The Effects of Energy Transition Policy on Manufacturing Sectors in Korea

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1. Introduction

The Moon Jae-in administration announced on December 2017 the 8th Basic Plan for Long-term Electricity Supply and Demand (8th BPLE), which emphasizes environmental and safety factors while reflecting the need for a stable power supply and economic efficiency. The 8th BPLE is called an "energy transition policy"[1] in that it shifts away from nuclear power toward renewables, unlike the existing BPLE.[2] Further, the policy prioritizes strengthening demand management and focuses on steadily increasing the use of distributed energy resources.[3] The energy transition policy takes into consideration the safety of national infrastructure and environmental security and protection from natural disasters such as Japan's Fukushima nuclear accident in March 2011, the Gyeongju earthquake in September 2016 and the Pohang earthquake in November 2017 in Korea.

While a policy moving from nuclear and coal power to renewables and natural gas is widely supported in terms of eco-friendliness and safety, there are also obstacles to realizing that policy goal. In particular, the stability of demand and supply of energy is the most important factor to consider in Korea, which has an energy-intensive industrial structure and relies on imports for most of its energy. This study focuses on the changes in electricity prices among the various changes that may arise from the

1 An energy transition is defined as a fundamental, structural change in the energy sector of a certain country, such as an increasing share of renewable energies and the promotion of energy efficiency combined with a phasing out of fossil energies. Energy transitions differ in terms of motivation and objectives, drivers and governance, and provide a diverse set of challenges and opportunities (World Energy Council, 2014).

2 The BPLE was established pursuant to Article 25 of the Electricity Utility Act and Article 15 of the Electricity Utility Decree biennially for a mid-to long-term forecast of electric power demand and the corresponding installation of more electric facilities. The first Basic Plan for Long-term Electricity Supply and Demand was established in 2002 and a total of eight BPLEs have been released so far (Ministry of Trade, Industry and Energy, 2017).

3 Distributed energy resources (DERs) refer to small-sized generation facilities (below 40 MW) and generation facilities applicable to points of demand (below 500 MW) with minimal construction of transmission lines (Ministry of Trade, Industry and Energy, 2017).

implementation of an energy transition policy and analyzes the impacts of those changes on manufacturing.

When a firm is facing an external shock such as a rise in electricity prices, it may transfer its increased costs to the prices of its products or it may absorb the cost internally, reducing revenue. Of these two strategies, the strategy a firm ultimately chooses generally depends on the price elasticity of demand. Firms that produce a product with high price elasticity will absorb the cost increases internally as price increases would result in a decline in demand. On the other hand, firms whose products exhibit weak price elasticity will maximize profits by raising prices, maintaining returns. In terms of product competitiveness, the more price-elastic a firm's product, the lower its product competitiveness. Therefore, the more competitive firms are, the more likely they will externalize the impact of rising costs; less competitive firms will adopt an internalization strategy.

While these strategic behaviors (internalization or externalization) are responses to the direct impact of rising activity costs, there are also indirect impacts caused by other economic behaviors. For example, the increase in electricity prices can negatively affect a firm's production, resulting in a decrease in product demand caused by lower levels of disposable household income. As such, the shock of rising costs may exert indirect effects on firms through multiple channels.

This study focuses on analyzing the direct impacts of changes in electricity prices caused by energy transition policy. In particular, we measures changes in operating profit margins in the manufacturing industry.

The remainder of the paper proceeds as follows. Section 2 analyzes changes in power generation costs and electricity prices between the new and the previous energy policy. Section 3 examines the impact of changing (rising) power costs on the profitability of manufacturing enterprises. In the fourth and final section, conclusions and drawn and the implications of the analytical results described.

2. Energy Mix and Changes in Electricity Prices

(1) Energy Mix of the 7th and 8th BPLEs

The 8th BPLE set the basic direction of the national energy mix to be economical, safe and clean, phasing out the use of nuclear energy and coal while increasing the shares of renewable energy and liquefied natural gas (LNG). The total installed capacity outlined in the 8th plan was projected to increase by 43.4 percent, from 117.0 gigawatts (GW) in 2017 to 167.8 GW in 2029, as shown in Table 1, which compares the energy capacity mix between the 7th and 8th BPLEs.

The capacity the 7th plan suggested for 2029 was 163.9 GW, which is only 4 GW (2.4 percent) larger than the capacity the updated 8th plan proposed for the, but there is a significant

Table 1. Comparison of Energy Capacity Mix between 7th and 8th BPLEs

	Nuclear	Coal	LNG	Oil	Pumped Storage	Renewable	Total
2017 year in the 8th (MW)	22,529	36,920	37,353	4,151	4,700	11,316	116,968
Share, in %	(19.3)	(31.6)	(31.9)	(3.5)	(4.0)	(9.7)	(100.0)
2029 year in the 8th (MW)	20,400	39,921	47,460	1,391	5,500	53,126	167,798
Share, in %	(12.2)	(23.8)	(28.3)	(0.8)	(3.3)	(31.7)	(100.0)
2029 year in the 7th (MW)	38,329	44,018	42,736	1,195	4,700	32,890	163,868
Share, in %	(23.4)	(26.9)	(26.1)	(0.7)	(2.9)	(20.1)	(100.0)

Source: Ministry of Trade, Industry and Energy (2015), The 7th Basic Plan for Electricity Supply and Demand (2015-2029); Ministry of Trade, Industry and Energy (2017), The 8th Basic Plan for Electricity Supply and Demand (2017-2031).

difference between the two plans in terms of the energy mix. In the 8th plan, while the combined renewable and LNG capacity is expected to rise from 41.6 to 59.9 percent of total capacity, it projects that the combined share of nuclear and coal energy would fall, from 50.8 percent to 35.9 percent. In contrast, the 7th plan projected a combined share of renewable and LNG at 46.2 percent in 2029 and the share of coal and nuclear power to be 50.3 percent for the same year. The 7th plan also estimated that the share of renewables would increase to 20.1 percent by 2029, but this figure is 11.6 percentage points lower than the 31.7 percent proposed in the 8th plan.

As described above, the 8th plan projected structural changes in the national energy mix. In particular, the plan does not lower projections for the share of nuclear power capacity compared to the 7th plan and instead merely raises the share of renewable capacity to those levels. The 8th plan estimates that by 2029 the share of renewable energy in the national energy mix will be 31.7 percent, 11.6 percentage points higher than the 20.1 percent estimated by the 7th plan, with a share of nuclear power 11.2 percent lower than the 23.4 percent prescribed in the 7th plan. Therefore, the 8th plan can be seen as an alternative energy transition policy in that it aims to fundamentally alter the previous energy mix, which was centered on nuclear and coal, to one centered around renewable energy and natural gas.

(2) Changes in Electricity Prices Caused by the 7th and 8th BPLEs

Electricity prices reflect the significant differences in energy capacity mixes, which in turn acts as a factor in changing power generation costs. Table 2 shows how power generation costs are estimated based on the capacity of

Table 2. 2029 Power Generation Costs, According to 7th BPLE

	Nuclear	Coal	LNG	Oil	Pumped Storage	Renewable	Total
(A) Capacity (MW)	38,329	44,018	42,736	1,195	4,700	32,890	163,868
(B) Operation rate (percent)	76.8	73.6	12.0	-	9.3	26.7	
(C) Transaction Volume (GWh)	257,875	283,753	44,780	-	3,812	83,554	673,774
(D) Unit price (KRW/kWh)	60.7	78.5	111.6	165.5	107.6	58.4	
(E) Electricity sales amount (Bill. Won)	15,648	22,272	4,998	-	410	4,878	48,206
(F) Volume share (%)	38.3	42.1	6.6		0.6	12.4	100.0

Note: 1) LNG includes collective energy; coal includes both anthracite and bituminous varieties.
2) Operation rate = (C)/(A)*365days*24hours)*100 for nuclear, coal, and pumped storage. LNG's operation rate= (C)*1000/(A)*365days*24hours)*100, and the renewable operation rate is the value that achieves the 8th plan's power generation target (20 percent of total, 134,961GWh).
3) Transaction volumes(C) = (A)*365days*24hours*(B)/100000 for nuclear, coal, pumped storage and renewables.
4) Electricity sales amount (E) = (C)*(D)/100.

each energy source in the 7th plan.

By row, Capacity (A) represents the 2029 outlook for the power generation mix by nominal capacity based on installed capacity as described in the 7th plan. In the operation rate (B), for nuclear, coal, and pumped storage, it is the average of the past three years (from 2015 to 2017) for each capacity. The operation rate to achieve the renewable generation targets of the 8th plan is applied to renewables, and the operation rate of LNG is calculated using the related capacity (A) and transaction volumes (C) as described the note for Table 2. The transaction volumes (C) of nuclear power, coal, pumped storage, and renewables are calculated using related capacity and operation rates. For LNG, reflecting the characteristics that is in charge of peak demand, transaction volumes (44,780Wh) are derived by subtracting the sum of the power trading volume of nuclear, coal, pumped storage, and renewables from the total transaction volume (673,773GWh).

In addition, the operation rate of LNG is calculated by using this transaction volume and the related capacity. The total transaction volumes estimated in the 8th plan take into account the transmission and distribution loss rate (2.44 percent) in the 2029 consumption outlook. For the normal unit price of electricity — one of the important assumptions — the actual price of 2017 is applied However, the 8th plan expects the generation cost of renewables in the 2029 just 65.5 percent of the actual price in 2017 (90.5 KRW per kWh). Electricity sales amounts (E) are calculated by multiplying the transaction volume (C) by unit price (D). Finally, the total cost of power generation in the 7th plan, assuming the maintenance of the existing policy,

is estimated to be 48.2 trillion KRW.

Table 3 shows the calculated power generation costs for 2029 using the energy mix of the 8th BPLE. The result is based on the same formula and assumptions as Table 2 above, except for assumptions for the operating rates of coal, coal and LNG unit prices. The coal operation rate is assumed to be 70 percent, 3 percent lower than the 73.6 percent of the 7th plan. This takes into account the fact that the 8th plan may further reduce the proportion of coal by introducing an environmentally friendly power dispatch, for which impacts on the environment (greenhouse gases, fine dust, and so on) and the economy should be considered comprehensively in deciding the dispatch order of power. The unit price of coal is raised 15 percent and LNG unit prices are lowered by 90 percent compared to the 7th plan. This adjustment takes into account implicit intent of the 8th plan to induce competition between LNG providers by reflecting environmental costs, adjusting taxes, and calculating equalized power generation costs.

As a result of applying the premises of the 8th plan, the total cost of power generation is estimated to 54.8 trillion KRW, 12.2 percent higher than the 48.2 trillion KRW projected in the 7th plan. This amount can be seen as the additional power generation costs under the energy conversion policy.

In fact, Korea's electricity prices tend to be determined by policy rather than actual fuel costs, so it may be a separate matter to increase power generation costs to increase electricity prices. Nevertheless, it is assumed that there is a greater justification for the future that electricity prices should be linked to fuel costs, and that for the convenience of analysis, an increase in power generation costs will lead to a rise in

Table 3. 2029 Power Generation Costs, According to 8th BPLE

	Nuclear	Coal	LNG	Oil	Pumped Storage	Renewable	Total
(A) Capacity (MW)	20,400	39,921	47,460	1,391	5,500	53,126	167,798
(B) Operation rate (percent)	76.8	70.0	36.6	-	9.3	29.0	
(C) Transaction Volume (GWh)	137,245	244,796	152,311	-	4,460	134,961	683,270
(D) Unit price (KRW/kWh)	60.7	90.3	100.4	165.5	107.6	58.4	
(E) Electricity sales (1 bln KRW)	8,328	22,096	15,298	-	480	7,880	54,082
(F) Volume share (%)	20.1	23.8	23.0		0.7	20.0	100.0

Note: The formula used is the same as Table 2. However, for the operation rate of coal, 70 percent, which is 3.6 percentage points lower than the 73.6 percent of the 7th plan, is assumed. For coal's unit price, the price of 90.3 KRW/kWh reflects an increase of 15 percent over the 7th plan. For LNG's unit price, a figure 90 percent of the 7th plan is applied.

electricity prices. This means that the profit structure of the Korea Electric Power Corporation (KEPCO), which produces all of Korea's electricity, is the same as in 2017, and assumes that inflation is not reflected.

The following section analyzes the profitability of manufacturing and the impact on changing prices by setting a base scenario in which 12.2 percent of the estimated additional costs of power generation leads to arise in electricity prices. In this regard, HRI(2017) expected that eco-friendly policies would further increase electricity prices for households by 11.9 percent in 2030 compared to existing policies. The research assumed that an additional increase in power generation costs would lead to a rise in electricity prices, as in this study, but detailed assumptions of existing and eco-friendly policies are set differently.[4]

3. The Effect of Changes in Electricity Price on Manufacturing's Operating Profit Margin (OPM)

Changes in electricity prices affect profits and production through changing the cost structure of firms that use electric power in the production process. This section analyzes the effect of a rise in electricity prices on operating profits by specific manufacturing subsector. The increase in production costs resulting from the rise in electricity prices can be passed on to consumers via product prices, but the degree of transfer will vary depending on corporate and sectoral characteristics. To simplify the analysis, it is assumed that an increase in electricity prices is not directly transferred to product prices, but rather increases production costs and thereby reducing operating profit margin (OPM), where OPM is defined by the ratio of operating income to sales revenue.

In reality, many firms will minimize the decline in operating profit by absorbing part of the rise in electricity prices as an increase in costs and transferring the other part to product prices. In this way, if the product price increases, the production costs of other industries increases, and as a result overall price levels increase, adding to the indirect effect of deteriorating operating profit. Although this indirect effect will not be large, the deterioration of operating profit that actually occurs will be smaller than the analytical results of this study.

We analyze manufacturing sectors at the division level (two-digit) of the Korean standard industrial classification (KSIC), and at the class level (two-digit) for the manufacture of electronic components, computer, radio, television and communication equipment and apparatuses (C26). Table 4 shows the numbers of firms and workers, electric costs, operating profit margins, and the proportion of normal operat-

4 VIP report of Hyndai Research Institute (HRI), 700ho, 2017.8.21.

ing firms.[5]

In 2016, average ratio of electricity costs to total costs across all of manufacturing was 1.9 percent. By sector, eight (C13, C16, C17, C20, C22, C24, C23, C26) of 25 sectors at the two-digit level and three (C261, C262 and C266) of six sectors at the three-digit level exceeded the manufacturing average. In particular, C17 (pulp, paper and paper products) accounted for the highest ratio, at four percent, followed by C23 (other non-metallic mineral products), at 3.9 percent and C24 (basic metal products), at 3.8 percent.

The average OPM of the manufacturing was 6.9 percent in 2016, with 15 of the 26 industries having exceeded the manufacturing average. In particular, C12 (tobacco) recorded the highest OPM, at 53.8 percent, followed by C11 (beverages) at 27.5 percent, and C21 (pharmaceuticals, medicinal chemicals and botanical products) at 19.6 percent, but C266 (magnetic and optical media) and C31 (other transport equipment) recorded negative ratios of -3.2 percent and -1.1 percent, respectively.

For firms with an OPM lower than one percent, C19 (coke, hard-coal and lignite fuel briquettes and refined petroleum products) accounted for 35 percent of industries, the highest proportion, followed by C26 (electronic components, computer, radio, TV and communication equipment and apparatuses) at 27.7 percent. C21 (medical substance and pharmaceutical manufacturing) industries accounted for 23 percent of the total, and the average for all of manufacturing is 17.6 percent.

On the other hand, Table 5 shows the result of calculating the difference between the actual OPM and the OPM which assumes a 12.2 percent increase in electricity prices (the difference between the electricity prices of the 7th and 8th plans) for every sector. The overall OPM of manufacturing decreases by 0.22 percentage points, 0.23 percentage points for firms with more than 300 employees, and 0.21 percentage points at firms with less than 300 employees.

The decline in OPM is greater for firms with more than 300 employees, but the OPM itself is lower at firms with less than 300 employees so the increase in electricity prices will have a greater impact on small firms. For example, in the semiconductor industry, with an average OPM of 11.7 percent, and it is estimated that OPM would drop by 0.35 percentage points due an increase in electricity prices. Looking at the impact of the increase in electricity prices by firm size, the OPM for firms with more than 300 employees drops by 0.37 percentage points from 12.4 percent, while the OPM for those with less than 300 employees decrease by 0.17

5 According to financial statement analysis by the Bank of Korea (BOK), the ratio of interest expense to sales in the manufacturing sector was 0.9 percent in 2017. With reference to this, we consider a firm that produces an operating profit margin covering interest costs of more than one percent as a normal operating firm.

Table 4. Electricity Costs and Operating Profit Margin by Sector in the Manufacturing Industry (2016)

KSIC Code	Korea Standard Industrial Category	Number of firms	Number of employees	Ratio of electricity cost to total cost (%)	Operating Profit Margin (%)	Firms with less than 1% OPM	
						Number of firms	Share (%)
C10	Food products	5,014	195,940	1.3	10.3	1,043	20.8
C11	Beverage	260	15,628	1.5	27.5	49	18.8
C12	Tobacco	9	2,140	1.0	53.8	–	0.0
C13	Textiles; except clothing	3,134	88,904	3.2	4.8	480	15.3
C14	Apparel, clothing accessories and fur articles	2,421	63,442	0.2	6.6	304	12.6
C15	Tanning and dressing of leather, luggage and footwear	775	19,699	0.8	7.5	137	17.7
C16	Wood products of wood and cork; except furniture	864	20,070	2.1	2.9	137	15.9
C17	Pulp, paper and paper products	1,812	59,915	4.0	7.3	328	18.1
C18	Printing and reproduction of recorded media	1,194	29,523	1.7	5.1	177	14.8
C19	Coke, hard-coal and lignite fuel briquettes and refined petroleum products	137	11,176	1.5	7.4	48	35.0
C20	Chemicals and chemical products except pharmaceuticals, medicinal chemicals	2,787	132,868	3.7	12.3	534	19.2
C21	Pharmaceuticals, medicinal chemicals and botanical products	505	38,536	1.2	19.6	116	23.0
C22	Rubber and plastic products	6,138	227,631	2.3	5.7	887	14.5
C23	Other non-metallic mineral products	2,603	87,108	3.9	9.8	439	16.9
C24	Basic metal products	2,921	140,209	3.8	3.7	580	19.9
C25	Fabricated metal products; except machinery and furniture	9,501	273,465	1.6	6.1	1,233	13.0
C26	**Electronic components, computer, radio, TV and communication equipment and apparatuses**	**3,084**	**371,523**	**2.2**	**6.4**	**1,055**	**27.7**
C261	Semiconductor	377	114,135	3.3	11.7	116	30.8
C262	Electronic components	1,810	168,289	2.6	2.8	461	25.5
C263	Computers and peripheral equipment	270	9,040	0.4	3.4	82	30.4
C264	Telecommunication and broadcasting apparatuses	1,039	60,367	0.4	3.0	324	31.2
C265	Electronic video and audio equipment	303	19,554	0.3	8.1	69	22.8
C266	Magnetic and optical media	5	138	3.3	-3.2	3	60.0
C27	Medical, precision, optical instruments, watches and clocks	2,317	85,271	0.6	4.8	501	21.6
C28	Electrical equipment	4,248	189,230	0.9	3.1	884	20.8
C29	Other machinery and equipment	9,416	316,519	0.9	5.3	1,510	16.0
C30	Motor vehicles, trailers and semitrailers	4,666	354,504	0.9	7.0	867	18.6
C31	Other transport equipment	1,589	163,831	0.8	-1.1	336	21.1
C32	Furniture	1,191	27,802	0.9	7.6	175	14.7
C33	Other manufacturing	1,045	26,462	1.0	8.7	198	18.9
C34	Repair of industrial machinery and equipment	717	21,781	0.2	8.5	151	21.1
	Manufacturing	**69,068**	**2,963,237**	**1.9**	**6.9**	**12,169**	**17.6**

Source: Statistics Korea, *2016 Mining and Manufacturing Survey*. Available at: kosis.kr.

Table 5. Estimated Drop in OPM due to 12.2 percent Increase in Electricity Prices

KSIC Code	Korea Standard Industrial Category	Total		More than 300 employees		Less than 300 employees	
		Drop (%p)	2016 OPM (%)	Drop (%p)	2016 OPM (%)	Drop (%p)	2016 OPM (%)
C10	Food products	0.14	10.3	0.13	15.8	0.15	9.3
C11	Beverages	0.13	27.5	0.13	37.6	0.13	23.9
C12	Tobacco	0.06	53.8	0.04	52.2	0.09	57.7
C13	Textiles; except clothing	0.37	4.8	0.75	-4.1	0.35	5.2
C14	Apparel, clothing accessories and fur articles	0.03	6.6	0.01	13.1	0.03	4.6
C15	Tanning and dressing of leather, luggage and footwear	0.09	7.5	0.07	-5.2	0.09	7.7
C16	Wood products of wood and cork; except furniture	0.25	2.9	0.76	-13.2	0.19	4.7
C17	Pulp, paper and paper products	0.45	7.3	0.64	13.8	0.41	5.7
C18	Printing and reproduction of recorded media	0.20	5.1	0.00	-320.7	0.20	5.3
C19	Coke, hard-coal and lignite fuel briquettes and refined petroleum products	0.16	7.4	0.17	6.7	0.05	14.8
C20	Chemicals and chemical products except pharmaceuticals, medicinal chemicals	0.39	12.3	0.38	14.8	0.40	9.8
C21	Pharmaceuticals, medicinal chemicals and botanical products	0.12	19.6	0.14	18.2	0.11	20.0
C22	Rubber and plastic products	0.26	5.7	0.26	6.0	0.27	5.6
C23	Other non-metallic mineral products	0.43	9.8	0.87	16.0	0.33	8.3
C24	Basic metal products	0.45	3.7	0.53	4.0	0.34	3.4
C25	Fabricated metal products; except machinery and furniture	0.19	6.1	0.13	7.1	0.20	5.9
C26	**Electronic components, computer, radio, TV and communication equipment and apparatuses**	0.25	6.4	0.27	7.1	0.14	2.5
C261	Semiconductor	0.35	11.7	0.37	12.4	0.17	0.4
C262	Electronic components	0.31	2.8	0.34	2.7	0.20	3.1
C263	Computers and peripheral equipment	0.05	3.4	0.00	3.2	0.05	3.5
C264	Telecommunication and broadcasting apparatuses	0.04	3.0	0.04	3.2	0.08	2.1
C265	Electronic video and audio equipment	0.03	8.1	0.02	10.2	0.06	3.3
C266	Magnetic and optical media	0.41	-3.2	-	-	0.41	-3.2
C27	Medical, precision, optical instruments, watches and clocks	0.07	4.8	0.05	-4.5	0.08	6.9
C28	Electrical equipment	0.10	3.1	0.10	1.9	0.10	3.9
C29	Other machinery and equipment	0.11	5.3	0.07	3.7	0.12	5.8
C30	Motor vehicles, trailers and semitrailers	0.10	7.0	0.07	8.9	0.17	3.5
C31	Other transport equipment	0.10	-1.1	0.10	-2.2	0.13	4.9
C32	Furniture	0.10	7.6	0.05	16.1	0.10	7.4
C33	Other manufacturing	0.11	8.7	0.13	13.8	0.11	8.5
C34	Repair of industrial machinery and equipment	0.02	8.5	0.06	-4.3	0.02	8.9
	Manufacturing	0.22	6.9	0.23	7.3	0.21	6.6

Source: Statistics Korea, *2016 Mining and Manufacturing Survey*. Available at: kosis.kr.

percentage points, from 0.40 percent. Although the decline in OPM at firms with more than 300 employees is twice as great as those with less than 300 employees (0.38 percentage points vs 0.17 percentage points), considering that the firms with less than 300 employees have very low OPM, the real impact of the increase in electricity prices is very significant. In addition, as 30 percent of firms in the semiconductor industry have an OPM lower than one percent, the impact of rising costs is greater than the actual decline in OPM for small firms, which could put many firms on the brink of survival.

In fact, large firms can maintain profitability by transferring cost increases to prices because they have the ability to set prices, but small and medium-sized firms are not able to set prices because they are mostly subcontractors and produce products in competitive markets, so they will likely internalize the impact of higher costs, which leads to lower returns. Therefore, if electricity prices rise, large firms will take an externalization strategy to reduce production, reducing production orders for smaller subcontractors, and small and medium-sized firms are likely to suffer from the double whammy of having to deal with production reductions and worsening returns from rising costs.

4. Summary and Conclusions

This study compares the impacts of the 7th and 8th BPLE, seen as energy transition policies in terms of electricity prices and examines the 8th plan's effects on manufacturing sectors. As a result of the energy transition policy, electricity prices are expected to increase by up to 12.5 percent. The effect of this price increase in manufacturing subsectors may seem small when looking at the economy as a whole, but significant at small firms and in sectors sensitive to electricity prices. The effect of the energy transition policy on manufacturing depends on the change in electricity prices. According to our estimations, any increase in electricity prices will be modest, so the effect is expected to be limited. However, this judgment is based on the assumption that the 8th plan will proceed smoothly as expected. In order for the energy transition policy to succeed, the government's will in pursuit of the policy's original intent is important. In addition, as the effect on the manufacturing varies by firm size and sector, a policy that can minimize negative effects through a combination of various measures will be required.

A main limitation of this paper is that it assumes that the industrial structure of the past will persist into the future. That is, changes in operating profit margins are based on 2016 data and thus do not reflect post changes in the industrial structure. For example, in the future, development in manufacturing technology will likely take place in a way that is environmentally friendly and consumes less electricity. Given this, industry-specific electricity demand will exhibit a different pattern than it does today, but this issue is difficult to address in this study,

so we leave it to future research. Next, it is assumed that all increases in power generation costs are passed on to electricity consumers in the form of higher electricity prices. However, this is likely not to be the case in reality. Since electricity prices directly and broadly affect consumer prices in general, it is a reality that the government cannot immediately pass changes in electricity costs to electricity prices. At the same time, it is necessary to keep in mind the justification that the fuel costs should be linked to electricity prices.

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