Buyer Power and Information Sharing

In Kyung Kim and Vladyslav Nora

We examine how buyer power affects the incentives of producers to share information with retailers. First, we develop a theoretical model suggesting that increasing buyer power will discourage information sharing between producers and retailers. Second, we test this prediction by adopting the idea that recommended retail prices (RPRs) serve as an information-sharing device between manufacturers and retailers. Using manually collected information on RPRs for certain grocery products in Korea, we find that the more the sales of a product rely on powerful retailers, the less likely manufacturers will recommend prices. As revealing information can increase industry profits, our analysis highlights potential inefficiencies from the rise of powerful retailers.

Keywords: buyer power; information disclosure; retail industry; retail price recommendation

JEL Classification: D82, D83, L81

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Introduction

A salient feature of the retail industry is the increasing dominance of large firms in the last few decades. Chain retailers gained substantial power in negotiating with suppliers, which may affect retail prices (Inderst and Valletti, 2011; Chen, 2003) or producers' incentives to invest in quality (Battigalli *et al.*, 2007) or alter product variety (Chen et al., 2004; Inderst and Shaffer, 2007). Another possible effect is on information sharing among firms. When faced with tough bargains from large retail chains, suppliers may be better off keeping to themselves, as sharing cost or demand information may result in powerful retailers capturing the suppliers' information rents.

Among the various channels through which product information can be shared, in this study, we focus on retail price recommendations (RPRs), whose role as an information-sharing device was recently established in the literature (Buehler and Gärtner, 2013; Lubensky, 2017; Faber and Janssen, 2019). Examples of manufacturers providing nonbinding price recommendations to retailers abound. For instance, in many countries, recommended book prices are printed on covers, and gas prices are posted on the website of oil companies. In Australia, recommended prices for tobacco products are published in a quarterly magazine, and in Korea, RPRs for some grocery products appear directly on packages. Anecdotal evidence suggests that small independent retailers, such as "mom-and-pop" stores, typically rely on such information for their pricing decisions.

In this study, first, we conduct a theoretical investigation on the effect of buyer power on manufacturers' incentives to share information with retailers. In our model, a manufacturer sells its product through two types of retailers: strong and weak retailers. The strong retailers make take-it-or-leave-it offers to the manufacturer, whereas the weak retailers must accept or reject the manufacturer's offer. In addition, buyer power is captured by the market share of the strong retailers. We compare the ex-ante profit of the manufacturer in two cases: when it truthfully shares demand information with the retailers and when it keeps information private. A key tradeoff faced by the manufacturer is that sharing information will increase downstream profits, which can be captured from the weak retailers, but destroy the information rents from trade with the strong ones. We show that incentive to share information decreases with buyer power. As information sharing increases industry profits, our analysis also highlights potential inefficiencies from the rise of powerful retailers.

Second, we empirically test whether buyer power negatively affects information sharing between manufacturers and retailers. For the analysis, we adopt the idea that RPRs serve as an information-sharing device and exploit the manually collected RPR information for a sample of products from four processed food categories in Korea. For each product, we measure buyer power with the proportion of sales through chain retailers.[1] Our analysis reveals that a 10-percentage-point increase in the share of sales through chain stores induces an 11-percentage-point decrease in the probability of using RPRs. We also find evidence showing that high buyer power discourages the use of RPRs after addressing the concern that retail chains are as well-informed as manufacturers about product demand, which reduces manufacturers' incentives to use RPRs regardless of retailers' buyer power. Our empirical results are robust across the different specifications and remain significant when we consider the potential endogeneity of the use of RPRs.

Our study contributes to the literature on the effects of buyer power. Battigalli *et al.* (2007) showed that an increase in buyer power will transfer the surplus from a producer to a retailer and hence reduce the producer's incentives to invest in product quality. Similarly, Inderst and Shaffer (2007) revealed that an increase in the concentration of the retail industry will induce suppliers to reduce product variety. Among the studies that examined the effects of buyer power on retail prices, the most notable are those of Chen (2003) and Inderst and Valletti (2011). Empirical research on the effect of horizontal mergers, and hence buyer power, on retail prices in grocery retail markets found evidence that prices increase after a merger (Smith, 2004; Allain *et al.*, 2017) or depend on the market structure (Hosken *et al.*, 2018).[2] Our study is

[1] As chain retailers are large firms with nationwide presence and store brands, they have higher bargaining power than individually owned nonchain retailers (Draganska *et al.*, 2010).

[2] The number of empirical studies estimating a structural model of demand and supply that incorporates bargaining over prices in various markets is growing (*e.g.*, Crawford and Yurukoglu, 2012, for multichannel television markets and Grennan, 2013, for medical device markets).

the first to emphasize the effect of buyer power on information sharing between suppliers and retailers.

Our study is also related to the literature on information sharing in the supply chain (Guo and Iyer, 2010; Kong *et al.*, 2013; Mittendorf *et al.*, 2013; Guan *et al.*, 2019). Specifically, our model highlights how the structure of the distribution channel is related to a manufacturer's incentives to share information with retailers. Methodologically, our model is related to the broad literature on information disclosure.[3] While existing studies mainly focused on models with full bargaining power on one side, our study explores how power balance affects optimal information disclosure. Hence, our model can shed light on the tradeoff between disclosing information and obtaining information rents.

Another strand of the closely related literature focuses on motivations for and effects of RPR use. Buehler and Ğartner (2013) were the first to suggest that RPRs transmit manufacturer cost and demand information to retailers. The authors showed that under repeat interactions, such information can be truthful and help achieve efficiency in the supply chain. Lubensky (2017) also treated RPRs as a communication device but between manufacturers and consumers. Specifically, consumers infer industry costs from RPRs to guide their search decisions. In addition, Faber and Janssen (2019) used RPRs to transmit information and empirically investigated the practice in gasoline markets. However, the authors observed that instead of conveying product information, RPRs help sustain collusion between retailers through the coordination of their prices. De los Santos *et al.* (2018) empirically examined the effect of RPRs and showed that they reduce retail prices in the packaged food industry. Puppe and Rosenkranz (2011) and Bruttel (2016), who considered RPRs as reference points that can affect consumers' valuation, investigated the behavioral mechanism behind RPRs. Our study adopts the approach of Buehler and Ğartner (2013) to show how the use of RPRs is affected by the rise in buyer power. The rest of this paper is organized as follows: Section 2 provides institutional details on RPRs and the grocery retail industry of Korea, Section 3 develops the theoretical framework behind the effect of buyer power on information-sharing incentives, Section 4 describes the data and empirical analyses

[3] See Kamenica and Gentzkow (2011) for the general treatment and Bergemann *et al.* (2015) for the application in bilateral trading.

and discusses the findings, and finally, Section 5 concludes the study.

II. Background

A. Buyer power in the retail industry

Manufacturers distribute their products through a variety of retail channels, including hypermarkets, supermarket chains, convenience store chains, and corner shops. Meanwhile, retailers differ from one another with respect to their size, assortment, geographical coverage, product procurement method, availability of store brands, and so on. Retail chains operate stores in various cities throughout the country and have centralized purchasing departments that negotiate directly with producers. In addition, retail chains typically have a variety of store brands and can easily substitute goods from a pool of branded products. By contrast, independently owned shops operate in a single location and buy products from local wholesale dealers for predesignated prices. Consequently, retail chains have higher bargaining power than independent stores when negotiating with manufacturers.[4]

This disparity in bargaining power was recognized in Korea, where efforts were exerted to increase the bargaining power of independently owned stores. For example, regional distribution centers were established recently for purchasing products in bulk from manufacturers and distributing them to independently owned stores. However, in 2013, only 17% of the total number of independent stores were transacting with such distribution centers owing to their high costs, low product variety, and lack of a delivery service (Kim *et al.*, 2013).

B. RPRs

In Korea, historically, manufacturers generally suggested retail prices. Such recommended prices were typically printed on packages and updated occasionally by manufacturers. However, in the late 1990s, trade authorities suspected some manufacturers of abusing

[4] Draganska et al. (2010) empirically assessed the role of retailer size, presence of store brands, and assortment as determinants of buyer power.

RPRs for price collusion. For instance, a survey conducted by the Korea Consumer Agency in 1998 showed that retailers experienced penalties such as verbal warnings (43.5%), deteriorated dealership conditions (17.0%), and dealership suspension (12.0%) when they set prices lower than the RPRs.[5] Consequently, in 1999, price recommendations were banned for clothes and certain consumer electronics such as TVs and VCRs, which were extended to cameras in 2000 and PCs in 2004.[6]

During the period of 2010–2011, RPRs were briefly banned for four processed food categories: snacks, biscuit & pie, ice cream, and instant noodles. Interestingly, when the ban was revoked the following year, producers reintroduced RPRs for some, but not all, their products.[7] Our analysis explores the logic behind the reintroduction of RPRs in the processed food categories after the ban was lifted. The main advantage of using the product group is that the lifting of the ban provides a natural experiment allowing us to observe producers' decision to start using RPRs. Specifically, the existence of products with RPRs does not imply that RPRs play any substantive role in the manufacturer–retailer relationship, because RPRs can continue to be printed out of tradition. However, when reintroducing RPRs after the revocation of the ban, producers should rationally expect them to have a positive impact on their profitability, such as by allowing information sharing.[8] Additionally, the sales information during the ban period provides us with a natural instrumental variable for our empirical analysis.

III. Theoretical mechanism

In this section, we propose a stylized theoretical mechanism of increasing buyer power, captured by the market share of strong

[5] https://www.kca.go.kr/home/sub.do?menukey=4002&mode=view&no=1000062719

[6] De los Santos *et al.* (2018) provided a detailed description of the changes in price regulations in Korea.

[7] The main reason behind the lift of the ban is that, contrary to expectations, retail prices increased. See the press release of the Ministry of Trade, Industry, and Energy, July 8, 2009 and June 30, 2010.

[8] When the ban was lifted, the government pressured manufacturers to reinstate RPRs at the previous level, thereby affecting their reinstatement decision (De los Santos *et al.*, 2018). However, over time, manufacturers were able to set RPRs at any level.

retailers, discouraging information sharing between a manufacturer and retailers.

A. Basic setup

We let a single producer P and the unit mass of independent downstream markets be indexed by m. In each market m, retailer R_m acts as a local monopolist. A single retail chain controls a fraction λ of retailers, whereas the remaining firms are independent and individually owned. We denote an independent retailer as R_i and a chain retailer as Rc. Hence, our model describes geographically segmented retail markets, where each outlet is a local monopolist in its neighborhood.

An intermediate product is produced by P at zero cost and can be transformed by retailers into a final product using a costless one-to-one technology. We suppose that P has a forward-integrating alternative in each market by distributing the final product on its own. If P integrates forward in a market, then it will become the sole supplier of the final product in this market. However, to integrate, P must pay $F > 0$ per market, representing the cost of opening new retail outlets or expanding the capacity of existing ones.

The intermediate product is characterized by its quality, which is captured by the parameter $\theta \in \{L, H\}$. Given quality θ, consumer demand is homogeneous across the markets, that is, demand in market m is $D(p_m, \theta)$, where p_m is the retail price in this market. We let $D(p, \theta)$ be decreasing in p and $D(p, L) < D(p, H)$ for each p. The quality is uncertain and directly observable only by P, which is low ($\theta = L$), with probability of $\alpha \in (0, 1)$. We suppose that before determining the quality, P can credibly commit to a disclosure rule. The disclosure rule π consists of a finite signal space S and two conditional distributions, that is, $\pi(\cdot|L)$ and $\pi(\cdot|H)$, over S. For example, we take $S = \{s^L, s^H\}$. Then, full disclosure can be represented by conditional probability distributions degenerate at the corresponding signals, whereas no disclosure can be represented by a pair of identical distributions. Given the disclosure rule π and realized signal s, retailers form the posterior μ_s for product quality using Bayes' rule. We assume that P cannot disclose information exclusively to some retailers and reveals the quality to either all or to no one.[9] That is, the

[9] Information leakage within a supply chain is emphasized in the literature. In the extreme case, a producer cannot prevent information shared with one

signals are public.

Trade between a producer and retailers is determined by contracts. In our stylized setting, we consider simple, "flat-fee contracts, without loss of generality, which allow a retailer to buy any quantity of the intermediate product at zero cost and specify a fixed transfer to the producer. As each local market has a different retailer, P must negotiate the amount of the flat fee with each retailer R_m. We suppose that the independent and chain retailers have different bargaining power in relation to the producer. The party with higher bargaining power enjoys the advantage of making a take-it-or-leave-it offer to its trading partner. Specifically, we assume that the chain retailers have high bargaining power and make take-it-or-leave-it offers to P, whereas the independent retailers must accept or reject P's offer. Therefore, the fraction of chain retailers λ captures buyer power in the product markets. We aim to investigate how buyer power affects the producer's incentives to disclose quality information to the retailers.

We consider a dynamic Bayesian game that proceeds as follows:

i. P commits to a disclosure rule π. Then, nature chooses quality θ according to the prior, and P observes θ. Given the quality θ and disclosure rule π, a public signal is chosen according to the corresponding distribution. P and all the retailers observe disclosure rule π and signal realization s.

ii. Simultaneously, each chain retailer R_c makes an offer to P, and P makes an offer to each independent retailer R_i. An offer specifies transfer from a retailer to P.

iii. P and each R_i simultaneously decide to accept or reject the offers. If an offer in market m is rejected, then P integrates forward in this market.

iv. The retailers set the retail prices, and profits are realized.

We investigate the perfect Bayesian equilibria of the game.

B. Discussion of assumptions

The number of features of the above model serves to simplify the analysis and exposition. First, the intermediate product is produced at

retailer from reaching others (see Ha and Tang, 2017).

zero cost, but most important, the marginal cost of production is the same for the high- and low-quality goods. This assumption implies that we can consider only simple, "flat-fee contracts. Moreover, a contract proposed by the informed party, namely, the producer, cannot be used to infer the product quality in equilibrium, which allows us to focus on the information-disclosure decision of the producer. Second, the assumption that quality is binary emphasizes the contrast between full and partial equilibrium information disclosure without obscuring the analysis by comparing various partial disclosure rules.[10]

The assumption that producers can credibly commit to disclosing product information is important. It is justified if producers can commit to certain standards of certification owing to legal constraints and systematically reveal the features of products that will affect their desirability. Another justification derives from considering relational contracts (Baker *et al.*, 2002). For instance, Buehler and Gartner (2013) argued that recommended retail prices can credibly transmit product information from suppliers to retailers owing to the typically long-term nature of their relation. Finally, even when the underlying assumption on credible information disclosure does not hold, our analysis can shed light on producers' incentives to share information. The model provides the upper bound on gains from information sharing achievable in all the alternative communication games (Kamenica and Gentzkow, 2011).

We suppose that the producer is more informed than the retailers. Given that retailers are "closer to the final consumers and hence can directly observe demand, this idea may seem to be an ad hoc assumption. However, some additional information may be available to producers (Guo and Iyer, 2010; Guan *et al.*, 2019). Before introducing a new or improved product, producers conduct consumer surveys, countrywide marketing campaigns, and so on. Moreover, producers decide on the introduction of substitute products or changes in branding strategies and thus are generally highly aware of demand changes.

Finally, though stylized, our bargaining model captures important features of actual producer–retailer negotiations. Retailers differ from one another in size, geographical coverage, assortment, product

[10] We can extend the model by considering an arbitrarily finite set of qualities. Although information disclosure is complicated, the results are qualitatively the same.

procurement method, availability of store brands, and so on. Chain retailers may operate in many cities throughout the country, whereas independently owned local shops operate in a single location.[11] Retail chains have centralized purchasing departments that negotiate directly with producers, whereas independently owned shops are typically characterized as price takers by industry practitioners. Retail chains may also have a variety of store brands and can easily substitute products from a pool of branded goods. Backward integration in the supply chain is typically associated with a fixed cost, which can be distributed over many retail outlets within a chain (Inderst and Valletti, 2011). Such characteristics of chain retailers give rise to their high bargaining power.[12] Moreover, proposing nonnegotiable offers to branded-goods producers is not an uncommon practice for retail chains.[13] Thus, our model, which gives retailers an all-or-none bargaining power, can capture the distinct imbalances in the industry.

C. Buyer power and information disclosure

We start our analysis from the final stage of the game. As demand is homogeneous across the markets, the retailers choose the same final product prices and receive the same expected profits. Specifically, we let a posterior distribution over the qualities be given by μ and denote the corresponding maximum expected profit of a retailer as $\Pi(\mu) = \max_p \; pE_\mu[D(p,\theta)]$. We let $\Pi^\theta = \mathbf{max}_p \; pD(p,\theta)$ denote a retailer's profit when the quality is θ. Then, because P directly observes the quality, its profit from integrating forward in a market is $\Pi^\theta - F$ for each θ.

Next, we consider the second and third stages, in which offers are made and accepted. We fix the disclosure rule π and realize signal s. The independent retailer R_i accepts P's offer if it is less than or equal to

[11] For example, an average convenience store chain in Korea operated 1,750 stores in 2009 (Retail Magazine Vol.11, 2011).

[12] Draganska et al. (2010) empirically assessed the role of retailer size, presence of store brands, and assortment as determinants of buyer power.

[13] For example, in 2015, the Australian Competition and Consumer Commission (ACCC) flagged Woolworths and Aldi supermarkets for offering suppliers an agreement that gave the impression that terms could not be negotiated (see ACCC press release MR 152/16 from 25 August 2016).

the retailer's expected profits. Therefore, P captures the entire expected surplus of each R_i by offering the transfer $\prod(\mu_s)$. However, P accepts the offer of chain retailer R_c if it is greater than or equal to P's profits from integrating forward, given by $\prod^{\theta}$ – F. Moreover, a contract accepted by an H-type P is also accepted by an L-type P. Therefore, retailer Rc can either trade with both types by offering $\prod^{H}$ – F or only with the L type by offering $\prod^{L}$ – F. Retailer Rc trades with both if

$$\Pi(\mu_s) - (\Pi^H - F) \geq \mu_s(L)(\Pi^L - (\Pi^L - F)), \tag{1}$$

where $\mu_s(L)$ is the probability of having a low quality. If the opposite of (1) holds, then retailer R_c trades only with the *L*-type P. Noting that the left-hand side is decreasing and the right-hand side is increasing in $\mu_s(L)$, and evaluating the inequality in the distributions degenerate at *H* and *L*, it follows that a unique distribution exists, which we call $\bar{\mu}$, transforming (1) into an equality. Hence, retailer R_c offers $\prod^{H}$ – F if $\mu_s(L) \leq \bar{\mu}$, and $\prod^{L}$ – F otherwise.

Finally, we examine the choice of a disclosure rule of *P*. Fully disclosing information will maximize downstream profits, which can be extracted from independent retailers. However, it will also allow chain retailers to capture producers' entire surplus. Meanwhile, withholding information will reduce the profits from trade with independent retailers but may provide information rents from trade with chain retailers.

Proposition 1. *The producer's disclosure of quality information decreases slightly with buyer power. Specifically,* $\bar{\lambda} \in (0, 1)$, *such that in a perfect Bayesian equilibrium, P*

(i) fully discloses information if $\lambda < \lambda$

(ii) partially discloses information if $\lambda > \bar{\lambda}$

The optimal partial disclosure rule has the following structure:[14] two signals exist. The first signal does not perfectly reveal the quality and induces posterior $\bar{\mu}$, making every chain retailer indifferent in either offering a high fee and trading with both types of *P* or offering a low fee and trading with the low type of P. The remaining signal fully reveals the quality. Packing high- and low-quality products together allows *P*

[14] The proof of the results is presented in the Appendix.

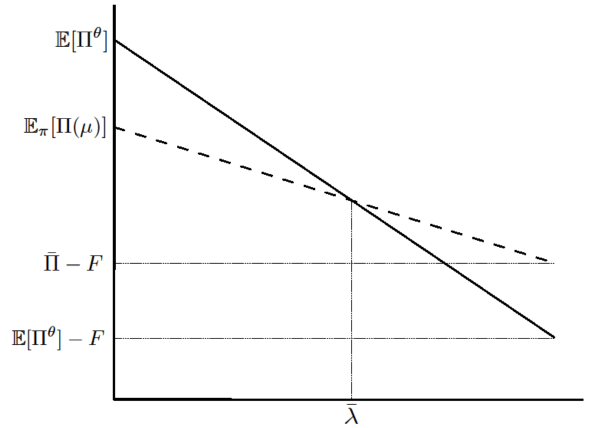


FIGURE 1

COMPARISON OF PRODUCER'S EX-ANTE PROFIT UNDER FULL AND PARTIAL DISCLOSURE

to receive information rents from trade with the chain retailers, which is a typical structure of optimal signals identified in the Bayesian persuasion literature (Kamenica and Gentzkow, 2011; Bergemann *et al.*, 2015).

Figure 1 illustrates the results. The ex-ante expected profit of P under full and partial information disclosure is represented by a solid line and dotted line, respectively. Under full disclosure, the ex-ante profit of P from trade with the independent retailers is $E[\Pi^{\theta}]$, and that from trade with the chain retailers is $E[\Pi^{\theta}] - F$. Given the optimal partial disclosure rule π, the ex-ante profit of P from trade with the independent retailers is $E_{\pi}[\Pi(\mu)]$, such that $E[\Pi^{\theta}] - F < E_{\pi}[\Pi(\mu)] < E[\Pi^{\theta}]$, and the profit from trade with the chain retailers is denoted as $\bar{\Pi} - F$, such that $E[\Pi^{\theta}] - F \leq \bar{\Pi} - F < E_{\Pi}[\Pi(\mu)]$.

The first inequality reflects the information rents: under the optimal disclosure rule, the H types of P will receive their reserve price, and the L types will occasionally receive the higher reserve price of the H types. The second inequality holds, because each signal chain retailer trades with P; hence, its ex-ante profit from the trade should be positive. For each disclosure rule, P's ex-ante profit is linear in λ. When the fraction of chain retailers is small, $\lambda < \bar{\lambda}$, the positive effect of information disclosure on downstream profits will dominate, and P will obtain high ex-ante profits under full disclosure. However, when the fraction of chain retailers increases above $\bar{\lambda}$, securing information rents will become highly important, and partial disclosure will be highly profitable.

We conclude our theoretical analysis by noting the effect of information disclosure on the total industry profits.

Proposition 2. *The total industry profits will be low under partial information disclosure.*

The proof of the results is straightforward. Retail profits are convex in the posterior, induced by the signals, because effective information allows retailers to adjust their prices based on demand, thereby increasing the total industry profits. Hence, high buyer power in product markets tends to reduce industry profits. The effect of information disclosure on consumer welfare is ambiguous. Consumers may benefit from increased information available to retailers if the information induces retailers to charge low prices, on average; otherwise, consumers may suffer.

IV. Empirical evidence

In this section, we empirically test whether producers' incentives to share information decrease with buyer power in the market. Our empirical analysis is based on the premise that manufacturers use RPRs to communicate demand information to retailers (Buehler and Gartner, 2013).

A. Data

We use sales data obtained from LinkAztec, which is a market research agency in Korea.[15] For each of the four processed food categories (biscuit & pie, ice cream, instant noodles, and snacks), we use the reported sales revenue from six retailer categories (*i.e.*, department stores, hypermarkets, chain supermarkets, convenience stores, independent supermarkets, and corner shops) in 2016.[16] The first four

[15] The agency was acquired by Nielsen Korea in 2018.

[16] A store that operates 24 hours a day is defined as a convenience store. An independent store equipped with two or more cash registers is defined as a

types of retailers have multiple stores nationwide and negotiate directly with producers, whereas the two remaining types of retailers are independently owned and supplied by wholesalers. We call the stores included in the first four categories chain stores and those in the last two categories independent stores. Table A1 in the Appendix lists the number of stores and size (measured by the number of employees) as well as total sales by retailer category in Korea. Although the number of independent stores is higher than the number of chain stores, the chain stores are larger than the independent stores. For instance, an average discount store hires 140 employees, whereas a typical corner shop has fewer than two employees.

Table A2 in the Appendix presents the sales of all the producers and eight largest major producers in the four categories. The combined market shares of the major producers range from 78% to 96% across the four product categories. Each major producer is present in multiple categories. For instance, the market share of Lotte is 29%, 51%, and 12% in the biscuit & pie, ice cream, and snack categories, respectively.

As the market is dominated by the major producers, we focus on their RPR decisions. In Korea, RPRs appear directly on packages and therefore can be easily collected manually.[17] We show an example of an RPR in Figure A1. To collect the RPR information, we visited 18 stores in three cities in Korea, namely, Seoul, Sungnam, and Donghae, in the summer of 2017. The stores cover all the retailer categories in our data. Among the 606 products of the major producers, we record the RPR information of 318 products.

The products not offered in any of the visited stores mainly have low sales. For instance, Table A2 in the Appendix shows that the combined sales of the 84 products under the snack category produced by the major producers that we found amount to USD 782 million, whereas the combined sales of the remaining 75 products that we could not find amount to only USD 43 million.

Table 1 reports the descriptive statistics of the sample data. Among the 318 products, 42% (134 products) have an RPR, and the remaining

supermarket, whereas a store with only one cash register is defined as a corner shop.

[17] According to industry insiders, manufacturers do not recommend prices to retailers in other ways, such as by inserting RPRs into purchasing contracts or publishing them online.

Table 1
Descriptive statistics

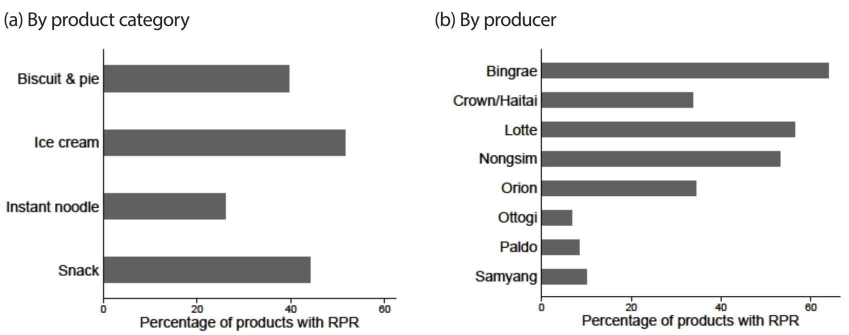
Variable	Avg.	Std. Dev.	Min.	Max.	Obs.
Product level					
Use of RPRs	0.42	0.49	0	1	318
Sales (M$)	11.59	20.25	0	229	318
Percentage of sales through chain stores Sample period (2016)	59.58	21.09	0	100	318
Ban period (July 2010–June 2011)	43.04	25.04	0	97	152
Producer level					
Number of products (in 1,000)	2.92	3.28	0.52	10.52	8
Total sales (B$)	3.26	2.79	0.58	9.22	8

Notes: Total sales are converted to billions of US dollars applying the average exchange rate in 2016; KRW 1,161 to USD 1.

58% (184 products) do not have an RPR. The average sales of a product totaled USD 11.6 million, and the average manufacturer-reported sales totaled USD 3.3 billion from 2.9 thousand processed food products in 2016. For each product, we compute the proportion of the chain store sales in the total sales, which captures buyer power. In 2016, the average proportion of chain store sales was 60%. The top left panel of Figure 1 shows that the percentage of the products with an RPR ranges from 26% for instant noodles to 52% for ice cream. In addition, the top right panel shows that each major producer uses RPRs on some products.

A striking feature of the data is that the percentage of sales through the chain stores tends to be high for the products without an RPR. The bottom panel of Figure 1 compares the distribution of the percentage of sales through the chain stores between the two product groups. The average percentage of sales through the chain stores for the products with no RPR was 63.5%, whereas that through the chain stores for the products with an RPR was only 54.2%. In terms of a comparison by product category, Figure A2 in the Appendix reveals a similar pattern. In the next section, we confirm our observations through regression analysis, controlling for other factors that may affect the use of RPRs.

Panel A: Percentage of products with RPR



Panel B: Distribution of percentage of sales through chain stores

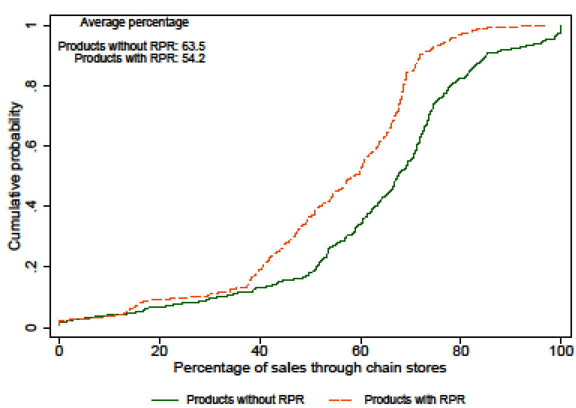


Figure 2

Use of RPRs in processed food industry

B. Empirical models and findings

In this section, we formally examine how buyer power affects producers' decision to use RPRs. We let $\Delta\pi_i$ denote the change in the profits from product i from the introduction of an RPR. We assume that it is given by

$$\Delta\pi_i = \delta ChainShare_i + z_i\lambda + u_i, \tag{2}$$

where *ChainSharei* is the percentage of the sales of product *i* through the chain stores, and $\mathbf{z}_i$ includes the log of the sales of the product as well as the producer and product-category fixed effects.[18] We assume that the error term *ui* has a standard normal distribution. The indicator variable RPR_i is equal to 1 if an RPR is used for product *i*. Assuming that a producer will use RPRs if and only if they increase profits, we obtain a probit model, as follows:

$$\Pr[RPR_i = 1 \mid X_i] = \Phi(X_i\beta), \tag{3}$$

where $\mathbf{x}_i$ = [ChainShare$_i$ z$_i$], $\beta = [\delta, \lambda]$, and Φ is the cumulative distribution function (CDF) of the standard normal distribution.

The first three columns of Table 2 present the marginal effects at the sample means. We start from the simplest specification, without any fixed effects, in column (1) and arrive at the full model in column (3). We find that the higher the percentage of sales through the chain stores, the less likely the product will have an RPR. For instance, the estimates in column (3) show that the likelihood of a producer recommending retail prices decreases by 11 percentage points when the proportion of the chain store sales rises by 10 percentage points.[19]

We may argue that chain retailers are as well-informed as manufacturers about product demand, so they will place a low incremental value on manufacturers' information, which may discourage manufacturers from using RPRs to share information regardless of retailers' buyer power. If so, then the likelihood of using RPRs would depend only on the retail market structure and would not be affected by how powerful a producer is relative to retailers. However, according to Figure A3 in the Appendix, the likelihood of using RPRs tends to be positively correlated with a producer's bargaining power, measured by its total sales in the processed food category. We confirm

[18] As noted previously, we could not collect RPR information on certain products with low sales. However, not all the products with low sales are unavailable for analysis, thereby relieving the concern of a potential sample selection problem. The minimum sales of a product in the sample data total USD 9,000.

[19] We also consider a linear probability model (LPM) by replacing $\Delta\pi_i$ with RPR_i in Eq. (2). The LPM estimate of the marginal effect (available upon request) is approximately the same.

TABLE 2
MARGINAL EFFECTS OF BUYER POWER ON RPR USE

Variable	(1)	(2)	(3)	(4)	(5)
Chain Share	-0.009***	-0.008***	-0.011***	-0.009***	-0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln(sales)	0.085***	0.083***	0.092***	0.087***	0.093***
	(0.018)	(0.018)	(0.020)	(0.019)	(0.020)
ln(total sales of the producer)				0.189***	0.196***
				(0.042)	(0.050)
Fixed effects					
Product category	No	No	Yes	No	Yes
Producer	No	Yes	Yes	No	No
Observations	318	318	318	318	318

Notes: Marginal effects are presented at sample means; the dependent variable *RPR* is equal to 1 when an RPR is used for a product, and 0 otherwise. Robust standard errors are in parentheses; *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

this observation by replacing the producer fixed effects with the log of the total sales of the producer for product i in specification (2).[20] Based on the marginal effects reported in the last two columns of Table 2, the products of the manufacturers with high total sales will likely have an RPR. Specifically, a 10% increase in the total sales leads to a 2-percentage-point increase in the probability of using RPRs. This finding suggests that powerful producers have considerable leverage in negotiating with retailers and therefore will likely use RPRs.

We also estimate the probit model by product category. The marginal effects of the chain store sales proportion reported in Table A3 in the Appendix are negative for all the product categories and significant at 1% for three categories. The effect is the largest in the snack category, specifically, given a 10-percentage-point increase in the proportion of

[20] The total sales of a producer are not limited to sales from the four product categories considered in this study. In addition, including both in the specification is impossible, because the total sales observation is unique to each producer. The results (available upon request) are similar when the number of products, instead of the total sales, is used as a proxy for a producer's bargaining power.

the chain store sales, the probability of using RPRs decreases by 25 percentage points.

C. Robustness

In this section, we address two empirical issues: the potential endogeneity of the chain store sales proportion and the presence of a vertically integrated producer. The use of RPRs may affect the distribution of product sales across the retailer categories. One possibility is that, without RPRs, retail chains still have more demand information than independent stores, so their retail prices will be more optimal. For instance, suppose that a producer learns that demand for its instant noodles has declined owing to an overall shift in consumer tastes away from packaged foods. Retail chains may have incorporated such information in their pricing, whereas “mom-and-pop stores may be unaware of the information. Hence, when a manufacturer adjusts RPRs to reflect this information, the proportion of sales through independent stores may grow. Another possibility is that a producer makes a decision on the distribution channel and price recommendation simultaneously based on unobserved product characteristics.

To alleviate the endogeneity concern, we exploit the ban of RPRs from July 2010 to June 2011. As the proportion of the chain store sales across the years will likely be correlated, we use the average proportion of the chain store sales during the ban period, namely, ChainShare^{2010}, as an instrumental variable in the model, as follows:[21]

$$ChainShare_i = \alpha Chainshare_i^{2010} + z_i\gamma + \varepsilon_{i,} \tag{4}$$

$$\Delta\pi_i = \delta ChainShare_i + z_i\lambda + u_{i,} \tag{5}$$

$$RPR_i = \delta ChainShare_i + z_i\lambda + u_i, \tag{6}$$

We obtain the sales information during the ban period from Nielsen

[21] As a robustness check, given that it may take time for the effects of the ban to materialize, we also use the average proportion of the chain store sales during the second half of the ban period (January–June 2011) as an instrumental variable. The results (available upon request) are not qualitatively different from the presented results.

Table 3
Estimates using instrumental variables

	2SLS		MLE	
Variable	(1)	(2)	(3)	(4)
Dependent variable: Chain Share				
Chain	0.425***	0.433***	0.440***	0.433***
Share2010	(0.101)	(0.100)	(0.101)	(0.098)
ln(sales)	3.812***	3.857***	3.942***	3.857***
ln(total sales of the producer)	(1.092)	(1.077)	(1.049)	(1.055)
		4.502**		4.502***
		(1.744)		(1.709)
Dependent variable: RPR				
Chain	-0.015***	-0.018***	-0.043***	-0.047***
Share	(0.005)	(0.006)	(0.014)	(0.013)
ln(sales)	0.088**	0.107***	0.274***	0.286***
ln(total sales of the producer)	(0.035)	(0.034)	(0.097)	(0.087)
		0.241***		0.649***
		(0.068)		(0.174)
Fixed effects				
Product category	Yes	Yes	Yes	Yes
Producer	Yes	No	Yes	No
Endogeneity test	1.63	3.16	1.10	2.81
p-value	0.20	0.08	0.29	0.09
F-statistic on significance of IV	17.72	18.64		
Observations	152	152	145	152

Notes: IV estimates are presented; results in the first two columns are from the 2SLS, and the results in the next two columns are from the joint estimation of Eqs. (4)–(6). None of the seven products produced by the manufacturer, namely, Ottogi, have an RPR and hence are dropped in column (3). Robust standard errors are in parentheses; *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at 10% level.

Korea Retail Measurement Service, which covers 152 of the 318 products in our sample. The products with no available data were introduced after the ban was lifted. According to Table 1, the average proportion of the chain store sales during the ban period was 43%, which was lower than that in 2016 (60%).

Using the subsample of 152 products, we employ the following estimation strategies. First, we use the linear two-stage least squares

(2SLS) approach. We estimate

Eq. (4) then regress *RPRi* on the predicted value of *ChainSharei,* along with *zi.* Second, as an alternative to the LPM, we jointly estimate Eqs. (4)–(6). This estimation requires us to assume that (ε_i, u_i) is independent, with an identical bivariate normal distribution.

Table 3 presents the estimation results of both strategies. The upper panel shows that the two chain store sales proportions are strongly correlated. The *F*-statistic of the excluded instrument in the first-stage regression is well above 10, thereby validating our instrument (Stock and Yogo, 2002). The estimates in the bottom panel suggest that the marginal effect of the chain store sales proportion is approximately the same under the two approaches. Under the 2SLS approach, a 10-percentage-point increase in the proportion of the chain store sales leads to a 15-percentage-point decrease in the likelihood of using RPRs. Similarly, under the second approach, the estimates suggest that the likelihood of using RPRs decreases by 16 percentage points when the proportion of the chain store sales increases by 10 percentage points.[22] The estimated effects are larger in magnitude than those in the previous probit analysis, thereby suggesting that the use of RPRs may increase the proportion of sales through independent stores.[23] However, the endogeneity test does not reject the null hypothesis stating that *ChainShare* is exogenous at the 5% level in all the specifications, thereby justifying our previous analysis.[24]

Lotte, which is the largest producer in the sample, also operates its own hypermarket and supermarket chains. As no bargaining exists between the two, the percentage of sales through the chain retailers cannot properly measure the buyer power that Lotte faces. However, when we estimate the probit model without the 83 products produced by Lotte, the estimation results are qualitatively the same as those

[22] We calculate the marginal effects at the sample means as the estimate of the coefficient of *ChainShare* (-0.043) times the value of the standard normal pdf at $\bar{x}\hat{\beta}$.

[23] The probit estimation results of the marginal effects using the subsample of 152 products reported in Table A4 in the Appendix are similar to those using the entire sample of 318 products reported in Table 2.

[24] For the MLE, we perform a Wald test, in which the correlation coefficient between ε and u is equal to 0. For the 2SLS, we use the Durbin–Wu–Hausman test of endogeneity.

reported in Table 4. The probability of using RPRs decreases by 9 percentage points in response to a 10-percentage-point increase in the proportion of the chain store sales and increases by 2.2 percentage points in response to a 10% increase in the total sales.

V. Conclusion

In recent decades, the retail industry witnessed the rising dominance of chain retailers. As a result, the balance of power in the supplier–retailer relationship shifted away from manufacturers of branded goods. This study contributes to understanding the consequences of the change by focusing on a particular aspect: information sharing between producers and retailers.

First, we propose a theoretical model that can explain how buyer power affects manufacturers' incentives to share demand information with retailers. The model emphasizes the tradeoff between sharing information to increase downstream profits, which can be captured from retailers with low buyer power, and keeping information private, which creates information rents from trade with high-buyer-power

TABLE 4

MARGINAL EFFECTS WITHOUT PRODUCTS OF VERTICALLY INTEGRATED PRODUCER

Variable	(1)	(2)	(3)	(4)	(5)
Chain Share	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln(sales)	0.073***	0.068***	0.068***	0.074***	0.070***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)
ln(total sales of the producer)				0.222***	0.215***
				(0.061)	(0.069)
Fixed effects					
Product category	No	No	Yes	No	Yes
Producer	No	Yes	Yes	No	No
Observations	233	233	233	233	233

Notes: Marginal effects are presented at sample means; products produced by Lotte are dropped from the analysis. The dependent variable *RPR* is equal to 1 when an RPR is used for a product, and 0 otherwise. Robust standard errors are in parentheses; *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

retailers.

Second, using unique manually collected data, we show that the likelihood of a manufacturer using RPRs decreases with the market share of chain stores. In addition, the more powerful the manufacturer, the more likely it will recommend retail prices for its products. In light of recent studies arguing that RPRs are a vehicle for information transmission from suppliers to retailers, our results suggest that an increase in buyer power will be detrimental to information sharing in the supply chain.

One implication of our analysis is for the evaluation of the effects of mergers between retailers. While the literature focuses mostly on prices (Smith, 2004; Allain *et al.*, 2017; Hosken et al., 2018), our study suggests that mergers may create negative externalities by reducing producers' incentives to share product information with the entire market, thereby decreasing industry profits.

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Appendix

Proof of Proposition 1. We begin by showing that in any perfect Bayesian equilibrium, the disclosure rule π may induce three different posteriors at most, that is, two degenerate ones (corresponding to perfectly revealing signals) and one nondegenerate posterior $\bar{\mu}$ (making each R_c indifferent in offering a high or low price). Suppose that P chooses disclosure rule π with signal space S. For the sake of contradiction, suppose that $s \in S$, such that $0 < \mu_s(L) < \bar{\mu}$. Then, we construct disclosure rule π' with signal space S′, resulting in the high profit of P from trade with each R_i and the same profit from trade with each R_c. The idea is to make the signal structure highly informative without losing information rents from trade with chain retailers. We define x as the value, solving

$$\mu = \alpha\pi(s \mid L) \,/\, [\alpha\pi(s \mid L) + (1 - \alpha)x]. \qquad \text{(A1)}$$

Note that $x < \pi(s|H)$, because $\mu_s(L) < \bar{\mu}$. We split signal s into two signals, that is, s' and s'', letting $S' = S \setminus \{s\} \cup \{s', s''\}$ and $\pi'(s'|\theta) + \pi'(s''|\theta) =$

$\pi(s|\theta)$ for each θ. We let $\pi'(s'|H) = x$, $\pi'(s''|L) = 0$, and $\pi'(\tilde{s}|\theta) = \pi(\tilde{s}|\theta)$ for each $\tilde{s} \in S \setminus \{s\}$ and θ.

First, P's ex-ante expected profit from trade with each Rc is the same under π and π'. We split signal s into signals s' and s'', and by construction, given these signals, each R_c offers the high price to P. Second, given $\tilde{s} \in s' \setminus \{s', s''\}$, the expected profit from trade with each R_i is the same for each θ. Hence, given s'or s'', the profit from trade with each R_i increases. However, because P captures each Ri's profit $\Pi(\mu)$, which is convex in μ, the standard argument, using Jensen's inequality, delivers the result. Similarly, we can show that a disclosure rule such that $\bar{\mu} < \mu_s(L) < 1$ for some $s \in S$ is not optimal.

We consider a disclosure rule that satisfies the above structure. Next, we show that the ex-ante expected profit of P from such a disclosure rule can be written as a convex combination of the profits from two special disclosure rules: the most informative (full disclosure) and the least informative, which has the above structure (partial disclosure). Without loss of generality, these rules can be restricted to having two signals, that is, s_1 and s_2. The full disclosure rule is such that given each signal, the posterior is degenerate. The partial disclosure rule has conditional distributions solving

$$\max_{\pi(s_1|L),\, \pi(s_1|H)} \alpha\pi(s_1 \mid L) + (1-\alpha)\pi(s_1 \mid H) \; s.t. \; \mu_{s_1} = \bar{\mu}. \tag{A2}$$

From the above equation, we determine that if $\mu \geq a$, then $\pi(s_1|L) = 1$, and if $\mu \leq a$, then $\pi(s_1|H) = 1$. In the first case, s_2 induces the posterior degenerate at H. In the second case, s_2 induces the posterior degenerate at L. Straightforward algebra confirms this claim.

When $\lambda = 0$ by convexity of the retailers' profit in μ and because P captures the profit of each R_i, the full disclosure rule dominates over the partial disclosure rule. Suppose that $\mu > \alpha$. If $\lambda = 1$, then the ex-ante expected profit under the full disclosure rule is $\alpha\Pi^L + (1-\alpha)\Pi^H - F = E[\Pi^\theta] - F$. However, under partial disclosure, the profit is

$$\frac{\alpha}{\bar{\mu}}\Pi^L + (1-\frac{\alpha}{\bar{\mu}})\Pi^H - F > E[\Pi^\theta] - F, \tag{A3}$$

where the inequality follows, because $\bar{\mu} > \alpha$. A symmetric argument furnishes the case when $\bar{\mu} < \alpha$.

Finally, given a disclosure rule, the ex-ante expected profit is linear in λ; hence, $\bar{\lambda}$ exists, as in the statement of the proposition.

Table A1

Number of stores and their size by retailer category

Retailer category	Number of stores	Total sales ($ Billions)	Avg. number of employees
Department store	101	14.1	146.4
Hypermarket	557	35.4	137.8
Supermarket	11,446	31.2	8.8
Convenience store	35,282	17.4	4.0
Corner shop	59,736	9.5	1.7

Notes: The data are obtained from the Korean Statistical Information Service for 2016. The information is provided for chain and independent supermarkets as a whole. The average exchange rate in 2016 was KRW1,161 to USD 1.

Table A2

Number of products and sales of major producers

Producers	Number of products		Sales	
	#	%	Millions	%
Biscuit & Pie				
All producers	944	100.0	937.6	100.0
Major producers:				
Crown/Haitai	59	6.3	323.9	34.6
Lotte	41	4.3	271.9	29.0
Orion	23	2.4	210.3	22.4
Major producers total	123	13.0	806.2	86.0
Included in the sample	81	8.6	782.9	83.5
Ice cream				
All producers	355	100.0	912.6	100.0
Major producers:				
Bingrae	47	13.2	245.0	26.8
Crown/Haitai	50	14.1	136.2	14.9
Lotte	113	31.8	465.0	51.0
Major producers total	210	59.2	846.1	92.7
Included in the sample	99	27.9	754.6	82.7
Instant noodles				
All producers	158	100.0	1,588.4	100.0
Major producers:				

Producers	Number of products		Sales	
	#	%	Millions	%
Nongsim	38	24.1	832.0	52.4
Ottogi	29	18.4	380.9	24.0
Paldo	21	13.3	152.5	9.6
Samyang	26	16.5	161.8	10.2
Major producers total	114	72.2	1,527.1	96.1
Included in the sample	54	34.2	1,365.8	86.0
Snacks				
All producers	1,361	100.0	1,056.5	100.0
Major producers:				
Crown/Haitai	66	4.8	254.8	24.1
Lotte	37	2.7	127.2	12.0
Nongsim	31	2.3	245.5	23.2
Orion	17	1.2	186.6	17.7
Samyang	8	0.6	10.9	1.0
Major producers total	159	11.7	825.0	78.1
Included in the sample	84	6.2	781.9	74.0

Notes: We apply the average exchange rate in 2016, that is, KRW 1,161 to USD 1.

Table A3
Marginal effects by product category

	Biscuit & Pie		Ice cream		Instant noodles		Snacks	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Chain Share	-0.010***	-0.010***	-0.009***	-0.008***	-0.005	-0.007*	-0.024***	-0.025***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)	(0.004)	(0.007)	(0.006)
ln(sales)	0.066**	0.066**	0.165***	0.159***	0.000	0.000	0.110**	0.110**
	(0.029)	(0.030)	(0.037)	(0.036)	(0.039)	(0.032)	(0.052)	(0.045)
ln(total sales of the producer)		0.313***		-0.087		0.323***		0.393***
		(0.112)		(0.091)		(0.083)		(0.121)
Fixed effects								
Producer	Yes	No	Yes	No	Yes	No	Yes	No
Pseudo *R*-squared	0.11	0.10	0.03	0.02	0.30	0.33	0.29	0.23
Observations	81	81	99	99	47	54	84	84

Notes: Marginal effects are presented at sample means; estimation is performed using products under each of the four product categories one by one. The dependent variable *RPR* is equal to 1 when an RPR is used for the product, and 0 otherwise. Seven types of instant noodles produced by Samyang with no RPR are dropped. Robust standard errors are in parentheses; *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

TABLE A4
MARGINAL EFFECTS OF BUYER POWER USING THE SUBSAMPLE

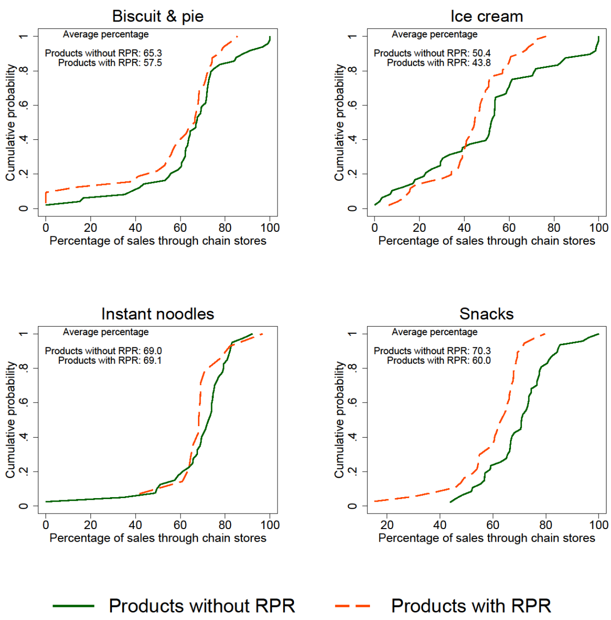
	(1)		(2)	
Variable	Coeff.	Std. Err.	Coeff.	Std. Err.
Chain Share	-0.011	(0.003)***	-0.011	(0.004)***
ln(sales)	0.085	(0.033)**	0.082	(0.034)**
ln(total sales of the producer)			0.214	(0.070)***
Fixed effects				
Product category		Yes		Yes
Producer		Yes		No
Observations		145		152

Notes: Marginal effects are presented at sample means using the subsample of 152 products. The dependent variable *RPR* is equal to 1 when an RPR is used for a product, and 0 otherwise. None of the seven products produced by Ottogi have an RPR; hence, they are dropped in column (1). Robust standard errors are in parentheses; *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

(a) Instant noodles with RPR: RPR of KRW 950 (b) Instant noodles without RPR

Note: An example of a product with an RPR (without RPR) is shown in the top panel (bottom panel) of the figure.

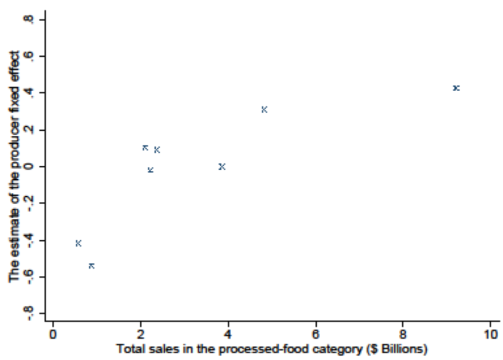
FIGURE A1
RPR EXAMPLE



Note: Each panel of the figure compares the distribution of the percentage of sales through chain stores between the two product groups for each of the four product categories.

Figure A2

Distribution of chain store sales percentage by product category



Note: The figure displays the relationship between the estimate of the producer fixed effects and the producer's total sales in the processed food category.

Figure A3

Producer power and likelihood of using RPRs

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