

# Slotting Allowances as a Facilitating Practice by Food Processors in Wholesale Grocery Markets: Profitability and Welfare Effects

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**Abstract:** Slotting allowances, which are lump-sum transfers paid by manufacturers to retailers in return for various retailer concessions, are an increasingly common practice in wholesale grocery transactions. A relatively vast literature has examined slotting allowances; however, two important features have been ignored: (i) the role of food processors in determining these wholesale price arrangements; and (ii) the effect of this payment structure on economic surplus in the vertical market system. This paper provides each of these links. Central results are that facilitating practices by food processors in the wholesale grocery market raise farm prices, increase farm surplus, and induce positive changes in total surplus in the food system.

*Key words:* Oligopsony; vertical structure; rent-shifting; slotting allowances

*JEL classification:* L13; L22; Q13

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# **Slotting Allowances as a Facilitating Practice by Food Processors in Wholesale Grocery Markets: Profitability and Welfare Effects**

## **I. Introduction**

Slotting allowances, which are lump-sum transfers paid by food manufacturers to grocery retailers for access to the consumer market, have become an increasingly common practice in wholesale grocery transactions. Slotting allowances are paid in return for various forms of retailer concessions, including one-time payments for new product introduction, periodic stocking fees, charges for manufacturer sales presentations, and display fees for special merchandising and promotion. The salient characteristic that unifies these pricing structures is that a slotting allowance is a lump-sum charge that does not vary with subsequent retailer sales.

Despite a relatively vast literature that contributes to the theory of slotting allowances, there is still no consensus on the purpose these fees serve. Indeed, there is considerable disagreement even on the central policy issue of whether slotting allowances have pro-competitive or anti-competitive effects in the food system. The pro-competitive view is that slotting allowances act as an instrument to ration new product introduction, thereby enhancing efficiency by serving as a signaling or screening device under circumstances in which agents have asymmetric information regarding product quality (see, e.g., Lariviere and Padmanabhan; Sullivan; Richards and Patterson). To the extent that manufacturers have superior information regarding the quality of new products, slotting allowances allocate shelf space only among retail goods that exceed a threshold quality level, which reduces product failure rates and improves efficiency. However, this notion of a pro-competitive role for slotting allowances under asymmetric information raises a fundamental and unresolved question. If slotting allowances serve as a signaling or screening device for new products, then why do manufacturers also pay slotting fees for well established products for which brand acceptance is relatively well understood? The similarity of the payment structure that supports slotting allowances for new product introduction and for periodic activities such as stocking, displaying, merchandising, and

promotion suggests the need to develop a unifying theory to encompass a general class of two-part tariff arrangements in the wholesale grocery market.

An alternative explanation that encompasses both new and existing products is the anti-competitive position that slotting allowances are motivated by retail market power. Under imperfect retailer competition, Shaffer demonstrates that two-part tariffs can be employed as a facilitating practice by retailers who seek to reduce downstream price competition in the consumer market. The essence of this argument is that the use of a slotting allowance permits a retailer to support a higher wholesale grocery price, which softens price competition in the consumer market by signaling rival retailers the intent to set a correspondingly high retail price. Cannon and Bloom and Desiraju show that imperfectly competitive retailers have the incentive to use slotting allowances as a method to price discriminate among manufacturers. Such anti-competitive motivations for slotting allowances provide a unifying treatment of two-part tariffs in the wholesale grocery market; however, this view of wholesale grocery markets also raises some important unanswered questions. In particular, if slotting allowances serve as a mechanism for retailers to exercise market power, then why are these lump-sum charges levied most frequently in the highly concentrated, processed food categories of the supermarket? Slotting allowances are commonly paid by food manufacturers processed product categories such as frozen and refrigerated foods, dry grocery, beverages, snacks, candy, and microwaveable shelf-stable foods. In the much-studied product class of fresh produce, by contrast, it is almost exclusively the shippers of bagged salad and other fresh-cut, branded products --and not the commodity shippers-- who pay slotting allowances to retailers (USDA/ERS).

This paper develops a theory of slotting allowances as a facilitating practice by food processing firms. Given the importance of the processing sector as a source of value-added in the food system, it is surprising to note that the role of the food processor in determining contractual arrangements for slotting allowances is a subject that has been entirely ignored.

The observations presented here on slotting allowances are based on a vertical market structure in which grocery production is organized between an upstream farm product market

and a series of subsequent downstream finished product markets. In the upstream market, competitive producers sell a homogeneous farm product to imperfectly competitive food processors. This conceptual treatment is broadly consistent with an emerging literature in this *Journal* on imperfect competition in the food system, which posits an oligopsonistic relationship in markets where farm product producers meet with food processing firms (see, e.g., Chen and Lent; Sexton; Wann and Sexton; Hamilton and Sunding; Alston, Sexton, and Zhang). Unlike previous research on slotting allowances, which has not explicitly considered the upstream farm product market, the focus here on the food processor relationship provides a formal link that allows welfare implications to be derived in terms of farm surplus, processor surplus, and total surplus measures in the vertical food system.

The possibility put forward here that slotting allowances are motivated by food processors raises an entirely new set of questions regarding the purpose these fees serve. For example, why (and under what circumstances) would a food processor with market power offer to make a lump-sum payment to a retailer? What are the optimal contract terms for a slotting allowance derived by a food processor and do these terms coincide, in some fashion, with observed practices in the grocery industry? And, finally, what implications do processor incentives for slotting allowances entail for the size and distribution of welfare changes in the food system? A goal of this paper is to develop a model that is capable of offering some insight into these questions.

An essential finding of the paper is that the optimal contract form for a food processor involves the payment of a positive slotting allowance. The welfare implications of this finding, moreover, are surprising and perhaps counterintuitive. Slotting allowances as a facilitating practice by food processors in the wholesale grocery market tend to induce positive changes in farm surplus, consumer surplus and total surplus in the vertical market system.

The remainder of the paper is structured as follows. Section 2 develops a model to characterize the optimal contract terms for a food processor in the wholesale grocery market. Section 3 derives implications of slotting allowances for the size and distribution of surplus

changes in the food system. Section 4 extends the model to consider differentiated retail products and develops consumer surplus implications. Section 5 discusses relevant empirical evidence that supports the present view of slotting allowances and section 6 concludes.

## **2. The Model**

The starting point for the analysis is an imperfectly competitive vertical food system in which an upstream farm sector sells a raw product to an imperfectly competitive food processing industry, which subsequently refines and sells a finished wholesale product to downstream grocery retailers. Following Just and Chern, Chen and Lent, Hamilton and Sunding, and Allston, Sexton, and Zhang, food processors are viewed to be oligopsony buyers of a homogeneous farm product in the upstream market.

The model considers slotting allowances as a fixed price contract form. A fixed price contract, which specifies a wholesale price and a lump-sum transfer between a manufacturer and a retailer, is a commonly employed contract form in the grocery industry (USDA/ERS). A fixed price contract is also the form considered by Shaffer in his seminal paper on slotting allowances.

In Shaffer's paper, the critical insight is that a contractual arrangement for a slotting allowance at the wholesale level provides the retailer with an instrument to leverage profit from consumers at the retail level. The key to understanding this role for slotting allowances is to look beyond the wholesale market, itself, to the effect of this pricing structure on the oligopoly relationship between rival retailers in the downstream market. In short, a high price set in the wholesale market provides a signal for a correspondingly high retail price in the consumer market. Shaffer centers attention on the role of the downstream consumer market in determining wholesale contracts for slotting allowances by considering the case of competitive food manufacturers with constant marginal cost. The analysis here departs from Shaffer's model in the opposite direction to examine the effect of multi-market contact by food manufacturers in the upstream farm product market. Accordingly, the engine for slotting allowances is processor market power in the upstream raw product market, and, to highlight these motivations, the

downstream consumer market is suppressed in this section by considering the case of competitive retailers. The model is then extended to encompass consumer markets in section 4, where this assumption of competitive retailers is relaxed.

Consider an upstream industry that produces a homogeneous farm product,  $X$ .<sup>1</sup> The farm product is sold in an oligopsony market comprised of  $n$  food processing firms. The level of farm product use by processor  $i$  is denoted  $x_i$  and total raw product use in the industry is  $X = \sum_i x_i$ . The price in the farm product market is given by the inverse supply function for the raw product,  $W = W(X)$ , where  $W'(X) > 0$ . In the processing sector, the processing technology of firm  $i$  is described by the production function  $y_i = f_i(x_i)$ , with  $f_i'(x_i) > 0$  and  $f_i''(x_i) \leq 0$ , where  $y_i$  is the (potentially heterogeneous) finished wholesale product produced by processor  $i$ . In the absence of any slotting allowance arrangement, food processor  $i$  sells the finished wholesale product to a competitive retail intermediary at a non-contracted wholesale price of  $P_i^w$ .

Strategic interaction between food processing firms is modeled as a three-stage game, the timing of which is described in Figure 1. In the first stage, the contract stage, food processor  $i$  writes an observable and non-renegotiable contract with one or more of its downstream retailers. The terms of the contract specify a contract price for the wholesale product ( $r_i$ ) in exchange for a slotting allowance to be made from the processor to the retailer ( $S_i$ ). The equilibrium value of the slotting allowance is allowed to emerge without restriction on sign. In the second stage, the acceptance stage, the retailer either accepts or rejects the processor's contract. If the contract is accepted, the food processor pays a slotting allowance of  $S_i$  to the retailer in return for an agreement to purchase the finished product at a unit price of  $r_i$ . If the contract is rejected, then the food processor sells the finished product to a retailer at the non-contracted wholesale price,  $P_i^w$ . In the third and final stage, the procurement stage, food processors compete in a Cournot oligopsony to acquire the farm product.

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<sup>1</sup> Under circumstances in which processors compete to procure heterogeneous farm products, such as would be the case when farm product suppliers produce locationally differentiated commodities, the qualitative predictions for the optimal processor contract are identical to those described here. For the interest of model clarity, these considerations are suppressed here; however, results on the optimal contract form under heterogeneous product competition are available from the author upon request.

Throughout the paper, it is assumed that

$$W'(X) + x_i W''(X) > 0, \forall i, \quad (1)$$

which ensures the existence and stability of the farm product equilibrium.<sup>2</sup> Condition (1) ensures that the marginal profit of each processor declines with the procurement level of rival processors.

The model is solved using backward induction. Hence, the analysis begins with the procurement stage, followed by the acceptance and contract stages respectively. To make the analysis more transparent, attention is confined to the case of duopsony processors.

In the procurement stage, suppose the downstream retailer has accepted the contract proposed by food processor  $i$ . In this event, the objective function of processor  $i$  is

$$\pi^i(x_i, X, r_i, S_i) = r_i f_i(x_i) - W(X)x_i - S_i, \quad i=1,2, \quad (2)$$

where  $W(X)x_i$  is the variable cost of farm product procurement for processor  $i$ . In addition, there is also a sunk cost component that explains the existence of imperfect competition in the processing sector; however, this plays no role in the analysis and can be omitted. Maximizing (2) with respect to  $x_i$  yields the following necessary condition:

$$\pi_i^i \equiv r_i f_i'(x_i) - W(X) - x_i W'(X) = 0, \quad i=1,2, \quad (3)$$

where the subscript on the food processor profit expression denotes the partial derivative with respect to the procurement quantity,  $x_i$ . The level of farm product use by each firm and total industry farm product use, which are denoted  $x_i^c(r_1, r_2)$ ,  $i = 1, 2$  and  $X^c(r_1, r_2)$  respectively, are obtained in the procurement stage by simultaneously solving equations (3).

Totally differentiating (3) yields the comparative statics effects associated with the processor's choice of  $r_i$ . Noting that  $\pi_{ii}^i < 0$ ,  $\pi_{ij}^i < 0$ , and  $\Delta = \pi_{ii}^i \pi_{jj}^j - \pi_{ij}^i \pi_{ji}^j > 0$  by (1), the comparative statics effects are as follows:

$$\frac{\partial x_i^c(r_1, r_2)}{\partial r_i} = \frac{-f_i'(x_i^c) \pi_{jj}^j}{\Delta} > 0, \quad (4)$$

and

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<sup>2</sup> Expression (1) is sufficient for the Routh-Hurwitz condition to hold on the Jacobian of equations (3) below.

$$\frac{\partial x_j^c(r_1, r_2)}{\partial r_i} = \frac{f_i'(x_i^c)\pi_{ji}^j}{\Delta} < 0. \quad (5)$$

Next define the ratio of comparative statics effects in (4) and (5) as

$$\frac{\partial x_j}{\partial x_i}(x_j^c, X^c) = \frac{\partial x_j^c(r_1, r_2)/\partial r_i}{\partial x_i^c(r_1, r_2)/\partial r_i} = \frac{W'(X^c) + x_j^c W''(X^c)}{r_j f_j''(x_j^c) - 2W'(X^c) - x_j^c W''(X^c)}, \quad (6)$$

which is negative by (1).

In the acceptance stage, a retailer is willing to accept the contract proposed by a processor provided it receives a payment no less than its opportunity costs. With a competitive retail industry, these opportunity costs can be normalized to zero without loss of generality.

Accordingly, the retailer accepts the contract proposed by processor  $i$  whenever

$$(P_i^w - r_i)y_i + S_i \geq 0. \quad (7)$$

In (7), processor  $i$  offers the retailer compensation for any departure of the contracted price from the non-contracted wholesale price through payment of a slotting allowance.

In the contract stage, processor  $i$  chooses the terms of the contract so as to maximize profits in (2) subject to the participation constraint (7) and the procurement stage solutions above. Substituting the procurement stage solutions into (2) and (7), the contracting problem is

$$\begin{aligned} \text{Max}_{r_i, S_i} \pi^i(r_i, S_i) &\equiv r_i f_i(x_i^c) - W(X^c)x_i^c - S_i \\ \text{s.t. } (P_i^w - r_i)f_i(x_i^c) + S_i &\geq 0. \end{aligned}$$

The optimal terms in the processor's contract specify that the retailer participation constraint be met with equality in (7), from which substitution results in the following unconstrained problem:

$$\text{Max}_{r_i} \pi_i(r_i) \equiv P_i^w f_i(x_i^c) - W(X^c)x_i^c. \quad (8)$$

Notice in (8) that only the indirect effect of the contracted wholesale price remains; the direct effect of the contract price on the profitability of processor  $i$  is exactly offset by the payment of the slotting allowance.

Differentiation of (8) with respect to  $r_i$  yields the necessary condition for a profit-maximizing contract,

$$(P_i^w f_i'(x_i^c) - W'(X^c)) \frac{\partial x_i^c}{\partial r_i} - x_i^c W''(X^c) \frac{\partial X^c}{\partial r_i} = 0. \quad (9)$$

*Proposition 1. The non-cooperative Nash contract equilibrium for food processor  $i$ ,  $i=1,2$ , is characterized by*

- (i) a wholesale price above the non-contracted price ( $r_i^* > P_i^w$ ); and*
- (ii) a positive slotting allowance ( $S_i^* > 0$ ).*

*Proof.* Let  $x_i^* = x_i(r_1^*, r_2^*)$ ,  $i=1,2$  denote the solution to the Nash equilibrium described by (9).

To determine the equilibrium choice of  $r_i^*$ , substitute the procurement stage solution (3) into (9), from which obtains

$$(P_i^w - r_i^*) f_i'(x_i^*) = x_i^* W'(X^*) \frac{\partial x_j}{\partial x_i}(x_j^*, X^*) < 0, \quad (10)$$

where the inequality holds by expression (6). Hence, the optimal contract terms of processor  $i$  specifies a wholesale price above the non-contracted wholesale market price for the processed good,  $r_i^* > P_i^w$ ,  $i=1,2$ .

To compensate the retailer for the higher expense on wholesale transactions, the optimal contract terms specify a positive lump-sum payment. The optimal level of the slotting allowance,  $S_i^*$ , is given by (7) as

$$S_i^* = (r_i^* - P_i^w) f_i(x_i^*) > 0, \quad i=1,2. \quad (11)$$

A slotting allowance is an attractive arrangement for an oligopsonistic firm. Through the use of the optimal slotting allowance (10), the processor is able to support a higher wholesale price in its contract with a retailer, which, in turn, shifts the processor's marginal value product function outward relative to the rival processor in the farm product market. This shift increases the marginal profitability of farm input procurement for the contracted firm. In total, of course, the direct contribution of the higher wholesale price to the processor's profit is exactly offset by the payment of the slotting fee. Nonetheless, the outward shift in its marginal value product function alters the set of credible actions for the processor in its rivalry for the oligopsony input. A higher wholesale price purchased with a compensatory slotting allowance changes the reaction

function of the contracted processor, thereby allowing the processor to commit to a higher procurement level that increases its oligopsony rent.

The formal structure of the precommitment mechanism derived above is similar to the form of the optimal contract design in the vertical separation literature (see, e.g., Lin, Bonanno and Vickers, Coughlin and Wernerfelt, Shaffer, Kühn, and Hamilton and Stiegert). A slotting allowance that supports a higher wholesale price for the processor is a commitment mechanism that creates an *ex post* beneficial expansion in its level of farm product procurement. Through use of this mechanism, the payment of a slotting allowance alters the non-cooperative oligopsony equilibrium in favor of the contracted processor.

Because the processors face similar market incentives, the noncooperative Nash contract equilibrium is characterized by the multilateral use of slotting allowances. Nonetheless, the noncooperative Nash contract equilibrium is jointly sub-optimal for the processors. The joint profit level of the two processors would be higher if slotting allowances were reduced below the Nash equilibrium levels. If one processor chooses not to pay a slotting allowance, however, it cannot expect to deter the rival processor from paying a slotting allowance to secure a relatively higher wholesale price. The non-contracting processor, in this case, would be worse off than if it had joined the contract game.

### **3. Surplus Implications**

The noncooperative Nash contract equilibrium has the following producer surplus consequences.

*Proposition 2. At the noncooperative Nash contract equilibrium:*

- (i) the joint profitability of food processors would increase if slotting allowances were reduced;*
- (ii) farm surplus would decrease if slotting allowances were reduced.*

*Proof.* First note by (7) that the equilibrium level of the slotting allowance by each processor increases monotonically with the contract price. Therefore, it is sufficient to show that joint

profitability of food processors would rise, and farm surplus would fall, in response to a decrease in the wholesale contract prices.

For part (i), the joint processor profit function is  $\Pi(r_1, r_2) = \pi^1(r_1, r_2) + \pi^2(r_1, r_2)$ . Since  $\frac{\partial \pi^i(r_1, r_2)}{\partial r_i} = 0$  at the Nash equilibrium point, it follows that

$$\frac{\partial \Pi(r_1^*, r_2^*)}{\partial r_i} = (P_j^w - r_j^*) f_j'(x_j^*) \frac{\partial x_j(r_1^*, r_2^*)}{\partial r_i} - x_j^* W'(X^*) \frac{\partial x_i(r_1^*, r_2^*)}{\partial r_i}, \quad i=1,2.$$

Substituting in for  $(P_j^w - r_j^*) f_j'(x_j^*)$  from (10) and gathering terms yields

$$\frac{\partial \Pi(r_1^*, r_2^*)}{\partial r_i} = x_j^* W'(X^*) \frac{\partial x_i(r_1^*, r_2^*)}{\partial r_i} \left[ \left( \frac{\partial x_i(x_i^*, X^*)}{\partial x_j} \right) \left( \frac{\partial x_j(x_j^*, X^*)}{\partial x_i} \right) - 1 \right], \quad i=1,2, \quad (12)$$

which is negative by (1), (4), and (6). Hence, a reduction in  $r_i^*$ ,  $i=1,2$ , increases the joint profitability of food processors.

For part (ii), farm surplus at the noncooperative Nash equilibrium point is given by

$$G(r_1^*, r_2^*) = W(X^*) X^* - \int_0^{X^*} W(z) dz.$$

It follows that

$$\frac{\partial G(r_1^*, r_2^*)}{\partial r_i} = W'(X^*) X^* \left( \frac{\partial X(r_1^*, r_2^*)}{\partial r_i} \right), \quad i=1,2, \quad (13)$$

which is positive by (1), (4), and (5). A reduction in  $r_i^*$ ,  $i=1,2$ , would decrease farm surplus.

Relative to the baseline case without slotting allowances, the noncooperative Nash contract equilibrium involves larger farm surplus. This is because the higher wholesale price negotiated by each food processor in its contract increases the total level of input procurement in the farm product market, which correspondingly increases the equilibrium farm price.

Figure 2 demonstrates the effect of a unilateral slotting allowance contract on total surplus in the vertical market system. The figure depicts the special case of linear farm supply, homogeneous products, and pure processor intermediation,  $f_i(x_i) = x_i$ ,  $i=1,2$ . In the figure,  $W_R^n(x_1^n) = W_R^n(X^n - x_2^n)$  and  $W_R^c(x_1^c) = W_R^c(X^c - x_2^c)$  denote the (inverse) residual farm supply function facing processor 1 in the non-contracted and contracted case, respectively, where each residual supply function is obtained by shifting the farm supply function to the left (by either  $x_2^n$

or  $x_2^c$  units). A unilateral arrangement by processor 1 for a slotting allowance has a beneficial profit effect for processor 1, because the higher contract price reduces the equilibrium level of farm product procurement by processor 2 through expression (5). This effect is shown in the figure by the outward shift in residual supply in the contracted case. The marginal outlay schedule corresponding to each residual farm supply function defines processor 1's reaction function in each case, which is denoted in the figure by  $R_1^n(x_2^n)$  in the non-contracted case and  $R_1^c(x_2^c)$  in the contracted case.

As a benchmark for the effect of slotting allowances on farm surplus, consider the case of a competitive raw product market. This situation is depicted by the market quantity,  $X^*$ , which is where the farm supply function,  $W(X)$ , equates with the non-contracted wholesale product price,  $P^w$ . Under a non-contracted oligopsony configuration, the equilibrium level of farm product use for processor 1,  $x_1^n$ , is determined by the intersection of the marginal outlay schedule  $R_1^n(x_2^n)$  with the wholesale price,  $P_w$ , which results in an equilibrium farm price of  $W^n$  and a total level of input procurement of  $X^n$ . The effect of a contractual arrangement by processor 1 to pay a positive slotting allowance results in the two effects shown in Figure 2: (i) the contract provides processor 1 with a relatively higher wholesale price,  $r_1 > P_w$ ; and (ii) the higher wholesale price shifts the reaction function of processor 1 outward from  $R_1^n(x_2^n)$  to  $R_1^c(x_2^c)$ . The equilibrium level of farm product use by processor 1 in the contracted case,  $x_1^c$ , is determined by the intersection of  $R_1^c(x_2^c)$  with the contract price,  $r_1$ , which results in an equilibrium farm price of  $W^c$  and a total level of farm product procurement given by  $X^c$ . Ignoring distributional considerations, the lump-sum transfer from processor 1 to its retailer(s) has no welfare effect; hence, the welfare gain under the slotting allowance is the shaded region of the figure.

In general, it is possible for processor 1's slotting allowance to decrease market surplus in the food system; however, this is only possible under extreme forms of asymmetry in the processing technology. Suppose, for instance, that processor 2 is the more cost-efficient food processor in the sense that  $f_2'(\bar{x}) > f_1'(\bar{x})$  and  $f_2''(\bar{x}) > f_1''(\bar{x})$  for all  $\bar{x}$ . Under these circumstances, if processor 1 writes a contract for a higher wholesale price, then there are two

countervailing effects on vertical market surplus. First, the total level of farm product use increases, which has a positive effect on economic surplus, but, second, the aggregate output increase is realized through a redistribution of production from the relatively low-cost processor to the high-cost processor, which reduces allocative efficiency. In the case of pure processor intermediation depicted in Figure 2, this latter effect of redistributing production between the two processors has no welfare implications. Nonetheless, if the processing technology differs substantially across food processors, it is conceivable that the loss in processing efficiency could swamp the positive farm surplus effect associated with the output increase.<sup>3</sup>

In a symmetric processor configuration,  $f_i(.) = f(.)$ ,  $i = 1, 2$ , the noncooperative Nash contract equilibrium is associated with a positive welfare effect in the vertical market system. The pro-competitive effect of slotting allowances in this case is summarized as follows.

*Proposition 3. At a noncooperative Nash contract equilibrium with symmetric food processors, total surplus in the vertical market system would fall if slotting allowances were reduced.*

*Proof.* Total surplus in the vertical system is  $S(r_1, r_2) = \Pi(r_1, r_2) + G(r_1, r_2)$ . At the noncooperative Nash equilibrium, the effect of a change in the wholesale price of processor  $i$  on total surplus is given by the sum of effects in (12) and (13). Combining these expressions yields

$$\frac{\partial S(r_1^*, r_2^*)}{\partial r_i} = W'(X^*) \frac{\partial x_i(r_1^*, r_2^*)}{\partial r_i} \left[ x_i^* \left( 1 + \frac{\partial x_j}{\partial x_i}(x_j^*, X^*) \right) + x_j^* \frac{\partial x_j}{\partial x_i}(x_j^*, X^*) \left( 1 + \frac{\partial x_i}{\partial x_j}(x_i^*, X^*) \right) \right].$$

Letting  $x_i^* = x^*$ ,  $i = 1, 2$ , denote the level of farm product procurement by each processor in a symmetric oligopsony configuration, and noting that  $\frac{\partial x_i}{\partial x_j}(x_i^*, X^*) = \frac{\partial x_j}{\partial x_i}(x_j^*, X^*)$  in the

symmetric case, this equation reduces to

$$\frac{\partial S(r_1^*, r_2^*)}{\partial r_i} = x^* W'(X^*) \frac{\partial x_i(r_1^*, r_2^*)}{\partial r_i} \left( 1 + \frac{\partial x_j}{\partial x_i}(x_j^*, X^*) \right)^2,$$

which is positive by (4).

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<sup>3</sup> Note, however, that this result cannot hold for processor 2. We have defined processor 2 to be the relatively cost-efficient processor; hence, a slotting allowance by processor 2 unambiguously increases welfare.

In a symmetric processor configuration, the noncooperative Nash contract equilibrium is associated with pro-competitive effects in the food system. Relative to the case of wholesale grocery transactions that do not involve slotting allowances, the joint profitability of food processors is lower, but the level of farm surplus is higher, and total surplus in the vertical market system is larger under an arrangement in which positive slotting allowances are paid.

The market equilibrium that supports each of the propositions above is sub-game perfect. Nonetheless, in dynamic processor games it is possible that trigger strategies could be employed to avoid the profit-reducing effect of positive slotting allowances. The collusive outcome can be analyzed as follows. Let  $x_i^m = x_i(r_1^m, r_2^m)$ ,  $i=1,2$ , denote the joint profit maximizing levels of farm input procurement, where  $r_i^m$  are the joint profit maximizing wholesale prices. The solution to the cooperative profit maximization problem provides the following result.

*Proposition 4. The cooperative solution that maximizes joint processor profit is characterized by negative slotting allowances.*

*Proof.* At the jointly optimal solution,  $\frac{\partial \Pi(r_1^m, r_2^m)}{\partial r_i} = 0$ ,  $i = 1, 2$ , where

$$\frac{\partial \Pi(r_1, r_2)}{\partial r_i} = \frac{\partial \pi^1(r_1, r_2)}{\partial r_i} + \frac{\partial \pi^2(r_1, r_2)}{\partial r_i}.$$

Making use of (3), the joint optimum simultaneously solves

$$\left[ (P_1^w - r_1) f_1'(x_1) - x_1 W'(X) \right] \frac{\partial x_1(r_1, r_2)}{\partial r_1} + \left[ (P_2^w - r_2) f_2'(x_2) - x_2 W'(X) \right] \frac{\partial x_2(r_1, r_2)}{\partial r_1} = 0. \quad (14)$$

and

$$\left[ (P_1^w - r_1) f_1'(x_1) - x_1 W'(X) \right] \frac{\partial x_1(r_1, r_2)}{\partial r_2} + \left[ (P_2^w - r_2) f_2'(x_2) - x_2 W'(X) \right] \frac{\partial x_2(r_1, r_2)}{\partial r_2} = 0. \quad (15)$$

By inspection of (14) and (15), the unique solution to this problem is

$$P_1^w - r_1^m = \frac{x_1^m W'(X^m)}{f_1'(x_1^m)} > 0, \quad \text{and} \quad P_2^w - r_2^m = \frac{x_2^m W'(X^m)}{f_2'(x_2^m)} > 0.$$

Thus, the joint profit maximizing contract prices are set below the non-contracted wholesale

prices. Accordingly, the levels of the slotting fees that maximize joint processor profit are

$$S_1^m = -x_1^m W'(X^m) \frac{f_1(x_1^m)}{f_1'(x_1^m)} < 0, \quad \text{and} \quad S_2^m = -x_2^m W'(X^m) \frac{f_2(x_2^m)}{f_2'(x_2^m)} < 0.$$

In a collusive situation, the processors maximize joint profit by establishing contract terms with retailers that stipulate negative slotting allowances in exchange for lower wholesale prices. A reduction in the wholesale price induces a downward shift in the marginal value product function of each processor for the farm input, which increases the joint oligopsony rent by reducing procurement levels and depressing farm prices towards the monopsony level.

It is interesting to note that, in some cases, large food manufacturers have claimed not to pay slotting allowances.<sup>4</sup> The above proposition is consistent with this outcome in the case of repeated market interaction, provided that the decision to not employ a slotting fee is reciprocated by rival manufacturers with market power in a common raw product market.

#### 4. Extension to Consumer Market(s)

Thus far, the analysis has suppressed market contact between grocery retailers and consumers. The goal of this section is to establish a formal link to the downstream consumer market(s).

Consider a single grocery retailer who faces downward-sloping demand for differentiated processed product  $i$ . In particular, suppose inverse demand for product  $i$  in the retail market is given by  $P_i^R(Y)$ , where  $Y$  is a vector of substitute and complementary goods, a subset of which may be produced by rival processors that procure farm inputs in a common raw product market. For analytic convenience, attention is confined to the case in which a single retailer stocks a single product for each of the two processors. Consequently, the vector of retail goods can be written as  $Y = (y_1, y_2)$ , where all other arguments are suppressed. The retail (inverse) demand functions are assumed to be differentiable and satisfy the following properties:

$$\frac{\partial P_i^R(Y)}{\partial y_i} < 0, \quad \text{and} \quad \left| \frac{\partial P_i^R(Y)}{\partial y_i} \right| \geq \left| \frac{\partial P_i^R(Y)}{\partial y_j} \right|. \quad (16)$$

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<sup>4</sup> A notable example is Proctor & Gamble.

Inverse demand for each retail brand slopes downward and, on the margin, a quantity change by brand  $i$  has a (weakly) greater effect on the brand  $i$  price than a quantity change by brand  $j$ . In the case of perfectly substitutable (homogeneous) retail products, the latter expression in (16) is met with equality; in all other circumstances the inequality is strict.

It is interesting to note that the possibility exists for rival food manufacturers to purchase a homogeneous, perfectly substitutable raw product in a common upstream market, but produce complementary processed goods in the retail market. For example, inputs of corn can be used to produce both tortillas and margarine. Given the specification of inverse retail demand, the processed products are substitutes if  $\partial P_i^R(Y)/\partial y_j < 0$  and complements if  $\partial P_i^R(Y)/\partial y_j > 0$ .

Next, consider the effect of a slotting allowance by food processor  $i$  on retail prices. The slotting contract, which, as described above, influences the input procurement levels of each processor, potentially changes retailer profitability through price and quantity effects in each consumer market. In particular, letting  $Y^c = (f_i(x_i^c), f_j(x_j^c))$  denote the retail quantity vector associated with the procurement stage solutions, the retail price effects of a slotting allowance by processor  $i$  are

$$\frac{dP_i^R(Y^c)}{dr_i} = \frac{\partial P_i^R(Y^c)}{\partial y_i^c} f_i'(x_i^c) \frac{\partial x_i^c}{\partial r_i} + \frac{\partial P_i^R(Y^c)}{\partial y_j^c} f_j'(x_j^c) \frac{\partial x_j^c}{\partial r_i} < 0, \quad (17)$$

and

$$\frac{dP_j^R(Y^c)}{dr_i} = \frac{\partial P_j^R(Y^c)}{\partial y_i^c} f_i'(x_i^c) \frac{\partial x_i^c}{\partial r_i} + \frac{\partial P_j^R(Y^c)}{\partial y_j^c} f_j'(x_j^c) \frac{\partial x_j^c}{\partial r_i}, \quad (18)$$

in markets  $i$  and  $j$ , respectively. In (17), the first term is the direct effect of an increase in the procurement level of processor  $i$  on retail price  $i$ , which is negative by (4). The second term is the indirect effect on retail price  $i$  that arises from the output reduction of processor  $j$  in (5). The indirect effect is negative if brands  $i$  and  $j$  are complements, but positive if brands  $i$  and  $j$  are substitutes. In either case, the sum of the direct and indirect effects in (17) is positive by (16). In expression (18), a slotting allowance by processor  $i$  reduces the output of processor  $j$ , which has a positive direct effect on the price of product  $j$ . The indirect effect in (18) is positive if brands  $i$

and  $j$  are complements and negative if brands  $i$  and  $j$  are substitutes. Overall, the sum of the two effects in (18) is ambiguous. For complementary products and for sufficiently differentiated substitute products, the retail price of brand  $j$  increases in response to a slotting allowance by processor  $i$ ; however, for relatively non-differentiated substitutes, the retail price of brand  $j$  decreases in response to a slotting contract by processor  $i$ . In the case of homogeneous retail products, for example, a slotting allowance by processor  $i$  increases the aggregate quantity of the retail good sold in the supermarket, which reduces the (common) retail price of both “brands”.

The consumer surplus implications of slotting allowances are encompassed by the price effects in (17) and (18). To see this, let  $V(y_1^*(r_1, r_2), y_2^*(r_1, r_2))$  denote the indirect utility of a representative consumer in the retail market. Evaluating this expression at the noncooperative Nash equilibrium point and applying the envelope theorem yields,

$$\frac{dV(r_1^*, r_2^*)}{dr_i} = -\lambda^* \left[ y_i^* \frac{dP_i^R(Y^*)}{dr_i} + y_j^* \frac{dP_j^R(Y^*)}{dr_i} \right], \quad (19)$$

where  $\lambda^* > 0$  is the marginal utility of money income. If the term in the square brackets of (19) is negative, then the expenditure level necessary to procure the original consumption bundle decreases and consumer surplus, commensurately, increases. The implication of a slotting allowance for consumer surplus is therefore determined by the quantity-weighted sum of the price effects in (17) and (18). In the case of homogeneous retail products, both price effects are negative and it follows that consumer surplus unambiguously increases in response to a slotting allowance by processor  $i$ , and, in general, a slotting allowance by processor  $i$  tends to increase consumer surplus through the positive effect of the contract on the aggregate level of farm product procurement. Nonetheless, it is conceivable that a slotting allowance by processor  $i$  reduces consumer surplus. For example, consider the case in which brand  $i$  and brand  $j$  are complements. In this case, a slotting allowance by processor  $i$ , which decreases the price of brand  $i$  but increases the price of brand  $j$ , can reduce consumer surplus if  $y_i^*$  is sufficiently small relative to  $y_j^*$ . However, the possibility of such a perverse outcome for consumer surplus requires a sufficient degree of asymmetry in the retail market and can only hold for the case of a

slotting allowance for the relatively less desirable retail good.

In a symmetric processor configuration, the noncooperative Nash contract equilibrium is associated with positive consumer surplus effects.

*Proposition 5. At a noncooperative Nash contract equilibrium with symmetric food processors, consumer surplus in the retail markets would fall if slotting allowances were reduced.*

*Proof.* Let  $x_i^* = x^*$ , and  $y_i^* = y^*$ ,  $i=1,2$ , denote the equilibrium level of farm product use and output by each processor in a symmetric market configuration and note that symmetric retail conditions imply that  $\partial P_i^R(Y^*)/\partial y_i = \partial P_j^R(Y^*)/\partial y_j$  and  $\partial P_i^R(Y^*)/\partial y_j = \partial P_j^R(Y^*)/\partial y_i$ .<sup>5</sup> Making use of these conditions, substitution of (17) and (18) into (19) yields

$$\frac{\partial V(r_1^*, r_2^*)}{\partial r_i} = -\lambda^* \left[ y^* f'(x^*) \frac{\partial x_i^*(r_1^*, r_2^*)}{\partial r_i^*} \left( \frac{\partial P_i^R(Y^*)}{\partial y_i} + \frac{\partial P_i^R(Y^*)}{\partial y_j} \right) \left( 1 + \frac{\partial x_j}{\partial x_i}(x_j^*, X^*) \right) \right] > 0,$$

where the inequality holds by (1), (4), and (6).<sup>6</sup>

In a symmetric processor configuration, the noncooperative Nash contract equilibrium entails positive implications for consumer surplus, the magnitude of which increases with the degree of substitutability between retail brands. For the remainder of this section, attention is confined to the case in which a slotting allowance by processor  $i$  increases consumer surplus.

Under what set of retail market conditions is a slotting contract a favorable arrangement for a food processing firm? To assess the various features that motivate a food processor to propose a slotting allowance, it is sufficient to identify the circumstances in which an incentive exists to depart from the non-contracted wholesale price in a two-part tariff structure.<sup>7</sup>

The marketing problem facing a multi-product retailer is interesting and important in its own right. However, to maintain the present focus on food processor behavior, the retailer's

<sup>5</sup> For substitute products, these equilibrium restrictions imply a structure that is equivalent to that in the symmetric substitutes model used to analyze monopolistic competition in retail markets (see, e.g., Dixit and Stiglitz).

<sup>6</sup> Note that the stability condition on retail demand (16) is met with a strict inequality only in the case of perfect substitutes, in which case the change in consumer surplus in this expression is at its maximum point.

<sup>7</sup> Calibrating the analysis to an initial non-contracted position is also useful in that it illustrates the types of market features that may have led to the emergence of slotting allowances in supermarkets.

problem is framed here with a minimal amount of structural detail. Consider a retailer that faces constant marginal cost of \$c per unit for each product stocked. The retailer has positive fixed costs that are shared jointly, though perhaps not recovered symmetrically, across the two products. Suppose a solution exists to the retailer's problem that is characterized by some equilibrium level of profit given by

$$\hat{\pi}_i^R(\hat{y}_i, \hat{Y}, P_i^w) = (P_i^R(\hat{Y}) - P_i^w)\hat{y}_i \equiv \hat{M}_i, \quad i = 1, 2, \quad (20)$$

in market  $i$ , where  $\hat{M}_i$  is the retailer's market return on product  $i$  and  $\hat{Y} = (\hat{y}_1, \hat{y}_2)$  is the vector of equilibrium retail quantities that coincide with the initial non-contracted wholesale price ( $r_i = P_i^w$  and  $S_i = 0$ ).<sup>8</sup> Marginal cost, which is constant, can be subsumed into retail demand without loss of generality.

At the initial non-contracted wholesale price, the retailer is willing to accept a contract proposed by processor  $i$  whenever the slotting allowance provides a total return in the retail market that (at least weakly) exceeds the sum of the reservation profit levels across processed goods in (20). Accordingly, the retailer accepts the contract proposed by processor  $i$  when

$$(P_i^R(Y) - r_i)y_i + S_i + (P_j^R(Y) - P_j^w)y_j \geq \hat{M}_1 + \hat{M}_2. \quad (21)$$

Processor  $i$  chooses the terms of the slotting allowance so as to maximize profits in (2) subject to the participation constraint (21) and the procurement stage solutions. Specifically, the contracting problem facing processor  $i$  is

$$\begin{aligned} & \underset{r_i, S_i}{\text{Max}} r_i f_i(x_i^c) - W(X^c)x_i^c - S_i \\ \text{s.t. } & (P_i^R(Y^c) - r_i)f_i(x_i^c) + S_i + (P_j^R(Y^c) - P_j^w)f_j(x_j^c) - (\hat{P}_i^R - P_i^w)\hat{y}_i - (\hat{P}_j^R - P_j^w)\hat{y}_j \geq 0. \end{aligned}$$

Because the optimal processor contract meets the participation constraint with equality, differentiating this expression with respect to  $r_i$  gives

$$\frac{d\pi_i(r_i)}{dr_i} = y_i^c \frac{dP_i^R}{dr_i} + y_j^c \frac{dP_j^R}{dr_i} + (P_i^R f_i' - W - x_i^c W') \frac{\partial x_i^c}{\partial r_i} + ((P_j^R - P_j^w) f_j' - x_i^c W') \frac{\partial x_j^c}{\partial r_i}, \quad (22)$$

where the arguments have been dropped for compactness. A contract that specifies a positive

<sup>8</sup> Possible interpretations of the retailer problem include Ramsey optimization, in which the sum of marketing returns across products recovers supermarket fixed costs, and multi-product retail monopoly (or oligopoly).

slotting fee in exchange for a higher wholesale price increases the profit of processor  $i$  whenever the sum of the four terms in expression (22) is positive. Notice that the sum of the first two terms, which is negative, depends on the magnitude of the (positive) change in consumer surplus. A slotting allowance that induces downward movements in the retail prices increases consumer surplus, but also proportionally increases the amount of compensation necessary to meet the retailer participation constraint in (21). In general, the market features that support slotting allowances as a processor-motivated outcome can be summarized as follows.

*Proposition 6. A food processor's incentive to pay a slotting allowance increases with:*

- (i) *the magnitude of the retail margin on its product;*
- (ii) *the elasticity of consumer demand for its product;*
- (iii) *the degree of oligopsony power in the farm product market.*

*Proof.* Substituting the procurement stage solutions (3) into (22) and evaluating this expression at the non-contracted wholesale price position (i.e.,  $x_i = \hat{x}_i^c$ ,  $y_i = \hat{y}_i$ ,  $\hat{r}_i = P_i^w$ ,  $\hat{S}_i = 0$ , and  $P_i^R(\hat{Y}^c) = \hat{P}_i^R$  for  $i = 1, 2$ ), processor  $i$  has an incentive to pay a positive slotting allowance when

$$\left(\hat{P}_i^R - P_i^w\right) f_i' \frac{\partial x_i^c}{\partial r_i} + \left(\hat{P}_j^R - P_j^w\right) f_j' \frac{\partial x_j^c}{\partial r_i} + \hat{y}_i^c \frac{dP_i^R}{dr_i} + \hat{y}_j^c \frac{dP_j^R}{dr_i} - \hat{x}_i^c W' \frac{\partial x_j^c}{\partial r_i} > 0. \quad (23)$$

The first two terms in (23) are retail margin effects. The first term is positive, as the increase in product  $i$  output under a slotting contract increases retailer rent in proportion to the size of the existing retail margin on product  $i$ . The magnitude of this increase in rent reduces the compensation necessary to meet the participation constraint in (21). The second term, which is negative, captures the corresponding contract adjustment necessary to compensate the retailer for the revenue loss in response to the decrease in the retail quantity of product  $j$ . The marginal gain (loss) from a quantity increase (decrease) in each retail market is proportional to the size of the existing retail margin. For the case of homogeneous products, the sum of the retail margin effects is unambiguously positive, as a slotting contract by processor  $i$  increases aggregate output. In general, the sum of the retail margin effects in markets  $i$  and  $j$  is positive unless a

sufficiently large difference exists in processor production technology and/or the initial magnitude of the retail margins.

The third and fourth terms in (23) capture the retail price effects of a slotting allowance by processor  $i$ . The sum of these two terms, which is inversely related to the consumer surplus effect in (19), is negative, with a magnitude that increases with the slopes of the inverse demand expressions on the right-hand side of (17) and (18). Because a slotting allowance has a relatively small effect on the retail price under elastic demand conditions, the payment necessary to induce retailer participation in a contract proposed by firm  $i$  decreases with the elasticity of market demand for product  $i$ . Consequently, the incentive for a slotting allowance by processor  $i$  tends to increase as the retail demand function for product  $i$  becomes more elastic at each marketing location (e.g., as the degree of retail competition increases across locations).<sup>9</sup> In the limiting case of infinitely elastic retail demands, these terms, as well as the margin effects captured by the first two terms in (23), vanish. In this case, the relevant “margin” for the retailer is the deviation in contracted and non-contracted wholesale prices, which, evaluated at the noncooperative Nash contract equilibrium position, yields (10).

The final term in (23) is the oligopsony incentive for slotting allowances captured by the effect of the contract on the procurement level of the rival processor. The magnitude of this effect increases as the farm supply function becomes more inelastic.

In light of these market conditions, an important question is whether changes in the characteristics of the food system provide some justification for the recent emergence of slotting allowances in the mid-1980s? There is a sense in which they do. In the 1961-86 period that largely preceded the emergence of slotting allowances, Sullivan provides evidence that the gross retail margin increased across all products sold in supermarkets. It is also widely recognized that the period preceding slotting allowances is characterized by considerable technological change in the farm sector. To the extent that technological change in farming reduces variable costs and

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<sup>9</sup> In practice, most slotting allowances are paid on a per-store, per-item basis.

increases fixed costs (e.g., by replacing farm labor with capital equipment), adoption of modern technology tends to make the farm supply function more inelastic.<sup>10</sup> Finally, a recent empirical study by White, Troy and Gerlich finds that slotting allowances predominantly occur in product classes with a large degree of retail competition, a circumstance that suggests relatively elastic retail demand conditions.

## **5. Discussion and Empirical Implications**

The observed structure of slotting allowances in wholesale grocery transactions is consistent, in many cases, with the contract design problem of a food-processing firm. The central observation that supports this result is that the payment of a slotting allowance allows a food processor to shift rent in the farm product market by contracting for a retailer concession that induces an upwards shift in its marginal value product function (i.e., a higher wholesale price).

In wholesale grocery transactions, slotting allowances are often paid by food processors in exchange for other retailer concessions besides a higher wholesale price. Slotting allowances are also paid in return for various other retailer concessions, such as to acquire a relatively more desirable shelf position in the supermarket (e.g., at chest level on an aisle) or to establish an exclusive dealing arrangement. Nonetheless, to the extent that these forms of retailer concessions induce an outward shift in the marginal value product function for the contracted processor, qualitatively similar predictions would arise.

For certain contract forms, a processor may be able to use a slotting allowance to establish a unilateral commitment mechanism. The obvious example is a contract that stipulates exclusive dealing, which, at least potentially, forecloses a dominant share of the retail channel to the rival processors. Similarly, if the quantity of a processed good sold at a given price is a function of product placement in the retail store, preferential shelf-space arrangements can provide another form of unilateral commitment mechanism.

The focus of the present model on processor motivations derives unique implications

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<sup>10</sup> This point was raised by Just and Chern regarding the adoption of the mechanized tomato harvester in California.

concerning the types of market conditions in which slotting allowances are likely to be observed. Unlike the case of retailer contracts, in which an incentive for a slotting allowance arises in all consumer markets characterized by retail market power, an analysis of processor contracts provides refined predictions regarding the subset of products in which incentives for slotting allowances exist. Two notable observations arise from this point. First, a necessary condition for a food manufacturer to have an incentive to pay a slotting allowance is multi-market contact at the upstream and wholesale level. In vertical markets where raw product producers sell directly to grocery retailers, there is no oligopsony incentive to shift upstream rent through the use of a slotting contract. This observation provides a testable prediction for why slotting allowances are common in certain processed product classes, but not in other product classes (such as fresh produce and in-store bakery products) where there is no intermediation between markets at the upstream level. Second, a slotting allowance is attractive for a food manufacturer in vertically structured markets in which the retail demand elasticity in the downstream market is large (in absolute value terms) relative to the farm supply elasticity in the upstream market.

Is the model consistent with observed practices in the supermarket? Unfortunately, negotiations for slotting allowances are made orally and in private; hence public data on individual transactions is virtually nonexistent. However, the theory developed here suggests an interpretation of aggregate supermarket data that is based on several relevant industry trends. In particular, critical differences between the present theory and existing models of slotting allowances are stratified in two dimensions of this data.

The observations supported by the present model contrast sharply with the predictions of retailer oligopoly models. In Shaffer's theory of retailer-mandated fees, which is closest to the approach taken here, the lens on slotting contracts is reversed in the sense that food processors (and not retailers) are driven down to their reservation profit levels by the contract terms. Positive slotting allowances and higher wholesale prices obtain identically in this case; however, the implication for market performance under retailer-designed contracts is exactly opposite to that described here. Under retailer oligopoly, a necessary condition for a slotting allowance to

increase retailer profit is that the practice supports higher retail prices, which implies that slotting contracts, to be effective, must reduce the total quantity of retail grocery sales.<sup>11</sup> Under processor oligopsony, conversely, a higher wholesale price implies a larger total quantity of retail grocery sales and non-increasing retail prices. It is therefore possible to gain insight into the nature of these contractual arrangements, in particular whether they are motivated predominantly by food processors or by grocery retailers, by examining the effect of slotting allowances on retail grocery sales and prices.

Figure 3 depicts annual U.S. grocery sales over the 1966-2000 period for all grocery stores and for supermarkets (in 1982-84 dollars adjusted by the food-at-home index). The figure shows that annual grocery sales, both in the U.S. grocery market and in U.S. supermarkets, have increased in a fairly stable manner over the period in which slotting allowances emerged.<sup>12</sup> This increase in sales has matched the general trend in U.S. resident population over the period: grocery and supermarket sales increased by 32.8% and 37.2%, respectively, compared with a growth rate of 34.2% in the U.S. resident population over the period. The stability of the trends in retail sales provides some indication that slotting allowances have not decreased the quantity of retail grocery transactions.

Table 1 compares price changes in the consumer price index (CPI) to price trends for all food and at-home food consumption, which excludes food sold in restaurant establishments. Notice that the food-at-home index has not increased relative to the CPI and overall food index in the period. These trends are consistent with a pro-competitive role for slotting allowances in the supermarket.

Among the theories that predict pro-competitive effects of slotting allowances, a unique construct of the present model is that slotting allowances arise in a structure framed by imperfect competition. The defining feature that supports slotting allowances under imperfect competition

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<sup>11</sup> The retailer contract story is difficult to reconcile with the empirical finding by White, Troy, and Gerlich, who show slotting allowances to be positively correlated with the degree of retail competition.

<sup>12</sup> The two discontinuities in the supermarket sales series reflect upward revisions in the nominal volume that defined a supermarket. In 1973, the minimum sales volume required to be classified as a supermarket increased from \$0.5 million to \$1 million, and, in 1981, it increased from \$1 million to \$2 million.

is that a lump-sum fee is paid in exchange for an increase in the wholesale grocery price. Hence, evidence to differentiate a pro-competitive role for slotting allowances under oligopsony from that derived by competitive market forces stems from changes in the dynamic profile of wholesale prices. Under an oligopsony contract outcome, wholesale prices increase and retail prices (in net) decrease, which implies a decrease in retail margins in the supermarket.

On this point, Sullivan provides a measure of the gross retail margin in time series data and finds that the gross retail margin did not decrease in the period in which slotting allowances emerged as a common grocery practice. However, two stylized facts in the grocery industry provide some indication as to why this may have occurred. First, as Sullivan points out, the period associated with non-decreasing retail margins is characterized by a rapid increase in the number of grocery products stocked. For example, between 1978 and 1987, A. C. Nielsen reports a 34.4 percent increase in the number of dry grocery items stocked and numerous trade articles report similarly high rates of growth in frozen and refrigerated items in grocery stores in the 1980s. Accordingly, it is likely that fixed costs in grocery stores have substantially increased over the period, which would indicate that the general underlying trend (in the absence of lump-sum transfers) may have been towards increased retail margins over the period. For this reason, the non-decreasing retail margins observed in supermarkets over this period are not inconsistent with contractual arrangement that re-structure wholesale grocery transactions between lump-sum and per-unit transfers. Indeed, such an inclination in retail margins would contribute to the emergence of slotting allowances according to the present theory. Second, evidence based on the gross retail margin provides only an aggregative trend across all supermarket products, for which the items exchanged with slotting allowances are a subset.

Table 2 presents a comparison of retail margins for a selection of products for which the magnitudes of slotting allowances are known. Notice that the refrigerated/frozen-foods category has higher slotting fees than the candy/snacks category, but that the margins for the refrigerated/frozen-foods category are notably smaller.

Oligopsony slotting contracts of the form considered here depend on multi-market

contact by a processor at the farm product level of the food system. To the extent that slotting allowances govern transactions in the processed product classes, it is important to compare the trends in retail margins on commodities and processed goods. Figure 4 depicts the relative trends in the gross retail margins for fresh and frozen vegetables.<sup>13</sup> The gross retail margin is taken to be the difference between the CPI and producer price index (PPI) in each product class, where the relative producer and consumer prices for each series are normalized to zero in 1978. Notice that the gross retail margin for fresh vegetables has increased substantially relative to that for frozen vegetables over the period, which is consistent with the general re-distribution of retail margins across processed goods and commodities that the model predicts.<sup>14</sup>

An alternative explanation for the trends in figure 4 is that the divergence in retail margins was driven by the proliferation of processed products in this period. To the extent that product proliferation makes retail demand (per brand) more elastic, an increase in the variety of processed products over this period would place downward pressure on gross retail margins for processed goods relative to commodities. However, an increase in the elasticity of retail demand would also provide a larger incentive for food processors to employ slotting allowances in (23), which, in light of the present model, suggests that a potentially important link may exist between slotting allowances and product proliferation in the processed product classes.

## 6. Concluding Remarks

This paper has demonstrated that slotting allowances may be motivated, not by grocery retailers, but by food processing firms. The model considered a profit maximization problem for an oligopsonistic food processor that resulted in an optimal contract design that conforms to a commonly observed practice in wholesale grocery transactions; a fixed price contract.

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<sup>13</sup> The margins for fresh and frozen vegetables are chosen for the comparison here, because, prior to 1997, the U.S. Bureau of Labor Statistics does not report price data on canned vegetables or on frozen and canned fruits.

<sup>14</sup> To the extent that increased retailer fixed costs can be attributed to the high rate of growth in frozen and refrigerated grocery products, which are relatively capital-intensive, the figure also provides evidence that cross-subsidization may have taken place between the fresh and processed product classes.

The payment of a slotting allowance by a food processor was shown to provide a commitment mechanism that allows rent-shifting to occur in the farm product market. The noncooperative Nash contract equilibrium of the model was demonstrated to involve mutual arrangements to pay slotting allowances to grocery retailers. Relative to the case of wholesale grocery transactions that do not involve slotting fees, moreover, the noncooperative Nash equilibrium was associated with superior welfare properties. For the equilibrium contractual arrangement with positive slotting allowances, farm surplus was shown to increase, and, in the case of a symmetric processor oligopsony configuration, both consumer surplus and total surplus in the vertical market system was demonstrably larger.

The results of the model were then contrasted with the structure of the optimal contract design that supports slotting allowances as a mechanism to increase retailer profits. Under each contractual arrangement, the optimal contract form specifies a higher wholesale price in exchange for a positive lump-sum transfer; however, the model implications were found to differ substantively in their predictions for retail grocery price and quantity movements. Evidence was provided to support differential trends in the retail prices of commodities and processed products in a fashion that is consistent with the present theory.

The model results raise interesting opportunities for future research into the nature of wholesale grocery transactions, particularly with regard to the optimal design of bilateral processor-retailer contracts. Under circumstances of bilateral contract design, the essential incompatibility between retailer and processor incentives for slotting allowances is the determination of an agreeable output level. A contract that specifies a higher wholesale price allows oligopsony rent-shifting only to the extent that processed output increases, whereas considerations of retailer profitability suggest the use of contractual arrangements as an instrument for output reduction.

The solution to this bilateral contracting problem may provide important insight into other observed trends in the grocery industry. For example, a contractual arrangement for a slotting allowance can increase the output of an individual processor and concurrently decrease

retail output through the specification of an exclusive-dealing contract that forecloses a dominant share of the retail grocery market to rival food processors. Alternatively, it may be possible to support bilateral contractual arrangements that involve multiple processors through product-line expansion of processed goods in the retail market. To the extent that consumer utility increases with product variety, it may be possible to sustain simultaneous increases in retail prices and quantity through the proliferation of processed goods. In this sense, facilitating practices in the upstream farm product market can provide additional incentives for the diversification of product varieties. Future analyses of optimal bilateral contractual arrangements along these lines may provide important insights to link the coincident trends toward slotting allowances and product proliferation in the processed product classes.

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Figure 1. The Timing of the Game

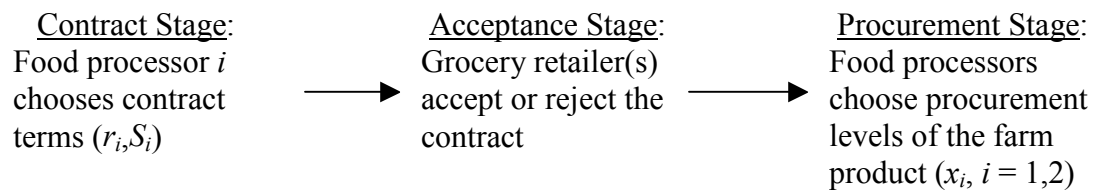
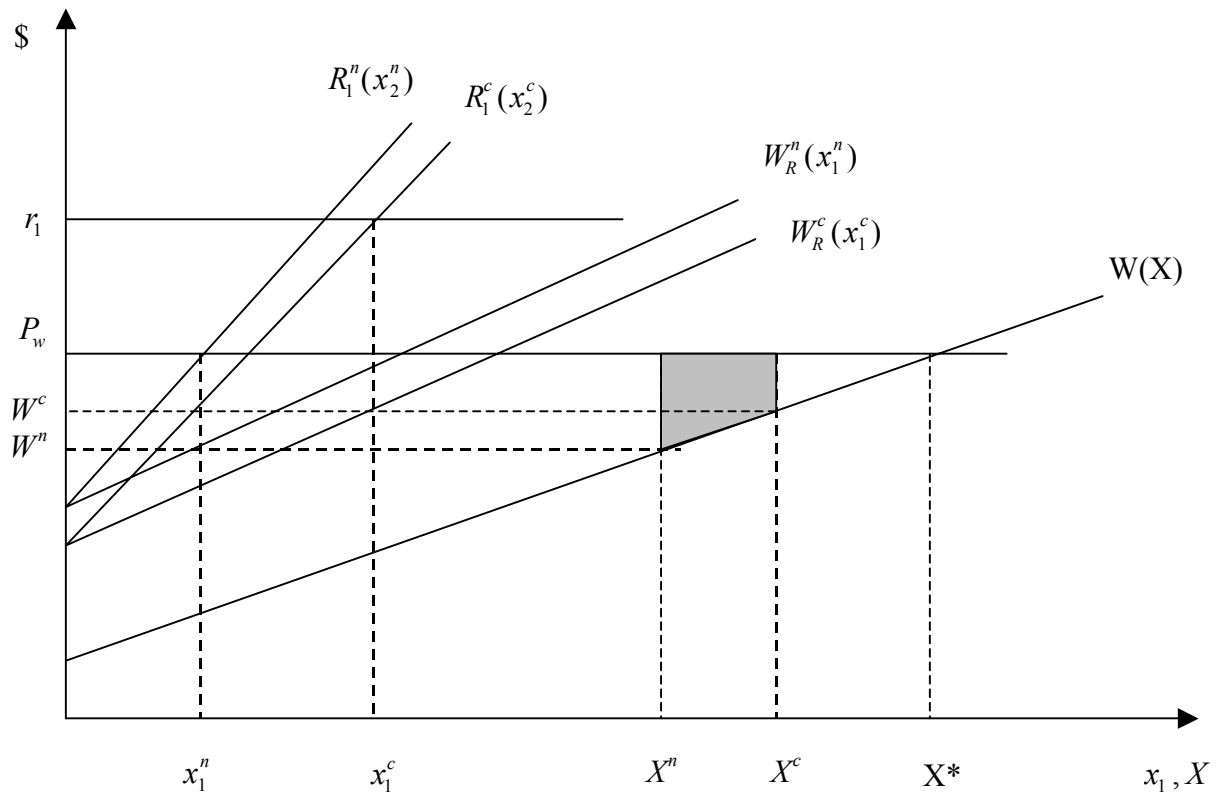
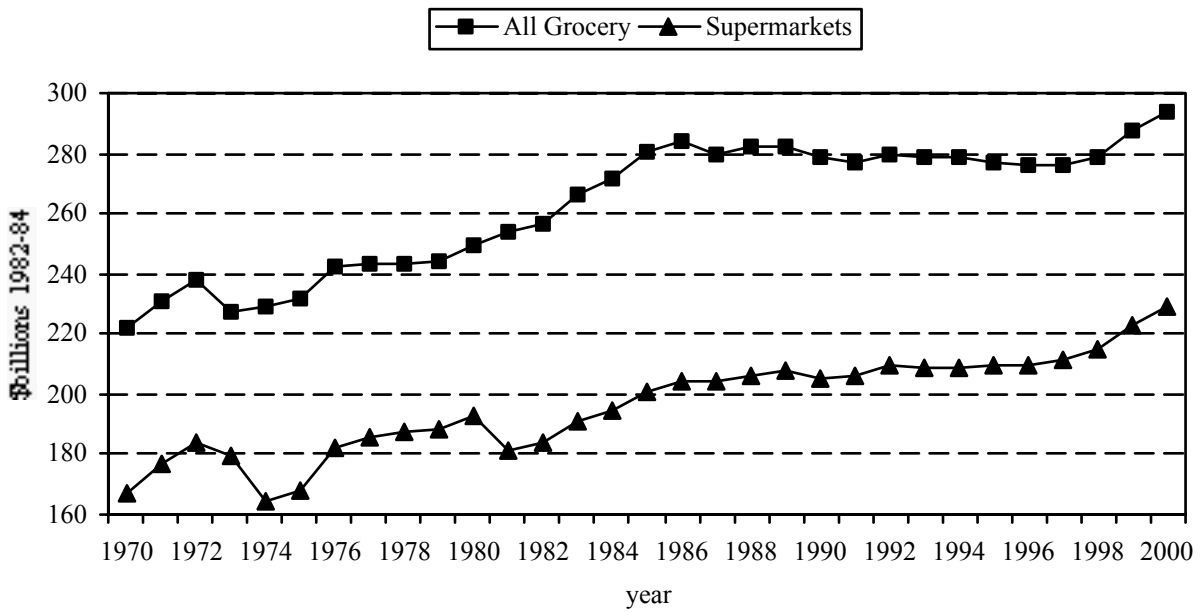


Figure 2. Residual Supply and the Farm Surplus Implication of a Slotting Allowance.



**FIGURE 3. Annual Grocery Sales in Billions of 1982-84 dollars.**

Source: Progressive Grocer, *Annual Report of the Grocery Industry* (April, 1971-2001).



**FIGURE 4. Percentage Change in Marketing Margins for Fresh and Frozen Vegetables, 1978-2000.** Source: U.S. Bureau of Labor Statistics  
(<http://stats.bls.gov/sahome.html>).

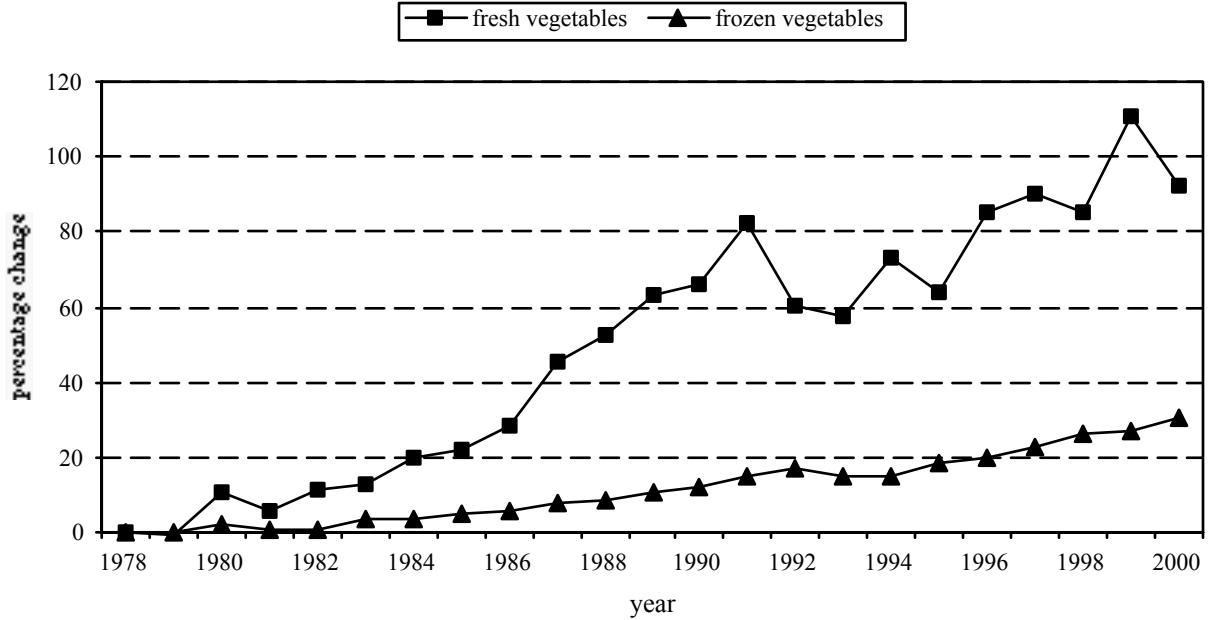


TABLE 1. The CPI, Food, and Food-at-Home Indexes

Year	CPI	Food	FAH
1966	100.0	100.0	100.0
1967	103.1	100.9	99.7
1968	107.4	104.4	103.1
1969	113.3	109.8	108.0
1970	119.8	116.0	113.4
1971	125.0	119.5	116.2
1972	129.0	124.6	121.3
1973	137.0	142.6	141.2
1974	152.2	163.0	162.2
1975	166.0	176.9	175.6
1976	175.6	182.2	179.3
1977	187.0	193.8	189.8
1978	201.2	213.0	209.7
1979	224.1	236.4	232.4
1980	254.3	256.8	251.1
1981	280.6	276.9	269.3
1982	297.8	288.2	278.7
1983	307.4	294.1	281.5
1984	320.7	305.3	292.0
1985	332.1	312.4	296.3
1986	338.3	322.5	304.8
1987	350.6	335.8	317.9
1988	365.1	349.7	331.3
1989	383.0	370.1	352.8
1990	403.4	391.7	375.9
1991	420.4	403.3	385.8
1992	433.0	408.0	388.6
1993	446.0	416.9	398.0
1994	457.4	426.9	409.4
1995	470.4	439.1	422.7
1996	484.3	453.6	438.4
1997	495.4	465.4	449.1
1998	503.1	475.4	457.7
1999	514.2	485.5	466.5
2000	531.5	496.4	477.0

SOURCE: U.S. Bureau of Labor Statistics  
(<http://www.bls.gov/data/sc.htm>), 2001.

NOTE: All price indexes are for all urban consumers; the U.S. city average is in 1966 dollars. CPI = the consumer price index. Food = the food index, including food at home. FAH = the food-at-home index.

TABLE 2. Sample Slotting Allowances and Retail Gross Margins, 1997.

Category	Slotting Allowance	Sub-category	Retail Gross Margin (percent)
Refrigerated and Frozen Foods	\$40,000	Dairy products	29.8
		Frozen Foods	31.7
Candy/Snacks	\$7,000	Crackers, Cookies, Biscuits	33.9
		Sweet Goods	39.2
		Chewing Gum	35.3
Instore Bakery	None		56.3

SOURCE: This table is taken from Desiraju (2001). The original source for slotting allowances was a report by the Market Research firm Clayton, Curtis, Cottrell (Boulder, CO); retail margins are from *Supermarket Business*, September, 1997.

NOTE: Slotting allowances are reported on a per item per store basis.