A note on teaching externalities: Distinguishing between consumption and production externalities

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A R T I C L E   I N F O

A B S T R A C T

The vast majority of microeconomics textbooks present production externalities as negative and consumption externalities as positive. Yet, both producers and consumers can cause positive and negative externalities. By discussing all four cases of externalities and separating the price effects for buyers and sellers, authors would offer a much clearer exposition of externalities and help resolve the misconception that negative externalities lead to prices that are too low.

1. Introduction

Textbooks for introductory microeconomics courses are effective when they are simple and comprehensible. Simplification can enhance clarity but also risks limiting understanding of fundamental concepts. Over-simplification of economic concepts can lead to misconceptions and confusion. The coverage of externalities in most introductory microeconomics texts is over-simplified contributing to such misconceptions. The most common problem with textbook presentation of externalities is the focus on negative production externalities and positive consumption externalities. As a result, many students erroneously conclude that negative externalities are caused by producers and lead to prices that are too low.

I became aware of this problem while advising two students working on research projects related to small-diameter timber harvesting in Oregon and Montana. Small-diameter timber is used to produce bio-fuels and other products such as window frames. Both students argued that there was a positive externality associated with harvesting small-diameter timber because it provided services to the greater community through fire-suppression and enhanced recreational opportunities. Given the typical presentation of the positive consumption externality in many courses and textbooks, the

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students correctly concluded that too little small-diameter timber is harvested but incorrectly concluded that the market price was too low. In fact the price buyers pay for goods with positive externalities is too high relative to the optimum.[1] Omitting positive production externalities and negative consumption externalities is affecting students' ability to think through and model these concepts in their original research. Some textbooks not only limit their coverage of externalities but also misrepresent production externalities as consumption externalities and vice versa.

Externalities are an important part of introductory economics courses and are fundamental to environmental economics. While most textbooks make an effort to model both negative and positive externalities, many textbooks lack an explicit and separate modeling of production and consumption externalities.[2] Gans et al. (2012) stands in contrast with the rest of the textbooks by explicitly discussing consumption and production externalities and presenting three of the four cases. Because they do not provide an example of a positive production externality their coverage of externalities may still lead one to conclude that producers cannot cause positive externalities. Some textbooks suggest subtly that there are production and consumption externalities (e.g., Mankiw, 2012; Hubbard and O'Brien, 2011; Sexton, 2013), and others are more explicit (e.g., Bade and Parkin, 2011; Nechyba, 2010).[3,4] However, none of the current texts I have examined explicitly model all four externality types. The standard coverage of externalities might imply that consumers do not cause negative externalities or that producers do not cause positive externalities.

A separate coverage of production and consumption externalities in introductory texts provides a better foundation for students confronted with externalities in more advanced economics courses and research. Explicitly discussing all four types of externalities provides the full toolkit needed to analyze the effects of externalities on the prices buyers pay and the prices sellers receive.

2. Problems with current coverage of externalities

The standard coverage of externalities in introductory texts has led many students and some educators to conclude that positive externalities should always be modeled as consumption externalities and negative externalities as production externalities. While the solutions and the effects on quantity are the same, the effects on market prices are different depending on which side of the market causes the externality or whether we are talking about buyers' price or sellers' price.

Evidence of this problem can be found in textbooks that erroneously conclude that both negative and positive externalities cause market prices to be too low.[5] Other textbooks make that erroneous statement with respect to just negative externalities.[6] While McConnell et al. (2011, pp. 105–106) do not discuss the price effects of externalities, they claim that negative externalities cause supply-side and positive externalities cause demand-side market failures. These textbooks show that oversimplification of externalities has also caused confusion among professional economists.

Furthermore, some texts misleadingly represent consumption externalities as production externalities and vice versa. For example, Klein and Bauman (2010) show a picture of a gasoline

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[1] Only in a borderline case with a perfectly elastic demand curve could the price buyers pay equal the optimum price.

[2] See for example Arnold (2011), Bernheim and Whinston (2008), Boyes and Melvin (2011), Browning and Zupan (2012), Colander (2006), Cowen and Tabarrok (2010), Frank and Bernanke (2012), Gottheil (2009), Gwartney et al. (2013), Hall and Lieberman (2010), Holt (2010), Hubbard and O'Brien (2011), Mankiw (2012), McEachern (2012), Nechyba (2010), Sexton (2013), Stiglitz and Walsh (2006), Stone (2012), Taylor and Weerapana (2012), Tucker (2011). Case et al. (2009) explicitly model just the negative production externalities. Krugman and Wells (2013) model the markets for environmental bads (pollution) and environmental goods (land preservation) directly rather than goods with externalities.

[3] In the instructor's manual accompanying Mankiw's 4th edition textbook, Ghent (2007) does offer an example of a negative consumption externality with an exercise related to alcohol consumption. Although a more recent instructor's manual accompanying Mankiw (2012), Ghent (2012) shows the negative consumption externality related to alcohol market as a production externality.

[4] While Bade and Parkin mention all four types of externalities, they model only the standard two. Bade and Parkin also show the common resources problem that could easily be defined as a negative consumption externality problem, yet the authors do not draw this parallel.

[5] For example, Bernheim and Whinston (2008, pp. 256–261), Colander (2006, pp. 424–425), Miller (2010, p. 111), and Pindyck and Rubinfield (2013, pp. 663–665).

[6] Frank and Bernanke (2012, p. 323), Gottheil (2009, p. 342), Guell (2010, p. 241), Schotter (2009, p. 611), Stone (2012, p. 323) and Tucker (2011, Ch. 14).

buyer causing a negative external cost. Yet, in their modeling of that picture, they shift the supply curve—representing producers. As a result, they claim that the price of gasoline is too low. In contrast, if the sole source of the externality truly came from consumers then the price is actually too high relative to the point where marginal social costs equal marginal social benefits. If the consumers who cause the externality were to pay for the external costs in addition to the market price, then the market price that they would be willing to pay for gasoline would fall. With lower market price the sellers of gasoline would reduce their quantity supplied. Hall and Lieberman (2010) make the same mistake by presenting the negative externalities associated with driving as a production externality in the gasoline market. Another example of a negative consumption externality modeled as a production externality can be found in Cowen and Tabarrok's (2010) textbook in their example of the overuse of antibiotics. An example of a modeling error where positive production externality of beekeeping is represented as a consumption externality can be found in Arnold (2011).

The problems with the coverage of externalities in current introductory textbooks range from omission of positive production and negative consumption externalities to making erroneous conclusions about the price effects of externalities and misrepresenting consumption externalities as production externalities. While limiting coverage to the standard cases of externalities may seem like a harmless simplification, I believe it is the source of the more explicit errors in textbooks and the cause of confusion for students. In the following section I provide a brief discussion to highlight how production externalities differ from consumption externalities in the case of negative, and then in the case of positive externalities.

3. Modeling the four cases of externalities and solutions to externalities

How externalities are modeled depends on the source of the externality. Production externality arises from the choice of inputs in production and affects the supply curve, whereas a consumption externality arises from the choice of outputs in generating utility and affects the demand curve. This section highlights the differences between the typically covered cases of externalities and those typically omitted. To help the discussion, I distinguish between the price sellers receive, P_S, and the price buyers pay, P_B, as is standard practice when taxes and subsidies are considered. I conclude this section with a streamlined discussion of solutions to negative and positive externalities.

3.1. Modeling negative production and negative consumption externalities

To begin with the standard example of a negative externality, consider a good that causes harmful pollution during production, i.e., a negative production externality. Here the social costs are higher than the private costs ($MC_{Social} > MC_{Private}$). Without government intervention too much of the good would be traded ($Q_{Mkt} > Q_{Opt}$) and the market price of the good would be too low relative to the optimal price paid by buyers ($P_{Mkt} < P_{B-Opt}$). Fig. 1 panel (a) depicts the case of a negative production externality.

Omitting discussion of negative consumption externalities, modeled in Fig. 1 panel (b), might imply that consumers do not cause negative externalities. Therefore, educators should be mindful that sometimes it is during consumption that a negative externality is generated, e.g., second hand smoke from cigarettes. Now the social benefit from consumption is lower than the private benefit ($MB_{Social} < MB_{Private}$) and as a result too much of the good is traded ($Q_{Mkt} > Q_{Opt}$) and the price received by sellers is too high ($P_{Mkt} > P_{S-Opt}$).

While it is true that negative externalities cause too much of the good to be traded, whether the market price is too low or too high depends on whether we are considering the price buyers pay or the price sellers receive. We can generalize the consequences of negative externalities without specifying whether production or consumption externalities are considered using Fig. 2 panel (a). Negative externalities cause market quantity to be too high, the price buyers pay to be too low and the price sellers receive to be too high. Even if educators do not discuss each of the negative externality cases separately, they should at least refrain from teaching that negative externalities cause market prices to be too low, thus incorrectly implying that price is too low for all market participants.
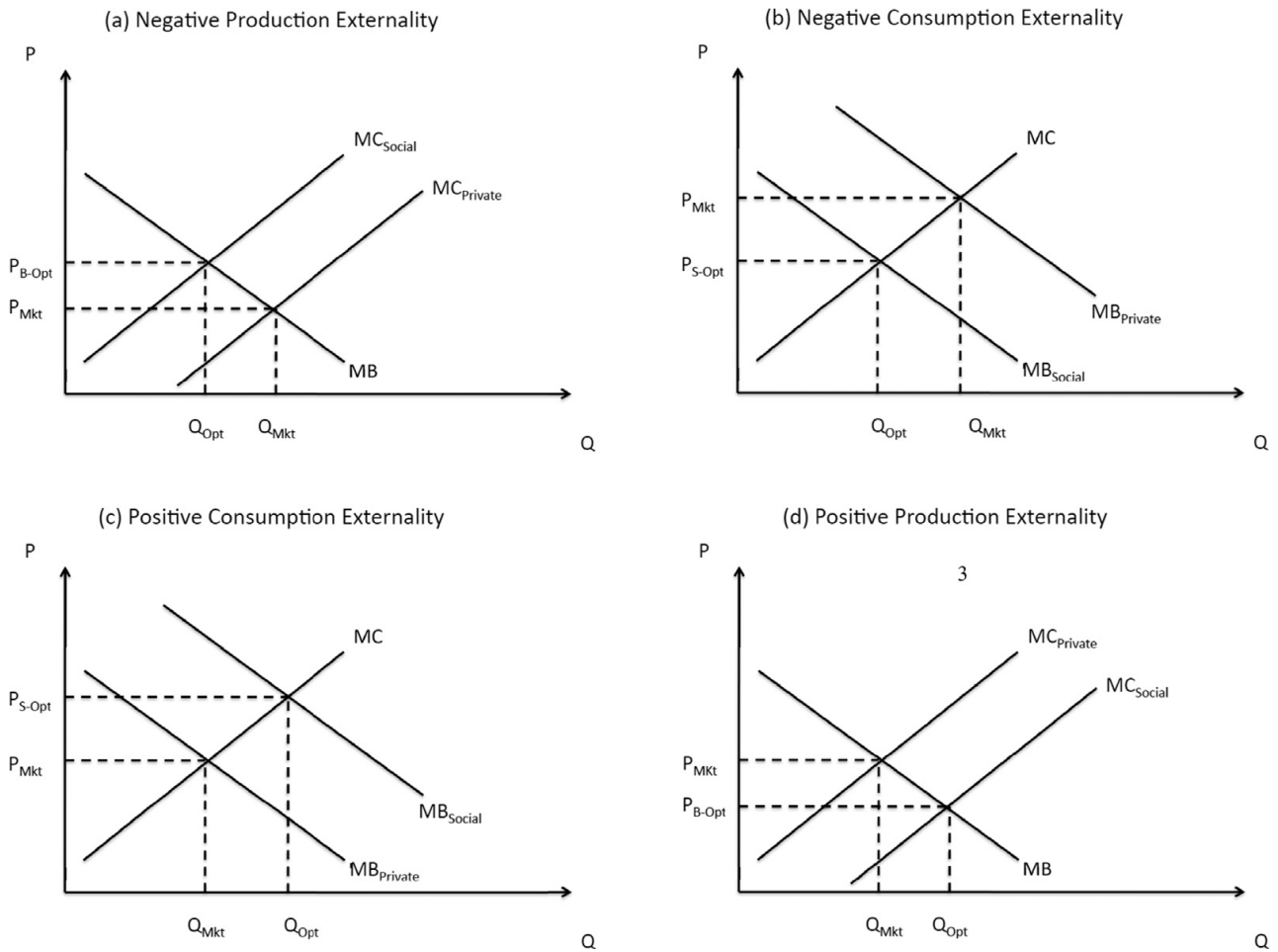
(a) Negative Production Externality

(b) Negative Consumption Externality

(c) Positive Consumption Externality

(d) Positive Production Externality

Fig. 1. The four cases of externalities.

(a) Solution to Negative Externality
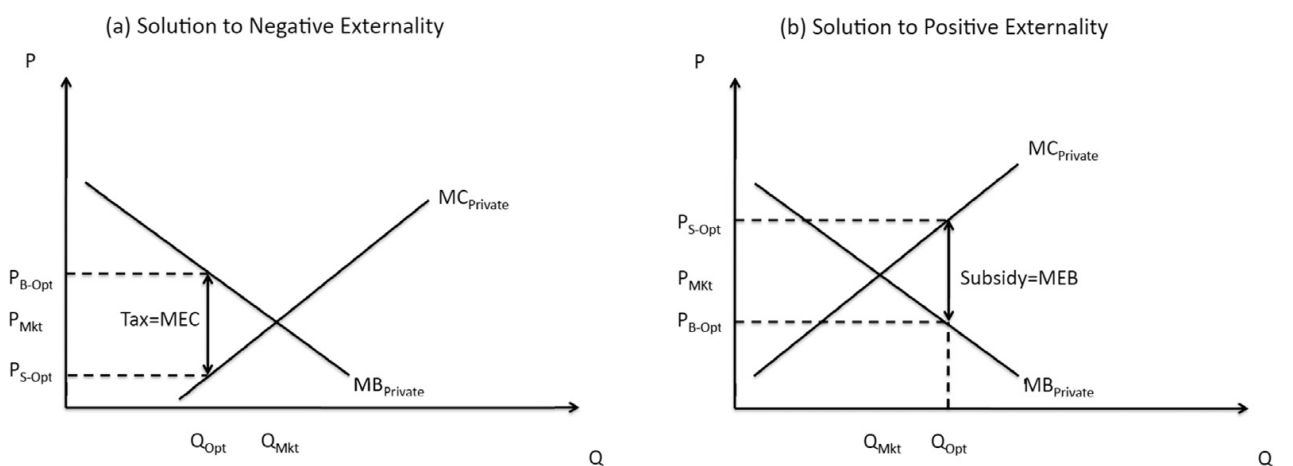
(b) Solution to Positive Externality

Fig. 2. Government solutions to negative and positive externalities. *Notes*: MEC—marginal external costs; MEB—marginal external benefits.

3.2. Modeling positive consumption and positive production externalities

Fig. 1 panel (c) depicts a market for a good with a positive consumption externality, for example vaccinations. In this case social benefits from consuming the good are higher than private benefits ($MB_{Social} > MB_{Private}$) leading the market to trade too little of the good ($Q_{Mkt} < Q_{Opt}$) at a market price that is too low relative to the optimal price sellers should receive ($P_{Mkt} < P_{S\text{-}Opt}$).

As illustrated above with small-diameter timber industry, students must understand that firms can also produce positive externalities in their production. For example, beekeepers provide a positive externality to nearby farmers. Then private costs to firms are higher than social costs ($MC_{Private} > MC_{Social}$), as shown in Fig. 1 panel (d). Still too little is traded ($Q_{Mkt} < Q_{Opt}$) because the initial market price charged is too high relative to the optimal price buyers should pay ($P_{Mkt} > P_{B-Opt}$). Regardless of the source of the externality, positive externalities reduce market size. When discussing the effect of externalities on prices it is important to distinguish between the price sellers receive and the price buyers pay. Fig. 2 panel (b) shows that positive externalities cause market quantity to be too low, the price buyers pay to be too high and the price sellers receive to be too low.

3.3. Solutions to negative and positive externalities

If the Coase Theorem holds then private parties involved—buyers, sellers and those affected by externalities—can solve the externality problem privately and achieve optimal outcome (Coase, 1960). If, on the other hand, the Coase Theorem fails then the government could intervene by taxing a market with negative externalities or subsidizing a market with positive externalities.

As is well understood, taxing sellers and taxing buyers have the same real effect on the market quantity, buyers' price and sellers' price. Therefore, without specifying which side of the market is taxed we can solve negative externality problems by imposing a per-unit tax that is equal to marginal external costs. Depending on the side of the market that is taxed, we could end up seeing the observed price in the market to either increase or decrease. However, in either case, the buyers' price would increase and the sellers' price would decrease as shown on Fig. 2 panel (a).

Symmetrically, for positive externalities problems the well-known solution is to subsidize market activity. As shown in Fig. 2 panel (b) we need not specify whether buyers or sellers are subsidized for market participation, as long as the subsidy is set equal to the marginal external benefit. Then the market would achieve optimal quantity with increased prices received by sellers and lower prices paid by buyers.

4. Conclusion

In this paper I argue that many economics textbooks misrepresent the modeling of externalities by only presenting the cases of negative production and positive consumption externalities. This has caused both students and academics to draw false conclusions about price effects of externalities. I recommend that all four cases of externalities be considered and that the price effects are separated for the price buyers pay and the price sellers receive. Even if adding extra layers of exposition are too long for lecture, adding a short discussion of this issue in textbook chapters is critical to improving understanding of the externality concepts and providing a better foundation for student research dealing with externalities.

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