55</b>	<b>0.48</b>
Food and beverage	79.2	85.3	83.4	90.7	100.0	102.0	104.7	109.1	1.07	0.58
Textile	110.0	95.3	83.6	92.1	100.0	103.5	109.8	110.9	0.32	0.69
pulp and wooden products	106.1	107.4	108.7	111.5	100.0	97.9	94.8	92.8	–0.47	–0.50
Printing and book binding	102.8	103.6	103.2	106.2	100.0	102.2	102.9	104.7	–0.23	0.31
Chemical industry	101.4	104.5	120.0	111.7	100.0	102.5	99.2	106.9	–0.30	0.44
Pharmaceutical industry	68.3	77.7	82.7	97.1	100.0	103.1	131.3	132.5	1.69	1.89
Petroleum and coal products	64.2	85.1	83.8	98.7	100.0	105.4	109.0	111.8	1.08	0.75
Rubber and plastics	122.6	113.3	105.4	108.9	100.0	96.2	93.0	90.8	–0.83	–0.64
Glass, cement and ceramics	81.8	83.1	94.5	94.4	100.0	98.5	95.1	93.4	1.24	–0.45
Iron and steel	76.1	76.4	105.2	93.8	100.0	106.1	117.2	125.8	1.81	1.54
Non-ferrous metal products	81.6	106.6	108.2	121.2	100.0	94.9	88.4	84.4	–0.43	–1.12
Metal products	119.3	115.8	114.0	104.3	100.0	89.9	79.3	67.6	–0.97	–2.57
General and special machines	98.7	95.3	97.2	90.1	100.0	100.4	100.8	101.3	0.32	0.09
Office and service machines	90.6	103.6	113.4	94.9	100.0	108.7	117.3	124.1	–0.23	1.45
Electronic parts	126.3	157.8	117.6	91.4	100.0	108.3	117.0	133.1	–2.99	1.92
Heavy electric machinery	103.9	86.4	81.8	86.6	100.0	104.5	113.9	126.3	0.98	1.57

	Historical				Forecast				2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Household electric appliances	97.9	92.5	93.1	104.9	100.0	97.7	99.5	99.6	0.52	-0.02
Computer and communication technologies	144.8	173.7	177.8	122.4	100.0	93.6	84.9	73.4	-3.62	-2.04
Transportation equipment	96.7	99.1	101.4	98.0	100.0	103.7	106.8	110.3	0.06	0.65
Automobile	104.1	98.3	99.3	93.7	100.0	105.0	109.5	113.4	0.12	0.84
Miscellaneous manufacturing	62.2	67.1	71.3	92.1	100.0	112.2	130.2	152.0	2.70	2.83
Construction and civil engineering	98.3	95.2	86.5	82.6	100.0	103.1	105.1	106.3	0.33	0.41
Electricity, gas and water supply	182.7	179.4	168.2	153.3	100.0	91.8	82.3	73.4	-3.82	-2.04
<b>Total service industries</b>	<b>103.3</b>	<b>107.6</b>	<b>110.4</b>	<b>99.1</b>	<b>100.0</b>	<b>99.1</b>	<b>98.3</b>	<b>97.5</b>	<b>-0.49</b>	<b>-0.17</b>
Commerce	113.3	112.1	120.2	101.8	100.0	93.3	87.1	80.9	-0.76	-1.40
Finance and insurance	82.4	90.4	104.8	87.3	100.0	110.8	123.2	139.0	0.67	2.22
Real estate and imputed rent	92.2	82.8	97.8	95.7	100.0	103.3	106.5	110.1	1.27	0.64
Transport services	110.2	105.0	112.6	101.7	100.0	97.5	96.2	95.5	-0.33	-0.31
Communication and information services	83.6	115.2	112.9	105.6	100.0	98.4	96.9	96.2	-0.94	-0.26
Public Administration	118.4	168.9	171.9	112.3	100.0	98.9	97.9	96.3	-3.43	-0.25
Education and research	114.5	125.0	125.1	108.6	100.0	96.3	92.7	89.7	-1.48	-0.72
Medical and nursery services	77.3	83.5	88.1	93.6	100.0	101.7	102.5	102.8	1.21	0.18
Business services	128.1	118.5	109.2	95.2	100.0	95.9	91.3	86.4	-1.13	-0.97
Personal services	106.0	112.2	109.6	98.4	100.0	100.7	102.3	104.6	-0.77	0.30
Not elsewhere classified	52.2	73.5	141.5	-39.6	100.0	103.8	135.3	152.6	2.08	2.86

Note: Value added figures are transformed in real terms by GDP deflator.  
The 85 sector's result of estimation aggregated in 35 sectors.

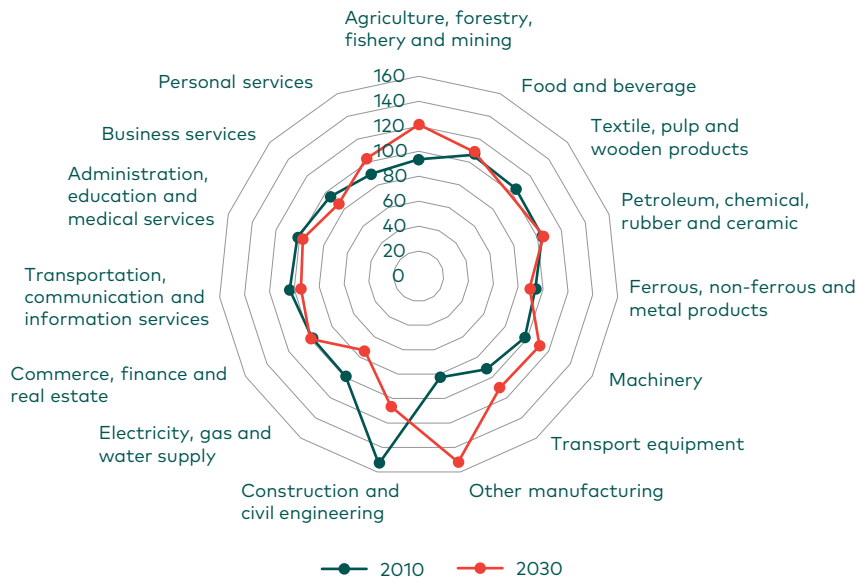


Fig. 3. Labor productivity index, 2015 = 100.

equipment and miscellaneous manufacturing show relatively high values in 2030, on the other hand, the electricity, water, gas and construction industries are stagnant and in some of the service industries the values of the index are decreasing (Fig. 3). The Japanese economy is driven by the high productivity of the large scale leading companies. However, we should not forget that relatively low level labor productivity sectors such as the service industries absorb the unemployed workers who lost

Table 7

Employed Population by Sectors, 100 Thousand

	Historical					Forecast				2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030			
Total	672.1	656.1	654.8	644.9	655.0	658.4	653.7	643.2	-0.01	-0.12	
Agriculture, forestry, fishery and mining	48.6	39.4	36.6	32.7	27.3	25.2	22.7	20.2	-2.42	-1.99	
Manufacturing total	224.3	204.3	185.8	169.2	170.1	168.5	163.5	156.5	-1.21	-0.55	
Food and beverage	16.6	16.0	15.6	14.7	12.8	12.4	11.9	11.2	-1.48	-0.89	

	Historical				Forecast				2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Textile, pulp and wooden products	32.5	26.9	21.9	17.2	16.0	14.8	13.7	12.6	-3.40	-1.58
Petroleum, chemical, rubber and ceramic production	12.6	11.6	10.6	9.9	9.9	9.7	9.5	8.9	-1.05	-0.71
Ferrous, non-ferrous and metal production	17.0	15.1	14.0	13.4	14.1	14.1	13.7	13.1	-0.46	-0.49
Machinery	37.9	35.3	31.2	29.8	30.2	29.0	27.3	25.2	-1.03	-1.20
Transport equipment	11.3	10.5	11.8	12.3	12.6	12.2	11.8	11.3	1.22	-0.72
Other manufacturing	7.9	6.6	5.3	4.2	3.7	3.4	2.9	2.4	-3.78	-2.84
Construction and civil engineering	82.5	76.4	69.6	61.9	64.8	66.8	66.6	65.4	-1.09	0.06
Electricity, gas and water supply	5.8	5.9	5.7	5.9	6.0	6.1	6.2	6.2	0.11	0.22
<b>Service industries total</b>	<b>399.2</b>	<b>412.4</b>	<b>432.4</b>	<b>443.0</b>	<b>457.7</b>	<b>464.8</b>	<b>467.4</b>	<b>466.6</b>	<b>0.70</b>	<b>0.13</b>
Commerce, finance and real estate	148.5	142.4	146.4	146.3	147.5	147.4	146.2	144.1	0.23	-0.16
Transportation, communication and information services	49.6	50.8	53.2	55.6	55.4	57.6	58.9	59.5	0.58	0.48
Administration, education and medical services	86.8	93.2	99.8	103.4	109.4	112.7	115.6	118.0	1.07	0.51
Business services	37.3	46.9	54.7	58.5	65.8	69.1	71.5	73.4	2.28	0.73
Personal services	77.2	79.1	78.3	79.2	79.6	77.9	75.1	71.6	0.04	-0.70

their jobs at shrinking manufacturing industries. Also, the growth of the service economy in Japan tends to keep labor productivity low.

The labor participation rate depends not only on vital statistics but also on the social situation such as the school attendance rate, the retirement system, the labor participation of housewives and the



economic growth rate or business cycle. Economic growth without a sufficient labor participation rate will cause a labor shortage, but in this model it does not happen because our model forecasts that the shrinking economy and increased labor productivity occur at the same time. If the economy grows faster than our projection, we fear a labor shortage will emerge. The workers are encouraged to work after the legal retirement age of 65 and the local governments are encouraged to make it easy for housewives to participate in the labor market by providing child care supports or expanding child nursing facilities.

Looking at the number of employees, it gradually increased from the low point in 2011 and reached its peak in 2016–2017 (Table 7). From 2015 to 2030, the number of employees in manufacturing will decrease. On the other hand, it will slightly increase in the service industries.

The capital intensive sectors are already so rationalized that it is difficult to reduce the labor any more. In the service sectors, except commerce, finance and real estate and personal services, the index will go up. The public sectors such as education and medical services will see a relatively high increase in the number of employees, except in public administration.

#### 1.4. Private investment

Some researchers believe that Japan does not need economic growth<sup>19</sup>. The arrival of a high interest age means a decrease of investment demand and disappearance of a new economic frontier. As we cannot expect new enlargement of the market, the global capital market is confronting the crisis of continuous stagnation. Japan is now stepping into the stage of a matured economy keeping the highest position in the world from the environmental, health and securities viewpoints. The most important factor influencing the decrease of the population is how to increase labor productivity. To exploit the new demand, new technical innovations and aggressive investment is vital to increase productivity.

Under the shrinking working age population, increasing labor productivity is essential to enforce economic viability and international competitiveness.

To increase labor productivity, it is essential to increase private investment. However, with a shrinking population Japanese entrepreneurs cannot keep the willingness to invest. In the age of the globalization economy, if a business person is keeping old production systems, is not trying to expand market share and is refusing innovative changes, the

<sup>19</sup> Kazuo Mizuno, Eisuke Sakakibara( 2015) "The End of Capitalism and the World After" (In Japanese), Sisousha-shinsho

Table 8

Private Investment by Purchasing Side, 2011 Prices, Trillion Yen

	Historical				Forecast				2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Total	94.593	89.919	89.711	74.852	85.600	84.724	81.513	76.631	-0.33	-0.74
Agriculture, forestry, fishery and mining	2.011	1.851	2.072	1.674	1.701	1.777	1.755	1.661	-0.56	-0.16
Manufacturing total	47.908	44.670	43.454	35.071	40.861	39.118	36.424	32.987	-0.59	-1.42
Food and beverage	1.844	1.720	1.769	1.564	1.718	1.724	1.665	1.562	-0.01	-0.63
Textile, pulp and wooden products	1.659	1.619	1.687	1.462	1.637	1.687	1.677	1.625	0.07	-0.05
Petroleum, chemical, rubber and ceramic production	3.941	3.820	4.086	3.474	4.033	4.188	4.197	4.110	0.36	0.13
Ferrous, non-ferrous and metal production	2.273	2.151	2.169	1.846	2.135	2.183	2.148	2.055	-0.05	-0.25
Machinery	6.850	7.001	7.528	6.395	7.397	7.738	7.821	7.737	0.37	0.30
Transport equipment	2.822	2.778	2.989	2.376	2.811	2.876	2.822	2.684	0.08	-0.31
Other manufacturing	0.638	0.638	0.657	0.559	0.641	0.662	0.659	0.640	0.03	-0.01
Construction and civil engineering	22.018	19.739	18.073	12.934	15.532	13.034	10.406	7.609	-1.59	-4.65
Electricity, gas and water supply	5.862	5.204	4.497	4.460	4.957	5.027	5.029	4.966	-0.32	0.01
Service industries total	44.674	43.399	44.187	38.106	43.038	43.829	43.335	41.983	-0.06	-0.17
Commerce, finance and real estate	13.770	13.804	13.922	11.581	13.759	14.567	14.919	15.020	-0.02	0.59
Transportation, communication and information services	10.925	9.744	9.158	8.600	9.694	9.486	9.026	8.381	-0.03	-0.97

	Historical					Forecast			2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Administration, education and medical services	7.949	7.470	7.444	5.943	6.735	6.537	6.131	5.574	-0.69	-1.25
Business services	7.597	7.870	8.763	7.662	8.245	8.566	8.592	8.382	0.31	0.11
Personal services	4.435	4.510	4.901	4.319	4.605	4.672	4.667	4.626	0.14	0.03

market will be deprived immediately by the competitor. While expecting the effort of the private sector, the government should remove improper regulations or irrational systems of market control, which distort free market mechanisms and prevent investment so as to improve the efficiency of Japanese society as a whole.

Total private investment reached a low point in 2011 and gradually increased until 2015, but afterwards it gradually decreased (Table 8). From 2015 to 2030, investment in manufacturing will decrease much more than in services. We have not added any assumption such as “innovative industries invest much more than traditional ones” but only assume that the historical investment trend of each sector continues into the future. Therefore the sectors, which are expected to grow considerably do not increase so much. If the government does not implement new policy such as deregulation of economic activity or preferential treatment for new investments, the weak investment forecasted by this model will be realized.

Looking at the changes in investment by sectors from 2015 to 2030, the forecast shows that the manufacturing sector will lose its share but the service sector enlarges its weight. Food and beverages, textile, and paper and furniture, keep their level, but the chemical, petroleum, rubber and ceramic, and machinery sectors will increase their weight. The iron, steel and non-ferrous metals, transport equipment and miscellaneous manufacturing sectors will increase slightly. Construction and civil engineering will experience an apparent decrease. In the service sector, commerce, finance and real estate will enlarge the share significantly, but on the contrary transportation, communication and information, public administration, education and medical service sectors will reduce their shares.

In summary, manufacturing industries, except food and beverages, keep their investment level from 2010 to 2030, but construction and civil engineering apparently will shrink, and in the service sectors total investment will be reduced, except in commerce, finance and real estate.

## 1.5. Exports and imports

The total real exports of Japan reached its peak in 2015 and are forecasted to gradually decrease (Table 9). The rate of decrease in services is much larger than in manufacturing. From 2015 to 2030, many sectors in the manufacturing industry will enlarge their export shares but only the transportation sector will reduce it. In the service sector, the export share of the commerce, finance and real estate sector, which is comparatively large, will gradually lose its weight.

Table 9  
Export Value by Sectors, 2011 Prices, Trillion Yen

	Historical				Forecast				2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Total	43.066	53.838	73.508	73.101	76.823	75.766	75.301	74.980	2.40	−0.16
Agriculture, forestry, fishery and mining	0.038	0.065	0.080	0.107	0.101	0.106	0.110	0.118	2.98	1.04
Manufacturing total	34.238	42.468	56.531	56.554	57.226	56.585	56.295	56.111	2.01	−0.13
Food and beverage	0.199	0.231	0.310	0.336	0.483	0.524	0.559	0.602	5.04	1.48
Textile, pulp and wooden products	0.874	0.984	1.069	0.915	0.989	0.950	0.928	0.913	0.03	−0.53
Petroleum, chemical, rubber and ceramic production	5.347	6.349	9.587	10.255	10.704	11.080	11.247	11.400	3.54	0.42
Ferrous, non- ferrous and metal production	4.405	5.105	6.342	6.571	6.641	6.728	6.797	6.899	1.77	0.25
Machinery	13.897	17.765	22.396	22.707	22.967	22.660	22.560	22.413	1.73	−0.16
Transport equipment	8.945	11.325	16.003	14.758	14.943	14.187	13.772	13.476	1.87	−0.69
Other manufacturing	0.543	0.676	0.779	0.973	0.460	0.422	0.396	0.377	−2.53	−1.32
Construction and civil engineering	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	n.a.	n.a.
Electricity, gas and water supply	0.029	0.032	0.046	0.040	0.038	0.035	0.034	0.032	1.15	−1.14
Service industries total	8.790	11.305	16.897	16.440	19.496	19.075	18.897	18.751	3.70	−0.26

	Historical				Forecast				2000 -15 CAGR (%)	2015 -30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Commerce, finance and real estate	3.358	5.120	9.672	9.213	9.917	9.322	8.946	8.614	4.51	-0.93
Transportation, communication and information services	4.375	5.042	5.584	4.892	7.057	7.203	7.356	7.507	2.27	0.41
Administration, education and medical services	0.066	0.067	0.063	0.399	0.125	0.129	0.133	0.137	4.25	0.61
Business services	0.548	0.637	0.600	1.038	1.498	1.492	1.498	1.497	5.87	0.00
Personal services	0.442	0.439	0.976	0.898	0.900	0.928	0.964	0.996	4.90	0.68

Note: n.a. – no value

From 2015 to 2030, total real imports will decrease slightly (Table 10). In the same period, the imports of the manufacturing industry will shrink a little but imports of services will keep almost the same level. Imports of agriculture, forestry and fishery, textile, paper and furniture (mainly classified as consumer goods) and imports of iron, steel and non-ferrous metals (classified as raw materials) will decrease. The decrease in imports of petroleum, coal and natural gas is very small. The imports of machinery (which includes electronics and communication equipment) will increase but the import of transportation equipment will decrease.

The import share of manufacturing goods and services will enlarge but the share of agriculture, forestry and fishery will decline.

Table 10  
Import Value by Sectors, 2011 Prices, Trillion Yen

	Historical				Forecast				2000 -15 CAGR (%)	2015 -30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
<b>Total</b>	<b>68.29</b>	<b>74.93</b>	<b>82.52</b>	<b>79.18</b>	<b>88.79</b>	<b>89.23</b>	<b>88.64</b>	<b>88.35</b>	<b>1.14</b>	<b>-0.03</b>
Agriculture, forestry, fishery and mining	27.87	27.86	27.93	26.16	26.84	26.50	25.91	25.25	-0.25	-0.40

	Historical				Forecast				2000 ~15 CAGR (%)	2015 ~30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
Petroleum, coal, natural gas	21.36	21.06	21.59	20.28	21.21	21.13	20.82	20.40	0.05	-0.26
<b>Manufacturing total</b>	<b>31.15</b>	<b>37.20</b>	<b>44.18</b>	<b>42.96</b>	<b>51.33</b>	<b>51.90</b>	<b>51.82</b>	<b>52.03</b>	<b>2.17</b>	<b>0.09</b>
Food and beverage	5.80	6.64	6.71	5.41	5.97	5.72	5.42	5.17	-0.71	-0.95
Textile, pulp and wooden products	4.63	5.54	6.12	5.45	5.81	5.62	5.32	5.04	0.31	-0.94
Petroleum, chemical, rubber and ceramic production	8.04	9.35	9.75	9.88	12.04	12.14	12.20	12.42	1.70	0.21
Ferrous, non-ferrous and metal production	4.84	4.84	5.60	4.56	4.96	4.68	4.35	4.06	0.15	-1.31
Machinery	3.86	6.82	10.94	13.27	17.11	18.26	19.06	19.83	6.32	0.99
Transport equipment	1.99	1.95	2.63	2.29	2.89	2.74	2.60	2.48	2.67	-1.02
Other manufacturing	1.99	2.05	2.43	2.10	2.56	2.74	2.87	3.02	1.48	1.12
Construction and civil engineering	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n.a.	n.a.
Electricity, gas and water supply	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.67	2.74
<b>Service industries total</b>	<b>9.27</b>	<b>9.87</b>	<b>10.41</b>	<b>10.06</b>	<b>10.63</b>	<b>10.83</b>	<b>10.91</b>	<b>11.07</b>	<b>0.50</b>	<b>0.27</b>
Commerce, finance and real estate	1.12	1.35	1.37	1.81	2.15	2.10	2.03	1.98	3.14	-0.56
Transportation, communication and information services	3.59	4.29	4.43	3.97	4.78	4.77	4.67	4.62	0.71	-0.22
Administration, education and medical services	0.07	0.12	0.13	0.75	0.26	0.28	0.30	0.31	5.38	1.23
Business services	1.05	1.24	0.92	1.15	2.39	2.68	2.98	3.29	4.45	2.17
Personal services	3.45	2.86	3.57	2.39	1.06	1.00	0.93	0.87	-6.43	-1.30

## 2. Changing input structure

### 2.1. Input structure

Looking at the Japanese input structure, the share of intermediate inputs gradually increases and that of value-added decreases (Table 11). Theoretically, sophistication of the industry means the increase in the share of value-added but in reality, Japanese value-added had a tendency of decrease from 1995 to 2010. The main cause of industrial sophistication or industrial complication is the increase in the procurements of other industries' products or services, that is to say, the increase of the external procurements. Industrial sophistication means a closely related inter-industry network. This tendency still continues, except in the epoch of reconstruction after the East Japan Great Earthquake disaster.

Concerning the details of the value added structure, the share of wages gradually decreases. This means that the labor share in value-added decreases, which will be explained in more detail later.

Table 11

The Structure of Inputs, %

	Historical				Forecast			
	1995	2000	2005	2010	2015	2020	2025	2030
<b>Total Output</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Intermediate Input	46.1	44.6	46.7	47.9	50.5	49.2	49.5	49.8
<b>Value added total (GDP)</b>	<b>53.9</b>	<b>55.4</b>	<b>53.3</b>	<b>52.1</b>	<b>49.5</b>	<b>50.8</b>	<b>50.5</b>	<b>50.2</b>
Wages	29.1	29.4	26.9	27.3	26.6	27.2	26.7	26.2
Profit	10.6	10.0	11.2	10.3	9.2	9.4	9.5	9.6
Depreciation	8.6	10.7	10.3	9.2	8.7	9.1	9.2	9.3
Taxes	3.9	3.8	3.4	4.0	4.0	4.2	4.2	4.3
Outside household	2.1	2.0	1.7	1.7	1.4	1.3	1.2	1.1
Subsidy (deduction)	-0.5	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4

### 2.2. Wages

The model calculates wages per employee first, and then multiplies it by the number of employees to get total wages. From 2015 to 2030, total wages are forecasted to gradually decrease, and the wages in services decrease much more than in manufacturing. In manufacturing such sectors as textile, pulp and wooden products, chemicals, petroleum,

rubber and ceramics, and electricity, gas and water, the wages will decrease much more than in others.

Regarding wage structure, in the service sectors, the decrease of the share in the commerce, finance and real estate sector is apparent. The share in public administration and education decreases but expands in medical and nursing services (Table 12).

Since 2015, the labor share in value-added decreases. The labor share decrease may be due to the wage level per regular employees, which does not shrink. However, the number of non-regular employees whose

Table 12

The Structure of Wages by Sectors, %

	Historical				Forecast			
	1995	2000	2005	2010	2015	2020	2025	2030
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Agriculture, forestry, fishery and mining	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.5
<b>Manufacturing total</b>	<b>31.7</b>	<b>30.1</b>	<b>28.4</b>	<b>26.3</b>	<b>28.8</b>	<b>29.4</b>	<b>29.7</b>	<b>29.7</b>
Food and beverage	1.9	1.8	1.8	1.9	1.9	1.9	1.9	1.9
Textile, pulp and wooden products	3.0	2.5	2.1	1.8	1.8	1.7	1.6	1.5
Petroleum, chemical, rubber and ceramic production	3.1	2.9	2.9	2.8	2.7	2.7	2.6	2.5
Ferrous, non-ferrous and metal production	2.8	2.6	2.6	2.4	2.5	2.5	2.5	2.5
Machinery	5.8	6.1	5.7	4.9	5.6	5.6	5.5	5.4
Transport equipment	2.2	2.3	2.5	2.6	3.0	3.0	3.0	3.0
Other manufacturing	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5
Construction and civil engineering	10.7	9.8	8.6	7.5	9.4	10.2	10.7	11.0
Electricity, gas and water supply	1.7	1.7	1.8	1.8	1.5	1.4	1.3	1.3
<b>Service industries total</b>	<b>67.6</b>	<b>69.3</b>	<b>71.0</b>	<b>73.1</b>	<b>70.6</b>	<b>70.0</b>	<b>69.8</b>	<b>69.8</b>
Commerce, finance and real estate	24.3	22.3	21.4	19.8	19.5	18.3	17.1	16.0
Transportation, communication and information services	9.6	10.3	10.6	10.9	9.3	9.4	9.6	9.9
Administration, education and medical services	21.5	23.3	24.9	27.8	26.8	27.3	28.0	28.8
Business services	6.3	6.9	7.9	8.7	9.3	9.4	9.4	9.3
Personal services	5.9	6.6	6.2	5.9	5.8	5.7	5.7	5.7



wage level is relatively lower will increase significantly<sup>20</sup>. The number of workers in the manufacturing sector will diminish and the workers in the service sector whose wage level is relatively low, will increase. This is also the cause of the shrinking of total labor share in value-added.

### 2.3. Profit

It is relatively difficult to forecast the profit. The deficit in profit is possible only in the short term and impossible in the long run for business to continue. However in reality, since 2011 in the observed data, a considerable number of sectors (mining, textile, furniture, petroleum and coal products, plastic, rubber, metal products, computer and communication equipment, heavy electric, motor vehicle parts, other transport equipment, electricity) have negative profits. When the last observed data in 2014 records a deficit, we assume that there will also be a deficit in the sector afterwards (Table 13). In the last forecasted year 2030, there are 15 sectors with negative profits and the total amount of these sectors' output accounts for 7 % of the total.

In spite of the long term deficit, the reason why business can continue could be explained as follows. The deficit of the head office may be covered by the overseas surplus. As the model is based on the I-O table, the data are constructed by the GDP concept and the profit data do not include the transfers from the overseas profits.

From 2015 to 2030, the total profit will continue at the same level, while in services it will grow by 0.13 % and in manufacturing fall by 1.28 % (Table 13). Since the disaster of the East Japan Earthquake, electricity production fell into a big deficit and it will continue until 2030.

The share of the manufacturing sector, which accounted for 26.5 % of total profits in 1995, decreased significantly to 8.4 % in 2015. On the contrary, the share of services increased from 68.1 % to 88.7 % in the same period. The share decreased in many sectors but in the machinery sector it increased. In services the profit share of commerce, finance and real estate and public administration, education and medical sectors significantly increased.

## Conclusions

With these forecasts, we can clarify how the service economy of Japan affects employment and wages. As an implication of these changes we can glimpse the future of the Japanese economy in 2030.

<sup>20</sup> The variable of non-regular employees is not endogenous in this model, though.

Table 13

Profit by Sectors, 2011 Prices, Trillion of Yen

	Historical				Forecast				2000 -15 CAGR (%)	2015 -30 CAGR (%)
	1995	2000	2005	2010	2015	2020	2025	2030		
<b>Total</b>	<b>99.7</b>	<b>94.7</b>	<b>108.5</b>	<b>92.0</b>	<b>89.9</b>	<b>89.5</b>	<b>89.7</b>	<b>89.9</b>	<b>-0.35</b>	<b>0.00</b>
Agriculture, forestry, fishery and mining	5.4	4.3	3.3	3.5	2.6	2.5	2.4	2.3	-3.26	-0.83
<b>Manufacturing total</b>	<b>26.4</b>	<b>20.9</b>	<b>16.1</b>	<b>15.7</b>	<b>7.5</b>	<b>7.0</b>	<b>6.6</b>	<b>6.2</b>	<b>-6.58</b>	<b>-1.28</b>
Food and beverage	2.8	4.2	4.1	4.4	3.1	3.2	3.2	3.3	-1.94	0.33
Textile, pulp and wooden products	3.0	2.2	1.7	1.3	0.3	0.2	0.1	0.0	-12.98	n.a.
Petroleum, chemical, rubber and ceramic production	4.2	3.0	2.5	2.5	1.4	1.3	1.2	1.0	-4.79	-2.13
Ferrous, non- ferrous and metal production	2.4	2.1	2.8	1.6	2.8	2.5	2.2	2.0	1.84	-2.27
Machinery	5.6	4.0	1.3	1.9	0.6	0.8	1.0	1.2	-11.67	4.48
Transport equipment	1.2	-0.1	0.7	1.0	0.3	0.3	0.3	0.3	n.a.	0.54
Other manufacturing	0.5	0.4	0.3	0.2	0.0	0.0	0.0	0.0	n.a.	n.a.
Construction and civil engineering	3.1	2.5	1.8	0.6	1.7	1.6	1.5	1.4	-2.85	-1.17
Electricity, gas and water supply	3.6	2.5	1.0	2.3	-2.6	-2.7	-2.8	-3.0	n.a.	n.a.
<b>Service industries total</b>	<b>67.9</b>	<b>69.5</b>	<b>89.1</b>	<b>72.7</b>	<b>79.8</b>	<b>80.0</b>	<b>80.6</b>	<b>81.3</b>	<b>0.92</b>	<b>0.13</b>
Commerce, finance and real estate	45.7	46.2	61.1	51.8	54.4	55.5	56.8	58.2	1.10	0.44
Transportation, communication and information services	5.3	6.8	9.6	6.7	9.8	9.6	9.4	9.3	2.47	-0.39
Administration, education and medical services	2.4	1.4	2.6	3.1	3.0	3.1	3.2	3.3	5.11	0.49
Business services	5.2	6.7	7.5	5.6	5.9	5.8	5.6	5.5	-0.84	-0.46
Personal services	9.4	8.3	8.3	5.4	6.5	6.0	5.5	5.1	-1.62	-1.60

Note: The profits are converted in real terms by GDP deflator.

n.a. – no value.

The labor shortage becomes more and more evident, and measures to avoid the shortage are urgently needed. The main measure might be to raise labor productivity. In this model, future labor productivity is assumed to grow by the same rate as in the past 15 years. Accordingly, it requires attention that the several industrial sectors' productivity is so low that a severe labor shortage appears for these sectors.

Labor productivity is the integrated result of the economic situation, such as economic cycles, technical innovations, and capital investment. To raise labor productivity in Japan, it is necessary to increase the efficiency of the whole economy, that is to say, to promote business activities by improving the institutional system or deregulation of outdated business controls. Especially now the spread of network society caused by IT and communication technologies creates new industries and new services, which should be actively integrated within the future Japanese industries. To promote technical innovation, measures to enrich the support of fundamental research and applied research should be taken. Adding to these direct measures, indirect measures such as increasing sophisticated human resources are also needed for raising labor productivity in the long run.

In the process of forecasts, we found several tasks to improve the model: to endogenize labor productivity, to improve the profit equation, and to add the compact finance and budget system in the model. Also, following the advancement of Japanese globalization, the Japanese economy expressed by the GDP concept does not cover the incomes from abroad. We should find measures to integrate income from abroad in the domestic economy, that is, to use the Gross National Income approach.

## APPENDIX

Table A1

The Original Sources of I-O Tables Used by JIDEA9

	Basic Table	2000 Linked Table	2005 Linked Table	2011 Linked Table	Extended Table		Extended Table by ITI	
	Sectors	Sectors	Sectors	Sectors	Base year	Sectors	Base year	Sectors
1995	519×402	498×399	514×401		1990	526×413		
1996					1995	517×401		
1997					1995	517×401		
1998					1995	517×401		
1999					1995	517×401		
2000	517×405	498×399	514×401	510×389			1995	517×403
2001							1995	517×403
2002							1995	517×403
2003							2000	517×403
2004					2000	515×403		
2005	520×407		514×401	510×389	2000	515×403		
2006					2000	515×403		
2007					2000	515×403		
2008					2005	520×407		
2009					2005	520×407		
2010					2005	520×407		
2011	518×397			510×389	2005	520×407		
2012					2010	516×395		
2013					2010	516×396		

Note: METI did not publish the full scale extended table from 2000 to 2003.