

The Gray Market in Video, Consumer Welfare, and Public Policy: An Economic Analysis*

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INTRODUCTION

Two generations ago, the only audiences for recorded visual entertainment products patronized movie theaters. Today films are shown on airplanes, televisions are commonplace household appliances throughout the world, and a dazzling variety of technologies allows viewers to tape television programs, purchase prerecorded videocassettes, and receive direct satellite transmissions of television programming. The same technology has facilitated the unauthorized sale or use of video products: It is now possible for unauthorized sellers to copy videocassettes (or live performances) for resale,¹

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¹ See, e.g., "On Bluebeard's Tapedeck," 1984, p. 56; "How Pirates are Plundering the Studios," 1983, p. 81; J. Melanson, 1983, p. 45; D. Groves, 1986, pp. 374, 418. The Motion Picture Association of America (MPAA) has traced some of the worldwide unauthorized videocassette sales to the unauthorized taping of movie theater prints (W. Nix, 1986). However, another spokesman for that trade association has indicated that almost all unauthorized videocassettes sold in the U.S. are copied from legitimate tapes or off cable television rather than made from stolen theater prints (Spillman, 1984).

for unauthorized viewers to intercept satellite or cable broadcasts,² and for unauthorized broadcasters to evade regulatory schemes by operating in international waters or territories outside governmental control (Growth in piracy, 1986; How pirates are plundering, 1987; Wentz, 1985). In addition, unauthorized distributors may import video products for resale.³ The film and television producers term all of these unauthorized practices "video piracy."

If film and television producers' estimates are to be believed, the extent of the unauthorized prerecorded videocassette trade in many countries is astounding.⁴ The market share of unauthorized videocassettes, measured in quantity units, is estimated at 100% in Turkey and Egypt⁵, 40% to 50% in Japan (Valenti, 1987; Melanson, 1987), 50% in Iceland (including 80% in Reykjavik; Keller, 1986), 20% in Australia (Groves, 1986), 85% in Panama (Besas, 1986), 100% in the Phillipines (Giron, 1986),⁶ 30% in Venezuela (Besas, 1986), and 70% in West Germany, France, and the Benelux countries (On Bluebeard's Tapedeck, 1984). Further, despite substantial decreases in share in the recent past, unauthorized video products account for a large fraction of the prerecorded videocassette trade in Britain (down from 65% in 1981 to 35% in 1983 and 25% in 1986; On Bluebeards Tapedeck, 1984;

² See Chad, 1987, p. C18; "Federal Injunction Bars Florida Motels From Cable-TV Theft," 1986, p. 1; Guild, 1986, pp. 1, 44. The MPAA contends that satellite signal and cable interception is the leading source of unauthorized video activity in the United States (Nix, 1986, p. 34), although new technology has increased the ability of cable companies to detect unauthorized users (Cleaver, 1984).

³ This is said to be the major source of unauthorized video cassette sales in New Zealand (Nicolaidi, 1987, p. 130). The MPAA claims that Venezuelan cassettes have been sold in other Latin American countries, Puerto Rico, and the United States, while United Kingdom cassettes "regularly appear" in Australia, Hong Kong, and New Zealand (Nix, 1986, p. 33; D. Groves, 1986, pp. 347, 418).

⁴ The primary source of these estimates appears to be the Motion Picture Association of America (MPAA), a film and television producer trade association strongly opposed to the unauthorized sale of these products. The American Film Marketing Association, an organization of smaller independent film producers, also opposes the unauthorized sale of video products (Rosenfield, 1986, p. 83).

Similarly, studies commissioned by record and tape producers show that a high fraction of sound recordings sold in many countries (excluding home taping or the unauthorized recording of live performances) are duplicated without authorization and sold under a label resembling the original. The market share of these unauthorized products is estimated at 90% in Turkey, 80% in Portugal, 70% in Greece, 50% in Spain, and 25% in Italy (Ruzicka, 1986). U.S. record companies have aggressively prosecuted U.S. record chains importing and selling compact disks purchased abroad when the same title is distributed domestically (Goldberg, 1986, p. 17).

⁵ These countries have an installed base of videocassette recorders and television sets in the millions. See the testimony of Jack Valenti, President, Motion Picture Association of America, Inc., Joint Economic Subcommittee on Trade, Productivity, and Economic Growth, Hearing on International Piracy and Counterfeiting, March 31, 1986.

⁶ The article reports that most of the unauthorized sales consist of feature films, principally from the U.S.

Stuart, 1986), in Brazil (down from 90% in 1984 to 50% in 1986; Besas, 1986),⁷ in Spain (down from 100% in 1983 to 30% in 1986; Stuart, 1986; Besas, 1987), and in Holland (down from 90% in 1983 to 40% in 1987; Variety, 1987).⁸ Yet in other countries with large markets for prerecorded videocassettes, the market share of unauthorized products is much lower, under 10%. That share is estimated at between 2% and 5% in Denmark, Sweden, and Norway (Keller, 1986) and 5% to 10% in the United States (Melanson, 1987).

The unauthorized sale or use of video products in general violates the law of most countries. However, the extent of copyright and trademark law protection for authorized sellers has been disputed, primarily because of the ambiguity of extending laws created for other products to video practices made possible by new technology.⁹ Even when such conduct is unambiguously illegal, it may be difficult and costly to police. For example, most unauthorized videocassette production in West Germany is reportedly undertaken in residential areas, where it is difficult to detect, and may be sold informally through "photocopy lists . . . circulated discreetly among acquaintances and colleagues at work" (Kindred, 1987). Further, countries that consume but do not produce video products may enact laws barring unauthorized distribution of those goods under pressure from trading partners who produce video products, but may find it expedient in terms of domestic politics not to enforce those laws. Enforcement initiatives advocated by the film and television industry or implemented in various countries have included increasing the civil and criminal penalties for copyright law violations, raising the cost of blank video recording tape through a tax, and increasing the public and private resources devoted to detecting and convicting violators.¹⁰

⁷ However, another estimate puts the market share of unauthorized sales in Brazil at 80% in 1986 (Hoineff, 1986).

⁸ In each of these countries the decline in the market share of unauthorized videocassette sales has been attributed at least in part to increased governmental enforcement efforts against the practice.

⁹ See, e.g., *Sony Corp. v. Universal City Studios, Inc.*, 464 U.S. 417 (1984) (*Betamax*); *Columbia Broadcasting System, Inc. v. Scorpio Music Distributors, Inc.*, 569 F. Supp. 47, 222 U.S.P.Q. 975 (E.D. Pa. 1983); *aff'd without opinion*, 738 F.2d 424 (3d. Cir. 1984).

¹⁰ Each of these methods has been employed or considered in EEC countries, the U.S., Singapore, and Australia ("On Bluebeard's Tapedeck," 1984, p. 56 (EEC); "How Pirates are Plundering the Studios," 1983, p. 81 (US); "Taping the Pirates," 1986, p. 71; D. Groves, 1986, p. 41; J. Stuart, 1986, pp. 5, 35). In 1984 the MPAA reportedly employed six full-time and 30 part-time ex-FBI agents investigating the unauthorized sale of video products in the United States (Spillman, 1984, p. 105). Film producers are also employing sophisticated labeling technology to detect the source of theater prints copied without authorization (Nix, 1986, pp. 33, 35) and are making videocassettes more difficult to copy (Bierbaum, 1986, pp. 5, 92).

Private litigation by copyright holders also deters unauthorized use. For example, the National Football League is embroiled in disputes with bar owners over the rights to view satellite disk pickups of sports event broadcasts (Chad, 1987, p. C18; see "Federal Injunction Bars Florida Motels From Cable-TV Theft," 1986, p. 1).

(continued)

Those retailers who defend various forms of unauthorized videocassette distribution argue that the practice permits lower consumer prices (Allen, 1980) and greater product variety.¹¹ The authorized distributors, in contrast, emphasize that a reasonable markup of price over marginal cost is necessary for producers to cover the high fixed costs for film production and the risks of box office flops.¹² Without the ability to recover such costs on box office successes, the video products most likely to be the subject of unauthorized distribution, the producers of authorized products may be forced to exit from the film business entirely, reducing over time the number and variety of new film products available to consumers.

The underlying policy tradeoff suggested by the debate over unauthorized video products is between the lower consumer prices that result from allowing their distribution and the reduction in producer incentives to invest in new products or services that results from permitting unauthorized distributors to compete with authorized firms. This tradeoff appears whenever firms can make investments that increase the value of their product to consumers, including the policy debates over patent protection, vertical restraints on distributors, counterfeit sales, and "gray market" goods.

In the familiar context of inventions, the tradeoff is resolved by allowing manufacturers to patent innovations for a term of years. Governments award patent monopolies even though consumer prices would be lower were unauthorized producers allowed to sell new products created by others, in order to preserve economy-wide incentives for investment in new techniques and products.

A similar policy tradeoff arises when governments decide whether to allow manufacturers to impose nonprice vertical restraints on distributors. Since 1977, U.S. antitrust law has recognized that limitations on intrabrand competition, as through territorial restraints on distributors, can be pro-competitive if they improve interbrand competition.¹³ In this way, dealers are encouraged to offer valuable point of sale services to consumers without fear that competing dealers will free ride on those actions. This antitrust

Some proposals for limiting the trade in unauthorized informational products seek governmentally imposed technological standards to raise the cost of evading the copyright and trademark laws. For example, record companies wish to restrict the sale or recording ability of new digital audiotape recorders (Burgess, 1987, p. H1; Mesce, (Associated Press report); B. Davis, 1987, p. 33). For an overview of the current U.S. policy debate on this topic, see generally, Burgess, 1987, p. H1.

¹¹ Some countries believe that the sale of both authorized and unauthorized foreign videocassettes reduces product variety, to limit the sale of foreign video products to preserve the local culture (Chilean vid distribution, 1986). See generally, C. Ogan, 1985, p. 63).

¹² See the testimony of Jack Valenti, President, Motion Picture Association of America, Inc., Before the Joint Economic Subcommittee on Trade, Productivity and Economic Growth, Hearing on International Piracy and Counterfeiting, March 31, 1987, p. 8. See also Spillman, 1984, p. 105.

¹³ *Continental TV Inc. v. GTE Sylvania, Inc.* 433 U.S. 36 (1977).

policy allows manufacturers to preserve distributor investment incentives by restricting competition among dealers.

This chapter analyzes the welfare consequences of the unauthorized sale of video products as a species of another question raising the policy tradeoff between preserving producer investment incentives and preserving low consumer prices: whether to allow the "gray market."¹⁴ This term refers to the unauthorized importation of trademarked or copyrighted products. In the 1980s U.S. consumers have been able to purchase a wide variety of branded products on the gray market, including Opium perfumes, Seiko watches, Mercedes automobiles, Duracell batteries, and Nikon cameras.

Among the many practices termed "video piracy" by the film and television producers, one of the most widespread is a form of gray-market sales: the unauthorized importation of copyrighted material. Other video piracy practices fit different legal categories more closely. The unauthorized resale of copied or covertly taped videocassettes is counterfeiting in legal schemes awarding property rights in visual recordings. Satellite and cable interceptions involve the resale of stolen goods when property rights in broadcasting exist. Regardless of legal category, all of these practices raise the same policy tradeoff, and all may be analyzed with the same economic model. Thus, for expositional convenience, the model of this paper will be discussed in terms of the gray market, and the examples of video piracy will emphasize the unauthorized trade in prerecorded video-cassettes. With the appropriate redefinition of variables, the same economic model could equally well describe counterfeiting or the fencing of stolen property, and thereby accommodate all the practices labeled video piracy. Further, the economic model could be recast to evaluate patent laws, vertical restraints, and other policy questions raising the tradeoff between low consumer prices and high manufacturer or distributor incentives to invest.

Unlike most gray markets, which involve small market shares, the trade in unauthorized prerecorded videocassettes often appears to result in a market share over 50%. The model presented in this chapter accommodates this wide disparity in market shares by relating it to the marginal cost curve of the unauthorized sector. The model therefore implicitly attributes the high market share of unauthorized video products, compared to the small market share of other gray market sectors, to the low cost of copying videocassettes and the low expected penalties facing gray market distributors resulting from difficulties enforcing laws prohibiting the practice.¹⁵

¹⁴ In the video realm, the manufacturers are winning the semantic battle, by the widespread adoption of the connotatively unfavorable term "video piracy" to describe the sale of unauthorized video products. The gray-market question is the subject of a semantic as well as a legal debate: The term "gray market" is employed by manufacturers to describe the unauthorized importation of trademarked or copyrighted products, while importers refer to the practice as "parallel importation."

¹⁵ So long as gray market sellers are small and numerous, they will act as a competitive fringe in a dominant firm model even in markets where they collectively hold a high share.

In discussing the gray market and video piracy, this chapter evaluates the underlying consumer welfare tradeoff. The gray market can harm consumers by removing producer incentives to invest in reputation, because it allows unauthorized distributors to free ride on the reputational investments of the authorized distributors. On the other hand, it may benefit consumers by lowering prices for the gray market product. The primary conclusion of this chapter is that, in most cases, the gray market is on balance detrimental to consumers, because the harm to consumers from deterring valuable investments will likely outweigh the consumer benefit from lower prices.

This result is shown for a world biased in favor of the gray market, because it assumes away a second likely form of consumer harm from the gray market, consumer confusion. Appendix E to this chapter extends the model to allow for the possibility that consumers of gray market products mistakenly think they are purchasing a more valuable authorized good, and shows that this possibility likely strengthens the case against the gray market. In the video piracy context, these results suggest that higher penalties and increased enforcement efforts aimed at reducing the unauthorized sale or use of video products will improve consumer welfare.

PREVIOUS ECONOMIC ANALYSES

The present analysis adds to the economic literature on the gray market by creating a formal economic model in order to derive conditions under which policies affecting the gray market improve consumer welfare. This model incorporates the primary arguments of the economists on each side of the policy debate.

Economists opposing the gray market emphasize the welfare costs of free riding by gray market sellers and dismiss the possibility that arbitrage will create welfare gains by lowering consumer prices. These authors argue that consumer prices can fall no further following the creation of a gray market because entry is already easy into most domestic markets selling the branded products that are prey to gray market competition. As entry will compete price down to long run average cost, the long run competitive equilibrium, gray market imports are said to be unnecessary for consumers to receive the benefits of competition (Knoll, 1986; Miller, 1986).

The argument against the benefits of additional competition depends crucially on its free entry assumption. Yet this assumption is not unchallengeable. Economists have applied strategic entry deterrence models to industries selling differentiated products, such as the branded goods subject to gray markets. In these models, entry is deterred by the credible threat of post-entry competition, allowing supercompetitive pricing by incumbent firms (Schmalensee, 1978; Mankiw & Whinston, 1986). Further, in order to

compete away incumbent firm market power in differentiated product industries, entrants must create a new product with characteristics similar to those of the brand sold by the successful incumbent. Yet this competitive response is problematic in the prerecorded videocassette industry, for one, as it can be difficult to replicate the attributes of a successful film in a later product.¹⁶ Because entry need not be easy, the possibility of consumer benefits from lower prices resulting from the gray market cannot be dismissed cavalierly.

The primary economic argument in favor of the gray market, in contrast, dismisses the incentive effects of gray market competition on the reputational investments of the authorized producer and emphasizes the lower prices created by international arbitrage (Hilke, 1987). If free riding were a problem, this argument contends, private contracting for exclusive distribution territories and the prevention of resale except to consumers would eliminate it.

This argument fails to recognize that if firms were able to contract to eliminate free riding, they could also contract to eliminate international arbitrage.¹⁷ In other words, this position ignores enforcement costs; private contracting to prevent resale may well be prohibitively expensive to enforce for consumer products sold in complex distribution chains, such as the branded consumer products most affected by the gray market.¹⁸ In consequence, a gray market may create a substantial disincentive for producer investments in reputation; importer free riding rather than arbitrage could be the primary economic force underlying the practice. To incorporate this possibility, the present model expressly allows for gray market sales to appropriate the benefit of the reputational expenditures of the authorized distributor.¹⁹

¹⁶ A successful film will often be followed by less successful imitations.

¹⁷ Further, this position's emphasis on the consumer benefits resulting from low gray market prices understates the social costs of the reduction in reputational investments that will occur if authorized sectors are unable to cover average costs.

¹⁸ The most cost-effective way to enforce such contracts in the international trade context is likely at the border, through the Customs Service. This is the remedy generally advocated by anti-gray market forces. The expenses of policing the unauthorized copying of videocassettes are equally high.

¹⁹ Gray market foes sometimes suggest that the consumer gains from international arbitrage necessarily exceed the costs of free riding on the authorized firms' reputational investment whenever the (domestic) wholesale price of the authorized product exceeds the (foreign) wholesale price of the gray market product. This position implicitly presumes that the authorized distributor makes no reputational investments valuable to domestic consumers.

When domestic distributions make reputational investments, the authorized foreign product can be thought of as a different good from the authorized domestic product. To the extent the domestic and foreign distributors invest in creating different physical or nonphysical product attributes, the two goods can be said to have "separate goodwills." For example, one distributor might provide more point of sale services, greater warranty protection, or a better reputation for quality than the other.

A recent economic analysis of counterfeit goods by Grossman and Shapiro addresses some of the issues confronted here.²⁰ These authors develop a two-country model of international trade in which foreign firms choose to produce either low-quality legitimate merchandise or counterfeit products, and in which the domestic producer chooses his quality level. Grossman and Shapiro focus primarily upon two issues of secondary importance for this chapter. They address the adverse selection problems associated with the marketing of counterfeit merchandise when consumers have imperfect information, by finding a rational expectations (subgame-perfect) steady-state equilibrium for their model. Further, Grossman and Shapiro examine the welfare effects of several policies for the disposal of confiscated products, an issue that is not a concern of the present chapter.

In a very general way, Grossman and Shapiro's results corroborate the welfare tradeoff emphasized here. When the number of sellers in the domestic market is fixed so that domestic producers have market power, these authors find that marginal increases in the enforcement of counterfeiting prohibitions may or may not improve domestic welfare. Welfare may fall if increased enforcement exacerbates a preexisting market distortion. Although the distortion emphasized by Grossman and Shapiro concerns producer choice of product quality, an issue not incorporated into the present analysis, this result parallels the discussion below. The present chapter similarly finds that a marginal increase in the marginal costs facing the gray market fringe (as from greater enforcement efforts) can either improve or reduce domestic welfare. Welfare may fall if the reduction in gray market imports exacer-

This chapter shows that the gray market sector will be most active when its marginal cost is low, as when authorized foreign distributors do not invest heavily in (foreign) reputation, and when the domestic selling price is high, as when authorized domestic distributors invest heavily in reputation. Under these circumstances, the gray market sector is free riding substantially on the reputational investments of the domestic distributor. This result is not inconsistent with the possibility that both authorized distributors, foreign and domestic, purchased the product for the same wholesale price; indeed free riding will be profitable for the gray market sector so long as the value to domestic consumers of the authorized distributor's reputational expenses exceeds the transportation and other marginal costs of importation (see generally, Lexecon Inc., 1986).

²⁰ See G. Grossman and C. Shapiro, 1986. For more general, nontechnical, and stimulating discussions of the welfare effects of trademarks, see Shapiro, 1982; Craswell, 1979.

Two recent papers analyze the welfare effects of counterfeiting snob goods, but neither confronts the issues addressed in the present discussion. The first emphasizes that some consumers benefit when they are able to purchase the prestige aspect of such products at a low price without the buying the quality attributes, but that the sale of fake products degrades the status associated with a given trademark for snobbish consumers (G. Grossman & C. Shapiro, forthcoming). The other emphasizes that the value of prestige goods to snobbish consumers may fall if the amount of goods in circulation rises (R. Higgins & P. Rubin, 1986, pp. 211-230). Neither of these dynamics applies to the gray market generally, or to the unauthorized sale of video products in particular.

bates the distortion created by the monopoly pricing of the trademarked product by more than it improves the incentives of authorized producers to invest in reputation. This chapter goes beyond Grossman and Shapiro on this issue, however, by assessing the practical significance of this tradeoff.

A MODEL OF GRAY MARKET TRADE

The model of the gray market described in this section is designed to examine the policy tradeoff between free riding and arbitrage. Gray market sellers free ride on the reputational investments of the sellers of the authorized product, thereby reducing the incentive of authorized sellers to undertake such investments regardless of the value of those investments to consumers. However, the gray market may also allow the arbitrage of international price differences, lowering consumer prices.

The discussion below uses the term "authorized" product to describe a good placed into domestic commerce by the domestic trademark or copyright owner, and employs the term "gray market" product for a good with similar physical characteristics placed into domestic commerce by anyone else. In the videocassette context, the gray market product represents both unauthorized parallel imports of video products (true gray market sales), and, more generally, unauthorized copies whether or not imported.

The industry is modeled as composed of a dominant firm, namely the authorized seller, and a gray market fringe. The industry produces a differentiated product, so its demand curve is downward sloping. The model assumes that only one authorized distributor exists for each product. The gray market is treated as a competitive fringe, selling a product perceived by consumers as identical to the authorized good along its upward sloping marginal cost curve.²¹

These assumptions plausibly characterize the video industry. For most video products, the authorized distributor makes reputational investments, while gray-market importers (or video cassette copiers) are small and numerous, and do not make such investments. The model implicitly treats possible

²¹ The gray market is implicitly characterized as a large number of independent distributors who act competitively, not as a small number of sellers involved in a more complex noncooperative interaction with the authorized domestic producer. This interpretation is consistent with the characteristics of many gray markets in the United States. This view may be less plausible when gray market sales equal half or more of total product sales, to the extent the larger share is serviced by a large importer able to take advantage of the downward-sloping industry demand curve. However, the model continues to apply in those situations if there are many importers, each of whom prices at marginal cost. If the gray market sector did not act competitively, the consumer welfare loss from allowing a gray market to exist would likely increase over the levels observed in the present model, even if the gray market sector also undertook its own reputational investments.

sanctions against the illegal acts of video pirates as a marginal cost, and ignores the possibility that the authorized producer might obtain damages in a private action against unauthorized firms.

The model presumes that the authorized and gray market products are identical. By assuming away the possibility of consumer confusion between the authorized and gray market products, the model highlights the policy tradeoff between encouraging new products by preserving the authorized firm's incentives to invest in reputation, and lowering consumer prices by allowing gray market sellers to compete with authorized distributors. However, courts have often, but not always, found consumer confusion in gray market litigation in the United States. When consumer confusion is important, the analysis below will likely underestimate the costs of gray market activities, perhaps substantially so. The significance of consumer confusion is treated in detail in Appendix E of this chapter.

The dominant firm, selling the authorized product, distributes Q units of the authorized product at marginal cost C and sells them for price P .²² Aside from the expenses included in the marginal cost function, distribution of the authorized product may require an investment A in reputation-creating activities. As the model has only one period,²³ A should be viewed as the discounted present value of all reputational investments.

The variable A may be thought of as advertising, although it may also represent a variety of other firm investments depending on the product, including other forms of promotion, warranty service, point of sale services, and expenses on preserving quality. The model presumes that all reputational investments benefit consumers (Telser, 1968). This assumes away the possibility that advertising by branded good distributors is a device for strategic entry deterrence,²⁴ and it presumes that all reputational investments are valued identically by marginal and inframarginal customers. If

²² The assumption that price is well defined for sellers of prerecorded videocassettes abstracts from several complications. Most importantly, video distributors must decide whether to rent or sell their products, or whether to do both simultaneously at different prices ("A No-Win War in Videocassettes," 1987, p. 152). Other pricing complexities arise from the ability of film and television producers to shift distribution from theater or television to cassette sales, and from the presence of alternative standard formats, Beta and VHS. In order to isolate the gray market issue, the price of a videocassette as used in the present model will be thought of as the discounted present value of the revenue stream resulting from the best set of marketing decisions available to the firm, divided by the number of cassettes placed in distribution. In other industries where gray market sales are prevalent (such as watches, perfume, and cameras), the good and its price are better defined.

²³ Profits in the model can be thought of as the discounted present value of an expected profit stream. Even if lower consumer prices from gray market competition occur before the dominant firm's foregone reputational investments would have been made, the model will fairly represent the consumer welfare tradeoff between lower consumer prices and reduced innovation because the value of future reputational investments is also discounted to the present.

²⁴ This assumption does not assume away all entry barriers, only the use of advertising to deter entry (Salop, 1979).

these assumptions are inaccurate, an observed advertising/sales ratio may overstate the level of the reputational investment relevant to the consumer welfare calculation.

In the model, the dominant firm's profits take the form:

$$\pi = (P - C)Q - A \quad (1)$$

Marginal cost C is assumed constant. For analytic simplicity, equation (1) assumes that there are no fixed costs of production (other than the investment in reputation). This assumption does not affect the welfare analysis of the model because that analysis is local rather than global. Thus, the role of dominant firm fixed costs in creating scale economies and the role of dominant firm sunk costs in creating entry barriers against the fringe are ignored, and a profit constraint is assumed satisfied.

The brand (inverse) demand function (2) depends upon the total of both authorized firm output Q and gray market output G , because consumers do not differentiate between the two goods. The notation X represents the total quantity of brand sales: $X = Q + G$. Brand demand also depends on the reputation created by advertising or other reputational expenditures A .

$$P = F(X, A) \quad (2)$$

The inverse demand curve is downward sloping in quantity ($F_x < 0$). Its slope will be steepest when competing brands are poor substitutes for the brand at issue.²⁵ Increasing expenditures on goodwill are assumed to increase the value of the product to consumers ($F_a > 0$).²⁶

The gray-market fringe sells at its marginal cost, so its output is determined by the fringe supply function (3).

$$P = T + K(G) \quad (3)$$

The fringe supply curve shifts vertically through changes in the intercept T . Exchange rate fluctuations are likely the most important source of shifts in T . This parameter permits investigation of the welfare consequences of policies encouraging or discouraging gray market imports. The model ignores the role of fixed costs in determining the number of fringe producers and in creating the possibility of scale economies in fringe production.

The fringe marginal cost curve is an increasing function of fringe output ($K_g > 0$). This slope reflects both the difficulties gray market importers have

²⁵ The greater the extent of product differentiation, the less important oligopoly behavior is in affecting the demand for any one brand. This chapter ignores rival brand reactions on the assumption that differentiation is extensive for brands subject to gray market competition. Thus, the output of competing brands is neglected in specifying equation (2).

²⁶ The second-order conditions will require that $F_{aa} > 0$.

in obtaining assured foreign supplies and domestic distribution as their sales increase, and gray market importers bidding up the foreign price of imports as their purchases increase.

Equations (2) and (3) imply equation (4), a residual demand curve facing the dominant (authorized) seller.

$$P = R(Q, A) \quad (4)$$

As is demonstrated in Appendix B, the residual demand curve facing the dominant firm is downward sloping in output ($R_q < 0$).

The dominant firm is the only nontrivial decision maker in the model. It chooses Q and A to maximize profits (1), thereby solving the optimization problem (5).

$$\max_{Q, A} \pi = (R(Q, A) - C)Q - A \quad (5)$$

The first-order conditions for an interior maximum are stated as equations (6) and (7).²⁷

$$QR_q + R - C = 0 \quad (6)$$

$$QR_a = 1 \quad (7)$$

Through algebraic manipulation, these first-order conditions take on familiar forms:

$$L \equiv (P - C)/P = -E_{r_q} \quad (8)$$

$$\Psi \equiv A/(PQ) = E_{r_a} \quad (9)$$

According to equation (8), a firm with market power chooses a price such that the Lerner Index (L) of markup of price over marginal cost equals the absolute value of the elasticity of inverse residual demand with respect to output. Equation (9) is the Dorfman-Steiner condition that a firm with monopoly power advertises until the advertising to sales ratio (Ψ) equals the advertising elasticity of inverse residual demand.²⁸ These first-order conditions, along with definitions (2) and (3), are sufficient to determine P , Q , G , and A ; they define the equilibrium.

²⁷ The two second-order conditions are: $R_{qq} + 2R_q < 0$ and $R_{aa} < 0$. The former condition is guaranteed by the assumption that $R_q < 0$, unless R_{qq} is large and positive. In the "linear" model that generates the primary results of this chapter, $R_{qq} = 0$, so this condition will necessarily be satisfied. Further, the proof of Corollary A.1 of Appendix A implies that R_{aa} has the same sign as F_{aa} , previously assumed negative. This guarantees that the condition $R_{aa} < 0$ holds.

²⁸ Note that both Ψ and L must be found in the interval $[0, 1]$.

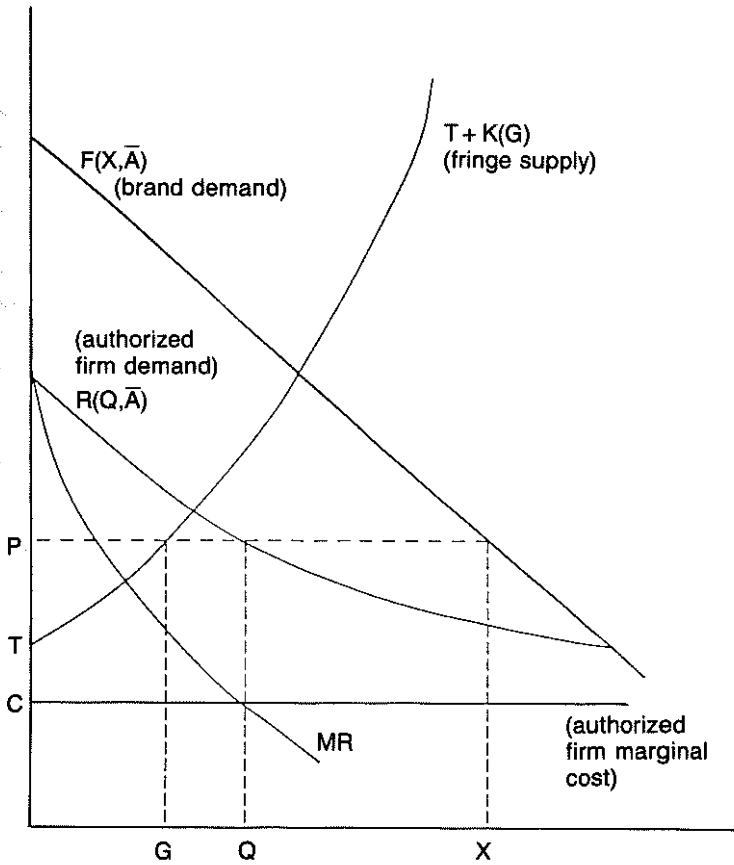


Figure 5.1. Authorized Firm Output in a Market With a Gray-Market Fringe

The equilibrium derived above is depicted in Figure 1. This diagram is similar to the familiar diagram of the equilibrium in a market with a dominant firm and competitive fringe. Unlike the familiar case, however, the curves drawn in Figure 1 hold constant the level of advertising. Thus, only first-order condition (6) is shown.

The comparative statics of this equilibrium, derived and signed in Appendix B, are summarized here. The derivatives of inverse residual demand (price) with respect to the dominant firm's two decision variables (Q and A) and the policy parameter (T) are:

$$R_q = -K_g F_x / (F_x - K_g) < 0, \tag{10}$$

$$R_a = -K_g F_a / (F_x - K_g) > 0, \text{ and} \tag{11}$$

$$R_t = F_x / (F_x - K_g) > 0. \tag{12}$$

Equation (10) shows that an increase in the dominant firm's output reduces price, because the dominant firm faces a downward sloping residual demand curve. When the dominant firm increases its investment in reputation, equation (11) shows that it raises consumer willingness to pay and raises the equilibrium price. Finally, if the marginal cost of gray market sales increase, equation (12) shows that the equilibrium price rises because the fringe provides less competitive discipline for the dominant firm. Intuitively, the higher cost to the fringe allows the dominant firm to internalize more of the benefits of the reduction in total brand sales, so the dominant firm increases output by less than the fringe reduces output. As total output declines, equilibrium price rises.

The derivatives of fringe output with respect to the same three variables are:

$$G_q = -F_x / (F_x - K_g) < 0, \quad (13)$$

$$G_a = -F_a / (F_x - K_g) > 0, \text{ and} \quad (14)$$

$$G_t = 1 / (F_x - K_g) < 0. \quad (15)$$

Equation (13) shows that an increase in dominant firm output takes sales away from the fringe.²⁹ The remaining equations show that an increase in the dominant firm's reputational investment allows fringe producers to increase sales by free-riding on that investment (equation (14)), and that an increase in the marginal cost of gray-market products reduces fringe output (equation (15)).

The effects of changes in T , vertical shifts in fringe marginal cost, on the dominant firm's decision variables are derived and signed in Appendix B under the assumptions of the "linear" model defined in Appendix A. The "linear" model sets all second derivatives to zero except F_{aa} and R_{aa} , which must be negative in order for the second order conditions for an interior profit maximum to hold.

$$A_t = R_a R_t / [4R_q Q R_{aa} - (R_a)^2] > 0 \quad (16)$$

$$Q_t = -(2R_{aa} Q R_t / (4R_q Q R_{aa} - R_a^2)) > 0 \quad (17)$$

The conclusion that both Q_t and A_t are positive in the "linear" model is a sensible one. First, an upward shift in fringe marginal cost will make the dominant firm's reputational investments more valuable on the margin by reducing fringe free riding, and thus will cause the dominant firm to increase

²⁹ In this case, fringe sales may decline less than dominant firm sales rise.

those investments. Second, a higher fringe supply curve will raise dominant firm output because the dominant firm will take sales away from the fringe.

As is evident from the comparative statics of G, the fringe's market share will be large whenever total brand demand is elastic, fringe marginal cost is flat, and fringe marginal costs are low. The model is not inconsistent with a high market share for the fringe, as has been observed for videocassettes in many countries. The most likely explanation for this observation in terms of the model is that T, the parameter generating vertical shifts in fringe supply, is low. Indeed, in comparison with the costs facing sellers of most gray market products, the marginal cost curve for fringe sellers of unauthorized videocassettes is probably very low, because unauthorized videocassettes can be obtained by copying without need for importation or the payment of royalties to trademark owners.

In terms of the model, the variation in market share of the unauthorized video product sector across countries may also be explained by variation in T, in this case by differences in the enforcement of intellectual property protections. It is unlikely that the slope of brand demand or fringe marginal cost differs substantially from one country to the next for the videocassette industry. Hence the large cross-sectional variation in the market share of unauthorized videocassettes is most likely explained by disparities in the level of gray market marginal costs. In particular, the U.S. and various Scandinavian countries most likely have a much lower incidence of video piracy than other market economies because more governmental resources are devoted to enforcement actions to prohibit this trade in those countries. This inference is consistent with the behavior of the film and television producers and their authorized distributors, who have emphasized private enforcement and lobbying for public enforcement in their efforts to stem the unauthorized trade. Intertemporal variation in gray market significance also is explained by variation in marginal cost. The size of the gray market sector in the U.S. has altered over the past decade along with the strength of the dollar. The stronger the dollar, the cheaper are imports in dollar terms, and the larger the gray market.³⁰

DETERMINANTS OF CONSUMER WELFARE

The welfare analysis of this chapter focuses on the surplus accruing to domestic consumers. This emphasis excludes the domestic benefit of the

³⁰ Thus, in a case involving gray market Duracell batteries, the U.S. International Trade Commission found that gray market transactions were "profitable to the importer due to the strong position of the U.S. dollar as against European currencies." *In re Certain Alkaline Batteries*, 225 U.S.P.Q. 823, 825 (U.S.I.T.C. 1984); *remedy disapproved*, 225 US12 862; *aff'd sub nom.*, *Duracell Inc. v. U.S.I.T.C.*, 778 F.2d 1578 (Fed. Cir. 1985).

producers' surplus accruing to the authorized and gray market sectors, and it excludes all benefits to foreign consumers.³¹ The domestic benefit of the producers' surplus is analyzed in Appendix D of this chapter.

The focus on consumer welfare is consistent with the consumer welfare emphasis of the gray market policy debate.³² Further, under one set of assumptions, described in Appendix D, producers' surplus will be zero, so that total surplus will consist solely of consumers' surplus. Although gray markets involve international trade, the welfare of foreign consumers is excluded on the view that sovereign policy makers are primarily concerned with their domestic consumers.

Consumer welfare is defined in this chapter as equal to the domestic consumer's surplus associated with purchases of Q and G , as indicated in equation (18).³³

$$CS = S(X,A) - R(Q,A)X, \text{ where } S(X,A) = \int_0^X F(X,A)dX \quad (18)$$

In equation (18), the expression $S(X,A)$ represents the aggregate consumer benefit of domestic consumers' purchases of both the authorized and gray market products, measured as the area under the demand curve. The expression $R(Q,A)X$ equals total consumer payments for those products.

The policy question addressed by this chapter—whether promoting or hindering the gray market aids consumer welfare—will be analyzed by computing dCS/dT , the change in consumer's surplus resulting from a small vertical shift in gray market marginal cost.³⁴ If this expression is positive,

³¹ The welfare analysis also excludes the social resources devoted to the enforcement of intellectual property laws limiting or prohibiting the gray market. In consequence, if enforcement costs are large relative to changes in consumers' surplus, as seems unlikely, the analysis in this chapter will overstate the case against the gray market.

³² The authorized and gray market production and distribution sectors will likely be vocal advocates of their position on the gray market, as the producer benefits and costs of gray market policy are typically concentrated in a few firms or trade associations with a direct economic stake in governmental policy. In U.S. debates over the gray market, the policy arguments of the producers and distributors are often framed around the impact of such policies on domestic consumers, for whom the benefits and costs of policies are typically diffuse.

³³ The analysis below assumes that consumers' surplus is an exact welfare measure, ignoring income effects. It further assumes that consumers have full information about the value of all products in the economy, including the authorized product (other than the possibility of confusion from the gray market good in the discussion of Appendix E). Thus, the downward sloping demand curve for the authorized product results from spatial location, not from imperfect buyer information. Under this assumption, the market demand curve reflects underlying preferences under full information, and is appropriately considered a welfare measure.

³⁴ This welfare analysis assumes that the dominant firm's foreign affiliate does not alter the foreign wholesale price in response to variation in domestic government policy affecting T . The foreign affiliate (foreign distributor) is taken to be an independent decision maker maximizing its own profits without regard to the impact of its decisions on affiliated entities. This assumption is most plausible when the gray market exports account for only a small fraction of foreign source sales. It is particularly plausible with respect to video piracy, to the extent this problem involves unauthorized cassette copying.

then policies which raise the marginal cost of gray market imports move the equilibrium locally in the direction of higher consumer welfare.³⁵ If the expression is negative, then policies reducing the cost of those imports on the margin will improve consumer welfare. The test statistic dCS/dT is derived in equation (19).³⁶

$$dCS/dT = S(X,A)_x X_t + S(X,A)_a A_t - P X_t - X R_t = S(X,A)_a A_t - X R_t \quad (19)$$

The first expression in equation (19), $S(X,A)_a A_t$, represents the influence of a change in gray market policy on the consumer welfare costs resulting from unauthorized distributors free riding on the authorized firm's reputational investment A . This expression has a positive sign. As indicated in equation (11), increased reputational expenditures by the dominant firm increase the market price ($R_a > 0$). This guarantees that $S_a > 0$ under the "linear" model.³⁷ Further, as indicated in equation (16), a policy raising fringe marginal cost increases dominant firm reputational investments by raising their marginal value ($A_t > 0$). Intuitively, higher gray market marginal costs lead the authorized firm to increase its investment in goodwill, and those investments increase the consumer benefit from the consumption of both goods. Hence, policies raising gray market marginal costs improve social welfare by reducing the inhibitions on authorized producer reputational investments created by fringe free riding.

In contrast, the second expression, $-X R_t$, representing the beneficial effect of arbitrage on domestic prices, is negative. As indicated in equation (12), an increase in gray market marginal costs leads to a higher market price for sales of both the authorized and gray market goods ($R_t > 0$). Thus, policies harming the gray market reduce consumer welfare insofar as they raise consumer prices.

Proposition 1 summarizes the analysis of equation (19), identifying the mechanisms by which policies regarding the gray market affect consumer welfare in the absence of consumer confusion. Appendix E examines the significance of consumer confusion, and demonstrates that omitting this

³⁵ Although the welfare analysis of this chapter is local, it is possible under some circumstances to make inferences from dCS/dT about the welfare effects of substantial changes in T . Substantial shifts in T are proposed by the advocates of complete prohibition or unimpeded sale of gray market products. Inferences about the welfare effects of these policies require the additional (and potentially controversial) assumption that the magnitudes of the various derivatives comprising equation (19) do not change following substantial fluctuations in the values of Q and G implied by large changes in T . In general, local analysis will show the likely direction of policy improvements resulting from an increase or decrease in T , although policies involving large changes in T may overshoot the welfare optimum.

³⁶ The equation simplified by recognizing that $S(X,A)_x = F(X,A) = P$.

³⁷ Under the "linear" model, S_a is related to R_a by the following equation: $S_a = \int F_a(X,A) dx = \int R_a F_{aa} / R_{aa} dx$. Both second derivatives are always negative by virtue of Assumption A of the "linear" model. As R_a is positive (see equation (A.8) of Appendix B), S_a must be positive as well.

effect likely biases the consumer welfare tradeoff described in Proposition 1 in favor of the gray market.

Proposition 1: In the absence of consumer confusion, a policy making the gray market more expensive affects consumer welfare by:

- increasing reputational investments by the authorized producer through limiting the effects of free riding by gray market sellers, thereby improving consumer welfare; and
- raising consumer prices on both authorized and gray market products, thereby reducing consumer welfare.

In the event the authorized and the gray market products are differentiated from each other, contrary to the assumption made for analytic convenience in the present model, some of the welfare loss attributed here to higher consumer prices will instead take the form of reduced product variety. Although the analytic details of the model will alter if differentiation is allowed, the main conclusions of the analysis will likely remain unaffected.³³

³³ The present model will continue to apply when consumers can distinguish authorized from gray market products, and when they prefer the authorized goods, so long as: (a) the two products are sufficiently close substitutes so that the reputational investments of the authorized producer raise consumer willingness to pay for both products in a similar way; and (b) the units of the gray market product are altered so that, in adjusted units, the two goods sell for the same price. Under these assumptions, for the purpose of applying the model the two products may be treated as identical.

Alternatively, the gray market product may provide more competitive discipline for other brands, such as low-quality fringe brands, than for the authorized branded product. The welfare consequences of this situation depend on entry conditions in the industry. In a zero-profit free-entry equilibrium with price discrimination, the gray market may harm consumers because authorized firms may well create optimal product variety, which the gray market disturbs. (Incumbent manufacturers can capture the social benefit of product variety while preserving production economies by creating private labels. The gray market sector has less control over the attributes of its good than a manufacturer selling a private label, so optimal variety is likely sacrificed in an equilibrium including a nontrivial gray market sector.)

If instead incumbent firms earn economic profits, as may occur if product differentiation deters entry, gray market competition will benefit consumers by increasing product variety, although it will also harm consumers by reducing the reputational investments of the authorized distributor whose product's attributes are closest to those of the gray market good. This observation generalizes to the differentiated product case the policy tradeoff between lower prices and free riding characteristic of the homogeneous product case described in the present model.

Retailers of gray market products on occasion make reputational investments, as by providing warranties different from the manufacturer's warranty. These investments may differentiate the gray market goods from the authorized product. The effect of such investments is ignored in this model.

FREE RIDING VERSUS ARBITRAGE IN THE "LINEAR" MODEL

The primary results in this chapter are derived for the special case termed the "linear" model. This model presumes that all second derivatives are zero, except the second derivatives of brand and dominant firm inverse demand, which must be negative in order for the second order conditions to be satisfied. The assumptions of the "linear" model are stated in Appendix A.

Propositions 2 and 3, stated below and proved in Appendix C, identify conditions under which consumers benefit from policies tending to raise gray market costs. These propositions assess the policy tradeoff presented by the gray market, between lower consumer prices and free riding on authorized producer investments in reputation.

One new variable is introduced in order to simplify notation: $\lambda = [E_{fx}Q/E_{rq}X - 1] = [-E_{fx}Q/LX - 1]$. The variable λ depends upon the ratio of the elasticity of the inverse structural demand curve with respect to output (E_{fx}), to the elasticity of the inverse residual demand curve with respect to output (E_{rq}). This ratio will always exceed unity, but will be close to one if the fringe supply curve is very inelastic. Equation (8) allows the substitution of the Lerner Index (L) for $-E_{rq}$ in the definition of λ . The variable λ also depends on the quantity share of the authorized product (Q/X), a number between zero and one. As the product of these quantities must be greater than one,³⁹ the variable λ cannot be negative ($\lambda > 0$).

Proposition 2: In the "linear" model, without consumer confusion, a policy marginally hindering the gray market improves consumer welfare if $[\Psi(2 + \lambda)/4(1 - \Psi)] > L$, but reduces consumer welfare if $[\Psi(2 + \lambda)/4(1 - \Psi)] < L$.

Proposition 2 is important because it shows that the resolution of the fundamental gray market policy tradeoff—stopping free riding versus allowing lower consumer prices—turns on the size of the Lerner Index (L) of the authorized producer's markup of price over marginal cost.⁴⁰ If the

³⁹ In the proof of Theorem 2, it is demonstrated that $(1 + \lambda) = F_x/R_q$. Equation (A.7) of Appendix B requires that the market demand curve be steeper than the dominant firm's residual demand curve. Hence, λ cannot be negative. In the limiting case in which the gray market disappears, Q/X goes to one. Further, as the residual demand curve approaches the market demand curve, $-E_{rq}$ rises to $-E_{fx}$. In this polar case, λ shrinks to zero.

⁴⁰ At least two approaches to inferring the Lerner Index of markup are available. The accounting approach to estimating the markup from annual report data employs the dominant firm's short run average variable cost as a proxy for its marginal cost, and employs average revenue as a proxy for price. This approach presumes that marginal cost is constant for large changes in output. For example, if marginal cost is rising, average variable cost will understate marginal cost, so this accounting approach will overstate the markup L .

(continued)

dominant firm's markup is high relative to the dominant firm's reputational expenses, measured in terms of the advertising/sales ratio (Ψ), then consumer welfare is improved by policies benefitting the gray market. In that case, the consumer gains from lower prices exceed the consumer harm created by the reduction in incentives of the authorized producer to invest in improving the value of his product to the consumer. In contrast, when prices are low relative to reputational expenses, a policy hindering the gray market benefits consumers on the margin.

The size of the observed markup depends in part upon the level of reputational expenses. (The markup also varies with the height of entry barriers, dominant firm market share, the slope of the fringe supply curve, and the demand substitutability of competing brands.⁴¹) Because the parameter λ does not remain constant as L changes, the condition in Theorem 2 cannot be used to compare observed values of L and Ψ . This comparison is instead the subject of Proposition 3.

Proposition 3: In the "linear" model, without consumer confusion, $dCS/dT > 0$ if and only if $L < L^*$, where $L^* = \Psi/8(1 - \Psi) + [\Psi^2 - 16(1 - \Psi)E_{fx}Q/X]^{1/2}/8(1 - \Psi)$.

Proposition 3 identifies the critical markup value L^* . If, for a particular product, L is greater than the indicated value of L^* , the gray market improves consumer welfare on the margin. If L is less than the appropriate critical value, a policy raising gray market costs improves consumer welfare on the margin. Proposition 3 shows that the critical value of the markup, that is, the markup level at which the gray market does not affect consumer welfare on the margin, depends on the level of reputational expenses (Ψ), and on the elasticity of industry demand ($-E_{fx}$) weighted by dominant firm market share (Q/X).

In making these computations, the price P , the marginal cost C , and promotional expenditures A must be consistently defined. If these variables are defined with respect to an upstream distributor who sells at wholesale to retailers, P would be the wholesale price, C would be the distributor's marginal cost, and A would be the promotional investments made by the distributor. Alternatively, the distributor and retailers could be viewed as an integrated distribution sector. The P would be the retail price, C the sum of the distributor and the retailer's marginal costs, and A the total promotional expenses made at both levels. Further, the variables in the model are discounted present values of expense and revenue streams. If L and Ψ are inferred from one year's accounting data, that inference would implicitly presume that these variables are stable over time.

However, accounting estimates of markup are often unreliable indicators of true economic profits (Fisher & McGowan, 1983, pp. 82-97). An alternative econometric approach, available for differentiated product industries such as those susceptible to gray markets, would infer L directly from the slope of the residual demand curve (Baker & Bresnahan, 1985, pp. 427-44).

⁴¹ See, generally, W. Landes & R. Posner, 1981, pp. 937-96.

Table 1. Critical Values of L.

Ψ	$-E_{fx}Q/X$					
	0.25	0.50	0.75	1.00	1.25	1.50
0.05	0.26	0.37	0.45	0.52	0.58	0.63
0.10	0.28	0.39	0.47	0.54	0.60	0.66
0.15	0.29	0.41	0.49	0.56	0.63	0.69
0.20	0.31	0.43	0.52	0.59	0.66	0.72
0.25	0.33	0.45	0.54	0.62	0.69	0.75
0.30	0.36	0.48	0.57	0.65	0.72	0.79
0.35	0.38	0.51	0.61	0.69	0.76	0.83
0.40	0.42	0.55	0.65	0.73	0.81	0.88
0.45	0.45	0.59	0.70	0.78	0.86	0.93
0.50	0.50	0.64	0.75	0.84	0.93	1.00

To interpret Proposition 3, it is necessary to assess the likely magnitudes of three terms: L , Ψ , and $-E_{fx}Q/X$. Table 1 reports the critical values L^* for various combinations of Ψ and $-E_{fx}Q/X$. The values of $-E_{fx}Q/X$ in Table 1 range from 0.25 to 1.50. In the absence of econometric estimates of the demand curve for products with gray markets, this range seems plausible for three reasons. First, in the present model, the elasticity of the inverse market demand curve deflated by the market share of the dominated firm ($-E_{fx}Q/X$) must exceed the markup chosen by the dominant firm (L).⁴² If the market demand curve has a roughly constant elasticity, then $-E_{fx}$ can be thought of as the likely markup that the dominant firm would choose were there no gray market;⁴³ this observation suggests $-E_{fx}$ less than but perhaps close to one,⁴⁴ and $(E_{fx}Q/X)$ roughly equal to the authorized firm's market share.

Second, the markup for a branded product (L) may substantially exceed zero, even if the firm earns zero economic profits, when promotional expenditures in support of the brand are substantial. As $-E_{fx}Q/X$ must be greater than L , this implies that $-E_{fx}Q/X$ can also substantially exceed zero. Finally, the requirement that $-E_{fx}Q/X$ must exceed L suggests that $-E_{fx}$ will be a large multiple of L when gray market goods have a high market share (e.g., more than 50%), because a large gray market sector will limit the ability of the authorized producer to take advantage of an inelastic

⁴² Equation (A.7) of Appendix B implies that $L = [K_g/(K_g - F_x)](-E_{fx})(Q/X)$. As $K_g > 0$ and $F_x > 0$, the expression $[K_g/(K_g - F_x)]$ lies in the interval from zero to one.

⁴³ This interpretation of $-E_{fx}$ is the most reasonable when gray market goods have a small market share (e.g., no more than 10%), as then the constant market demand elasticity assumption will be the most plausible.

⁴⁴ Because a brand monopolist would not operate on an elastic portion of its demand curve, in equilibrium it would choose an output level such that L is no larger than one.

brand demand curve. In such a case, $-E_{fx}$ could be substantially larger than one, although there is no reason to believe that the product $-E_{fx}Q/X$ will be much larger than one.⁴⁵ To the extent a typical value for $-E_{fx}Q/X$ can be assigned based on the above considerations, perhaps 0.75 is a fair estimate. The values of the advertising/sales ratio (Ψ) in Table 1 range from 0.05 to 0.50. There is some evidence that the advertising/sales ratio of typical products subjects to a gray market is high, on the order of 20% to 30%.⁴⁶ As these estimates may not take into account all forms of promotion, the highest value for Ψ in the table is above 30%.

The line separating the lower left hand quadrant of Table 1 from the rest indicates that the critical values of L in that quadrant must be higher than the actual value of L , by virtue of the condition that $L < -E_{fx}Q/X$. Hence whenever Ψ and $-E_{fx}Q/X$ map to positions to the left and below this line, a marginal increase in the costs of the gray market sector necessarily increases consumer welfare. This quadrant includes the lowest critical values in the table.

Table 1 shows that a product's markup L must be very high before a policy encouraging the gray market on the margin will benefit consumers.⁴⁷ Outside of the lower-left quadrant, where L necessarily exceeds its critical value L^* , the critical markup values are in general closer to one than zero. Further, these values are in every case greater than the advertising/sales ratio for the authorized producer. Thus policies deterring the gray market on the margin will likely benefit consumers in most cases, no matter where on Table 1 the market in question is found.

Although Table 1 reflects a marginal analysis, this property permits a global policy conclusion: a complete prohibition of the gray market will, in most cases, improve consumer welfare. Even in the absence of consumer confusion, the policy tradeoff between preserving reputational incentives and lowering consumer prices is readily resolved in favor of prohibiting free riding. Hence, as discussed further in Appendix E, when gray market products are less desirable to consumers than authorized goods, and when consumers are confused at time of purchase between the two, a policy raising the costs of gray market imports almost surely benefits consumers.

This conclusion describes a general tendency; in any particular case, the balance between arbitrage and free riding may tilt the other way, to favor a

⁴⁵ Note that E_{fx} , X and L determine E_{fa} . This is evident from the two first order conditions and the formula for R_a of Appendix B: $(L)(E_{fa}) = (-E_{fx})(Q/X)\Psi = -E_{fx}(A/PX)$. Thus, if $(-E_{fx})(Q/X) = 0.75$, if Ψ equals 0.25, and if L equals the critical value indicated in Table 2 of 0.54, then E_{fa} will equal 0.35, a reasonable number.

⁴⁶ See Hilke, 1987, p. 17 n. 41; Miller, 1986, p. 373.

⁴⁷ Assumption C of Appendix A requires that $L > \Psi/4(1 - \Psi)$. This technical condition also relating L and Ψ will readily be satisfied. If it does not hold, then the "linear" model is not an appropriate approximation for the industry at issue.

gray market. A gray market is most likely to improve consumer welfare in industries where the authorized distributor would face a steep brand demand curve ($-E_{fx}$ large) even absent substantial advertising expenses.⁴⁸ However, Table 1 suggests such a situation will be the exception rather than the rule.

CONCLUSION AND APPLICATION

The dominant firm/gray market fringe model of this paper plausibly characterizes gray markets generally, and video piracy in particular. In terms of the model, the variation in gray market share across products, across countries, and over time is explained by differences in the height of the fringe marginal cost curve, which in turn shifts primarily in response to exchange rate fluctuations and variation in governmental enforcement efforts.

The main conclusion of this chapter is that the typical gray market most likely hurts consumers more than it helps them, although it is possible for the reverse to occur in particular cases. However, the formula of Proposition 3, relating the policy tradeoff between arbitrage and free riding to the dominant firm's markup and its level of advertising, allows in principle for a case-by-case analysis.

The formula is particularly difficult to apply to the prerecorded videocassette industry because neither the advertising sales ratio (Ψ) nor the authorized distributor's markup (L) can readily be measured. Most importantly, it is difficult to measure the advertising and promotional expenses benefiting the consumers in any particular country.

The first problem in measuring the reputational investments of cassette distributors is accounting for the spillover from prior theater advertising. If a film has been released in theaters prior to its cassette release, promotional expenditures undertaken in support of the theater showings may influence later consumer decisions to purchase videocassettes. To the extent these expenditures are undertaken by an affiliate of the videocassette distributor or the party who sold distribution rights to the distributor, so that the distributor expects to internalize this spillover, some fraction should be included in A and thus recognized in Ψ .

⁴⁸ This exceptional case is perhaps plausible with respect to U.S. gray markets for expensive automobile brands, such as Mercedes. Consumers of gray market luxury automobiles are generally aware that they are purchasing a gray market product which will require the addition of pollution control equipment to meet U.S. standards. Thus, consumer confusion is probably not an issue for consumers of this product. If, as has been contended, the U.S. authorized distributors price these automobiles at a substantial markup over marginal cost, exceeding the critical values of L in Table 1 given the promotional investment of authorized distributors, policies encouraging the gray market in these products may benefit consumers.

A second problem for measuring reputational investments in the videocassette industry comes from the need to account for other spillovers: Promotional expenses on related products and expenditures in other countries will affect consumer willingness to pay for videocassettes. To the extent one country's film reviews, film-related products such as toys or movie soundtracks, and film related topical illusions in the popular culture have audiences in other countries, the advertising and promotional expenditures in any one market will be difficult to determine.⁴⁹ Further, these spillovers imply that reputational expenditures affecting the value of videocassettes are unlikely to be stable from year to year, complicating the estimate of the typical value of Ψ required to apply the model.

The second difficulty applying the formula of Proposition 3 to the pre-recorded videocassette industry is in measuring the markup L . Revenue and cost data on individual films will be misleading because of the high failure rate for new products in the industry. Even aggregate revenue and cost data will require smoothing over time to account properly for the occasional blockbuster.

Because of these difficulties, the accounting records of videocassette distributors are unlikely to generate the appropriate measures of Ψ and L needed to apply Table 1 to the videocassette industry. Further, this accounting data is not in general publicly available. Policy makers addressing the issue of video piracy may, by default, find it necessary to apply the above generalization concerning the gray market, as it is unlikely, even in the absence of consumer confusion,⁵⁰ that the practices termed "video piracy" will benefit consumers.

Alternatively, one might speculate that blockbuster movie successes are the subject of the most substantial fraction of unauthorized videocassette distribution. Because sales are so large for these products, the worldwide average advertising/sales ratio may be low, even if promotional expenses in film related products are higher than average. The market demand for videocassettes of blockbuster film successes is likely to be relatively inelastic ($-E_{fx}$ close to one), so that the $-E_{fx} Q/X$ term can be approximated by the authorized firm's worldwide average market share. If that share is in the broad range of 50% to 100%, Table 1 suggests that the critical value of L is likely in the 40% to 50% range. Under these assumptions, the sales price must exceed 1.6 to 2.0 times marginal cost before incremental policy shifts *in favor of the gray market benefit consumers*. However, marginal cost,

⁴⁹ Such spillovers may be large. They undoubtedly contribute to the success of video pirates in distributing unauthorized videocassettes in some countries before the authorized product is released there either in theaters or as cassettes.

⁵⁰ As the MPAA does not emphasize consumer confusion in its extensive publicity effort concerning video piracy, it is likely that this is no more than a second order concern in the video industry, so is not emphasized here.

measured correctly, includes the risk that new films are box office failures. If one in ten films is a blockbuster success, the sales price for an authorized videocassette must exceed 16 to 20 times the incremental costs directly related to that film before it is sufficiently high as to make a gray market benefit consumers on the margin. As it is unlikely that actual markups are this high, this back-of-the-envelope calculation suggests that video piracy is unlikely to benefit consumers.

In sum, an identical conclusion results from both the general presumption and the speculative application of the model to the videocassette industry: Video piracy likely harms consumers. Three approaches to solving the video piracy problem have been proposed by the film and television industry: raising penalties, devoting more resources to enforcement, and taxing blank videotape (to raise the cost of unauthorized taping).⁵¹ If the demand for blank tape for uses other than the unauthorized taping of copyrighted videocassettes is large and elastic, taxing that product should be the last policy resort rather than the first, because such legislation could impose a substantial welfare loss on legitimate purchasers of the product. The first two proposals both work by increasing the expected penalty to unauthorized video product sellers; one raises the absolute penalty for those who are convicted, while the other raises the likelihood that a violator will be detected and convicted. Because of the difficulties identifying the source of unauthorized video products, and because it is easy for new individuals to enter the business of copying cassettes without permission, it is likely that public enforcement is more cost effective than private enforcement.⁵²

⁵¹ A higher price for videotape would create the same disincentive to unauthorized taping whether it is created by a tax, with revenues going to the government, or by awarding "royalties" to the film industry paid by blank tape purchasers. This difference in approach matters little to those who are concerned with consumer welfare, although it may have a substantial distributional effect on the film industry.

⁵² This observation does not resolve whether the public or the film producers should pay for increased public enforcement, however.

The discussion in the text treats two alternative public policies toward the gray market: complete prohibition or free gray market trade. These alternatives exclude two intermediate public policies to differentiate gray market goods from authorized products—demarking and labeling—because these intermediate policies are not readily applicable to film products. As it is impossible to separate the physical film product from the identity of the authorized producer, neither demarking nor labeling will reduce free riding by unauthorized videocassette distributors.

These intermediate public policies likely have greater applicability to other gray market goods. Both demarking and labeling reduce consumer confusion and increase product variety (generating similar consumer welfare benefits as obtained from a price reduction). Further demarking, and to some extent labeling, reduces unauthorized distributor free riding. These intermediate remedies may be understood as resembling a requirement that authorized producers create private label versions of their brand name products.

(continued)

APPENDIX A. THE "LINEAR" MODEL

This Appendix defines the "linear" model, a set of largely linear approximations. These approximations allow various derivatives to be signed in the comparative statics exercise of Appendix B. The assumptions of the "linear" model should be thought of as plausible local approximations to the behavior of the functions at issue. The term "linear" is placed in quotes because some functions cannot be linearized without violating the second order conditions for an interior solution to the dominant firm's optimization problem.

The "linear" model makes three sets of assumptions.

Assumption A: All the second derivatives of the functions $F(X,A)$, $K(G)$, and $R(Q,A)$ equal zero, except that the two partial derivatives R_{aa} and F_{aa} are assumed negative.

Assumption A linearizes the model to the maximum extent consistent with the second order conditions. It has the following corollary:

Corollary A.1: $F_{aa}/F_a = R_{aa}/R_a$

Proof: Under the conditions of Assumption A, $R_a = -K_g F_a / (F_x - K_g)$. This is demonstrated as equation (A.8) of Appendix B. As K_g and F_x can be treated as constants under the conditions of Assumption A, equation (A.8) implies $R_{aa} = -K_g F_{aa} / (F_x - K_g)$. The corollary follows immediately.

Assumption B imposes a constant elasticity approximation on a parameter which cannot be approximated linearly.

Assumption B: The "elasticity" $R_{aa}A/R_a$ is a constant, denoted μ .

A corollary of Assumption B is employed in the later analysis.

Corollary B.1: $\mu = \Psi - 1$

Because the model of this chapter demonstrates that the consumer welfare losses from free riding generally dominate the consumer benefits of arbitrage, the demarking remedy, which most likely reduces free riding more than the labeling remedy, is probably the better of these two intermediate policies for across the board application. Further, it is possible that an intermediate policy would be superior to either of the extreme policies of gray market prohibition or free gray market trade. The United States Customs Service has been studying this question (Customs Service, Importations Bearing Recorded U.S. Trademarks; Solicitation of Public Comment on Gray Market Policy Options, 51 Fed. Reg. 22,005, 1986).

Proof: Assumption B implies that $R(Q, A)$ can be written in the form $R = \alpha(Q)A^{\mu+1}/(\mu+1)$. This equation implies that $R_a = (\mu+1)R/A$, and thus that $E_{ra} = \mu+1$. Yet first-order condition (9) requires that $E_{ra} = \Psi$.

Assumption C: $2R_qQR_{aa} - R_a^2 - 2R_qQK_gF_{aa}/(F_x - K_g) > 0$, or equivalently, $L > \Psi/4(1 - \Psi)$

Comment: The equivalence depends upon Assumption A.

$$2R_qQR_{aa} - R_a^2 - 2R_qQK_gF_{aa}/(F_x - K_g) > 0$$

$$\Leftrightarrow 2R_qQR_{aa} - R_a^2 + 2R_qQR_{aa} > 0$$

(applying the definition of R_{aa} in the proof of Corollary A.1 above)

$$\Leftrightarrow R_qQ < R_a^2/4R_{aa}$$

(the inequality changes sign because $R_{aa} < 0$)

$$\Leftrightarrow -L = R_qQ/R < (R_aA/R)/4(R_{aa}A/R_a) = \Psi/4\mu = \Psi/4(\Psi - 1)$$

$$\Leftrightarrow L > \Psi/4(1 - \Psi)$$

Assumption C requires that the markup not be close to zero. For example, if $\Psi = .08$, a plausible number for a variety of consumer product industries, then the condition requires no more than that $L > .02$. If $\Psi = .25$, a large value sometimes found for branded products subject to gray markets, then $L > .08$. As is evident, this technical condition will be readily satisfied in the differentiated product industries, such as the sale of trademarked or copyrighted products, where gray markets can be found.

Corollary C.1: $2R_qQR_{aa} - (R_a)^2 > 0$

Comment: By an analysis similar to that in the Comment to Assumption C, this condition is equivalent to $L > \Psi/2(1 - \Psi)$. This inequality is implied by Assumption C.

APPENDIX B. COMPARATIVE STATICS

This Appendix performs comparative statics on the first-order conditions to assess the likely signs of the model's derivatives. The model's four equations in four unknowns are totally differentiated. The block recursive structure of the model—the two first order conditions (6) and (7) determine Q and A , which then determine P (or equivalently R) and G using equations (2) and (3)—permits the differentiation of each subsystem of equations separately.

First, first order conditions (6) and (7) are differentiated with respect to the two variables they determine, Q and A , and with respect to the exogenous

variable T creating the comparative static exercise. This procedure implicitly determines Q_t and A_t . The following equations are derived:

$$(2R_q + QR_{qq})dQ + (QR_{qa} + R_a)dA = -(QR_{Rqt} + R_t)dT \quad (\text{A.1})$$

$$(QR_{aq} + R_a)dQ + (QR_{aa})dA = -(QR_{at})dT \quad (\text{A.2})$$

Next, the two equations (2) and (3) are differentiated with respect to the two variables they determine, R and G , and with respect to three variables predetermined from the point of view of this subsystem of equations: Q , A , and T . This determines R_t and G_t as functions of the previously derived Q_t and A_t . The following equations are generated:

$$dR + (-F_x)dG = (F_x dQ + F_a dA) \quad (\text{A.3})$$

$$dR + (-K_g)dG = dT \quad (\text{A.4})$$

The simultaneous equation system (A.3) and (A.4) implies the following expressions for dR and dG :

$$dR = [-K_g F_x dQ - K_g F_a dA + F_x dT] / (F_x - K_g) \quad (\text{A.5})$$

$$dG = [-F_x dQ - F_a dA + dT] / (F_x - K_g) \quad (\text{A.6})$$

Comparative Statics Independent of the "Linear" Model

The signs of the derivatives of R have particular interest. They can be determined for the general model, without imposing the linearity restrictions. Under the assumptions made in the text ($F_x < 0$, $F_a > 0$, and $K_g > 0$), equation (A.5) implies:

$$R_q = -K_g F_x / (F_x - K_g) < 0, \quad (\text{A.7})$$

$$R_a = -K_g F_a / (F_x - K_g) > 0, \text{ and} \quad (\text{A.8})$$

$$R_t = F_x / (F_x - K_g) > 0. \quad (\text{A.9})$$

Equation (A.7) implies that the sign of R_{qq} is identical to the sign of F_{xx} . This is evident from Lemma 1:

$$\begin{aligned} \text{Lemma 1: } R_{qq} &= [-K_g F_{xx}(F_x - K_g) + K_g F_x F_{xx}] / (F_x - K_g)^2 \\ &= (K_g)^2 F_{xx} / (F_x - K_g)^2 \end{aligned}$$

Similarly, equation (A.6) implies:

$$G_q = -F_x / (F_x - K_g) < 0, \quad (\text{A.10})$$

$$G_a = -F_a / (F_x - K_g) > 0, \text{ and} \quad (\text{A.11})$$

$$G_t = 1 / (F_x - K_g) < 0. \quad (\text{A.12})$$

Comparative Statics For the "Linear" Model

Equations (A.1) and (A.2) are simplified further under the assumptions of the "linear" model of Appendix A, so that comparative statics can be performed. One additional lemma is required.

Lemma 2: Under the "linear" model,
 $R_{qt} = 0$ and $R_{at} = -K_g F_{aa} A_t / (F_x - K_g)$.

Sketch of Proof: Differentiating R_a (equation A.8) with respect to T (recognizing that G , A and Q are functions of T), and applying the assumptions of the "linear" model yields this expression for R_{at} .

With the simplifications implied by the "linear" model and the above lemma, equations (A.1) and (A.2) can be written as:

$$(2R_q)dQ + (R_a)dA = -(R_t)dT \quad (\text{A.1}')$$

$$(R_a)dQ + (QR_{aa})dA = (QK_g F_{aa} A_t / (F_x - K_g))dT \quad (\text{A.2}')$$

This system of equations implies the following expressions for Q_t and A_t :

$$dA/dT = A_t = [2R_q Q K_g F_{aa} A_t / (F_x - K_g) + R_a R_t] / D \quad (\text{A.13})$$

$$dQ/dT = Q_t = -[QR_{aa} R_t + R_a Q K_g F_{aa} A_t / (F_x - K_g)] / D \quad (\text{A.14})$$

$$\text{where } D = 2R_q QR_{aa} - (R_a)^2$$

Rearranging equation (A.13) to group together the A_t terms leads to equation (A.13').

$$A_t = R_a R_t / [D - 2R_q Q K_g F_{aa} / (F_x - K_g)] \quad (\text{A.13}')$$

$$= R_a R_t / [D + 2R_q QR_{aa}]$$

$$= R_a R_t / [4R_q QR_{aa} - (R_a)^2]$$

The second line of this equation results from employing the definition $R_{aa} = -K_g F_{aa} / (F_x - K_g)$ in the proof of Corollary A.1. Because $R_a > 0$, $R_t > 0$, $R_q < 0$, $R_{aa} < 0$, and, by Assumption C, the denominator in (A.13') is positive, $A_t > 0$.

The expression Q_t in equation (A.14) may be simplified further by employing the formula for A_t from equation (A.13').

$$\begin{aligned} Q_t &= [-QR_{aa}R_t + R_aQR_{aa}A_t]/D = R_{aa}Q[R_aA_t - R_t]/D & (A.14') \\ &= (R_{aa}Q/2R_qQR_{aa} - R_a^2)[(R_a^2R_t/(4R_qQR_{aa} - R_a^2)) - R_t] \\ &= -(2R_{aa}QR_t/(4R_qQR_{aa} - R_a^2)) > 0 \end{aligned}$$

This expression is positive because the denominator is positive by Assumption C.

Equations (A.13') and (A.14') are identical to equations (16) and (17) of the text.

Comparative Statics Summary for the "Linear" Model

This comparative statics discussion for the "linear" model may be summarized in the following way:

positive signs: R_a , R_t , G_a , Q_t , and A_t

negative signs: R_q , G_q , and G_t .

APPENDIX C. CONSUMER WELFARE IN THE "LINEAR" MODEL

This Appendix proves Proposition 2 and Proposition 3.

Proposition 2: In the "linear" model, without consumer confusion, a policy hindering the gray market on the margin improves consumer welfare if $[\Psi(2+\lambda)/4(1-\Psi)] > L$, and reduces consumer welfare if $[\Psi(2+\lambda)/4(1-\Psi)] < L$.

Proof: The proof of this proposition proceeds by signing dCS/dT . As indicated in equation (19), dCS/dT has the following form:

$$dCS/dT = S(X, A)_a A_t - XR_t$$

This equation is simplified through several steps.

1. Simplification of S_a

$S(Z, A) = S(X, A) = \int F(X, A) dX$. Hence $S_a = \int F_a dX$. In the "linear" model, $F_{ax} = 0$, so F_a does not vary with X . Thus $S(X, A)_a = F(X, A)_a X$.

From equation (A.8), $F_a = -R_a(F_x - K_g)/K_g = R_a(1 + \lambda)$, where $\lambda = -F_x/K_g > 0$. Note that equations (A.7) and (A.8) imply alternative representations for $(1 + \lambda)$ consistent with the definition of λ in the text: $(1 + \lambda) = E_{fa}/E_{ra} = F_x/R_q = -E_{fx}Q/LX > 1$.

2. Simplification of A_t

Equation (A.14') shows that $A_t = R_a R_t / [4R_q Q R_{aa} - (R_a)^2]$

3. Revised Expression for dCS/dT

Substituting these expressions in dCS/dT implies:

$$\begin{aligned} dCS/dT &= R_a^2 R_t X (1 + \lambda) / [4R_q Q R_{aa} - (R_a)^2] - X R_t \\ &= [R_a^2 (1 + \lambda) / [4R_q Q R_{aa} - (R_a)^2] - 1] X R_t \end{aligned}$$

4. Sign of dCS/dT

The expression for dCS/dT has the same sign as $[R_a^2(1 + \lambda) / [4R_q Q R_{aa} - (R_a)^2] - 1]$, because $R_t > 0$. Note that $[4R_q Q R_{aa} - (R_a)^2] > 0$ by virtue of Assumption C of the "linear" model.

Hence, $dCS/dT > 0 \iff$

$$\begin{aligned} &R_a^2(1 + \lambda) / [4R_q Q R_{aa} - (R_a)^2] > 1 \\ \iff &R_a^2(1 + \lambda) > [4R_q Q R_{aa} - (R_a)^2] \\ \iff &R_a^2(2 + \lambda) > 4R_q Q R_{aa} \\ \iff &(R_a A / R)(2 + \lambda) > 4(R_q Q / R)(R_{aa} A / R_a) \\ \iff &y(2 + \lambda) > 4(-L)(\Psi - 1) = 4L(1 - \Psi) \\ \iff &L < \Psi(2 + \lambda) / 4(1 - \Psi) \end{aligned}$$

These simplifications rely upon equations (8) and (9) and Assumption B of the "linear" model.

Similarly, $dCS/dT < 0 \iff L > \Psi(2 + \lambda) / 4(1 - \Psi)$.

Corollary: The following condition is sufficient for $dCS/dT > 0$:

$$L < \Psi / 2(1 - \Psi).$$

The Corollary follows from $\lambda > 0$.

* * * * *

Proposition 3: In the "linear" model, without consumer confusion, $dCS/dT > 0$ if and only if $L < L^*$, where $L^* = \Psi / 8(1 - \Psi) + [\Psi^2 - 16(1 - \Psi)E_{fx}Q/X]^{1/2} / 8(1 - \Psi)$.

Proof: From the proof of Proposition 2, $dCS/dT > 0$ if and only if:

$$L < \Psi(2 + \lambda)/4(1 - \Psi), \text{ where } (1 + \lambda) = -E_{fx}Q/LX$$

Hence, $dCS/dT > 0 \Leftrightarrow$

$$L^4(1 - \Psi) < \Psi(1 + [-E_{fx}Q/LX])$$

$$\Leftrightarrow L^2 4(1 - \Psi) < \Psi(L - E_{fx}Q/X)$$

$$\Leftrightarrow L^2 4(1 - \Psi) - \Psi L + \Psi E_{fx}Q/X < 0$$

The critical L^* such that $L^2 4(1 - \Psi) - \Psi L - \Psi E_{fx}Q/X = 0$ can be derived (for $\Psi > 0$) by solving this quadratic equation:

$$L^* = \Psi/8(1 - \Psi) + [\Psi^2 - 16(1 - \Psi)E_{fx}Q/X]^{1/2}/8(1 - \Psi)$$

The negative root is rejected because it would make the critical L negative.

The function $g(L) = [L^2 4(1 - \Psi) - \Psi L + \Psi E_{fx}Q/X]$ is upward sloping in L for $L > \Psi/8(1 - \Psi)$, because $g'(L) - 8(1 - \Psi)L - \Psi > 0$. Hence $g(L) > 0$ (and thus $dCS/dT > 0$) if and only if $L < L^*$.

* * * * *

APPENDIX D. PRODUCER WELFARE

If producers' surplus is zero, the total social surplus is captured completely by the consumers' surplus. This can occur if the three following conditions are simultaneously satisfied. First, a zero-profits free-entry equilibrium must characterize the branded product of interest. Then the typical authorized distributor will earn no economic profit. Second, authorized firms must have roughly constant marginal costs, as is assumed by the present model. Third, the fringe's marginal cost curve must rise because the gray market sector finds it necessary to bid up the foreign wholesale price of imports in order to increase sales. Then each gray market distributor will have constant marginal costs in the equilibrium. Under these conditions, no firm earns any rents to fixed factors of production, so producer welfare can be ignored in the social welfare calculation.

This Appendix analyzes the effect of policies changing gray market costs on producers' surplus under two alternative plausible assumptions that make producers' surplus non-zero. First, the analysis below allows the authorized distributor to earn economic profits. This assumption takes seriously the possibility of entry barriers into branded product industries. Second, the analysis presumes that fringe marginal cost rises because gray market importers find it increasingly costly to locate product overseas as the quantity they wish to import rises. Then marginal cost rises for each gray market distributor whenever it rises for the gray market sector.

This Appendix shows that, under these assumptions, the effect of policies concerning the gray market on domestic producer welfare is crucially dependent on the slope of the fringe supply curve (K_g). In particular, when fringe marginal cost is steeply sloping and the gray market sector is large, policies harming the gray market in the margin will reduce producers' surplus because that surplus will accrue largely to the gray market sector. Conversely, if fringe marginal cost is flat, the effect of the gray market on aggregate producers' surplus is dominated by its effect on the authorized production sector, so a policy hindering the gray market improves aggregate producer welfare.

Aggregate domestic producers' surplus (PS) can be written in the following form:

$$PS = \Gamma_1[(R(Q,A) - C)Q - A] + \Gamma_2 \int_0^G [R(Q,A) - (T + K(G))] dG + \Gamma_3 MG \quad (A.15)$$

where $\Gamma_i \in [0,1]$

The first component of aggregate domestic producers' surplus is the profits of the authorized domestic seller. Because marginal cost is assumed constant, firm profits are identical to the total surplus accruing to this firm. These profits are weighted by Γ_1 , representing the fraction of the authorized firm owned by domestic entities. This adjustment is required in order to exclude the surplus accruing to foreign countries.⁵³

The second component of aggregate domestic producers' surplus is the producers' surplus accruing to the domestic gray market sector, weighted by Γ_2 , the share of that sector owned by domestic entities. The final component of the aggregate surplus is the producers' surplus accruing to the foreign source of the gray market imports. This surplus is assumed to equal the profits of that sector, defined by a fixed markup M of price over (constant) foreign marginal cost times the number of imports G . These profits are weighted by Γ_3 , representing the domestic fraction of the ownership of the source of the gray market imports.⁵⁴

In the model, the authorized sellers' marginal costs are constant and no costs are fixed. This assumes away another possible effect of the gray market on producer welfare. If the gray market sector is large, the authorized seller may be forced to operate at an inefficiently small scale, raising the social costs of production. However, this social cost may to some extent be offset if gray market distributors are able to achieve scale economies of their own.

⁵³ It may not be easy to determine the location of the firm's shareholders. For example, if a company has substantial institutional ownership, as by pension funds and mutual funds, one could take the view that those entities have legal personality in their country of incorporation. Alternatively one could identify the locations of an institution's ownership with the domiciles of its shareholders.

⁵⁴ To the extent that authorized film and television distributors are owned by U.S. citizens, whatever producers' surplus exists in this industry may be greatest in the United States.

The effect of a marginal change in policy on aggregate domestic producers' surplus can be derived from differentiating equation (A.15), assuming the restrictions on second derivatives of the "linear" model.

$$\begin{aligned} dPS/dT &= \Gamma_1[(R(Q,A) - C)Q_t + R_tQ - A_t] \\ &\quad + \Gamma_2[(R_t - 1)G + (R(Q,A) - T - K(G))G_t] + \Gamma_3MG_t \\ &= \Gamma_1[(R(Q,A) - C)Q_t + R_tQ - A_t] + \Gamma_2(R_t - 1)G + \Gamma_3MG_t \end{aligned} \quad (A.16)$$

Equation (A.16) was simplified by applying equation (3), which presumes that the gray market fringe acts competitively to equate price with marginal cost.

The first term in this expression represents the change in the authorized firm's producers' surplus resulting from an exogenous increase in fringe costs. This term is likely to be positive. If A_t is a large negative number, however, a policy raising gray market marginal costs may reduce authorized firm profits by placing the authorized firm in a new environment in which its optimal decision involves a substantial increase in advertising. The second term reflects the reduction in producers' surplus of the gray market distributors resulting from an exogenous increase in their costs.⁵⁵ The final term indicates the reduction in profits of the foreign supplier of gray market profits resulting from an increase in domestic gray market distribution costs.

The further analysis of producers' surplus specializes to what will be termed the "benchmark" ownership case. This case presumes that gray market goods are purchased by the gray market distribution sector from a firm wholly owned by foreigners, while both the authorized and gray market distributors are completely owned by domestic citizens. These assumptions will represent the gray market in video products well in at least two cases. First, the gray market sellers may import their product from abroad. Second, the gray market sellers may undertake most of their own "production" in the form of cassette copying, so there is in effect no source for the product.

By the assumptions of the benchmark case, $\Gamma_1 = \Gamma_2 = 1$, and $\Gamma_3 = 0$. Hence, equation (A.16) becomes:

$$\begin{aligned} dPS/dT &= [(R(Q,A) - C)Q_t + R_tQ - A_t] + (P_t - 1)G \\ &= R_tX + (R(Q,A) - C)Q_t - G - A_t \end{aligned} \quad (A.17)$$

In addition to the benchmark ownership assumptions, the welfare calculation of Proposition 4 assumes that $L = L^*$, that is, that the markup is such that a policy maker concerned solely with consumers' surplus will be indifferent between a marginal increase in gray market costs and a marginal decrease. This assumption guarantees that the change in producers' surplus

⁵⁵ The expression $R_t - 1$ will be negative so long as $K_g > 0$.

will dominate the change in consumers' surplus, and thus creates a situation where welfare analysis properly focuses on the effect of the gray market on producers' surplus.

Proposition 4: For the "benchmark" ownership case, and the "linear" model, assume that a marginal change in the policy parameter T has no effect on consumer welfare ($dCS/dT=0$). Then $dPS/dT > 0$ if and only if $F_x/(F_x - K_g) > G/X - A_t\lambda/X$, and $dPS/dT < 0$ if $F_x/(F_x - K_g) < G/X$.

Note that the terms $F_x/(F_x - K_g)$ and G/X both fall in the open interval between zero and one.

Proof:

$$\begin{aligned} dPS/dT &= R_t X + (R(Q, A) - C)Q_t - G - A_t \\ &= R_t X - G + [-2(R - C)R_{aa}QR_t - R_a R_t] / (4R_q QR_{aa} - R_a^2) \\ &\quad \text{(for the "linear" model)} \\ &= R_t X - G + R_t R_a [2L(1 - \Psi) / \Psi - 1] / (4R_q QR_{aa} - R_a^2) \end{aligned}$$

By assumption $dCS/dT=0$, so, for the "linear" model, when $\lambda=0$, $L = \Psi(2 + \lambda) / 4(1 - \Psi)$. Thus,

$$\begin{aligned} dPS/dT &= R_t X - G + R_t R_a (\lambda/2) / (4R_q QR_{aa} - R_a^2) \\ &= F_x X / (F_x - K_g) - G + A_t (\lambda/2) \\ &\quad \text{(by equation (A.9))} \end{aligned}$$

Thus, $dPS/dT > 0 \iff F_x / (F_x - K_g) > G/X + A_t \lambda / 2X$

Because $A_t \lambda / 2X > 0$, $dPS/dT < 0$ if $F_x / (F_x - K_g) < G/X$.

* * * * *

The significance of Proposition 4 is suggested by its corollary.

Corollary: If fringe marginal cost is steeply sloping (K_g large) and gray market sellers' market share is large (G/X near one) then, under the conditions of Proposition 4, $dPS/dT < 0$. Conversely, if fringe marginal cost is nearly flat (K_g large) then, under the conditions of Proposition 4, $dPS/dT > 0$ unless gray market sellers' market share is large (G/X near one).

The intuition behind this corollary is that a small increase in the marginal costs of gray market distribution will lead to a large decrease in net producers' surplus if it lowers substantially the surplus accruing to the gray market sector. This will occur when the fringe supply curve is steeply sloping, so that earlier gray market sales were lower costs than later sales, and when

there are many such earlier sales.⁵⁶ On the other hand, if fringe marginal cost is flat, the gray market sector earns little surplus, because marginal cost pricing generates little rent for the early gray market imports. Hence a policy harming the gray market on the margin does not affect the surplus of the unauthorized production sector, although it reduces the surplus of the authorized production sector. As the authorized distribution sector loses profits, on balance, total producers' surplus declines.

APPENDIX E. CONSUMER CONFUSION

Consumers are "confused" by the gray market if they are unable to distinguish between authorized and unauthorized products at point of sale, yet would be willing to pay more for authorized goods.⁵⁷ In the videocassette context, consumer confusion could arise if consumers think that unauthorized cassettes are on average less likely to have high technical quality than the authorized goods, but cannot tell whether a cassette is authorized at point of sale.⁵⁸ Consumer confusion does not require physical quality differences; consumers may prefer the authorized product because it is sponsored by the manufacturer or because of other nonphysical attributes of the product image. The confusion question is often raised in discussions of gray market goods (see Hilke, 1987; Knoll, 1986; Miller, 1986). This Appendix shows how the model of this paper extends to the case of consumer confusion, and demonstrates the plausibility of the generally accepted view that consumers are harmed by confusion.

Consumer confusion creates an adverse selection problem (see generally, Akerlof, 1970; Wilson, 1978). This Appendix presumes a pooling equilibrium, where the authorized and gray market products sell for the same price. Con-

⁵⁶ In the "linear" model, $A_t = \Psi PL/K_g[4L(1 - \Psi) - \Psi]$. With estimates of K_g and λ , further analysis of the sign of dPS/dT would be possible because the magnitude of the expression $A\lambda$ could then be assessed.

⁵⁷ Consumer confusion between gray market and authorized products, in the sense that two products valued differently sell at the same price, is not uncommon. For example, one reporter discovered gray market film, which may be substantially more likely to have been damaged in distribution than the authorized product, selling at the same price, side by side with the authorized good (Grundberg, 1987, p. 63). Similarly, although U.S. consumers preferred authorized Duracell batteries to the gray market product, the two goods sold at the same price because consumers were confused. *In re Certain Alkaline Batteries*, 225 U.S.P.Q. 823, 835 (1984); *remedy disapproved*, 225 U.S.P.Q. 862; *aff'd sub nom., Duracell Inc. v. U.S.I.T.C.*, 778 F.2d 1578 (Fed. Cir 1985).

⁵⁸ In Brazil, unauthorized videocassettes sell at a price 2/3 of authorized cassettes (Hoineff, 1986, p. 41). This anecdote suggests both that consumers are willing to pay more for authorized products and that consumer confusion may not arise in the sale of videocassettes, although it is far from conclusive evidence on either question.

sumers may know that the goods differ, but remain unable to distinguish them at time of purchase (although they may discover the truth at time of consumption).

If consumers prefer the authorized product, but cannot tell at point of sale which goods are gray market products, consumers will obtain the fraction Θ of the benefits of the authorized product from the gray market product, where $\Theta \in [0,1]$ (and small Θ reflects very costly confusion). In the limiting case where consumers are not confused, so buyers obtain equal value from a purchase of the gray market good as of the authorized good, Θ equals one. The model assumes that Θ is the same for all consumers, implicitly presuming that any buyer who values a unit of the authorized good highly also values a unit of the gray market product fairly highly.

This Appendix assumes that consumers treat the authorized and gray market products as identical at time of purchase. This assumption is most appropriate in two situations. First, it is appropriate when the authorized and gray market products are in fact identical. In this case Θ is near one. In addition, the assumption is appropriate when the authorized and gray market products are different, but when consumers are unaware at time of purchase that they are buying the gray market product (although they discover the truth at time of consumption). In the latter case, confusion is substantial, so Θ is low; the gray market seller free rides extensively on the reputation of the authorized seller. In either case the two goods will sell for the same price.

Under these assumptions, consumer welfare depends upon the benefits of purchases of "authorized good equivalents," where one unit of the gray market product equals the fraction Θ of a unit of the authorized product. These authorized good equivalents are denoted Z , where $Z = Q + \Theta G$. Consumer welfare CS is then written as equation (A.18).

$$CS = S(Z,A) - R(Q,A)X, \text{ where } S(Z,A) = \int_0^Z F(Z,A) dz \quad (\text{A.18})$$

In equation (A.18), the expression $F(Z,A)$ represents the aggregate consumer benefit of domestic consumers' authorized good equivalents, measured as the area under the demand curve. CS is the consumers' surplus associated with buyer purchases of both products. When confusion disappears, so $Q = 1$ and $Z = X$, equation (A.18) reduces to equation (18), the definition of consumers' surplus in the text.

This Appendix section analyzes dCS/dT when consumer confusion is present, generalizing Proposition 3 to this case. From equation (A.18), the relation $S(Z,A)_z = F(Z,A)$ and the definitions of X and Z :

$$dCS/dT = [F(Z,A)(Q_t + \Theta G_t) - P(Q_t + G_t)] + S(Z,A)_a A_t - X R_t.$$

This expression is simplified using the definition (2), the implication of the "linear" model that $S(Z,A)_a = F(Z,A)_a Z$, and the relation $P_t = R(Q,A)_t$.

$$dCS/dT = Q_t[F(Z,A) - F(X,A)] + G_t[\Theta F(Z,A) - F(X,A)] + F(Z,A)_a Z A_t - X R_t \quad (A.19)$$

Equation (A.19) adds consumer confusion to the free riding/arbitrage tradeoff raised in the gray market policy debate. The first two expressions, $Q_t[F(Z,A) - F(X,A)]$ and $G_t[\Theta F(Z,A) - F(X,A)]$, represent the effect of a policy changing gray market costs on the welfare losses from consumer confusion. When consumers increase their purchases of the authorized and gray market products, the consumer benefit from authorized and gray market purchases rises by $Q_t F(Z,A)$ and $G_t \Theta F(Z,A)$ respectively, while the costs of those purchases rise by $Q_t F(X,A)$ and $G_t F(X,A)$ respectively. These expressions differ only when $\Theta < 1$ (and thus when $Z < X$), namely when consumer confusion is present. Thus, these two terms measure the marginal change in the consumer welfare costs of consumer confusion.

The third and fourth expressions are similar to those analyzed previously in Proposition 1. The expression $F(Z,A)_a Z A_t$ represents the influence of a change in gray market policy on the welfare costs of gray market free riding on the authorized firm's reputational investment. The last expression, $-X P_t$, represents the beneficial effect of arbitrage on domestic prices.

Equation (A.19) is subject to further analysis under the assumptions of the "linear" model. Here the notation F refers to the function $F(X,A)$, with X as an argument; $\alpha = G/X$ is the market share of the gray market sector; and $(1 - \alpha) = Q/X$ is the market share of the authorized producer.

Proposition 5: For the "linear" model, when consumers may be confused, $dCS/dT > 0$ if and only if

$$\{2L(1 - \Theta)\alpha(1 - \Psi)(1 + \lambda) + (1 + \lambda)\Psi[(1 - \alpha) + \alpha\Theta]\} / [4L(1 - \Psi) - \Psi] + (1 - \Theta)(1 - \alpha) / [(1 + \lambda)L] > 1 + \Theta(1 - \Theta)$$

Proof: The following approximations are implied by the assumptions of the "linear" model:

$$F(Z,A) = F(X,A) + F(X,A)_x(Z - X) = F(X,A) - F(X,A)_x(1 - \Theta)G \\ F(Z,A)_a = F(X,A)_a$$

With these approximations, equation (A.19) becomes:

$$dCS/dT = -Q_t F_x(1 - \Theta)G + G_t[-(1 - \Theta)P - F_x(1 - \Theta)G] + F_a A Z_t - X R_t$$

Substituting in the expressions (A.13') and (A.14'), the relationship $G_t = R_t/F_x$ from the "linear" model, the definition of Z , the relationship $F_a = R_a(1 + \lambda)$ derived from equations (A.7) and (A.8) and the definition of λ , and rearranging terms, implies:

$$[dCS/dT][1/R_t] = \\ \{2F_x(1 - \Theta)G R_{aa}Q + (1 + \lambda)[Q + \Theta G]R_a^2\} / (4R_q Q R_{aa} - R_a^2) \\ - (1 - \Theta)[P + \Theta F_x G] / F_x - X$$

Further simplification comes from recognizing that $-E_{fx} = (1 + \lambda)XL/Q$, and from applying equations (8) and (9) and Assumption B of the "linear" model. Thus:

$$\begin{aligned} [dCS/dT][1/XR_t] = \\ \{2L(1 - \Theta)\alpha(1 - \Psi)(1 + \lambda) + (1 + \lambda)\Psi[(1 - \alpha) + \alpha\Theta]\} / [4L(1 - \Psi) - \Psi] \\ + (1 - \Theta)(1 - \alpha) / [(1 + \lambda)L] - 1 - \Theta(1 - \Theta) \end{aligned}$$

The condition in Proposition 5 now follows, as X and R are positive.

* * * * *

To analyze the condition in Proposition 5, note first that when $\Theta = 1$ so confusion disappears, the condition reduces to the following condition found in Proposition 2: $(1 + \lambda)\Psi / [4L(1 - \Psi) - \Psi] > 1$. Further analysis of the consumer confusion case is the subject of Proposition 6.

Proposition 6: For the "linear" model, consumer confusion makes the gray market more likely to harm consumers on the margin if and only if:

$$0 > \alpha(1 + \lambda)[\Psi - 2L(1 - \Psi)] + [\Psi L(1 - \Psi) - \Psi][\Theta\alpha - (1 - \alpha)/(1 + \lambda)L]$$

Proof:

When consumer confusion is assumed away, Proposition 2 implies that $dCS/dT < 0$ if and only if $\Psi(1 + \lambda) - [4L(1 - \Psi) - \Psi] > 0$.

When consumer confusion is present, Proposition 5 implies that $dCS/dT > 0$ if and only if $(1 + \lambda)\Psi - [4L(1 - \Psi) - \Psi] > (1 + \lambda)(1 - \Theta)\alpha[\Psi - 2L(1 - \Psi)] + [4L(1 - \Psi) - \Psi](1 - \Theta)[\Theta\alpha - (1 - \alpha)/(1 + \lambda)L]$

Proposition 6 follows directly.

* * * * *

To interpret the condition in Proposition 6, note that $(\Psi L(1 - \Psi) - \Psi) > 0$ by Assumption C of the "linear" model, and that $[\Psi - 2L(1 - \Psi)] < 0$ by Corollary C.1. When confusion is extensive, so that Θ is small, the primary determinant of whether the condition in Proposition 6 is satisfied will therefore be the gray market sector's market share, α . If this share is small, the condition in Proposition 6 will readily be met. In this case, consumer welfare will be improved by a policy harming the gray market, because that policy will reduce consumer confusion. If instead the gray market share is very large, a policy harming the gray market can increase consumer confusion and, in this limited respect, harm consumer welfare.

As a general rule, the condition in Proposition 6 will be satisfied for plausible parameter values. For example, suppose L equals 0.5, Ψ equals 0.3, and $\lambda = 1.0$. Further, assume that confusion is significant and fairly costly so Θ equals 0.5. Then the test condition is satisfied so long as $1.1 > 0.85\alpha$, which will always hold as α lies in the interval $[0,1]$.

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