

What Does Undergrad Micro Theory Say about Music Downloading

Michael Peters

October 29, 2005

“Most of us would never even consider stealing something, say a picture or a piece of clothing from a friend’s house. Our sense of right and wrong keeps most of us from doing something so selfish and antisocial. Yet when it comes to stealing digital recordings of copyrighted music, people somehow seem to think the same rules don’t apply even though criminal penalties can be as high as five years in prison or \$250,000 in fines. Contrary to popular opinion, illegally downloading or copying copyrighted music is the same as stealing; there is no difference.” - Christian Music Trade Association (www.cmta.com)

“No, I’d say that of the world’s economies, there’s more that believe in intellectual property today than ever. There are fewer communists in the world today than there were. There are some new modern-day sort of communists who want to get rid of the incentive for musicians and movie makers and software makers under various guises. They don’t think that those incentives should exist.” - Bill Gates Cnet interview (news.com.com/Gates-taking-a-seat-in-your-den/2008-1041-3-5514121.html)

“Because of the ad skips.... It’s theft. Your contract with the network when you get the show is you’re going to watch the spots. Otherwise you couldn’t get the show on an ad-supported basis.

Any time you skip a commercial or watch the button, you're actually stealing the programming." - Jaimie Kellner, CEO Turner Broadcasting

"Music is everybody's possession. It's only the publishers who think people own it." - John Lennon

Despite the righteousness of the Christian Music Association, there is an important difference between a picture or a piece of clothing and a music file. When you steal a picture or a sweater of mine, I don't have them anymore. If you download a file from my computer, you can't diminish my enjoyment of the same song on the same file at all. Neither do I hurt you in any way if I copy a software program from your computer, or watch the same TV show as you. No matter how rhetorically attractive this sounds to a music company's lawyers, you can't steal digital music or a television show.

On the other hand, courts – especially in the United States – have supported large corporations who have tried to sue file swappers. This hasn't apparently had much impact on file sharing in general, but has shutdown websites associated with file sharing; for example, Napster and, more recently, Lokitorrent were shutdown. The motivations of the Recording Industry Association of America (RIAA) are clear in trying to close these websites: they feel that most people who download music over the internet would pay the record company if they could not get the song for free. It seems the American courts agree with this and feel the recording companies are entitled to their money.

Not all countries agree on music downloading. For example, downloading music files from p2p networks in Canada for personal use is apparently legal (<http://www.cb-cda.gc.ca/new-e.html>). This isn't a loophole, there is a specific "fair dealing" exemption that applies to personal use, nor does Canada have particularly weak copyright legislation. Canadian policy toward music downloading is simply different than it is in the US. Since Americans can pretty easily download music files from Canadian computers, you can see that this situation might create problems for the RIAA.

Since only communists – according to Mr. Gates – could possibly disagree with strong copyright legislation being applied to music and software, you might expect simple microeconomic theory to make all of this pretty easy to understand. In particular, basic micro theory – as it is currently taught in, say, second-year university courses – must show why copyright is such

a fundamental part of capitalist economics. It would also be nice to have this explanation in a form that could be freely downloaded using bittorrent instead of paying a lot of money to a publisher. This short article is the result.

The bottom line is the same as it often is in economics. Strong copyright legislation is neither all good nor all bad. It benefits some people greatly, and hurts others. Since ‘strong copyright’ is a very crude approximation to the method that one is supposed to use to create incentives for artists and musicians, it can screw things up pretty badly for everyone. Finally, ‘strong copyright’ always comes with a cost. As it is implemented in the US, copyright implies monopoly. Monopoly power will typically be used to restrict output. In this sense, copyright must always work against the provision of music and software at the same time that it works for it (which is one reason why Canadian law differs from US law). Whether copyright is good or bad depends on whether the monopoly effect is bigger or smaller than any incentive effect. This will vary with the product involved, so copyright may be good for music and bad for software or conversely.

The first part of this reading simply shows the basic logic behind copyright as applied to music downloading. When a musician creates a digital recording of a performance, the digital recording is freely available to everyone with an internet connection. Basically, the act of making a recording conveys a very special kind of positive externality: everyone can enjoy the recording equally without diminishing the enjoyment of anyone else. This is what economists often call a *public good*. Competitive markets by themselves don’t create the right incentives for musicians to produce this public good. So, some kind of intervention is needed to make things work nicely. This note describes the *Lindahl* solution to the problem, which was actually invented in 1919 (any micro text should have this). This solution ignores some important problems, but it explains the basic rationale for copyright protection in the first place, and makes it possible to illustrate in a simply way why it might also fail.

From my perspective, the music downloading problem is a nice way to illustrate the principles behind public goods. The simple model described in this note also makes it possible to discuss some of the distributive consequences of the Lindahl solution. Left to their own devices, musicians won’t produce ‘enough’ music. The Lindahl solution will implement a Pareto optimal outcome. In other words, at the Lindahl allocation itself, it won’t be possible to do anything that makes everyone better off at the same time. Any change in policy must hurt someone. That doesn’t mean, though, that

imposing a Lindahl solution on a market which is otherwise uncontrolled will make everyone better off. It may or may not. It is simple enough to illustrate situations where the imposition of the Lindahl solution makes non-musicians worse off. It is obvious why this should be – they initially get free music. After Lindahl, they have to pay, and the new music that is created may not make them any better off at all.¹

The theory and implementation of the Lindahl solution are two entirely different things. For example, for Lindahl to work, we need to know how much everyone is willing to pay for music. Obviously, we don't have this information. Copyright legislation is the compromise – just treat everyone the same way (it seems fair as well). Since this way of trying to implement the Lindahl solution distorts it, this method can also distort the final equilibrium outcome, as well. The example below shows that it can distort the outcome in ways that actually make everyone *worse off* than they would have been if musicians had simply been left to their own devices without copyright protection.

The main problem with copyright legislation is that it grants monopoly powers to the copyright holder. If the copyright holder then tries to maximize profits, he or she will restrict output and raise price, which partly (or possibly completely) defeats the purpose of the copyright legislation in the first place. Of course, no musician really wants to restrict the number of people who listen to his music. Yet, he will typically sell the copyright to a corporation who has exactly this intention in mind. These costs associated with monopoly power must be weighed against the incentive effects of copyright before the public interest can be determined.

This exact trade off explains the differences between copyright law in Canada and the US. Canada uses alternative means to create incentives for musicians, which allows it to limit the monopoly costs associated with traditional copyright. We discuss this briefly at the end of the note.

1 What is Wrong with Leaving Things Alone

Let's start with a situation where everyone is left to their own devices: musicians make music, everybody else does what they do. Musicians aren't going

¹Lovers of both classical and industrial music are united by the fact that they won't be any better off if the music companies offer them more Britney Spears records.

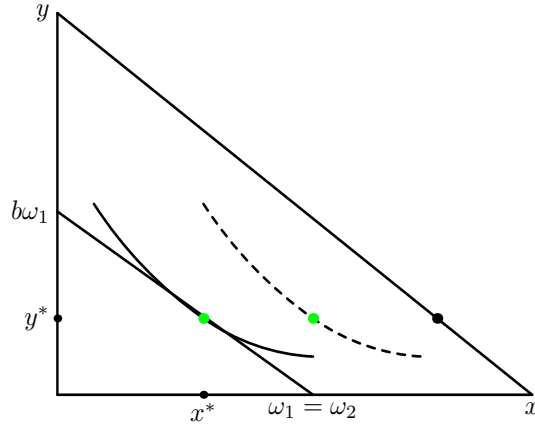


Figure 1: The Voluntary Contribution Game

to disappear because people download music files. Some people argue that musicians like file sharing because it gives more visibility to their music.

We will imagine that there are two consumers, only one of whom can produce music out of his or her endowment. Call her the musician. The music that she produces is a pure public good - her music is enjoyed equally by both of them. To make things transparent, assume that both consumers have an equal endowment ω of the private good and that the production technology is linear. Each unit of the private good that the musician gives up in order to create her music produces exactly b units of music.

In this environment, the musician faces a 'budget constraint' that looks exactly like the one used in standard consumer theory. She can consume her entire endowment of ω units of the private good if she wants. Alternatively, she could convert her entire endowment into music (maybe spend all her time on her music). The production technology in this case would give her $b\omega$ units of music. Anything in between is also possible. All of these possibilities are summarized in a simple diagram in Figure 1 by the line connecting the point ω on the horizontal axis with the point $b\omega$ on the vertical axis.

The musician's preferences are summarized by a family of indifference curves, which are convex toward the origin. She chooses the highest indifference curve that lies in her budget set and picks the combination (x^*, y^*) . The other consumer can't do a lot about this. He cannot make music from his own endowment, so he has nothing to add to what the musician has already

produced. On the other hand, the music that the musician has produced is available for download, and the non-musician can consume all of it if he wants to. His consumption bundle is then the point (ω, y^*) . This outcome is usually referred to as the equilibrium of the *voluntary contribution game*. Everyone acts on their own and does the best they can with what is available to them.

The non-musician does considerably better than the musician in all of this, so you might not think that the outcome is ‘fair’ in some sense. The real problem with this outcome is not so much that it isn’t fair. The real problem is that it is possible to change things in such a way that makes both the musician and the non-musician better off. The basic idea is to have the non-musician pay the musician some of his endowment to make a little more music.

Just to make things work out in a provocative way, let’s suppose that both musicians and non-musicians have identical *quasi-linear* preferences. That means that each of them has a utility function like this:

$$U(x, y) = x + v(y)$$

where v is some concave increasing function representing utility for the public good. We can conveniently think of good x as just being some quantity of money. The interesting thing about quasi-linear utility functions is that the marginal rate of substitution between the public and private good depends only on consumption of the public good. No matter the output of the public good, both consumers will always have the same marginal rate of substitution, since they will always consume the same amount of the public good.

Then in Figure 1, the slope of the musician’s indifference curve at (x^*, y^*) is exactly the same as the slope of the non-musician’s indifference curve at (ω, y^*) . How are we going to go about making both of them better off? You have probably heard of schemes like the following: the non-musician promises to match dollar for dollar any further contribution that the musician makes. If the musician accepts this, and if she contributes another dollar to making music, then the non-musician will throw in another dollar that the musician can use. Next, each dollar that she contributes generates $2b$ units of music instead of only b units of music, assuming the musician doesn’t just run away with the money.

The non-musician still can’t make any music, but he has changed the musician’s incentives. The new ‘budget set’ the musician faces is shown in

Figure 2. If the musician gives up an additional dollar of her endowment, the non-musician will match it and she will be able to produce $2b$ units of music instead of just b units, as before, as long as she uses the extra ‘money’ to make music and not to increase her consumption of other goods. The ‘budget line’ that the musician faces is now twice as steep as it was before. This is the dashed line in Figure 2 that starts at the point (x^*, y^*) . Since this line is steeper than the original budget line, it is also steeper than the musician’s indifference curve. So, she can make herself better off by increasing the amount of music that she produces.

The non-musician will then give up some of his endowment of the consumption good and get more music in return. By the quasi-linearity assumption, this will make him better off. To see why, observe that the musician starts with consumption (x^*, y^*) and ends up at the point (x', y') where she is better off. This means that

$$x' + v(y') > x^* + v(y^*)$$

or $v(y') - v(y^*) > x^* - x'$. The musician gives up $(x^* - x')$ units of the consumption good to get $y' - y^*$ additional units of music. This last inequality says that this makes the musician better off. Since the non-musician is matching any contributions that the musician makes, he also gives up $(x^* - x')$ units of the consumption good to get $y' - y^*$ units of music. Then

$$\omega - (x^* - x') + v(y') > \omega + v(y^*)$$

and the non-musician is also made strictly better off. This is all outlined in Figure 2.

Thus, the equilibrium of the voluntary contribution game is not Pareto optimal. Since you can make both musicians and non-musicians alike better off by inducing the musician to make more music, it is legitimate to say that too little music is produced in this equilibrium. The same argument can be made for virtually any type of intellectual property: software, games, movies, academic research, scientific discoveries, and so on. This isn’t a problem that has arisen simply because of the internet.

You should also understand some of the immediate pitfalls in this argument. First, the non-musician in the example above is made better off if he matches the contributions of the musician. He should be happy to pay part of the cost of production. In this simple example above, as long as the non-musician gets some utility from the musician’s music, then there is some fee

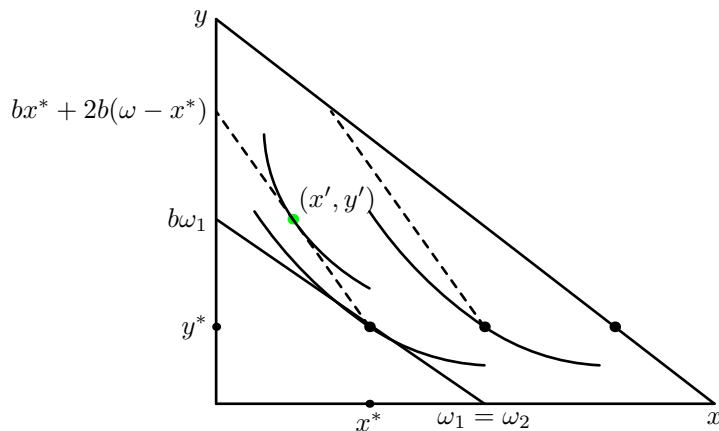


Figure 2: The Matching Contributions Solution

and increase in production of music that will make both better off. Finding this fee may be difficult.

For example, in the scheme above, the musician is allowed to choose whatever level of music she wishes to produce. If the non-musician doesn't value music as much as the musician does, then the musician may overdo it. The non-musician may be forced to match payments he would rather that the musician never make. As an extreme, the non-musician may not value the musician's music at all. If that were true, the musician shouldn't be paid at all. This is a classic defence of file sharers who claim that they would never buy any of the tracks that they download anyway. If you are going to start making the payments dependent on how much the non-musicians like the music, this is problematic because all the non-musicians will want to tell you that they don't like the music.

2 The Lindahl Solution

Let's try to implement this solution with something that looks like a market. First, suppose we create a fictitious firm. We can give this firm each of the consumers' endowments and all the decision-making power over how much music it produces with those endowments. The firm will use the musician to produce the music. It will give her, say, x dollars and expect bx units of music in return. The musician won't be able to keep the music, however.

By creating the music, it becomes the firm's possession. File sharing will be completely illegal; so much so that the musician won't even be able to share files on her own computer. If she wants to consume music, she will have to buy it back from the firm. To make things work out in a straightforward way, suppose we also require that the consumers buy the consumption good from the firm. To allow them to pay for this, we will create money. When the firm chooses how much music to produce, it will offer that music and any remaining private good to consumers at market prices. This will generate profits for the firm that it will distribute back to the consumers as money. The consumers use the money they get from the firm to buy the music and consumption goods they want.

This fiction is the 'publisher's world' that John Lennon described above. How does it work? We will announce that the price that each consumer has to pay for each download (that is, each unit of music) is exactly $\frac{1}{2b}$. The price for a unit of the private good is just 1. The firm then makes its decision to produce, say, x'' units of the private good and y'' units of music. If the consumers want to buy all this, then the firm's total profits are then $\frac{1}{2b}y'' + \frac{1}{2b}y'' + x''$. The first term is the money that the firm makes from selling music to the musician, the second term is the money from selling music to the non-musician, while the final term is the money earned by selling the private good to both of them.

If this production decision by the firm is feasible for it, then the firm's profits are easy to figure out. They are

$$\frac{1}{2b}y'' + \frac{1}{2b}y'' + x'' = \frac{2y''}{2b} + x'' = \frac{b(2\omega - x'')}{b} + x'' = 2\omega$$

That means that each of the two consumers has ω (half the firm's profit) to spend on music and consumption. Each faces a 'budget line' whose slope is $2b$ and which allows them to purchase back their endowment ω if they want to.

All of this information is plotted in Figure 3. You should verify that the choice (x'', y'') by the firm actually maximizes the firm's profits given the price $\frac{1}{2b}$ being paid by each consumer (show that the slope of the firm's iso-profit curves are all equal to b). Given this choice, the common budget line for each of the two consumers is the red line starting at ω on the x axis and winding up at $2b\omega$ on the y axis. Since both consumers have the same preferences, then each of them will make the same choice along this budget line. This choice is given by the green point labeled (x_1, y_1) in the picture.

musician end up in exactly the same situation. They get the same consumption bundle, which seems fair somehow. Yet, notice something else about this solution. If you look back at the equilibrium of the voluntary contribution game, the musician does a lot better than she did in that case, but the non-musician is *worse off* than he was in the equilibrium of the voluntary contribution game. He originally was able to download music for free. Now, he has to pay. He gets more music, but that doesn't compensate him for the loss of consumption that he incurs.

You should keep one observation in mind: a possible alternative exists that will make everyone better off than they are in the equilibrium of the voluntary contribution game. But you can't do this by simply forcing people to pay for the music they download. The case illustrated here is a best-case situation in which the music firm actually takes the Lindahl price $\frac{1}{2b}$ to be fixed and beyond its control. As you will see below, this will not happen. But even if it did, the non-musician is made worse off. In this best of all possible cases, forcing people to pay for things they could get for free is largely an exercise in redistribution. It hardly seems like the non-musician needs to be a communist to oppose it.

3 Some potential problems

Before we get to the real problem with copyright, let's consider a few complications. One reasonable change in this simple model would be to acknowledge the fact that non-musicians probably aren't willing to pay quite as much for music downloads as musicians are. For example, the musician might have utility function

$$x + v_m(y)$$

while the non-musician has utility function

$$x + v_n(y)$$

where $v'_n(y) < v'_m(y)$ (the marginal utility of music for the non-musician is smaller than the marginal utility of music for the musician) for all y . It is easy enough to capture this in the figure above by making the non-musicians indifference curve steeper than the musician's indifference curve.² If we did this, and continue to charge the price $\frac{1}{2b}$ to each of them, then

²The slope of the musician's indifference curve is $\frac{1}{v'_m(y)}$.

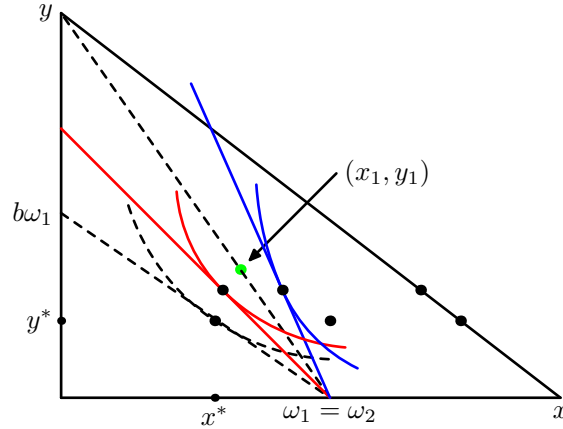


Figure 4: The Lindahl Solution

the non-musician would want more of the private good x and less music. This wouldn't work because the firm isn't actually producing enough of the private good to allow this. Thus, there would be an excess demand for the private good.

The Lindahl solution to this problem is to charge the non-musician a different, lower price for music (and a correspondingly higher price for food) than is charged to the musician. The solution is given in Figure 4. As reference points to show what is going on, the solutions to the voluntary contribution game from Figure 1 and the symmetric solution from the last Figure 3 are included in the diagram. Note that, because the outcome of the voluntary contribution game is determined entirely by the musician, the outcome of the voluntary contribution game is independent of what the non-musician's preferences are. The dashed line through the bundle (x_1, y_1) is the budget line that both of them face in the symmetric solution. To satisfy the non-musician's preference for other consumption goods, the Lindahl price-setter would lower the price of music and raise the price of the private good until the non-musician faced the blue budget line. He would then pick the bundle of goods that maximizes his utility at the point where the blue indifference curve just touches this budget line. Once he has changed the non-musician's price, the price-setter can't leave the musician's price at $\frac{1}{2b}$. This would create two problems. First, the non-musician still wants more food and less music than he did in the symmetric solution. If nothing else

happens, there is an excess demand for food. Also, the non-musician isn't going to buy all the music that is produced. He will quickly realize that he can download the rest of it over the internet for free anyway and he won't end up on the blue budget line where we want him to be. The solution is to have the firm produce more food and less music, and to raise the price that the musician pays for music until she faces the red budget line. To keep the diagram a little less cluttered, the tangency for the musician isn't labeled, but notice that she and the non-musician both choose the same amount of music. As mentioned above, there is really no alternative since, if they don't, one of them will simply download, whatever they don't, have freely on the internet.

3.0.1 A digression on how to compute the Lindahl prices in this example

You may be wondering exactly how I calculated the prices for each of the two consumers in Figure 4. I won't do the calculation, but I'll explain the procedure. Pick an arbitrary, but small value for y , say y_0 . Both consumers have quasi-linear preferences, so if we fix output of music at y_0 , then no matter how much food either of them eat, the slope of their indifference curves will be exactly $\frac{1}{v'_m(y_0)}$ for the musician and $\frac{1}{v'_n(y_0)}$ for the non-musician. Starting at the point ω on the horizontal axis, draw a budget line for the musician with slope $\frac{1}{v'_m(y_0)}$ and for the non-musician with slope $\frac{1}{v'_n(y_0)}$. Each consumer's indifference curve will be tangent to this budget line at y_0 . This is illustrated in Figure 5

Now, suppose we try to sell music to the musician at price $v'_m(y_0)$ and to the non-musician at price $v'_n(y_0)$. Each of them will choose y_0 . The corresponding demands for food will be x_m^* and x_n^* , both of which are plotted in Figure 5. The total amount of food that is available when we produce y_0 units of music is given by the distance from the vertical axis to the point A in Figure 5. If you add x_m^* and x_n^* together, you will get an x value given by the dark point just horizontally to the left of A . So, some food will be left over that no one wants to buy at current prices. In other words, there will be an excess supply of food.

On the other hand, try doing the same exercise with a very high value for y , say y_2 , as in Figure 5. Compute $v'_m(y_2)$ and $v'_n(y_2)$, and charge these prices to the two consumers after doling out ω to each of them. The budget lines they face are given by the red lines in the figure. In this case it is sort of

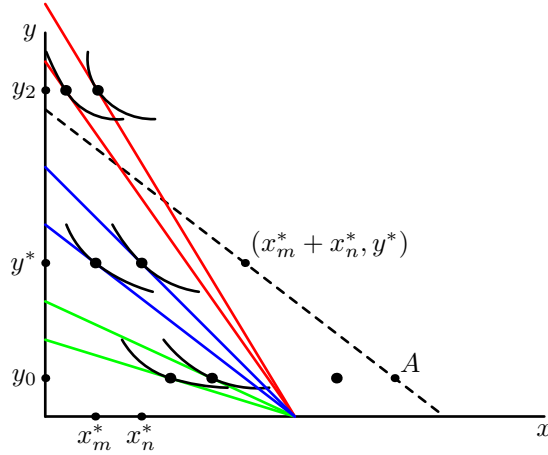


Figure 5: Computing Lindahl Prices

obvious from the diagram that they will want far more food than is actually produced. The amount of music produced in this case is unfeasible anyway.

As we raise the amount of music we produce from y_0 to y_2 , the marginal utilities of both consumers fall. So, the prices they are charged for music will fall, accordingly. Their demand for music will rise, and we will use up more food in production of music. Both consumers' demand for food will also be falling as we lower the price of music, but total demand won't be falling as fast as the amount of food being produced.

At some point in between, we will produce some amount of music equal to y^* . Prices for music would be set to $v'_m(y^*)$ and $v'_n(y^*)$ for the musician and the non-musician respectively. They will each choose to buy y^* units of music and buy food with whatever is left over in their budget. Summing up the amounts of food they choose to buy, we will get exactly the amount of food left over after we produce y^* units of music.

What of the firm in this calculation? The firm receives $v'_m(y^*)y^*$ from the musician, $v'_n(y^*)y^*$ from the non-musician for the music it produces, and x_m^* and x_n^* for the food that it offers. So, its total profits are

$$v'_m(y^*)y^* + v'_n(y^*)y^* + x_m^* + x_n^*$$

Since this outcome is feasible, it must be that

$$x_m^* + x_n^* = 2\omega - \frac{y^*}{b}$$

since $\frac{y^*}{b}$ is the amount of the endowment that is needed to produce y^* units of music.

Then, since both consumers choose bundles that lie on their respective indifference curves, and each is given income ω ,

$$x_m^* + x_n^* + v'_m(y^*)y^* + v'_n(y^*)y^* = 2\omega$$

Subtracting this second equation from the first gives

$$\frac{1}{b} = v'_m(y^*) + v'_n(y^*)$$

The term on the left is the marginal cost of producing one more unit of the public good. The term on the right is the sum of the two consumers' willingness to pay for an additional unit of the public good. If you ever take public finance, you will learn this as the Samuelson condition for efficient production of the public good. Taking the reciprocal of the equation gives

$$b = \frac{1}{v'_m(y^*) + v'_n(y^*)}$$

The right hand side of this last expression is the slope of the firm's iso-profit line when prices for music are $v'_m(y^*)$ and $v'_n(y^*)$. The term on the left is the slope of the production possibilities frontier faced by the firm. So, the firm is maximizing profits at these prices by producing y^* units of music. As a result, this outcome is actually a competitive equilibrium with all consumers and the firm acting as price-takers, and demand equal to supply. It is Pareto optimal by the first welfare theorem.

3.1 A Second Problem

Stepping back a bit, the non-musician has a lower willingness to pay for the public good than the musician, which means that he pays a lower price. This doesn't seem fair. In addition, there is no real way to know the non-musician's willingness to pay. Obviously, he is going to claim that it is very low if he wants to buy music at a low price. This would be too complicated to work out in the real world where there are millions of different non-musicians whose tastes we have to try to figure out. We probably want a solution that charges everyone the same price. Without going in to a lot of technical details, it is pretty clear that the musician and non-musician will want different amounts

of music. If we can enforce this, say by forcing everyone to buy CD's, so the non-musician can be prevented from consuming the freely available music, then the final outcome won't be Pareto optimal. The non-musician could be made better off without hurting the musician by letting him download the rest of the music for free. We don't want that, because that is the problem we were trying to resolve with our copyright legislation in the first place.

Even if we ignore the free music available to the non-musician, we will have problems with the final production of music. The outcome could in fact be worse than it was in the voluntary contribution game. The example discussed here is a bit extreme because the production possibilities frontier is linear. The profit maximizing firm will either be indifferent about how much music it produces or will want to produce at one of the extremes. This makes for an pretty unintuitive equilibrium in this case. Suppose we charge each consumer $\frac{1}{2b}$ for music as we did in the symmetric Lindahl solution we discussed above. However, let's assume now that the non-musician has a lower willingness to pay for music than the musician does. Along the budget line the non-musician faces when music costs $\frac{1}{2b}$, he will want to consume more food and less music. But, there is no more food if the firm produces the music that the musician wants. Normally, an excess demand like this would cause us to want to raise the price of food and lower the price of music. Unlike a pure private good example, though, this won't work because there is not an excess supply of the public good. Demand is exactly equal to supply (Walras Law fails) for the public good, given that we simply prevent the non-musician from listening to some of the music. If we lower the price of music, the musician will want more of it, but the firm will want to produce less of it. So, the usual remedy will simply make the problem worse.

In fact, the only equilibrium for this case (with quasi-linear preferences and linear production technology) when the firm produces only music and the price of music is set equal to $v'_n(2b\omega)$. This induces both of the consumers to buy *only* music. This outcome produces a kit more music than any other solution. However, this isn't necessarily good. Looking back at Figure 3 or Figure 4, this will make both consumers worse off than they were in the voluntary contribution game as long as the indifference curve for the musician in the solution to the voluntary contribution game lies to the right of the point $(0, 2b\omega)$, which is quite reasonable.³

³There are only two goods here, but this illustrates the fact that you don't buy the latest CD by the Mad Caddies because you have to pay so much for a CD by U2.

4 The Monopoly Problem

In everything we have discussed in this note so far, we have assumed that the firm that is making all the decisions about music and food is a *competitive* firm. It doesn't believe that it has any influence over price. The essence of copyright is *monopoly* – just as it is for patents (I'll come back to explain why in a moment). A single firm that produces all of the output of a good will inevitably try to control (i.e. raise) its price. To see how this might work, let's go back to our previous version of the model where the musician and the non-musician have exactly the same quasi-linear preferences. At the Lindahl solution, the firm takes prices as fixed. The competitive price for music is $\frac{1}{2b}$ and as we showed above, the quantity of music that both consumers demand is y_1 . Totaling up profits for the firm at this price and output gives profits 2ω . The firm distributes these profits equally between the musician and the non-musician which is where they get the ω dollars that they spend on music and food.

What happens if the firm decides on its own that it wants to charge a higher price for music, say q ? Since preferences are quasi-linear, the demand for music will fall to some new level, let's call it $y' < y_1$. The firm's profits are easy to calculate. It earns q dollars for each of the y' songs that it sells to the musician. It also receives q for each of these *same* songs from the non-musician. The firm's costs of producing the songs is $\frac{y'}{b}$ units of food, so it has $2\omega - \frac{y'}{b}$ units of food left over that it sells for a dollar per unit. So, total profits are

$$2qy' + 2\omega - \frac{y'}{b} = 2\omega + \left(2q - \frac{1}{b}\right) y'$$

From this, it is immediately apparent that if the firm sets a price for music higher than the Lindahl price $\frac{1}{2b}$, then it will make more profits than it does in the Lindahl solution. So, we *aren't going to get the Lindahl (Pareto optimal) solution by assigning copyright and creating a monopoly*.

What price will we get? All we need to do at this point is maximize the firm's profit by choosing the appropriate price. The first order condition is

$$2y' + \left(2q - \frac{1}{b}\right) \frac{dy'}{dq} = 0$$

The solution will depend on the nature of preferences. To see how, suppose that we set the price equal to $\frac{1}{b}$, which is the implicit price in the voluntary

contribution game. Then, we can try to evaluate how profits are changing at this point. The derivative (with quasi-linear preferences) above becomes

$$2y^* + \frac{1}{b} \frac{dy'}{dq}$$

because demand for music is equal to y^* at price $\frac{1}{b}$ with quasi-linear preferences. Divide both sides by y^* and multiply both sides by b (both of which are positive) so that this becomes

$$2b + \frac{\frac{dy'}{dq}}{y^*}$$

This suggests something pretty remarkable: if the elasticity of demand for music $\left(-\frac{\frac{dy'}{dq}}{y^*}\right)$ is smaller than $2b$ when demand for music is equal to y^* , the profits will be strictly increasing in price at y^* . This means that the profit maximizing firm will raise the price of music so much that there will actually be less music produced than there was in the voluntary contribution game. Strong copyright, because of the monopoly power it conveys, can easily have a very perverse effect. The tendency for the monopoly firm to restrict output can easily outweigh the benefits of double charging for the output to subsidize the production of music.

To make matters simple, let's suppose that conditions are such that the firm simply decides to charge the price $\frac{1}{b}$, which is the implicit price in the outcome of the voluntary contribution game. No more music is produced than would be the case if downloading were absolutely free, all the monopoly firm wants to do in this case is to charge non-musicians for the downloads that they were previously making for free. Where does this money go? In the example here, the firm is acting in a way that is in the interest of its shareholders. It produces the largest profits that it can possibly attain, then distributes them back equally to the musician and the non-musician. Since total profits have increased, the musician's share of these profits rises and his budget line lies to the right of the one that he faced in the voluntary contribution game (free downloading outcome). Total production of music hasn't changed, so total production of food is also the same. This means the musician gets more food in the new equilibrium. Correspondingly, the non-musician gets less.

So, as you may have guessed, strong copyright legislation has a redistributive impact (toward shareholders) even when it has very perverse effects on

music production. It happens that musicians own a lot of shares in the example in this little note. Of course, they may not own so many shares.

5 Are there Any Alternatives?

Strong copyright is an imperfect solution to the problem of creating incentives for producers of public goods. Are there alternatives? The Canadian approach, as I mentioned in the introduction, is different from the US approach. Private use (or private ‘study’ as it is called in the law) is allowed under Canadian copyright legislation. This doesn’t mean that Canadian law doesn’t want to provide incentives for musicians, these are just created in a different way.

First, there is a tax imposed on media that are used to record digital versions of music, tapes, CD’s hard disks etc. These taxes are remitted to the Canadian Private Copying Collective (<http://cpcc.ca>), which is supposed to distribute the money. The proceeds of the tax were around \$28 million in 2002/3.⁴ This money is passed on to organizations representing artists. For example, 18.9% of these revenues were to be distributed to performers, 15.1% to record companies, and the rest to authors and publishers. The ACTRA Performers’ Rights Society received about \$7 million of this money to distribute to their members. For a variety of reasons, less than 1% of this money was actually paid out to performers and artists (the figures are given at <http://www.actra.ca>), nonetheless, the money is there in principle. At least, ACTRA tells you what they do with the money. I haven’t had any luck figuring out what the record companies do with the money they receive from CPCC – they no doubt pay it to their lawyers.

Second, Canada directly subsidizes music through programs like the Sound Recording Development Program (see <http://www.canadianheritage.gc.ca> for a description) and through CRTC Canadian Content Restrictions.

Copyright policy involves a balance between incentives and monopoly power. Strong copyright legislation by itself doesn’t necessarily balance these interests. Hopefully, some of the simple economics presented here make some of these issues clearer.

⁴Total CD sales in Canada by comparison, were about \$600 million (<http://www.cria.ca>).