

# Who Makes the Law?

## Political Economy Analysis and Evidence from Copyright Levies

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### Abstract

Are laws made by voters or industry? Here, we address this question in the context of copyright levies. Many Western countries allow private copying subject to a compulsory copyright levy. Applying political economy analysis, we show that (i) content producers always prefer a copyright levy to no levy; and (ii) if ethical costs are high, the median voter will prefer a copyright levy, while the content producers' preference for a levy would be weaker. Using a new data-set of copyright levies in up to 28 Western Christian countries between 1992-2005, we find evidence that copyright levies are influenced by both content producers and consumers. Copyright levies are more common in countries where ethical costs are low. Specifically, a reduction in ethical costs by one standard deviation was associated with the odds of a copyright levy being  $0.515(\pm 0.332)$  to  $1.702(\pm 0.823)$  higher, which suggest that levies *were* determined by content producers. On the other hand, copyright levies were not universal, which suggests that levies were *not* determined by content producers. Further, in countries that were more democratic, the odds of a copyright levy were lower with lower ethical costs, which is additional evidence that levies were determined by consumers.

Keywords: Political economy; copyright; JEL codes: K19, D72

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# 1 Introduction

Considerable research in political economy has considered how voters influence laws and policy in the arenas of taxes, privatization, environmental policy and education (Roberts 1977; Barbaro and Sudekum 2009; Traxler 2009; Ahrend and Winograd 2006; Fredriksson 1997; Brunner and Ross 2010). In addition, there has also been substantial research into how industry influences laws and policy (Persson and Tabellini 2002), and specifically, in the context of trade policy (Baldwin 1989).<sup>1</sup>

What if the interests of voters and industry are in conflict? Who would prevail in making laws and policy – voters or industry lobbyists? Here, we address this question in the context of copyright levies. Many Western countries allow private copying subject to a compulsory copyright levy. For instance, in Canada, in the year 2008-2009, the copyright levy was C\$0.24 on audio cassettes and C\$0.29 on CD-R media and Mini-Discs. The Copyright Board of Canada distributes the proceeds to content producers – composers, authors, performers, and music publishers.

Private copying and copyright levies can be legalized only with the appropriate law. Law is made by legislators, who are in turn, responsible to voters. However, producers of music and other content producers are intensely interested in copyright levies. For instance, in late 2009, when Italy’s Ministry of Cultural Heritage extended the national copyright levy to MP3 players, multimedia mobile phones, computers, and hard drives, an association of independent music producers welcomed the change as “a breath of oxygen for a [music] industry which, alas, is disappearing” (*Billboard*, February 13, 2010). Content producers can be expected to influence legislators in their favor.

Here, we draw on multiple sources to assemble a new data-set of copyright levies among up to 28 Western Christian countries between 1992-2005. We test whether the pattern of levies is consistent with levies being determined by voters or content producers. We use political economy analysis to derive empirical implications regarding copyright levies. The analysis implies that (i) content producers always prefer a copyright levy to no levy; and (ii) if ethical costs are high, the median voter will prefer a copyright levy while content producers’ preference for a copyright levy would be weaker.

Empirically, we find evidence that copyright levies are influenced by both content producers and consumers. Overall, the odds of the presence of a copyright levy were 0.515( $\pm 0.332$ ) to 1.702( $\pm 0.823$ ) higher in a country where ethical costs were lower by

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<sup>1</sup>In 2009, U.S. expenditure on lobbying amounted to \$3.49 billion (opensecrets.org <http://www.opensecrets.org/lobby/index.php> [Accessed, August 5, 2010]).

one standard deviation, which suggests that the levies *were* determined by content producers. On the other hand, copyright levies were not universal, which suggests that levies were *not* determined by content producers. Further, in more democratic countries, where consumers would be more influential, the odds of the presence of a copyright levy were lower with lower ethical costs, which is additional evidence that that levies were determined by consumers.

Our general approach could be applied to other contexts – such as privatization, environmental policy and education – to determine whether the policies are set by consumer or producer interests. These would contribute to a better understanding of the political process underlying important economic and social policies.

## 2 Setting

We consider potential users (for simplicity, “users”) of some variety  $x$  of creative material (software, movies, music albums, or books). User types are characterized by their marginal benefit from the content,  $u$ . They are distributed according to the distribution function,  $G(u)$ , and density,  $g(u)$ , on  $[0, 1]$ . Let  $\hat{u}$  represent the median voter. As in the literature, we assume that the distribution,  $G(\cdot)$ , satisfies a decreasing inverse hazard rate,  $[1 - G(u)]/g(u)$  is decreasing in  $u$ , which ensures that the content producers’ profit is concave.

In the *setting without a copyright levy*, suppose that the price of the content is  $p$  per unit and the variety of content is  $x_N$ . Users have three choices: (i) Buy the legitimate product, which provides utility,  $ux_N$ , at price  $px_N$ , (ii) Copy the material, which provides utility,  $[1 - \lambda]ux_N$ , and be subject to some ethical cost,  $ex_N$ ; and (iii) Do not use, which provides zero utility. The parameter,  $\lambda \in [0, 1]$ , represents the loss of quality in the copy relative to the legitimate version. The greater the loss of quality, the lower is the substitutability between the legitimate product and the copy. The parameter,  $e$ , can also be interpreted as the expected penalty from enforcement against piracy.

As presented in Table 1, if a user buys the legitimate product, her net utility is

$$V_{NB}(u) = ux_N - px_N. \tag{1}$$

If she copies, her net utility is

$$V_{NC}(u) = [1 - \lambda]ux_N - ex_N. \tag{2}$$

If she does not use, her net utility is simply 0. The user's utility, depending on the choice between buy, copy, and do not use, is

$$V_N(u) = \max[V_{NB}(u), V_{NC}(u), 0]. \quad (3)$$

The marginal user,  $\bar{u}_N$ , just indifferent between buying the legitimate product and copying is defined by  $V_{NB} = V_{NC}$ , or

$$\bar{u}_N = \frac{p - e}{\lambda}. \quad (4)$$

The marginal user,  $\underline{u}_N$ , just indifferent between copying and not using is defined by  $V_{NC} = 0$ , or

$$\underline{u}_N = \frac{e}{1 - \lambda}. \quad (5)$$

To avoid the analysis being trivial, we assume that<sup>2</sup>

$$\underline{u}_N < \bar{u}_N. \quad (6)$$

As for the content producers, they would receive revenue from sales of the legitimate product and would incur some cost to produce the content. For simplicity, we assume that the content producers set a uniform price,  $p$ , and incur a constant once-only cost,  $c$ , to produce each variety of content, but no additional cost to reproduce the content for individual buyers.

Hence, the revenue from sales of the legitimate product is  $px_N [1 - G(\bar{u}_N)]$ , and the profit of content producers is

$$\Pi_N = px_N [1 - G(\bar{u}_N)] - cx_N. \quad (7)$$

We assume that the content producers choose the price to maximize profit.

Next consider the *setting with a copyright levy,  $f$* . Suppose that the price of the content is  $p$  per unit and the variety of content is  $x_L$ . With the copyright levy, private copying would be legalized through compulsory licensing. Hence, if the user chooses to copy, she would not incur ethical costs but she must pay the levy.

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<sup>2</sup>The following is a condition on the exogenous parameters. By Lemma 1, (A1), as proved in the Appendix, in equilibrium with content producers maximizing profit,  $\bar{u}_N$  is given by  $[1 - G(\bar{u}_N)]/g(\bar{u}_N) - \bar{u}_N = e/\lambda$ . The left-hand-side is a decreasing function of  $\bar{u}_N$ . Hence,  $\bar{u}_N > \underline{u}_N$  if and only if  $[1 - G(\underline{u}_N)]/g(\underline{u}_N) - \underline{u}_N > e/\lambda$ , which is a condition on  $e$ ,  $\lambda$ , and  $G(u)$ .

Table 1: Setting

	No levy (N) $f = 0$ Ethical cost of copying	With levy (L) $f \geq k$ Copying is legalized
Buys legitimate	$V_{NB} = ux_N - px_N$	$V_{LB} = ux_L - px_L - [1 - \alpha]f$
Copies	$V_{NC} = [1 - \lambda]ux_N - ex_N$	$V_{LC} = [1 - \lambda]ux_L - f$
Does not use	0	0
Upper margin	$\bar{u}_N = \frac{p-e}{\lambda}$	$\bar{u}_L = \frac{px_L - \alpha f}{\lambda x_L}$
Lower margin	$\underline{u}_N = \frac{e}{1-\lambda}$	$\underline{u}_L = \frac{f}{[1-\lambda]x_L}$

The copyright levy aims to impose a price on those who make copies and so, deter piracy. However, to varying extents, the levy might leak out and apply to buyers as well. Specifically, we assume that a user who chooses to buy the legitimate product would be subject to a partial levy,  $[1 - \alpha]f$ . The parameter,  $\alpha$ , represents “policy leakage”. For instance, a levy on Internet access would apply to buyers as well, which would be a situation with  $\alpha = 0$ . By contrast, a levy on blank CDs would apply mainly to copiers, which would be a situation of  $\alpha = 1$ .

Since the copyright levy is instituted together with legalization of private copying, it must be of reasonable magnitude. It would not be reasonable to legalize private copying for an infinitesimal levy. Accordingly, we suppose that the levy must meet some threshold,  $f \geq k > 0$ . This also ensures that the copyright levy does not require government financing.

We assume that the variety of content,  $x_L$ , is exogenous and increasing, differentiable, and concave in the levy,  $f$ . The marginal supply of content is

$$\frac{d}{df}[x_L - x_N] = \frac{dx_L}{df}, \quad (8)$$

since  $x_N$  is independent of the levy.

In this setting with a copyright levy, users have three choices: (i) Buy the legitimate product, which provides utility,  $ux_L$ , at price  $px_L$ , and be subject to a levy  $[1 - \alpha]f$ ; (ii) Copy the material, which provides utility,  $[1 - \lambda]ux_L$ , and be subject to the levy,  $f$ ; and (iii) Do not use, which provides zero utility.

As presented in Table 1, if a user buys the legitimate product, her net utility is

$$V_{LB}(u) = ux_L - px_L - [1 - \alpha]f. \quad (9)$$

If she copies, her net utility is

$$V_{LC}(u) = [1 - \lambda]ux_L - f. \quad (10)$$

If she does not use, her net utility is simply 0. The user's utility, depending on the choice between buy, copy, and do not use, is

$$V_L(u) = \max[V_{LB}(u), V_{LC}(u), 0]. \quad (11)$$

The marginal user,  $\bar{u}_L$ , just indifferent between buying the legitimate product and copying is defined by  $V_{LB} = V_{LC}$ , or

$$\bar{u}_L = \frac{px_L - \alpha f}{\lambda x_L}. \quad (12)$$

The marginal user,  $\underline{u}_L$ , just indifferent between copying and not using is defined by  $V_{LC} = 0$ , or

$$\underline{u}_L = \frac{f}{[1 - \lambda]x_L}. \quad (13)$$

To avoid the analysis being trivial, we assume that<sup>3</sup>

$$\underline{u}_L < \bar{u}_L. \quad (14)$$

With a copyright levy, the content producers would receive revenue,  $px_L[1 - G(\bar{u}_L)]$ , from sales of the legitimate item, revenue,  $[1 - \alpha]f \cdot [1 - G(\bar{u}_L)]$ , in levies from users who buy the legitimate product, and revenue,  $f \cdot [G(\bar{u}_L) - G(\underline{u}_L)]$ , in levies from users who copy. Hence, the profit of content producers is

$$\begin{aligned} \Pi_L &= px_L[1 - G(\bar{u}_L)] + [1 - \alpha]f[1 - G(\bar{u}_L)] + f[G(\bar{u}_L) - G(\underline{u}_L)] - cx_L, \\ &= [px_L - \alpha f][1 - G(\bar{u}_L)] + f[1 - G(\underline{u}_L)] - cx_L. \end{aligned} \quad (15)$$

We next analyze the copyright levy and the impact of changes in the ethical cost, technology, and levy characteristics in two scenarios. In one scenario, the copyright levy is set by voters, while, in the other, the levy is set by content producers.

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<sup>3</sup>The following is a condition on the exogenous parameters. By Lemma 2, (A4), as proved in the Appendix, when the content producers maximize profit,  $\bar{u}_L$  is given by  $[1 - G(\bar{u}_L)]/g(\bar{u}_L) - \bar{u}_L = 0$ . The left-hand side is a decreasing function of  $\bar{u}_L$ . Hence,  $\bar{u}_L > \underline{u}_L$  if and only if  $[1 - G(\underline{u}_L)]/g(\underline{u}_L) - \underline{u}_L > 0$ , which is a condition on  $f/x_L$ ,  $\lambda$ , and  $G(u)$ .

### 3 Voting

In the scenario where the copyright levy is set by voters, we stipulate that the levy is set through a political process of majority voting. Each person casts one vote, regardless of her (subsequent) choice among buy, copy, or not use. We use the median voter model to characterize the voting process (Persson and Tabellini 2002).

The sequence of events is as follows. Each of two political parties proposes a levy and all persons vote on the two alternative proposals. The levy that wins the majority of votes becomes law and is enforced. When consumers vote in this stage, they will vote based on their expected utilities realized in the last stage. Second, given the levy winning the majority of votes, the variety of content supplied is exogenously determined, while the content price,  $p$ , is chosen by the content producer to maximize profits. In the last stage, consumers choose between buy, copy, and do not use.

We define the levy that maximizes the utility of user with type  $u$  as<sup>4</sup>

$$f^*(u) = \max\{\arg \max_f V_L(u, f)\}. \quad (16)$$

For our analysis to be meaningful, we need to show the existence of a median voter equilibrium. In the appendix, we prove that there exists an equilibrium and that the median voter's preferred levy,  $f^*(u)$ , is increasing in the voter's type,  $u$ . Further, we prove that the scenario is not trivial in the sense that the median voter does not always prefer a levy or no levy.

Given the existence of a median-voter equilibrium, we can then investigate the impact of changes in the ethical cost, technology, and levy characteristics on the median voter's preference for or against a copyright levy. We characterize the median voter's preference for a levy by the difference between her maximized utility with a levy and her utility with no levy,

$$V_L(\hat{u}, f^*(\hat{u})) - V_N(\hat{u}). \quad (17)$$

**Proposition 1** *The median voter's preference for a levy is*

- (i) *increasing in the ethical cost if and only if the price of content is increasing in ethical cost;*

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<sup>4</sup>It is possible that the user's utility would be maximized with two distinct levies –  $f = 0$  and some  $f \geq k$ , with each levy providing the same utility. In such cases, we break the tie by specifying the preferred levy to be the higher  $f$ .

*(ii) increasing in the marginal supply of content,*

*(iii) invariant to the partial levy;*

*(iv) ambiguous in the quality of copies.*

The first result is quite intuitive. Consider a median voter who, in the setting without a copyright levy, would choose to copy. She would be subject to the ethical cost. Essentially, the ethical cost is the “price” of copying. An increase in the ethical cost possibly affects the median voter’s utility in two ways – it reduces the utility from copying, and, it changes the utility from buying depending on how content producers adjust their price to the higher ethical cost.

If the ethical cost is higher, then the demand for the legitimate product would be less elastic, and hence it is reasonable to suppose that the content producers would charge a higher price. Under this condition, with higher ethical cost, the median voter’s utility from buying would also be lower. Accordingly, legalized copying (with the copyright levy) would be relatively more attractive.

The above argument applies to a median voter who, in the setting without a copyright levy, would choose to buy. Under the condition that a higher ethical cost would lead content producers to raise price, the median voter who chooses to buy would also prefer a copyright levy.

Next, consider the impact of the marginal supply of content. For the median voter – whether she copies or buys in the absence of a copyright levy, the impact is the same. If she perceives that the supply of content is elastic with respect to the levy, then the levy would be relatively more attractive. The levy payment would be outweighed by the benefit from the additional content.

With regard to the partial levy, the median voter’s preference for a levy does not vary with the partial levy because, in equilibrium, the content producers adjust their price to fully absorb the partial levy. If the partial levy is higher, the content producers reduce their price by the same amount, leaving user utilities unchanged. Hence, the partial levy does not affect the median voter’s preference for a levy.

Finally, an increase in the quality of the copy (better substitute for the legitimate product) would affect the utility from copying and buying. Obviously, if quality of copies is higher, the utility from copying would increase. Further, if the quality of copies is higher, content producers would reduce the price of the legitimate product, which would

increase the user's utility from buying. Since the variety of content is higher with a copyright levy than without a copyright levy, the higher quality of copies has a larger impact on the median voter's utility in the setting with a levy. For this reason, the median voter's preference for a levy would *tend* to increase with the quality of the copy.

However, a countervailing factor is that, between the settings without and with a levy, the median voter's choice might switch among not using, copying, and buying. For instance, if the median voter chooses to copy in the absence of a levy and not use in the presence of a levy, then, the increase in quality would make the setting of no levy relatively *more* attractive. Hence, the impact of the quality of copies on the median voter's preference for a levy is ambiguous.

## 4 Lobbying

In the alternative scenario, we suppose that the decision of whether to impose a copyright levy and legalize private copying is made through a political process of lobbying by content producers acting as a profit-maximizing monopoly. The sequence of events is the same as in the voting scenario except that, in the first stage, the levy is decided by content producers rather than voters, and the content producers set the levy to maximize their profit.

In this scenario, with the copyright levy set by content producers, the content producers always prefer a levy to no levy. The intuition is as follows. Without a levy, the profit of content producers increases in the users' ethical cost. In the extreme, with sufficiently high ethical cost, no user chooses to copy, and the content producers achieve the highest possible profit. Now, with a copyright levy, the content producers can set both the price and levy, and can do so to induce users not to copy, which would result in at least the same level of profit as the highest possible profit in the setting without a levy. Thus, the content producers always prefer a levy when they can set both the price and levy. Note, however, that this does not mean that the content producers would always prefer a levy that is set by voters.

In equilibrium, the content producers would set the price and levy in such a way that no user would choose to copy – they would either buy or not use. The reason is as follows. If a user buys the legitimate product, she receives benefit of  $ux_L$ , while, if she were to copy, she would receive strictly less benefit,  $[1 - \lambda]ux_L$ . Since the content producers control both the price and levy, hence they can always increase their profit

by adjusting the price and levy so that the user switches from copying to buying. This would increase the users' benefit and the content producers could extract the higher benefit through either the price or levy.

**Proposition 2** *With the copyright levy set by content producers, (i) content producers always prefer to set a levy, and (ii) in equilibrium, users would choose to either buy or not use, but would not choose to copy.*

We define the levy that maximizes the content producers' profit by

$$f^\dagger = \arg \max_f \Pi_L(f).$$

In the Appendix, we show that the profit-maximizing levy exists.

By Proposition 2, if the content producers set the levy, they would always prefer to set a positive levy. Nevertheless, for policy purposes, it is interesting and important to understand the strength of the content producers' preference for a levy and how this preference varies with users' ethical costs, technology, and levy characteristics. The strength of preferences would suggest how much content producers would be willing to pay to influence the determination of the levy.

We characterize the content producers' preference for a levy by the difference between their maximized profit with a levy and their profit with no levy,

$$\Pi_L(f^\dagger) - \Pi_N. \tag{18}$$

By studying how changes in users' ethical costs, technology, and levy characteristics affect this difference, we prove the following result.

**Proposition 3** *The content producer's preference for a copyright levy is*

- (i) decreasing in the ethical cost,*
- (ii) increasing in the marginal supply of content,*
- (iii) invariant to the partial levy,*
- (iv) increasing in the quality of copies.*

This result with respect to ethical cost is quite intuitive. As analyzed above, absent a copyright levy, the ethical cost is the “price” of copying. If the ethical cost is higher, then the users’ demand to buy the legitimate content would be less elastic. Hence, the content producers would earn relatively more from selling the content to legitimate buyers even without the levy. Accordingly, the content producers would be relatively less in favor of legalization of private copying.

The result with respect to the marginal supply of content is also intuitive. When the levy induces a relatively larger variety of content, the profit of content producers would increase to a larger extent. Hence, the content producers tend to prefer the copyright levy.

The intuition of the result with respect to the partial levy is exactly the same as in the voting scenario. The content producers adjust their price to fully absorb the partial levy.

Finally, with regard to the quality of copies, an increase in the quality does not affect the profit of content producers with a levy because with a levy, the content producers will price out all users who copy and therefore the quality of copies does not matter at all. Without a levy, the price and sales of the legitimate product fall with increases in the quality of copies. Hence, it is intuitive that the profit of content producers decreases, and so, content producers would relatively prefer a levy.

## 5 Empirical Analysis

Our research question is, in the context of copyright levies, who makes the law – voters or content producers? We addressed this question by testing two empirical implications of our political economy analysis: (i) Content producers always prefer a copyright levy to no levy; and (ii) If ethical costs are higher, the median voter would relatively prefer a copyright levy, while content producers’ preference for a levy would be weaker.

We framed the empirical analysis as a logit model,

$$\ln \text{Odds}(\text{Copyright levy}_{it}) = \beta_i + \beta_t + \gamma_1 \cdot \text{Ethical costs}_{it} + \gamma_2 X_{it}, \quad (19)$$

for country  $i$  and year  $t$ , where the  $\beta_i$  and  $\beta_t$  are country and year fixed effects, and where  $X_{it}$  represents other national characteristics that might possibly influence the adoption of copyright levies. By Proposition 1, if consumers determine copyright levies,  $\beta_1 > 0$ , while, by Proposition 2, if content producers determine copyright levies,  $\beta_1 < 0$ .

To estimate the model, we assembled data on copyright levies in 28 Western Christian countries between 1992-2005. We limited the empirical analysis to Western Christian countries to reduce unobserved heterogeneity which can be significant in contexts of social policy (see, for instance, Abadie and Gay’s (2006) study of organ donations).

Our main source of data on copyright levies was periodic international surveys, from 1992 onward, by the Dutch collecting society, Stichting de Thuiskopie. We compiled the presence and rates of copyright levies on three media – 60-minute audio-cassettes, 700 Megabyte data CDs (CD-Rs), and 256 Megabyte MP3 players. To supplement the Thuiskopie information, we drew on European Commission (2008) and additional research on Australia, New Zealand, and the United States.

Between 1992 and 2005, four countries – Canada, Estonia, Norway, and Sweden – changed their laws on copyright levies. Hence, our empirical strategy exploited difference-in-differences between the countries that did change their law as “treatment” and countries that did not change their law as controls, and also across media within countries among countries that maintained different policies across media. In the estimation, all standard errors were clustered by country and medium (Bertrand et al. 2004).

As measures of ethical costs, we used two measures from the World Values Survey (2009). The World Values Survey is conducted every five years across many countries to measure religion, politics, and economic and social life, and is widely applied in academic research. We identified two questions from the Survey as good measures of the ethical costs involved in illicit coping and used data from four waves of the Survey, administered between 1989 and 2007.

The two questions were whether “Avoiding a fare on public transport” and “Cheating on taxes if you have a chance” can be justified (1 = never justifiable, 10 = always justifiable). It seems reasonable to suppose that people who feel that avoiding fares to be justified would incur lower ethical costs in making illicit copies. Similarly, people who consider that tax evasion is justified would incur lower ethical costs in making illicit copies. Hence the two measures are *inversely* related to ethical costs.

Then, we compiled information from multiple sources on other national characteristics that might possibly influence the adoption of copyright levies,  $X_{it}$ . With a sufficient set of control variables, the estimate of  $\gamma_1$  would be unbiased. During the period of study, 1992-2005, the content most copied was music. Accordingly, the first set of controls was macro-economic factors that would affect or represent the demand and supply of music: population, national income per capita, and music spending per capita.

The second set of controls was economic factors, besides those that affect the demand for music, that would affect the demand to copy music (Hui and Png 2003; Png 2006): computer ownership and broadband penetration.

The third control is essential in a political economy analysis of law-making – a measure of democracy. We used the Polity2 index from the Polity IV project. The Polity IV project measures democratic and autocratic authority in governing institutions. The Polity2 index ranges on a 21-point scale from -10 (representing hereditary monarchy) to +10 (representing consolidated democracy) (Marshall and Cole 2009).

Table 2 presents summary statistics of the data, and the Data Appendix presents the details of the variables, including sources and construction. We organized the data by country-medium, with up to three observations per country – for audio cassettes, CD-R, and MP3 for the years 1992-2005.<sup>5</sup>

Copyright levies are one element of copyright law. As a preliminary, we checked whether countries adopted copyright levies together with other revisions to copyright law, as characterized by Reynolds' (2003) index of copyright law. As reported in Table 3, the panel-wise correlations of Reynolds' (2003) copyright index with the adoption of copyright levies for audio-cassettes and CD-Rs were 0.275 and 0.043 respectively. So, copyright levies were quite unrelated to copyright law in general.

Our first empirical prediction was that, if levies were set by content producers, then there would always be a positive levy. Table 3 reports the proportion of countries that imposed copyright levies on the various media in 2005. Clearly, levies were not universal, which is not consistent with Proposition 2, that content producers always prefer a levy. Hence, the absence of copyright levies on media in some countries is evidence against levies being set by content producers.

Table 4 presents the estimates by logistic regression of the presence (= 1) or absence (= 0) of a copyright levy on the medium in the country and year. Table 4, column (1), reports a baseline specification, including population, national income per capita, music spending per capita, PC ownership, broadband penetration, and indicators for CD-R and MP3 (audio cassette was the omitted medium).

Among the various macro-economic factors, only PC ownership was significant. Apparently, copyright levies were less likely in countries with higher PC ownership. PC

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<sup>5</sup>We gratefully acknowledge use of the Stata utility, `kountry` (Raciborski 2008) to construct the data-set.

ownership has multiple implications for the demand for music and copying. Using a PC is a substitute as well as complement with listening to music. Further, PCs may be used to copy music. However, while ethical costs affect only illicit copying, the time and effort involved in copying affects both illicit and legitimate copying.

The coefficients of both CD-R and MP3 were negative and significant. These coefficients measure the log-odds of a copyright levy on the respective medium relative to audio-cassettes. Apparently, copyright levies were more prevalent on analog than digital media.

Table 4, column (2), reports a specification including the Polity IV measure of democracy. The coefficient of Polity IV measure was negative but not precisely estimated,  $-0.641(\pm 2.407)$ . Apparently, copyright levies were less likely in countries that were more democratic.

Table 4, column (3), reports a specification including the justifiability of avoiding fares as a measure of ethical costs. A higher value of this measure characterizes *lower* ethical costs. The coefficient was positive but not precisely estimated ( $p = 0.121$ ), consistent with copyright levies being more likely where ethical costs are low. Using the estimated coefficient, we calculated that a one standard deviation reduction in ethical costs was associated with the odds of a copyright levy being higher by  $0.515(\pm 0.332)$ .

Next, Table 4, column (4), reports a specification including the justifiability of evading taxes as a measure of ethical costs. A higher value of this measure characterizes *lower* ethical costs. The coefficient was positive and marginally significant, consistent with copyright levies being more likely where ethical costs are low. Using the estimated coefficient, we calculated that a one standard deviation reduction in ethical costs was associated with the odds of a copyright levy being higher by  $1.461(\pm 0.826)$ .

While the degree of democracy itself did not have a significant main effect on the likelihood of a copyright levy, it might affect the impact of consumer vis-a-vis producer interests. Accordingly, in the next two specifications, we included the interaction of the measure of ethical costs (specified as the difference from its mean) with Polity2.

As reported in Table 4, column (5), the main effect of ethical costs was substantially larger than in the regression without the interaction of ethics and democracy, and more precisely estimated. Especially interesting was that the coefficient of the ethical costs with Polity2 was negative and statistically significant. Apparently, in more democratic countries (Polity2 higher), where consumers would have a relatively larger influence on law-making, lower ethical costs were associated with copyright levies being less likely.

Recall from Proposition 1 that the median voter’s preference for a levy is increasing in ethical costs. Hence, our empirical finding is consistent with consumers determining levies.

Using the estimated coefficients, a one standard deviation reduction in ethical costs was associated with the odds of a copyright levy being higher by  $0.636(\pm 0.324)$ . It was comforting that the estimated impact was quite close to the (less precisely estimated) impact, as calculated from the regression without the interaction of ethics and democracy.

As reported in Table 4, column (6), the regression including the interaction of ethical costs, as measured by the justifiability of evading tax, with Polity2 yielded quite similar results to the regression with ethical costs measured by the justifiability of avoiding fares. In particular, the ethics-related coefficients were precisely estimated and the estimated impact of a reduction in ethical costs was close to that as calculated from the regression without the interaction of ethics and democracy.

Overall, we preferred the specifications including the interaction of ethics and democracy. The coefficients of the control variables were the same as in the other specifications, while the ethics-related coefficients were precisely estimated and the estimated impact of ethical costs was close to that implied by the regressions without the interaction of ethics and democracy. We did not see reason to prefer one or the other measure of ethical costs – justifiability of avoiding fares or evading taxes.

We checked the robustness of our findings in a number of ways. For brevity, we focus on the estimates with ethical costs measured by the justifiability of avoiding fares. For easy reference, Table 5, column (1), presents the estimate by logit regression of the preferred specification from Table 4, column (5).

The first check was the estimation method. Table 5, column (2), reports on estimate by probit regression. The results were very similar to those from the logit. Among the controls, the coefficients of PC ownership, CD-R, and MP3 were negative and significant. The main effect of ethical costs was positive and significant, while its interaction with democracy (Polity2) was negative and significant.

Next, we considered the robustness to two additional controls. One was the percentage of youths (ages 0-14) in the population, they being large consumers of music and perhaps less sensitive to enforcement against copying. The youth percentage might affect the demand for music and copying. The other additional control was the World

Bank’s measure of rule of law. A country with stronger rule of law might also maintain stronger enforcement against copying.

As reported in Table 5, column (3), the inclusion of youth did not significantly affect the coefficients of the ethics-related variables. The estimated impact of a reduction in ethical costs was somewhat smaller and less precisely estimated ( $0.509(\pm 0.339)$   $p = 0.134$ ). Similarly, as reported in Table 5, column (4), the inclusion of the rule of law did not significantly affect the coefficients of the ethics-related variables. Likewise, the estimated impact of a reduction in ethical costs was somewhat smaller and less precisely estimated ( $0.480(\pm 0.312)$   $p = 0.123$ ).

Our preferred specification included country fixed effects. This is a standard way to control for non-time-varying heterogeneity across countries. However, their inclusion would reduce the degrees of freedom and possibly reduce the available data. Table 5, column (5), reports an estimate without country fixed effects. The sample was over 50% larger. Consistent with the estimate of the preferred specification, the coefficient of ethical costs (justifiability of avoiding fares) was positive and significant and the coefficient of the ethics-democracy interaction was negative and significant.<sup>6</sup>

Finally, we applied least squares regression to explore the impact of ethical costs on the rate of copyright levy. As our theoretical analysis did not generate any predictions with regard to the amount of the copyright levy, this analysis was exploratory. Data on the copyright levy rates was more limited, and so, the sample was reduced. Several observations were extreme outliers (mean = 4.683, standard deviation = 42.432, minimum = 0.0006, maximum = 728.86). Accordingly, we Winsorized the top and bottom 1% of the rates of copyright levy.<sup>7</sup>

As reported in Table 5, column (6), among the controls, only CD-R and MP3 were significant – consistent with levies on CD-Rs and MP3s differing systematically from those on audio-cassette tapes. The ethics-related variables were not significant. Apparently, neither ethical factors nor the degree of democracy affected the rates of copyright levies.

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<sup>6</sup>The only slight dissonant result was that the estimated impact of a reduction in ethical costs was negative. However, it was not statistically significant ( $-0.126(\pm 0.144)$   $p = 0.380$ ).

<sup>7</sup>Table 2 reports the Winsorized rates of copyright levy.

## 6 Concluding Remarks

Through a cross-country study of data assembled from multiple sources, we found that copyright levies were influenced by both content producers and consumers. Overall, levies were more likely in countries with weaker ethics (lower ethical costs), which is consistent with copyright levies being determined by content producers rather than voters. However, copyright levies were not universal, which is evidence that levies were determined by consumers. Further, in more democratic countries, where consumers would be more influential, the odds of the presence of a copyright levy were lower with lower ethical costs, which is additional evidence that levies were determined by consumers.

In the analysis of levies set by voters, we characterized the consumer interest by the median voter. We can also derive the comparative statics with the consumer interest represented by consumer surplus, which is equivalent to representing the consumer interest by the average voter. Accordingly, our results for the voting scenario are robust to the characterization of the consumer interest.

In the analysis of levies set by content producers, we directly assumed that the levy was set to maximize the profit of content producers. A more sophisticated model would have accounted for the mechanics of lobbying – where industry invests to influence legislators or voters and so, indirectly affects the law. We do expect that the more sophisticated model would yield the essential comparative static – that content producers’ preference for a levy would be stronger when users’ ethical costs are low. To this extent, our results would be robust.

For tractability, we assumed that the supply of content was exogenous. Our first empirical implication – that content producers would always prefer a levy and set price and levy so that no user would copy – is robust to endogenous content. The analysis would be the same: the content producers would prefer to adjust the price and levy so that no user would copy, and the content producers would earn higher profit with a levy than without. Our second empirical implication – regarding the impact of higher ethical costs among users on voters vis-a-vis content producers – might be affected by endogenous content. If users’ ethical costs are higher, then, absent a copyright levy, content producers would likely supply more content, hence reducing the marginal difference in content between the settings without and with a copyright levy. To this extent, the assumption of exogenous supply of content is a limitation of our theoretical model.

Our general approach could be applied to privatization, environmental policy, education, and other contexts to determine the influence of consumer vis-a-vis producer interests. These studies would contribute to a better understanding of the political process underlying important economic and social policies.

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## Appendix

We begin by characterizing the profit maximum of the content producers. Our first two results hold in both scenarios – whether the levy is set by voters or content producers.

**Lemma 1** *Absent a copyright levy, the content producers maximize profit such that*

$$\frac{1 - G(\bar{u}_N)}{g(\bar{u}_N)} - \bar{u}_N = \frac{e}{\lambda}, \quad (\text{A1})$$

$$p = \lambda \bar{u}_N + e, \quad (\text{A2})$$

$$\Pi_N = \left\{ \lambda \left[ \bar{u}_N + \frac{e}{\lambda} \right]^2 g(\bar{u}_N) - c \right\} x_N. \quad (\text{A3})$$

**Proof.** Condition (A2) follows directly from (4). Differentiating (7),

$$\frac{\partial \Pi_N}{\partial p} = [1 - G(\bar{u}_N)] x_N + p x_N [-g(\bar{u}_N)] \frac{d\bar{u}_N}{dp} = 0.$$

Substituting from (4), this simplifies to

$$[1 - G(\bar{u}_N)] - g(\bar{u}_N) \left[ \bar{u}_N + \frac{e}{\lambda} \right] = 0,$$

which proves (A1). Substituting in (7), we have

$$\Pi_N = \left\{ p \left[ \bar{u}_N + \frac{e}{\lambda} \right] g(\bar{u}_N) - c \right\} x_N.$$

Substituting for  $p$  from (A2) yields (A3). ■

**Lemma 2** *With a copyright levy,  $f \geq k > 0$ , the content producers maximize profit such that*

$$\frac{1 - G(\bar{u}_L)}{g(\bar{u}_L)} - \bar{u}_L = 0. \quad (\text{A4})$$

**Proof.** By (15), the content producers' profit can be rewritten as

$$\Pi_L = [p x_L - \alpha f] \cdot [1 - G(\bar{u}_L)] + f \cdot [1 - G(\underline{u}_L)] - c x_L. \quad (\text{A5})$$

Differentiating (A5) with respect to price,

$$\frac{\partial \Pi_L}{\partial p} = x_L [1 - G(\bar{u}_L)] - [p x_L - \alpha f] g(\bar{u}_L) \frac{d\bar{u}_L}{dp} = 0.$$

Substituting from (12) for  $\bar{u}_L$  and  $d\bar{u}_L/dp$ , the above simplifies to

$$[1 - G(\bar{u}_L)] - \bar{u}_L g(\bar{u}_L) = 0, \quad (\text{A6})$$

which proves (A4). ■

The next result applies only in the scenario where the levy (if any) is set by content producers.

**Lemma 3** *In the scenario where content producers set the copyright levy, they maximize profit such that*

$$\bar{u}_L = \underline{u}_L, \quad (\text{A7})$$

$$f = [1 - \lambda]\bar{u}_L x_L, \quad (\text{A8})$$

$$p = [\lambda + \alpha[1 - \lambda]]\bar{u}_L, \quad (\text{A9})$$

$$\Pi_L = [\bar{u}_L^2 g(\bar{u}_L) - c] x_L. \quad (\text{A10})$$

**Proof.** Differentiating (A5) with respect to the levy, and substituting from (12) and (13) for  $d\bar{u}_L/df$  and  $d\underline{u}_L/df$ ,

$$\frac{\partial \Pi_L}{\partial f} = -\alpha [1 - G(\bar{u}_L)] + [px_L - \alpha f] g(\bar{u}_L) \frac{\alpha}{\lambda x_L} + [1 - G(\underline{u}_L)] - fg(\underline{u}_L) \frac{1}{[1 - \lambda]x_L} = 0.$$

Substituting from (12), the above simplifies to

$$-\alpha [1 - G(\bar{u}_L)] + \alpha \bar{u}_L \cdot g(\bar{u}_L) + [1 - G(\underline{u}_L)] - fg(\underline{u}_L) \frac{1}{[1 - \lambda]x_L} = 0.$$

By (A6), the first two terms on the left-hand side of the above sum to zero, and using (13), the above simplifies to

$$[1 - G(\underline{u}_L)] - g(\underline{u}_L)\underline{u}_L = 0. \quad (\text{A11})$$

Comparing (A6) and (A11), we infer that  $\bar{u}_L = \underline{u}_L$ , which is (A7).

Condition (A8) follows from (13) and (A7). Using (12) and (A7), we have

$$p = \lambda \bar{u}_L + \frac{\alpha f}{x_L} = [\lambda + \alpha[1 - \lambda]]\bar{u}_L,$$

which proves (A9). Substituting in (A5), the maximum profit is given by

$$\Pi_L = [px_L - \alpha f + f] [1 - G(\bar{u}_L)] - cx_L.$$

After substituting from (12) and from (A8) for  $f$ , and using (A4), the above simplifies to (A10). ■

**Lemma 4** (i)  $\bar{u}_N$  is decreasing in  $e/\lambda$ ; (ii)  $\bar{u}_L$  is independent of  $e$  and  $\lambda$ ; (iii)  $\bar{u}_L > \bar{u}_N$ .

**Proof.** (i) Referring to the left-hand side of (A1), the first term is decreasing in  $\bar{u}_N$ , because, by assumption, the distribution,  $G(\cdot)$ , satisfies a decreasing inverse hazard rate. The second term is clearly decreasing in  $\bar{u}_N$ . Hence  $\bar{u}_N$  is decreasing in  $e/\lambda$ . (ii) Referring to (A4), the upper critical type,  $\bar{u}_L$ , does not depend on either  $e$  or  $\lambda$ . (iii) The left-hand sides of (A1) and (A4) are the same function, which, by (i), is decreasing in its argument. Since the right-hand side of (A1) is larger than that of (A4), we infer that  $\bar{u}_L > \bar{u}_N$ . ■

We next prove that, in the voting scenario, a median-voter equilibrium exists. We prove existence in three steps: first, that each user has a well-defined preferred levy; second, that the user's preferred levy level is increasing in the user type; and finally, that the median voter's preferred levy wins the majority votes in any two-party majority voting game.

For ease of analysis, in the setting with a copyright levy, we specify the user's utility as a function of two variables – user type,  $u$ , and the levy,  $f$ . By (9) and (12), for a user who chooses to buy,

$$V_{LB}(u, f) = ux_L - [\lambda x_L \bar{u}_L + \alpha f] - [1 - \alpha]f = ux_L - \lambda \bar{u}_L x_L - f. \quad (\text{A12})$$

Differentiating with respect to  $f$ ,

$$\frac{dV_{LB}(u, f)}{df} = u \frac{dx_L}{df} - \lambda \bar{u}_L \frac{dx_L}{df} - \lambda x_L \frac{d\bar{u}_L}{df} - 1.$$

Now, by Lemma 2,  $\bar{u}_L$  depends only on the distribution,  $G(\cdot)$ , and hence  $d\bar{u}_L/df = 0$ , and so, the above simplifies to

$$\frac{dV_{LB}(u, f)}{df} = [u - \lambda \bar{u}_L] \frac{dx_L}{df} - 1. \quad (\text{A13})$$

By assumption,  $x_L$  is concave in  $f$ , hence the user's utility is concave in  $f$ , and so, if the user's preferred levy is an interior solution, it is characterized by the first-order condition,

$$\left. \frac{dx_L}{df} \right|_{f=f^*} = \frac{1}{u - \lambda \bar{u}_L}.$$

Similarly, for a user who chooses to copy, differentiating (10) with respect to  $f$ ,

$$\frac{dV_{LC}(u, f)}{df} = [u - \lambda u] \frac{dx_L}{df} - 1. \quad (\text{A14})$$

By assumption,  $x_L$  is concave in  $f$ , hence the user's utility is concave in  $f$ , and so, if the user's preferred levy is an interior solution, it is characterized by the first-order condition,

$$\left. \frac{dx_L}{df} \right|_{f=f^*} = \frac{1}{u - \lambda u}.$$

In general, the preferred levy could be one of three possibilities –  $f^*$ ,  $k$ , or 0. To characterize the preferred levy, we need to compare the utilities with each possibility.

**Lemma 5** *There exists a preferred levy for every user type.*

**Proof.** In the absence of a copyright levy, for any  $u$ ,  $V_{NC}(u, 0)$  and  $V_{NB}(u, 0)$  are well-defined functions that are independent of  $f$ . Hence, by (3),  $V_N(u, 0) = \max\{V_{NC}, V_{NB}, 0\}$  is a well-defined function that is independent of  $f$ .

Next, we show that for any  $u$ , there exists a preferred copyright levy,  $f^* \geq k$ . For any  $u$ , by (11),  $V_L(u, f^*) = \max\{V_{LC}, V_{LB}, 0\}$ . Next, we show that  $V_L(u, f)$  is strictly concave in  $f$ , and so, there exists a preferred levy. By Lemma 2,  $\bar{u}_L$  does not depend on the choice of  $f$ . If  $u > \bar{u}_L$ , by definition  $V_{LC}(u, f) < V_{LB}(u, f)$ , and  $V_L(u, f) = V_{LB}(u, f)$ , which is concave in  $f$ , given any  $u$ , as shown by (A13). If  $u < \bar{u}_L$  and  $u > \max_f \underline{u}_L$ , by definition  $V_{LC}(u, f) > V_{LB}(u, f)$ , and  $V_L(u, f) = V_{LC}(u, f)$ , which is concave in  $f$ , given any  $u$ , shown by (A14). If  $u < \max_f \underline{u}_L$ , then this median voter always receive zero if there is a levy. As a result, the median weakly prefers a zero levy.

Then, the overall preferred levy is 0 if  $V_N(u, 0) > V_L(u, f^*)$ , and  $f^*$  if  $V_N(u, 0) < V_L(u, f^*)$ . If  $V_N(u, 0) = V_L(u, f^*)$ , then we assume that the user will choose  $f^*$  rather than a zero levy. ■

Given Lemma 5, we know that there exists at least one levy that maximizes the user's utility function. It is possible that two levies – no levy and some  $f^* \geq k$  – provide the same utility. Accordingly, we define each user  $u$ 's preferred levy by

$$f^*(u) \equiv \max\{\arg \max_f V(u, f)\}. \quad (\text{A15})$$

**Lemma 6** (*Monotonicity*) *The user's preferred levy  $f^*(u)$  is increasing in  $u$ .*

**Proof.** The proof proceeds in three steps. First, we identify the order, if any, of the four critical values in the user's choices,  $\underline{u}_N$ ,  $\underline{u}_L$ ,  $\bar{u}_N$ , and  $\bar{u}_L$ . By dividing the range

of  $u$ , we can then simplify the analysis of the user's choices. Second, we show that the preferred levy is increasing in  $u$  within each region of  $u$ . Finally, we show that the user's choice is increasing at the critical values.

#### Order of critical values

By Lemma 4,  $\bar{u}_N < \bar{u}_L$ . Now, by assumption,  $\underline{u}_N \leq \bar{u}_N$ , and hence, we have

$$\underline{u}_N \leq \bar{u}_N \leq \bar{u}_L. \quad (\text{A16})$$

It remains to establish the relative position of  $\underline{u}_L$ . By (12),  $\underline{u}_L$  depends on  $f$ . Accordingly, there are two cases: (i)  $\underline{u}_N \leq \min_{f \in [k, \infty]} \underline{u}_L$ , and (ii)  $\underline{u}_N > \min_{f \in [k, \infty]} \underline{u}_L$ .

**Case (i):**  $\underline{u}_N \leq \min_{f \in [k, \infty]} \underline{u}_L$ .

In this case, we must consider four regions as defined by three critical values,  $\min_{f \in [k, \infty]} \underline{u}_L$ ,  $\bar{u}_N$ , and  $\bar{u}_L$ . The four regions are:

- (i)(a)  $\hat{u} \leq \min_{f \in [k, \infty]} \underline{u}_L$ . For such values of  $\hat{u}$ , the median voter would never vote for a copyright levy because, with a levy, she chooses not to consume and receives zero utility.
- (i)(b)  $\min_{f \in [k, \infty]} \underline{u}_L < \hat{u} \leq \bar{u}_N$ . For such values of  $\hat{u}$ , the median voter chooses to copy whether there is a levy or not.
- (i)(c)  $\bar{u}_N < \hat{u} \leq \bar{u}_L$ . For such values of  $\hat{u}$ , the median voter chooses to buy the legitimate product if there is no levy and chooses to copy if there is a copyright levy.
- (i)(d)  $\bar{u}_L < \hat{u}$ . For such values of  $\hat{u}$ , the median voter chooses to buy the legitimate product whether there is a levy or not.

**Case (ii):**  $\underline{u}_N > \min_f \underline{u}_L$ . In case (ii), there are five regions separated by four critical values,  $\min_{f \in [k, \infty]} \underline{u}_L$ ,  $\underline{u}_N$ ,  $\bar{u}_N$ , and  $\bar{u}_L$ . Compared with Case (i), the only difference is the case when  $\min_{f \in [k, \infty]} \underline{u}_L < u \leq \underline{u}_N$ . For such values of  $\hat{u}$ , the median voter chooses not to use if there is no levy, and chooses to copy if there is a levy.

#### Preferred levy increasing within region

We now show that, in case (i), the preferred levy is increasing in  $u$  within each region of  $u$ . In region (i)(a), the preferred levies are zero, hence the result is trivial. In the other regions, if the preferred levy is an interior solution,  $f^* > k$ , then it is straightforward to

show monotonicity. Consider the preferred levy of a user who chooses to buy. By the Implicit Function Theorem,

$$\frac{df^*}{du} = -\frac{\frac{\partial^2 V_{LB}}{\partial f \partial u}}{\frac{\partial^2 V_{LB}}{\partial f^2}}. \quad (\text{A17})$$

By partially differentiating (A13) with respect to  $u$ , we have

$$\frac{\partial^2 V_{LB}(u, f)}{\partial f \partial u} = \frac{dx_L}{df} > 0. \quad (\text{A18})$$

By Lemma 5,

$$\frac{\partial^2 V_{LB}}{\partial f^2} < 0.$$

Substituting from (A18) and the above in (A17), we have  $df^*/du > 0$ , and thus, that the preferred levy,  $f^*$ , is increasing in  $u$ .

Similarly, for a user who chooses to copy, her preferred levy

$$\frac{df^*}{du} = -\frac{\frac{\partial^2 V_{LC}}{\partial f \partial u}}{\frac{\partial^2 V_{LC}}{\partial f^2}}.$$

By partially differentiating (A14) with respect to  $u$ , we have

$$\frac{\partial^2 V_{LC}(u, f)}{\partial f \partial u} = [1 - \lambda] \frac{dx_L}{df} > 0, \quad (\text{A19})$$

and hence,  $df^*/du > 0$ . Thus, the preferred levy,  $f^*$ , is increasing in  $u$  for all interior solutions whether the user chooses to buy or copy.

If the preferred levy is a corner solution,  $f^* = k$ , then, for a user who chooses to buy,  $\partial V_{LB}(u, f)/\partial f < 0$ . By (A18), for a higher type,  $u' > u$ , the marginal utility,  $\partial V_{LB}(u', f)/\partial f$  will be higher. Accordingly, the higher type's preferred levy would either be  $f^* = k$  or some  $f^* > k$ . The argument is similar for a user who chooses to copy.

To complete this part of the proof, we need to show that if some user,  $u$ , prefers a levy,  $f \geq k$ , then no user,  $u' > u$ , would prefer a zero levy. In region (i)(b), the user's utility with no levy is  $V_{NC} = [1 - \lambda]ux_N - ex_N$ , which increases with  $u$ . The user's utility with a levy is  $V_{LC} = [1 - \lambda]ux_L - f$ . By the Envelope Theorem,  $dV_{LC}/du = \partial V_{LC}/\partial u = [1 - \lambda]x_L$ .  $V_{LC}$  also increases with  $u$  but at a faster rate, since  $x_L > x_N$ . Hence, if some  $u$  prefers a levy, then any user,  $u' > u$ , will also prefer a levy.

Similarly, in region (i)(d), the user's utility with no levy is  $V_{NB} = ux_N - px_N$ , which increases with  $u$  at a rate of  $x_N$ . The user's utility with a levy is  $V_{LB} = ux_L - px_L -$

$[1 - \alpha]f$ , which, by the Envelope Theorem, also increases with  $u$ , but at a faster rate,  $x_L > x_N$ . Hence, if some  $u$  prefers a levy, then any user,  $u' > u$ , will also prefer a levy.

In region (i)(c), the user's utility with no levy is  $V_{NB}(u, 0) = ux_N - px_N$ , which increases with  $u$ . The user's utility with a levy is  $V_{LC}(u, f) = [1 - \lambda]ux_L - f$ , which also increases with  $u$ , and at a faster rate if  $x_N > [1 - \lambda]x_L$  or a slower rate otherwise. Thus, if  $x_N < [1 - \lambda]x_L$ , then, if some  $u$  prefers a levy, then any user,  $u' > u$ , will also prefer a levy.

If  $x_N > [1 - \lambda]x_L$ ,  $V_{NB}(u, 0)$  increases faster than  $V_{LC}(u, f)$ . If at the same time,  $V_{NB}(\bar{u}_N, 0) > V_{LC}(\bar{u}_N, f)$ , then the preferred levy is always zero within region (i)(c), which satisfies the monotonicity. If  $V_{NB}(\bar{u}_N, 0) < V_{LC}(\bar{u}_N, f^*(\bar{u}_N))$ , we maintain an additional assumption that

$$V_{NB}(\bar{u}_L, 0) < V_{LC}(\bar{u}_L, f^*(\bar{u}_L)), \quad (\text{A20})$$

under which the median voter always prefers a levy in region (i)(c), within which the preferred levy is increasing in  $u$  by (A19). If (A20) does not hold,  $V_{NB}(\bar{u}_L, 0) > V_{LC}(\bar{u}_L, f^*(\bar{u}_L))$ , then for a range of  $u$  in region (i)(c), higher type users prefer zero levy, violating the monotonicity requirement for the majority voting game.

#### Preferred levy increasing at boundaries

Next, we show that the preferred levy is also increasing at the critical user types,  $\underline{u}_N$ ,  $\min_f \underline{u}_L$ ,  $\bar{u}_N$ , and  $\bar{u}_L$ . In case (i),  $\underline{u}_N \leq \min_f \underline{u}_L$ . A user with  $u' \in [0, \min_f \underline{u}_L)$  would also prefer no levy whereas a higher type with  $u' > \min_f \underline{u}_L$  would prefer a positive levy in region (i)(b). The monotonicity holds across regions (i)(a) and (i)(b).

Consider a user with  $u = \bar{u}_N$ . If, in region (i)(b) including  $\bar{u}_N$ , the preferred levy is zero, then preferred levy is trivially increasing at  $u = \bar{u}_N$ . If, in region (i)(b) and at  $u = \bar{u}_N$ , the preferred levy is positive, our assumption in the proof within region (i)(c) ensures that all voters in region (i)(c) prefer a positive levy. If, in both regions (i)(b) and (i)(c), the preferred levy is positive and the median voter chooses to copy in both regions. By (A19),

$$\frac{\partial^2 V_{LC}(u, f)}{\partial f \partial u} > 0,$$

which implies that, if the preferred levies in regions (i)(b) and (i)(c) are interior solutions, then the preferred levy is increasing in  $u$ . This shows that monotonicity holds across regions (i)(b) and (i)(c).

Consider a user with  $u = \bar{u}_L$ . If, in region (i)(c) including  $\bar{u}_L$ , the preferred levy is zero, then preferred levy is trivially increasing at  $u = \bar{u}_L$ . If, at  $u = \bar{u}_L$ , the preferred levy

is positive, our proof within region (i)(d) ensures that all voters in region (i)(d) prefer a positive levy. If the preferred levies in regions (i)(c) and (i)(d) are both positive, then by (A13) and (A14), it follows that

$$\frac{\partial V_{LB}(u, f)}{\partial f} > \frac{\partial V_{LC}(u, f)}{\partial f},$$

for all  $f$  around  $\bar{u}_L$ . This inequality implies that the preferred levies are increasing in  $u$ . This shows that monotonicity holds across regions (i)(c) and (i)(d).

**Case (ii):**  $\underline{u}_N > \min_f \underline{u}_L$ . As analyzed above, the only difference between cases (i) and (ii) is the region,  $\min_{f \in [k, \infty]} \underline{u}_L < u \leq \underline{u}_N$ . In this region, the median voter would get zero utility with no levy and positive utility with a levy and if she copies, hence, she would always vote for a positive levy and choose to copy. Within this region, if the levy is positive, then, as in case (i), the preferred levy is increasing in the user type because  $\partial^2 V_{LC}(u, f) / \partial f \partial u > 0$ .

It remains to check that the preferred levy is increasing at the critical value,  $\underline{u}_N$ . For  $\underline{u}_N < u < \bar{u}_N$ , the user's utility with no levy is  $V_{NC} = [1 - \lambda]ux_N - ex_N$ , which increases with  $u$ . However, the user's utility with a levy is  $V_{LC} = [1 - \lambda]ux_L - f$ , which also increases with  $u$  but at a faster rate, since  $x_N < x_L$ . Therefore, if a user with  $u = \underline{u}_N$  prefers a positive levy, all higher types will prefer positive levy. ■

**Lemma 7** *There exists a unique  $f_{MV} = f^*(\hat{u})$ , which is the median voter's preferred levy. All other levies will be voted down in a two-party majority voting game.*

**Proof.** Define  $f_{MV} = f^*(\hat{u})$ . By Lemma 5, there exists a preferred levy, and by (A15), it is, by definition, unique. Consider another levy  $f' > f_{MV}$ . For  $u < \hat{u}$ , by Lemma 6 her preferred levy  $f^*(u) < f^*(\hat{u}) = f_{MV} < f'$ . Now, by the proof of Lemma 5,  $V_L(u, f)$  is concave. Hence, all users  $u \in [0, \hat{u}]$  would prefer  $f_{MV}$  to  $f'$ . These users comprise a majority of voters, and, accordingly, the levy  $f'$  would be voted down.

A similar argument applies to any  $f' < f_{MV}$ . All users  $u \in [\hat{u}, 1]$  would prefer  $f_{MV}$  to  $f'$ . Thus,  $f_{MV} = f^*(\hat{u})$  is the equilibrium levy in the majority voting game. ■

## Proof of Proposition 1

(i) Effect of  $e$ . We aim to show that  $V_L(\hat{u}, f^*(\hat{u})) - V_N(\hat{u})$  is increasing in  $e$ . By (9) and (10),  $V_{LB}$  and  $V_{LC}$  are independent of  $e$ , hence, by (10),  $V_L$  is independent of  $e$ . Thus, it is sufficient to show that  $V_N(\hat{u})$  is decreasing in  $e$ .

Suppose that there is no levy. If the median voter chooses to copy, by (2),

$$\frac{dV_{NC}}{de} = -x_N < 0,$$

which proves the result. If the median voter chooses to buy, by (1),

$$\frac{dV_{NB}}{de} = -x_N \frac{dp}{de}, \quad (\text{A21})$$

hence, the impact of  $e$  on the voter's utility depends on its impact on the price of the legitimate product.

We claim that  $dp/de > 0$  provided that the density of demand does not decrease too fast ( $dg(u)/du$  is not too negative) at  $\bar{u}_N$ . The proof is as follows. The content producers set the price to maximize profit,  $\Pi_N$ , as specified in (7). By the Implicit Function Theorem,

$$\frac{dp}{de} = -\frac{\frac{\partial^2 \Pi_N}{\partial p \partial e}}{\frac{\partial^2 \Pi_N}{\partial p^2}}.$$

Now, by the assumption that the distribution  $G(\cdot)$  satisfies an increasing hazard rate,  $\partial^2 \Pi_N / \partial p^2 < 0$ . Hence,  $dp/de$  has the same sign as  $\partial^2 \Pi_N / \partial p \partial e$ .

Differentiating (7) with respect to price,

$$\frac{\partial \Pi_N}{\partial p} = x_N [1 - G(\bar{u}_N)] + px_N [-g(\bar{u}_N)] \frac{1}{\lambda}.$$

By further differentiating with respect to  $e$  and substituting from (4),

$$\frac{\partial^2 \Pi_N}{\partial p \partial e} = x_N \left[ g(\bar{u}_N) \frac{1}{\lambda} + \frac{dg(\bar{u}_N)}{d\bar{u}_N} \frac{p}{\lambda^2} \right]. \quad (\text{A22})$$

Consider the terms in the brackets: the first term is positive while the sign of the second term is that of  $dg(\bar{u}_N)/d\bar{u}_N$ . If  $dg(\bar{u}_N)/d\bar{u}_N \geq 0$ , then  $dp/de > 0$  and, by (A21),  $V_N(\hat{u})$  is decreasing in  $e$ , which is the result.

Finally, we consider the case of  $dg(\bar{u}_N)/d\bar{u}_N < 0$ . The second-order condition of the content producers' profit with respect to price is

$$\frac{\partial^2 \Pi_N}{\partial p^2} = -x_N \left[ g(\bar{u}_N) \frac{2}{\lambda} + \frac{dg(\bar{u}_N)}{d\bar{u}_N} \frac{p}{\lambda^2} \right] < 0. \quad (\text{A23})$$

The terms in the bracket must be positive and these terms differ from those in the brackets in (A22) by  $g(\bar{u}_N)/\lambda$ . Hence, if  $dg(\bar{u}_N)/d\bar{u}_N$  is not too negative,  $\partial^2 \Pi_N / \partial p \partial e > 0$ , and so,  $dp/de > 0$  and, by (A21),  $V_N(\hat{u})$  is decreasing in  $e$ , which is the result.

(ii) Effect of  $x_L$ . We aim to show that  $V_L(\hat{u}, f^*(\hat{u})) - V_N(\hat{u})$  is increasing in  $x_L$  given any  $f$ . By (1) and (2),  $V_N$  is independent of  $x_L$  and  $f$ , thus, it is sufficient to show that  $V_L$  is increasing in  $x_L$ .

Consider the setting with a levy. For a median voter who chooses to buy the legitimate product, substituting from (A9) in (9),

$$V_{LB} = \hat{u}x_L - [\lambda\bar{u}_Lx_L + \alpha f] - (1 - \alpha)f = \hat{u}x_L - \lambda\bar{u}_Lx_L - f.$$

By Lemma 2,  $\bar{u}_L$  depends only on the distribution,  $G(\cdot)$ , and not  $x_L$ . Hence, differentiating the above,

$$\frac{dV_{LB}}{dx_L} = \hat{u} - \lambda\bar{u}_L > 0.$$

Similarly, for a median voter who chooses to copy, we can show that

$$\frac{dV_{LC}}{dx_L} = \hat{u} - \lambda\hat{u} > 0.$$

(iii) Effect of  $\alpha$ . We aim to show that  $V_L(\hat{u}, f^*(\hat{u})) - V_N(\hat{u})$  is independent of  $\alpha$ . By (1) and (2),  $V_{NB}$  and  $V_{NC}$  are independent of  $\alpha$ , and so,  $V_N = \max(0, V_{NC}, V_{NB})$  is obviously independent as well.

It remains to show that  $V_L$  is independent of  $\alpha$ . In the setting with a levy, for a median voter who chooses to buy, by (A12),

$$V_{LB} = \hat{u}x_L - \lambda x_L \bar{u}_L - f.$$

By Lemma 2,  $\bar{u}_L$  is independent of  $\alpha$ , and so,  $V_{LB}$  is independent of  $\alpha$ . For a median voter who chooses to copy, by (10),  $V_{LC}$  is obviously independent of  $\alpha$ , which completes the proof.

(iv) Effect of  $\lambda$ . We claim that  $V_L(\hat{u}, f^*(\hat{u})) - V_N(\hat{u})$  may be increasing or decreasing in  $\lambda$ . The effect of higher  $\lambda$  on the median voter's preference for a levy depends on the median voter's choice without and with a levy. As a preliminary, we derive the impact of  $\lambda$  on the voter's utility according to her choice of copy or buy in the settings without and with a levy.

Consider the setting with no levy. Differentiating (1) with respect to  $\lambda$ ,

$$\frac{dV_{NB}}{d\lambda} = -\frac{dp}{d\lambda}x_N < 0, \tag{A24}$$

since

$$\frac{dp}{d\lambda} = \frac{d}{d\lambda}[\lambda\bar{u}_N + e] = \bar{u}_N + \lambda \frac{d\bar{u}_N}{d\lambda} = \bar{u}_N + \lambda e \frac{d\bar{u}_N}{d(e/\lambda)} > 0,$$

using (A1) and Lemma 4(i), which shows  $\bar{u}_N$  is decreasing in  $(e/\lambda)$  and is increasing in  $\lambda$ . Differentiating (2) with respect to  $\lambda$ ,

$$\frac{dV_{NC}}{d\lambda} = -\hat{u}x_N < 0. \quad (\text{A25})$$

Consider the setting with a copyright levy. By applying the Envelope Theorem to the maximization of utility of a voter who chooses to buy with respect to the levy,  $f$ , and using (9), we have

$$\frac{dV_{LB}}{d\lambda} = \frac{\partial V_{LB}}{\partial \lambda} = -\bar{u}_L x_L < 0. \quad (\text{A26})$$

Similarly, for a median voter who chooses to copy, we have

$$\frac{dV_{LC}}{d\lambda} = \frac{\partial V_{LC}}{\partial \lambda} = -\hat{u}x_L < 0. \quad (\text{A27})$$

We focus on the case where, without a copyright levy, the median voter chooses to copy,  $\hat{u} \in [\underline{u}_N, \bar{u}_N]$ . The analysis depends on her choice if there is a levy. By Lemma 4(iii),  $\bar{u}_N < \bar{u}_L$ , hence, if there is a levy, the median voter would choose to either not use or copy, but would not choose to buy.

(a) Suppose that, when there is a levy, the median voter chooses to not use. Then, the difference,  $V_L - V_N = 0 - V_{NC}$ , which, by (A25) is increasing with  $\lambda$ .

(b) Suppose that, when there is a levy, the median voter chooses to copy. Then, the difference,  $V_L - V_N = V_{LC} - V_{NC}$ , which is decreasing in  $\lambda$ , since, by using (A25) and (A27), we show that

$$\frac{d}{d\lambda}[V_{LC} - V_{NC}] = -\hat{u}[x_L - x_N] < 0.$$

Thus, in the case where, without a copyright levy, the median voter always chooses to copy, an increase in  $\lambda$  has an a priori ambiguous effect on the median voter's preference for a levy. For brevity, we do not present the other cases – where, without a copyright levy, the median voter chooses to not use or buy. [ ]

**Lemma 8** *The median voter's preference for a copyright levy is non-trivial if*

$$\begin{cases} 0 < \left[1 - \frac{\frac{f}{x_L}}{[1-\lambda]\hat{u}}\right] \frac{x_L}{x_N} < 1 & \text{if } \hat{u} < y \\ 1 < \left[1 - \frac{\frac{f}{x_L}}{\hat{u}-y}\right] \frac{x_L}{x_N} < 1 + \frac{(1-\lambda)y}{\hat{u}-y} & \text{if } \hat{u} \geq y \end{cases} \quad (\text{A28})$$

where  $y$  is given by

$$1 - G(y) - g(y)y = 0. \quad (\text{A29})$$

**Proof.** We claim that sufficient conditions for the voter's preference not to be trivial are: when  $e = 0$ , the median voter prefers no levy, and when  $e \rightarrow \infty$ , the median voter prefers a positive levy. Suppose that these conditions hold. By (1), (2), and (3), absent a copyright levy, the median voter's utility is decreasing in the ethical cost,  $e$ , while by (9), (10), and (11), with a copyright levy, the median voter's utility is independent of the ethical cost,  $e$ . Hence, by continuity, there exists some  $e^*$  such that, for  $e < e^*$ , the median voter prefers no levy, while for  $e \geq e^*$ , the median voter prefers a positive levy, and the scenario is not trivial.

To derive the sufficient conditions, we compare the median voter's utility without and with a copyright levy in the cases of  $e = 0$  and  $e \rightarrow \infty$ . The median voter's utility with a copyright levy is independent of  $e$ , hence, for convenience, we derive it first.

Consider the setting with a copyright levy. By (A4), (12) and Lemma 2, if  $\hat{u} \geq y$ , the median voter chooses to buy and her utility would be  $V_{LB}(\hat{u}, f) = \hat{u}x_L - yx_L - f$ , where  $y$  is given by (A29). The lower critical type,  $\underline{u}_L$ , is given by the median voter's preferred levy using (13). By (10), if  $\underline{u}_L \leq \hat{u} < y$ , the median voter chooses to copy and her utility would be  $V_{LC}(\hat{u}, f) = \hat{u}x_L - \lambda\hat{u}x_L - f$ . If  $\hat{u} < \underline{u}_L$ , the median voter chooses to not use and receives zero.

(i)  $\underline{e} = 0$ .

Suppose that there is no copyright levy. By (A1), if  $\hat{u} \geq y$ , the median voter chooses to buy and receives  $V_{NB}(\hat{u}) = \hat{u}x_N - \lambda yx_N$ . If  $0 \leq \hat{u} < y$ , by (5), the median voter chooses to copy and receives  $V_{NC}(\hat{u}) = [1 - \lambda]\hat{u}x_N \geq 0$ . The median voter will never choose to not use.

We now use the above analyses to derive sufficient conditions for the median voter to prefer no levy. If  $\hat{u} < \underline{u}_L$ , with a levy, the median voter chooses not to use and receives zero utility. Hence, she trivially prefers no levy.

If  $\underline{u}_L \leq \hat{u} < y$ , with a levy, the median voter chooses to copy and her utility would be  $V_{LC}(\hat{u}, f) = \hat{u}x_L - \lambda\hat{u}x_L - f$ . Without a levy, she chooses to copy and receives  $V_{NC}(\hat{u}) = [1 - \lambda]\hat{u}$ . Hence, she prefers no levy if  $V_{NC}(\hat{u}) > V_{LC}(\hat{u}, f)$ , or,

$$[1 - \lambda]\hat{u}x_N > \hat{u}x_L - \lambda\hat{u}x_L - f. \quad (\text{A30})$$

If  $\hat{u} \geq y$ , with a levy, by (A4), (12) and Lemma 2, the median voter chooses to buy and her utility would be  $V_{LB}(\hat{u}, f) = \hat{u}x_L - yx_L - f$ , where  $y$  is given by (A29). Without

a levy, by (A1), the median voter chooses to buy and receives  $V_{NB}(\hat{u}) = \hat{u}x_N - \lambda yx_N$ . Hence, she prefers no levy if  $V_{LB}(\hat{u}, f) < V_{NB}(\hat{u})$ , or

$$\hat{u}x_L - yx_L - f < \hat{u}x_N - \lambda yx_N. \quad (\text{A31})$$

(ii)  $e \rightarrow \infty$ .

Suppose that there is no copyright levy. With  $e \rightarrow \infty$ , no user would choose to copy. If the median voter chooses to buy, by (1), she would get  $V_{NB}(\hat{u}) = \hat{u}x_N - yx_N$ , where  $y$  is again given by (A29). Hence, if  $\hat{u} \geq y$ , the median voter buys and receives  $\hat{u}x_N - yx_N$ , while if  $\hat{u} < y$ , she does not use and receives zero utility.

We now use the above analyses to derive sufficient conditions for the median voter to prefer a levy. If  $\hat{u} < \underline{u}_L$ , with no levy, the median voter chooses not to use and receives zero utility. Hence, she trivially prefers a levy.

If  $\underline{u}_L \leq \hat{u} < y$ , with no levy, the median voter chooses not to use and receives zero utility. With a levy, by (10), the median voter chooses to copy and her utility would be  $V_{LC}(\hat{u}, f) = \hat{u}x_L - \lambda\hat{u}x_L - f$ . Hence, she prefers a levy if  $V_{LC}(\hat{u}, f) > 0$ , or

$$\hat{u}x_L - \lambda\hat{u}x_L - f > 0. \quad (\text{A32})$$

If  $\hat{u} \geq y$ , with no levy, she chooses to buy and receives  $V_{NB}(\hat{u}) = \hat{u}x_N - yx_N$ . With a levy, by (A4), (12) and Lemma 2, the median voter chooses to buy and her utility would be  $V_{LB}(\hat{u}, f) = \hat{u}x_L - yx_L - f$ , where  $y$  is given by (A29). Hence, she prefers a levy if  $V_{LB}(\hat{u}, f) > V_{NB}(\hat{u})$ , or

$$\hat{u}x_L - yx_L - f > \hat{u}x_N - yx_N. \quad (\text{A33})$$

By the analyses above, the voter's preference is generally non-trivial when  $\hat{u} < \underline{u}_L$ . Combining (A30) with (A32), a sufficient condition for the voter's preference to be non-trivial when  $\underline{u}_L \leq \hat{u} < y$ , is

$$0 < [1 - \lambda]\hat{u}x_L - f < [1 - \lambda]\hat{u}x_N,$$

which simplifies to

$$0 < \frac{[1 - \lambda]\hat{u} - \frac{f}{x_L} x_L}{[1 - \lambda]\hat{u}} \frac{x_L}{x_N} < 1,$$

which is the first part of (A28). To interpret this condition, consider  $f/x_L$  to be the “unit cost” of the levy and  $x_L/x_N$  to be the “benefit” in terms of additional content.

Provided that  $f/x_L$  is small enough, the first inequality would be satisfied and, provided that  $x_L/x_N$  is not too large, the second inequality would be satisfied.

Combining (A31) with (A33), a sufficient condition for the voter's preference to be non-trivial when  $\hat{u} \geq y$ , is

$$[\hat{u} - y] x_N < [\hat{u} - y] x_L - f < [\hat{u} - \lambda y] x_N,$$

which simplifies to

$$1 < \frac{\hat{u} - y - \frac{f}{x_L} x_L}{\hat{u} - y} < \frac{\hat{u} - \lambda y}{\hat{u} - y},$$

which is the second part of (A28). The cost-benefit trade-off to the median voter is the same as in the preceding case of  $\underline{u}_L \leq \hat{u} < y$ . Obviously,  $[\hat{u} - \lambda y]/[\hat{u} - y] > 1$ . Thus, by suitably adjusting the parameter  $x_N$  alone, it would be possible to satisfy both inequalities. ■

## Proof of Proposition 2

In Proposition 3 below, we show that the content producers' profit with no levy is increasing in the user's ethical cost,  $e$ . Hence, it is largest if  $e \rightarrow \infty$ . To prove that content producers always prefer a copyright levy, we show that, if  $e \rightarrow \infty$ , the content producers' profit with a levy is greater than their profit with no levy. Hence, for smaller  $e$ , the content producers' profit with a levy would exceed their profit with no levy.

With a copyright levy, by Lemmas 2 and 3, the content producers' profit is

$$\Pi_L = [y^2 g(y) - c] x_L, \tag{A34}$$

where  $y$  is characterized by (A29).

Consider the situation absent a copyright levy and with  $e \rightarrow \infty$ . Since  $e \rightarrow \infty$ , no users would choose to copy, and by (7) the content producer's profit would be

$$\Pi_N^{e \rightarrow \infty} = p x_N [1 - G(p)] - c x_N = [p[1 - G(p)] - c] x_N. \tag{A35}$$

Differentiating (A35) with respect to  $p$ , the content producers would maximize profit by setting price according to

$$1 - G(p) - g(p)p = 0, \tag{A36}$$

which is identical to (A29). Comparing (A35) and (A36) with (A34), we have

$$\Pi_L > \Pi_N^{e \rightarrow \infty},$$

since  $x_L > x_N$ . Finally, using Proposition 3, the above implies

$$\Pi_L > \Pi_N^{e \rightarrow \infty} > \Pi_N,$$

which is the result.

Lemma 3 proves the second part of the proposition, that the content producers would set the price and levy such that users would choose either to buy or not use, but not to copy.  $\square$

### Proof of Proposition 3

(i) Effect of  $e$ . We aim to show that  $\Pi_L - \Pi_N$  is decreasing in  $e$ . By (15),  $\Pi_L$  is independent of  $e$ , so, we only need to show that  $\Pi_N$  is increasing in  $e$ . By (7), the content producers' profit with no copyright levy,

$$\Pi_N = px_N [1 - G(\bar{u}_N)] - cx_N. \quad (\text{A37})$$

Applying the Envelope theorem, and using (4),

$$\frac{d\Pi_N(p(e), e)}{de} = \frac{\partial \Pi_N(p, e)}{\partial e} = -px_N g(\bar{u}_N) \left[ \frac{-1}{\lambda} \right] > 0,$$

which is the result.

(ii) Effect of  $x_L$ . We aim to show that  $\Pi_L - \Pi_N$  is increasing in  $x_L$ , given any level of  $f$ . By (7),  $\Pi_N$  is independent of  $x_L$  and  $f$ , hence, it is sufficient to show that  $\Pi_L$  is increasing in  $x_L$ . By Lemma 3,

$$\frac{d\Pi_L}{dx_L} = \frac{d}{dx_L} [\bar{u}_L^2 g(\bar{u}_L) - c] x_L = [\bar{u}_L^2 g(\bar{u}_L) - c] > 0.$$

(iii) Effect of  $\alpha$ . By (7),  $\Pi_N$  is independent of  $\alpha$ . As for  $\Pi_L$ , the profit function, maximized with respect to price, is given in Lemma 3, which does not depend on  $\alpha$ . Accordingly, the content producers' preference for the copyright levy is independent of  $\alpha$ .

(iv) Effect of  $\lambda$ . We aim to show that  $\Pi_L - \Pi_N$  is decreasing in  $\lambda$ . Differentiating (7) with respect to  $\lambda$ ,

$$\frac{d\Pi_N(p(\lambda), \lambda)}{d\lambda} = \frac{\partial \Pi_N(p, \lambda)}{\partial \lambda} = [\lambda \bar{u}_N + e] x_N g(\bar{u}_N) \frac{\bar{u}_N}{\lambda} > 0. \quad (\text{A38})$$

Differentiating (A5) with respect to  $\lambda$ ,

$$\frac{d\Pi_L(p(\lambda), f(\lambda), \lambda)}{d\lambda} = \frac{\partial\Pi_L(p, f, \lambda)}{\partial\lambda} = [px_L - \alpha f]g(\bar{u}_L)\frac{\bar{u}_L}{\lambda} - fg(\underline{u}_L)\frac{\underline{u}_L}{(1-\lambda)} = 0,$$

after substituting  $\bar{u}_L = \underline{u}_L$ ,  $px_L - \alpha f = \lambda\bar{u}_Lx_L$ , and  $f = (1-\lambda)\bar{u}_Lx_L$  from Lemma 3. Thus, combining with (A38), the content producers' preference for the copyright levy is decreasing in  $\lambda$ .

# Data Appendix

Period of study: 1992-2005.

- N1 Copyright levy. Sources: Stichting de Thuiskopie, European Commission (2008).
- N2 Copyright levy rate. Rate of copyright levy in local currency deflated by consumer price index and converted to U.S. dollars using exchange rates as computed by the World Bank Atlas method. Then, the top and bottom 1% observations were Winsorized. Sources: Stichting de Thuiskopie (levy rate), European Commission (2008) (levy rate), World Development Indicators (consumer price index, exchange rate).
- N3 Population. Source: World Development Indicators.
- N4 Income per capita. Calculated as GDP in U.S. dollars deflated by GDP deflator and divided by population. Source: World Development Indicators.
- N5 Music spending per capita. Calculated as retail spending on music in U.S. dollars deflated by consumer price index and divided by population. Sources: International Federation of the Phonographic Industry (retail spending on music), World Development Indicators (consumer price index, population).
- N6 Personal computer ownership (per 100 persons). Source: World Development Indicators.
- N7 Fixed broadband subscription (per 100 persons). Source: World Development Indicators.
- N8 Polity IV. Polity2 index from the Polity IV project. The index ranges on a 21-point scale from -10 (representing hereditary monarchy) to +10 (representing consolidated democracy) (Marshall and Cole 2009). Source: Polity IV project.
- N9 Justifiable to avoid fare. “Avoiding a fare on public transport” can be justified (1 = never justifiable, 10 = always justifiable). Linearly interpolated for missing years. Source: World Values Survey.
- N10 Justifiable to evade tax. “Cheating on taxes if you have a chance” can be justified (1 = never justifiable, 10 = always justifiable). Linearly interpolated for missing years. Source: World Values Survey.

- N11 Youth – percentage of population between ages 0 and 14. Source: World Development Indicators.
- N12 Rule of law – an index with mean zero and standard deviation of one that measures “extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence” (Kauffman et al. 2007). Source: World Bank

Table 2. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Levy	905	0.549	0.498	0	1
Levy rate (USD)	296	2.218	6.760	0.004	42.878
Income per capita (USD '000)	770	53.497	62.749	2.926	611.982
Population (millions)	799	31.016	60.592	0.367	304.060
Music per capita (USD)	418	47.512	20.812	3.028	126.025
Polity2	736	9.798	0.575	6	10
Personal computers per 100 persons	608	38.632	21.958	0.661	94.337
Fixed broadband per 100 persons	684	11.695	10.295	0.000	37.100
Justifiable to avoid fare	725	2.436	0.417	2.080	3.419
Justifiable to evade tax	725	2.386	0.413	2.000	3.431
Youth (%)	815	17.922	2.370	13.700	26.121
Rule of law	650	1.382	0.534	0.0316	2.043

Table 3. Copyright levy by medium, 2005

Medium	No. of countries	Mean	Std dev	Min	Max	Correlation with Reynolds index (1992-2005)
Audio-cassettes	27	0.704	0.465	0	1	0.275
CD-R	28	0.714	0.460	0	1	0.043
MP3	28	0.429	0.504	0	1	not estimable

Note: Reynolds' (2003) copyright index available only up to the year 2002. Last column reports panel-wise correlation. In regression of Reynolds index on levy for MP3, levy was dropped, so panel-wise correlation could not be estimated.

Table 4. Copyright levy

VARIABLES	(1) Demo- graphics	(2) Demo- cracy	(3) Ethics	(4) Ethics	(5) Ethics x democracy	(6) Ethics x democracy
Population (mill)	0.998 (0.652)	0.899 (0.838)	0.899 (0.838)	0.899 (0.838)	0.813 (0.901)	0.778 (0.898)
Income p.c. (USD '000)	0.044 (0.076)	0.052 (0.083)	0.052 (0.083)	0.052 (0.083)	0.053 (0.089)	0.056 (0.089)
Music p.c. (USD)	-0.080 (0.073)	-0.083 (0.073)	-0.083 (0.073)	-0.083 (0.073)	-0.073 (0.076)	-0.075 (0.075)
PC ownership	-0.107** (0.044)	-0.105** (0.045)	-0.105** (0.045)	-0.105** (0.045)	-0.105** (0.044)	-0.105** (0.044)
Broadband subscription	-0.009 (0.097)	-0.034 (0.152)	-0.034 (0.152)	-0.034 (0.152)	-0.046 (0.153)	-0.046 (0.153)
CD-R	-3.848*** (1.118)	-3.860*** (1.138)	-3.860*** (1.138)	-3.860*** (1.138)	-3.846*** (1.140)	-3.846*** (1.145)
MP3	-6.645*** (1.478)	-6.648*** (1.484)	-6.648*** (1.484)	-6.648*** (1.484)	-6.635*** (1.481)	-6.636*** (1.483)
Polity2		-0.641 (2.407)	-0.641 (2.407)	-0.641 (2.407)	-0.863 (2.553)	-0.998 (2.572)
Justifiable avoid fare			1.120 (0.722)		24.123** (9.855)	
Justifiable evade tax				3.289* (1.861)		35.914** (15.826)
Avoid fare x Polity2					-2.311** (0.994)	
Evade tax x Polity2						-3.261** (1.570)
Observations	196	196	196	196	196	196
Impact			0.515 (0.332)	1.461* (0.826)	0.636** (0.324)	1.702** (0.823)

Notes: Estimation by logit regression. Dependent variable: Ln odds of copyright levy. In columns (5) and (6), the interaction was constructed as the measure of ethics (specified as the difference from its mean) multiplied by Polity2. All regressions included country and year fixed effects, and constant. Robust standard errors clustered by country and medium in parentheses (\*\*\*) p<0.01, \*\* p<0.05, \* p<0.1). Impact was effect on ln of odds ratio of one standard deviation increase in ethics measure – degree to which avoiding fare is justifiable (columns (3) and (5)), and degree to which evading tax is justifiable (columns (4) and (6)).

Table 5. Copyright levy – Further results

VARIABLES	(1) Logit	(2) Probit	(3) Logit: Youth	(4) Logit: Rule of law	(5) Logit: Without fixed effects	(6) OLS: Levy rate
Population (mill)	0.813 (0.901)	0.359 (0.382)	0.838 (0.892)	1.168 (1.202)	-0.004 (0.004)	0.017 (0.251)
Income p.c. (USD '000)	0.053 (0.089)	0.036 (0.049)	0.067 (0.085)	0.111 (0.110)	0.022 (0.018)	-0.040 (0.025)
Music p.c. (USD)	-0.073 (0.076)	-0.029 (0.042)	-0.078 (0.077)	-0.020 (0.081)	-0.034** (0.016)	-0.017 (0.031)
PC ownership	-0.105** (0.044)	-0.052** (0.021)	-0.125** (0.055)	-0.114** (0.048)	-0.039* (0.021)	0.026 (0.015)
Broadband subscription	-0.046 (0.153)	-0.022 (0.076)	0.004 (0.179)	0.052 (0.170)	0.229*** (0.088)	0.005 (0.036)
CD-R	-3.846*** (1.140)	-1.989*** (0.491)	-3.713*** (1.050)	-2.887*** (0.885)	-1.156* (0.683)	-0.363** (0.146)
MP3	-6.635*** (1.481)	-3.473*** (0.645)	-6.524*** (1.405)	-5.856*** (1.193)	-2.538*** (0.767)	2.539*** (0.369)
Polity2	-0.863 (2.553)	-0.434 (1.121)	-3.214 (3.163)	-0.332 (2.577)	-0.527 (0.701)	-2.365 (5.690)
Justifiable avoid fare	24.123** (9.855)	14.072** (5.926)	27.146** (12.186)	36.460* (21.650)	15.979*** (5.777)	-2.423 (2.082)
Avoid fare x Polity2	-2.311** (0.994)	-1.359** (0.594)	-2.647** (1.240)	-3.599* (2.173)	-1.652*** (0.575)	0.190 (0.198)
Youth			-1.123 (1.230)			
Rule of law				-3.301 (6.522)		
Country fixed effects	Yes	Yes	Yes	Yes	No	Yes
Observations	196	196	196	173	313	140
R-squared						0.831
Impact se	0.636** 0.324		0.509 0.339	0.480 0.312	-0.126 0.144	-0.252 0.266

Notes: Estimation method as stated in respective column heading. Dependent variable: Ln odds of copyright levy (columns (1)-(5)), ln copyright levy in USD (column (6)). Avoid fare x Polity2 was constructed as the measure of ethics (specified as the difference from its mean) multiplied by Polity2. All regressions included year fixed effects and constant. Robust standard errors clustered by country and medium in parentheses (\*\*\* p<0.01, \*\* p<0.05, \* p<0.1). Impact was effect on dependent variable of one standard deviation increase in ethics measure – degree to which avoiding fare is justifiable.