Tax Responses in Platform Industries

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Abstract

Two-sided platform firms serve distinct customer groups that are connected through interdependent demand, and include major businesses such as the media industry, banking, and the software industry. A well known result of tax incidence is that consumers of a more heavily taxed good pay a higher price and thus consume less of the good. The present paper shows that this result need not hold in a two-sided market. On the contrary, consumers may actually buy more of a good sold by a two-sided platform firm if the tax rate increases. In particular, a higher ad valorem tax may not only lower the end-user price of the more heavily taxed good, but also the price charged to the other customer group. Hence, a platform may not engage in tax shifting via price increases at all.

Keywords: Two-sided markets, ad-valorem taxes, specific taxes, imperfect competition, industrial organization

JEL Codes: D4; D43; H21; H22; L13

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## 1 Introduction

Media is crucial to society both in terms of economic importance and its impact on information flows. The latter issue has recently been reconsidered in a variety of papers which shed more light on the working of the media industry by e.g. looking at what determines the accuracy of reporting (Mullainathan and Shleifer, 2005, and Gentzkow and Shapiro, 2006, 2008) or how the media industry influences voting decisions (Strömberg, 2004, and Della Vigna and Kaplan, 2007). In this paper we turn to a different aspect of the media sector, namely how taxes influence market behavior of media firms. The media industry is subject to preferential tax treatment in many countries. Newspapers, for example, are taxed at a reduced rate or completely exempted from value-added taxation in most countries.\(^1\) The reason for this is that governments consider newspapers to be an essential channel for disseminating vital information about e.g. culture, politics, and international affairs, and that public policy measures should be used to stimulate high circulation and low prices. Such preferential tax treatment indeed reduces prices and increases output in most markets.\(^2\) However, in this article we show that this need not apply for the newspaper industry and other platform industries that operate in two-sided markets.

Two-sided platform firms cater to two distinct groups of customers that are connected through quantity spillovers, and the firms maximize profit by facilitating value-creating interactions between these groups.\(^3\) Two-sided platforms operate in many economically significant industries, such as the media sector, the financial sector (payment card systems), real-estate brokerage, and the computing industry (computer operating systems, software,

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\(^1\) In Germany, newspapers are subject to a rate of 7% (19% is the regular rate) while in e.g. the UK, Denmark, and Norway they are exempted from value-added taxation all together (European Commission, 2004). Newspapers are also either fully or partially exempted from sales taxes in a number of U.S. states.

\(^2\) An overview of the tax incidence literature is given by Fullerton and Metcalf (2002).

\(^3\) Evans (2003a,b) provides examples and classifications of two-sided markets.
game consoles etc.). The pricing strategies of a platform firm must account for interactions between the demands of different customer groups and the externalities that arise in these relationships. For instance, in the media industry, advertising may be perceived as a nuisance (a negative externality) or a benefit (a positive externality) by readers/viewers, while advertisers benefit from an increase in readers/viewers of the media outlet. In the credit card industry there are positive quantity spillovers between merchants and cardholders. Merchants who accept a credit card welcome an increase in the number of households joining the credit card system, and vice versa.¹

We show that the sign, size and direction of externalities in two-sided markets are decisive for the effects of changes in ad valorem tax rates. Specifically, an increase in the ad valorem tax in one side of the market affects the relative profitability between the two markets, such that the firm will want to shift its earnings to the side where the tax rate is unchanged. By doing so it reduces the burden of the tax increase. Contrary to what one might expect, this may involve increasing output and reducing prices on both sides of the market. The platform may thus decide not to shift taxes via price increases. Our analysis consequently has implications for the understanding of tax incidence in two-sided markets.

The behavior of the platform firm in response to a tax increase in one side of the market can be illustrated by a media firm. A media firm is a two-sided platform that derives income from selling a newspaper and advertisements, and where the income from advertisements depends positively on newspaper sales. An increase in the ad valorem tax rate on the newspaper may induce the media firm to rely more on income from advertisements. Thus, it may reduce the price of the newspaper in order to attract more readers. A larger readership means that the newspaper becomes more attractive for the advertisers, and the media firm may therefore end up selling more of both ads and newspapers following a tax increase. We show that this is particularly

¹As will become clear in the discussion below, it is important to distinguish the concept of two-sided markets from that of complementarities. See also Rochet and Tirole (2003).
likely to be true if newspaper readers consider ads as a nuisance (rather than as a complement which increases the intrinsic value of the media product). A very high tax on newspapers could even lead a media platform to provide the newspaper free of charge and rely on income from advertising only.

Our analysis is related to a growing literature on Industrial Organization that analyzes the price-setting behavior of firms in two-sided markets. In this literature a key result is that two-sided platform firms may find it profitable to charge prices that are below marginal cost or even negative for one product (customer group). This is in contrast to conventional markets (one-sided) where marginal cost equal to marginal revenue pricing is well established as a guidance. In such markets the effects of taxation are well known both under perfect and imperfect competition. Under imperfect competition a tax can be overshifted onto the consumer side in certain circumstances, but in general the burden of the tax is shared between producers and consumers depending on elasticities of supply and demand. Except for our companion paper, Kind et al (2008), the literature on two-sided platforms does not consider taxation issues. The literature on indirect taxation, on the other hand, does not consider the effects two-sidedness has on tax shifting via market price changes. The present paper tries to bridge this gap.

The rest of the paper is organized as follows: Section 2 sets up the basic model, while Section 3 analyzes the effects of an ad valorem tax on prices and quantities. Section 4 carries out an analysis with respect to specific taxes. Section 5 illustrates the results by means of a numerical example and section 6 concludes.


6 See Keen and Delipalla (1992), Dierickx, Matutes and Neven (1998) and Anderson et. al. (2001a,b), and Fullerton and Metcalf (2002) for a survey.
2 The Model

Consider a two-sided monopoly platform which sells good \( N \) at price \( p^N \) to one group of customers and good \( A \) at price \( p^A \) to another group of customers. Let \( n \) and \( a \) denote the respective quantities of the two goods.

We assume that both customer groups are price takers. The inverse demand function for each good is downward-sloping in own quantity; \( p^N_n = \partial p^N/\partial n < 0; p^A_a = \partial p^A/\partial a < 0 \) (subscripts henceforth denote partial derivatives). The willingness to pay for each good may also depend on how much is sold of the other good. The sale of good \( A \) imposes a positive externality on buyers of good \( N \) if the willingness to pay for \( N \) is increasing in output of good \( A \) (\( p^N_a > 0 \)) and a negative externality if \( p^N_a < 0 \). In the same manner, good \( N \) may impose a positive (\( p^A_n > 0 \)) or negative (\( p^A_n < 0 \)) externality on the demand for good \( A \). The inverse demand functions can thus be written as \( p^N = p^N(n, a) \) and \( p^A = p^A(n, a) \). We resort to a partial equilibrium analysis by abstracting from other determinants of demand.

For the sake of convenience, and to emphasize the economic intuition and policy relevance of our results, we shall in what follows relate our model and results to a media firm (the platform). A newspaper is a typical example of a two-sided platform firm, which derives income from two distinct customer groups (newspaper readers and advertisers), and where there are externalities (possibly positive from readers to advertisers, and negative from advertisers to readers) between the two groups. In such a setting we may interpret \( n \) as sales of newspapers, and \( a \) as sales of advertising space to firms.

An ad valorem tax \( t \) is levied on sales of newspapers (good \( N \)), which implies that the media firm receives the price \( p^N/(1 + t) \) per copy it sells of the newspaper. The tax rate \( t \) may deviate from the general VAT rate \( \bar{t} \) which for simplicity is set to 0. Our focal point here is to examine the effects of a change in the tax rate \( t \), holding \( \bar{t} \) fixed.

\footnote{This is an externality since producers and consumers are price takers. Thus, they do not take into account the effect of their actions on the demand in either side of the market.}
The newspaper (the platform) has the following profit level:

$$\pi = \max_{n,a} \left[ ap^A(a,n) + \frac{np^N(n,a)}{1+t} - k(n,a) \right] ,$$

(1)

where $k(n,a)$ is the cost function, with $k_i \geq 0 \ (i = a,n)$ and $k_{na} \geq 0$.

The first-order condition for good $A \ (\pi_a = 0)$ implies

$$\left[p^A + ap^A_a\right] - k_a = -\frac{np^N_a}{1+t} .$$

(2)

The squared bracket in equation (2) measures marginal revenue on the advertising side of the market of selling more ads. In the profit maximizing optimum in a one-sided market this term is equal to marginal cost ($k_a$) so that the left-hand side would be zero. However, in a two-sided market there is an additional term (right-hand side) that captures the fact that the sales of advertising (good $A$) may influence the sales of newspapers (good $N$). This term is positive if the demand for newspapers is decreasing in the level of advertising (that is, $p^N_a < 0$), while it is negative if advertising imposes a positive externality on demand for newspapers. In the former case, the level of advertising should be set lower than the level that maximizes profit in the advertising market in isolation (i.e., in a one-sided market), while the opposite is true if a larger advertising volume increases the demand for newspapers.

From the first-order condition for good $N \ (\pi_a = 0)$, we likewise find that

$$\left[ p^N + np^N_n \right] - k_n = -ap^A_n .$$

(3)

The squared bracket is marginal revenue from selling the newspaper (good $N$) to consumers, and would in optimum be equal to $k_n$ in a one-sided market (i.e., when $p^A_n = 0$). However, if demand for ads is higher the larger the number of readers ($p^A_n > 0$), profit is maximized by raising the sale of newspapers beyond the volume that maximizes profit on newspaper sales in isolation (and vice versa for $p^A_n < 0$).

From the first-order conditions we see that equilibrium prices and quantities on both sides of the market depend on the tax rate. Since $p^A = p^A(a,n)$
and \( p^N = p^N(n, a) \), the price changes subsequent to a tax increase are given by

\[
\frac{dp^A}{dt} = p^A_a \frac{da}{dt} + p^A_n \frac{dn}{dt}, \quad \text{and} \quad \frac{dp^N}{dt} = p^N_n \frac{dn}{dt} + p^N_a \frac{da}{dt}.
\]

We shall assume that the second-order conditions for profit maximization hold, which means that \( \pi_{aa} < 0 \), \( \pi_{nn} < 0 \), and \( H \equiv \pi_{aa} \pi_{nn} - \pi_{an}^2 > 0 \). In order to simplify the following discussion we further state:

**Assumption:** Let \( p^A_a > 0 \) and \( \pi_{an} > 0 \).

The assumption that \( p^A_a > 0 \) seems reasonable in our context, since it implies that the advertisers have a higher willingness to pay for ads the larger is the readership of the newspaper. We might also have \( p^N_a > 0 \), in which case the willingness to pay for a newspaper is increasing in the ad volume. However, empirical evidence is inconclusive as to whether consumers consider advertising to be a good or a bad.\(^8\) We shall therefore not make any assumptions regarding the sign of \( p^N_a \).

The assumption \( \pi_{an} > 0 \) ensures that the marginal profitability for the media firm of selling advertising space is increasing in the newspaper circulation.

It should be emphasized that the model is applicable to two-sided markets in general, and that our mathematical derivations and results also hold for \( p^A_n \leq 0 \) (in which case two-sidedness requires \( p^N_a > 0 \)) and/or \( \pi_{an} \leq 0 \).\(^9\) In the Appendix we discuss how to interpret our results if \( \pi_{an} < 0 \).

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\(^8\)Readers in European countries seem to be averse to advertising (see Ferguson 1983, p. 637; Blair and Romano 1993, and Sonnac 2000) For retail advertising there is some evidence showing that American readers like advertising.

\(^9\)Evans (2003b) defines a two-sided market as one where we have (a) two distinct groups of customers, (b) positive network externalities (at least from one of the customer groups to the other), and (c) an intermediary that internalizes the externalities between the groups. See Rochet and Tirole (2004) for a more formal definition.
3 Profit-maximizing platform responses to a tax increase

It is evident from our discussion above that the effect of a change in the ad valorem tax depends on assumptions linked to the externalities between the two customer groups. Our analysis should not be confused with the standard theory of complements. Complements are used to describe a situation where an increase in the price of one good causes a decline in consumption of both goods, measured by the change in the compensated demand by a single consumer (see e.g., Kreps 1990, p. 61). This is different from a two-sided market, where there are two distinct groups of customers that may respond differently to changes in prices (see Rochet and Tirole (2003, 2006) for a general discussion). Also, the main results of our analysis do not hinge on the goods being complementary in demand by the two groups of customers. In order to see this as simply as possible, we start out by considering a situation where newspaper readers are indifferent about the advertising level.

3.1 Consumers indifferent to the ad level \((p_a^N = 0)\)

There is no externality from good \(A\) to good \(N\) if newspaper readers are indifferent to the advertising level. Therefore the advertising level (i.e., output of good \(A\)) does not affect the willingness to pay for newspapers. In this case we have that \(p_a^N = 0\). The effect of a higher value-added tax can be found by using (4) and totally differentiating first order conditions (2) and (3). We then obtain\(^{10}\)

\[
\left. \frac{dp^N}{dt} \right|_{p_a^N = 0} = p_n^N \left. \frac{dn}{dt} \right|_{p_a^N = 0} ; \quad \left. \frac{dn}{dt} \right|_{p_a^N = 0} = -\frac{\pi_{aa} (ap^n_A - k_n)}{H (1 + t)} \quad (5)
\]

and

\(^{10}\)The full derivation is stated in the Appendix.
Equations (5) and (6) show that we may get the seemingly paradoxical result that a higher VAT on newspapers reduces the end-user price of that good and increases sales on both sides of the market. This happens if \( (ap_n^A - k_n) > 0 \). To see why, recall that the willingness to pay for advertising increases by \( p_n^A \) units if the newspaper attracts one more reader. With a total advertising volume equal to \( a \), the value for the newspaper of attracting one extra reader equals \( ap_n^A \). If the size of this indirect network effect is greater than the marginal cost \( k_n \) of serving one extra reader, it is profitable for the media firm to charge a lower price for the newspaper subsequent to the tax increase.\(^{11}\) Thereby the readership increases, allowing the media firm to sell more advertising and make a higher profit than if it increased the price and reduced the output of newspapers.\(^{12}\)

Whether \( ap_n^A - k_n > 0 \) holds depends on the industry in question. In our media example there are high fixed cost of creating the first copy of a newspaper, but relatively low marginal cost of reproducing it (and on the internet \( k_n \) is approximately equal to zero even for pay-to-view sites). It should further be noted that advertising is the primary or only source of income for some media outlets, indicating that \( ap_n^A \) is relatively high.

The results in equations (5) and (6) are in stark contrast to benchmark results in one-sided markets, from which it is well known that (i) consumers buy less of a taxed good if marginal costs are positive \( (k_n > 0) \), and that

\[
\frac{da}{dt} \bigg|_{p_n^a=0} = \frac{\pi_{an} (ap_n^A - k_n)}{H (1 + t)} \quad (6)
\]

\(^{11}\)Differentiating the equilibrium value of equation (1) with respect to \( t \), and using the envelope theorem, we find \( d\pi/dt = -p^N(n, a)n(1 + t)^{-2} < 0 \) so the profit level is strictly decreasing in the tax rate. However, the marginal change in profits earned in the ad market is \( (p_n^a a + p^A) da/dt + p_n^A dn/dt \) which, by (2) and \( p_n^A > 0 \), is positive if quantity responses are positive (i.e., \( ap_n^A - k_n > 0 \)).

\(^{12}\)To see the intuition for this result as clearly as possible, assume that \( t \) approaches infinity. Obviously, the newspaper would then have no reason to charge a positive consumer price. However, it can still raise revenue through the advertising market and give the newspaper away for free.
(ii) an ad valorem tax is effectively a tax on pure profit with no effect on output if marginal costs are zero \((k_n = 0)\). Contrary to a firm operating in a one-sided market, a two-sided platform firm can reduce its tax burden by shifting revenue to the side of the market where the tax rate is unchanged. This is particularly profitable if the marginal costs of the more heavily taxed good are smaller than the size of the indirect network effect. In such a case our results demonstrate that consumers of the more heavily taxed good buy more of the good at a lower price. Thus, the platform does not shift even part of the burden onto consumers.

The effect of the tax increase on the price of ads is from equation (4) given by

\[
\frac{dp^A}{dt} \bigg|_{p^N_a=0} = p^A_a \frac{da}{dt} \bigg|_{p^N_a=0} + p^A_n \frac{dn}{dt} \bigg|_{p^N_a=0} \geq 0.
\]

Since \(p^A(n, a)\) is downward-sloping in own quantity, an increase in the advertising volume tends to reduce \(p^A (p^A_a < 0)\). At the same time, the firm can charge a higher advertising price if the size of the readership increases (since \(p^A_n > 0\)). Consequently, it is uncertain whether the price of advertising will go up or down.

### 3.2 Newspaper readers dislike ads \((p^N_a < 0)\)

When \(p^N_a < 0\), the demand for newspapers (good \(N\)) depends negatively on the advertising level (good \(A\)). One might think that higher value-added taxes are more likely to reduce the sales of newspapers the more consumers dislike ads (since tax-motivated increased sales of ads would reduce demand for newspapers). However, total differentiation of equations (2) and (3) makes it clear that the opposite is true:

\[
\frac{da}{dt} \bigg|_{p^N_a<0} = \frac{da}{dt} \bigg|_{p^N_a=0} + \left( \frac{1}{1+t} \right)^2 \frac{\pi_{nn} np^N_a}{H}.
\]
$$\frac{dn}{dt} \bigg|_{p_a^N < 0} = \frac{dn}{dt} \bigg|_{p_a^N = 0} + \left( \frac{1}{1 + t} \right)^2 \frac{\bar{\pi}_a n p_a^N}{H}.$$ \hfill (8)

The first term in (7) and (8) shows how advertising and newspaper sales respond to a tax increase if consumers are indifferent about ads ($p_a^N = 0$). As argued above, this term may be positive or negative. The second term, though, is unambiguously positive and increasing in the consumers’ disutility of ads. The reason is that if sales in the newspaper market are adversely affected by advertising ($p_a^N < 0$) the media firm has incentives to set a smaller advertising level than the volume which maximizes profit in the advertising market (c.f. equation (2)). However, this incentive becomes weaker with a heavier taxation of newspaper sales, making it optimal to increase sales of ads. The media firm can achieve this by enlarging the size of the readership, which requires a reduction of the newspaper price. This implies that the tendency for the newspaper price to fall subsequent to a tax increase is even more pronounced when $p_a^N < 0$ than when $p_a^N = 0$.\hfill 13 It should be noted, though, that we still cannot sign the change in the price of advertising if both the advertising level and the size of the readership increase. This opens up for the possibly surprising result that the price for both readers and advertisers fall subsequent to a tax rise, and that the platform bears the full tax burden - see Section 5 for a numerical example.

Summing up the discussion so far, we can state:

**Proposition 1:** If $p_a^N \leq 0$, a sufficient condition for a higher value-added tax on good $N$ to increase equilibrium quantities of both goods is that $ap_n^A > k_n$. The price of good $N$ (inclusive of VAT) is lowered, while the sign of the change in the price of the untaxed good ($A$) is ambiguous.

\hfill 13With $p_a^N < 0$ and $p_n^A < 0$ it follows immediately from equation (4) that $dp^N/dt < 0$ if $da/dt > 0$ and $dn/dt > 0$, and that the price reduction is larger the more consumers dislike ads.
Undoubtedly, the market price $p^N$ is only part of the total price readers pay when $p^N_a < 0$. The total, hedonic price includes the market price and the disutility readers incur from advertising exposure. Readers buy more of the more heavily taxed good when $ap^A_n > k_n$. Appealing to a revealed preference argument, the rise in advertising volume does not dominate the reduction of the market price. Hence, not only the market price $p^N$, but also the hedonic price falls subsequent to the tax rise.

### 3.3 Newspaper readers as ad-lovers ($p^N_a > 0$)

Demand for newspapers depends positively on the advertising level if $p^N_a > 0$. An example of where this constellation may occur is specialized magazines, where $p^N_a > 0$ reflects a taste for commercials (ad-lovers). Car ads in automobile magazines and perfume ads in beauty magazines are examples of magazines whose readers appreciate ads (see Depken II and Wilson, 2004).

Equations (7) and (8) still hold when consumers are ad lovers, but with the potentially important difference that the last terms in both equations turn from positive to negative, that is,

\[
\frac{da}{dt}\bigg|_{p^N_a>0} = \frac{da}{dt}\bigg|_{p^N_a=0} + \left(\frac{1}{1+t}\right)^2 \frac{\pi_{nn} n p^N_a}{H} \quad (9)
\]

\[
\frac{dn}{dt}\bigg|_{p^N_a>0} = \frac{dn}{dt}\bigg|_{p^N_a=0} + \left(\frac{1}{1+t}\right)^2 \frac{-\pi_{an} n p^N_a}{H}. \quad (10)
\]

If $p^N_a > 0$ is small, the last term is insignificant relative to the first term and our results in the previous sections are reproduced. If $p^N_a$ is sufficiently high, it follows from equations (9) and (10) that the sales of newspapers and advertising are decreasing in taxes. To see why, notice that the newspaper

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14Another example is from the financial sector, where cardholders have a higher willingness to pay for holding a credit card the larger the number of merchants that accept it.
has more ads than the quantity which maximizes profit on the advertising side when consumers are ad-lovers (c.f. equation (2)). An increase in VAT, though, implies that it becomes less profitable for the media firm to attract readers by having many ads. Instead, the media firm will have incentives to reduce the level of advertising, and approach the volume that maximizes profit on the advertising side. If \( p^N_a \) is sufficiently high, both the level of advertising and newspaper sales will therefore fall, and the signs of \( dp^A/dt \) and \( dp^N/dt \) will be ambiguous (c.f. equation 4).

To summarize:

**Proposition 2:** Suppose \( p^N_a > 0 \).

(a) If \( p^N_a \) is not too high, a higher value-added tax on good \( N \) increases sales on both sides of the market and lowers the price of good \( N \) if \( ap^A_n > k_n \).

(b) If \( p^N_a \) is sufficiently high, a higher tax on good \( N \) reduces sales on both sides of the market, while the effect on prices is ambiguous.

In the sections above we have shown that a higher ad valorem tax on newspapers may increase newspaper sales and reduce the newspaper price, particularly if consumers dislike ads. The purpose of the next section is to show that it may be a more robust policy recommendation to use negative specific taxes (unit subsidies) than to reduce the VAT rate if the aim is to increase newspaper circulation.

### 4 Specific Taxation

Under a specific tax the profit of the platform is

\[
\pi = \max_{n,a} \left[ ap^A(n, a) + \left( \frac{p^N(n, a)}{1 + t} - \tau \right) n - k(n, a) \right],
\]

where \( \tau \) is the specific tax that falls on good \( N \) (newspapers). From the first order conditions \( \pi_a = 0 \) and \( \pi_n = 0 \), we can characterize the profit maximizing behavior of the platform as follows

\[
p^A + ap^A_n - k_n = \frac{-np^N_a}{1 + t} \tag{11}
\]
\[
\left[ \frac{p^N + np_N^N}{1 + t} \right] - k_n = -ap_n^A + \tau. \tag{12}
\]

The first-order conditions for the platform are the same as before (c.f. equations (2) and (3)), except that the specific tax imposes an additional cost on the production of newspapers, as is evident from the right-hand side of (12).

Totally differentiating (11) and (12), holding \( t \) fixed, we find
\[
\frac{dn}{d\tau} = \frac{\pi_{aa}}{H} < 0 \text{ and } \frac{da}{d\tau} = -\frac{\pi_{na}}{H} < 0. \tag{13}
\]

Equation (13) makes it clear that specific taxes unambiguously have a negative impact on output in both markets, independently of consumer preferences for ads. The reason is that higher specific taxes are equivalent to increased unit costs, as shown by equation (12). Since higher unit costs lower the marginal profitability for any given output, it is optimal to reduce sales of newspapers \( (dn/d\tau < 0) \). As a result, the advertising level falls \( (da/d\tau < 0) \).

Note, however, that we would have \( da/d\tau > 0 \) if \( \pi_{an} < 0 \). The intuition for this is simple; if the marginal profit of advertising is decreasing in the newspaper circulation, a lower sale of newspapers will make it optimal for the media firm to sell more advertising space. In contrast, the equations in Section 3 make it clear that the sign of the change in sales of advertising does not depend critically on whether \( \pi_{an} \) is positive or negative under ad valorem taxation (see also Appendix).

The change in the newspaper price is
\[
\frac{dp^N}{d\tau} = p^N \frac{dn}{d\tau} + p^N \frac{da}{d\tau}. \tag{14}
\]

Equation (14) is unambiguously positive if consumers dislike ads \( (p^N_a < 0) \). However, with ad-lovers \( (p^N_a > 0) \) the second term is negative, reflecting that the consumers’ willingness to pay for the newspaper falls when the level of advertising decreases. Unless this effect is sufficiently strong, we get the standard result from one-sided markets that the end-user price is increasing in the tax level \( (dp^N/d\tau > 0) \).
For the advertising price we find

\[ \frac{dp^A}{d\tau} = p_a^A \frac{da}{d\tau} + p_n^A \frac{dn}{d\tau}. \] (15)

The fact that the advertising volume falls subsequent to a higher specific tax, tends to increase the advertising price. However, the reduced newspaper circulation \((dn/dt < 0)\) reduces the value of advertising. If this effect dominates (i.e., \(p_n^A\) is relatively large), the advertising price falls.

Our result above can be summarized as follows:

**Proposition 3:** A higher specific tax on good \(N\) reduces output of both goods. Unless \(p_n^A\) and \(p_n^N\) are positive and sufficiently large, end-user prices increase.

The analysis in Sections 3 and 4 makes it clear that raising ad valorem taxes and specific taxes may have opposite quantity effects. The reason for this is that with specific taxes, there is a one-to-one relationship between tax payments and quantity, while there is no direct link between output and the burden of taxation under ad valorem taxation. In fact, subsequent to a higher ad valorem tax the firm can in principle both reduce tax payments and increase the quantity by lowering the price.

The important insight from the discussion above, is that unit subsidies (a negative value of \(\tau\)) unquestionably increase newspaper circulation, and also reduces the newspaper price unless the readers are relatively strong adherers. A reduction of the VAT rate, on the other hand, has more ambiguous effects - in the worst case, such a policy may reduce newspaper circulation and increase newspaper prices.

## 5 A Numerical Example

In this section we illustrate our findings by considering Anderson and Coate’s (2005) well-established model of a monopoly newspaper, which raises revenue
both from consumer payments and advertising. The inverse demand curve for advertising is given by

\[ p^A = n (1 - a) , \]  

(16)

where a non-negative advertising price requires \( a < 1 \). Anderson and Coate provide a detailed description of the microfoundation for (16) which we will not go into here. Instead we just note that the willingness to pay for an ad is increasing in the size of the readership, since \( p^A_n = 1 - a > 0 \) (such that we have positive externalities from good \( N \) to good \( A \)).

The inverse demand for newspapers equals

\[ p^N = 1 - \gamma a - n. \]  

(17)

Ads impose a positive externality on newspaper readers if \( p^N_a = -\gamma > 0 \) (readers are ad-lovers), while the externalities are negative if \( p^N_a = -\gamma < 0 \) (readers are ad-haters).

The newspaper’s profit level is equal to,

\[ \pi = \max_{a,n} \left\{ \frac{(p^N - \tau) n}{1 + t} + p^A a \right\}, \]  

(18)

where we have set production costs equal to zero. As above, \( t \) denotes the VAT rate, and \( \tau \) the unit tax. It can be shown that all non-negativity constraints and second-order conditions are satisfied if \( \gamma \in (-1, 1) \), and we shall assume that this holds.

5.1 Price and quantity effects of ad valorem taxation

We start out by considering the effects of ad valorem taxes, and thus set \( \tau = 0 \). Maximizing newspaper profit in (18) yield equilibrium output:

\[ n = \frac{5 - \gamma (2 - \gamma)}{8} + t \frac{(1 + t) - \gamma^2}{8 (1 + t)} \]  

and

\[ a = \frac{1 - \gamma}{2} + \frac{t}{2 (1 + t)} \gamma. \]  

(19)
Our primary interest is to find the consequences on newspaper sales of higher newspaper taxation, and by using equations (16), (17), and (19) we find that:

\[
\frac{dn}{dt} = \frac{(1 + t)^2 - \gamma^2}{8 (1 + t)^2} > 0; \quad \frac{dp}{dt} = -\frac{1}{8} - \frac{3\gamma^2}{8 (1 + t)^2} < 0. \tag{20}
\]

In line with the general discussion above - but in sharp contrast to standard results in one-sided markets - we see from (20) that it is optimal for the media firm to reduce the end-user price and increase sales of newspapers subsequent to the tax increase.\(^\text{15}\) Provided \(\gamma \in (-1, 1)\), this holds independent of whether the readers are ad-lovers or ad-haters.\(^\text{16}\)

To simplify the algebra we have set production costs equal to zero, but it can easily be shown that the qualitative results in (20) hold as long as the marginal costs of producing newspapers are not "too large".\(^\text{17}\)

For the advertising side of the market, the volume and price effect of a higher newspaper tax are equal to

\[
\frac{da}{dt} = \frac{\gamma}{2 (1 + t)^2}; \quad \frac{dp}{dt} = \frac{1}{16} - \left[ \frac{(4 - \gamma)(1 + t) + 2\gamma^2}{16 (1 + t)^3} \right] \gamma. \tag{21}
\]

From (21) we see that \(\text{sign} \left( \frac{da}{dt} \right) = \text{sign} \left( \gamma \right)\). Since the square bracket in (21) is always positive for \(\gamma \in (-1, 1)\), we further see that we always have

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\(^{15}\)The results \(dn/dt > 0\) implies that the hedonic price of newspapers, \(p^N + \gamma a\), falls. Formally, from (20) and (21), the change in \(p^N + \gamma a\) in response to a higher tax is \(dp^N/dt + \gamma (da/dt) = -1/8 + (\gamma)^2/(8(1 + t)^2)\). Since \(\gamma \in (-1, 1)\) it is evident that the hedonic price change is negative.

\(^{16}\)This sharp result is partly due to the fact that \(\pi_{an} = 0\) in the Anderson-Coate framework, such that the second term on the right-hand side of the general equations (8) and (10) are equal to zero.

\(^{17}\)An example to illustrate this may be useful. Let the marginal costs of producing newspapers be equal to \(k\), such that \(\pi = p^N n/(1 + t) + p^A a - kn\). If the consumers are indifferent to ads (\(\gamma = 0\)), we find that \(p^N = (3 + 4k)/8\) at \(t = 0\). It can then be shown that \(dn/dt|_{t=0} = (1 - 4k)/8 > 0\) for \(k < 1/4\). At \(k = 1/4\), we have \(p^N = 1/2\). Thus, a small tax increase leads to higher newspaper sales even if marginal costs approach fifty per cent of the end-user price.
$dp^A/dt > 0$ for $\gamma < 0$, while we might have $dp^A/dt < 0$ if $\gamma$ is positive and sufficiently large. This is illustrated graphically in Figure 1, which shows the consequences of marginally increasing the tax rate from $t = 0$.

**Figure 1:** VAT on newspapers - consequences in the advertising market.

The intuition for the results in Figure 1 follows from the explanations for Proposition 1 and 2. Since the media firm responds to the higher newspaper tax by increasing newspaper sales, demand for advertising will also increase. Thereby the media firm will be able to increase the advertising volume and/or the advertising price. With ad-lovers, the newspaper will attract readers by having a relatively large advertising volume - a higher volume than the one which maximizes profits on the advertising side of the market. However, higher newspaper taxes reduce the incentive to "over supply" ads, and therefore makes it optimal to reduce the ad volume. The combination of a lower advertising volume and a larger newspaper circulation unambiguously allows the media firm to increase the advertising price. This explains why we necessarily have $da/dt < 0$ and $dp^A/dt > 0$ for $\gamma < 0$. With ad-haters, it will similarly be optimal for the media firm to sell more ads subsequent to the tax increase, possibly at the expense of a lower advertising price.

From Propositions 1 and 2 we know that the media firm will reduce its tax burden by shifting profits from the newspaper to the advertising side.
of the market, independent of whether $\gamma$ is positive or negative. For our demand example this is illustrated by the curves $\left. \frac{d(ap^x)}{dt} \right|_{t=0}$ (upper solid line) and $\left. \frac{d}{dt} \left( \frac{np^x}{1+t} \right) \right|_{t=0}$ (lower solid line) in Figure 2. The media firm is naturally negatively affected by a higher tax on newspaper sales even if it shifts profits to the advertising side of the market. The dotted curve in Figure 2 shows the newspaper’s total loss in profit due to the tax increase.

Figure 2: Profit shifting.

5.2 Price and quantity effects of unit taxes

The example above illustrated that a government policy of setting a low VAT rate on newspapers to increase circulation and reduce newspaper prices might be highly counter productive. We shall now look at the effects of unit taxes ($\tau$) on newspapers in the Anderson Coate framework. Setting $t = 0$ and solving (18) yield:

$$n = \frac{5 - \gamma (2 - \gamma)}{8} - \frac{\tau}{2} \quad \text{and} \quad a = \frac{1 - \gamma}{2}.$$  \hspace{1cm} (22)

From equations (16), (17) and (22) we now find that

$$\frac{dn}{d\tau} = -\frac{1}{2}; \quad \frac{dp^N}{d\tau} = \frac{1}{2} \quad \text{and} \quad \frac{da}{d\tau} = 0; \quad \frac{dp^A}{d\tau} = -\frac{1}{4} (1 + \gamma).$$  \hspace{1cm} (23)
As in a one-sided market, we thus see that higher unit taxes reduce output of newspapers. With a downward-sloping demand curve for this good, the consumer price will therefore increase (the advertising volume does not change in the Anderson-Coate framework, since $\pi_{an} = 0$). The smaller circulation of the newspaper in turn implies that the price that media firm can charge for ads falls.

The purpose of this Section has been to illustrate as simple as possible that governments should be careful in reducing the VAT rate if the aim is to increase newspaper circulation; the output expansion might only be weakly positive - or even negative, as in the example. Unit subsidies ($\tau < 0$), on the other hand, will unambiguously increase sales of newspapers.

### 6 Conclusion

Traditional analysis of tax incidence has focused on conventional (one-sided) markets. In such markets a general insight is that indirect taxes are partly shifted (or even overshifted) onto consumers, resulting in lower sales of the taxed good. Our analysis has shown that this result is challenged in a two-sided market. If demand for the taxed good matters for the quantity sold to a different group of customers, the incidence of taxation changes. In a two-sided market an increase in an ad valorem tax may, under certain conditions, lead to lower prices for both goods as well as to higher sales. The results obtained under ad valorem taxation are in sharp contrast to our findings under specific taxation, where a higher tax unambiguously has a negative effect on output.

Our study has been carried out in a monopoly setting. An interesting path for future research would be to check the robustness of our results under different market structures. There are strong reasons to believe that the main results in this paper would survive under oligopoly as well, and we can show that this conjecture holds in a simple duopoly model with linear
demand functions. As long as firms have some market power, a tax increase on one side of the market implies that firms have incentives and the abilities to shift profit to the other side of the market. The existence of market power, therefore, is really what is driving our results.

Even though our discussion is related to the media market, we have not incorporated particularities of the media market or the advertising market into the model. The reason is that we have used a model sufficiently general in structure to highlight the most common mechanisms in two-sided markets. This said, we believe that there is also a need for industry-specific analysis in both theoretical and empirical terms to identify peculiarities of the respective industries for tax policy design.

7 Appendix

Derivation of the relationship between quantities and ad valorem taxes
We assume that the second order conditions hold with non-negative prices and quantities, so that the equilibrium is characterized by first order conditions (2) and (3). To find how a higher value-added tax affects prices on the two sides of the market, we totally differentiate (2) and (3). This yields

\[ \pi_{aa} \frac{da}{dt} + \pi_{an} \frac{dn}{dt} = \left( \frac{1}{1+t} \right)^2 np_a^N \]
\[ \pi_{an} \frac{da}{dt} + \pi_{nn} \frac{dn}{dt} = \left( \frac{1}{1+t} \right)^2 \left( p^N + np_n^N \right) . \]

Making use of the first-order condition (3), the effect of the tax on quantities is now given by

\[ \frac{da}{dt} = \left( \frac{1}{1+t} \right)^2 \frac{\pi_{an} (1 + t) (ap_n^A - k_n) + \pi_{nn} np_n^N}{H} \tag{24} \]

and

\[ ^{18} \text{A proof of this is available from the authors upon request.} \]
\[
\frac{dn}{dt} = -\left(\frac{1}{1+t}\right)^2 \pi_{aa} (1 + t) \left(ap_n^A - k_n\right) + \pi_{an} np_a^N. \tag{25}
\]

Consequences of relaxing the assumption that \(\pi_{na} > 0\)

Differentiating equation (2) or (3) we find

\[
\pi_{an} = \frac{p_n^N + np_a^N}{1 + t} + p_n^A + ap_a^A - k_{an}. \tag{26}
\]

The cross derivative \(\pi_{an}\) measures how the marginal profitability of selling advertising space, \(\pi_a\), changes if the number of readers increases. In the main text we have assumed that \(\pi_{an} > 0\), but from (26) it is clear that \(\pi_{an} < 0\) if for instance \(k_{an}\) is sufficiently large (such that a higher newspaper circulation significantly increases the marginal costs of selling and producing ads).

Suppose that \(\pi_{an} < 0\) and \(p_n^N = 0\). From equation (5) we see that a higher ad valorem tax still increases sales of the newspaper and reduces the corresponding price if \(ap_n^A - k_n > 0\) : thus the media firm’s incentive to sell a larger number of newspapers in order to shift revenue to the advertising side is unaltered. However, from equation (6) we find that \(da/dt < 0\) if \(\pi_{an} < 0\).

If \(p_n^N < 0\), we know that there will be less advertising than the volume which maximizes profit on the advertising side of the market. If the ad valorem tax rate on sales of newspapers increases, the media firm will care less about the revenue it captures directly from the readers (independent of the sign of \(\pi_{an}\)). The second term in equation (7) shows that the media firm thereby tends to sell more advertising space if \(t\) increases. The higher output of ads in turn might make it optimal for the media firm to reduce newspaper sales if \(\pi_{an} < 0\), as shown by the second term in (8).

The case where \(p_n^N > 0\) has a similar interpretation. If consumers are ad lovers, the newspaper has more ads than the level that maximizes profit on the advertising side of the market. Independent of the sign on \(\pi_{an}\), the newspaper will therefore reduce the advertising level if \(t\) increases (\(da/dt < 0\)). However, a lower advertising level means that the marginal profit of selling
newspapers increases if \( \pi_{an} < 0 \), which induces the newspaper to sell more newspapers \( (dn/dt > 0) \).

The effects of assuming \( \pi_{an} < 0 \) when we consider specific taxes are analogous, and seen from equations (13) - (15).

References


