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A Transactions Cost Analysis of the Welfare and Output Effects of Rebates and Non-Linear Pricing

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Abstract

Ronald Coase famously exposed the limitations of economic analyses that rely upon assumptions of frictionless markets. He highlighted the importance of including transaction costs in economic analyses and issued a challenge to economists to think seriously about how transaction costs affect economic systems. Harold Demsetz, extended Coase's analysis to show how these costs alter the way firms price and market their products. Demsetz's analysis underscored that the costs of providing a market sometimes exceed the benefits of creating one in the first place and examined conditions where transaction costs imply that zero amounts of explicit market pricing will be efficient. This article extends Demsetz's insights with respect to non-linear pricing contracts that *seem* not to "price" key side effects of the economic exchange. In particular, we analyze the welfare and output effects of two examples of such contracts that are commonly used by firms that are frequently subject to antitrust scrutiny: metered pricing; and loyalty discounts. The analysis demonstrates how a firm's choice to set prices for its products are influenced by transaction and information costs and examines whether changes in output that are caused by the use of these non-linear pricing schemes are positively correlated with changes in total and consumer welfare. The article then discusses conditions under which measuring output effects can reliably differentiate between welfare-increasing and welfare-reducing uses of non-linear pricing.

Keywords Transactions costs · Non-linear pricing · Conditional discounts · Shelf-space contracts · Metering ties · Antitrust

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1 Introduction

In his seminal articles on the nature of the firm and the problem of social cost, Ronald Coase sought to expose the limitations of economic analyses that rely upon the assumption of frictionless markets. In Coase (1937, pp. 390–92) on the nature of the firm, he demonstrated that there is no reason for firms to exist in the frictionless markets that are assumed to exist in neoclassical price theory, and he highlighted the critical role that transaction costs play in determining the organization of firms and markets.

In Coase (1960, pp. 15–19) on the problem of social cost, he demonstrated that, in a world with well-defined property rights and zero transaction costs, parties would costlessly contract to eliminate any spillover effects. In such a world, the final allocation of resources is invariant to the initial assignment of property rights or choice of liability rule. The article highlighted the importance of including transaction costs in the economic analysis and issued a challenge to economists to think seriously about how the costs of exchanging goods and services affected our economic system.

No economist more diligently—or more successfully—answered Coase's challenge than our teacher and friend Harold Demsetz. Demsetz's seminal work in other areas—market structure and performance; the theory of the firm; and property rights—undoubtedly warrant significant attention. Our focus, in this article, is the extension of Demsetz's insights with regard to the implications of transaction costs for contract choice and economic efficiency. In particular, in *The Exchange and Enforcement of Property Rights*, Demsetz (1968a) explores conditions under which transaction or monitoring costs imply that zero amounts of market pricing, or the government equivalent, will be efficient—contrary to oft-applied economic intuition that the absence of a market price implies market failure. Demsetz reminds readers that the costs of providing a market—usually costs that are associated with a "side effect" that is generated by economic activity within the market—sometimes exceed the benefits of creating one.

Where transaction costs are trivial, parties will contract to eliminate any deadweight losses from monopoly (Demsetz, 1968b, pp. 33–34). One way to achieve such an outcome would be through non-linear rather than uniform pricing. Outside of the zero transaction costs world, a firm's endogenous choice of how to set prices for its products or services—including its ability to use linear versus non-linear pricing—will depend upon transaction and information costs.

Carlton and Keating (2015a, 2015b) show that transaction costs and the choice of non-linear pricing can alter the predicted effects that are produced by mergers, and alter the antitrust analysis of such transactions. They argue that antitrust analyses that ignore transaction costs and assume that uniform pricing will be used before and after a merger can be "seriously misleading."

In this article, we analyze how transaction and information costs affect how firms optimally price their products in non-merger settings. In particular, we explore Demsetz's insights with respect to contracts that *seem* not to "price" key side effects of the economic exchange.[1] We analyze two examples of the endogenous choice of non-linear pricing that are commonly used by firms and that are the frequent subject of antitrust scrutiny: a metering tie-in where the capital good (a patent) is not priced; and shelf-space contracts with conditional discounts.[2] Standard antitrust analyses of both of these contracts focus on similar mechanisms through which they can reduce allocative efficiency and consumer welfare: their use to extract surplus from consumers through price discrimination, as well as their use to disadvantage rivals and foreclose entry.[3] In contrast, our paper examines the diverse ways in which these two contracts are used in these specific settings to address transactions costs in a way that can increase consumer welfare and allocative efficiency.

Section II of the paper analyzes the welfare effects of a special case of metered tying: the use of an implied license for the capital good (in this case, a patent). In the example, a firm can sell/license a patented capital good that is used with a consumable product: e.g., a patent on a method to selectively kill weeds with an unpatented chemical.[4] The analysis examines how transaction costs that are associated with selling the capital good—and the ability of the firm to avoid them through implied licensing—alters the firm's pricing structure and results in the capital good's not being explicitly priced in equilibrium. The analysis also examines how this choice affects output and measures of welfare as transaction costs change. Section III of the paper similarly analyzes the welfare effects of using various forms of loyalty discounts—including volume discounts and market-share discounts—when contracting for retail shelf space in the presence of transaction and information costs.[5] Section IV briefly discusses the relationship between measures of output and welfare. Section V concludes.

2 Transaction Costs and Metering Ties

This section examines how transaction costs alter a firm's decision to use and structure a particular form of non-linear pricing: a metering tie.[6] In this model, we assume that a monopoly seller produces and sells a capital good – K – that is used with a consumable product: C. For example, in the *Dawson Chemical* case, K is the patent on a method to spray an unpatented chemical C (propanil) to kill weeds

[1] Demsetz (1968a, p.24) recognizes that the "activities of labeling, branding, and advertising allow for internalization of side effects by tying in the sale of information with other goods." *See also* Telser (1966) (applying Demsetz' insight to the absence of explicit pricing of advertising); Cooper (2013) (discussing the absence of explicit pricing of consumer data).

[2] *See, e.g.,* Moore & Wright (2015).

[3] *Id. See also* Economides (2012).

[4] *See Dawson Chemical v. Rohm & Haas*, 448 U.S. 176, 186, 223 (1980).

[5] *See* Carlton & Keating (2015b, pp. 311–12, 317–180.

[6] *Illinois Tool Works Inc. v. Independent Ink, Inc.*, 547 U.S. 28 (2006); *see* Kobayashi (2008, p. 23); Wright (2006, p. 335).

selectively around rice crops.[7] Individual farmers' demand for K derives from the process of using the consumable product C with K: K has no stand-alone value to consumers. It costs k to sell a unit of K, and individuals each demand one unit of K. The analysis breaks k into two components: $k=z+t$, where z is the resource cost of producing a unit of K, and t are the transaction costs of selling a unit of K. Given that K in the *Dawson Chemical* case is a method patent, there is no marginal cost of production ($z=0$), so k equals the transactions costs t that are associated with licensing the patent directly to end users of the patent.

Individual i has the following demand curve for units of the consumable product C:

$$p_i = a - b_i q_i.$$

The seller is assumed to observe a, but knows only the distribution of b. We assume that b_i are distributed $U[b^L, b^U]$, so that $f(b) = \frac{1}{b^U - b^L}$.[8]

Figure 1 illustrates the demand for the chemical C as b_i varies.[9] Units of the consumable good, C, are produced at marginal cost c. The maximal welfare available is generated when all consumers with $MGS_i > k$ purchase the capital good and obtain consumable goods at marginal cost c, where MGS_i is the maximum possible gross surplus from buyer i who consumes any units of M:

$$MGS_i = \frac{(a-c)^2}{2b_i}.$$

When $b_i=10$, the $MGS_i=405$ is depicted in the top panel of Fig. 1 by the shaded area that lies below the demand curve for consumers with $b_i=10$ and above the marginal cost curve $c=10$. Figure 1b depicts the smaller $MGS_i=40.5$ when $b_i=100$.

The individual MGS_i can be used to construct a derived market demand curve for the patent K. Figure 2 depicts the $MGS_i=(a—c)/2b_i=90^2/2b_i$ as a function of b_i when M is priced at its marginal cost of production $c=10$. The MGS_i for individuals with $b_i=10$ and $b_i=100$, which is illustrated in Fig. 1, are plotted on Fig. 2. Under the assumption that b_i is uniformly distributed $U[b^L, b^U]$, the curve that is depicted in Fig. 2 will be proportional to the derived market demand for the patent K: $D_K(b_i) \propto MGS_i=90^2/2b_i$. Without loss of generality, we will assume that $D_K(b_i)=MGS_i$.

If both the capital good, K, and the consumable good, C, are priced at the marginal costs of licensing and production—k and c, respectively—all consumers with

[7] Herbicidal 3,1-Dichloroanilides, U.S. Patent No. 3,816,092, https://patents.google.com/patent/US3816092A/en?oq=3%2c816%2c092 (a method for selectively inhibiting growth of undesirable plants in an area containing growing undesirable plants in an established crop, which comprises applying to said area 3,4-dichloropropionanilideat a rate of application which inhibits growth of said undesirable plants and which does not adversely affect the growth of said established crop). The patent cover page and abstract are illustrated in Fig. 4, below.

[8] The mean of b equals $\mu = \frac{b^U + b^L}{2}$, and the variance equals $\sigma^2 = \frac{(b^U - b^L)^2}{12}$.

[9] The figures and examples in the paper are based on an example that assumes $a=100$, and b is uniformly distributed between $[b_L=0.5, b_U=250]$. The figures also assume that $c=10$.

$$b_i \leq min(b^{C^*} = \frac{(a-c)^2}{2k}, b^U)$$

will choose to purchase a unit of the capital good. Pricing the consumable good at marginal cost c results in gross consumer surplus equal to MGS_i, so that maximal total welfare equals:

$$E(MTW) = \int_{b^L}^{bC^*} [MGS_i - k]\frac{1}{b^U - b^L}db$$
$$= \frac{(a-c)^2}{2(b^U - b^L)}\ln\left[\frac{b^{CM}}{b^L}\right] - \frac{k}{b^U - b^L}\left[b^{CM} - b^L\right].$$

2.1 Explicit Licensing (Linear Uniform Pricing)

In this section, we examine the optimal linear price of the patent—p_K—when the consumable good is competitively supplied and priced at $p_C = c$, as well as the relevant measures of consumer surplus,[10] output,[11] profit,[12] and total surplus[13] that are generated in equilibrium.

Figure 3 depicts the derived demand for K and the equilibrium linear price p_K^* under the demand and cost assumptions that are stated in note 9 and the assumption that $k = 15$. The expected total welfare that is generated by explicit licensing is lower than $E(MTW)$ because the capital good K is priced above marginal cost k. When depicted in the p_K, b_i space, linear pricing results in the traditional deadweight loss that is associated with above-marginal-cost uniform pricing by a firm with power over price. Note that this will be true in the case that is depicted in the Figure where

[10] Under these circumstances, the consumer surplus for a consumer that chooses to purchase a unit of K equals $CS_i^{LP} = MGS_i - p_k$. Consumers will choose to purchase a unit of K when $MGS_i > p_K$, or, equivalently, when $b_i \leq b^{CL} = \frac{(a-c)^2}{2p_K}$. Expected consumer surplus equals $E(CW^L) = \int_{b^L}^{b^{CL}} (MGS_i - p_k)\frac{1}{b^U - b^L}db = \frac{(a-c)^2}{2(b^U - b^L)}\ln\left[\frac{b^{CL}}{b^L}\right] - \frac{(a-c)}{b^U - b^L}\sqrt{\frac{k}{2b^L}}[b^{CL} - b^L]$.

[11] Expected output will equal $E(Q^L) = \int_{b^L}^{b^{CL}} \frac{a-c}{b}\frac{1}{b^U - b^L}db = \frac{(a-c)}{(b^U - b^L)}\ln\left[\frac{b^{CL}}{b^L}\right]$.

[12] Because the consumable good is supplied competitively and priced at marginal cost, the profit from selling to an individual that chooses to purchase a unit of K will equal $p_K - k$. The seller's expected profit will equal $E(\pi(p_K)) = \int_{b^L}^{b^{CL}} \frac{p_K - k}{b^U - b^L}db = \frac{p_K - k}{b^U - b^L}[\frac{(a-c)^2}{2p_K} - b^L]$. The firm's first-order condition is $\frac{\partial E(\pi(p_K))}{\partial p_K} = \left[-\frac{(p_K - k)(a-c)^2}{2{p_K}^2} + \frac{(a-c)^2}{2p_K} - b^L\right]\frac{1}{b^U - b^L} = 0$. Solving for p_K and taking the positive root yields ${p_K}^* = (a-c)\sqrt{\frac{k}{2b^L}}$.

[13] The total surplus that is generated by those who buy the capital good equals $MGS_i - p_K + p_K - k = MGS_i - k$. Thus, expected total welfare will equal $E(TW^L) = \int_{b^L}^{b^{CL}} (MGS_i - k)\frac{1}{b^U - b^L}db = \frac{(a-c)^2}{2(b^U - b^L)}\ln\left[\frac{b^{CL}}{b^L}\right] - \frac{k}{b^U - b^L}[b^{CL} - b^L]$.

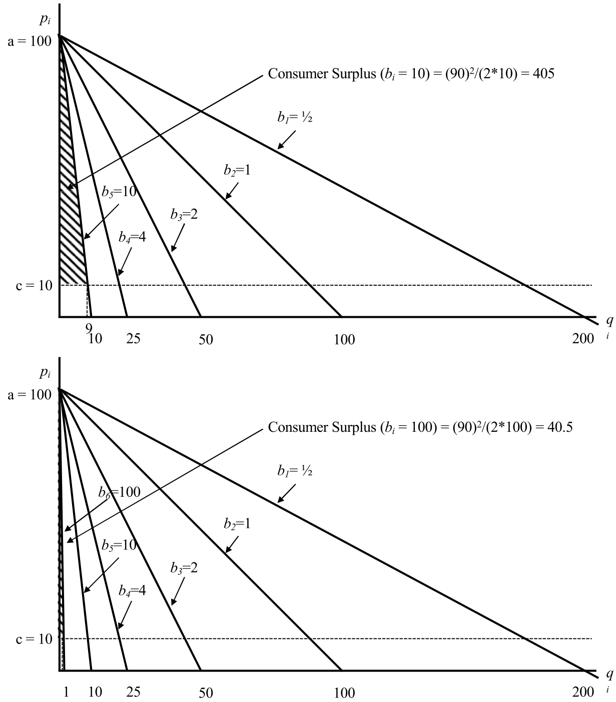


Fig. 1 Individuals' demand for the unpatented consumable good (gallons of propanil)

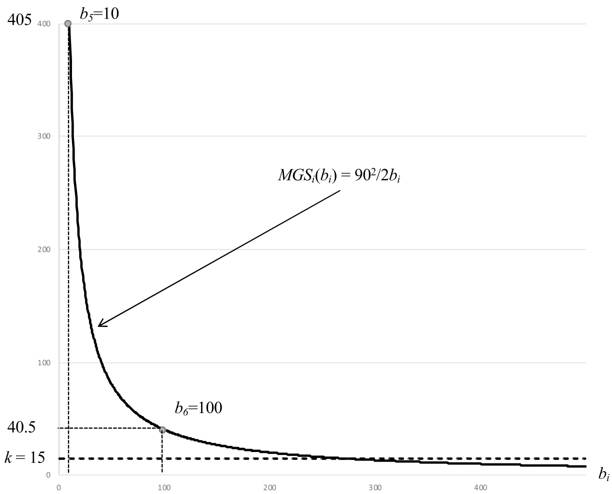


Fig. 2 Derived market demand for the method patent (with marginal cost pricing of the consumable)

the derived demand for the capital good K incorporates full extraction by consumers of the gross surplus (MGS_i) from consumption of the consumable product C.

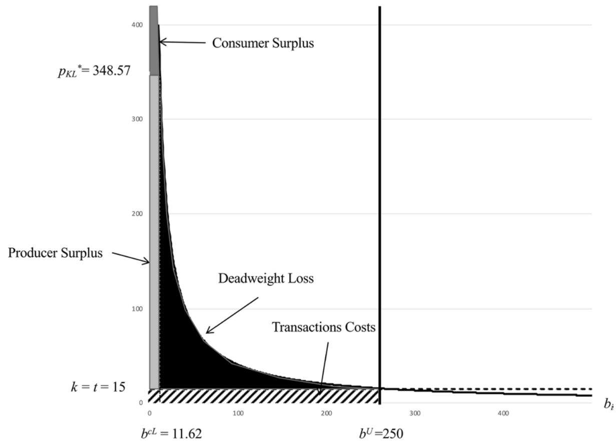


Fig. 3 Linear pricing of patented method (marginal cost pricing of the consumable, $b_i \sim U$ [.5, 250])

2.2 Non-Linear (Metered) Pricing in an Implied License

In this section, we examine the prices and welfare that are generated when the seller uses non-linear pricing and an implied license, where the price of the capital good $p_K = 0$ and the price of the consumable good is $p_C = m > c$.[14] To price the consumable good above marginal cost, the seller has to ensure that buyers purchase units of consumable goods that are used in conjunction with the capital good only from that same seller.[15]

The use of implied licensing in the *Dawson Chemical Case* illustrates a case where a key side effect of a transaction—the right to use the patent—was not explicitly priced. The patent at issue in the *Dawson Chemical* case—which is illustrated in the left panel of Fig. 4—disclosed a method to apply an unpatented chemical, propanil, around rice crops to kill weeds selectively. The patent is practiced by following the directions on the product label, which is illustrated in the right panel of Fig. 4.

The patentee in the case—Rohm & Hass—chose to forgo direct licenses for the method patent. Instead, end users were given an implied license to use the method patent when they purchased the unpatented chemical, propanil, from Rohm & Haas.

[14] In an earlier version of this paper, we examined the case where both the capital good and consumable good are priced in a metering contract. We show that under the assumptions of the example that is used in this section the optimal price of the capital good *K* is set below the marginal cost of selling the good *k*, as the patentee would want to subsidize the taking of licenses so as to expand the profitable sales of consumables that are priced above cost. In the case where the use of an implied license allows the patentee to avoid *k*, these contracts would not be used, as an implied license dominates the optimal two-part tariff where both the capital good and consumable good are explicitly priced. For analyses of metered pricing where the capital good is explicitly priced and its treatment under the antitrust laws, *see* Oi (1971); Klein (1996); and Ahlborn, et al. (2004).

[15] This can be achieved through a metering tie or some other mechanism (in the case of *Dawson Chemical*, successful suits for contributory infringement under the patent laws) that prevents others from selling the consumable good to the buyers of the capital good.

Rohm & Haas appropriated the value of the patent by selling propanil at a positive markup over marginal cost ($m—c > 0$).

One of the benefits of implied licensing is that it avoids the transactions costs that would be incurred if explicit licenses for the method patent were used. Under the assumption that $k = t$, and that t is avoidable through implied licensing, then $p_K = 0$ and $k = t = 0$. Another benefit is that it expands the use of the capital good K. When $p_K = 0$, all consumers $b_i \in [b^U, b^L]$ are served. In contrast, under explicit licensing of the patent, only consumers with $b_i \in [b^U, b^{CL}]$ are served. Appropriating the return to the patent is achieved by selling the consumable good at a price $m^* = \frac{a+c}{2}$ that is above marginal cost c.[16] Using the parameters from the example, $m^* = 55$, which results in a positive unit margin that is equal to $m^*—c = 45$.

The pricing of the consumable good under implied licensing is illustrated in Fig. 5. The Figure also illustrates the consumer surplus that is obtained by a buyer of the consumable good with $b_i = 100$.[17] Thus, as is depicted in Fig. 6, the consumer surplus curve equals $D_{KIL}(b_i) \propto (a—m)^2/2b_i = (45)^2/2b_i$ Total surplus from a unit of $K \propto 3(a—m)^2/2b_i = 3*(45)^2/2b_i$. Both the total surplus and consumer surplus curves are shifted downward compared to the MGS curve that is depicted in Fig. 2.

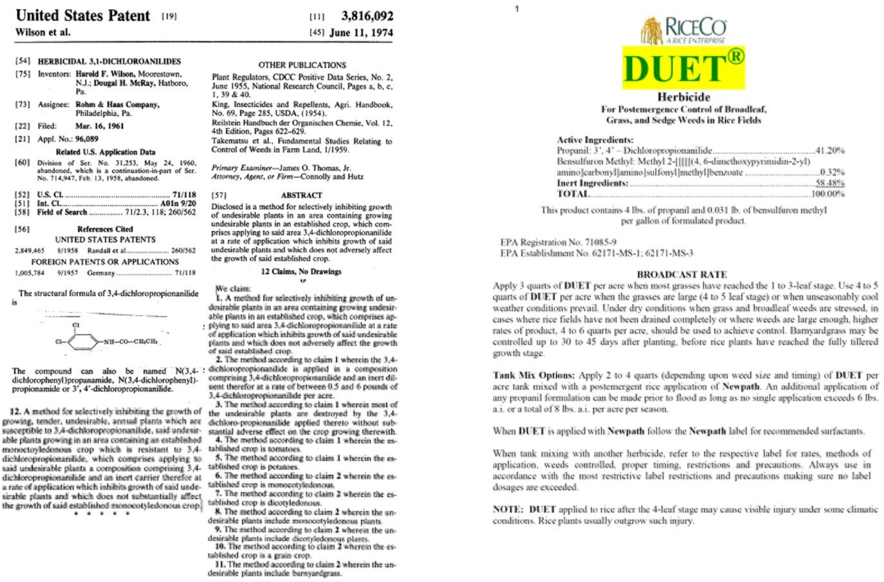
Figure 7 shows the consumer surplus, producer surplus, and the deadweight loss that are generated by implied licensing. With implied licensing ($p^K = 0$, $m* = 55$), the output of the capital good K increases, as all user types $b_i \epsilon [b^L = 0.5, b^U = 250]$ will practice the patent. In contrast, only user types $b_i \epsilon [b^L = 0.5, b^{CL} = 11.62]$ explicitly license the patent when linear pricing ($p^K = 348.57$, $p^C = c = 10$) is used.

However, in the example, total output of the consumable good falls 1.2% compared to total output under explicit licensing in the example. This shows the opposing effects on consumable output that are generated by a move from explicit to implied licensing: there is a reduction in output on the *intensive* margin when users who would license the patent under explicit licensing and continue to practice the patent under implied licensing ($b_i \epsilon [b^L = 0.5, b^{CL} = 11.62]$) reduce their output in the face of the higher metered price for the consumable. But there is an increase in output on the *extensive* margin from users who practice the patent under implied licensing ($b_i \epsilon [b^{CL} = 11.62, b^U = 250]$, but would not license the patent under explicit licensing.

Even though consumable output falls, total welfare increases by 50.1%: This is driven by both greater extraction of surplus by the patentee as well as the transaction costs savings that are associated with not having to incur the transactions costs of explicitly licensing the patent t. Consumer welfare falls by 29%, which reflects the greater extraction of surplus by the patentee.

[16] Expected profits with the use of an implied licensing approach equal $E\left(\pi(p_K = 0, m)\right) = \frac{1}{(b^U - b^L)}\left[(m-c)(a-m)\left[\ln\left(b^U\right) - \ln\left(b^L\right)\right]\right]$. The first-order condition is $\frac{\partial E(\pi(p_K, m))}{\partial m} = [a - 2m + c]\frac{[\ln(b^U) - \ln(b^L)]}{b^U - b^L} = 0$. Solving the first-order condition for m yields $m^* = \frac{a+c}{2}$.

[17] Because $p_K = 0$, net and gross consumer surplus are the same with implied licensing.



United States Patent [19]
Wilson et al.

[11] **3,816,092**
[45] **June 11, 1974**

[54] **HERBICIDAL 3,1-DICHLOROANILIDES**

[75] Inventors: **Harold F. Wilson,** Moorestown, N.J.; **Dougal H. McRay,** Hatboro, Pa.

[73] Assignee: **Rohm & Haas Company,** Philadelphia, Pa.

[22] Filed: **Mar. 16, 1961**

[21] Appl. No.: **96,089**

Related U.S. Application Data

[60] Division of Ser. No. 31,253, May 24, 1960, abandoned, which is a continuation-in-part of Ser. No. 714,947, Feb. 13, 1958, abandoned.

[52] **U.S. Cl.** **71/118**
[51] **Int. Cl.** **A01n 9/20**
[58] **Field of Search** 71/2.3, 118; 260/562

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The structural formula of 3,4-dichloropropionanilide is

The compound can also be named N(3,4-dichlorophenyl)propanamide, N(3,4-dichlorophenyl)-propionamide or 3′, 4′-dichloropropionanilide.

12. A method for selectively inhibiting the growth of growing, tender, undesirable, annual plants which are susceptible to 3,4-dichloropropionanilide, said undesirable plants growing in an area containing an established monoctoyledonous crop which is resistant to 3,4-dichloropropionanilide, which comprises applying to said undesirable plants a composition comprising 3,4-dichloropropionanilide and an inert carrier therefor at a rate of application which inhibits growth of said undesirable plants and which does not substantially affect the growth of said established monocotyledonous crop.

* * * * *

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Primary Examiner—James O. Thomas, Jr.
Attorney, Agent, or Firm—Connolly and Hutz

[57] **ABSTRACT**

Disclosed is a method for selectively inhibiting growth of undesirable plants in an area containing growing undesirable plants in an established crop, which comprises applying to said area 3,4-dichloropropionanilide at a rate of application which inhibits growth of said undesirable plants and which does not adversely affect the growth of said established crop.

12 Claims, No Drawings

We claim:

1. A method for selectively inhibiting growth of undesirable plants in an area containing growing undesirable plants in an established crop, which comprises applying to said area 3,4-dichloropropionanilide at a rate of application which inhibits growth of said undesirable plants and which does not adversely affect the growth of said established crop.

2. The method according to claim 1 wherein the 3,4-dichloropropionanilide is applied in a composition comprising 3,4-dichloropropionanilide and an inert diluent therefor at a rate of between 0.5 and 6 pounds of 3,4-dichloropropionanilide per acre.

3. The method according to claim 1 wherein most of the undesirable plants are destroyed by the 3,4-dichloro-propionanilide applied thereto without substantial adverse effect on the crop growing therewith.

4. The method according to claim 1 wherein the established crop is tomatoes.

5. The method according to claim 1 wherein the established crop is potatoes.

6. The method according to claim 2 wherein the established crop is monocotyledonous.

7. The method according to claim 2 wherein the established crop is dicotyledonous.

8. The method according to claim 2 wherein the undesirable plants include monocotyledonous plants.

9. The method according to claim 2 wherein the undesirable plants include dicotyledonous plants.

10. The method according to claim 2 wherein the established crop is a grain crop.

11. The method according to claim 2 wherein the undesirable plants include barnyardgrass.

1

RICECO
A RICE ENTERPRISE

DUET®

Herbicide

For Postemergence Control of Broadleaf, Grass, and Sedge Weeds in Rice Fields

Active Ingredients:
Propanil: 3′, 4′ – Dichloropropionanilide 41.20%
Bensulfuron Methyl: Methyl 2-[[[[[(4, 6-dimethoxypyrimidin-2-yl) amino]carbonyl]amino]sulfonyl]methyl]benzoate 0.32%
Inert Ingredients: 58.48%
TOTAL 100.00%

This product contains 4 lbs. of propanil and 0.031 lb. of bensulfuron methyl per gallon of formulated product.

EPA Registration No. 71085-9
EPA Establishment No. 62171-MS-1; 62171-MS-3

BROADCAST RATE

Apply 3 quarts of **DUET** per acre when most grasses have reached the 1 to 3-leaf stage. Use 4 to 5 quarts of **DUET** per acre when the grasses are large (4 to 5 leaf stage) or when unseasonably cool weather conditions prevail. Under dry conditions when grass and broadleaf weeds are stressed, in cases where rice fields have not been drained completely or where weeds are large enough, higher rates of product, 4 to 6 quarts per acre, should be used to achieve control. Barnyardgrass may be controlled up to 30 to 45 days after planting, before rice plants have reached the fully tillered growth stage.

Tank Mix Options: Apply 2 to 4 quarts (depending upon weed size and timing) of **DUET** per acre tank mixed with a postemergent rice application of **Newpath**. An additional application of any propanil formulation can be made prior to flood as long as no single application exceeds 6 lbs. a.i. or a total of 8 lbs. a.i. per acre per season.

When **DUET** is applied with **Newpath** follow the **Newpath** label for recommended surfactants.

When tank mixing with another herbicide, refer to the respective label for rates, methods of application, weeds controlled, proper timing, restrictions and precautions. Always use in accordance with the most restrictive label restrictions and precautions making sure no label dosages are exceeded.

NOTE: DUET applied to rice after the 4-leaf stage may cause visible injury under some climatic conditions. Rice plants usually outgrow such injury.

Fig. 4 Method patent and use label

2.3 Transactions Costs, Welfare, and Output

The above example illustrates the well-known, complex, and ambiguous welfare and output effects of metered pricing. However, there are some cases where the relationship between output and welfare can be determined: For example, the use of implied licensing instead of explicit licensing increases total welfare as long as consumption of the consumable weakly increases.[18] In the case where output is unchanged, the lost purchasers of low b_i demanders (below $m^{**}=55$) on the extensive margin are replaced by an equal or greater number of high-value purchases (above $m^{**}=55$) by high b_i demanders on the extensive margin.[19] However, even when output of both the capital and consumable goods increase, consumer welfare can decrease, as the use of non-linear pricing allows the patentee to increase the percentage of the total surplus that is extracted.[20]

[18] When the output of both the consumable good and the capital good increase relative to linear pricing, total welfare must increase; and when the capital good is costless, total welfare increases if total sales of the consumable good increase. *See* Elhauge & Nalebuff (2017, p. 74). Elhauge & Nalebuff also analyze an example of consumer and total welfare reducing metering where capital good output falls.

[19] This is in contrast to the familiar result from third degree-price discrimination with linear demand, where output is unchanged, but welfare falls because lost purchases from the inelastic demanders are replaced by an equivalent number of lower-valued purchases from elastic demanders. See Kaftal & Pal (2008); Elhauge (2009, pp. 405, 431–3).

[20] As Carlton & Heyer (2008, pp. 290–92) point out, the extraction of surplus by a patentee that increases allocative efficiency may increase overall efficiency when one takes into account dynamic efficiency. Moreover, even if static consumer welfare falls, dynamic consumer welfare can rise. *See also* Hausman & Mackie-Mason (1988, p. 263). *But see* Elhauge (2009, pp. 239–40).

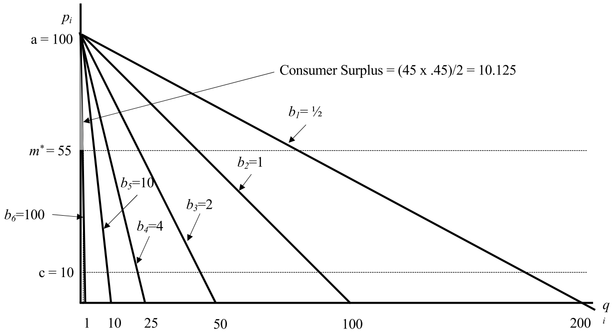

Fig. 5 Individuals' demand for unpatented consumable good and metered pricing

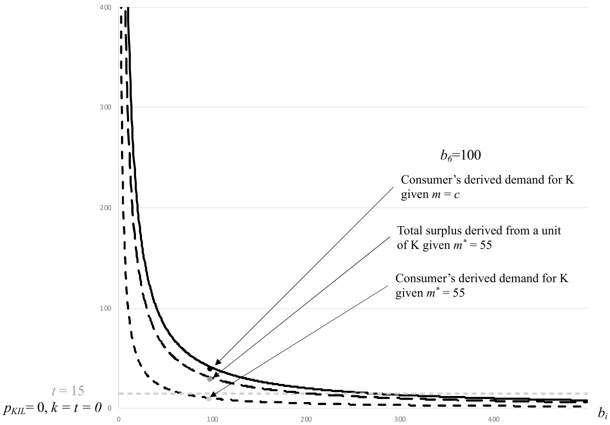

Fig. 6 Derived market demand for the method patent (implied license, $m^*=55$)

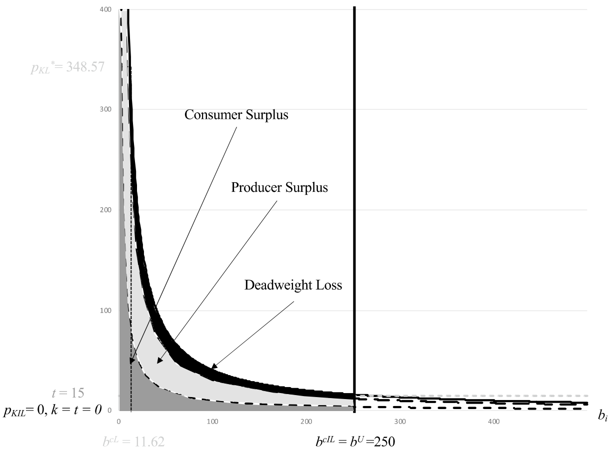

Fig. 7 Derived market demand for the method patent and welfare (implied license, $m^*=55$, $b_i \sim U$ [.5, 250])

Table 1 Changes to output and welfare from moving from linear pricing to implied licensing ($k = 15$)

	b^L							
$\%\Delta Q$	0.5	1	1.5	2	2.5	3	3.5	4
250	−1.22%	−1.37%	−1.48%	−1.57%	−1.64%	−1.71%	−1.77%	−1.83%
300	1.67%	1.88%	2.03%	2.15%	2.25%	2.34%	2.42%	2.50%
b^U 350	4.12%	4.64%	5.00%	5.29%	5.54%	5.77%	5.97%	6.16%
400	6.25%	7.02%	7.57%	8.01%	8.39%	8.73%	9.04%	9.33%
450	8.12%	9.12%	9.84%	10.41%	10.91%	11.35%	11.75%	12.13%
500	9.79%	11.01%	11.87%	12.56%	13.16%	13.69%	14.18%	14.63%
$\%\Delta CW$								
250	−29.02%	−25.79%	−23.46%	−21.55%	−19.90%	−18.42%	−17.06%	−15.80%
300	−26.94%	−23.34%	−20.73%	−18.59%	−16.73%	−15.05%	−13.52%	−12.09%
b^U 350	−25.18%	−21.27%	−18.43%	−16.09%	−14.05%	−12.21%	−10.52%	−8.95%
400	−23.65%	−19.47%	−16.43%	−13.92%	−11.72%	−9.75%	−7.93%	−6.23%
450	−22.31%	−17.89%	−14.67%	−12.00%	−9.67%	−7.57%	−5.64%	−3.83%
500	−21.10%	−16.47%	−13.09%	−10.29%	−7.84%	−5.63%	−3.59%	−1.69%
$\%\Delta TW$								
250	50.13%	51.02%	51.81%	52.54%	53.23%	53.88%	54.52%	55.13%
300	54.53%	56.01%	57.22%	58.30%	59.29%	60.23%	61.12%	61.97%
b^U 350	58.26%	60.22%	61.79%	63.17%	64.42%	65.59%	66.70%	67.76%
400	61.48%	63.88%	65.76%	67.39%	68.86%	70.24%	71.53%	72.77%
450	64.33%	67.10%	69.25%	71.11%	72.78%	74.33%	75.80%	77.18%
500	66.88%	69.98%	72.38%	74.44%	76.29%	78.00%	79.61%	81.14%

As was noted above, the net effect of moving from linear pricing under explicit licensing to nonlinear pricing under implied licensing will depend on the relative sizes of the increase in consumable output from the extensive margin and the decrease in consumable output from the intensive margin. The relative size of these effects depends upon the relative distribution of consumers with high and low b_i. Table 1 lists the percentage change in equilibrium output and welfare measures that would occur when a firm moves from an explicit to an implied licensing regime as the support of the distribution of b_i, $[b^L, b^U]$ is varied. Table 1 assumes that $t = 15$.

Consistent with the example that is depicted in the Figures, total welfare always increases when linear pricing is replaced with implied licensing, while consumer welfare always decreases under the conditions that are assumed in Table 1. Table 1 shows that as either b^L or b^U is increased, the relative measures of consumer welfare and total welfare from a move from explicit to implied licensing both improve. In addition, the change in output is negative for low values of b^U.[21]

[21] Intuitively, as b^U is increased holding b^L constant, the increase in consumable output from the extensive margin increases. In addition, the increase in the range of the distribution decreases the weight that is attached to lower b_i users that would have the largest reductions in consumable output on the intensive margin.

In addition, both output and welfare are affected by the size of the transaction costs of licensing *t*. An increase in *t* does not affect the implied licensing equilibrium but does affect the explicit licensing equilibrium by increasing the marginal cost of explicitly licensing the patent ($k=t$). With convex demand for *K*, this increase in cost is passed through to licensees (rice farmers in the case of the Rohm & Haas patent) at a high rate, which decreases the welfare and output that are generated by the explicit licensing of *K*.[22]

Because the size of *t* does not affect the implied licensing equilibrium, the relative measures of output and welfare from moving from explicit to implied licensing improve. Table 2 lists the percentage change in equilibrium output and welfare measures when $t=20$. For the parameter values that are listed in the Table, both output and total welfare increase when explicit licensing is replaced by implied licensing. Consumer welfare decreases for low values of b^L or b^U, but increases for the larger values of b^L and b^U.[23]

3 Transaction Costs and Loyalty Discounts: The Case of Shelf-Space Contracts

Efficient pricing and contracting for its products and services is a function of a firm's ability to use linear versus non-linear pricing. In the case of metered pricing, we showed in Section II that modeling firms as economizing—not only upon production costs, but also on transaction and information costs—illuminates important features of pricing decisions and their ultimate effect on economic welfare.

In this Section, we further explore endogenous transaction costs, and show the role of transaction costs in understanding not only pricing, but also other contract terms. We analyze the role of transaction costs in determining an efficient contractual form between vertically related firms: vertical restraints. In particular, we analyze the use of vertical shelf space contracts—which include loyalty discounts, shelf-space share contracts, and linear discounting—and explain the critical role of transaction costs in the choice of contract.

The case we analyze is a general one: we analyze vertical restraints in the context of a manufacturer that sells its product to a distributor that, in turn, sets retail prices and sells the product to final consumers. Manufacturers compete for access to distributors' shelves. Distributors or retailers face downward sloping demand and compete against one another to attract consumers until all economic profit is dissipated. One can think of the parties as contracting over the retailer's non-price decisions that impact efficiency. Vertical integration is an alternative solution to similar problems, but may not be efficient in many multi-product retail environments (Klein and Wright (2007)).

[22] For example, if the transactions costs of licensing rise from $t=15$ to $t=20$, p^K rises from 348.57 to 402.49, which results in a pass-through rate of $53.92/5=10.784$.

[23] Our results present an example that produces a counter example to Elhauge (2009, pp. 433, 479–481). In his article, he presents an example of a metering tie where consumer welfare always falls with the use of a metering tie and suggests that the example "provides no support for the claim by critics of tying law that the consumer welfare effects are ambiguous or less clear than the total welfare effect. To the contrary, the decline in consumer welfare is clear and strong, while the ex post total welfare effect is mixed and weak.".

3.1 Shelf-Space Contracts and Competition for Distribution

Competition for retail distribution is a critical component of the normal competitive process. This phenomenon is well recognized in both economics and law.[24] Manufacturers accordingly compete vigorously over key retail distribution assets—including retail shelf space. The competitive process often generates shelf-space arrangements in which manufacturers compensate retailers, in exchange for a commitment of a large share of their shelf space to the manufacturer's product category. These agreements vary along several dimensions, depending on both the specific product category as well as market conditions for the particular manufacturer and retailer.[25]

One such dimension is the contracted-for performance of the retailer: various shelf locations have greater or lesser values from a manufacturer's perspective. A retailer might commit highly lucrative, eye-level shelf space or an endcap to the manufacturer's brand. Alternatively, a retailer might commit to providing a particular share of its category shelf space. Retailers price these locations accordingly.

Shelf-space contracts also vary by the method of payment. Manufacturers must compensate retailers for larger shares of shelf space or prime locations on the shelf. Manufacturers compensate retailers for shelf space through: wholesale price discounts; incremental price discounts; per-unit time payments ("slotting fees"); or other forms of compensation.

Another dimension upon which shelf-space contracts vary is their degree of exclusivity, if any. Some shelf-space contracts place restrictions on the retailer's ability to carry rival brands or include a commitment from the retailer to dedicate a specified *percentage* of its relevant category shelf space to the manufacturer's product(s). This commitment can run the gamut from total exclusivity—where the retailer dedicates 100 percent of its shelf space to the manufacturer—to partial exclusivity, which covers only some lesser percentage of the category shelf space, or limits exclusivity to a certain type of shelf space: e.g., an endcap or special display.

One particular form of a partially exclusive shelf-space arrangement is a shelf-space share discount contract: as we will discuss below, shelf-space share discounts involve a discount that is paid to retailers in exchange for a commitment of less than 100 percent of its shelf space. We note that the benefit of shelf-space share discounts in particular (or, more generally, loyalty discounts) in facilitating the efficient allocation of shelf space is highlighted by the fact that such contracts are ubiquitous. Loyalty discounts (including shelf-space share discounts) are common between wholesalers and retailers (as well as between retailers and final consumers) in many consumer products markets, including: drugs; books; records; soda; tobacco products; juices; breakfast cereals; and snack foods.[26]

[24] *See, e.g.*, *Paddock Publ'ns, Inc. v. Chicago Tribune Co.*, 103 F.3d 42, 45 (7th Cir. 1996) (noting that "competition-for-the-contract is a form of competition that antitrust laws protect rather than proscribe, and it is common").

[25] *See generally* Klein & Wright (2007).

[26] *See* Klein & Wright (2007, pp. 421–22).

Table 2 Changes to output and welfare from moving from linear pricing to implied licensing ($k=20$)

b^L								
$\%\Delta Q$	0.5	1	1.5	2	2.5	3	3.5	4
250	3.51%	3.97%	4.30%	4.56%	4.80%	5.00%	5.19%	5.37%
300	6.55%	7.40%	8.01%	8.51%	8.94%	9.33%	9.69%	10.02%
b^U 350	9.11%	10.30%	11.16%	11.85%	12.45%	12.99%	13.48%	13.94%
400	11.34%	12.82%	13.88%	14.74%	15.49%	16.16%	16.77%	17.35%
450	13.30%	15.04%	16.28%	17.29%	18.17%	18.96%	19.68%	20.35%
500	15.05%	17.02%	18.43%	19.57%	20.57%	21.46%	22.27%	23.03%
$\%\Delta CW$								
250	−24.27%	−20.01%	−16.88%	−14.28%	−12.00%	−9.94%	−8.04%	−6.25%
300	−22.05%	−17.37%	−13.92%	−11.04%	−8.52%	−6.23%	−4.11%	−2.12%
b^U 350	−20.17%	−15.13%	−11.41%	−8.31%	−5.57%	−3.09%	−0.79%	1.37%
400	−18.55%	−13.20%	−9.24%	−5.94%	−3.02%	−0.37%	2.09%	4.40%
450	−17.11%	−11.49%	−7.33%	−3.85%	−0.77%	2.03%	4.62%	7.07%
500	−15.83%	−9.97%	−5.62%	−1.98%	1.24%	4.17%	6.89%	9.46%
$\%\Delta TW$								
250	57.75%	59.89%	61.63%	63.17%	64.59%	65.93%	67.20%	68.42%
300	62.37%	65.17%	67.39%	69.33%	71.11%	72.77%	74.34%	75.85%
b^U 350	66.29%	69.63%	72.26%	74.54%	76.62%	78.55%	80.38%	82.13%
400	69.68%	73.50%	76.48%	79.05%	81.39%	83.56%	85.61%	87.56%
450	72.67%	76.91%	80.20%	83.03%	85.60%	87.98%	90.22%	92.36%
500	75.34%	79.96%	83.53%	86.60%	89.36%	91.93%	94.35%	96.65%

Market-share discounts are another notable example of loyalty discounts and, in several ways, are similar to shelf-space share discounts. For example, in their dealings with travel agents, airlines encourage "travel agents to make additional passenger bookings [on a particular airline] by paying commission 'overrides' to travel agencies for surpassing set sales goals."[27] Typically, these override commissions are structured to base the airline's payment to the travel agent on the airline's share of the travel agent's total airline ticket sales.[28] Since the airlines discontinued base commissions to agents several years ago, these override commissions are the most common form of commissions that are paid to travel agents by airlines.[29]

As another example: in cigarette marketing, RJ Reynolds and Philip Morris have utilized market-share discount programs that they offer to retailers in the distribution of lower-priced cigarettes: the companies offer increasing tiers of discounts based on the

[27] U.S. Gov't Accountability Office, GAO-03–749, Airline Ticketing, Impact of Changes in the Airline Ticket Distribution Industry 9 (2003).

[28] *See Market Share Override Program*, Travel Indus. Dictionary, http://www.travel-industry-dictionary.com/market-share-override-program.html (last visited Jan. 27, 2020).

[29] See, for example, the June 2007 report from Amadeus, a Global Distribution System. Amadeus, Service Fees and Commission Cuts, Opportunities and Best Practices for Travel Agencies 4 (2007).

shelf-space share of each of their brands.[30] Market-share agreements are also common in non-retail product settings, such as among participants in payment card networks. Visa and MasterCard offer "dedication" agreements to credit and debit card issuers, where payments and other remuneration are based on the card issuer's achieving a specific market share for the network.[31] In particular, these agreements may specify that a certain share of that issuer's new credit or debit card solicitations are for cards on that network.

3.2 Incentive Conflicts in Vertical Distribution Relationships

It is important to understand why manufacturers enter into shelf space contracts at all—rather than merely relying entirely upon retailers to determine how much shelf space to allocate to particular products without a contractual arrangement—in order to appreciate why both retailers and product manufacturers enter into the particular shelf-space loyalty discounts.

Retail shelf space is a valuable asset to manufacturers for multiple reasons: first is the role of shelf space as a form of promotion: shelf-space contracts (including shelf space share contracts) arise because the retailer's incentives to allocate additional (or higher-quality) shelf space to a given product are often significantly weaker than those of the product manufacturer. When considering whether to allocate additional shelf space to a manufacturer's product, the retailer's independent, profit-maximizing decision does not take into account the manufacturer's profit margin. As a result, the retailer might decide to allocate the additional shelf space to another product simply because the retail margin of that other product is larger than that of the manufacturer's product—even though the total (wholesale + retail) margin is larger for the manufacturer's product than for the other product.

In the absence of shelf-space contracts, therefore, the retailer may inefficiently allocate the additional shelf space to that other product, and thus inefficiently undersupply shelf space to the manufacturer's product. Shelf-space arrangements thereby arise to correct this inefficient undersupply of shelf space.[32]

A brief examination of the respective cost structures of manufacturer and retailer will elucidate this inefficiency and misalignment of incentives. Let MC_R equal a retailer's marginal cost of selling an additional unit of a product to consumers. This is composed of the wholesale price charged by the manufacturer—P_W—plus the

[30] *See R.J. Reynolds Tobacco Co. v. Philip Morris Inc.*, 199 F. Supp. 2d 362, 369 (M.D.N.C. 2002), *aff'd per curiam*, 67 F. App'x 810 (4th Cir. 2003); *see also* Cooper (2007).

[31] *See United States v. Visa U.S.A., Inc.*, 163 F. Supp. 2d 322, 328–29 (S.D.N.Y. 2001) and Release and Settlement Agreement, Exhibit 10.2, MasterCard 10-Q, August 1, 2008.

[32] *See generally* Klein & Murphy (2008); Klein & Wright (2007). The pro-competitive effects and usefulness of shelf space arrangements are greater when the manufacturer margin is large relative to the retailer margin: This is because, in the absence of a slotting fee or price discount from the manufacturer, the profitability to the retailer of devoting more shelf space to the manufacturer's brand would be only a small fraction of the total (or joint) profitability to both the retailer and the manufacturer. As a consequence, the retailer would be more likely to undersupply shelf space to valuable products. Thus, when manufacturer margins are much larger than retailer margins, shelf-space arrangements are particularly useful as they allow manufacturers of valuable products to provide retailers with additional compensation and thus increase the retailer's incremental profitability of devoting more shelf space to their brands.

retailer's marginal cost of selling the product (including the costs of providing shelf space): MC_S[33]:

$$MC_R = P_W + MC_S.$$

Every retailer will set its retail price—P_R—and sell q_R units based on MC_R and its price elasticity of demand: η_{q_R,P_R}:

$$\frac{P_R - MC_R}{P_R} = -\frac{1}{\eta_{q_R,P_R}}.$$

Summing across n (assumed) identical retailers, with the same elasticity of demand and each selling q_R units, results in a total quantity that is sold by all retailers Q_R (equivalent to nq_R), and the market-level elasticity of demand for retail, η_{Q_R,P_R}, equals η_{q_R,P_R}. Rewriting the above equation in terms of quantities sold in the market by all retailers gives us:

$$\frac{P_R - MC_R}{P_R} = -\frac{1}{\eta_{Q_R,P_R}}.$$

Analogously, the manufacturer will maximize profits by setting the wholesale price based on the marginal cost of production—MC_M—and its price elasticity of demand: η_{Q_M,P_W}:[34]

$$\frac{P_W - MC_M}{P_W} = -\frac{1}{\eta_{Q_M,P_W}}.$$

As the quantity of product sold by the manufacturer (Q_M) is exactly equal to the total quantity sold by all retailers (Q_R), the following relationship is established:[35]

$$\frac{\partial Q_R}{\partial P_R}\left(P_R - MC_R\right) = \frac{\partial Q_M}{\partial P_W}\left(P_W - MC_M\right).$$

This approximate equivalence—between the perceived return to retailers from reducing the price (on the left) and the manufacturer's return from such a price reduction (on the right)—describes the underlying inefficiency and incentive mismatch that motivates manufacturers to contract with retailers for promotional efforts, including shelf-space share discounts.[36] At equilibrium, the manufacturer margin,

[33] Klein & Wright (2007, p. 429).

[34] *Id.*, p. 430.

[35] The left-hand side of the equation is obtained by solving the retailer's Lerner condition for Q_R, and the right-hand side of the equation is obtained by solving the manufacturer's Lerner condition for Q_M.

[36] *Id.* It is only approximately optimal because the small margin earned by the retailer implies that the manufacturer's profit from incremental sales is slightly less than the total profit from incremental sales earned by both the manufacturer and retailers. That is, there is a small double-marginalization problem and, hence, slightly less than the joint-profit-maximizing amount of retail price competition.

$(P_W - MC_M)$, is substantially greater than the retailer margin, $\left(P_R - MC_R\right)$, which implies that the retailer demand responses to price changes—$\partial Q_R/\partial P_R$—must be proportionally greater than the manufacturer demand response:$\partial Q_M/\partial P_W$.[37] Price decreases by retailers cause shifts in the manufacturer's sales (between retailers) that largely cancel out (in terms of the manufacturer's net sales).[38]

There is another reason why a retailer might have a reduced incentive to allocate additional shelf space to the manufacturer's product: From the retailer's perspective, any increase in shelf-space allocation to the manufacturer's product within the category will be, at least partially, offset by a decrease in the sales of substitute products.

For example, if Coca-Cola contracts with a retailer for the provision of additional shelf space, the increased sales of Coca-Cola will be at least partially offset by a decrease in the sales of Pepsi and other soft drink brands that are sold from less prominent shelf space. This "cannibalization effect" reduces the gains to the retailer from allocating additional or promotional shelf space to the manufacturer's product, and thus would exacerbate the undersupply of shelf space in the absence of shelf-space agreements.

Compensation from shelf-space contracts helps remedy this undersupply problem and thus provides a more efficient allocation of shelf space to the manufacturer's product.

3.3 Shelf-Space Contract Choice with Transaction Costs

Pervasive incentive conflicts in distribution contracts over promotional services provide a reason for contractual arrangements to exist between manufacturers and distributors—instead of simply relying upon the separate, profit-maximizing decision of the retailer to allocate shelf space.

However, the existence of the incentive conflict leaves unanswered the question: what kind of shelf-space contract? As we discussed above, shelf-space distribution contracts vary across a large number of dimensions. We focus here on comparing shelf-space share discounts with uniform pricing and volume discounts and provide an example from a recently litigated antitrust decision—*Mayer v. Church & Dwight*[39]—which involved shelf-space discounts in the condom market.

[37] *Id.*

[38] *Id.* This form of slotting contract analysis stands in contrast to the classic inter-retailer free-riding analysis that was popularized by Telser (1960, pp. 91–92). In Telser's analysis, consumers are presumed to value retailer supplied promotional services, such that they would be willing to pay for them independently. Under his framework, consumers do not pay for such services, because they can free ride by obtaining these services from a full-service retailer—and then purchase the product from a discount retailer. Telser does not, however, explain why the full-service retailer would be willing to provide this valuable service free of charge to begin with, rather than charging for the service, and thereby creates the free-riding problem in the first place. Klein & Wright answer this gap by explaining that these services target marginal customers who are unwilling to pay for the promotional efforts; these customers nevertheless remain of value to manufacturers (particularly given their relatively higher margins) and explains why manufacturers contract with and compensate retailers to engage in promotional efforts. S*ee also* note 17 above and accompanying text; Klein & Wright (2007, p. 427, n. 25).

[39] *Church & Dwight Co. v. Mayer Labs., Inc.*, 868 F. Supp. 2d 876 (N.D. Cal. 2012).

3.3.1 Shelf-Space Share Discounts Can Reduce Monitoring and Transaction Costs Relative to Other Types of Discounts

The structural advantages that explain the profusion of shelf-space slotting contracts also help explain the form that these contracts often take. Compared to other forms of vertical controls in which manufacturers might engage (such as, *e.g.*, exclusive dealing) slotting contracts offer some notable advantages: chief among these is the ease and relatively low cost of monitoring performance.[40] Compared to more complicated contractual arrangements, compliance with a slotting contract can be verified nearly instantaneously, by visual inspection. Likewise, should the retailer fail to perform on the contract, scheduled payments can be withdrawn with commensurate ease. The flexibility that is offered by this type of contractual arrangement—coupled with the relatively low monitoring costs—helps to keep these contracts in the highly efficient self-enforcement range.[41]

Analogous logic justifies implementing slotting contracts on a share or percentage basis. Similar to other loyalty discounts, shelf-space share contracts typically specify discounts that are conditional on the retailer allocating a minimum *share* of its shelf space to the manufacturer's products.

In principle, it may be possible to match the efficacy of these contracts by having the discounts depend on the *amount* of shelf space rather than the share. Similarly, it may be possible in principle to identify volume discounts—that is, discounts that are conditional upon the retailer's sales of the manufacturer's product—that would be as effective as shelf-space discounts in facilitating and protecting a manufacturer's investments, and in generating the other pro-competitive effects discussed above. But there are a number of reasons why this might not be the case:

Transaction costs are one key reason that shelf-space share discounts are more efficient than volume-based alternatives in many circumstances. For example, consider the challenges that face the design of a discount program that is tailored for individual retail chains. If the discount obtained by any given retail chain is conditional upon the total amount of shelf space or the total volume of sales of that retail chain, then a manufacturer would need to offer different discount schedules to different retail chains. These schedules would need to vary according to the retail chain's overall scale, the variability in size and location of the chain's stores, and other chain-specific details. Moreover, the manufacturer would have to adjust these discount schedules frequently as some retail chains grow and others shrink, due to changes in demand, increases or decreases in the number of retail outlets in the chain, and other market conditions. In the aggregate, these are substantially burdensome informational requirements.

One obvious alternative to negotiating a single discount schedule, based on the retail chain's total performance, is to negotiate a contract with the retail chain that effectively specifies the discounts for each individual chain store (or groups of stores); but this would magnify the transaction costs of negotiating and reaching the

40 *See* Wright (2009, pp. 25–6).

41 *See id.*, pp. 20–26.

terms of the contract. Target, for example, as of 2020 had over 1750 retail stores for which the negotiations would have to occur.[42]

Offering discounts based on the share of a retailer's shelf space has the advantage of reducing transaction costs. The amount of shelf space that is allocated to a manufacturer adjusts automatically as the retailer adjusts the total amount of shelf space that is devoted to that product category in each store of a retail chain. For example, when a retail chain opens a new store, the manufacturer and the retail chain do not have to negotiate a new contract. Instead, they can simply include the new store in their current shelf-space share contract. The retail chain can freely determine how much shelf space to allocate to the product category in that store (based on local market conditions) and how to divide it among the various competing manufacturers based upon the contracted-for shelf-space share discounts and other factors.

Shelf-space share discounts can also provide a retailer with further incentive to exert non-contractible efforts that increase the sales of a manufacturer's product—such as improving the location of the product's shelves or encouraging more frequent restocking. This pro-competitive effect has been analyzed in the economics literature, including by Mills (2010, p. 134). Mills considers the case of a manufacturer that sells a differentiated product through non-exclusive retailers and compares market-share discounts with unconditional discounts. In some instances, market-share discounts induce increased selling effort by retailers and improve market performance relative to unconditional discounts. In other instances, they merely shift upstream to the manufacturer the rents that are created by the induced selling effort. In no case, as long as the producers of substitute products retain sufficient sales to remain viable, do market-share discounts impair market performance.[43]

In the abstract, a share or percentage-based slotting contract has the advantage of economizing on two fronts: transaction costs, and monitoring costs. Compliance with slotting contracts can be easily verified by visual inspection; and structuring these contracts on a share basis makes them flexible enough to adapt to myriad retail arrangements without costly renegotiation or specification.

3.3.2 Shelf-Share Discounts in Mayer Laboratories, Inc. v. Church & Dwight

We turn to evaluating shelf space share discounts in *Mayer Laboratories, Inc. v. Church & Dwight*: an antitrust case that was litigated in the Northern District of California that alleged that Church & Dwight's shelf-share discount program in the condom market violated the antitrust laws.[44]

Church & Dwight manufactures Trojan and other brand-name condoms; among its promotional efforts, the company offers retailers percentage rebates based on the share of shelf space that is dedicated to its products.[45] Mayer Laboratories,

[42] *See All About Target*, Target, https://corporate.target.com/about (last visited Jan. 27, 2020).

[43] *See also* Klein & Murphy (1988, p. 276).

[44] *Church & Dwight*, 868 F. Supp. 2d at 883. One author (Wright) was retained as the economic expert for Church & Dwight.

[45] *Id.* at 885, 887–88.

a rival condom manufacturer, challenged this practice (among others) as anticompetitive.[46]

The court, relying on the Ninth Circuit's *Allied Orthopedic*[47] opinion, rejected this challenge: the court found the shelf space share discounts "arguably permissible as a matter of law."[48] The court noted a complete lack of direct evidence of anticompetitive effect, and recognized several economic justifications for such contracts.[49]

For Church & Dwight, shelf space share discounts are likely superior to a discount that is conditional upon the total number of facings, because the former more accurately measures the contracted-for service that Church & Dwight seeks in exchange for its payments: as the court noted, condom manufacturers attach great value to obtaining prominent shelf space because it is a very effective means of advertising their brands, given the challenges that traditional promotions face in the condom market.[50]

By obtaining either prominent shelf space or a large share of the condom shelf space, Church & Dwight is effectively advertising the quality and popularity of its products to consumers. As the court notes, "common sense dictates that retailers will give more space to those products which are more popular with consumers and available for sale."[51]

To that end, consumers who learn from observing which products occupy the most prominent shelf space will make inferences about the popularity and quality of the products based on the shelf space share of each product.[52] Church & Dwight's shelf-space share discounts may also provide a retailer with further ancillary incentives to exert non-contractible efforts that increase the sales of Church & Dwight's condoms (such as improving the location of the condom shelves or encouraging more frequent restocking), as we discussed above.[53]

Fundamentally, Church & Dwight's shelf-space share discounts purchase advertising services from the retailer. The value and quantity of the advertising services that are provided by the retailer are measured more accurately by the share of the category that is dedicated to Church & Dwight products rather than by the number of facings that are committed to Church & Dwight. A retailer might, for example, expand the number of facings while reducing the overall shelf presence and still be in compliance with a "total shelf-space" discount contract. But this change will reduce the in-store promotional value to Church & Dwight. In this way, consistent

46 *Id.*

47 *Allied Orthopedic Appliances Inc. v. Tyco Health Care Grp. LP*, 592 F.3d 991 (9th Cir. 2010).

48 *Church & Dwight*, 868 F. Supp. 2d at 901–03.

49 *See id.* at 886, 911–12.

50 *See id.* at 886 ("[C]ondoms are unique products that rely heavily on point of sale advertising because manufacturers face constraints in television and print advertising. In that respect, condoms are generally displayed on, and sold from, pegboards and shelves in one area of a store where consumers can quickly glance at them at once. The number and visibility of products available from a particular brand are therefore important in condom sales because of the private nature of the transaction and the speed by which buying decisions are made.").

51 *See id.* at 921.

52 *See id.*

53 *See* Mills (2010); n. 37 above and accompanying text.

with the economics that we outlined above, we should expect to see contracts that more precisely condition the retailer's discount on shelf-share measures that better reflect what Church & Dwight is purchasing from the retailer: the promotional value of the shelf space as a means of advertising to consumers.

4 Output and Welfare

Finally, we examine the relationship between output and welfare. Recent commentators have criticized the use of output tests in antitrust law. They argue that increases in output from conduct or transactions do not necessarily indicate that welfare also increases.[54] While it is certainly the case that there are well-known examples of conduct where increased output is associated with reduced measures of welfare, the important question when evaluating conduct on a case-by-by case approach is not whether such examples exist. Rather, the usefulness of output comes from its ability to distinguish between competing pro- and anticompetitive hypotheses with regard to the effect of the conduct.

In both examples that we set out above, the effect of the conduct on output can be used as a reliable indicator of the effect on consumer or total welfare. For example, in the case of metering, an increase in the output of the capital good is a necessary condition for welfare to increase.

Relative to a "but-for" world where the seller appropriates the return to the patent by setting a uniform price for the capital good, the price of the capital good decreases, and output of the capital good increases. In the case of an implied license the explicit price of the capital good is set to zero.

Moreover, an increase in the output of the consumable is a sufficient but not necessary condition for total welfare to increase. While the price of the consumable increases, the resulting lost sales on the intensive margin will be less valuable than are the sales that are gained on the extensive margin.[55]

For this reason, total welfare can increase even if output of the consumable decreases. Consumer welfare can increase or decrease—depending on the size of the avoided transactions costs.

Newman (2022) cites two examples of price discrimination as examples of what he calls the "output-welfare fallacy". First, he discusses perfect price discrimination, which is allocatively efficient, but eliminates consumer welfare. Second, he notes that when third-degree price discrimination is possible, and both types are served with a uniform price, one type protects the other from price increases.

[54] *See, e.g.*, Newman (2022). *See also* Hovenkamp (2021, p. 815); Allensworth (2016, p. 19); Rosenquist et al., (2022, pp. 438, 475); Crane (2005, pp. 343, 376); Nagler (2011, p. 410).

[55] As we noted above, consumer surplus increases as long as consumption of the consumable weakly increases because the lost purchases of low b_i demanders on the intensive margin (below $m^{**}=55$) are replaced by an equal or greater number of high-value purchases on the extensive margin (above $m^{**}=55$) by high b_i demanders who are induced to purchase a small number of high-valued units of the consumable by the zero explicit license fee for the use of the patent.

Newman's price discrimination analysis is unconvincing and incomplete: first-degree price discrimination does demonstrate a form of non-linear pricing where output and consumer surplus are negatively correlated (relative to uniform pricing). However, first-degree price discrimination is the quintessential example of "blackboard economics": seen in theory but not in practice.

Newman's other example derives from the well-known and ubiquitous analysis of third-degree price discrimination.[56] Indeed, with linear cost and demand, total output is unchanged when both types are served at the uniform price, and total welfare falls when price discrimination is imposed.[57] But his analysis misses the fact that when the marginal type is not served with a uniform price, then third-degree price discrimination that allows both types to be served unambiguously increases both output and total and consumer welfare.[58]

The example that was presented in Section II examines metering: a form of second-degree price discrimination and a frequent source of antitrust inquiry, unlike first-degree price discrimination.[59] As we discussed above, the total welfare result in the analysis of metering is the opposite of the familiar result from third-degree price discrimination where relatively high-valued uses from one type of users are replaced by relatively low-valued uses of the other type.

In contrast, the opposite is true under our example of metering and implied licensing[60]: Low-valued marginal uses of the consumable product on the intensive margin are replaced by higher-valued uses on the extensive margin. In addition, the seller and consumers benefit from the transaction costs savings that are associated with not having to incur the costs of explicitly licensing the patent t. When t is large enough, consumer welfare also will improve when the seller moves from linear pricing to an implied license.

Output is also key to distinguishing between the anticompetitive and procompetitive hypotheses in the loyalty discount example: the anticompetitive hypothesis is that the loyalty discount contract raises rivals' costs, deprives the rival of the opportunity to compete for minimum efficient scale by locking up an input (e.g., shelf space) for a significant period of time, and enables the incumbent to raise the market price and reduce output. The theory of harm in a claim that alleges that loyalty discounts violate the antitrust laws is precisely that, because the conduct raises the costs of a rival to expand its own output, the contracts will successfully result in higher market prices and reduced market output.[61]

On the other hand, the procompetitive explanation of loyalty discount contracts is that they align the incentives of manufacturers and distributors that surround the supply of promotional effort, and thus increase demand and generate greater output.[62] Loyalty discounts can effectively reduce the price to marginal consumers, and

[56] Newman (2022, p. 603).

[57] Kaftal & Pal (2008, p. 565); Elhauge (2009, pp. 431–3).

[58] *See id.*

[59] *See* Kobayashi (2008, p. 15); Wright (2006, pp. 335–39).

[60] *See* Elhauge (2009), and n. 23 above.

[61] *See* Moore & Wright (2015, pp. 1211, 1214).

[62] *See id.*, pp. 1236–37.

thereby increase output.[63] The result of the loyalty contract—as with other vertical restraints such as resale price maintenance—may be to move along the demand curve effectively with additional sales to marginal consumers.

Incentive alignment over promotional services might also result in a shift—an increase—in demand. In former case, the nominal price might remain the same while output increases; in the latter case, both price and output increase.

The key insight is that in the case of vertical restraints, both the anticompetitive and procompetitive theories may predict an increase in price. However, output provides clear identification as the competing theories point in opposing directions.

This general insight—that output can provide a much more reliable predictor of competitive effects than price or other signals—occurs in many settings: as we discussed above, vertical restraints are one such example. Another is assessing competitive effects in a multisided market setting.[64] For platforms, focusing solely upon price is complicated by the fact that there are two prices that determine output for transactional platforms such as payment cards and services such as Uber or Airbnb. With non-transaction platforms—such as search engines—the prices on each side are interrelated by cross-group effects.

In these settings, with significant cross-group effects, price can be a noisy and unreliable signal for overall consumer welfare as compared to single-sided markets. In transactional platforms, the shared output level inextricably binds each side together and makes for a superior and more reliable measure of welfare. Even in non-transactional platforms, output is a more reliable measure than price in a setting where it is well known that one side often "subsidizes" the other with low or zero prices that are accompanied by supra-competitive prices on the other side.

Newman's critique is based on the fact that consumers are "not all identical" and claims that this "effect can occur whenever add-on services offer less value to inframarginal consumers than to marginal consumers—as is often the case."[65] To demonstrate this theoretical possibility, Newman uses an example from Comanor (1985, pp. 993–96) where the demand for high-valued inframarginal users is not affected by the add-on service, but generates a perfectly elastic demand over a large enough range so that the new higher profit-maximizing price equals the new willingness to pay along this segment. This results in reduced consumer surplus for the inframarginal users and no consumer surplus for the marginal users.

But showing that consumer welfare can fall when output increases in specialized circumstances is not the same as showing that this effect can occur "whenever add-on services offer less value to inframarginal consumers than marginal consumers." To see this, consider, for example, the type of demand rotation that we used in Section III of this paper: in particular, let $P = a - \frac{bQ}{\alpha}$, where $\alpha = 1$ without promotion and $\alpha > 1$ with promotion. Under these conditions, promotion increases demand by rotating it outward from the vertical axis, and for any equilibrium price P^*, will "offer less value to inframarginal consumers than marginal consumers."

[63] *See generally* Klein & Lerner (2016).

[64] *See* Wright & Yun (2019, p. 733).

[65] Newman (2022, p. 590).

If c is the marginal cost of producing a unit of Q, then equilibrium output equals:

$$Q^* = \frac{(a-c)\alpha}{2b}.$$

Thus, promotion increases output, as increases in α increase the equilibrium quantity. Increasing α also increases consumer surplus:

$$CS = \frac{(a-P^*)Q^*}{2} = \frac{b[Q^*]^2}{2\alpha} = \frac{\alpha}{8b}(a-c)^2.$$

Under these circumstances, promotion will simultaneously increase output and consumer welfare in a case where it offers "less value to inframarginal consumers than to marginal consumers."

5 Conclusion

Outside the world of frictionless contracts, a firm's contract choice decisions with respect to prices for its products or services, the supply of efficient promotional services, and other dimensions of performance will depend upon transactions and information costs. Extending Demsetz's seminal insights with regard to the implications of transaction costs for contract choice and economic efficiency, we demonstrate how the information and transaction costs that are inherent in providing a market (for ancillary promotional efforts) influence contract choice—including the decision not to price valuable assets explicitly—such as promotional effort.[66]

Two examples of non-linear pricing that are commonly used by firms—and are frequently the subject of antitrust scrutiny—elucidate this conclusion: metered pricing; and various forms of loyalty discounts, including market-share discounts. We expound on how the presence of transaction and information costs alters a firm's pricing structure and how this choice affects measures of output and welfare.

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Declarations

Conflict of interest The authors declare no competing interests.

[66] *See* Demsetz (1968a; 1968b).

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