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THE DEADWEIGHT LOSS OF COUPON REMEDIES FOR PRICE OVERCHARGES*

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Consumers injured by price overcharges often are awarded coupons that can be used for a limited period of time to purchase the good at a price below that which prevails after the overcharge has been eliminated. Coupon remedies cause a deadweight loss by inducing excessive consumption by consumers with relatively low demand during the remedy period. The magnitude of the loss can be comparable to that caused by the price overcharge. As demand variability goes to zero, the deadweight loss from coupon remedies goes to zero. Eliminating the expiration date for the use of coupons does not eliminate the loss.

I. INTRODUCTION

IN MANY LAWSUITS ALLEGING THAT PRICES ARE IMPROPERLY HIGH, the remedy takes the form of awarding injured consumers coupons that can be used to purchase the good at a price below that which prevails after the overcharge has been eliminated. Such coupons usually have an expiration date and either are not transferable or are limited in their transferability.[1] For example, in 1994 passengers who had traveled on major U.S. airlines between January 1988 and June 1992 received coupons with a total face value of approximately $400 million that could be applied toward their cost of subsequent flights; these coupons expired after three years and could be transferred only to immediate family members or to someone designated in advance.

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[1] Even when transfers are permitted, markets for coupons might not arise because of transaction costs.

Although coupon remedies have been widely used (in over nine per cent of class actions),[2] commentators generally are critical of them. The dominant reason is that coupons are thought to facilitate settlements between the lawyers representing the class of consumers and the defendant that are not in the interests of the consumers. Because the lawyers' compensation usually is based in large part on the value of the remedy to the class, the lawyers will try to convince the judge who has to approve the settlement that the coupons are worth close to their face value, even though many, if not most, of the coupons will not actually be used.[3] If the lawyers succeed, they may be well rewarded, while the effective cost to the defendant of the settlement will be relatively low; and consumers will obtain a remedy that is of relatively little value.

Our analysis of coupon remedies focuses on a different criticism—even if consumers are adequately compensated by the award of coupons, the coupons can significantly distort their consumption decisions.[4] To see why, suppose that individual demand for a product (for example, airline travel) is stochastic from period to period. Consider a consumer whose demand in the remedy period is substantially less than that in the injury period. Such a consumer will have a surplus of coupons and be induced to buy a socially excessive amount of the good during the remedy period—the availability of the coupons effectively lowers the price of the good below the remedy-period price, which we assume to be the competitive price. But if the consumer's demand is higher in the remedy period, there will not be a distortion. This is because he will purchase more of the good at the competitive price than he did during the injury period at the marked-up price, resulting in his running out of coupons. Consequently, his marginal purchases during the remedy period will be at the competitive price. The deadweight loss of coupons thus depends on the number of consumers in the first situation and the extent of each consumer's distortion. We demonstrate that the deadweight loss from excessive consumption induced by the coupon remedy can be comparable in magnitude to the deadweight loss from insufficient consumption due to the price overcharge during the injury period.

Because the deadweight loss of coupons depends on the number of consumers whose demand in the remedy period is sufficiently less than that

[2] See Willging and Wheatman [2005, p. 51, Table 20]. In a similar vein, Leslie [2005, p. 1396] concludes that 'coupon settlements are sufficiently prevalent that they warrant scholarly and government attention . . . .'

[3] According to Gramlich [1986, p. 274], the average coupon redemption rate for consumer and corporate plaintiffs combined is 26.3 per cent. For consumer plaintiffs alone, it is 13.1 per cent.

[4] The possible distorting effect of coupons on consumption decisions has been noted in passing by Gramlich [1986, p. 268] and Borenstein [1996, p. 384], but has not been analyzed previously. Other examinations of coupon remedies have focused on different points. See note 5 below.

in the injury period, a key determinant of the loss is the variability of demand. We show that as demand variability between the injury period and the remedy period goes to zero, the deadweight loss goes to zero. This result is easiest to understand if demand is the same from period to period. Then it will always be the case that consumption during the injury period at the marked-up price—and hence the number of coupons awarded—would be less than consumption during the remedy period at the competitive price. Consequently, all of the coupons would be used for inframarginal purchases and would not result in excessive consumption.

We also consider the desirability of extending the period of time during which coupons can be used. We demonstrate that the deadweight loss from coupons does not go to zero as the number of remedy periods increases. This result may be surprising because one might think that the longer a consumer has to use coupons, the more likely they will be used for purchases that would have been made anyway—not causing a consumption distortion—and if they can be used forever, all coupons would be used in this way. Extending the expiration date for coupons does not eliminate the distortion, however, because a positive discount rate makes it privately worthwhile for consumers to use some coupons during early remedy periods to make purchases that they otherwise would not have made—the value of these purchases exceeds the present value of later inframarginal purchases to which the coupons could be applied.

Our article is organized as follows. Section II presents the model used to analyze coupons. Section III derives the main results, including the two limiting results discussed above. Section IV contains an example that is used to illustrate the main results and provide plausible magnitudes of the deadweight loss. Section V concludes with some remarks about, among other things, how firms set prices in response to coupons and alternatives to coupon remedies.[5]

[5] We are aware of only four analytical studies of coupon remedies. Gramlich [1986] discusses several rationales for using coupon remedies and, in an unpublished appendix, formally analyzes the effects of coupons on the market equilibrium under different assumptions about, among other things, the existence of nondefendant sellers, the cost of production, and market power. Borenstein [1996] focuses on the motivation of firms to raise prices in response to the availability of coupons applicable to their goods, and proposes a time-unlimited coupon remedy that mitigates this effect (see also note 6 below). Gramlich [2003] evaluates how the form of the coupon remedy—whether it is a fixed discount, a percentage discount, or the right to buy at a fixed price—affects the benefits obtained by consumers, the profits lost by the defendant, and the efficiency (total surplus) of the market when firms have market power. Polinsky and Rubinfeld [2007] develop an argument for a hybrid remedy that includes the use of coupons—giving consumers a choice between a cash amount and a certain number of coupons—as a mechanism to facilitate the proper measurement of damages. Coupon remedies also are discussed informally in several law review articles. See, for example, Note [1996], Miller and Singer [1997], and Leslie [2002].

II. THE MODEL

The cost of producing the good at issue is assumed to be constant per unit, with no fixed costs. During the injury period, the producer wrongfully charges more than the competitive price—which we treat as the marginal cost of production. We assume for simplicity that after the price overcharge has been stopped, the remedy does not affect the price that would otherwise prevail, and that this price is the competitive price (we relax both of these assumptions in the concluding section).[6] Let

$$c = \text{constant marginal cost of production; and}$$
$$m = \text{price markup during the injury period.}^{7}$$

Thus, the price during the injury period is $c + m$, and the price thereafter is c, aside from the effect of the remedy.

As noted in the introduction, a key determinant of the deadweight loss of coupon remedies is the extent to which a consumer's demand in the remedy period differs from that in the injury period. For simplicity, we assume that each consumer's demand is non-stochastic and identical in the injury period, but stochastic in the remedy period. Let

$$D(p) = \text{consumer demand in the injury period; and}$$
$$\varepsilon = \text{additive random term affecting demand in the remedy period,}$$

where ε is assumed to be continuously and symmetrically distributed with mean zero and support no greater than $(-D(0), D(0))$.[8] The population of consumers is normalized to be unity, which allows us to refer to an individual consumer and the class of consumers interchangeably.

Next consider the losses suffered by consumers during the injury period. Let

$$K = \text{the consumer surplus loss during the injury period due to the price markup.}$$

[6] Borenstein [1996, pp. 386–92] shows that the price charged by sellers generally will increase in response to the existence of coupons. We make our assumption in order to distinguish our points from those of Borenstein and to focus on the effects of the remedies on consumption distortions. Moreover, we demonstrate in the concluding section that even if a firm raises its price in response to coupons, the price increase is less than the value of the coupon, so the price net of the coupon still declines as the value of the coupon rises.

[7] Although our numerical example utilizes the monopoly markup, our general qualitative conclusions hold for any markup.

[8] Limiting the support of ε in this way assures that demand will be positive for some range of sufficiently low prices.

Thus,

$$(1) \qquad K = \int_{c}^{c+m} D(p)dp.$$

We assume that the benefit conferred by the coupon remedy equals K, so that consumers are made whole.[9]

Consumers who bought the good at the marked-up price are given coupons equal in number to the units of the good that they purchased during the injury period.[10] The coupons then can be used to buy the good during the remedy period at the competitive price c less the face value of the coupon.[11,12] We initially assume that there is one remedy period equal in length to the injury period. Let

r = face value of each coupon; and

$\hat{q}$ = number of coupons awarded to each consumer,

where

$$(2) \qquad \hat{q} = D(c+m).$$

Since demand is $D(p) + \varepsilon$ in the remedy period, consumption in that period is

$$(3) \qquad \begin{cases} 0 \text{ if } \varepsilon \leqslant -D(c-r) \\ D(c-r) + \varepsilon \text{ if } -D(c-r) < \varepsilon < -[D(c-r) - \hat{q}] \\ \hat{q} \text{ if } -[D(c-r) - \hat{q}] \leqslant \varepsilon < -[D(c) - \hat{q}] \\ D(c) + \varepsilon \text{ if } \varepsilon \geqslant -[D(c) - \hat{q}] \end{cases}$$

These cases are illustrated in Figure 1 by the four demand curves $D(p) + \varepsilon_1$ through $D(p) + \varepsilon_4$, respectively.

The first possibility (first row of (3) and $D(p) + \varepsilon_1$ in Figure 1) occurs when demand in the remedy period is so low that nothing would be purchased even

[9] The assumption that consumers are made whole is applied on a class-wide basis, not on an individual-by-individual basis. Some consumers will benefit from coupons by more than their harm from the markup (those with relatively high demand in the remedy period), and some by less (those with low demand in the remedy period).

[10] We make this assumption because it corresponds most closely to the use of coupons in practice. In section V, however, we suggest that awarding fewer coupons will reduce the deadweight loss.

[11] Although producers will be losing money on the sale of goods purchased with coupons, we assume for reasons outside of our model that they will not exit the industry. Such reasons might include the temporary nature of the remedy, the long-term reputational interests of firms, and the transactions costs associated with exit and re-entry.

[12] We do not consider the possibility of allowing consumers to apply multiple coupons to the purchase of a single unit of the good. Such a policy could be socially desirable, however, as we point out in section V below.

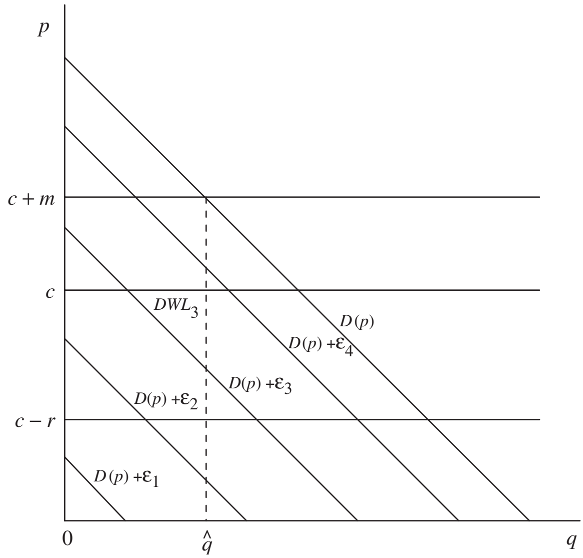

Figure 1

at the discounted price $c - r$. In this case coupons have no value to consumers and there is no distortion of their consumption since they would not have purchased the good at the competitive price c.

The second possibility occurs when demand is high enough to generate some purchases at price $c - r$, but not high enough to exhaust the use the coupons. Coupons then are valued by consumers at less than their face value r both because some are not used and because the marginal consumer surplus for at least some purchases is less than the face value of the coupon. In this case coupons lead consumers to buy more of the good than they would have at the competitive price and thereby distort consumption.

The third possibility occurs when demand is higher and results in all of the coupons being used, but not sufficiently high to generate additional purchases at the competitive price c. In this case, too, coupons are valued at less than their face value—marginal consumer surplus for at least some purchases is less than r—and cause consumers to buy too much of the good.

The last possibility occurs when demand is higher still, resulting in consumption at price c equal to or greater than the number of coupons. In this case coupons are used for inframarginal purchases, are valued at their face value r, and do not result in any distortion.

Let

$$V = \text{expected value of coupons to consumers.}$$

It follows from the preceding discussion that[13]

$$(4) \qquad V = E\left[\int_{c-r}^{c} \min[D(p) + \varepsilon, \hat{q}]dp\right].$$

In other words, V equals the consumer surplus from the coupons used by consumers who have positive demand at the discounted price $c - r$, subject to the constraint that they cannot use more coupons than the $\hat{q}$ that they were awarded. Setting V equal to K and solving for r determines the face value of the coupons that makes consumers whole.

Similarly, let

$L =$ deadweight loss from the excess consumption induced by coupons.

Again, it follows from the discussion of (3) that

$$(5) \qquad L = E\left[\int_{c-r}^{c} [\min[D(c-r) + \varepsilon, \hat{q}] - \min[D(p) + \varepsilon, \hat{q}]]dp\right].$$

The deadweight loss with respect to each consumer consists of the difference between production cost c and his willingness to pay for consumption beyond that which would occur at price c, up to his demand at price $c - r$, subject to the constraint that he cannot use more than $\hat{q}$ coupons, and provided that his demand at price c is less than $\hat{q}$ (otherwise all of the coupons would be used for inframarginal purchases and there would not be a deadweight loss). For example, when demand corresponds to $D(p) + \varepsilon_3$ in Figure 1, the deadweight loss is the triangle labeled DWL_3.[14]

III. ANALYSIS

In this section we show that: (1) the face value of coupons must exceed the price markup; (2) coupons cause a deadweight loss if the variance of demand is sufficiently great; (3) the deadweight loss goes to zero as the variance of demand goes to zero; (4) the deadweight loss generally declines if consumers

[13] We do not formally include in the following expression, or in subsequent expressions, the constraint that demand cannot be negative if ε is sufficiently low. This omission does not affect any of our results, but it allows us to write the expressions in a simpler way (for example, referring in (4) to $D(p) + \varepsilon$ rather than $\max[D(p) + \varepsilon, 0]$).

[14] To the extent that coupons are valued by consumers at less than their face value, resulting in a deadweight loss, the payment by the injurer required to make consumers whole will exceed the loss suffered by consumers. If optimal deterrence of potential injurers rather than compensation of consumers is the goal, it may be desirable to lower the face value of coupons. Our qualitative results regarding the deadweight loss of coupons hold in either case. The only difference is that the magnitude of the deadweight loss would be lower if the face value of coupons is lower.

are given additional time to use their coupons; and, (5) the deadweight loss is positive even if coupons can be used forever.

Proposition 1. The face value of coupons r that makes consumers whole exceeds the price markup m.

Proof: We prove this by contradiction. Specifically, we show that if $r \leqslant m$, $V < K$, so consumers would not be made whole. Since $\min[D(p) + \varepsilon, \hat{q}] \leqslant \hat{q}$, observe from (4) that

$$V \leqslant E\left[\int_{c-r}^{c} \hat{q}dp\right] = \hat{q}r. \tag{6}$$

Furthermore, since $D(p) > \hat{q}$ for $p \in [c, c+m)$,

$$\hat{q}m < \int_{c}^{c+m} D(p)dp = K. \tag{7}$$

Hence, if $r \leqslant m$, $V < K$, so r must strictly exceed m in order for consumers to be made whole. ■

Comment: The face value of coupons must exceed the markup both because consumers do not receive coupons to compensate them for their reduced consumption during the injury period due to the markup, and because some of the coupons they do receive are valued at less than their face value (for reasons explained in the paragraphs following (3)).

Proposition 2. The deadweight loss of coupons L is positive if the variance of demand $Var(\varepsilon)$ is sufficiently great.

Proof: (i) Since $D(c-r) \geqslant D(p)$ for $p \in [c-r, c]$, it is clear that the integrand in (5) cannot be negative. Thus, to establish that $L > 0$, it is sufficient to show that there exists an interval of ε and an interval of p for each ε in its interval over which the integrand is strictly positive. We demonstrate that such intervals exist if the lower bound on the support of ε—designated $\underline{\varepsilon}$—is sufficiently low.

(ii) Specifically, suppose that $\underline{\varepsilon} < -[D(c) - \hat{q}]$. Then for every ε in the interval $[\underline{\varepsilon}, -[D(c) - \hat{q}]), D(c) + \varepsilon < \hat{q}$. Given ε, there clearly exists an interval of p, say $(\tilde{p}(\varepsilon), c]$, where $c - r < \tilde{p}(\varepsilon) < c$, such that for $p \in (\tilde{p}(\varepsilon), c]$, $D(p) + \varepsilon < \hat{q}$ and the integrand of (5) is strictly positive. Thus, if $\underline{\varepsilon} < -[D(c) - \hat{q}], L > 0$.

(iii) Given the assumption that ε is continuously and symmetrically distributed around 0, if the support of ε is $[-[D(c) - \hat{q}], [D(c) - \hat{q}]]$, an upper bound on the variance of demand is $[D(c) - \hat{q}]^2$, which occurs when ε equals $-[D(c) - \hat{q}]$ and $[D(c) - \hat{q}]$ with equal probability. Therefore, if

$Var(\varepsilon) > [D(c) - \hat{q}]^2$, $\underline{\varepsilon}$ must be below $-[D(c) - \hat{q}]$, in which case, by step (ii), $L > 0$. ■

Comment: Coupons cause a deadweight loss when they induce consumers in the remedy period to purchase more of the good than they would have at the competitive price c. If demand is sufficiently low in the remedy period, consumption at price c will be less than the number of coupons $\hat{q}$, in which case the use of coupons lowers the effective marginal price to $c - r$ and results in excessive consumption and a deadweight loss. If the variance of demand in the remedy period is sufficiently great, there will be some consumers with low enough demand to generate this outcome.

Proposition 3. The deadweight loss of coupons L goes to zero as the variance of demand $Var(\varepsilon)$ goes to zero.

Proof: If $Var(\varepsilon) = 0$, $\varepsilon = 0$. Then, since $\min[D(c - r), \hat{q}] = \hat{q}$ and $\min[D(p), \hat{q}] = \hat{q}$ for $p \in [c - r, c]$, $L = 0$. The result follows, given continuity. ■

Comment: The intuition behind this result is apparent in the limiting case in which demand in the remedy period is the same as demand in the injury period. In this case, consumption in the injury period at the marked-up price $c + m$—which determines the number of coupons awarded—clearly will be less than consumption in the remedy period at the competitive price c. Hence, all coupons will be used in the remedy period for inframarginal purchases and will not distort consumption. The lower the variance of demand in the remedy period, the closer the outcome is to the one just described.

Before proceeding, we need to modify the model in section II to allow for multiple remedy periods—in effect extending the expiration date of coupons. In the multiple-remedy-period model, consumers decide in each period how many coupons to use and how many to save for possible future use. This decision depends on the distribution of the random term ε and on the discount rate. Let

$$\delta = \text{per-period consumer discount factor;}\ 0 < \delta < 1.$$

Proposition 4. If all coupons would be utilized when there is one remedy period, the deadweight loss of coupons declines if the number of remedy periods is increased to two.

Proof: (i) For all coupons to be utilized when there is one remedy period, ε must equal or exceed $-[D(c - r) - \hat{q}]$ (see the discussion following (3)). We assume that this is the lower bound of the support of ε.

(ii) If there is one remedy period, let V_1 be the resulting expected value of coupons to consumers and r_1 be the face value of coupons that makes consumers whole, so

$$(8) \qquad V_1 = E\left[\int_{c-r_1}^{c} \min[D(p)+\varepsilon, \hat{q}]dp\right] = K.$$

Similarly, let L_1 be the resulting deadweight loss:

$$(9) \qquad L_1 = E\left[\int_{c-r_1}^{c} [\hat{q} - \min[D(p)+\varepsilon, \hat{q}]]dp\right].$$

(iii) Now suppose there are two remedy periods. If the face value of coupons remained at r_1, it would be privately optimal for consumers to defer some coupons to the second period for ε sufficiently close to $-[D(c-r)-\hat{q}]$ (since at $\varepsilon = -[D(c-r_1)-\hat{q}]$, the marginal value of a coupon is zero). Consequently, the face value of coupons must decline; otherwise, the value of coupons to consumers would exceed K. Let $r_2 < r_1$ be the face value of coupons when there are two remedy periods, $q_1(\varepsilon)$ be the number of coupons used in the first period, and let $q_2(\varepsilon) = \hat{q} - q_1(\varepsilon)$. Now the discounted expected value of coupons to consumers that makes them whole is

$$(10) \qquad \begin{aligned} V_2 = {} & E\left[\int_{c-r_2}^{c} \min[D(p)+\varepsilon, q_1(\varepsilon)]dp\right] \\ & + \delta E\left[\int_{c-r_2}^{c} \min[D(p)+\varepsilon, q_2(\varepsilon)]dp\right] \\ = {} & K. \end{aligned}$$

The corresponding deadweight loss is

$$(11) \qquad \begin{aligned} L_2 = {} & E\left[\int_{c-r_2}^{c} [q_1(\varepsilon) - \min[D(p)+\varepsilon, q_1(\varepsilon)]]dp\right] \\ & + \delta E\left[\int_{c-r_2}^{c} [min[D(c-r_2)+\varepsilon, q_2(\varepsilon)] - \min[D(p)+\varepsilon, q_2(\varepsilon)]]dp\right]. \end{aligned}$$

(iv) We now show that $L_2 < L_1$. Since $V_1 = V_2 = K$, substitute the terms between the equal signs in (10) for the second term on the right-hand side of (9). Then the condition that $L_2 < L_1$ can be seen to be equivalent to

$$(12) \qquad \begin{aligned} & E\left[\int_{c-r_2}^{c} q_1(\varepsilon)dp\right] + \delta E\left[\int_{c-r_2}^{c} \min[D(c-r_2)+\varepsilon, q_2(\varepsilon)]dp\right] \\ & \qquad < E\left[\int_{c-r_1}^{c} \hat{q}dp\right] = r_1\hat{q}. \end{aligned}$$

The left-hand side of (12) is less than or equal to

$$(13) \qquad E\left[\int_{c-r_2}^{c} [q_1(\varepsilon) + \delta q_2(\varepsilon)]dp\right],$$

which is less than or equal to $r_2\hat{q}$ since $q_1(\varepsilon) + \delta q_2(\varepsilon) \leqslant \hat{q}$. The result then follows from the fact that $r_2 < r_1$. ■

Comment. One would expect that the greater flexibility that consumers have as a result of a later expiration date would lead to a lower deadweight loss of coupons. For example, coupons that would be used when there is only one remedy period to acquire units of the good that otherwise would not have been purchased might be employed instead in a subsequent remedy period to buy units of the good that would have been purchased anyway. The fact that the face value of coupons declines when there are multiple remedy periods reinforces the conclusion that the deadweight loss will be reduced. (It is apparent from this logic that the deadweight loss also would decline if the number of remedy periods were extended from one to more than two.)

Proposition 4 does depend, however, on the assumption that all coupons are utilized when there is one remedy period. If this were not the case, we could not rule out the possibility that there would be increased coupon usage when the number of remedy periods increases and that this increased usage would lead to greater deadweight loss.

Proposition 5. If the deadweight loss of coupons L is positive when there is one remedy period, the deadweight loss does not go to zero as the number of remedy periods goes to infinity.

Proof: (i) We first demonstrate in the one-remedy-period model that if $L > 0$, it must be that $\underline{\varepsilon}$, the lower bound on the support of ε, is less than $-[D(c) - \hat{q}]$. Step (ii) of the proof of Proposition 2 established that if $\underline{\varepsilon} < -[D(c) - \hat{q}], L > 0$. We now show that if $\underline{\varepsilon} \geqslant -[D(c) - \hat{q}]$, $L = 0$. If $\varepsilon \geqslant -[D(c) - \hat{q}], D(c-r) + \varepsilon \geqslant D(c-r) - D(c) + \hat{q} > \hat{q}$. Hence, $\min[D(c-r) + \varepsilon, \hat{q}] = \hat{q}$. Similarly, for $p \in [c-r, c], D(p) + \varepsilon \geqslant D(p) - D(c) + \hat{q} \geqslant \hat{q}$, so $\min[D(p) + \varepsilon, \hat{q}] = \hat{q}$. Thus, $L = 0$.

(ii) Now suppose there are n remedy periods, where $n \geqslant 2$, and let $r(n)$ be the corresponding face value of coupons that makes consumers whole. If a coupon is not used during the first remedy period, its present value is at most $\delta r(n)$, and then only if it is used in the second remedy period for an inframarginal purchase (so that its value in the second remedy period is its face value $r(n)$).

(iii) We next show that the deadweight loss in the first remedy period of an n-remedy-period model has a positive lower bound, $\underline{L}_1(n) > 0$. Let

$v(n) = \delta r(n)$. Consider a consumer for whom $\varepsilon \in [\max[\underline{\varepsilon}, -D(c)], -[D(c) - \hat{q}])$. If that consumer does not use any coupons in the first remedy period, his consumption would be $D(c) + \varepsilon < \hat{q}$ and the marginal value of a coupon at that level of consumption would be $r(n) > v(n)$. He clearly will increase consumption, and use some coupons, at least until the marginal value of a coupon declines to $v(n)$, which occurs at $D(c - r(n) + v(n)) + \varepsilon$, unless he exhausts his coupons before reaching that level of consumption. The consumption between $D(c) + \varepsilon$ and $\min[D(c - r(n) + v(n)) + \varepsilon, \hat{q}]$ results in a deadweight loss. Hence,

$$\underline{L}_1(n) = E\left[\int_{c-r(n)+v(n)}^{c} [\min[D(c - r(n) + v(n)) + \varepsilon, \hat{q}] - \min[D(p) + \varepsilon, \hat{q}]]dp\right] > 0, \tag{14}$$

where the expectation is over the interval $\varepsilon \in [\max[\underline{\varepsilon}, -D(c)], -[D(c) - \hat{q}]]$.

(iv) The final step is to show that $\underline{L}_1(n)$ does not go to zero as $n \to \infty$. We assume that the relevant limits exist. First observe that $\hat{q}r(n)$ is an upper bound on the value of coupons to a consumer. The limit of $r(n)$ as $n \to \infty$ must be positive; otherwise, consumers would not be made whole for n sufficiently large. Since $v(n) = \delta r(n)$, the limit of $v(n)$ also is positive. Hence, the limit of $\underline{L}_1(n)$ is positive. ■

Comment: No matter how a consumer decides to use his coupons over time, the present value of a coupon whose usage is delayed will be less than its face value because of discounting. Specifically, as noted in the proof, if a coupon is not used during the first remedy period, its present value is at most $\delta r(n)$, its face value discounted by one period. Thus, the consumer will have an incentive in the first remedy period to continue using coupons as long as their value exceeds $\delta r(n)$, which implies that some purchases will be made using coupons that are valued at less than their face value. Since these are purchases that would not have been made without the coupons (otherwise the coupons would have been valued at their face value), their usage results in a deadweight loss. Note that this logic holds regardless of the length of time the coupons can be used.[15]

IV. AN EXAMPLE

We present an example that illustrates the preceding results and provides plausible magnitudes of the deadweight loss of coupon remedies. Because the calculations are straightforward, the details are omitted.

[15] It is clear from this argument that the deadweight loss will disappear as the discount factor δ goes to 1.

Suppose $D(p) = \$200 - p$, $c = \$100$, and monopoly price setting occurs during the injury period. Then the monopoly price markup is $m = \$50$, consumption at the monopoly price, and therefore the number of coupons issued, is $\hat{q} = 50$, and the consumer surplus loss in the injury period is \$3,750. Demand in the remedy period(s) is $D(p) \pm \varepsilon$ with equal probability, where $\varepsilon = \$100$.

If there is one remedy period, the face value of coupons that makes consumers whole is $r = \$87.50$ (exceeding the \$50 price markup, illustrating Proposition 1). At the discounted price $c - r = \$100 - \$87.50 = \$12.50$, consumers would want to purchase 87.5 units of the good if their demand in the remedy period is low, $D(p) - \varepsilon$, but they only have 50 coupons and therefore only buy 50 units of the good. At the competitive price $c = \$100$, their demand would have been 0. Thus, the coupons lead them to purchase 50 more units than is efficient, causing an expected deadweight loss of \$625. These results are illustrated in Figure 2, which shows the demand curve in the injury period, $D(p)$, the demand curve in the remedy period if demand is low,

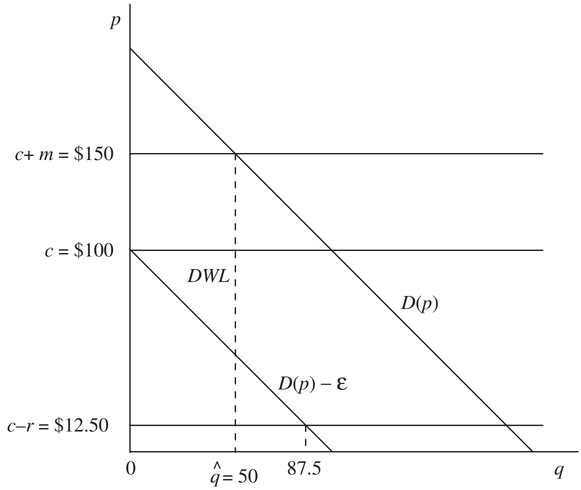

Figure 2

$D(p) - \varepsilon$, and the area representing the deadweight loss of coupons when demand is low, labeled DWL.[16]

If the variance of demand in the remedy period were higher, the deadweight loss would be greater. For example, if $\varepsilon = \$125$, the deadweight loss would be \$1,250. Conversely, if ε were lower, say \$75, the deadweight

[16] Area DWL in Figure 2 equals \$1,250. Because this loss occurs with a probability of .5, the expected deadweight loss of coupons in this example is \$625. (For simplicity, we do not illustrate the case when demand is high, $D(p) + \varepsilon$, because, for reasons explained previously, there is no deadweight loss in this case).

loss would be less, \$156.25; and for $\varepsilon \leqslant$ \$50, there would be no deadweight loss. This illustrates Propositions 2 and 3. To put the potential deadweight loss of the coupon remedy in perspective, note that the deadweight loss from the price overcharge in this example is \$1,250. Thus, the deadweight loss from coupons can be quite substantial relative to the deadweight loss from the original injury—even equal to it.

Now consider extending the use of coupons to a second remedy period and suppose the per-period discount factor is $\delta = .91$ (corresponding to a per-period discount rate of 10 per cent). Again, assume initially that $\varepsilon =$ \$100. The face value of coupons that makes consumers whole declines from \$87.50 to \$73.51. Consumers with low demand in the first-remedy period use 20 of their 50 coupons, saving the remainder for use in the second remedy period. The deadweight loss of coupons declines from \$625 to \$202.99, due to the fact that many more coupons are used for inframarginal purchases when there are two remedy periods than when there is one remedy period. This illustrates Proposition 4.

The preceding example shows that the reduction in the deadweight loss of coupons from extending their expiration date can be dramatic.[17] But, as noted in Proposition 5, the deadweight loss does not go to zero as the number of remedy periods increases. This result can be easily illustrated when $\varepsilon =$ \$75. In this case, the deadweight loss is \$24.18 if there are two remedy periods. Consumers with low demand in the first-remedy period use 32 of their 50 coupons. The 18 coupons they save for the second remedy period will be used for inframarginal purchases even if their demand is low again. Thus, no matter how many remedy periods there were in excess of two, consumer behavior would not be affected and the deadweight loss would remain at \$24.18.

V. CONCLUDING REMARKS

We conclude by discussing two extensions of our analysis and some alternative remedies.

(1) *Firm price setting in response to coupons*. In an influential article on coupons, Borenstein [1996] emphasized that firms will raise the price they charge if they are forced to offer coupons. This point, which we have ignored

[17] This observation is similar in spirit to the result in Gilbert and Shapiro [1990] on optimal patent life. They show that the deadweight loss of a patent can be reduced by increasing the life of the patent but narrowing its breadth so that the patent holder earns lower per-period profit. The analogue in our case is extending the expiration date of coupons but lowering their face value. However, much of the benefit from increasing the number of remedy periods in our analysis stems from the greater use of coupons for inframarginal, and therefore non-distorting, consumption, which does not have a parallel in the Gilbert-Shapiro discussion. Moreover, in an earlier version of our article in which we allowed for stochastic demand in the injury period as well as in the remedy periods, we provided an example in which the deadweight loss of coupons actually increases as the number of remedy periods is extended from one to two.

for simplicity, does not affect our conclusion that coupons lead to excessive consumption.

To understand why, consider Borenstein's analysis of firm decisionmaking in response to coupons. In his model demand is linear and non-stochastic, and the fraction of consumers who have coupons is treated as an exogenous parameter, α. He shows that the monopoly price is (in our notation) $c + m + \alpha r$, where m is the monopoly markup in the absence of coupons. The greater the fraction of consumers with coupons, or the higher the face value of coupons, the higher the price set by the monopolist.

After subtracting the value of the coupon r, the effective price paid by consumers with coupons therefore is $c + m - (1 - \alpha)r$. This price is decreasing in r, and can be made as low as desired by setting r sufficiently high. Thus, even though the firm responds to a higher coupon value by raising the price, it is possible to choose r so that consumers with coupons are able to purchase the good at a price below the competitive price c and thereby be compensated for the harm they suffered during the injury period. In other words, had we taken the Borenstein point into account in our analysis, coupons still could be used to compensate consumers for the price overcharge, and coupons still would result in excessive consumption and a corresponding deadweight loss. For simplicity, we assumed that firms do not respond to coupons by changing prices.

(2) *Benchmark prices that exceed marginal cost*. We calculated the harm to consumers from a price overcharge under the assumption that the price that would have prevailed in the absence of an overcharge—which we will refer to here as the benchmark price—equals marginal cost. If the benchmark price exceeded marginal cost, the harm suffered by consumers from any given inappropriately-set price would be less, and therefore the value of the coupons needed to make consumers whole would be less. To the extent this point applies, it lessens the problem of excessive consumption that we have focused on in this article.

Although the deadweight loss of coupons declines as the benchmark price rises, so too does the deadweight loss from the price overcharge. Thus, even if the benchmark price is above marginal cost, the distortion from excessive consumption due to coupons can remain important relative to the distortion from the price overcharge. If price overcharges are a social concern, then consumption inefficiencies due to the use of coupons probably should be as well.

(3) *Alternative remedies*. One might wonder why coupon remedies are employed in practice when a superior remedy is available—paying cash to the consumers injured by a price overcharge. While cash remedies can compensate consumers without distorting consumption in the way that coupon remedies do, coupon remedies are nonetheless widely used. The explanation may be the one we mentioned in the introduction—that coupon

remedies provide a way for plaintiff attorneys and defendants in class action cases to benefit at the expense of the class members.

Because coupon remedies undoubtedly will continue to be used, we mention here three ways to reduce their distorting effects. First, as we have shown, extending the period of time during which coupons can be used can dramatically reduce the deadweight loss of coupons. Second, allowing coupons to be fully transferable will make them more like a cash remedy, though the transactions costs of buying and selling coupons may significantly limit this benefit. Third, awarding fewer coupons than the number of units of the good purchased during the injury period (or, in a similar vein, allowing consumers to apply multiple coupons to the purchase of a single unit of the good) will increase the likelihood that coupons will be used for non-distorting inframarginal purchases.[18]

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[18] A countervailing factor is that the face value of coupons will have to rise to compensate consumers for receiving fewer coupons, so the distortions that do occur will be greater. Nonetheless, if the support of ε is not too great, a policy of awarding fewer coupons than the number of units purchased in the injury period can eliminate the distortion of coupons.