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Article

COMPETITOR COUPONS: A REMEDY FOR RESIDUAL COLLUSION*

Joseph E. Harrington, Jr.**

ABSTRACT

There are well-documented episodes of prices remaining at supracompetitive levels even after a cartel was shut down by the competition authority. As long as market conditions remain reasonably stable, collusive prices may still be incentive compatible so the collusive equilibrium could continue after firms are no longer engaging in illicit communications. This situation poses a challenging dilemma: consumer harm persists because of past unlawful conduct but there is no apparent recourse. This paper offers a remedy in the form of coupons. As part of the penalty imposed by the competition authority, each cartel member is required to distribute coupons to its past purchasers. Contrary to their usual form, these coupons can only be used to buy from a firm's *competitors*. I show how this temporary intervention can help destabilize collusion and restore competition.

KEYWORDS: collusion, antitrust, competition policy

I. INTRODUCTION

Residual collusion refers to the continuation of supracompetitive prices after a cartel has been shut down, by which I mean firms no longer communicate for the purpose of coordinating their prices. Although the discontinuance of a cartel's operations is typically followed with a decline in prices – as competition returns to the market – there are documented episodes for which prices remained at the level when the cartel was active. One explanation is that firms have switched from explicit collusion to tacit collusion.

To illustrate the phenomenon of residual collusion, consider the vitamins cartel. Encompassing about a dozen vitamins, the cartel began operating as early as 1990 and was no longer active by the late 1990s due to internal collapse or prosecution by competition authorities. Figure 1 shows the time path of the price for a vitamin A product. Starting from the beginning of the plea era period (which was the official cartel birth date), price gradually climbed, stabilized, and then drastically fell around 1999 in association with the investigations by the European Commission and the Antitrust Division of the U.S. Department of Justice. Although that is a typical cartel price path, another vitamin – beta-carotene – tells a very different story (Figure 2). Though again one observes price rising and then levelling off, there is not the sharp decline associated

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** Department of Business Economics & Public Policy, The Wharton School University of Pennsylvania, Philadelphia, PA, USA

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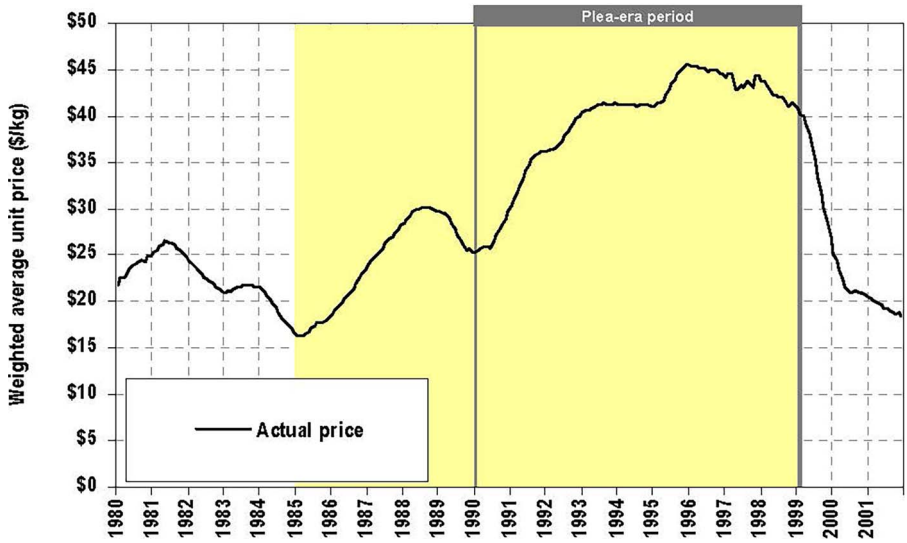

Figure 1. Vitamin A price. Source: Bernheim (2002).

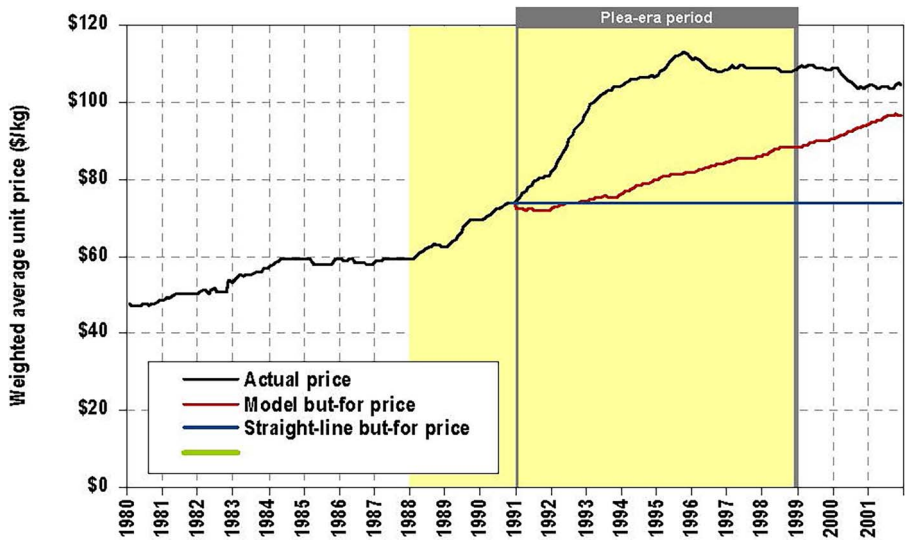

Figure 2. Beta carotene price (top curve). Source: Bernheim (2002).

with the cartel's discovery. Even after guilty pleas were submitted, price remained roughly at its level before the investigation. The most likely explanation is that firms continued to charge the collusive price even though the cartel was no longer operating.

It is not difficult to imagine that residual collusion could occur. During the time in which the cartel was active, it was stable for firms to charge supracompetitive prices. If market conditions remain largely the same and monitoring can be done without communication then the collusive arrangement could still be stable; the equilibrium conditions that were satisfied when the firms were meeting may still be satisfied when they are no longer meeting. Thus, residual collusion is plausible in theory and there is evidence that it exists in practice.

Residual collusion poses a serious enforcement challenge because consumer harm is occurring as a result of unlawful conduct but there is no apparent legal path for ending it. Firms cannot be prosecuted, for they have already been convicted of the competition law offense. In principle, price regulation could be used to force firms to price lower but that is a heavy-handed instrument which comes with various concerns: At what level to set price caps? How long should they be in place? As residual collusion would not be expected to persist indefinitely – eventually market conditions will change and undermine the stability of the collusive prices – price regulation runs the risk of interfering with the competitive process should regulation persist too long.

Another possible remedy for residual collusion is removal of managers through debarment (such as used in the United Kingdom) and incarceration (such as used in the United States). Replacing the managers who orchestrated collusion could disrupt the mutual understanding between firms necessary to transition from explicit to tacit collusion. Indeed, the experimental evidence in Chowdhury and Crede (2020) provides support for this remedy. [1] However, a limitation to this approach is that firms as organizations have institutional memories so the new managers could adopt the position that it makes sense to continue to charge supracompetitive prices. Although removing managers who engaged in explicit collusion is an appropriate policy for many reasons, it is not a panacea for residual collusion.

Ideally, a remedy for residual collusion would be a temporary intervention that destabilizes collusion and allows the market to return to competition. In this paper, such a remedy is proposed. As part of the penalty imposed by the competition authority, each cartel member is required to issue coupons to its past purchasers. Coupons have been previously used as part of damage litigation where a cartel member compensates a past purchaser through the provision of coupons to be used in making a future purchase from that firm. In contrast, the proposal here is that coupons can only be used for a future purchase from a *competitor* of the cartel member. Illustrating it with the vitamins cartel, BASF would offer coupons to its past beta carotene customers to buy beta carotene from Hoffman LaRoche, and Hoffman LaRoche would offer coupons to its past beta carotene customers to buy beta carotene from BASF. Referred to as *competitor coupons*, this paper shows how such coupons can destabilize collusion. Intuitively, if firms continue to charge the collusive price then they can expect to lose some of their past customers to a rival firm and, furthermore, to subsidize those purchases. As a result, the incremental profit gain from undercutting the collusive price is higher because, for every additional past purchaser who is retained, a coupon payment is avoided in addition to the profit earned from that customer. This serves to make the equilibrium conditions more stringent so it is less likely collusion is still stable.[2]

Section II summarizes some empirical evidence of residual collusion. In laying the groundwork for proposing a remedy for residual collusion, Section III describes a simple market model. After describing firm conduct when the cartel was active, Section IV introduces the proposed remedy for addressing residual collusion and shows how it undermines the stability of collusion. In Section V, the same operative force that causes competitor coupons to destabilize collusion

[1] Chowdhury and Crede (2020) consider an indefinitely repeated price game with three subjects who can communicate only in the first ten periods. Starting in period 11, there are two treatments: one where the same three subjects continue to interact and one where each subject is matched with two new subjects (which they equate to a policy of debarment). They find clear evidence of residual collusion as prices remain above supracompetitive levels when the same three subjects interact even though they are no longer allowed to communicate. When subjects are rematched, prices significantly decline which is evidence that collusion has been undermined. Although this evidence is supportive of debarment preventing residual collusion, the experimental setting does not allow for the institutional memory that actual firms have.

[2] The idea of mandating one company to issue coupons that could be used to buy competitors' products is not unprecedented. In a case against Microsoft in the state of California, the settlement provided "vouchers that may be used to buy any manufacturer's desktop, laptop and tablet computers, any software used with those computer products and specified peripheral devices for use with computers." (https://news.microsoft.com/2003/01/10/microsoft-and-california-plaintiffs-settle-california-class-action-lawsuits/) Competitor coupons differ in that they can *only* be used to buy another firm's product.

is shown to cause conventional coupons (whereby a firm offers past purchasers a coupon to buy its own product) to stabilize collusion. Thus, conventional coupons exacerbate the problem of residual collusion. Section VI discusses some issues related to the robustness of our analysis and the implementation of competitor coupons, while Section VII concludes.

II. EVIDENCE OF RESIDUAL COLLUSION

Consider a cartel that has been discovered and, although no longer operating, prices are not substantively lower after the cartel's shut down. To my knowledge, there are three candidate explanations for the absence of a meaningful price effect. First, prices were competitive before the cartel's discovery in which case prices did not decline because they were already at competitive levels. That could be due to the cartel having collapsed before its discovery, as in the case of the vitamin C cartel which closed down due to the expansion of non-cartel supply Igami and Sugaya (2022). Alternatively, the cartel could have been active but simply ineffective at raising price. Although the latter may be plausible for a cartel that has only existed for a year or two, it stretches credulity for firms to engage in the costly and risky activity of illegally colluding for many years without any apparent benefit.

A second explanation for why prices are not lower after the cartel's shut down is that firms are independently maintaining supracompetitive prices in order to reduce estimated customer damages. Damages are quantified by multiplying the cartel overcharge (how much higher price was because of collusion) by the number of units purchased. A common empirical approach for estimating the cartel overcharge – referred to as the before-and-after approach – compares the average price during the cartel period and the average price during the post-cartel period (under the maintained hypothesis that the latter is characterized by competition), while controlling for other factors that are changing over time. Firms may independently price above competitive levels in order to artificially inflate the post-cartel price so as to result in an underestimate of the overcharge.[3] Although this theory explains why prices would not fall to competitive levels after the cartel's demise, one would still expect some decline in prices. Indeed, it would be rather coincidental for this strategic pricing effect to imply prices remain at their collusive levels.

The third explanation for why the cartel's discovery would not result in lower prices is that firms are still colluding. This could mean explicit collusion so they are persisting with unlawful communications. However, continued communications after an investigation has opened up is exceedingly rare if not non-existent in jurisdictions with reasonably active enforcement. More likely is residual collusion so firms have replaced explicit with tacit collusion as they perpetuate the collusive arrangement without engaging in any further communications. In the remainder of this section, let me summarize some evidence in support of residual collusion. [4]

Returning to the vitamins cartel, vitamins markets with only two suppliers – such as beta carotene with BASF and Hoffman LaRoche (see Figure 2) – saw prices fall by only 5% in the year after the end of the cartel.[5] Of course, one could attribute this finding to the first explanation: prices were already at near-competitive levels upon the cartel's discovery. However, that explanation is untenable upon observing what happened in vitamins markets occupied by a cartel with more than two suppliers. In vitamin markets with a three-firm cartel, price fell by 25% and those with a four-firm cartel experienced a 32% decrease in price. By this alternative explanation, collusion was effective when the cartel had three or four firms – as the collusive price must have been well above the competitive price to fall so far upon the cartel's collapse – but

[3] This theory is due to Harrington (2004) and an empirical test of it can be found in Erutku (2012).

[4] In addition to evidence from actual cartels, there is experimental evidence of residual collusion; see Fonseca and Normann (2014) and Chowdhury and Crede (2020).

[5] The estimates for the price effects are from Kovacic *et al.* (2007).

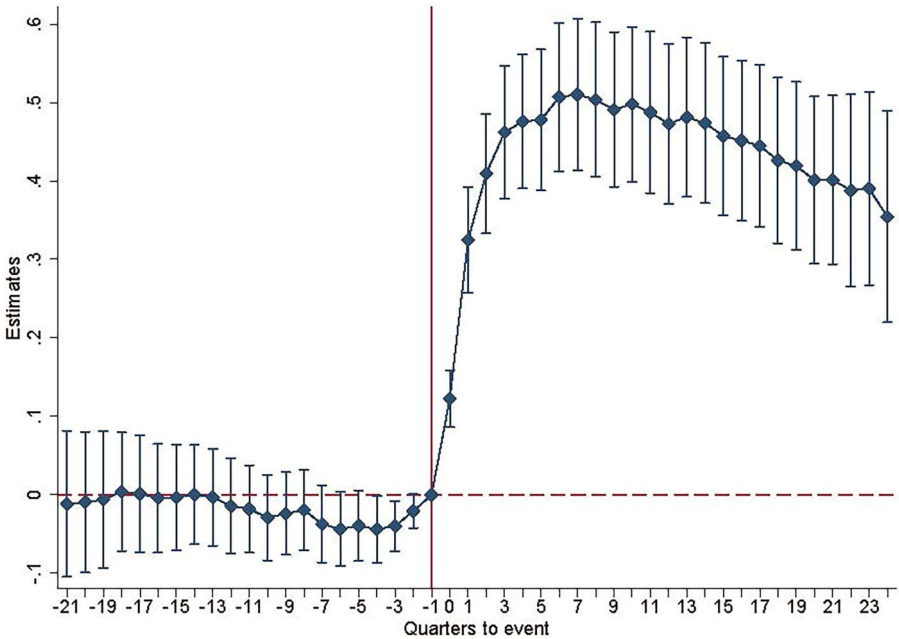

Figure 3. Generic drugs. Source: Starc and Wollmann (2022).

was ineffective when the cartel had two firms – as the collusive price barely fell at all. Given that collusion is easier with fewer firms, this explanation contradicts our general understanding. In conclusion, the evidence is compelling that residual collusion took place in vitamins markets with two suppliers.

A more recent episode is the on-going investigation into collusion in the U.S. generic drugs industry. Initiated by an employee of Teva Pharmaceuticals in July 2013, she sequentially cartelized various generic drugs that Teva supplied. The last generic drug markets were cartelized in January 2015 when investigations by state and federal agencies became public. Figure 3 shows the effect of collusion on drug prices in cartelized markets (relative to uncartelized markets) starting from the date of cartel formation (with the bars being 95% confidence intervals). Prices sharply increased by around 50% within four quarters. Noting that the longest cartel duration for a generic drug was seven to eight quarters (with it being formed in July 2013 and then shutting down in January 2015), prices remained high many quarters after the cartel was no longer operating. Even four years after the investigation became public, competition had not returned: "For drugs listed in the complaint, the data strongly reject competition in favor of collusion from the formation of the cartel through [2019]."[6] The generic drugs cartel offers another episode of residual collusion.

Beginning in late 1999, the air cargo cartel colluded through the coordinated adoption of a fuel surcharge. Though the cartel ended in early 2006 with a leniency application by Lufthansa (who initiated the cartel), a recent study provides evidence that the suppliers continued with the same collusive practice Turner (2022). Using data on fuel prices and fuel surcharges during 2002–2013, the author concluded: "During the cartel's operation, cargo airlines developed a specific pricing formula, based on the price of jet fuel, for calculating a common (and collusive)

[6] Starc and Wollmann (2022), p. 29.

fuel surcharge to be applied throughout the industry. I find that post-cartel fuel surcharges closely resemble the fuel surcharge implied by the cartel's pricing formula." Residual collusion appears to have taken the form of maintaining the fuel surcharge formula agreed to when firms were unlawfully communicating.

The episodes just described are clear-cut cases of residual collusion. There are many other examples of price not falling upon a cartel's demise which may also be due to residual collusion. Sproul (1993) examined 25 cartel cases from the files of the U.S. Department of Justice between 1973 and 1984 and concluded: "There is little doubt that in the great majority of cases antitrust prosecution does not lead to lower prices. In general, an indictment for price fixing results in slightly higher prices."[7] His explanation is that cartels reduced cost so their shutdown raised costs and prices. However, there is little evidence that cartels lower cost, and more likely explanations are that collusion was not effective (so prices were at competitive levels) or was very effective in that tacit collusion replaced explicit collusion (so prices remained at supracompetitive levels). For the graphite electrodes cartel (1992–1997), cartel shutdown did not result in a return to competitive prices as they remained 20% above pre-cartel levels even two years later (Harrington (2004)). Although the author attributes it to strategic behavior for the purpose of reducing damage estimates, it could also reflect residual collusion. For the lysine cartel (1992–1995), de Roos (2006) found that prices did not decline upon the initiation of an investigation and puts forth residual collusion as one possible explanation.[8] Following investigations into the Spanish processed food sector, Ordóñez-de-Haro and Torres (2014) document a pattern consistent with residual collusion. Examining the markets for bread, chicken, chocolate, eggs, flour and semolina, ice cream, industrial bread, milk, pasta, and sauces, they observe "a dramatic reduction in the annual price change in all the products [and] that the price of most affected food products remained nearly unchanged, at high levels over a long period of time, even after the termination of the competition proceedings."[9] They also offer residual collusion as an explanation.[10] Although classifying any of these episodes as residual collusion requires additional evidence (in particular, that prices before the cartel's collapse were supracompetitive), the lack of a decline in prices in response to shutting down a cartel is not rare.

III. MODEL AND COMPETITIVE EQUILIBRIUM

This section describes the market model and, in the ensuing section, the environment faced by firms after the cartel becomes inactive. With that set-up, the proposed remedy for destabilizing residual collusion is introduced. Although the model is simple and restrictive, the intuition behind the results seems quite general.

Consider a market with two single-product firms, denoted firms A and B. They offer differentiated products at a common cost c. As we will see, it is essential that the good is repeat purchase, which is a characteristic of many goods supplied by cartels as they commonly involve commodities purchased by industrial buyers.[11] There is a continuum of consumers represented by the continuously differentiable cdf $F : [\underline{v}, \bar{v}] \to [0, 1]$ where $\underline{v} < 0 < \bar{v}$. Assume F is strictly

[7] Sproul (1993), p. 753.

[8] "A second possible explanation is that an implicit understanding may have developed between the cartel participants, facilitating the continuation of collusive behaviour, albeit tacitly." (de Roos 2006, p. 1104)

[9] Ordóñez-de-Haro and Torres (2014), pp. 237, 255.

[10] They refer to "a new pricing strategy... which consists of keeping prices above competitive levels, but stable so as to minimize the risk of another antitrust intervention. This would correspond to a situation of tacit collusion where price changes are minimized to rule out any suspicion of anticompetitive behavior." (Ordóñez-de-Haro and Torres 2014, p. 256)

[11] Ivaldi *et al.* (2017) document all prosecuted cartels in 22 developing countries over 1995-2013 and some of the most prevalent markets are for petroleum products, cement, poultry processing, shipping, and industrial and medical gases, all of which are repeat purchase goods. That is also the case with the 22 cartels reviewed in Harrington (2006) from European Commission cases over 2000–2004. With the exception of the fine arts auction houses cartel, all involved regularly purchased industrial inputs such as chemicals, industrial tubes, and plasterboard.

increasing on $(\underline{v}, \overline{v})$. Each consumer buys one unit from either A or B. For a type $v \in [\underline{v}, \overline{v}]$ consumer, the difference between the value of consuming firm A's product and firm B's product is measured by v. If $v > (<)0$ then the consumer prefers the product of firm A (B). Letting p_i denote the price of firm i, a consumer buys from A if and only if (iff) $v > p_A - p_B$.

Under competition, firms A and B simultaneously choose their prices to each maximize their own profit. The profit functions of firms A and B, respectively, are

$$(p_A - c)(1 - F(p_A - p_B))$$

$$(p_B - c)F(p_A - p_B)$$

First-order conditions are

$$\begin{aligned} 0 &= (1 - F(p_A - p_B)) - (p_A - c)F'(p_A - p_B) \\ 0 &= F(p_A - p_B) - (p_B - c)F'(p_A - p_B). \end{aligned}$$

Assuming second-order conditions are satisfied then Nash equilibrium prices (p_A^*, p_B^*) are the solution to:

$$\begin{aligned} p_A^* &= c + \frac{(1 - F(p_A^* - p_B^*))}{F'(p_A^* - p_B^*)} \\ p_B^* &= c + \frac{F(p_A^* - p_B^*)}{F'(p_A^* - p_B^*)} \end{aligned}$$

Define the associated profits:

$$\begin{aligned} \pi_A^N &\equiv \left(p_A^* - c\right)(1 - F(p_A^* - p_B^*)) \\ \pi_B^N &\equiv \left(p_B^* - c\right)F(p_A^* - p_B^*) \end{aligned}$$

If $F(0) = 1/2$ then $p_A^* = p_B^*$. Let us show that if $F(0) \neq 1/2$ then the firm with the more popular product – in the sense that more consumers prefer it (when prices are the same) – has a higher competitive price. Suppose $F(0) < 1/2$ so firm A's product is more popular. In order to show $p_A^* > p_B^*$, let us suppose not and derive a contradiction. If $p_A^* \leq p_B^*$, we then have:

$$p_A^* = c + \frac{(1 - F(p_A^* - p_B^*))}{F'(p_A^* - p_B^*)} \leq c + \frac{F(p_A^* - p_B^*)}{F'(p_A^* - p_B^*)} = p_B^*$$

which implies

$$1 - F(p_A^* - p_B^*) \leq F(p_A^* - p_B^*) \Leftrightarrow 1/2 \leq F(p_A^* - p_B^*).$$

As it is presumed $p_A^* - p_B^* \leq 0$, the preceding condition implies:

$$1/2 \leq F(p_A^* - p_B^*) \leq F(0),$$

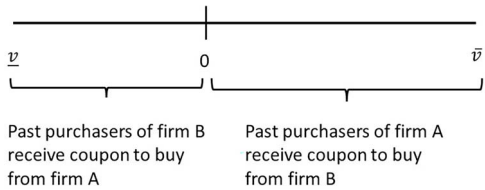

Figure 4. Allocation of customers at the collusive price.

which contradicts the assumption $F(0) < 1/2$. Hence, if $F(0) < 1/2$ then $p_A^* > p_B^*$.

IV. COLLUSION AND REMEDY

Collusion will be examined in the context of the infinitely repeated game with perfect monitoring where $\delta \in (0, 1)$ denotes firms' common discount factor. Though the competitive equilibrium may involve firms setting different prices, I will focus on a symmetric collusive price for that is common with many cartels and simplifies the analysis. Thus, let us suppose firms A and B operated a cartel which had them coordinate on a supracompetitive price $\widehat{p}$ that exceeds competitive prices, $\widehat{p} > \max\left\{p_A^*, p_B^*\right\}$, and delivers higher profits than under competition:

$$\begin{aligned}(\widehat{p} - c)(1 - F(0)) &> \pi_A^N \\ (\widehat{p} - c)F(0) &> \pi_B^N.\end{aligned} \tag{1}$$

Further suppose the collusive price has each firm pricing above its best response:

$$\begin{aligned}(1 - F(0)) - (\widehat{p} - c)F'(0) &< 0 \\ F(0) - (\widehat{p} - c)F'(0) &< 0.\end{aligned} \tag{2}$$

The allocation of customers at the collusive price is shown in Figure 4.

Our analysis begins with the cartel's discovery. Firms are presumed to no longer communicate and, as a result, there are two paths available to them. They can revert to competitive prices $\left(p_A^*, p_B^*\right)$ or perpetuate the agreement that was in place and price at $\widehat{p}$. The latter is an option iff it is stable for firms to continue to price at $\widehat{p}$. $\widehat{p}$ is said to be stable if the incentive compatibility constraints (ICCs) hold assuming the grim punishment:

$$\begin{aligned}\text{Firm A's ICC}: \frac{(\widehat{p} - c)(1 - F(0))}{1 - \delta} &\geq \max_{p_A}(p_A - c)(1 - F(p_A - \widehat{p})) + \left(\frac{\delta}{1 - \delta}\right)\pi_A^N \\ \text{Firm B's ICC}: \frac{(\widehat{p} - c)F(0)}{1 - \delta} &\geq \max_{p_B}(p_B - c)F(\widehat{p} - p_B) + \left(\frac{\delta}{1 - \delta}\right)\pi_B^N.\end{aligned} \tag{3}$$

The grim punishment is appropriate since, as they are no longer communicating, it would be difficult for firms to coordinate on a more severe punishment or coordinate on returning to a collusive outcome after a punishment.

Consider the competition authority requiring each firm to provide coupons to past purchasers of its product. Given firms previously charged a common collusive price, past purchasers of firm A's product are consumers with $v \in (0, \bar{v}]$ and past purchasers of firm B's product are those consumers with $v \in [\underline{v}, 0)$, as depicted in Figure 4. The coupon a firm provides can only be

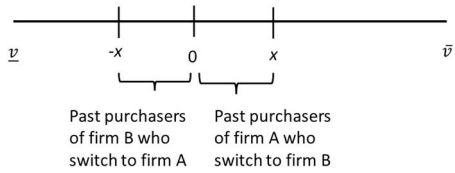

Figure 5. Switching of customers with competitor coupons.

used in purchasing the other firm's product. Let x denote the coupon amount per unit purchased (which is assumed to be the same for firms A and B). A coupon issued by firm A to one of its past purchasers gives that consumer a discount x when they buy from firm B, where the coupon is paid by firm A. Analogously, a coupon issued by firm B to one of its past purchasers gives that consumer a discount x when they buy from firm A, where the coupon is paid by firm B. These coupons are referred to as *competitor coupons* for they have a firm providing a coupon to buy from its competitor.[12]

Our objective is to explore the effect of competitor coupons on firms' ability to maintain the collusive price after the cartel has been shut down. Formally, this will involve assessing how competitor coupons affect the ICCs for supporting the collusive price $\widehat{p}$. The analysis will be conducted when the coupon rate is not too large compared to the incremental amount that a consumer is willing to pay for their preferred product: $x \in (0, \min\{\bar{v}, -\underline{v}\})$.[13] It is assumed the quantity of the coupon is equal to one period's demand and that coupons have an expiration of one period. Although these assumptions are restrictive, they significantly enhance analytical tractability and, as I hope will become apparent to the reader, the intuition associated with the ensuing results seems quite general.[14]

Let's begin by deriving collusive profit in the presence of competitor coupons. With a coupon x to buy from firm B, consumer $v \in (0, \bar{v}]$ prefers to buy firm A's product iff $v > p_A - (p_B - x)$. As collusion has $p_A = \widehat{p} = p_B$ then the consumer buys from firm A iff $v > \widehat{p} - (\widehat{p} - x)$ or $v > x$. Hence, consumers in $(0, \bar{v}]$ buy firm A's product when $v \in [x, \bar{v}]$ and firm B's product when $v \in (0, x)$. Finally, a consumer $v \in [\underline{v}, 0)$ buys from firm A iff $v > (\widehat{p} - x) - \widehat{p}$ or $v > -x$. Figure 5 depicts the allocation of consumers when firms maintain the collusive price and issued competitor coupons to their past purchasers.

Firm A's collusive profit is

$$\pi_A^{coll} \equiv (\widehat{p} - c)(1 - F(x)) - x(F(x) - F(0)) + (\widehat{p} - c)(F(0) - F(-x)). \tag{4}$$

The first term is the profit earned from firm A's past customers who still buy from it. The second term is the coupon payments that firm A makes to its past customers who switch to buying from firm B. The last term is the profit earned from firm B's past customers who switch to buying from firm A. Analogously, firm B's collusive profit is:

$$\pi_B^{coll} \equiv (\widehat{p} - c)F(-x) - x(F(0) - F(-x)) + (\widehat{p} - c)(F(x) - F(0)).$$

[12] For a different setting in which a firm issues coupons which are then honored by a competitor, see Gelman and Salop (1983).

[13] If this condition did not hold then, when firms charge a common price, all past purchasers for at least one of the firms would switch to buying from the other firm. Our analysis focuses on the less extreme outcome when some, but not all, purchasers would switch.

[14] The analysis would be greatly complicated to allow coupon duration to exceed one period as then the stock of unused coupons would be a state variable.

Consider the effect of the coupon rate on firm A's collusive profit:

$$\frac{\partial \pi_A^{coll}}{\partial x} = -(F(x) - F(0)) - (\widehat{p} - c)F'(x) - xF'(x) + (\widehat{p} - c)F'(-x).$$

Given coupon payments equal $x(F(x) - F(0))$, the first term, $-(F(x) - F(0))$, is the rise in coupon payments from those who were already switching. With the higher coupon rate that consumers receive in buying from firm B, firm A loses demand of $F'(x)$ which results in foregone profit of $(\widehat{p} - c)F'(x)$ and increased coupon payments of $-xF'(x)$ to those additional switchers; those are the second and third terms. Finally, firm A gains demand of $F'(-x)$ because of the higher coupon rate received by past purchasers of firm B's product when they buy from firm A; that translates into additional profit of $(\widehat{p} - c)F'(-x)$ which is the fourth term. If $F'(x) \simeq F'(-x)$ then firm A loses approximately as much demand as it gains, which implies collusive profit is decreasing in the coupon rate.

Now consider firm A deviating from the collusive price with $p_A < \widehat{p}$. Compared to pricing at $\widehat{p}$, charging the lower price p_A will result in firm A picking up some of its past customers with values in $(0, x)$ who would have otherwise switched to buying from firm B, and to obtain some of firm B's past customers with values in $(\underline{v}, -x)$ who would have otherwise continued buying from firm B. Recognizing the boundaries to these sets, the deviation profit is

$$\begin{aligned}&(p_A - c)(1 - F(\max\{p_A - \widehat{p} + x, 0\})) - x\left(F(\max\{p_A - \widehat{p} + x, 0\}) - F(0)\right) \quad (5)\\ &+(p_A - c)\left(F(0) - F(\max\left\{p_A - \widehat{p} - x, \underline{v}\right\})\right).\end{aligned}$$

As it would never be optimal for firm A to set p_A so that $p_A - \widehat{p} - x < \underline{v}$,[15] we then have: $\max\left\{p_A - \widehat{p} - x, \underline{v}\right\} = p_A - \widehat{p} - x$, so (5) becomes

$$\begin{aligned}\pi_A^{dev} \equiv\ & (p_A - c)(1 - F(\max\{p_A - \widehat{p} + x, 0\})) - x\left(F(\max\{p_A - \widehat{p} + x, 0\}) - F(0)\right)\\ &+(p_A - c)\left(F(0) - F(p_A - \widehat{p} - x)\right). \quad (6)\end{aligned}$$

Using (4) and (6), the ICC for firm A is:

$$\begin{aligned}&(\widehat{p} - c)(1 - F(x)) - x(F(x) - F(0)) + (\widehat{p} - c)(F(0) - F(-x))\\ &\quad + \left(\frac{\delta}{1 - \delta}\right)(\widehat{p} - c)(1 - F(0))\\ &\geq (p_A - c)(1 - F(\max\{p_A - \widehat{p} + x, 0\})) - x\left(F(\max\{p_A - \widehat{p} + x, 0\}) - F(0)\right)\\ &\quad + (p_A - c)\left(F(0) - F(p_A - \widehat{p} - x)\right) + \left(\frac{\delta}{1 - \delta}\right)\pi_A^N, \forall p_A < \widehat{p}.\end{aligned}$$

[15] If $p_A - \widehat{p} - x < \underline{v}$ then $p_A < \widehat{p} + x + \underline{v}$. Next note $\widehat{p} + x + \underline{v} < \widehat{p} - x \Leftrightarrow x/2 < -\underline{v}$ which is true by our assumption that $x < \min\left\{\overline{v}, -\underline{v}\right\}$. Hence, if $p_A < \widehat{p} + x + \underline{v} < \widehat{p} - x$ then firm A's demand is

$$(1 - F(\max\{p_A - \widehat{p} + x, 0\})) + \left(F(0) - F(\max\left\{p_A - \widehat{p} - x, \underline{v}\right\})\right) = (1 - F(0)) + \left(F(0) - F(\underline{v})\right) = 1.$$

In sum, if $p_A - \widehat{p} - x < \underline{v}$ then firm A has the entire market demand in which case it could slightly raise its price without affecting its demand. Thus, p_A cannot be an optimal deviation price.

The LHS of the inequality is the current period's collusive profit with competitor coupons plus the present value of future collusive profit (and recall that competitor coupons only last for one period). The RHS of the inequality is the deviation profit plus the present value of future competitive profit (associated with the grim punishment). Subtracting the expression on the RHS from that on the LHS, we have:

$$\begin{aligned}\Lambda_A(p_A,x) \equiv\ & (\widehat{p}-c)(1-F(x)) - x(F(x)-F(0)) + (\widehat{p}-c)(F(0)-F(-x)) \\ & + \left(\frac{\delta}{1-\delta}\right)(\widehat{p}-c)(1-F(0)) \\ & - (p_A-c)(1-F(\max\{p_A-\widehat{p}+x,0\})) + x\left(F(\max\{p_A-\widehat{p}+x,0\})-F(0)\right) \\ & - (p_A-c)\left(F(0)-F(p_A-\widehat{p}-x)\right) - \left(\frac{\delta}{1-\delta}\right)\pi_A^N. \end{aligned} \tag{7}$$

Firm A's ICC is $\Lambda_A(p_A,x) \geq 0\ \forall p_A < \widehat{p}$. Analogously, firm B's ICC is $\Lambda_B(p_B,x) \geq 0\ \forall p_B < \widehat{p}$ where

$$\begin{aligned}\Lambda_B(p_B,x) \equiv\ & (\widehat{p}-c)F(-x) - x(F(0)-F(-x)) + (\widehat{p}-c)(F(x)-F(0)) \\ & + \left(\frac{\delta}{1-\delta}\right)(\widehat{p}-c)F(0) \\ & - (p_B-c)F(\min\{\widehat{p}-p_B-x,0\}) + x\left(F(0)-F(\min\{\widehat{p}-p_B-x,0\})\right) \\ & - (p_B-c)\left(F(\widehat{p}-p_B+x)-F(0)\right) - \left(\frac{\delta}{1-\delta}\right)\pi_B^N. \end{aligned} \tag{8}$$

Collusion is said to be "less stable" when $\Lambda_A(p_A,x)$ and $\Lambda_B(p_B,x)$ are smaller so the ICCs are less likely to hold. To assess the effect of competitor coupons, we will examine how the coupon rate x affects $\Lambda_A(p_A,x)$ and $\Lambda_B(p_B,x)$.

Consider a firm undercutting the collusive price with deviation price $p_A \in (\widehat{p}-x,\widehat{p})$. Using (7),

$$\begin{aligned}\frac{\partial \Lambda_A(p_A,x)}{\partial x} =\ & -\left(F(x)-F(p_A-\widehat{p}+x)\right) - x(F'(x)-F'(p_A-\widehat{p}+x)) \\ & + (\widehat{p}-c)(F'(-x)-F'(x)) - (p_A-c)(F'(p_A-\widehat{p}-x)-F'(p_A-\widehat{p}+x)). \end{aligned} \tag{9}$$

Embedded in (9) are three effects of the coupon rate on the ICC. Raising the coupon rate results in a higher coupon payment to each of those past customers of firm A who switch. This rise in coupon payments is less when firm A undercuts the collusive price because fewer customers switch, as measured by $F(x)-F(p_A-\widehat{p}+x)$. Referring to it as the "higher payment per switcher" effect, it is the first term in (9) which, as it is negative, indicates that it makes collusion less stable; a firm is inclined to deviate in order to reduce customer switching and the benefit from doing so is magnified when the coupon rate is higher. Next note that a higher coupon rate also raises coupon payments by causing more past customers to switch. Coupon payments increase by $xF'(x)$ at the collusive price and by $xF'(p_A-\widehat{p}+x)$ at the deviation price. Referring to it as the "more switchers" effect, it is measured by $-x(F'(x)-F'(p_A-\widehat{p}+x))$ which is the second term in (9).

Its sign is ambiguous as it depends on the shape of F. The last effect comes from how a change in the coupon rate affects firm A's demand. A higher coupon rate means losing more of one's own past customers – as they are attracted by the subsidy to buy from firm B – but gaining more of the rival firm's past customers – as they are attracted by the subsidy to buy from firm A. Collusive profit changes by $(\widehat{p} - c)(F'(-x) - F'(x))$ – as the higher coupon rate causes firm A to lose $F'(x)$ of its past customers and to gain $F'(-x)$ of the other firm's past customers – and deviation profit analogously changes by $(p_A - c)(F'(p_A - \widehat{p} - x) - F'(p_A - \widehat{p} + x))$. Referred to as the "demand shifting" effect, it is the difference between the third and fourth terms in (9). Its sign is ambiguous as it depends on the shape of F.

Next consider when deviation involves a steeper price cut so $p_A < \widehat{p} - x$. At that deviation price, firm A sells to all consumers in $(0, \overline{v}]$ and thus makes no coupon payments. Using (8),

$$\frac{\partial \Lambda_A(p_A, x)}{\partial x} = -(F(x) - F(0)) - xF'(x) - (\widehat{p} - c)(F'(x) - F'(-x)) - (p_A - c)F'(p_A - \widehat{p} - x). \tag{10}$$

The first term, $-(F(x) - F(0))$, measures the lower coupon payments from deviating because more (in fact, all) past customers are retained. The second term, $-xF'(x)$, is the rise in coupon payments at the collusive price because more past customers switch when the subsidy to buying from firm B is higher. Both those terms are negative so a higher coupon rate makes collusion less stable. The last two terms capture the effect of a change in the coupon rate on firm A's demand. At the collusive price, the third term is from firm A picking up more demand of $F'(-x)$ from firm B but losing more demand of $F'(x)$ to firm B. The sign of $-(\widehat{p} - c)(F'(-x) - F'(x))$ is ambiguous. The last term is negative because, at the deviation price, firm A picks up more of firm B's past customers from a higher coupon rate.

There are two general forces through which competitor coupons affect the stability of collusion. The first force is how competitor coupons affect the payments made to a firm's past purchasers. At the collusive price, a firm is subsidizing some of its past purchasers to buy from its rival. By undercutting the collusive price, fewer customers are switching which reduces coupon payments; that makes deviation more attractive. The second force comes from the demand-shifting effect of competitor coupons. Firm A loses some of its past customers to firm B, but also gains some of firm B's past customers. Because the net demand effect for a firm depends on the shape of F, this second force has an ambiguous impact on the stability of collusion.

Theorem 1 shows that the introduction of competitor coupons is assured of making collusion less stable when the coupon rate is not too high.

Theorem 1. There exists $x' > 0$ such that if $x \in (0, x')$ then $\Lambda_A(p_A, x)$ and $\Lambda_B(p_B, x)$ are decreasing in x.

Proof. If $p_A \in (\widehat{p} - x, \widehat{p})$ then, using (9),

$$\lim_{x \to 0} \frac{\partial \Lambda_A(p_A, x)}{\partial x} = -\left(F(0) - F(p_A - \widehat{p})\right) < 0.$$

When the coupon rate is low and the deviation price lies in $(\widehat{p} - x, \widehat{p})$, the first-order effect of a higher coupon rate is to increase the coupon payments for those past purchasers who are

switching. As undercutting the collusive price reduces the magnitude of that effect by decreasing how many customers switch, deviation becomes more profitable, which reduces $\Lambda_A(p_A, x)$.

If $p_A < \widehat{p} - x$ then, using (10),

$$\lim_{x \to 0} \frac{\partial \Lambda_A(p_A, x)}{\partial x} = -(p_A - c)F'(p_A - \widehat{p}) < 0.$$

When the coupon rate is low and the deviation price is less than $\widehat{p} - x$, the first-order effect of a higher coupon rate is to increase how many of firm B's past purchasers switch to firm A. Given $p_A < \widehat{p} - x$ implies that firm A is retaining all of its past purchasers at the deviation price, there is no countervailing effect of a higher coupon rate causing more of firm A's past purchasers to switch to firm B. Thus, a higher coupon rate enhances the profitability of undercutting the collusive price.

This proves $\Lambda_A(p_A, x)$ is decreasing in x $\forall p_A < \widehat{p}$ when x is sufficiently small. A similar analysis applies to firm B. ■

When the coupon rate is not low, the demand-shifting effects come into play. How they affect $\Lambda_A(p_A, x)$ and $\Lambda_B(p_B, x)$ depends on the shape of F which can confound the analysis. However, when F is uniform (or close to being uniform) then the demand-shifting effects cancel so competitor coupons make collusion less stable for all coupon rates.

Theorem 2. If F is uniform then $\Lambda_A(p_A, x)$ and $\Lambda_B(p_B, x)$ are decreasing in x.

Proof. Under the assumption of a uniform distribution, if $p_A \in (\widehat{p} - x, \widehat{p})$ then, using (9),

$$\frac{\partial \Lambda_A(p_A, x)}{\partial x} = -\left(F(x) - F(p_A - \widehat{p} + x)\right) < 0;$$

and if $p_A < \widehat{p} - x$ then, using (10),

$$\frac{\partial \Lambda_A(p_A, x)}{\partial x} = -(F(x) - F(0)) - xF'(x) - (p_A - c)F'(p_A - \widehat{p} - x) < 0.$$

Thus, $\Lambda_A(p_A, x)$ is decreasing in x. A similar analysis applies to firm B. ■

If F is not uniform, the possibility that $\Lambda_A(p_A, x)$ is increasing in x for some x has not been dismissed. However, even if that were true, it does not follow competitor coupons would make collusion more stable. Competitor coupons with coupon rate x' make collusion less stable at deviation price p_A when $\Lambda_A(p_A, x') < \Lambda_A(p_A, 0)$ so the ICC is less likely to hold compared to when firms are not mandated to issue coupons for their rival firm's product. Given Theorem 1, we know that $\Lambda_A(p_A, x) < \Lambda_A(p_A, 0)$ for low x so, should $\Lambda_A(p_A, x)$ be increasing in x for some $x < x'$, it is still possible that $\Lambda_A(p_A, x') < \Lambda_A(p_A, 0)$. In other words, $\Lambda_A(p_A, x)$ and $\Lambda_B(p_B, x)$ decreasing in x for all x is a sufficient but not necessary condition for competitor coupons to make collusion less stable.

Going beyond the formal analysis, I want to offer a general argument for why firms are likely to view competitor coupons as making deviation more profitable. When the deviation price lies in $(\widehat{p} - x, \widehat{p})$, the discussion surrounding (9) referred to three effects from a higher coupon rate.

The "higher payment per switcher" effect is always negative (i.e., deviation is more profitable) as it just relies on a positive density, $F' > 0$. It is based on a higher coupon rate being more detrimental to a firm's profit when there are more past customers switching and using coupons to buy from the rival firm. As undercutting the collusive price means fewer past customers are switching, deviation directly lowers the magnitude of those coupon payments and thus is made more profitable when the coupon rate is higher. Although the "higher payment per switcher" effect is unambiguous and transparent, the "more switchers" and "demand shifting" effects are ambiguous and subtle. They are both zero when $F'' = 0$ and particular properties on F'' are required for the "more switchers" and "demand shifting" effects to be positive and of a magnitude to override the "higher payment per switcher" effect.[16] But even beyond that, a firm would need to be sufficiently confident about the second derivative of F for it to believe the "more switchers" and "demand shifting" effects dominate the more salient "higher payment per switcher" effect.

Now suppose the deviation price is less than $\widehat{p} - x$ so (10) applies. A sufficient condition for $\partial \Lambda_A(p_A, x)/\partial x < 0$ and $\partial \Lambda_B(p_B, x)/\partial x < 0$ to be negative is $F'(x) \simeq F'(-x)$.[17] A firm would then need to believe $\left|F'(x) - F'(-x)\right|$ is sufficiently large in order for $\Lambda_A(p_A, x)$ or $\Lambda_B(p_B, x)$ to be increasing in x. Again, that requires firms to confidently believe certain properties of the second derivative of F. In sum, given the knowledge that firms are apt to have about the distribution of consumer valuations, it seems plausible they would perceive the imposition of competitor coupons as making it more profitable to undercut the collusive price which would contribute to destabilizing collusion.

V. COLLUSION WITH CONVENTIONAL COUPONS

In association with private litigation, coupons have been used as a device for cartel members to compensate harmed customers.[18] Those coupons are of the more conventional type whereby a past purchaser of a firm receives a coupon from that firm to buy from that firm. As we show here, such coupons stabilize collusion rather than destabilize it. Intuitively, if a past customer of firm A has a coupon to buy from firm A then firm B will have to undercut the collusive price more in order to induce those consumers to buy from it. Thus, conventional coupons are counter-productive from the perspective of undermining residual collusion.

Assume a past customer of firm A (B) receives a coupon of an amount $y > 0$ to buy from firm A (B). Given that past collusion had both firms pricing at $\widehat{p}$, this means consumers with $v \in (0, \overline{v}]$ receive a coupon to buy from firm A and consumers with $v \in [\underline{v}, 0)$ receive a coupon to buy from firm B. Assume the coupons are of one-period duration. The analysis will focus on firm A. The current period's collusive profit is $(\widehat{p} - c - y)(1 - F(0))$. Consider it deviating with a price of p_A. Those past purchasers will continue to buy from firm A and the profit earned on them is $(p_A - c - y)(1 - F(0))$. It may also succeed in attracting some of firm B's past customers. Consumers with $v < 0$ will buy from firm A when $v - p_A > \widehat{p} - y$ or $v > p_A - \widehat{p} + y$. That

[16] The point is that $F'' \neq 0$ is a necessary but not sufficient condition for the "more switchers" and "demand shifting" effects to be positive. And those effects being positive is a necessary but not sufficient condition for $\partial \Lambda_A(p_A, x)/\partial x > 0$.

[17] Note that if $p_B < \widehat{p} - x$ then

$$\frac{\partial \Lambda_B(p_B, x)}{\partial x} = -(F(0) - F(-x)) - xF'(-x) - (\widehat{p} - c)\left(F'(-x) - F'(x)\right) - (p_B - c)F'(\widehat{p} - p_B + x).$$

Thus, $F'(x) \simeq F'(-x)$ is also sufficient for $\partial \Lambda_B(p_B, x)/\partial x < 0$.

[18] The interested reader is referred to Leslie (2002) and Rubinfeld (2012).

delivers additional profit of $(p_A - c)(F(0) - F(\min\{p_A - \widehat{p} + y, 0\}))$. The ICC for firm A is:

$$(\widehat{p} - c - y)(1 - F(0)) + \left(\frac{\delta}{1-\delta}\right)(\widehat{p} - c)(1 - F(0)) \geq \max_{p_A}(p_A - c - y)(1 - F(0))$$
$$+ (p_A - c)(F(0) - F(\min\{p_A - \widehat{p} + y, 0\})) + \left(\frac{\delta}{1-\delta}\right)\pi_A^N. \quad (11)$$

In the absence of coupons, the ICCs are as in (3). Coupons make collusion more stable when:

$$(\widehat{p} - c - y)(1 - F(0)) + \left(\frac{\delta}{1-\delta}\right)(\widehat{p} - c)(1 - F(0))$$
$$- (p_A - c - y)(1 - F(0)) - (p_A - c)(F(0) - F(\min\{p_A - \widehat{p} + y, 0\})) - \left(\frac{\delta}{1-\delta}\right)\pi_A^N$$
$$> (\widehat{p} - c)(1 - F(0)) + \left(\frac{\delta}{1-\delta}\right)(\widehat{p} - c)(1 - F(0))$$
$$- (p_A - c)(1 - F(p_A - \widehat{p})) - \left(\frac{\delta}{1-\delta}\right)\pi_A^N, \forall p_A < \widehat{p}. \quad (12)$$

The LHS of the inequality is the collusive payoff minus the deviation payoff with coupon y and the RHS is the collusive payoff minus the deviation payoff without coupons. If this inequality holds then: if collusion is stable without coupons (so the RHS is non-negative) then collusion with coupon y is stable. Furthermore, if LHS $> 0 >$ RHS then collusion is stable with coupon y but not without coupons. Cancelling terms and simplifying (12), we have

$$- y(1 - F(0)) - (p_A - c - y)(1 - F(0)) - (p_A - c)(F(0) - F(\min\{p_A - \widehat{p} + y, 0\}))$$
$$> -(p_A - c)(1 - F(p_A - \widehat{p})) \Leftrightarrow$$
$$- (p_A - c)(1 - F(0)) - (p_A - c)(F(0) - F(\min\{p_A - \widehat{p} + y, 0\}))$$
$$> -(p_A - c)(1 - F(p_A - \widehat{p})) \Leftrightarrow$$
$$(p_A - c)F(0) - (p_A - c)(F(0) - F(\min\{p_A - \widehat{p} + y, 0\})) > (p_A - c)F(p_A - \widehat{p}) \Leftrightarrow$$
$$F(\min\{p_A - \widehat{p} + y, 0\}) > F(p_A - \widehat{p})$$

which holds because $\min\{p_A - \widehat{p} + y, 0\} \geq 0 > p_A - \widehat{p}$.

In conclusion, the standard practice of requiring a cartel member to issue coupons to it past purchasers exacerbates the problem of residual collusion. For the same reason that competitor coupons make deviation from collusive prices more attractive (as customers are incentivized to switch firms), conventional coupons make deviation less attractive (as customers are incentivized *not* to switch firms), and that causes post-cartel tacit collusion to be more stable.[19]

[19] Technically, conventional coupons do not affect the stability of collusion. Even though the ICC is loosened for the period in which coupons are used, if collusion is stable then that is not the binding ICC. As stable collusion also requires the ICC to hold for the periods after coupons are used and that ICC is more stringent, it is the binding ICC. Thus, if collusion is stable without coupons then it is stable with coupons, and if collusion is not stable without coupons than it is not stable with coupons. However, coupons will make collusion more stable if we enrich the environment. For example, suppose firms' discount factor is stochastic. In that case, coupons could enhance stability because it makes it more likely the ICC will hold in the period with coupons. Or suppose demand or cost are stochastic so the ICC varies over time. By weakening the ICC, coupons make it more likely the ICC will hold, ceteris paribus, and thus less likely for collusion to collapse.

VI. DISCUSSION

This section discusses some issues related to the robustness of the analysis, some necessary or desirable properties of competitor coupons, and the practical implementation of competitor coupons.

A. Robustness of Analysis

In the model, each buyer buys some fixed number of units q from the same firm (where q is normalized to one). Suppose instead a buyer had bought r units from firm A and $q-r$ from firm B. In that case, it would receive r coupons from firm A to be used in buying from firm B, and $q-r$ coupons from firm B to be used in buying from firm A. In the extreme case when a buyer had equally split its purchases (so $r = q/2$), the buyer will not switch any purchases if both firms are charging the collusive price; it'll use the coupons issued by A to buy $q/2$ units from B and the coupons issued by B to buy $q/2$ units from A. As a firm is not losing past customers at the collusive price, it does not have an enhanced incentive to deviate from it. Although competitor coupons have no effect in this extreme case, it will generally have an effect as long as a buyer's purchases are not equal across firms. In that case, the firm who had sold more to a buyer will, at the collusive price, see some of that buyer's purchases switch to the other firm. That will provide the firm with a greater incentive to undercut the collusive price in order to retain them. Generally, competitor coupons will make collusion less stable even when buyers purchase from more than one firm.

The model assumed two firms but the intuition would seem to extend for any number of firms. However, a new issue does arise when there are three or more firms as there is the possibility the cartel did not encompass all firms. In that case, a cartel member's coupons could be used by a past purchaser to buy from firms that were not part of the cartel as well as those who were. I suspect this option would enhance the effectiveness of competitor coupons. In our model with two firms, firm A benefitted from firm B issuing competitor coupons as it subsidized firm B's past purchasers to buy from firm A. Of course, this positive demand effect was offset by the negative demand effect coming from coupons issued by firm A to its past purchasers to be used in buying from firm B. Although those demand effects will tend to cancel (so competitor coupons do not affect a cartel member's demand), that is not true when the cartel is not all-inclusive. Given firms who were part of the cartel are issuing coupons to its past purchasers but firms who were not part of the cartel are not, cartel members will, on net, lose demand and that will lower profit from continuing to set the collusive price. As a result, I conjecture competitor coupons will be more effective in destabilizing collusion when the cartel is not all-inclusive.

B. Properties of Competitor Coupons

The efficacy of competitor coupons in destabilizing collusion requires they are not transferable. If coupons are transferable then past purchasers of product A and past purchasers of product B would choose to swap their coupons in order to get the discount on their more preferred product. In that case, competitor coupons would become like conventional coupons (where the coupon can only be used to buy the coupon issuer's product) which, as explained in Section V, stabilizes collusion.

In principle, firms could tacitly coordinate to return prices to collusive levels either when all coupons are redeemed or when the coupons' expiration date is reached (should those dates be different, which they probably would be in practice). However, this is unlikely to be easy. It may not be public information when all coupons have been redeemed which makes coordination on that event difficult. Although the expiration date is common knowledge, there will still be uncertainty on the part of any firm as to whether its rival will raise price and that could discourage

it from doing so. Setting an expiration date far into the future is likely to make it less effective as a focal point for returning prices to the original collusive level.

Finally, there is a concern that firms could offset the collusion-destabilizing force of competitor coupons by issuing conventional coupons to their past purchasers. Past purchasers of firm A who would have switched to firm B (because of the competitor coupon provided by A to buy from B at a discount x) would no longer switch if they also had a coupon to buy from A at a discount x. The issuance of such coupons would undermine the ability of competitor coupons to undermine collusion. To prevent that from happening, a competition authority could either prohibit the issuance of such coupons (at least for the duration of competitor coupons) or mandate that the rate of competitor coupons exceed a firm's own coupons in order to maintain the incentive for past purchasers to switch.

C. Implementation of Competitor Coupons

In implementing a policy of competitor coupons, the first question is when this remedy should be imposed. It is recommended that competitor coupons be used when prices have not declined since an investigation was opened and there is evidence that prices are at a supracompetitive level. Evidence of supracompetitive prices could take the form of documents establishing the cartel was effective – so it is unlikely the prices before cartel shutdown were competitive – or comparison of post-cartel prices to some competitive benchmark. As investigations typically takes years, there is likely to be sufficient time to assess whether there is residual collusion and to make competitor coupons a component of the penalties. Of course, firms may lower prices during the investigation in order to avoid the imposition of competitor coupons, but such a strategic response is desirable.

The second implementation question is how many coupons should be issued and what should be the coupon rate. Here one wants to think of the quantity and rate that are likely to destabilize collusion. The rate should be large enough to cause customer switching should firms maintain the collusive price, and that will depend on the cross price-elasticity of firm demand and customer switching costs. Data from the pre-cartel period on customers moving their demand between firms in response to price differences could inform the competition authority as to the appropriate coupon rate. As to the quantity of coupons, it should be large enough to substantively affect sales and profits for then it is more likely to induce firms to undercut the collusive price and dissuade some of its past purchasers from switching. What exactly is that amount will depend on the specifics of the situation.

VII. CONCLUDING REMARKS

Competitor coupons offer a possible remedy to the persistence of supracompetitive prices after a cartel has been discovered and shut down. By requiring a former cartel member to offer coupons to its past purchasers which can only be used in buying a rival firm's product, the firm is incentivized to undercut the collusive price in order to reduce customer switching and the associated coupon payments. The appeal of this remedy is that it is a temporary intervention, as opposed to indefinite price regulation. Ideally, a remedy would have no effect if, in fact, firms are setting competitive prices. Although competitor coupons harm firms in that situation – as they either make coupon payments or price below the competitive level to avoid doing so – it does benefit consumers through lower prices. Thus, even if firms are competing in the post-cartel environment, one could justify competitor coupons as a form of penalty for former cartel members and compensation for harmed consumers.

Although competitor coupons were created to address the challenge of tacit collusion after an episode of explicit collusion, they could be used more broadly to undermine tacit collusion.[20] For example, consider a market study conducted by a competition authority, such as the United Kingdom's Competition and Markets Authority, which finds evidence of supracompetitive prices apparently supported by (lawful) tacit collusion. At present, the only available remedy for restoring competition is to break up firms which, due to its drastic nature, is unlikely to be used. Competitor coupons offers a less draconian policy which could still achieve the goal of replacing tacit collusion with competition.

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