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Excess Capacity and Effectiveness of Policy Interventions: Evidence from the Cement Industry*

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Abstract

Strategic interaction among firms may hinder the reduction of excess capacity in a declining industry. Policy interventions that attempt to reduce excess capacity may increase efficiency by accelerating the capital adjustment but may decrease efficiency by increasing the market power of firms and/or by distorting firms' divestment decisions. We study capacity coordination policies—forcing firms to reduce their capacity *simultaneously*—applied to the Japanese cement industry. Estimation results suggest that these interventions (i) did not increase market power because reduction in capacity resulted in higher utilization of the remaining plants, and (ii) did not distort firms' scrappage decisions.

JEL Classification: D24, L13, L52, L61.
Keywords: Excess Capacity, Capacity Coordination, Cartels, Cement, Industrial Policy.

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1 Introduction

Excess production capacity, also known as overcapacity, has been a major concern in many countries, in particular when an industry faces declining demand—e.g., the US steel industry in the 1970s, the hard disk drive industry in Asia in the 2010s, the current shipbuilding industry in China and Korea, and the current US hydraulic fracturing industry. The excess capacity literature dates back to at least Bain (1962), who defines excess capacity as a "persistent tendency toward redundant capacity at times of maximum or peak demand." Excess capacity is one source of social inefficiency; it might cause capital misallocation, create unnecessary running costs or limit land use. Although policymakers have been particularly concerned about this excess capacity issue, as discussed in several high-level meetings and policy roundtables at the OECD, economists have yet to provide a rigorous empirical analysis, believing that this problem may be resolved through a market mechanism and natural selection, as theoretically shown by Ghemawat and Nalebuff (1990). However, it is also well known that firms' strategic interaction may delay the exit and divestment process when oligopolistic firms are waging a "war of attrition" (Smith, 1974). Such a strategic delay may create social inefficiency, as empirically confirmed by Takahashi (2015). Thus, explicit cooperation among firms may improve efficiency, though it may be prohibited from an anti-trust point of view.

Capacity coordination, allowing firms to coordinate their capacity, is a common policy intervention in a distressed industry, to accelerate the process of capacity adjustment. Even though it is, in principle, prohibited due to its collusive nature, there are some cases where exemptions were granted. Competition law in Europe may allow firms in a recession industry to form crisis cartels—e.g., the European synthetic fiber industry in the 1980s and the Dutch brick industry in the 1990s. Even recently, in the United States, two airline companies in Hawaii were allowed to coordinate their capacity in response to declining demand after the September 11, 2001, terrorist attacks. Though we observe such occasional capacity coordination policies in many countries, to the best of our knowledge, the literature has not comprehensively examined them yet. Therefore, in order to consider policy design, this paper attempts to empirically evaluate capacity coordination policies from the viewpoints of both consumers and producers.

To this end, this paper focuses on a series of capacity coordination policies applied to the Japanese cement industry in the 1980s and 1990s, which provides an ideal environment with detailed data for precisely evaluating how capacity coordination policies would enhance and harm welfare. We believe that this case is ideal because of (i) its historical background and market structure, (ii) the characteristics of cement—a homogeneous product and simple production process—and (iii) availability of excellent data. First, even though the industry faced declining demand in the 1970s triggered by two oil crises, the oligopolistic firms did not adjust their capacity to the change in demand, which led to low capacity utilization. Observing this, the Ministry of International Trade and Industry (hereinafter MITI) initiated a series of policies called "capacity coordination" that forced the cement firms to divest their production capacity *simultaneously*, based on the allotment authorized by MITI. Second, thanks to the homogeneity of the product and simplicity of the production process, we can estimate the demand function and production function accurately. These recovered primitives enable us to obtain firms' markups and plant productivity, which we relate consumer welfare and firms' behavior. Furthermore, very detailed plant-level data are available for this industry; for each plant, we observe not only the production amount and capacity, which enables us to calculate the utilization rate of a plant, but also how many and which type of kilns (technology) each plant owned.

Our empirical analysis begins with examining the changes in firms' market power, which is closely related to consumer welfare. In particular, we specifically ask whether these policy interventions increased prices and/or markups, due to the collusive nature of capacity coordination. The first capacity coordination policy targeted a reduction of 30 million out of the 129 million tons of existing capacity and, out of that 30 million tons, 25 million tons was from nonoperating capacity and 5 million tons was from *operating* capacity–whereas the second capacity coordination policy targeted a further reduction of 10.7 million of the existing 98 million tons, all of which was from *operating* capacity. Thus, we naturally expect that firms would be able to set higher markups after the policy implementations, because these capacity coordination policies forced the firms to divest *operating* capacity and thus the supply could no longer meet the demand. To answer the question, we first recover the demand function and obtain the plant-level marginal costs based on the first-order conditions for the firms. We then use regression analysis and find that neither capacity coordination policy increased the markups charged by the cement firms. These results are counterintuitive, but further investigation reveals that the cement firms concentrated their production within the remaining plants and the utilization rates for those plants increased to almost 100%. In other words, although the capacity coordination policies forced the firms to shut down some operating plants, they could meet demand by fully utilizing their remaining capacity. Therefore, the policies allowed the firms to save unnecessary running costs by divesting the plants with low utilization rates, which enhanced social welfare given that consumer welfare was not harmed.

The data clearly demonstrate that a series of policies successfully accelerated the capital adjustment process, and this observation raises the next set of questions: whether this policy intervention distorted the scrappage decisions of the firms and whether the divested plants were also inefficient from a social point of view. To do so, we first recover plant-level productivity via production function estimation and relate productivity to their divestment decisions. Our estimation results show that the firms were likely to divest inefficient plants before the policy introduction and their scrappage decision rules were unchanged during the policy implementation period. The results are robust, regardless of our measurements of productivity—labor productivity, utilization rates, or TFP from production function estimation—and regardless of measurements of divestment—difference in capacities or difference in the number of kilns. Furthermore, our estimation results also support that these divested plants were inefficient not only from the viewpoint of the firms but also from the viewpoint of social welfare.

From our empirical analysis, we conclude that, if allotments and total reduction capacity are well crafted, capacity coordination policy potentially accelerates the divestment process, which increases producer surplus, without lowering consumer welfare. In particular, capacity coordination could effectively reduce excess capacity without distorting firms' scrappage decisions. Moreover, those divested plants were unproductive from the viewpoint of social welfare.

This paper contributes to the literature on declining industries and capacity coordination. Even though the study of declining industries is becoming increasingly important, there is only a handful of theoretical and empirical studies in this area. Ghemawat and Nalebuff (1985, 1990), Fudenberg and Tirole (1986), and Whinston (1988) consider an oligopolistic market and examine firms' decisions to divest and/or exit when the industry faces declining demand. On the empirical side, Lieberman (1990), Deily (1991), and Nishiwaki and Kwon (2013) study firms' exit or plants' closure behavior relating to the firms' observable characteristics and unobserved productivity. More recently, Nishiwaki (2016b) and Takahashi (2015), using a structural approach, study firms' exit and divestment decisions, respectively, in declining industries. Nishiwaki (2016b) examines the effect of mergers on divestment behavior in the Japanese cement industry and finds that strategic interaction, through business stealing in particular, distorts incentives for divestment. Takahashi (2015) estimates an exit game played by US movie theaters, which builds on a theoretical framework developed by Fudenberg and Tirole (1986), and finds that strategic interaction among the theaters delays the exit date substantially. Both results suggest that policy intervention may help restore efficiency by eliminating strategic interaction among firms, which motivates us to thoroughly examine how capacity coordination policies work in this paper.

Excess capacity in declining industries creates social inefficiency, and one of the policy instruments discussed among policymakers that can address this inefficiency is capacity coordination. Kamita (2010) investigates a recent case from the US airline industry: the Aloha–Hawaiian immunity agreement. In response to declining demand after September 11, 2001, the US Department of Transportation allowed Aloha Airlines and Hawaiian Airlines to coordinate capacity for a limited time.[1] She finds that the two firms maintained high prices not only during the immunity period, but also during the subsequent 2.5 years, until a new competitor entered the market. Although empirical analysis on capacity coordination is scarce, Hampton and Sherstyuk (2012) conduct an experimental study on this topic. They show that capacity coordination by an enforceable institution—the government initiative in our context or agreements with enforceable punishment in the Aloha–Hawaiian case—accelerates the capital adjustment process. While their main focus is the effects of capacity coordination on prices and the speed of the capital adjustment process, we also examine its implications for the effectiveness and efficiency of capacity coordination policy.

This paper is organized as follows. Section 2 describes the industry and provides the historical background of the Japanese cement industry as well as the data used in our empirical analysis. Our empirical models and estimation results are presented in Section 3. Given our findings, we discuss the policy implications and caveats in Section 4. Section 5 concludes.

2 Industry and Historical Background

2.1 Cement and Its Production Technology

Cement is one of the most important ingredients for construction works, as concrete and mortar are made from cement. To produce cement, crushed limestone, cray and other minerals are mixed and put into a kiln to be heated. This process yields clinker, which is an intermediate cement product. Note that once cement kilns start the heating process, they are kept heated until the next regular maintenance, which occurs once or twice a year, as rebooting takes a long time and involves energy loss. Even though kilns run 24 hours a day, firms can control the output and utilization rate by adjusting the input. Thus, low utilization

[1] See Blair, Mak and Bonham (2007) for more detailed information.

rates potentially create inefficiency from unnecessary running costs. The final procedure of mixing grinded clinker with gypsum produces cement. The simplicity of this process and homogeneity of the product allow us to analyze and evaluate the capacity coordination policy precisely. In our analysis, we mainly use clinker as our measure of output, because some plants specialize in the production of cement from clinker and do not own any kilns.

Cement kilns are the heart of the production process, and it is important for us to understand some technological aspects of cement kilns in Japan. Even though there are several types of kilns, we can roughly categorize them into two types: dry process kilns and wet process kilns.[2] Dry process kilns were developed in the late 19th century, and wet process kilns became dominant in subsequent periods. In the 1960s, the suspension preheater (SP) process, part of the dry process, was imported from Germany and, due to its high energy efficiency, SP kilns gained in popularity and took a dominant position. Most of the newly built kilns in the 1960s were SP kilns and, in the 1970s, continuing improvements were made by the Japanese companies, and new suspension preheater (hereinafter NSP) kilns were developed. In our data, from 1970 to 1995, almost all newly built kilns were NSP kilns, and this homogeneity of investment simplifies our analysis; the firms simply chose an amount of investment rather than types of investment.

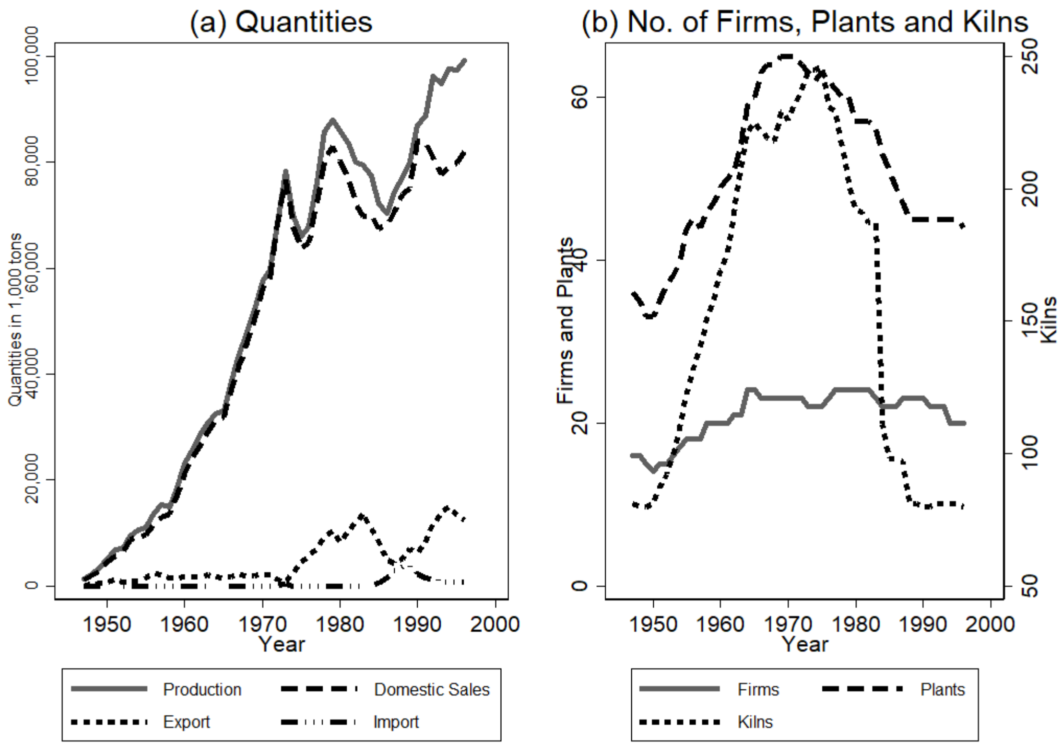
2.2 The Japanese Cement Industry

2.2.1 Historical Background and Excess Capacity

The cement industry in Japan, which dates back to the late 19th century, grew rapidly with the recovery and high growth of the Japanese economy from the late 1940s to the early 1970s. In the period of economic recovery between 1946 and 1954, there was an urgent need to reconstruct the infrastructure and buildings damaged during World War II. In addition, in the so-called high growth period between 1955 and 1973, further investment in infrastructure, such as roads, sea ports, and dams was necessary. These construction investments generated vast demand for cement. Panel (a) of Figure 1 illustrates the demand and supply of cement in Japan. As shown in the figure, domestic sales of cement, denoted by the dashed line, increased sharply until 1973, when the first oil crisis occurred, and demand was met by domestic production, denoted by the solid line. As summarized in Panel (b) of Figure 1, new entries took place mainly from the late 1950s to the early 1960s, as the number of cement

[2] More precisely, there are also semi-dry and semi-wet process kilns. See Shimoda (2016).

Figure 1: Industry Evolution over Time



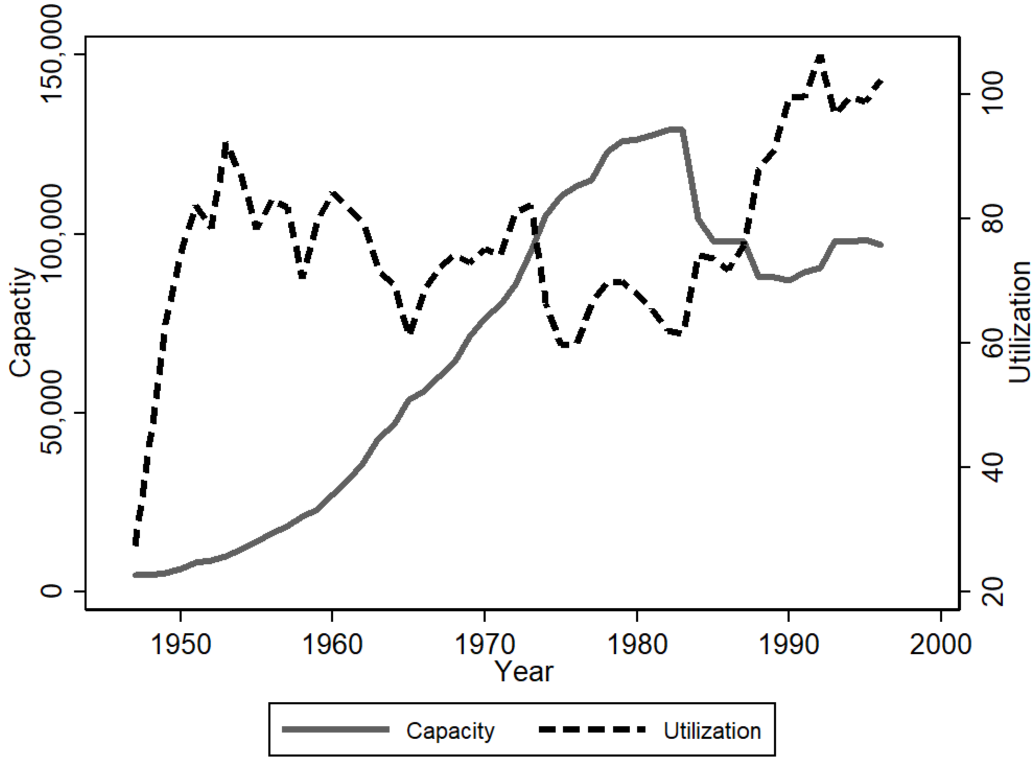
Source: Japan Cement Association (1998), p.117.

firms increased from 17 in 1954 to 24 in 1964.[3] Furthermore, the number of plants and kilns increased in tandem with the new entries and continued to increase until the late 1960s, when the new entries of firms ceased. The production capacity of the industry increased even more rapidly in the 1950s and 1960s, as denoted by the solid line in Figure 2.

The first oil crisis in 1973 was a turning point for the postwar Japanese economy. In 1974, the growth rate of real GDP became negative for the first time in the postwar period and put an end to the high growth of previous decades. In the 1950s and 1960s, the Japanese economy had continued growth at around 10% per year, but after the first oil crisis the growth rate fell to 4–5%. This slowdown in economic growth caused a decline in construction investment. Moreover, the increase in the cumulative government deficit and the effort toward fiscal reconstruction reduced public construction investment. This substantial decline in construction investment caused a decline in domestic demand for cement, as shown in panel (a) of Figure 1. In addition, the second oil crisis occurred in 1979 and, afterward, excess

[3]In this period, strong growth in the cement market induced new entries from related industries, such as coal, chemicals, iron, and steel (Wada, 1995).

Figure 2: Capacity and Utilization Rate



Source: Japan Cement Association (1998), p.118-119.

capacity emerged in the cement industry. While demand for cement declined, production capacity was maintained or even increased slightly until 1985. Although the utilization rate of the equipment (production/capacity) was around 70–80% in the 1950s and 1960s, it fell below 70% in the early 1970s and was consistently below 70% and sometimes fell below 60% in the late 1970s, as in Figure 2. To maintain profitability under a sharp increase in oil prices, the cement firms were allowed, three separate times, to organize a "recession cartel."[4] Although these recession cartels raised the cement price temporarily, they did not promote divestment of capacity, which led to further policy intervention—capacity coordination—by MITI.

[4]These cartels were approved by the Japan Fair Trade Commission under the Antitrust Law and the precise terms of the cartels were (1) November 11, 1975 to January 31, 1976, (2) June 24, 1977, to December 31, 1977, and (3) August 3, 1983, to December 31, 1983 (Japan Cement Association, ed, 1998: pp.49–50).

2.2.2 Capacity Coordination Policies

As the cement industry and other industries—including electric furnace steelmaking and aluminium refining—faced excess capacity problems, the Japanese government arranged capacity coordination in each designated industry by organizing cartels ("instructed cartels") under the Temporary Law for Structural Improvement of the Special Industries (Tokutei Sangyō Kōzō Kaizen Rinji Sochi Hō).[5] More precisely and legally speaking, the cement industry first submitted an application to MITI, which was approved in April 1984, and then MITI announced the "Basic Plan for Structural Improvement of the Cement Industry" in August 1984 (Japan Cement Association, ed, 1998: p.51) instructing the cement firms to organize a cartel in January 1985 (Cement Press ed. 1985, p.18) to implement the capacity reduction plan.

The plan consisted of two main components: capacity coordination and organization of firms into five groups to promote cooperation within the groups. Regarding capacity coordination, the plan prescribed that 30 million tons of the 129 million tons of existing capacity for cement clinker be scrapped. Of this 30 million tons, 25 million tons was from nonoperating equipment and 5 million tons was from operating equipment (Cement Press ed. 1985, pp.16–7). Moreover, the allotment of capacity reduction to each firm was decided through negotiation between the firms and MITI by January 1985. The allotment is shown in Table 1 and indicates there was heterogeneity in divestment rates. The firms were required to dispose of their excess capacity according to the allotment by the end of March 1985 except for six operating kilns, and these six operating kilns were to be disposed of by the end of March 1986. To alleviate unequal allotment across the firms, monetary side-payments were introduced.[6] To smooth the implementation of capacity coordination, 23 cement firms were organized into five groups, each of which established a new company for cooperative businesses within the group, such as consignment production, joint sales, and arrangement of transportation (Japan Cement Association, ed, 1998: p.51).[7]

Although the divestment plan was completed as scheduled, the cement industry faced a new challenge—namely, a sharp appreciation of the yen after the Plaza Agreement in September 1985. Due to the increase in imports and decline in exports, excess capacity

[5]Prior to this law, a similar law called "The Temporary Law for Stabilization of the Special Recession Industries" (Tokutei Fukyo Sangyō Antei Rinji Sochi Hō) was legislated in May 1978. Although the cement industry was not subject to this earlier law, many other industries that were subject to the Temporary Law for Structural Improvement of the Special Industries were also subject to the earlier law.

[6]See Appendix A.

[7]This grouping remained after the removal of the Temporary Law for Structural Improvement of the Special Industries (Japan Cement Association, ed, 1998: p.53).

Table 1: Allotment of Capacity Reduction

		1st Policy Intervention			2nd Policy Intervention		
		Existing	Reduction		Existing	Reduction	
Group	Firm	Capacity	Amount	%	Capacity	Amount	%
1	Onoda Cement	15,378	5,605	36.4	9,840	746	7.6
	Mikawa Onoda Cement	-	-	-	360	0	0.0
	Hitachi Cement	1,543	230	14.9	872	0	0.0
	Mitsui Kozan	3,827	1,618	42.3	2,209	0	0.0
	Shin-Nittetsu Kagaku	1,172	378	32.3	794	0	0.0
	Toyo Soda Kogyo	4,134	906	21.9	3,228	0	0.0
2	Nihon Cement	17,967	4,936	27.5	13,031	1,555	11.9
	Myojo Cement	3,150	699	22.2	2,451	0	0.0
	Daiichi Cement	1,449	357	24.6	1,092	0	0.0
	Osaka Cement	7,965	1,205	15.1	6,760	1,469	21.7
3	Mitsubishi Kogyo Cement	14,120	926	6.6	12,799	2,198	17.2
	Tokuyama Soda	6,886	1,780	25.8	5,106	0	0.0
	Tohoku Kaihatsu		0	0	2,314	0	0.0
4	Sumitomo Cement	12,558	1,833	14.6	10,112	1,677	16.6
	Hachinohe Cement	1,310	0	0	1,310	0	0.0
	Aso Cement	1,672	356	21.3	1,316	0	0.0
	Karita Cement	2,318	661	28.5	1,657	659	39.8
	Nittetsu Cement	1,789	282	15.8	1,507	0	0.0
	Denki Kagaku Kogyo	3,517	881	25	2,636	0	0.0
5	Ube Kosan	10,887	363	3.3	10,524	2,411	22.9
	Chichibu Cement	10,797	5,020	46.5	5,777	0	0.0
	Tsuruga Cement	1,893	248	13.1	1,645	0	0.0
	Ryukyu Cement	690	150	21.7	540	0	0.0
	Total	125,615	29,027	23.1	97,880	10,705	10.9

Source: Cement Press (1989), p.47.
Note: The values in the third, fourth, sixth and seventh columns are measured in thousands of tons.

remained despite completion of the divestment plan. Thus, MITI again prepared a law for further capacity reduction, the Law for Facilitating Transformation of Industrial Structure (Sangyō Kōzō Tenkan Enkatsuka Rinji Sochi Hō) in April 1987. A divestment plan to scrap 10.7 million tons of the operating capacity out of 98 million tons of existing capacity was authorized by MITI in December 1988, and this plan was completed by March 1991. At that time, however, because of an increase in demand under the "Heisei bubble" boom, cement firms experienced capacity shortages. Consequently, they applied to MITI to cancel their obligations under the law, which was approved in May 1991 (Japan Cement Association, ed, 1998: pp.52-3).

2.3 Data Sources and Descriptive Statistics

We manually collect the data from various issues of *Cement Yearbook (Cement Nenkan)*, published by the Cement Press Co. Ltd. (Cement Shinbunsha), which is also used by

Nishiwaki and Kwon (2013) and Nishiwaki (2016b). This yearbook provides plant-level information on monthly production capacity, production output (both clinkers and cement), number of workers, number of kilns, size of individual kilns, kiln ownership, and the geographical location of the plants. In terms of geographical location, we divide the territory of Japan into eight areas, as in Nishiwaki (2016b). We obtain the price of gypsum from the Corporate Goods Price Index, published by the Bank of Japan. We use the price as an instrument when estimating the demand function in our empirical analysis.

Summary statistics of our data, from 1970 to 1995, are given in Table 2. Panel (a) presents two firm-level statistics: the number of firms and the number of plants within a firm. The number of firms varies across the years in the sample, ranging from 20 to 24, because of some entries and exits, including several mergers and company splits, as shown in Figure 1. The number of plants within a firm varies substantially, ranging from 1 to 11, which indicates there is heterogeneity in firm size. Panel (b) of Table 2 presents plant-level statistics for 1970 and 1995, the start and end years of our sample. It is clear that the number of plants decreased from 54 to 40 during this period. Monthly capacity is defined as how much clinker a plant can produce when operating for 600 hours per month, and the utilization rate is defined as clinker production divided by annualized capacity. Both monthly capacity and annual production increased, but the growth rate of production was higher than that of monthly capacity, which resulted in a higher utilization rate in 1995. Note that the average utilization rate in 1970 was about 70%, which is lower than our expectation, as it was prior to the first oil crisis and the Japanese economy was still experiencing high growth. We can also see a dramatic decrease in the number of workers: in 1970, the average number of workers was about 382, but in 1995 this had fallen to 145. This change indicates that there was substantial technological advancement in the form of automation and, consequently, labor productivity increased sharply.

3 Empirical Analysis

In order to comprehensively evaluate the series of capacity coordination policies, we examine the policy from two angles: the demand side and the supply side. Due to the potentially anti-competitive nature of this policy, we first ask whether this policy increased market power of the firms and harmed consumer welfare in Subsection 3.1. Second, in Subsection 3.2, we ask whether the firms' divestment decisions were distorted by the policy and whether divested plants were inefficient not only from the viewpoint of an individual firm but also

Table 2: Summary Statistics

	Num. of Obs.	Mean	Std. Dev.	Min	Max
Panel (a): Firm-Level Statistics					
# of Firms		–	–	20	24
# of Plants within a Firm		2.50	1	1	11
Panel (b): Plant-Level Statistics					
In 1970 (beginning year)					
Monthly Capacity (tons)	54	128,815	80,133	25,000	350,000
Annual Clinker Production (tons)	54	1,031,160	616,927	48,000	2,684,197
Utilization (%)	54	69.1%	20.7	9.3%	115.3%
# of Workers (person)	54	318.8	175.6	114	1205
In 1995 (last year)					
Monthly Capacity (tons)	40	202,656	123,469	55,167	588,417
Annual Clinker Production (tons)	40	2,227,377	1,528,054	616,784	7,405,758
Utilization (%)	40	88.9%	10.8	54.4%	104.9%
# of Workers (person)	40	145.2	67.0	51	399

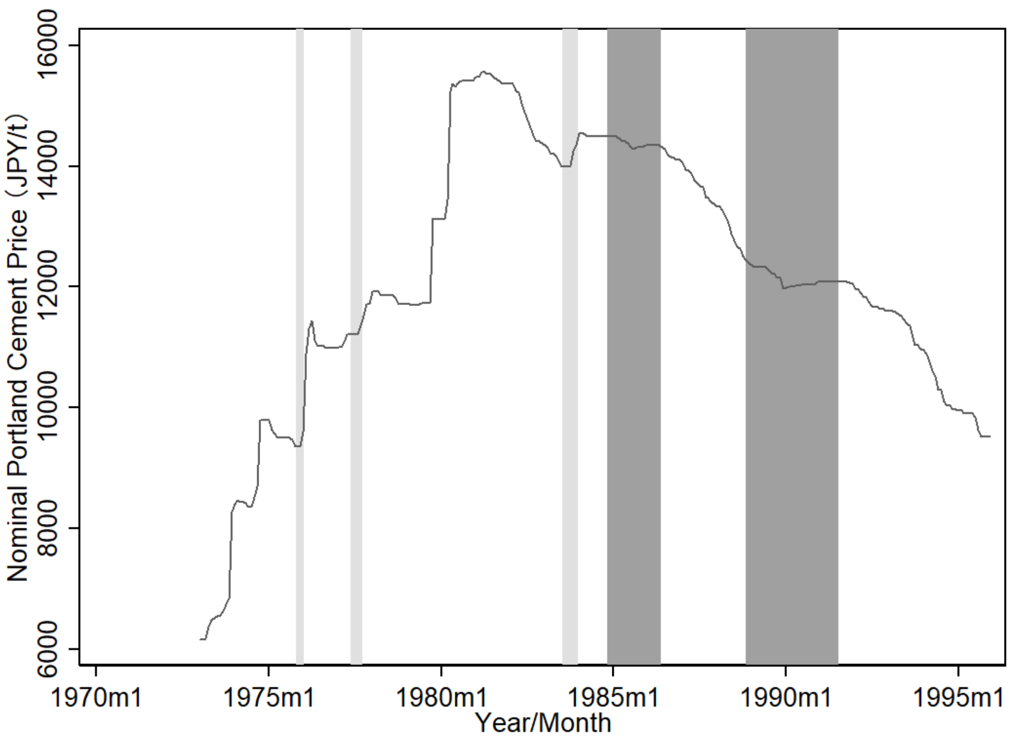
from the viewpoint of social welfare. After finishing our assessment of the policy, we come back in Subsection 3.3 to a more fundamental question of why firms did not divest their unused plants before the capacity coordination policies

3.1 Impact on Prices and Markups

As capacity coordination is often used for cartels and is viewed as an anti-competitive business practice, we first ask whether this policy increased market power of the firms and harmed consumer welfare. In other words, we are interested in examining whether the policy distorted the functioning of the market. Figure 3 shows changes in the nominal national average price of Portland cement in Japan. This figure demonstrates that, although there were significant price increases during the three recession cartel periods in the 1970s and the early 1980s, which are denoted by the light gray shaded areas, there were no obvious price increases during the capacity coordination policy implementations, which are denoted by the dark gray shaded areas. However, the existing literature, e.g., Kamita (2010) and Hampton and Sherstyuk (2012), points out that capacity coordination policies have pro-collusive effects, facilitating implicit or explicit collusions. To examine whether this policy also facilitated collusion, we focus on not only the prices but also the markups charged by the firms, because prices are also driven by other factors, whereas markups are a more accurate measure of market power.

Empirical framework To recover the markups charged by the firms, we use a two-step method commonly used in the literature, including by Röller and Steen (2006) who study the

Figure 3: Transition of the Nominal Portland Cement Price in Japan



Note: The first three light gray shaded areas represent the recession cartel formation periods, whereas the last two dark gray shaded areas represent the periods when the capacity coordination policies were implemented.

Norwegian cement industry. In the first step, we specify and estimate the following demand function:

$$\log(Q_{mt}) = \alpha \log(P_{mt}) + X_{mt} + \varepsilon_{mt}, \tag{1}$$

where Q_{mt} and P_{mt} are the total quantity produced and the price in region m in a given year t; X_{mt} denotes region- and year-specific demand shifters; and ε_{mt} is the regression error term. Note that the unit of observation here is a combination of year and region. The use of this log–log specification for cement demand can be also found in Ryan (2012). To address the simultaneity bias, we take an instrumental variable approach using the price of gypsum as an instrument, which is an intermediate input explained in Section 2.

The second step relies on microeconomic theory. Assuming that the firms compete in quantity, we can use the first-order conditions with respect to the quantity, which gives us the following equation:

$$\frac{\partial \pi_{fmt}}{\partial q_{fmt}} = P_{mt} + \frac{\partial P_{mt}}{\partial Q_{mt}} q_{fmt} - \frac{\partial c(q_{fmt})}{\partial q_{fmt}} = 0, \tag{2}$$

where π_{fmt} and q_{fmt} are the profit and production of firm f operating in region m at time t, respectively, and $c(\cdot)$ is a cost function. Note that, if a firm owns more than one plant in a given region, we aggregate them up to obtain q_{fmt}, because each firm jointly decides the quantity in a given region across plants. On the right-hand side of the equation, the sum of the first two terms represents the marginal revenue, whereas the last term is the marginal cost, which we want to recover. In the data, we directly observe P_{mt}, Q_{mt} and q_{fmt}. Moreover, as the estimates of α are elasticities of demand, we can rewrite $\frac{\partial P_{mt}}{\partial Q_{mt}}$ using α, P_{mt}, and Q_{mt}:

$$\frac{\partial P_{mt}}{\partial Q_{mt}} \Bigg/ \frac{P_{mt}}{Q_{mt}} = \frac{1}{\alpha}, \tag{3}$$

which means that, knowing α, P_{mt}, and Q_{mt}, we can obtain the marginal cost. Once we have the marginal costs, we can easily calculate the markups as a function of α, q_{fmt}, and Q_{mt}:

$$\frac{P_{mt} - mc}{P_{mt}} = -\frac{1}{\alpha}\frac{q_{fmt}}{Q_{mt}}.$$

One might worry that, due to the collusive nature of the industry, the first order conditions might not hold. In order to check the robustness of our results, therefore, we relax the assumption on the mode of competition later.

Estimation results and recovered markups Table 3 shows the estimation results for the demand function. Ideally, we want to include the year fixed effects in the demand equation (1). Unfortunately, there is no variation in gypsum prices across regions—i.e., we only observe a national-level gypsum price in a given year. Thus, instead of including the year fixed effects, we control for the year effects using a flexible polynomial function of year. The table contains the results for four different specifications. The first column, labeled Model (i), shows the regression results without using any instruments. The rest of the specifications use an instrument, but the flexibility of year is slightly different in each case: the second-order, third-order or forth-order polynomials. As expected, the estimated price coefficient using OLS is higher than those of other specifications, indicating that Model (i) suffers from upward bias, due to simultaneity. Thus, we use an instrumental variable approach to estimate the demand and show both the first- and second-stage estimation results for Models (ii), (iii), and (iv). For each model, we demonstrate the first stage regressions under the columns of $\log(P)$, whereas the results for the second stage regressions are demonstrated under the columns of $\log(Q)$. The results for the first stage regressions enable us to confirm that the gypsum price is indeed a valid instrument. Although Models (ii) to (iv) provide similar qualitative results, the magnitude of the price coefficient in Model (ii) is slightly different from those of Models (iii) and (iv). We believe this discrepancy reflects the time trend of price. As in Figure 3, the trend in price movement is inverse-U shaped but not exactly symmetric. Thus, to mimic this pattern, we should include at least the third-order polynomial term of the year effects.

Table 3: Demand Function Estimation

	Model (i)	Model (ii)		Model (iii)		Model (iv)	
	OLS	IV		IV		IV	
	4th Order	2nd-Order		3rd-Order		4th-Order	
		1st	2nd	1st	2nd	1st	2nd
Dependent Var.	log(Q)	log(P)	log(Q)	log(P)	log(Q)	log(P)	log(Q)
log(P_{mt})	-0.07		-5.99*		-.83*		-1.11*
	(.16)		(3.35)		(.47)		(.58)
Controls							
Year	√	√	√	√	√	√	√
Year^2	√	√	√	√	√	√	√
Year^3	√			√	√	√	√
Year^4	√					√	√
GDP	√	√	√	√	√	√	√
Area Fixed Effects	√	√	√	√	√	√	√
Instrument Used							
log(Gypsum Price$_t$)		.02*	√	.06***	√	.06***	√
		(.01)	√	(.01)	√	(.02)	√
F-test	–	3.61*	–	23.17***	–	17.0***	–
Adj or Centered R^2	.96	.91	.65	.92	.96	.92	.96
N	184	176	176	176	176	176	176

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors. Adjusted R^2 are reported for the first-stage regressions, whereas centered R^2 are reported for the second-stage regressions.

Using the estimated demand elasticity coefficients and equation (3), we recover the markups for the firms, which are given in Panel (a) of Table 4. The three specifications correspond to the three different elasticities estimated by Models (ii), (iii), and (iv) in Table 3. Moreover, the results in the first, third, and fifth columns assume that each individual firm maximizes its own profit, whereas the results in the second, fourth, and sixth columns assume that each group of firms maximizes its joint profit. As explained in Section 2, when MITI initiated this capacity coordination policy, the firms were categorized into five groups and the firms in a group could cooperate to some extent. Thus, to capture such effects and to check robustness, we also estimate the model assuming that each group maximizes its joint profit. In terms of the estimation results, again, although Models (ii), (iii), and (iv) provide similar qualitative results, the magnitude in Model (ii) is quite different from those in Models (iii) and (iv): Model (ii) gives us about 4% markups on average, whereas Models

(iii) and (vi) give us around 25% markups. Inclusion of the higher order terms of year effects does not change our quantitative results from those in Models (iii) and (vi). Given that cement is a typical process industry with high fixed costs, we believe that relatively large markups in Models (iii) and (vi) seem more realistic than the estimates in Model (ii). Moreover, when assuming joint profit maximization, both the average and median markups are higher than those with assumed individual profit maximization. Theoretically speaking, in order to rationalize the observed price, marginal costs under joint profit maximization must be estimated to be lower than marginal costs under individual profit maximization, which predicts that we would find higher markups under the joint profit maximization assumption and is verified in our results.

Table 4: Markups Charged by the Firms

Panel (a): Summary Statistics for Recovered Markups						
	Model (ii)		Model (iii)		Model (vi)	
	Ind. Firm	Group	Ind. Firm	Group	Ind. Firm	Group
Average Markup	4.3%	5.5%	31.0%	39.4%	23.2%	29.5%
Median Markup	3.2%	4.6%	23.4%	33.4%	17.5%	25.0%

Panel (b): Markup Regression Results						
	Model (ii)		Model (iii)		Model (vi)	
	Ind. Firm	Group	Ind. Firm	Group	Ind. Firm	Group
1985/1986 Dummy	.000	.000	.001	.001	.001	.001
	(.003)	(.002)	(.020)	(.016)	(.015)	(.012)
1988/1990 Dummy	.000	-.000	.003	-.002	.002	-.002
	(.003)	(.002)	(.021)	(.017)	(.015)	(.013)
Year up to 4th	√	√	√	√	√	√
Firm Fixed Effects	√	√	√	√	√	√
Area Fixed Effects	√	√	√	√	√	√
Num. of Obs.	829	829	829	829	829	829
Adj R^2	.643	.828	.643	.828	.643	.828

Note: Panel (a) shows the average and median markups for three different specifications, corresponding to models (ii), (iii) and (iv) in Table 3. Panel (b) shows the results for the following regression:

$$\text{Markup}_{mt} = \gamma_0 + \gamma_1 \mathbf{1}_{\{t=1985,1986\}} + \gamma_2 \mathbf{1}_{\{t=1988,1989,1990\}} + \text{Controls} + \varepsilon_{mt}.$$

Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

Did the firms gain market power? Next, to investigate whether the policy increased markups for the firms, we regress the markups charged by firm j in market m in year t on the indicator variables for 1985/1986 and 1988/1990:

$$\text{Markup}_{jmt} = \gamma_0 + \gamma_1 \mathbf{1}_{\{t=1985,1986\}} + \gamma_2 \mathbf{1}_{\{t=1988,1989,1990\}} + F_m + F_f + \varepsilon_{mt},$$

including the firm- and market-fixed effects. If the markups charged by the firms increased during policy implementations, the estimated coefficients for these indicator variables, namely γ_1 and γ_2, should be positive. The estimation results are summarized in panel (b) of Table 4. Again, we use three different demand specifications to check the robustness of our results, corresponding to models (ii), (iii), and (vi) in Table 3. The first, third, and fifth columns in panel (b) present the results, assuming that each individual firm maximizes its own profit, whereas the results in the second, fourth, and sixth columns assume that each group of firms maximizes its joint profit. Regardless of the specifications under the label of "Ind. Firm," the coefficients for the indicator variables of 1985/1986 and 1988/1990 are not statistically significant, implying that the policy had no effect on markups. Our results are robust, even if we assume that each group jointly decided their production quantities. Therefore, we conclude that the markup charged by the cement firms did not increase during the periods of policy implementation.

Estimation results: Impacts on plant utilization How are these results possible? The reason the coefficients for the 1985/1986 dummies are insignificant could be because most of the scrapped capacity during the first capacity coordination policy was nonoperating capacity. Thus, even though the firms shut down these plants, the market power of the firms was unaffected. However, if this explanation is true, we cannot explain why the 1988/1990 dummy has no impact on markups. The second capacity coordination policy in fact forced the firms to shut down some *operating* plants, and thus, demand would most likely have exceeded supply (production capacity), which must have given firms market power.

To investigate why the firms did not experience an increase in market power during the second policy intervention, we hypothesize that demand did not exceed production capacity. As plant utilization rates were relatively low prior to the second policy intervention, the firms could concentrate production to the remaining efficient plants and meet the demand by fully utilizing these plants. Motivated by this hypothesis, we regress utilization rates on the indicator variables for 1985/1986 and 1988/1990, and the results are presented in Table 5. We control for year effects through polynomial approximation in Specifications (i) and (iii), and through year fixed effects in Specifications (ii) and (vi). The estimation results are consistent with our expectations and support our hypothesis. Regardless of the specifications, positive and statistically significant coefficients on the 1988/1990 dummy variable indicate that the firms increased the utilization rates of their remaining plants to meet demand during the second policy intervention. Our hypothesis is also supported by

Table 5: Plant-Level Utilization Rate and Policy Interventions

	(i) Utilization	(ii) Utilization	(iii) Utilization	(vi) Utilization
1985/1986 Dummy	1.974	-3.979	1.574	-4.841*
	(2.173)	(2.911)	(1.835)	(2.885)
1988/1990 Dummy	5.798***	14.666***	5.613***	13.881***
	(2.405)	(2.925)	(2.011)	(2.896)
Year up to 4th	√		√	
Year Fixed Effects		√		√
Area Fixed Effects	√	√	√	√
Firm Fixed Effects	√	√	√	√
Plant Fixed Effects			√	√
Num. of Obs.	1,206	1,206	1,206	1,206
Adj R^2	.280	.329	.498	.598

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

Figure 2, as we can clearly see that the firms met demand exactly by fully utilizing their remaining production facilities.

Robustness check: Collusion in the industry As pointed out by Nishiwaki (2016a), collusion among Japanese cement firms was prevalent in the 1970s and 1980s. Thus, our assumption that the firms played a Cournot game and competitively chose their quantities could be failed and, as a result, our recovered marginal costs might be biased. In order to address this concern, we consider a case where the firms colluded throughout our sample period, assuming that they used one of the common cartel practices, called "proportional reduction"—the firms reduce their output proportionately from a benchmark output—which is studied by Shcherbakov and Wakamori (2017). We believe that our choice of proportional reduction assumption is appropriate in this context, because the cement firms indeed used this proportional reduction collusive technique when they were allowed to form recession cartels in the 1970s and the 1980s.

Under the proportional reduction assumption, the first-order conditions in equation (2) would not be satisfied with the observed quantity and prices. However, thanks to our proportional reduction assumption, we can still recover the first-order conditions using adjusted quantities and prices. To make this statement clear, consider a case where every firm reduces their output by 5% from the Cournot quantity, i.e., $q_j^{Observed} = 0.95q_j^{Cournot}$. Here, we choose 5% because it is the actual reduction percentage implemented during the recession cartel mentioned in Subsection2.2.1. (This choice of 5% reflects the fact that the firms indeed reduced their output by 5% from the benchmark Cournot quantities during recession cartels.)

Now the observed quantities, $q_j^{Observed}$, and the observed price, $P(\sum_j q_j^{Observed})$, would no longer satisfy the first-order conditions, but the inflated quantities, $q_j^{Observed}/0.95$, which are equivalent to the Cournot quantity, and the deflated price, $P(\sum_j q_j^{Observed}/0.95)$, would. In other words, the following recovered first-order conditions must be satisfied:

$$\frac{\partial c(q_{fmt})}{\partial q_{fmt}} = P_{mt}\left(\sum_j \frac{q_j^{Observed}}{0.95}\right) + \frac{\partial P_{mt}}{\partial Q_{mt}}\frac{q_j^{Observed}}{0.95}.$$

The estimation results, based on these recovered first-order conditions, are demonstrated in Table 6. The format of this table is exactly the same as Table 4, i.e., Panel (a) shows the average and median markups, and Panel (b) shows the regression results whether the markups were increased during the periods of policy implementations. Again, there are three models, corresponding to the specifications in Table 3, and each model has two columns, assuming each individual firm maximizes its profit and each group of firms maximizes its joint profit. Regardless of the models and assumptions, the results are essentially the same as in Table 4, both qualitatively and quantitatively. Pair-wise comparisons between Tables 4 and 6 enable us to see that the markups under joint profit maximization are consistently higher, which also validates our results. Lastly, we would like to emphasize one caveat; as we assume that the firms were competitive in the previous analysis and the firms always colluded in this robustness check, the results demonstrated here could be seen as lower and upper bounds and true markups would be probably in between.

Based on our analysis, we conclude that the policy interventions did not have any significant impact on the markups charged by the firms. In other words, the policy successfully accelerated the capital adjustment process without lowering consumer welfare. As a corollary, if the government reduced production capacity a little bit more, then there would be excess demand, which would possibly increase the market power of the firms because the utilization rate was close to 100%. Therefore, the amount of capacity reduction was key to the success of the policy, and we discuss this issue further in Section 4.

3.2 Which plants were divested?

Turning to the supply side, we first address the question of which plants were divested during the policy implementation. Given the allotment and relatively short time-frame, the firms might have shut down the plants that were relatively efficient. Thus, we first ask whether the individual firm's divestment decision was distorted by the policy interventions. At the

Table 6: Robustness: Markups Charged by the Firms

Panel (a): Summary Statistics for Recovered Markups	Model (ii)		Model (iii)		Model (vi)	
	Ind. Firm	Group	Ind. Firm	Group	Ind. Firm	Group
Average Markup	5.2%	6.4%	39.2%	48.8%	28.7%	35.8%
Median Markup	4.1%	5.7%	31.1%	42.8%	22.9%	31.4%

Panel (b): Markup Regression Results	Model (ii)		Model (iii)		Model (vi)	
	Ind. Firm	Group	Ind. Firm	Group	Ind. Firm	Group
1985/1986 Dummy	.000	-.000	.002	-.001	.001	-.001
	(.003)	(.002)	(.019)	(.016)	(.015)	(.012)
1988/1990 Dummy	.000	-.000	.003	-.001	.002	-.000
	(.003)	(.002)	(.021)	(.017)	(.016)	(.013)
Year up to 4th	√	√	√	√	√	√
Firm Fixed Effects	√	√	√	√	√	√
Area Fixed Effects	√	√	√	√	√	√
Num. of Obs.	940	940	940	940	940	940
Adj R^2	.656	.839	.656	.839	.656	.839

Note: Panel (a) shows the average and median markups for three different specifications, corresponding to models (ii), (iii) and (iv) in Table 3. Panel (b) shows the results for the following regression:

$$\text{Markup}_{mt} = \gamma_0 + \gamma_1 \mathbf{1}_{\{t=1985,1986\}} + \gamma_2 \mathbf{1}_{\{t=1988,1989,1990\}} + \text{Controls} + \varepsilon_{mt}.$$

Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

same time, it is important to know whether the divested plants were also inefficient from a viewpoint of social welfare. The goal of this subsection is to answer these two questions.

These questions motivates us to examine the following relationship between the investment (divestment) decision and the productivity of the plants:

$$\begin{aligned}\Delta\text{Capacity}_{i,t} \quad = \quad & \beta_0 + \beta_1 \text{Productivity}_{i,t-1} + \beta_2 \text{Productivity}_{i,t-1} \cdot \mathbf{1}_{\{t=1985,1986\}} \\ & + \beta_3 \text{Productivity}_{i,t-1} \cdot \mathbf{1}_{\{t=1988,1989,1990\}} + \text{Controls}_{i,t} + \epsilon_{i,t},\end{aligned}$$

where $\Delta\text{Capacity}_{i,t} = \text{Capacity}_{i,t} - \text{Capacity}_{i,t-1}$. The left-hand-side variable is positive (negative) if the firm invests (divests). The right-hand-side variables reflect the productivity of plant i and interact with the two indicator variables during policy implementations. Naturally, we expect that β_1 is positive, as we believe that the firms invest in plants that are efficient and divest otherwise. If the estimates of β_2 are different from zero, then it means that the divestment decision during policy implementation is different from the base years. In particular, if β_2 is statistically significantly positive, it implies that the firms divested inefficient plants more than they did in the base years. Conversely, if β_2 is statistically significantly negative, it implies that the firms divested inefficient plants less than they did in the base years. The same inference holds for β_3.

Table 7: Divestment Decisions with Three Productivity Measures

Productivity Measure	(i) Labor Productivity	(ii) Utilization Rate	(iii) TFP from OP (1996)	(iv) Labor Productivity	(v) Utilization Rate	(vi) TFP from OP (1996)
Productivity Baseline	.030***	.002***	.113***	.021***	.002***	.111***
	(.009)	(.000)	(.014)	(.007)	(.000)	(.013)
Productivity × 1985/1986	-.027	-.001	-.031	-.026	-.001	-.023
	(.027)	(.001)	(.049)	(.027)	(.001)	(.048)
Productivity × 1988/1990	-.012	-.001	-.030	-.015	-.001	-.026
	(.026)	(.001)	(.078)	(.026)	(.001)	(.076)
Local Price	.301**	.186	.255*	0.285**	0.161	0.219
	(.145)	(.152)	(.141)	(.145)	(.151)	(.140)
Fixed Effects						
Year	√	√	√	√	√	√
Firm	√	√	√			
Area	√	√	√	√	√	√
N	908	972	908	908	972	908
Adj$-R^2$	.230	.244	.276	.230	.244	.284

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

We use three productivity measures. The first one is labor productivity, which is conveniently available in the dataset. The second measure is the utilization rate of plants, which is a proxy of productivity, like investment.[8] The third measure is total factor productivity, which is widely used in the industrial organization literature. Assuming Cobb–Douglas production functions, our measure can be recovered as unobserved productivity, ω_{it}, in the following model:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \epsilon_{it},$$

where (i) y_{it}, k_{it}, and l_{it} are logarithms of output, capital input, and labor input for plant i at period t, and (ii) ϵ_{it} is an idiosyncratic error term. We estimate this model using an approach developed by Olley and Pakes (1996) that relies on dynamic investment in an entry/exit model of firms. Of course, three measurements have their own limitations and thus developing a new estimation method, which takes into account utilization rate of the firms, would certainly be an interesting direction to pursue. However, it is the beyond the scope of this paper and we leave it to future research.

The estimation results are presented in Table 7, whereas the production function results are summarized in Table 8 in Appendix B. Table 7 includes the results for six specifications:

[8]For example, Gavazza (2011) also uses the utilization rate as a productivity measure.

the first and fourth columns use labor productivity as the productivity measure, the second and fifth columns use the utilization rate as the productivity measure, and the third and sixth columns use TFP, recovered using the method of Olley and Pakes (1996), as the productivity measure. For all specifications, we add local prices to control for market demand conditions. The first, second, and third columns include fixed effects of year, firm, and area, whereas the fourth to six columns include only year and area fixed effects.

Regardless of the productivity measures, the estimates of baseline productivity, β_1, are always positive and statistically significant at any level, which implies that the firms invest in more productive plants and divest unproductive plants. This result is consistent with our expectation. However, the coefficients for productivity interacted with the 1985/1986 or 1988/1990 dummies, β_2 and β_3 respectively, and are statistically insignificant for all specifications, which indicates that the firms did not change their investment/divestment decisions during policy implementations. These results are very robust and we can conclude that this policy did not distort the firms' scrappage decision rule.

These results naturally raise an additional question: were those divested plants also inefficient from a social point of view? The results described above imply that inefficient plants within a firm were divested; but not necessarily that inefficient plants from a social point of view were divested. Therefore, to answer this additional question, we drop firm fixed effects from the regression and the results are presented in the fourth to sixth columns in Table 7. As is clear from the results, the previous results still hold, not only qualitatively but also quantitatively, which means that the divested plants were not only individually inefficient but also socially inefficient. How is this possible? We believe that it is because the plan proposed by MITI was very well crafted. Perhaps, a simple production process, one of the characteristics of this industry, enabled the regulator to easily measure unobserved productivity of the plants and the side-payment scheme helped the firms to agree on the allotment. We discuss this issue further in Section 4.

Robustness Check: Discreteness, sample period and technology In our main analysis, the difference in capacity, which is a continuous variable, is used as a left-hand-side variable. However, the firms' divestment decision could be more or less discrete, because the firms probably scrapped one of the kilns in a surviving plant to decrease their capacity in the divestment process. This discreteness could cause some issues in our estimation. Thus, in order to address this concern, we use ordered logit models to examine how the productivity of a plant affect the firms' choice of how many kilns to scrap in a given plant. More

Table 8: Divestment Decisions with Three Productivity Measures (Ordered Logit)

Productivity Measure	(i) Labor Productivity	(ii) Utilization Rate	(iii) TFP from OP (1996)	(iv) Labor Productivity	(v) Utilization Rate	(vi) TFP from OP (1996)
Productivity Baseline	.635*	.040***	2.365***	.432*	.031***	1.905***
	(.352)	(.008)	(.473)	(.261)	(.007)	(.415)
Productivity × 1985/1986	-1.269	.024	1.352	-1.230	.021	1.174
	(1.150)	(.026)	(1.649)	(1.089)	(.025)	(1.551)
Productivity × 1988/1990	.626	.062**	5.751**	.475	.047	4.843*
	(1.173)	(.031)	(2.863)	(1.155)	(.031)	(2.773)
Local Price	7.111	3.009	4.990	6.855	2.654	4.537
	(5.851)	(5.742)	(6.162)	(5.831)	(5.677)	(6.147)
Fixed Effects						
Year	√	√	√	√	√	√
Firm	√	√	√			
Area	√	√	√	√	√	√
N	908	972	908	908	972	908
Adj$-R^2$	.233	.241	.266	.218	.220	.248

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

specifically, we estimate the following model:

$$\begin{aligned}\Delta(\#\text{ of Kilns}_{i,t}) &= \beta_0 + \beta_1 \text{Productivity}_{i,t-1} + \beta_2 \text{Productivity}_{i,t-1} \cdot \mathbf{1}_{\{t=1985,1986\}} \\ &\quad + \beta_3 \text{Productivity}_{i,t-1} \cdot \mathbf{1}_{\{t=1988,1989,1990\}} + \text{Controls}_{i,t} + \epsilon_{i,t}.\end{aligned}$$

The estimation results are summarized in Table 8. We have exactly the same specifications as in Table 7, i.e, we run a series of ordered logit models with the firm fixed effects to examine whether the firms divested inefficient plants *within* a firm in the first three columns, whereas we do the same exercise but dropping the firm fixed effects to examine whether the divested plants were also inefficient from a social point of view in the last three columns. The results presented here support our previous conclusions; basically the firms invest in productive plants and divest unproductive plants from the viewpoints of both the individual firm and social welfare, and their decision rule was not affected by the policy interventions. Moreover, one interesting observation here is that even some coefficients on Productivity interacted with a dummy of 1988/1990 are positive and statistically significant, which implies that the firms carefully choose unproductive plants to divest even during the second policy intervention.

Another potential concern for our analysis could be that the results are mainly driven by a building phase in the 1970s rather than by a scrappage phase in the 1980s. To address this concern, we first estimate the main model, which uses the change in capacity as a left-hand-side variable, limiting our samples to the observations between 1980 and 1995. Most of the construction of NSP kilns took place in the 1970s, so excluding the samples prior to 1980 enables us to exclusively focus on the divestment. The results are demonstrated in the first three columns in Table 9. To further ease concerns, we even more explicitly control this by focusing on the samples with a negative difference in capacity. Moreover, when doing so, we also control for the technological aspect of the plant by including the fraction of new types of kilns. The fraction of new kilns is defined as the number of SP and NSP kilns over the total number of kilns in a plant. As explained in Section 2, SP and NSP kilns are relatively new technology that became dominant in the 1970s and 1980s. Therefore, inclusion of this variable enables us to control for the heterogeneity in firms' technology across plants. These estimation results are in the last three columns in Table 9.

The results are not different from the previous specifications. We can again confirm that the firms divested unproductive plants within the firm.[9] For the first three specifications, the results are not only qualitatively, but also quantitatively very similar, implying that the results are not driven by the building-up phase but driven by the divestment phase. Also, the last three specifications demonstrate that even controlling for the technology, the coefficients on productivity (β_1) are still positive and statistically significant, whereas the fraction of new kilns is not. This result could indicate that productivity is a better measure than the fraction of new kilns, which would justify the usage of productivity when implementing capacity coordination policy.

3.3 Why did the firms not divest their unused plants?

We have shown that the policy interventions did not harm consumer welfare nor distort scrappage decision of the firms. However, we have not answered a more fundamental question—why did the firms not divest their unused plants? There are two possibilities: the firms kept their facility because of (i) strategic interactions and/or (ii) their own merit. In this subsection, as it is extremely difficult to directly quantify the effect of each possibility, we attempt to examine whether these two hypotheses can explain the phenomenon via regression analysis.

[9] We also check the robustness of our results by dropping the firm fixed effects, and confirm that the results are not changed.

Table 9: Divestment Decisions with Three Productivity Measures (Technology Controlled)

Productivity Measure	(i) Labor Productivity	(ii) Utilization Rate	(iii) TFP from OP (1996)	(iv) Labor Productivity	(v) Utilization Rate	(vi) TFP from OP (1996)
Productivity Baseline	.031**	.002***	.125***	.111**	.006***	.299***
	(.013)	(.000)	(.019)	(.054)	(.001)	(.064)
Productivity × 1985/1986	-.035	-.000	-.030	-.035	.002	0.187
	(.027)	(.001)	(.048)	(.226)	(.005)	(.297)
Productivity × 1988/1990	-.020	-.000	-.013	-.004	.001	-.006
	(.026)	(.001)	(.075)	(.026)	(.002)	(.009)
Fraction of New Kilns				-.143	-.082	-.092
				(.123)	(.101)	(.104)
Num. of Kilns				-.034*	-.015	-.019
				(.020)	(.017)	(.018)
Local Price	.292	.211	.222	.990	.793	.903
	(.149)	(.144)	(.144)	(.726)	(.625)	(.638)
Fixed Effects						
Year	√	√	√	√	√	√
Firm	√	√	√	√	√	√
Area	√	√	√	√	√	√
N	617	622	617	111	111	111
Pseudo$-R^2$	.283	.332	.332	.255	.445	.419

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

3.3.1 Impact of Excess Capacity on Investment

The strategic incentive in investment/divestment has been studied mainly in growing industries since the seminal work of Spence (1979), who unravels the preemptive role of investment.[10] The literature has extended to declining industries, both theoretically and empirically, as demonstrated by Ghemawat and Nalebuff (1990) and Nishiwaki (2016b). Motivated by these theoretical explanations of why firms have an incentive to keep their production capacity, we empirically examine whether having (excess) capacity affects the investment/divestment behavior of other firms. More specifically, based on the theoretical literature that shows that investing in capacity may deter investment by other firms, we attempt to test whether the firms delay divestment because they expect divestment by other firms. Demonstrating such an effect, however, is difficult because we cannot directly observe

[10]There could be another strategic role of investment—facilitating collusion or reducing quantity produced by other firms. See Appendix D for more detailed discussion.

firms' expectations. Rather, we employ the following regression model to test our hypothesis:

$$i_{j,t} = \alpha_0 + \alpha_1 \sum_{i \neq j} i_{i,t-1} + \varepsilon_{j,t}, \qquad \text{where } i_{j,t} = K_{i,t} - K_{i,t-1}.$$

If our hypothesis is true, no divestment by other firms in the previous periods leads to divestment in the current period. Or, equivalently, by observing divestment of other firms, firms may decide to keep their production capacity. Therefore, we expect α_1 to be negative.

Table 10: Why did the firms not divest?

Panel (a): Strategic Role of Excess Capacity on Divestment			
	Model (i)	Model (ii)	Model (iii)
Divestment by other firms	-.123***	-.120**	-.101*
$\sum_{i \neq j} \log(i_{i,t-1})$	(.041)	(.055)	(.054)
Own investment	-.130***		-.142***
$\log(i_{j,t-1})$	(.036)		(.041)
Controls			
Plant Fixed Effects	√	√	√
Year Fixed Effects	√	√	√
Some other controls	√	√	√
Num. of Obs.	805	388	388
Adj-R^2	.275	.083	.112

Panel (b): Shape of Marginal Cost Functions			
	Model (ii)	Model (iii)	Model (vi)
log(Capacity)	.0127	.0148	.0193
	(.0096)	(.0254)	(.0161)
log(Clinker)	-.0116	-.1355***	-.0893***
	(..0114)	(.0302)	(.0192)
Controls			
Productivity	√	√	√
Plant Fixed Effects	√	√	√
Year Fixed Effects	√	√	√
Num. of Obs.	972	696	972
Adj-R^2	.9374	.9547	.9510

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

Panel (a) of Table 10 show the estimation results. We run three regressions, including and excluding own investment as a right-hand-side variable. Model (i) uses a whole sample, whereas Model (ii) and (iii) use samples only after 1986, because we worry that the results from Model (i) might be mostly driven by investment or divestment behaviors of the firms caused by policy interventions. Moreover, Model (ii) does not include own investment, whereas Model (iii) does. Including own investment is particularly important because it is well documented that investment is lumpy, and we need to control for it. Moreover, all modelsinclude regional-level GDP, and plaster and oil prices, to control for demand and supply conditions. Here, our interest is in the coefficients on other firms' investment, which are negative and statistically significant for all models. This result suggests firms do take into account other firms' investment (divestment) behavior in the previous year when making investment (divestment) decisions this year. In particular, the results mean that the firms divest their capacity less when they observe divestment of other firms. These outcomes are consistent with the hypothesis that firms delay their own divesting and wait for other firms to divest.

3.3.2 The Shape of Marginal Cost Functions

Another possible explanation for excess capacity is that firms keep their capacity by their own merit. If the production exhibits economies of scale in terms of capacity, the seemingly excess part of capacity may contribute to a reduction in costs, and firms may want to hold excess capacity even with the absence of a strategic role. If this is the case, forcing the firms to divest their capacity may harm social welfare. To examine this hypothesis, we regress the estimated marginal cost on capacity, production quantity, productivity measures, and other controls.

$$\log(\mathrm{MC}_{jmt}) = \delta_0 + \delta_1 \log(\mathrm{Clinker}) + \delta_2 \log(\mathrm{Capacity}) + \mathrm{Controls} + \varepsilon_{mt}.$$

The estimation results are shown in Panel (b) of Table 10. Models (ii), (iii), and (iv) correspond to models in Table 3 in Subsection 3.1. We use these models in Subsection 3.1 to get the estimated marginal cost. Our focus is on the coefficient of capacity. As for the controls, on top of year- and plant-fixed effects, we include either labor productivity or TFP. We report the estimates when we use labor productivity as the productivity measure. The results are qualitatively similar to the case with TFP. As one can expect, the coefficients on clinker are negative in Models (iii) and (iv), implying that the marginal cost could be lower when the firms produced more, given capacity. However, the interpretation of the sign is not clear. It could be that there are some scale merits in production, or it could be just a result from endogeneity; the firms produce more at the plant with a lower marginal cost. What we want to highlight is the coefficient on capacity. It is not statistically significant in each of the models, which means that capacity has no effects on production cost. Even if economies of scale exist, the scale merit comes from the actual production but not from the capacity. That is, the *excess* capacity does not contribute to a reduction in cost. Therefore, we conclude that the second hypothesis would not explain the firms' behavior of not divesting their unused plants.

Returning to our original question of "why did the firms not divest their production facility?" our short answer is because of strategic interaction. The cement firms may have played an attrition game by not divesting their production facility while expecting other firms to divest. The government may have noticed this strategic incentive and thus initiated the capacity coordination policy—reducing the firms' capacity simultaneously—which eliminates such strategic incentives.

4 Policy Implications and Caveats

4.1 Assessment of Policy Interventions

Our empirical analysis shows that this series of policy interventions accelerated capital adjustment successfully without increasing firms' market power or distorting their divestment decisions. In principle, the policy helped firms reduce unused production capacity and should not have had any influence on their market power unless the capacity constraint was violated. In this case, it seems that the total reduction was well estimated by the government, and the capacity constraint was held with equality. Therefore, although this capacity coordination policy seems to be anti-competitive, our estimation results do not support this view.

One missing piece is the welfare analysis of this policy, in particular how much benefit accrues for the firms. Given our results that consumer welfare was not hurt, the changes in social welfare must be aligned with the change in producer surplus. In order to quantify the changes in producer surplus, we must know (i) how much cost the firms must bear to keep their plants, and, more importantly, (ii) how long it would take for the firms to divest their plants in the absence of this series of capacity coordination policies. These types of hypothetical analyses perhaps require us to have a dynamic oligopoly model with firms' divestment decisions, as in Nishiwaki (2016b), so that we can conduct conterfactual simulations. Our approach would be the first step toward a quantitative evaluation of the policy.

4.2 Caveats

In the previous subsection, we conclude that the capacity coordination policy applied to the Japanese cement industry successfully reduced excess capacity without hurting consumer welfare and caused scrapping excessive plants in order of productivity. Do these results immediately support the application of this policy to other industries? This subsection provides discussion on the possibility of generalization and caveats regarding the capacity coordination policy.

Estimation of excess capacity and its allotment One of the key factors that led to the success of this policy was the well-crafted plan: the total divestment amount and divestment allotment. First of all, determining how much capacity should be scrapped in the industry as a whole is a challenging task. This issue raises an informational problem: the government may not be able to predict future demand accurately, whereas firms in the industry have better information about demand and supply. If regulators can predict future demand with high accuracy, they can correctly measure excess capacity. In practice, however, this may not be realistic. In fact, right after the second policy intervention, the Japanese economy faced a boom called the "Heisei bubble" or the "Japanese asset price bubble" between December 1986 and February 1991, and cement demand recovered during this period, as shown in panel (a) of Figure 1.[11] Even though net exports were consistently positive, the cement industry needed to decrease exports and increase imports during this period to meet domestic demand. Although this event might be irregular in declining industries, it is important that policymakers keep such possibilities in mind when developing policy.

Second, for effective policy implementation, regulators need estimates of the productivity of firms' facilities to decide the allotment of capacity reduction. As is often pointed out in the literature on regulation, however, productivity is typically private information and such asymmetric information between regulators and private companies results in inefficiency. In our context, asymmetric information is not a serious problem because the technology of cement production can be evaluated relatively straightforwardly. In particular, during the period of our analysis, technological advancement was modest and the regulator was able to catch up with firms in terms of understanding and evaluating existing technology. Furthermore, detailed micro data on production were available to obtain precise estimates of productivity. These factors enabled the regulator to assess the facilities accurately. Note that even without perfect information on the productivity of each plant, regulators could induce private firms to design a mechanism that would efficiently allot divestment. As mentioned in Section 2, under the policy, the private firms in the Japanese cement industry, together with MITI, developed such a mechanism with side payments through negotiations. This fact

[11] Though the Heisei period started in January 1989, the Heisei bubble began in December 1986 because of a gap in recognition.

may raise endogeneity concerns, which is discussed in the following section.

Endogeneity concerns The government's involvement in the negotiation process might raise two potential endogeneity concerns: endogeneity of allotment and endogeneity of this policy itself. As for the former type of concern, we are not interested in the outcomes when allotment is randomly assigned to each firm, but we are interested in evaluating the policy from the viewpoints of consumers and producers when it is well designed by the regulator. In this regard, our results should not be affected by such an endogeneity concern. Of course, how to allocate divestment allotment itself is an important question and, as mentioned earlier, designing a mechanism would be of interest, in particular from a theoretical point of view. However, it is beyond the scope of this paper and left to future research. As for the latter type of concern, we must admit that our results cannot be applied to all industries. We are not claiming that this policy is universally effective, and it should be obvious that applying this policy to a growing industry does not make any sense. In other words, we are interested in measuring the effects of this policy when applied to a declining industry or an industry in recession where there is a need for capacity reduction, rather than the effects of this policy when it is exogenously applied to a randomly chosen industry. Therefore, we believe that the results presented in this paper would not be affected by such endogeneity concerns.

Dynamic consequences As pointed out by Kamita (2010), capacity coordination may induce collusion over time. In this regard, we do not find evidence of such anticompetitive behavior in the Japanese cement industry after policy implementation, whereas the Aloha–Hawaii case promoted cooperation for several years until new entrants joined the market. It is, therefore, important to monitor the industry even after policy implementation. Another dynamic consequence that our analysis cannot capture is whether this policy prolonged the life of inefficient firms. Thanks to this policy intervention, some inefficient firms did survive in the low demand periods. Without this policy intervention, some inefficient firms would have been forced to exit the market. In Subsection 3.2, we find that the divested plants are socially inefficient, and the firms' divestment decisions are not distorted by the policy, which suggests that the firms' exit decisions are also not distorted. However, we do not model or estimate exit decisions explicitly.

5 Conclusion

Excess production capacity has been a major concern in many countries, particularly when an industry faces declining demand. Strategic interaction among firms may delay efficient scrappages of production capacity and policy interventions that eliminate such strategic incentives may improve efficiency. Using plant-level data on the Japanese cement industry, this paper empirically studies the effectiveness of a capacity coordination policy that forces the firms to simultaneously reduce their production capacity.

Our estimation results show that a capacity coordination policy can effectively reduce excess capacity without increasing their market power or distorting firms' scrappage decisions. Although this series of policy interventions seems to be successful, some caveats apply in relation to capacity coordination policy in other industries/countries: (i) estimation of excess capacity and its allotment, and (ii) dynamic effects and consequences of the policy intervention. Thus, policymakers with an interest in introducing capacity coordination policy must keep these caveats in mind.

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Appendix A: Production Function Estimation

Table A1: Production Function Estimation

	FE	OP
Capital	.856***	.941***
	(.025)	(.112)
Labor	.286***	.160***
	(.036)	(.056)
Firm Fixed Effects	√	
Controlling for Year	√	√
Num. of Observations	1,130	1,124

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors.

Appendix B: Side-Payment for Divestment Allotment

On February 1, 1985, 22 cement firms concluded an agreement to divest cement kilns. This agreement included such items as the quantity of divestment for each firm, a reporting and auditing scheme, penalty charges for deficiency of divestment, side-payment to adjust for divestment costs, and so on. The agreement had two supplementary agreements: one on auditing and one on side-payment. The latter supplementary agreement prescribed a side-payment scheme as follows:

1. **Subsidies**: Each firm receives the following amount of subsidies from the special account of the Japan Cement Association based on the quantity of capacity reduction:
   - Nonoperating kilns:
     Hourly production capacity of divested kilns (in tons) $\times$ 7200 (annual operating hours) $\times$ 50 JPY
   - Operating kilns:
     Hourly production capacity of divested kilns (in tons) $\times$ 7200 (annual operating hours) $\times$ 100 JPY
2. **Contribution**: Each firm contributes a portion of the total subsidies according to the following "adjustment coefficient" for each firm:

$$\begin{aligned}&\text{Adjustment Coefficient}_i\\&\quad= [(\text{Average of clinker production shares from FY 1981 to 1984})\\&\quad\quad+ (\text{The share of expected remaining production capacity after the}\\&\quad\quad\quad\text{capacity reduction in FY 1985})] \times \frac{1}{2},\end{aligned}$$

   where FY denotes fiscal year.

Appendix C: A Chronological Table

Table C1 below summarizes the historical events that were related to the capacity coordination policies.

Table C1: A Chronological Table

1970	Data begin
1973	Demand shock 1: The first oil crisis
1975.11-1976.1	Recession cartel was allowed in the cement industry
1977.6-1977.12	Recession cartel was allowed in the cement industry
1979	Demand shock 2: The second oil crisis
1983.8-1983.12	Recession cartel was allowed in the cement industry
1985.1-1986.3	Capacity coordination 1: Government allowed cartel to reduce capacity by 30 out of 129 million tons (of which only 5 were in use)
1985.09	Demand shock 3: Yen appreciation due to Plaza agreement
1986.01-1991.02	Demand shock 4: Heisei bubble started
1988.12-1991.03	Capacity coordination 2: Government allowed cartel to reduce capacity by 10.7 out of 98 million tons (of which all 10.7 were in use)
1995	Data end

Appendix D: Why did not the Firms Divest?

As shown in Section 2, the firms did not divest their production capacity even though demand for cement was much lower than the industry's total capacity. A natural question then arises: "Why did the firms not divest their production facility?" In answering this question, we first investigate the firms' behavior theoretically to determine the possible impacts of holding (excess) capacity. Consider a dynamic oligopoly model, similar to Nishiwaki (2016b), with both static and dynamic decisions. Static decisions include choices regarding quantity, whereas dynamic decisions include investment/divestment and entry/exit. This framework enables us to determine whether excess capacity could potentially affect other firms through three distinct channels. Excess capacity may affect (1) quantity produced by rival firms, (2) investment or divestment of rival firms, and (3) entry or exit of rival firms. The last channel is addressed in two different bodies of literature: strategic entry deterrence as in Wenders (1971) and Spence (1977), and exit games as in Fudenberg and Tirole (1986), Smith (1974), Ghemawat and Nalebuff (1985), and Takahashi (2015). In our case, however, there were few entries or exits observed in the data, which does not allow us to study such effects quantitatively. Therefore, in the following analysis, we focus on the first and second channels which are closely related to each other.

The first channel examines the effect of investment, a dynamic decision, on the quantity produced, a static decision. Naturally, firms cannot produce more than their capacity and thus, quantity is affected by capacity choices as in Kreps and Scheinkman (1983). Moreover, if production cost depends on production capacity (e.g., economies of scale), firms may invest more to reduce their own production costs, which results in a change in production quantities of their rivals. Even capacity has no direct impact on production costs, however, unused capacity may still affect other firms' production quantities in a repeated game. As pointed out by Devidson and Deneckere (1990), by holding excess capacity, it is easier to sustain collusion because excess capacity makes the punishment harsher. The possibility of economies of scale and the second channel are examined in Section 3.

Impact of excess capacity on quantity produced Here, we empirically investigating the first channel, i.e., whether having (excess) capacity affects production. To do so, consider the following static maximization problem of firm j:

$$\max_{q_j} P(q_j, q_{-j})q_j - c_j(q_j) \text{ s.t. } q_j \leq K_j,$$

where q_j and q_{-j} are the output of firm j and all other firms, respectively, $c_j(\cdot)$ is a cost function for firm j, and K_j is the maximum capacity that firm j can produce. When solving for an equilibrium, the equilibrium quantity for firm j is expressed as:

$$q_j^* = Q_j^*(K_j, K_{-j}),$$

which means that the equilibrium quantity is a function of capacities.[12] Therefore, we first estimate this relationship using the following specification:

$$\text{[Specification 1]} \qquad q_{j,t} = \alpha_0 + \alpha_1 K_{j,t} + \alpha_2 \sum_{i \neq j} K_{i,t} + \varepsilon_{j,t}.$$

Here the parameter of interest is α_2, which quantifies the impact of rivals' capacity on the quantity produced. Although Specification 1 is derived from a theoretical model and α_2 reveals whether or not having capacity itself affects the production of other firms, we still cannot determine whether having *excess* capacity affects production. To see the impact of excess capacity on quantity produced, therefore, we further control for the total quantity produced by other firms in Specification 2:

$$\text{[Specification 2]} \qquad q_{j,t} = \alpha_0 + \alpha_1 K_{j,t} + \alpha_2 \sum_{i \neq j} K_{i,t} + \alpha_3 \sum_{i \neq j} q_{i,t} + \varepsilon_{j,t}.$$

Intuitively, by adding the production quantity of the other firms, the coefficient on rivals' capacity now captures the effect of excess capacity on own production. Furthermore, there is one additional reason for controlling for the production quantity of the other firms. Production technology in the cement industry might exhibit economies of scale, which implies that a larger capacity may enable firms to produce cement at lower marginal cost. Suppose a rival firm has a large production capacity. This cost advantage induces more output from this rival firm and, in response to such a cost advantage, firm j must produce a smaller amount because of strategic interaction. This effect arises from economies of scale, and Specification 1 cannot capture this effect separately from the other strategic effects of capacity. Thus, we must control for production quantity of the other firms. If this is the only strategic role of capacity, we would expect that α_2 is zero. However, if capacity has some other strategic roles, such as a threat of future punishment as found by Devidson and Deneckere (1990), we would expect α_2 to be negative.

[12] Note that cost differences across the firms are already captured by the differences in function $Q_j^*(\cdot)$.

Table D1: Impact of Excess Capacity on Production

	Specification 1		Specification 2		
	(i) OLS	(ii) OLS	(iii) IV	(iv) IV	(v) IV
Dependent Variable	$q_{j,t}$	$q_{j,t}$	$q_{j,t}$	$q_{j,t}$	$q_{j,t}$
Own Firm Capacity	.950***	.948***	.955***	.955***	.961***
$\log(K_j)$	(.030)	(.031)	(.062)	(.036)	(.074)
Other Firm Capacity	-.493***	-.502***	-.312	-.299	-.270
$(\log(\sum_{l\neq i} K_l))$	(.099)	(.104)	(.235)	(.246)	(.397)
Other Firm Quantity			-.257	-.510	-14.99
$\log(\sum_{l\neq i} q_l)$			(.233)	(1.814)	(152.0)
Other Firm Quantity^2				.008	-.934
$(\log(\sum_{l\neq i} q_l))^2$				(.056)	(9.720)
Other Firm Quantity^3					-.020
$(\log(\sum_{l\neq i} q_l))^3$					(.207)
Other Controls		√	√	√	√
Fixed Effects					
Year	√	√	√	√	√
Area	√	√	√	√	√
Firm	√	√	√	√	√
No. of Observations	461	461	419	419	419
Adjusted R^2	.919	.919	.921	.920	.919

Note: Significance levels are denoted by < 0.10 (*), < 0.05 (**), and < 0.01 (***). The numbers in parentheses show the standard errors. In Specification 2, instrumental variables are used to cope with endogeneity for $\sum_{i\neq j} q_{i,t}$ arising from simultaneity.

Unfortunately, from an econometrics point of view, this relationship cannot be estimated straightforwardly, as there is an endogeneity concern between $q_{j,t}$ and $\sum_{i\neq j} q_{i,t}$ because of simultaneity, and a possible nonlinearity concern with $\sum_{i\neq j} q_{i,t}$. Thus, we use an instrumental variable approach and flexibly control for $\sum_{i\neq j} q_{i,t}$. The instruments exploited here are similar to that of Berry, Levinsohn and Pakes (1995), i.e., other firms' quantity produced in another area and other firms' number of kilns in another area. Usage of this set of instruments assumes that a firm having a cost advantage in one region must have the same cost advantage in other regions. Hopefully, these instruments solve the endogeneity problem, but to further ease concerns about endogeneity, we control for fixed effects for year, area, and firm.

Results Table D1 summarizes the results for all specifications. The first two columns, labeled (i) OLS and (ii) OLS, present the results for Specification 1. Although both (i) and (ii) include year, area, and firm fixed effects, (ii) additionally includes regional-level GDP, and plaster and oil prices to control for demand and supply conditions. The third to fifth columns, labeled (iii) IV, (iv) IV, and (v) IV, present the results for Specification 2. As explained above, these three models under Specification 2 use an IV approach to cope with endogeneity arising from simultaneity of $q_{j,t}$ and $q_{-j,t}$. The differences among (iii), (iv), and (v) are the number of higher order terms that are included: (iii) includes up to a second order term of other firms' quantities, but (iv) and (v) include up to third and fourth order terms, respectively. Moreover, these three models include, again, regional-level GDP, and plaster and oil prices to control for demand and supply conditions.

In both specifications, we are ultimately interested in the coefficient on other firms' capacity. When not controlling for other firms' production as in Specification 1, other firms' capacity has negative impacts on own production quantity. Regardless of the inclusion of some additional controls, this finding is robust. However, after controlling for the quantity produced by other firms as in Specification 2, other firms' capacity no longer has any impact. The absence of any effect of other firms' capacity suggests that it plays a strategic role *via* other firms' production behavior. When a firm competes against rival firms that have large capacity, then naturally these rival firms produce more, which results in less production by this firm. However, we do not observe other strategic aspects of excess capacity, such as the channel pointed out by Devidson and Deneckere (1990).