Research Institute of Economy, Trade and Industry (RIETI)

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"The Economic Impact of the Great East Japan Earthquak"

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The Economic Impact of the Great East Japan Earthquake

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RIETI Research Project (Program Leader: Joji Tokui)

“Construction of a Regional Productivity Database and Analysis of Changes in Economic Structure after the Great East Japan Earthquake”

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0. Introduction of the JIP/CIP Database Project

The RIETI program "Raising Industrial and Firm Productivity" updates and expands the Japan Industrial Productivity (JIP) Database and is constructing the China Industrial Productivity (CIP) Database in collaboration with Hitotsubashi University. This program will also construct an industrial productivity database by prefecture for Japan and examine the impact of the recent earthquake on regional economies and policies for reconstruction.

0. Introduction of the JIP/CIP Database Project

The JIP Database 2011, which will cover 1970-2008, will become available by September 2011.

The CIP Database Round 1.0 will also become available by September 2011.

Coverage and Compatibility

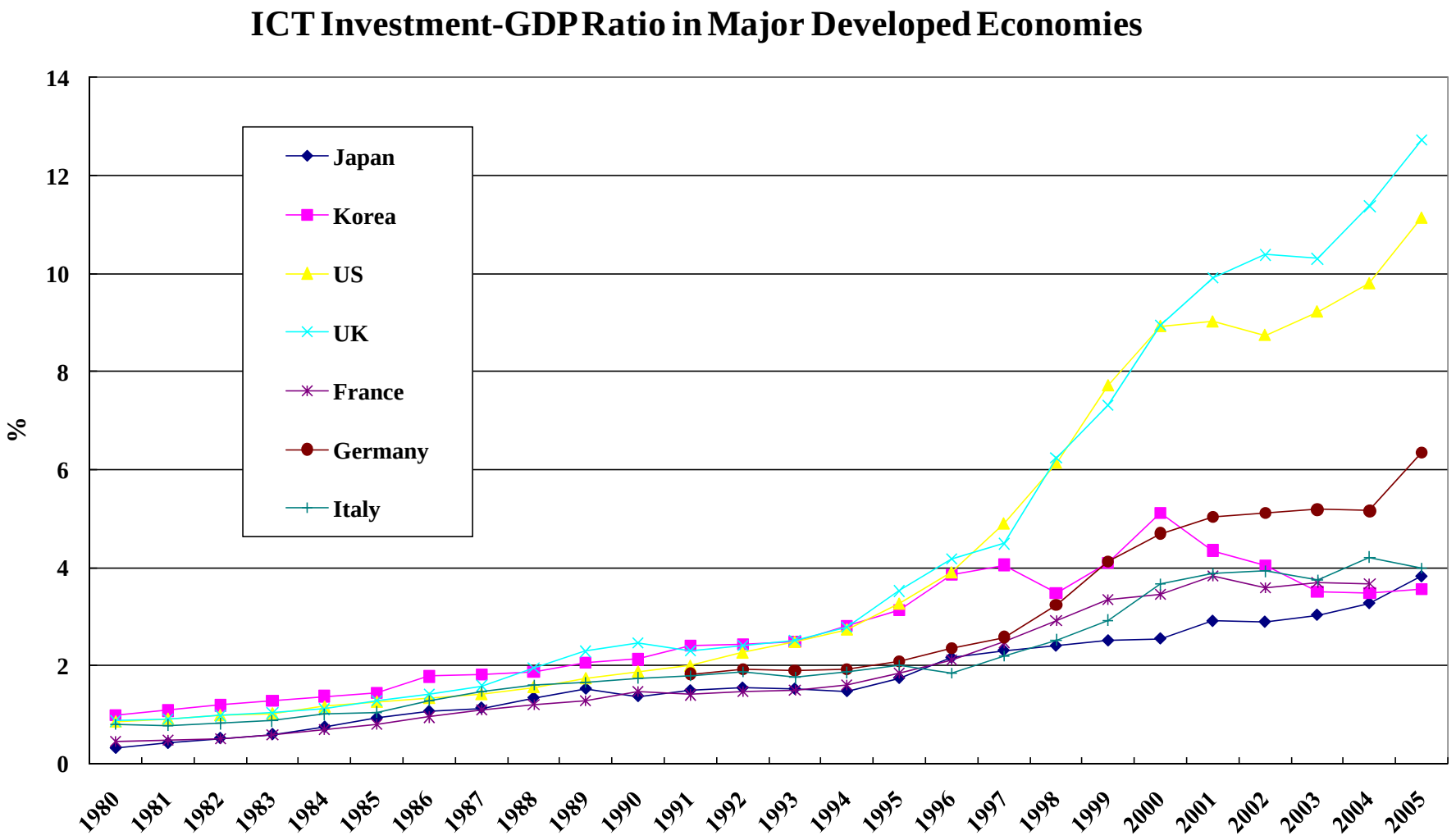
CIP Round 1.0 covers the period 1987-2008. It satisfies the CSIC (China Standard of Industrial Classification) 2002 in principle, but groups industries into 35 categories in line with the classifications of the EU/KLEMS project implemented by the GGDC (Groningen Growth and Development Center, Groningen University).

List of Main Indicators

1. **GVO (gross value of output) at 2005 prices**
2. **GVA (gross value added) at 2005 prices**
3. **Number of workers**
4. **Hours worked**

Some Results of the JIP and EU KLEMS databases

Japan's ICT Investment-GDP Ratio is Very Low in Comparison with Other Major Developed Economies

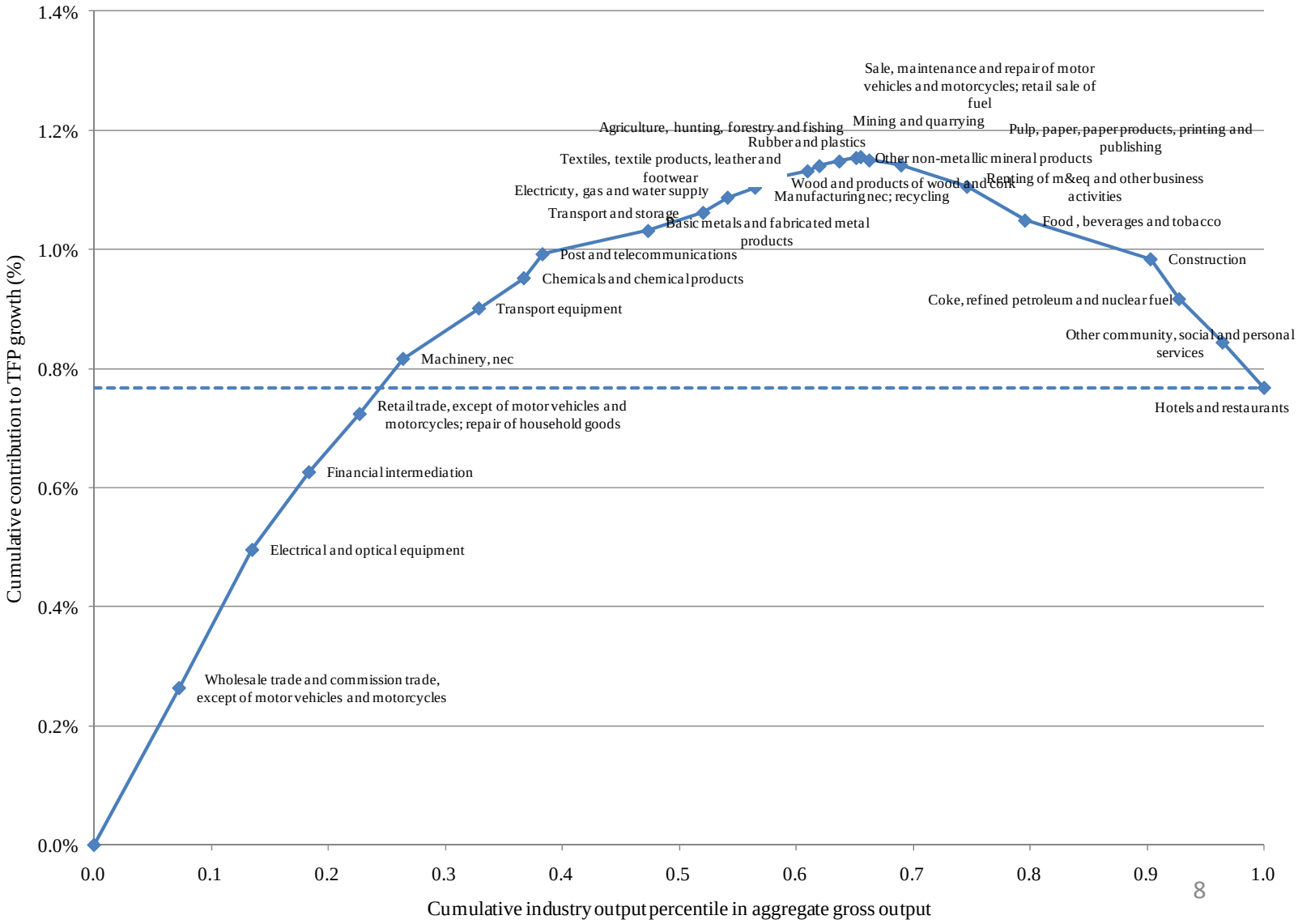


Source: Fukao, Miyagawa, Pyo and Rhee (2009).

Some Results of the JIP Database

Productivity growth in the economy as a whole, which is represented by the broken horizontal line, was lower than the sum of the contributions of these five leading sectors.

Figure 4. Cumulative Contribution of Industries to TFP Growth: Japan, 1973-2006, Market Economy



Some Results of the JIP Database

In Japan, the reallocation effect of labor input was negative in all periods from 1975 to 2006. However, there was a positive and substantial reallocation effect of capital input for the whole period except for the period 2000-06. Moreover, during the period 1990-2000, the total reallocation effect of labor and capital input became greater than the contribution of Domar-weighted TFP growth.

Table 4. Aggregate Reallocation Effects in Japan and Korea

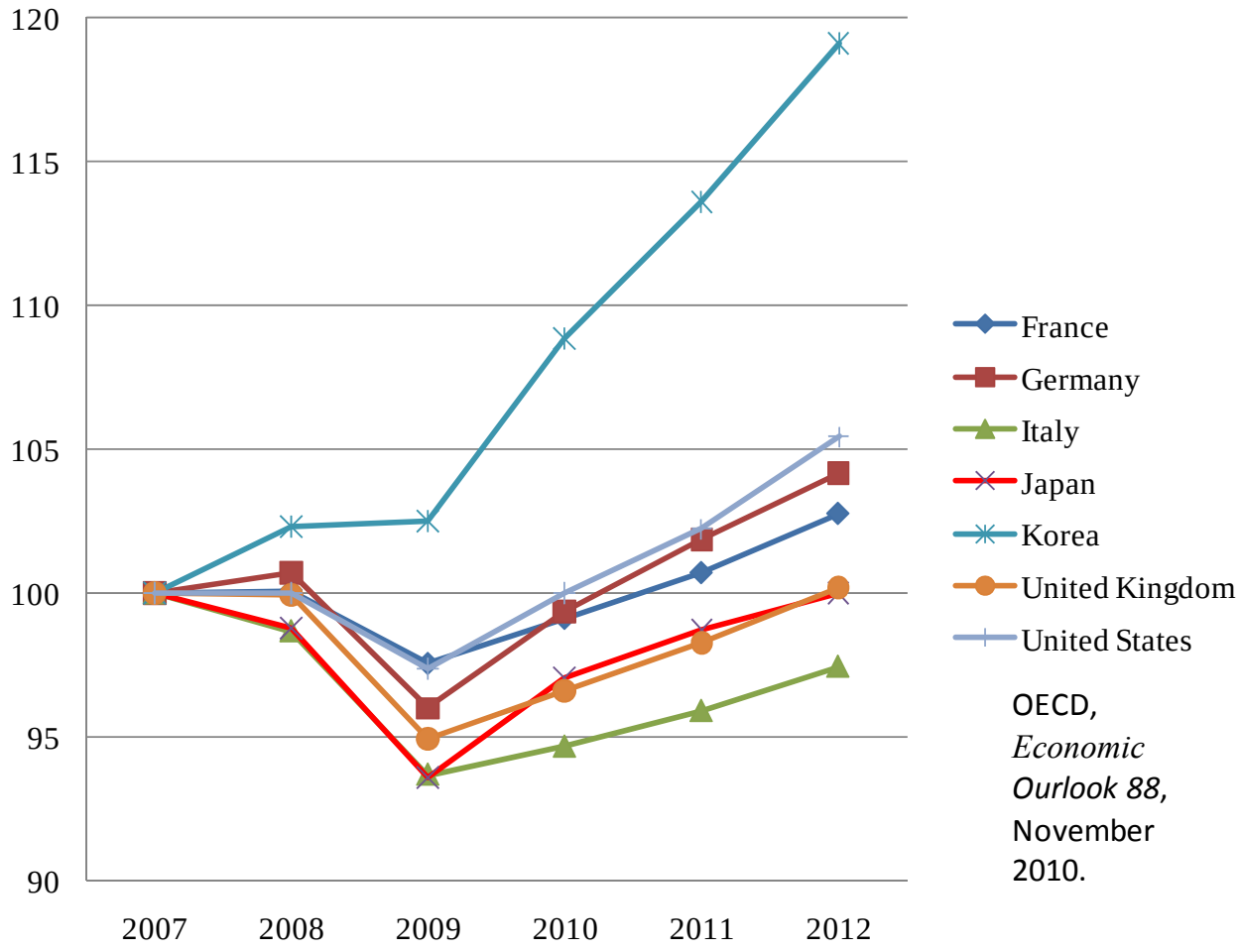
(Average annual growth rates: %)

Japan		1975-80	1980-90	1990-2000	2000-06
(1) Growth rate of aggregated TFP, v_T	a=b+c+d	2.71	1.64	0.23	0.51
(2) Domar weighted TFP growth, v_T^D	b	2.60	1.73	0.10	1.13
(3) Reallocation effect of capital input	c	0.13	0.27	0.15	-0.29
(4) Reallocation effect of labor input	d	-0.01	-0.36	-0.03	-0.33

1. Japan's Economic Conditions Before the 3/11 Earthquake

Before the earthquake, Japan's economy was slowly recovering following the global financial crisis and still had a large GDP gap. The global financial crisis hit the Japanese economy mainly through a sharp drop in exports.

Figure 16. Real GDP of Major OECD Countries: Past Record and Forecast (2007=100)



OECD, *Economic Ourlook 88*, November 2010.

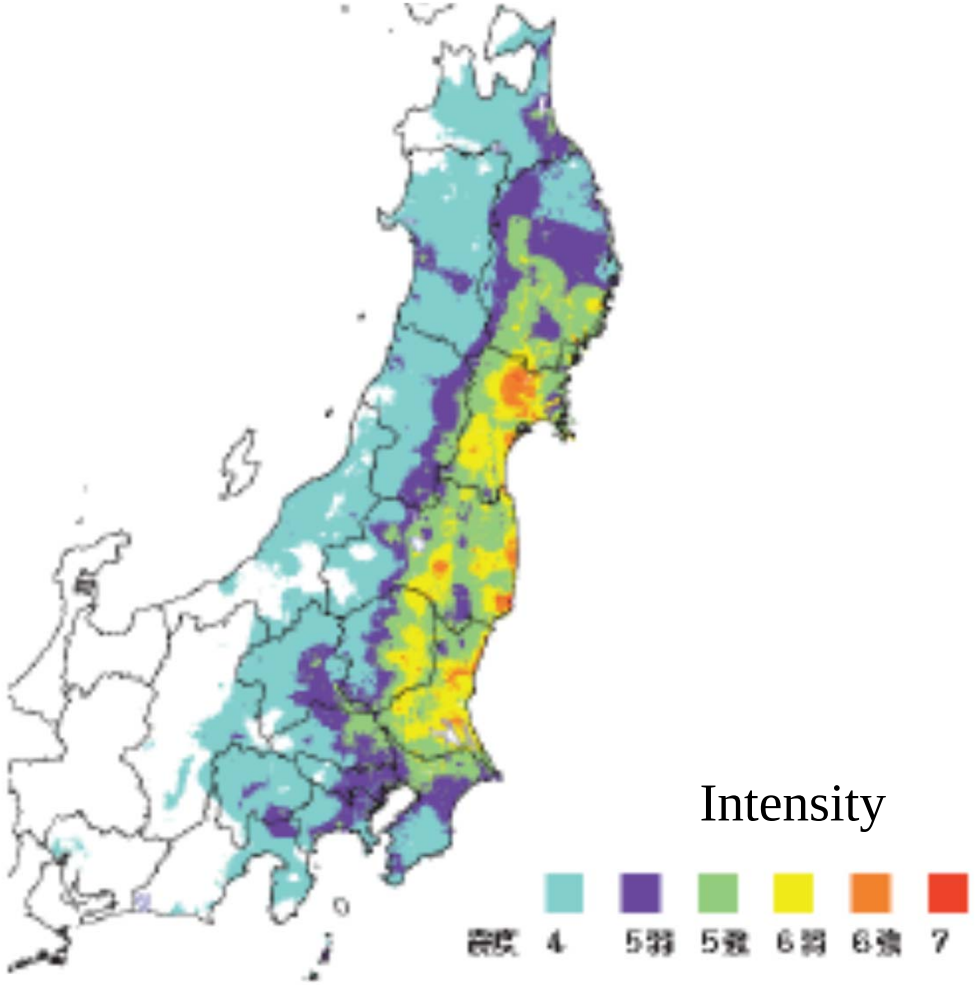
2. The 3/11 Earthquake in Figures

- **Date: March 11, 2011**
- **Affected Region: 450km ×200km**
- **Magnitude: 9.0 (4th largest in world history since 1900)**
- **Seismic Intensity Level: 7 (maximum)**
- **Maximum Height of Tsunami: 9.3m**
- **Run-up Height of Tsunami: 40.5m**
- **Loss of Life: 20,542 (including those missing: 4,937)**

  (as of July 22, 2011)

2. The 3/11 Earthquake in Figures

3/11 Earthquake Area by Seismic Intensity



3.11 Earthquake: Very large areas were damaged by the tsunami.

2. The 3/11 Earthquake in Figures

The Great Hanshin-Awaji (Kobe) Earthquake (1995)

- **Direct Loss**
  - **- ¥ 9.9 trillion (Hyogo Prefectural Gov., 1995)**
  - **- ¥ 13.3 trillion (Toyoda & Kawauchi, 1997)**

- **Indirect Loss**
  - **- ¥ 7.2 trillion (Toyoda & Kawauchi, 1997)**

  The loss was estimated for the first year.

2. The 3/11 Earthquake in Figures

The Great East Japan (3/11) Earthquake

- **Direct Loss**

  - ¥ 16.9 trillion (Cabinet Office, 2011)

  The loss does not include direct losses due to the accident at the Fukushima nuclear power plant.

- **Indirect Loss**

  - unknown

3. The Impact of Supply Chain Disruptions

- **Which industries were severely damaged by the 3/11 earthquake?**
- **And how great is the damage?**

- **Which industries' production was severely affected by the supply chain disruptions?**
- **And how great is the impact?**

Data Sources and Methodology (1)

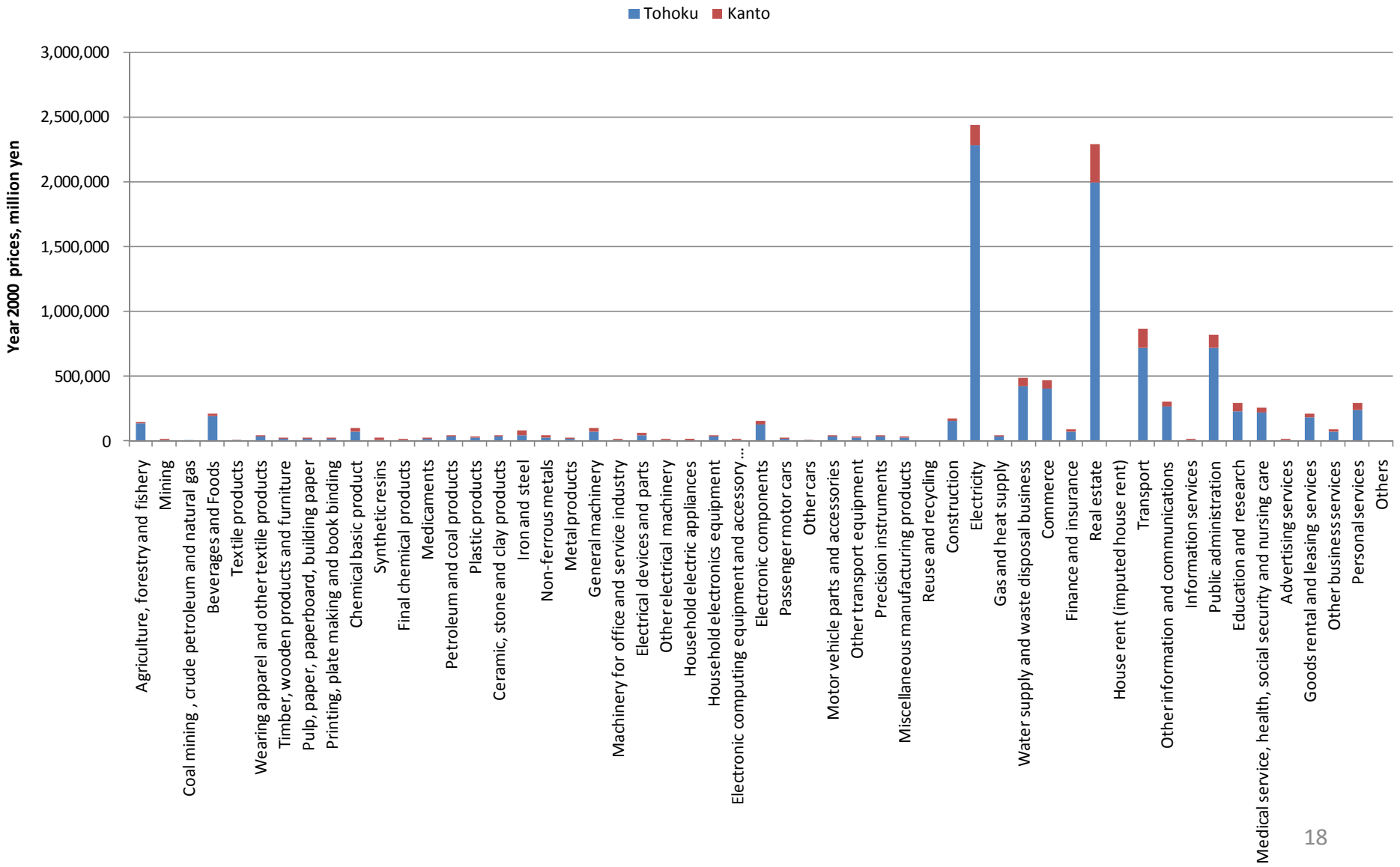
- **To estimate the damage, we used the following sources and data:**

  2009 Economic Census → # of workers in each industry in each city (town, village) affected by the earthquake.

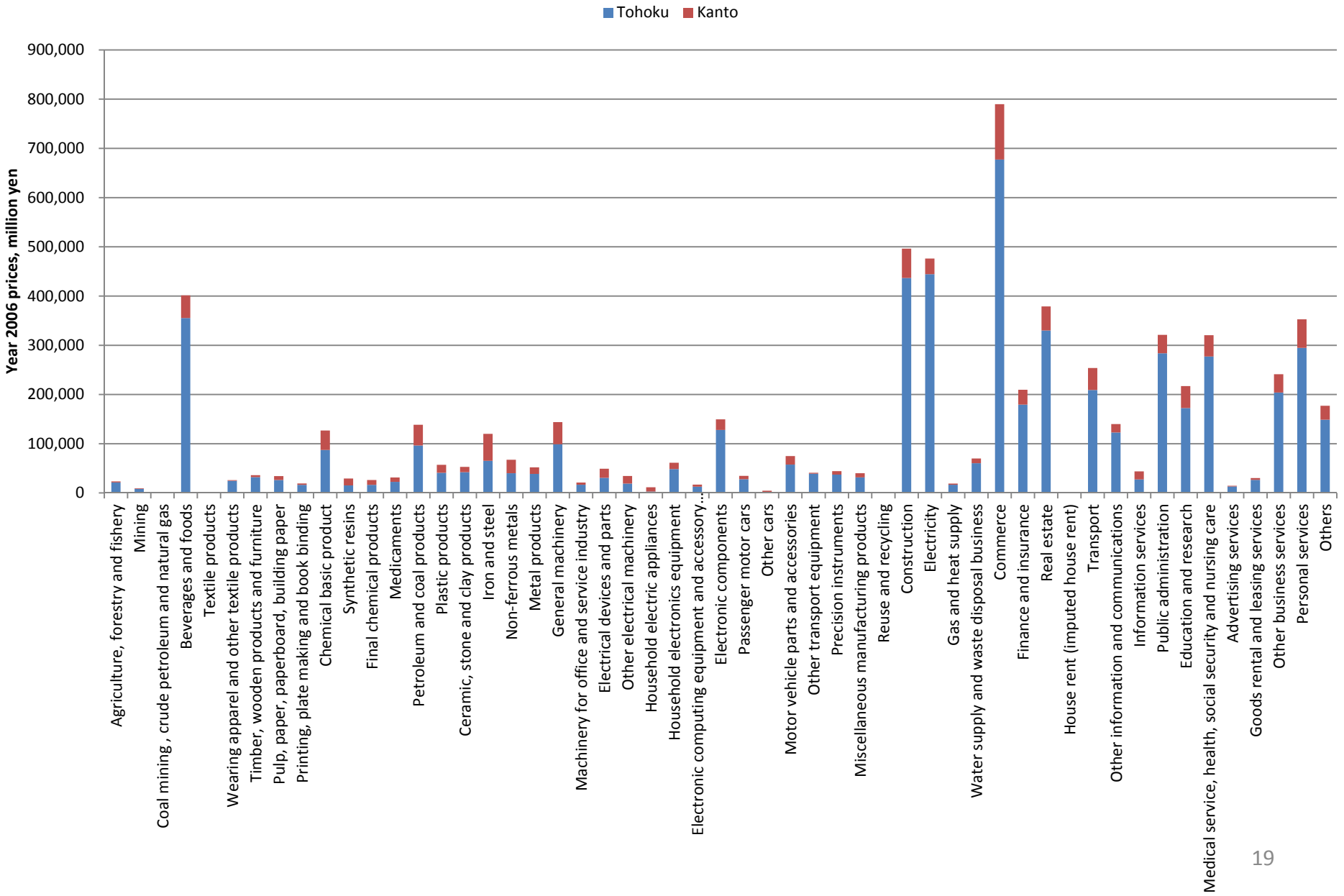
  JIP2010 → capital stock per worker and output per worker in each industry.

  We estimated the damage ratio for each city (town, village) based on the # of dead, the # of evacuees, and the # of newspaper reports on factory damage.

Damage to the Net Capital Stock



Direct Damage (on an annual gross output basis)



Data Sources and Methodology (2)

- **To estimate the impact of supply chain disruptions:**

  Inter-regional I-O Tables 2005 (METI)

  53 sectors × 9 regions

  Tohoku region…Iwate, Miyagi, Fukushima

  Kanto region…Ibaragi

  Based on the concept of "Forward Linkages" by Miller and Blair, *Input-Output Analysis* (2nd ed.), 2009.

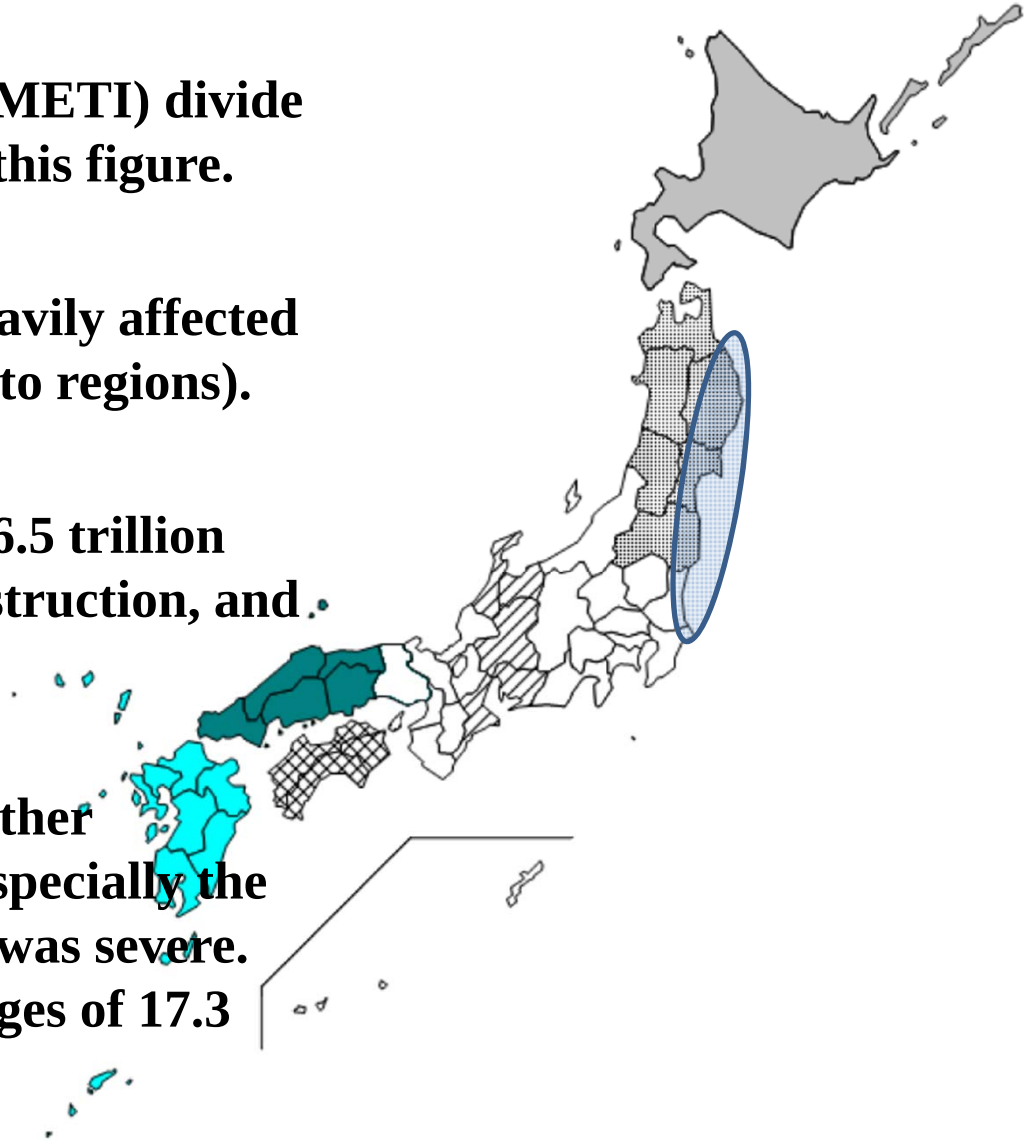
Regional Subdivision and Estimation Results

The Inter-regional I-O Tables 2005 (METI) divide Japan into nine regions as shown in this figure.

The circle indicates the area most heavily affected by the earthquake (Tohoku and Kanto regions).

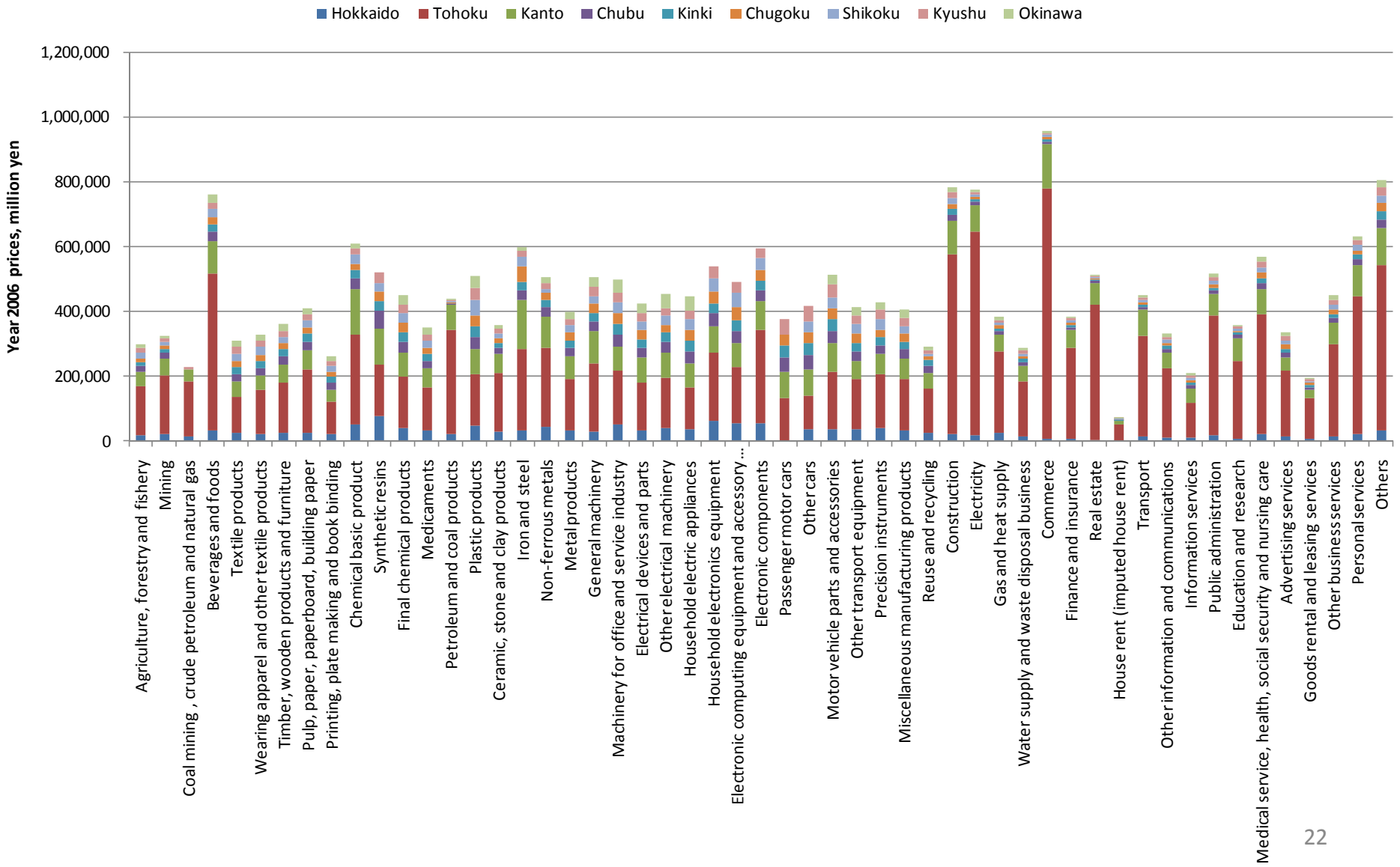
This area suffered direct damage of 6.5 trillion yen. The impact on commerce, construction, and electricity was especially severe.

This direct damages spilled over to other industries through supply chains. Especially the impact on the manufacturing sector was severe. Our estimate suggests indirect damages of 17.3 trillion yen.

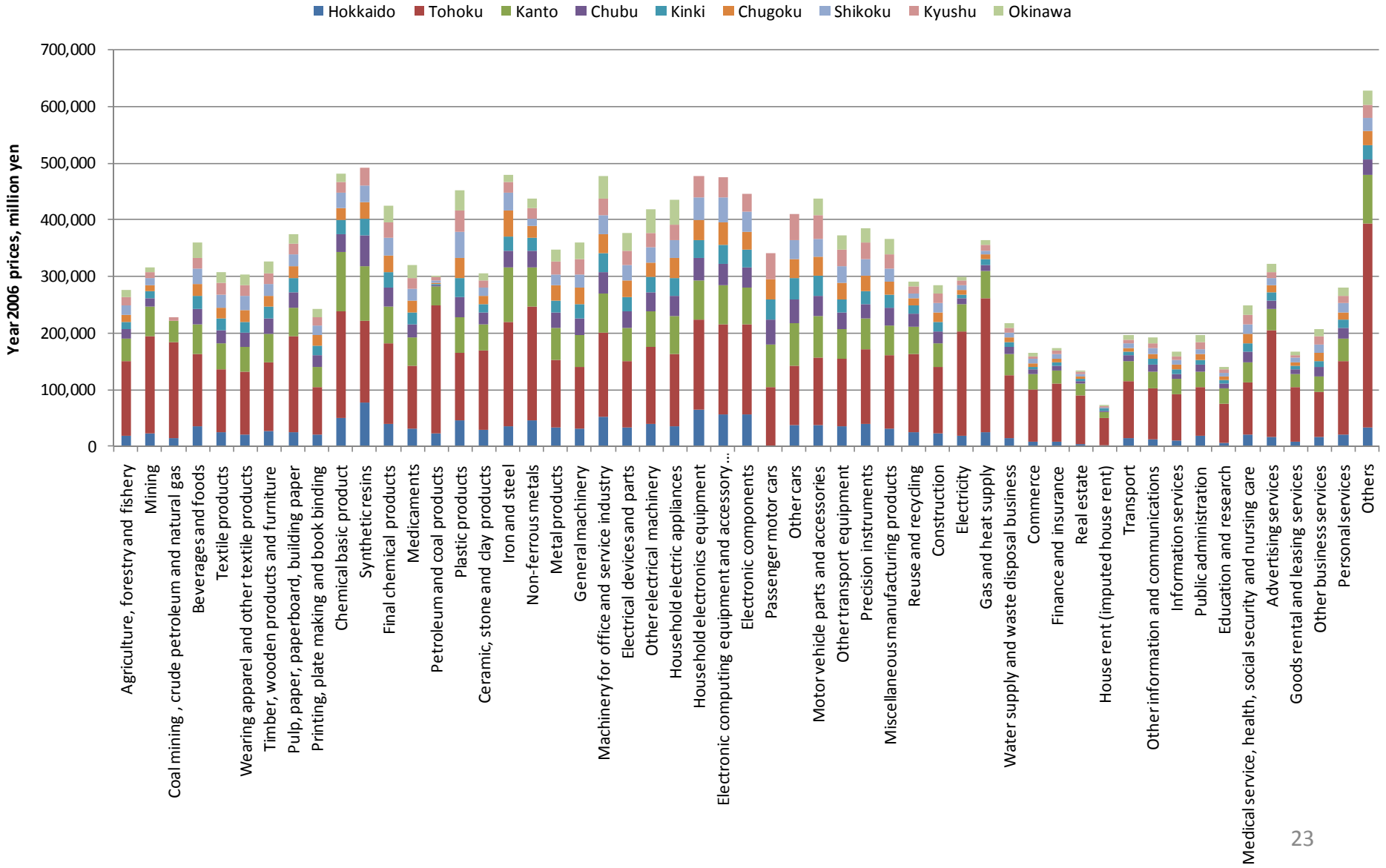


We estimate total damages is 23.8 trillion yen.

The total damage (direct + indirect) (annual gross output base)



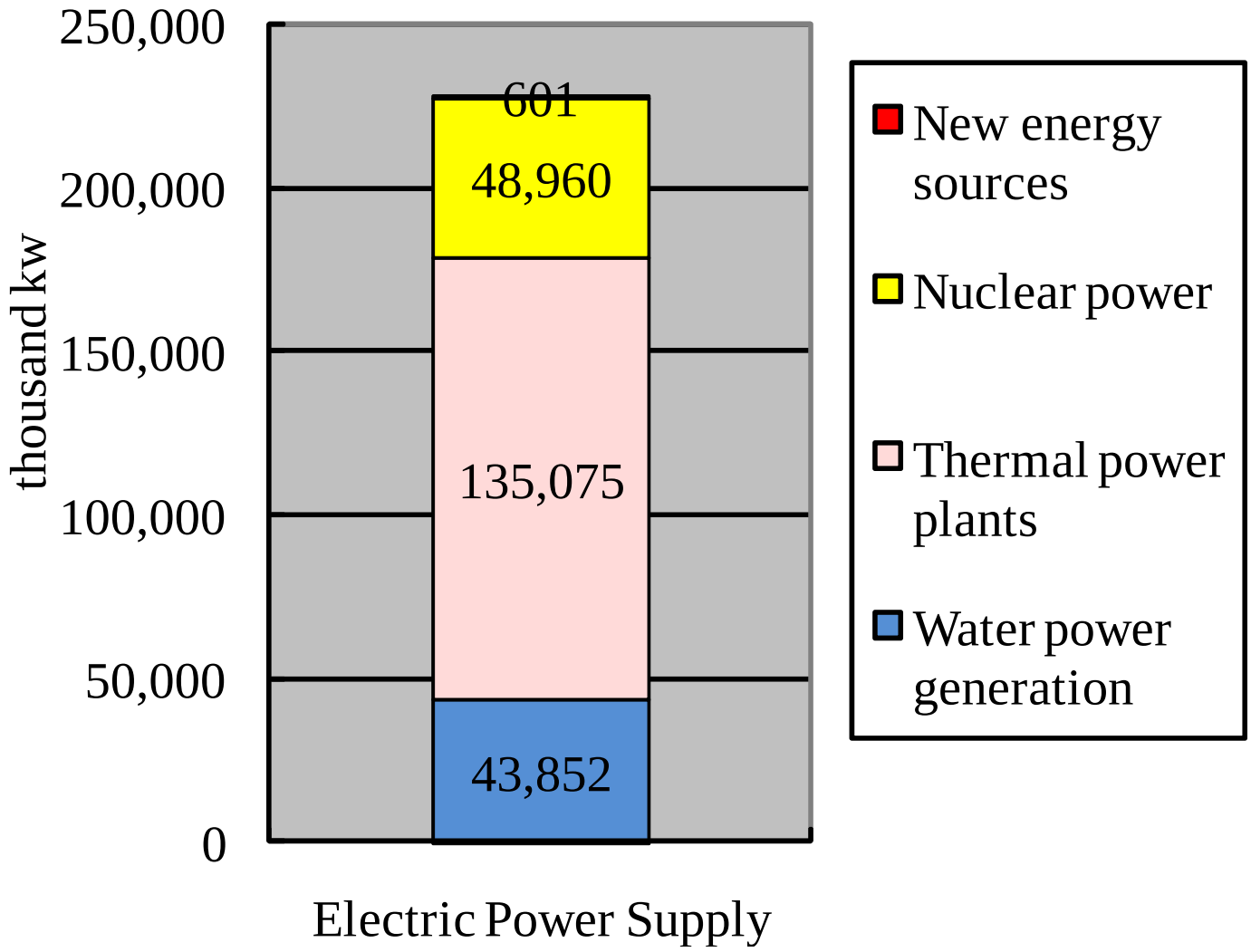
The Effect of Supply Chain Disruptions (annual gross output base)



4. The Impact of Electric Power Supply Constraints on the Japanese Economy

- **Another serious effect of the 3/11 Earthquake: The impact of electric power supply constraints due to the severe accident at the Fukushima nuclear power plant.**
- **21% of the electric power supply in Japan comes from nuclear power.**
- **The Institute of Energy Economics, Japan (IEE Japan) expects that all nuclear power plants in Japan will stop operating by next spring if currently operating nuclear power plants stop operating for regular maintenance and stopped nuclear power plants are not allowed to operate again.**
- **The IEE Japan expects that, if this scenario materializes, 7.8% of the demand for electric power will not be met.**

Japan's Electric Power Supply Capacity (May, 2011)



Source: Agency for Natural Resources and Energy.

4. The Impact of Electric Power Supply Constraints on the Japanese Economy

- **Following Hogan and Jorgenson (1991) and Manne and Richels (1991), we estimate the following demand equation using the IV method with industry dummies:**

$$\ln E_j = const. + \alpha_1 t + \alpha_2 \ln(p_E / p_j) + \alpha_3 Y_j$$

E_j: Demand for electric power use by industry *j*

P_E/P_j: Relative price, electric power/output price

Y_j: Output (gross value added) of industy *j*

Estimation Results for Sectoral Demand Equations for Electric Power Use

	All industries	Manufacturing	Non-manufacturing
Trend	0.018***	0.010***	0.026***
	[0.001]	[0.001]	[0.002]
ln(Pe/Pj)	-0.267***	-0.236***	-0.424***
	[0.030]	[0.037]	[0.055]
ln(VA)	0.577***		
	[0.020]		
ln(Y)		0.703***	0.527***
		[0.025]	[0.032]
Cons	2.034***	0.062	1.844***
	[0.271]	[0.366]	[0.476]
Number of observations	3228	1768	1462
Number of groups	95	52	43
R-squared within model	0.547	0.631	0.618
R-squared overall model	0.318	0.327	0.532
R-squared between model	0.276	0.267	0.533

1) *, **, *** indicate 10%, 5%, and 1% significance respectively.

4. The Impact of Electric Power Supply Constraints on the Japanese Economy

- **Based on the estimation results, we examine the effects of the electric power supply constraints on relative prices and output (we assume that there are no constraints on other inputs which can substitute for electric power input).**
- **We examine two scenarios:**

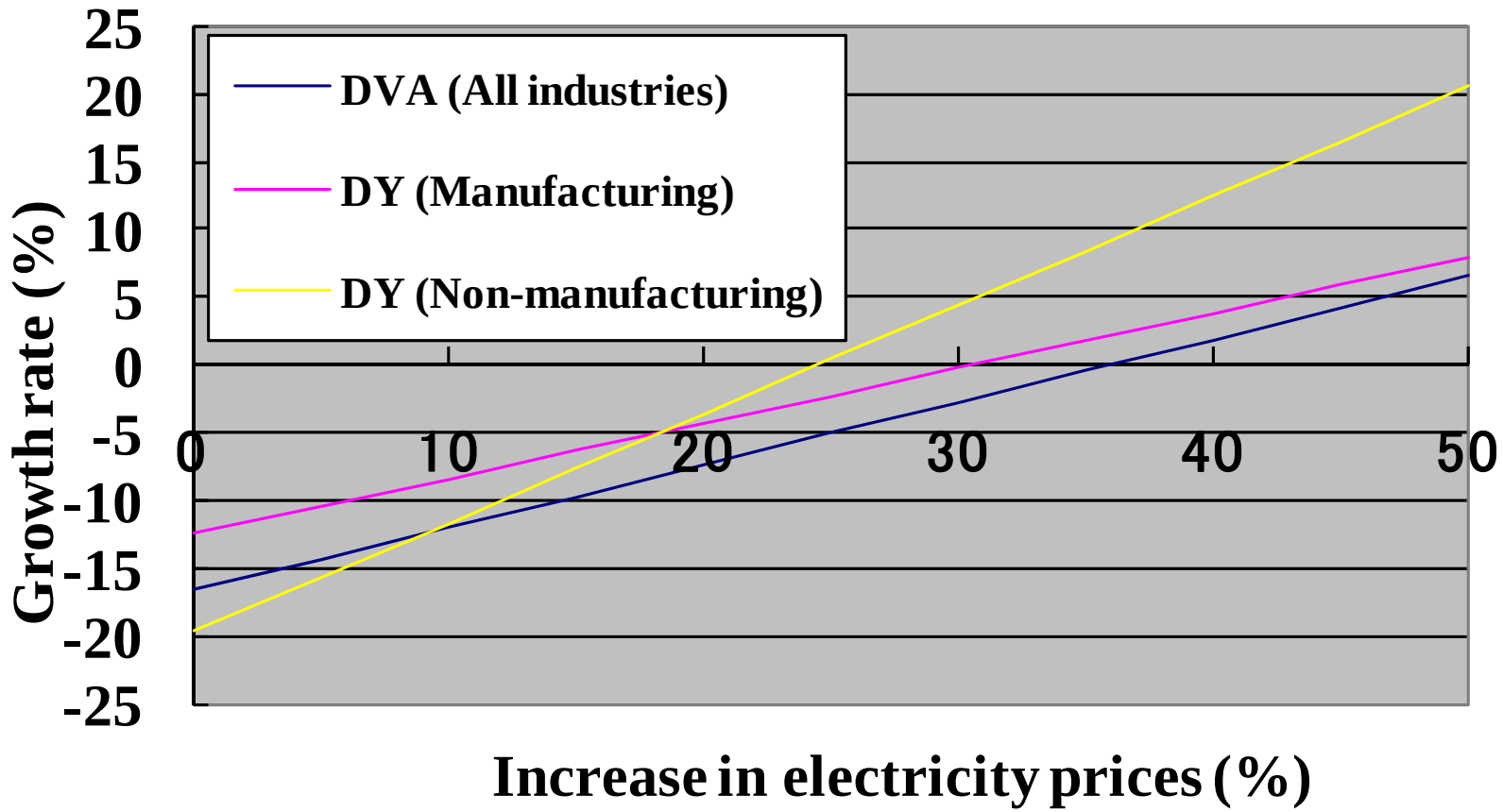
Case 1: Following IEE Japan, we assume that the total demand for electric power use needs to be reduced by 7.8%.

Case 2:The total demand for electric power use in summer (July to September) needs to be reduced by 7.8%. In this case, the annual average demand needs to reduced by 2%=7.8%*(1/4).

4. The Impact of Electric Power Supply Constraints on the Japanese Economy

- **With no increase in the price of electricity, output needs to decrease by 16.6% in Case 1 and by 6.6% in Case 2 respectively.**
- **The output loss in the non-manufacturing sector will be greater than that in the manufacturing sector, if we assume that electricity use in the two sectors is reduced in a parallel manner.**
- **If output is to grow by 1%, the price of electricity needs to increase by 38% in Case 1 and by 16% in Case 2 to achieve the necessary reduction in electric power use.**

Output growth and increase in electricity prices: 7.8% reduction in electric power use



Output growth and increase electricity prices: 2% reduction in the elcetric power use