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Tax-free digital news?

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ABSTRACT

News platforms are struggling. Their printed readership is predominantly old, and their digital product struggles to win the attention of the young. For several decades tax reductions have been used in Europe to increase the circulation of printed newspapers. Would extending these reductions to digital platforms stimulate digital consumption? Using a two-sided pricing model where a print platform and a digital platform compete for multi-homing consumers and advertisers we show that the answer is no. The two-sidedness of the market means that the digital price would increase. Not only would digital circulation decrease but so too would the fraction of consumers that access news from both platforms. Key media policy goals of reach (circulation) and pluralism (multi-homing) would be harmed.

1. Introduction

For several hundred years newspapers have operated in a two-sided market selling news and commentary to readers and eyeballs to advertisers. The United Kingdom's

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Table 1
VAT Rates in selected European countries. Source: European Commission (2016a) and Statsministerens Kontor (2015).

	Standard rate	Printed newspaper	e-Newspaper
Austria	20%	10%	20%
Belgium	21%	6%	21%
France	20%	2.1%	2.1%
Germany	19%	7%	19%
Spain	21%	4%	21%
Norway	25%	0%	25% (pre 1/3/2016) 0%
UK	20%	0%	20%

first regular newspaper, The Daily Courant, was launched in 1702 and consisted of a single page of news with adverts on the back (Williams, 2009). For most of the time afterwards, and certainly since the early 19th century, newspapers have been seen as important for the health of democracy (Gentzkow et al., 2011).

Preferential tax treatment of printed newspapers is widespread, particularly in Europe as illustrated in Table 1.[1] In the UK and Norway, printed newspapers do not pay value added tax (VAT) on sales to readers.[2,3] The preferential treatment aims to increase circulation and ensure that people get information from several different sources (multi-homing in the two-sided market terminology).

The circulation of printed newspapers is shrinking rapidly, leading to questions over their future. For example, the reach of national printed newspapers in the UK decreased by more than a quarter between 2005 and 2015 (Ofcom, 2015). Circulation in Norway also fell by more than a quarter between 1999 and 2013.[4] In the UK The Independent has already ended its print edition, believing that it "will be the first of many leading newspapers to embrace a wholly digital future" (Lebvedev, 2016).

A key driver of the fall in the circulation of printed newspapers is the news consumption habits of the young. The young have always been less likely to buy a newspaper than the old, but readership of newspapers has fallen faster for the young. In 2005, national printed newspapers in the UK reached around 75% of those aged 65 or above and slightly under 70% of those aged between 15 and 34. By 2015, reach had fallen to around two thirds and one third respectively (Ofcom, 2015). The current situation in Norway is even more stark: In 2014, 82% of 67–79 year olds read a newspaper on an average day compared to 26% of those aged 16–24 (EFTA Surveillance Authority, 2016).

[1] In the US "Federal, state, and local governments have traditionally provided a variety of special economic supports to the industry, including exemptions from newspaper and advertising sales taxes and excise taxes on telecommunications equipment used for information gathering" (Picard, 2004).
[2] Value added refers to "the value that a producer.....adds to his raw material or purchases (other than labour) before selling the new or improved product or service" and can be calculated as the sum of wages and profits (Tait, 1988). Developed in France in the middle of the 20th Century VAT had become widespread by the turn of the millennium, particularly in Europe. For more on the theory, history and practical details of VAT, see Tait (1988).
[3] Since 1 March 2016 digital newspapers in Norway also do not pay VAT.
[4] Calculation by authors based on data presented in Statministerens Kontor (2015)

Given the frequent use of VAT policy to stimulate consumption of printed news and the increasing proportion of digital content that is placed behind a paywall, it is natural for policy makers to ask whether the VAT exemption should be extended to digital news. Member States of the European Union are prohibited by the VAT Directive from applying a beneficial rate to digital news.[5] However, the European Commission and the European Council are seeking to amend the VAT Directive and allow Member States the option to offer e-publications in each country the same tax rate as their printed counterparts (See European Commission (2016b, 2016c, 2016a); European Council (2017). Norway, a member of the European Economic Area (EEA)[6] but not of the European Union, is not constrained by the VAT Directive and was the first within the EEA to implement a zero tax regime for digital as well as printed news.[7]

In the State aid approval of the Norwegian zero-tax regime towards digital news, EFTA Surveillance Authority (2016) noted (page 13): "*The main objective of the proposed zero VAT rate is to support the demand and use of news and current affairs content among consumers, thereby also promoting media pluralism and diversity. This requires instruments aimed at consumers. Reducing the cost of electronic news services is a direct and effective means of ensuring high news consumption and thereby a broad and enlightened public discourse.*" Furthermore, the following concern of the Norwegian government was accentuated (EFTA Surveillance Authority (2016), page 12): *"the existing zero VAT rate for newspapers primarily supports the media consumption of the middle-aged or elderly."*

Against this backdrop, our research question is:

- Does reducing VAT on digital news reduce the price of digital news and stimulate digital news consumption?

Surprisingly, the answer is no. If the VAT exemption is extended to digital platforms then the price towards digital readers increases. Demand for the digital platform decreases, as does the fraction of consumers getting information from different sources (multi-homing).

The departure from the standard intuition is driven by the presence of the ad market. A lower tax rate on the digital product increases the profitability of the reader market for the platform, but has no direct effect on the advertising market. This means that the digital platform will place more weight on reader market profits and less weight on advertising market profits; it becomes more important to set a relatively high subscription price and boost reader margins despite the consequent reductions in readership and ad revenues.

Naturally, the profit of the digital platform increases following a reduction of VAT on digital subscriptions. But, surprisingly, the profit of the printed platform also increases.

[5] This restriction has not prevented some Member States from reducing VAT on electronic newspapers. As can be seen in Table 1 France uses a lower rate. Belgium, Luxembourg and Italy have all offered lower than standard VAT rates on electronic newspapers at some point.

[6] The EEA comprises the Member States of the European Union and three non members: Iceland, Liechtenstein, and Norway.

[7] In Iceland newspapers are taxed at a reduced rate of 11%, whilst the rate in Liechtenstein is 2.5%.

So, tax-free digital news may help the survival of print newspapers, albeit at the expense of reduced online readership.

Our model is based upon Hotelling (1929); the dominant workhorse for analysing two-sided media markets (the seminal contribution is Anderson and Coate (2005). We allow for asymmetric platforms with respect to tax rates and marginal costs. The digital platform has lower marginal costs and, at the outset, a higher (standard) tax rate than the print platform. Our model incorporates two-sided pricing; both platforms sell subscriptions to consumers and eyeballs to advertisers. We start by recognising the reality that consumers have long bought more than one newspaper.[8] Thus we allow multi-homing by both consumers and advertisers.

To our knowledge, we are the first to assess the reaction to tax changes by two-sided duopolists facing multi-homing consumers (consumers that are "shared" between each platform). As well as being a significant measure of media pluralism, multi-homing by consumers has important implications for competition between platforms. When all consumers buy only one product (they each single-home or are "exclusive" to a platform), the "competitive bottleneck" problem of Armstrong (2002, 2006) exists: since an exclusive reader can only be accessed through the platform from which she purchases there is no direct competition for advertisers among platforms. Recent contributions by Athey et al. (forthcoming), Ambrus et al. (2016) and Anderson et al. (2018) introduce competition for advertisers by allowing consumers to multi-home.

We combine ingredients from Anderson et al. (2018), which considers multi-homing consumers in a pure ad-financed two-sided market, and Anderson et al. (2017), which considers multi-homing consumers in a one-sided user financed market. These ingredients are used to extend the simple single-homing model with dual source financing (two-sided pricing) of Anderson and Gabszewicz (2006). Despite the many components we construct a simple model to highlight the core mechanism driving our results: the two-sidedness of the market.

There are papers assessing the impact of VAT on price in two-sided markets with a monopolist platform (Kind et al., 2008), with duopolists (Kind et al., 2013) and with perfect competition (Kind et al., 2008). An important limitation of these models is that, even when there is more than one platform, consumers are assumed to single-home. Platforms are also assumed to have symmetric cost structures. We relax both these assumptions.

We also extend our model to the pure single-homing consumer case, for two reasons. First, we show that this might be the outcome of a VAT reduction in our model. It is possible that reducing VAT on digital news could increase the digital price to the extent that no consumer buys both products. Second, previous investigations of the reaction to tax changes by two-sided duopolists facing single-homing consumers have been location games. In those papers reduced tax rates have increased reader prices through increased

[8] American survey data from 1917 to 1919 showed that 15% of households who reported reading a daily newspaper reported reading two or more (Gentzkow et al., 2014), but the digitisation of news has increased the prevalence of multi-homing (see Athey et al., forthcoming and Peitz and Reisinger (2015)).

horizontal differentiation. In our pure single-homing model we find the same inverse relationship between tax rates and prices without any change in horizontal differentiation.

In Sections 2 and 3 we present the foundations and findings of our model with shared consumers (multi-homing). In Section 4 we investigate the case when there are only exclusive consumers (single-homing). In Section 5 we discuss the robustness of our main results. We summarise and discuss our results in Section 6.

2. The model

Consider two competing media platforms; one producing a printed newspaper, and the other a digital newspaper. The digital platform (D) has marginal costs equal to $c_D \geq 0$, while the print platform (P) faces a marginal cost equal to $c_P > 0$. Throughout we assume $c_P > c_D$.[9] In the basic model we set $c_D = 0$, while in Section 5 we allow for $c_D > 0$. We abstract from any fixed costs. The tax rate (VAT) on subscriptions for each platform is τ_i, where $i = D, P$. The platforms are located at the extremes of a "Hotelling line" with length 1. Platform D is at the far left and platform P at the far right. Platforms sell subscriptions at price p_i to consumers and eyeballs to advertisers. This implies that the consumers pay p_i and platforms receive $\frac{p_i}{1+\tau_i}$. We specify ad prices below.

Consumer (reader) tastes are uniformly distributed along the line. We may interpret the horizontal differentiation as age. Young people to the left, old people to the right. Consistent with empirical studies of the US newspaper market (Gentzkow, 2007; Fan, 2013), and Gentzkow et al. (2014)) we assume that consumers are ad-neutral.[10] In Section 5 we consider the outcome when consumers dislike ads. The distance disutility (transportation costs) is given by t.

Remark (one-sided market): Marginal costs are approximately equal to zero for digital goods (e.g. e-books). It is well known from the tax literature that such a cost structure implies that VAT acts as a pure surplus tax with no impact on consumer prices in one-sided markets. To see this, consider the zero marginal cost profit function $\pi = \frac{p}{1+\tau}x(p)$, where $x(p)$ is the demand function. The tax rate τ clearly drops out of the first-order condition $\partial\pi/\partial p = 0$, so that it only affects the 'profit-split' between the firm and the government. This insight provides us with a clear benchmark in the two-sided markets we analyse.

2.1. Consumer demand

Let the consumer utility of buying from only platform D or only platform P be

$$u_D = v_D - tx - p_D \text{ and} \tag{1}$$

$$u_P = v_P - t(1-x) - p_P, \tag{2}$$

[9] We also use D and P to refer to the digital and printed product, respectively.

[10] See Chandra and Kaiser (2015) for a comprehensive survey of the literature on consumers' attitude towards ads in newspaper markets.

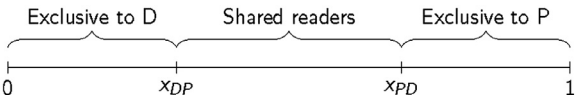

Fig. 1. Shared and exclusive readers.

respectively, where v_i is the vertical quality of platform i, p_i is the subscription fee and x is the location of the consumer.

The utility of a consumer who buys both products is the sum of individual utilities less any utility loss due to overlap:[11]

$$u_{(D+P)} = u_D + u_P - d. \tag{3}$$

We follow the essence of Anderson et al. (2017) and say that consumers with $u_D > u_P$ perceive D as their primary good and P as their secondary good. A consumer will buy both products if the incremental utility of multi-homing is positive,[12] where her incremental utility of multi-homing is specified as $u_{(D+P)} - \max[u_D, u_P]$. To find the location of the consumer indifferent between buying only D and buying both D and P we set $u_{(D+P)} - u_D = 0$ and solve for x, yielding

$$x_{DP} = 1 - \frac{v_P - p_P - d}{t} \tag{4}$$

where we implicitly assume that $t > v_P - p_P - d > 0$.

Likewise the location of the consumer who is indifferent between buying only P and buying both P and D is

$$x_{PD} = \frac{v_D - p_D - d}{t}. \tag{5}$$

Fig. 1 identifies those consumers who buy only D, those who buy both D and P and those who buy only P.

Under multi-homing, consumer demand at each platform is

$$X_D^{MH} = \underbrace{x_{DP}}_{\substack{\text{D's exclusive}\\ \text{readers}}} + \underbrace{(x_{PD} - x_{DP})}_{\substack{\text{shared}\\ \text{readers}}} = x_{PD} \tag{6}$$

$$X_P^{MH} = \underbrace{1 - x_{PD}}_{\substack{\text{P's exclusive}\\ \text{readers}}} + \underbrace{(x_{PD} - x_{DP})}_{\substack{\text{shared}\\ \text{readers}}} = 1 - x_{DP}. \tag{7}$$

[11] We are grateful to Paul Belleflamme and the Editor for specifying this formulation. Our qualitative findings hold for other formulations, including when the utility "loss" from the incremental purchase is proportional to the sum of vertical qualities and when the "loss" is proportional to the vertical quality of the secondary product (as in Anderson et al. (2017)).

[12] In our model consumers who buy both products are those in the middle of the Hotelling line, their distaste for either publication is not "too" strong.

Demand for each newspaper is strictly decreasing in own price ($\partial X_i^{MH}/\partial p_i = -1/t$).[13] The number of exclusive readers for each newspaper is, however, independent of the price it charges. This is because we have assumed that all consumers read at least one newspaper. A newspaper's number of exclusive readers is therefore determined by, and more precisely, is inversely related to, the demand for the other newspaper. Since an increase in p_i does not affect the incremental value of newspaper j (leaving demand for that newspaper unchanged), it cannot affect newspaper i's number of exclusive readers either. This partly reflects the peculiarities of the Hotelling model and our specific assumptions, but does not qualitatively affect the results we derive below (see Section 5.1 for a discussion).

2.2. Platforms and advertisers

Both platforms can costlessly place commercials in their newspaper. As in Anderson et al. (2018) we assume that platforms set a price per ad, and that advertisers only place one advert per platform. We assume a perfectly elastic demand curve for ads, with a mass A of homogenous advertisers.

The expected value for an advertiser of reaching a reader who sees the ad on one and only one of the platforms is equal to β. This value reflects the advertiser's profit margin and the proportion of consumers who, on seeing the ad for the first time, buy the product. As in Anderson and Coate (2005) the platforms are able to extract all the advertisers' surplus from exclusive consumers. We allow for the second impression to be worth less than the first. Thus the expected value to an advertiser of a consumer seeing his advert twice is $\beta(1+\sigma)$, with $\sigma\epsilon(0,\,1]$.

To specify the equilibrium price per advert we use the principle of incremental pricing as developed in Anderson et al. (2018), i.e. prices at a given platform will be determined by the incremental value to an advertiser of advertising on that platform. This prevents either platform from charging more than σb for its shared consumers. The price per ad at platform i will therefore be $a_i = \beta X_i^e + \sigma\beta X^s$, where X_i^e is platform i's exclusive consumers and X^s represents the number of consumers that purchase both products.[14] Total ad revenues at platform i will be $A(\beta X_i^e + \sigma\beta X^s)$ or $bX_i^e + \sigma bX^s$, using the identity $b \equiv A\beta$.

Table 2 compares the values, incremental values and prices for a platform's single-homing and multi-homing consumers.

Our model set-up allows for multi-homing consumers, asymmetric platforms with respect to marginal costs and tax rates, as well as two-sided pricing (platforms charge both

[13] For instance, a higher price on the digital newspaper moves x_{PD} to the left (which implies that a larger share of the consumers will read only the printed newspaper).

[14] To fix ideas consider a numerical example. Let the value of a first impression (β) be 0.9 and the value of a second impression ($\sigma\beta$) be 0.36. The mass of consumers is normalised to 1. Furthermore, let 20% of consumers buy exclusively from the printed firm, 30% exclusively from the digital firm and 50% from both. Then the per advert prices under incremental pricing will be $a_D = 0.9 * 0.3 + 0.36 * 0.5 = 0.45$ and $a_P = 0.9 * 0.2 + 0.36 * 0.5 = 0.36$. A subscription fee decrease at the printed firm that led to 60% of consumers buying from both firms and the remaining 40% exclusive consumers split equally would lead to the symmetric per advert prices: $a_D = a_P = 0.9 * 0.2 + 0.36 * 0.6 = 0.396$.

Table 2
Advertising values for exclusive and shared consumers.

	Exclusive consumer	Shared consumer
Value to advertiser	β	$\beta(1+\sigma)$
Incremental value to advertiser	β	$\sigma\beta$
Incremental price	β	$\sigma\beta$
Advertiser Surplus	0	$\beta(1+\sigma)-2\sigma\beta=\beta(1-\sigma)$

consumers and advertisers). Given this complex set up, for the sake of simplicity, we search for Nash equilibria in a setting where platforms set prices for readers and for ads simultaneously.

3. Multi-homing consumers

When some consumers buy both products, the platforms face the following profit functions:

$$\pi_D = \frac{p_D}{1+\tau_D} X_D^{MH} + bX_D^e + \sigma b X^s \text{ and} \tag{8}$$

$$\pi_P = \left(\frac{p_P}{1+\tau_P} - c_P\right) X_P^{MH} + bX_P^e + \sigma b X^s, \tag{9}$$

where the first terms represent reader market profit and the second and third terms represent ad market profits. Note that in a one-sided market ($b=0$), τ_D would act as a pure surplus tax since marginal costs on the digital newspaper are zero (see Remark above).

Using (6) we can rewrite (8) to separate profit from exclusive and shared consumers

$$\pi_D = \left(\frac{p_D}{1+\tau_D} + b\right) X_D^e + \left(\frac{p_D}{1+\tau_D} + \sigma b\right) X^s,$$

and write the first order condition for the digital platform as

$$\frac{d\pi_D}{dp_D} = \left[\frac{X_D^e + X^s}{1+\tau_D} + \frac{p_D}{1+\tau_D}\frac{\partial X^s}{\partial p_D}\right] + \sigma b \frac{\partial X^s}{\partial p_D} = 0 \tag{10}$$

Raising p_D has the standard effect on reader market profitability. It increases the profit margin but reduces sales. If there were no ads in D (in which case we would have a one-sided product), profit maximization dictates that the term in the square bracket of (10) should be set to zero (marginal revenue equal to marginal cost, which is zero). However, the term outside the bracket is negative when second impressions have a positive value, showing that $D's$ optimal two-sided price is lower than its optimal one-sided price.[15] This is due to the fact that the increased advertising profits gained from selling eyeballs (alongside the additional reader sales) exceed the foregone margin on existing consumers.

[15] Since $\frac{\partial X^s}{\partial p_D} < 0$ and $\sigma b > 0$. To see the former substitute (4) and (5) into $X^s = x_{PD} - x_{DP}$.

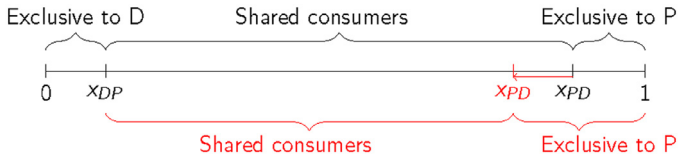

Fig. 2. Effect of a digital price rise on reader demands.

Note that $D's$ marginal consumers are the ones it shares with P. While a small price rise will reduce the surplus of infra-marginal customers (including exclusive consumers) the only consumers that will stop buying D are those buying it as a secondary product, in other words for its incremental value, as Fig. 2 shows. Mathematically, raising p_D reduces x_{PD} but has no effect on x_{DP}.

A lower tax rate on the digital product increases the profitability of the reader market for the platform, but has no direct effect on the advertising market. This means that the digital platform will place more weight on the term in the square bracket of (10) compared to the term outside; it becomes more important to set a relatively high subscription price and boost reader margins despite the consequent reductions in readership and ad revenues. In contrast to typical results in one-sided markets, we might therefore expect the consumer price to be decreasing in the tax rate, other things being equal. This is confirmed by solving (10) to find the digital platform's reaction function

$$p_D(\circ) = \frac{v_D - d - \sigma b(1+\tau_D)}{2} \tag{11}$$

from which we immediately see that $\frac{\partial p_D(\circ)}{\partial \tau_D} = -\frac{\sigma b}{2}$. Furthermore, we observe that the size of the price change depends on the (incremental) value of the shared consumers on the advertising market. The reason for this is, as noted above, that the platform can only affect the number of shared readers - and not the number of exclusive readers - through its pricing behaviour.

Note also that $p_D(\circ)$ is independent of p_P. The intuition is that a consumer who is considering purchasing D as a secondary product, will only consider the price of D. Prices are thus strategically independent. See Anderson et al. (2017) for a further discussion of this issue.

The reaction function of the printed platform is qualitatively similar:

$$\frac{d\pi_P}{dp_P} = \left[\frac{X_P^e + X^s}{1+\tau_P} + \left(\frac{p_P}{1+\tau_P} - c_P\right)\frac{\partial X^s}{\partial p_P}\right] + \sigma b \frac{\partial X^s}{\partial p_P} = 0$$

yielding the best response function

$$p_P(\circ) = \frac{v_P - d - (b\sigma - c_P)(1+\tau_P)}{2}. \tag{12}$$

This shows that the subscription price of platform P is decreasing in its own tax rate if $\sigma b > c_P$ or when the value on the ad market of reaching a multi-homing consumer exceeds the marginal cost of producing an extra copy.

Since prices are strategically independent, reaction functions (11) and (12) are also equilibrium values.[16] A further important implication of price independence is that the tax rate on one platform has no effect on the price of the other platform.

It is noteworthy that for sufficiently valuable ad markets, equilibrium subscription prices at either or both platforms could in principle be negative. We restrict our attention to cases where prices are positive.[17] An important reason to abstract from negative prices is that pure negative prices are rarely observed in practice, although often there may be complimentary gifts or other exclusive offers for subscribers. It is possible that the platforms would prefer to have negative prices irrespective of the VAT rate they face but are unable to feasibly implement this. In this situation the price would remain stable at zero.

Summing up the above analysis we can state:

Proposition 1. *The price of the print platform is independent of the tax rate on the digital platform, and vice versa. Suppose that there is a decrease in the tax rate on*

a) The digital platform. Then own price will increase if second impressions have any incremental value ($\sigma b > 0$).
b) The print platform. Then own price will increase if the incremental value of second impressions is worth more per consumer than the marginal cost of printing an extra copy ($\sigma b - c_P > 0$).

This proposition could also be worded that own prices decrease in own tax rates as long as the advertising value to the platform of a shared consumer exceeds that platform's marginal cost.

One might expect that due to price independence, the tax rate on one platform does not affect the profits of the other. Interestingly, this is not true. Suppose that τ_D increases. This will not affect the price (p_P) or total demand ($X_P^{MH} = 1 - x_{DP}$) for the print platform, but will affect its composition of exclusive ($X_P^e = 1 - x_{PD}$) and shared readers ($X^s = x_{PD} - x_{DP}$). Inserting for (4), (5) and (12) into (8) and differentiating π_P with respect to τ_D yields

$$\frac{d\pi_P}{d\tau_D} = b\frac{dX_P^e}{d\tau_D} + \sigma b\frac{dX^s}{d\tau_D}.$$

The digital platform will charge a higher subscription price if its tax rate, τ_D, decreases. As Fig. 2 illustrates, the total demand for P is unaffected, but some consumers who previously bought both products will now only buy P. The increase in the digital price has "converted" some of $P's$ shared consumers into exclusive consumers.[18] This conversion will not affect the print platform's reader market profit, as its reader price and total demand are unchanged but its advertising market profit will

[16] The second-order condition is $\frac{d^2\pi_i}{dp_i^2} = -\frac{2}{t(1+\tau_i)} < 0$.
[17] Specifically we assume $v_D > d + \sigma b(1+\tau_D)$ and $v_P > d + (b\sigma - c_P)(1+\tau_P)$.
[18] The increase in exclusive consumers is $\frac{dX_P^e}{d\tau_D} = \frac{\sigma b}{2t}$.

increase. Exclusive consumers are worth more on the ad market than shared consumers so the print platform will increase the price of its ads, a_P. We consequently find that $\frac{d\pi_P}{d\tau_D} = -\frac{\sigma b}{2t}(b - \sigma b) = -\frac{b^2\sigma(1-\sigma)}{2t} < 0$. A lower digital tax rate increases the printed platform's profit.

For the digital platform we likewise find $\frac{d\pi_D}{d\tau_P} = -\frac{b(b\sigma - c_P)(1-\sigma)}{2t}$ which is negative if $b\sigma > c_P$. Under this condition a lower tax rate τ_P increases p_P and we have the same mechanism. We can state:

Proposition 2. *The print platform's profit decreases in the tax rate of its rival ($\frac{d\pi_P^{MH}}{d\tau_D} < 0$). The digital platform's profit decreases in the rival's tax rate if $b\sigma > c_P$.*

From a media pluralism perspective, a major rationale for preferential tax treatment of newspapers has been to increase their circulation and to ensure that people get information from several different sources (multi-homing, in our terminology). This may be important for e.g. democratic processes, knowledge spillovers and anti-bias measures. We will not go into these rationales, but note that the number of multi-homers is equal to

$$X^s = x_{PD} - x_{DP} = \frac{(v_P + v_D) + b\sigma(1 + \tau_D) - (c_P - b\sigma)(1 + \tau_P) - 2d}{2t} - 1, \qquad (13)$$

from which it immediately follows that:

Proposition 3. *Reducing the tax rate on the digital platform (τ_D) decreases the number of multi-homing consumers. Reducing the tax rate on the print platform (τ_P) decreases the number of multi-homers if the incremental value of a multi-homing consumer is larger than the print platform's marginal cost ($b\sigma > c_P$).*

We also observe from (13) that the comparative statics of the number of shared readers are intuitively reasonable. The number of shared readers is increasing in the value of second impressions ($b\sigma$) and is decreasing in the strength of horizontal preferences (t), the amount of overlap (d) and the printed platform's marginal cost (c_P).

Fig. 3 shows a numerical example where we set $\tau_P = 0$ and vary τ_D.[19] With a tax rate of 25%, as Norway used to have, 2.0%of readers are shared. A tax rate of 20% as in the UK, implies 1.3% of readers are shared. Reducing the tax rate for the digital platform below 10% implies that there would only be exclusive consumers. In the absence of shared consumers, the nature of competition between the two platforms changes significantly. We investigate this in Section 4.

The logic of two-sided markets, as described above, clearly indicates that subsidising newspapers through reduced value-added taxes might be an ineffective or even counterproductive means to increase newspaper circulation.

[19] The other parameters are $v_D = v_P = 0.9, c_P = 0.3, t = 0.55, b = 0.55, \sigma = 0.26, d = 0.35$.

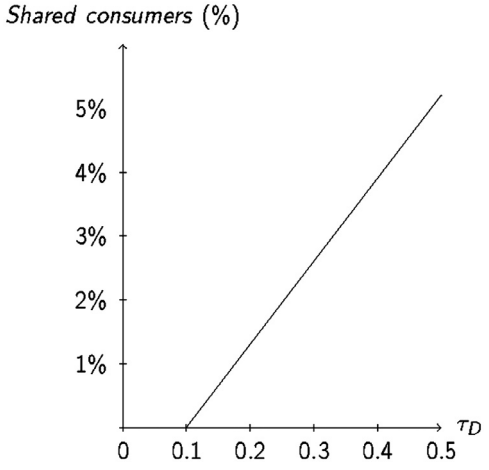

Fig. 3. Impact of the digital tax rate on the number of shared consumers.

Before we proceed to a single-homing environment, we note a more positive insight from the analysis above. A public policy which contributes to higher media quality (an increase in v_i) could be an effective way to increase multi-homing (despite higher newspaper prices) as well as being a political goal in its own right. More precisely, from Eqs. (11), (12) and (13) we observe:

Proposition 4. *Assume that media quality improves (v_D and v_P increase). Then subscription prices and the extent of multi-homing increase.*

Rather than lowering the tax rate on digital platforms (which would lead to a higher digital price but lower circulation), governments could for instance subsidise journalism to ensure both higher media quality and larger newspaper circulation.

4. Single-homing consumers

In the previous section we observed the possibility that no consumers multi-home (e.g. due to low VAT rates, as illustrated in Fig. 3). Furthermore, in the introduction we noted that the previous literature on tax in two-sided markets has followed the Hotelling convention of assuming that each consumer buys a maximum of one product. We now extend the "pure single-homing" literature by assessing asymmetric platforms.

Suppose that the market is shared and each consumer buys one and only one of the media products.[20] Consumer demands resemble the standard Hotelling set-up: $X_i^{SH} = \frac{1}{2} + \frac{v_i - v_j}{2t} - \frac{p_i - p_j}{2t}$.[21] Using a similar methodology to that used in Section 3 we can derive

[20] Consumers will choose D or P to maximise (1) or (2). The market is covered iff $t \leq \frac{1}{3}(v_D + v_P + 2b + b(\tau_D + \tau_P) - c_P(1 + \tau_P))$. The market sharing condition is $t > \max[\frac{1}{3}(v_D - v_P + b(\tau_D - \tau_P) + c_P(1 + \tau_P)), \frac{1}{3}(v_P - v_D - b(\tau_D - \tau_P) - c_P(1 + \tau_P))]$.

[21] See the Appendix for full details.

the digital platform's reaction function:

$$p_D(\circ) = \frac{t + v_D - v_P - b(1+\tau_D)}{2} + \frac{p_P}{2}. \tag{14}$$

Eq. (14) shows that D's reaction function shifts up if its tax rate is reduced. As in the multi-homing case it is optimal for D to shift profit from the advertising side to the consumer side by increasing the reader price. As in the multi-homing case, the price increase will be greater the greater the per-reader advertising revenue.[22]

Following the same process for the printed platform yields the best response function

$$p_P(\circ) = \frac{t + v_P - v_D - (b - c_P)(1+\tau_P)}{2} + \frac{p_D}{2}. \tag{15}$$

Also the print platform will respond to a low tax rate on its reader revenues with high reader prices if the value on the advertising market of an extra reader is greater than its marginal cost.

From the response functions we note that prices are strategic complements, so that they tend to move in tandem in response to changes in exogenous variables (e.g. in tax rates). Combining (14) and (15) we find the equilibrium prices:

$$p_D^{SH^*} = t + \frac{(v_D - v_P) - 2b(1+\tau_D) - (1+\tau_P)(b - c_P)}{3} \text{ and} \tag{16}$$

$$p_P^{SH^*} = t + \frac{(v_P - v_D) - 2(1+\tau_P)(b - c_P) - b(1+\tau_D)}{3}. \tag{17}$$

Summing up:

Proposition 5. *Single-homing. Suppose that there is a reduction in the tax rate on*

a) The digital platform. Then both platforms will increase consumer prices.

b) The print platform. Then both platforms will increase consumer prices if $b > c_P$. *Both will decrease consumer prices if* $b < c_P$.

It is straight forward to see that profit is strictly decreasing in own tax rate (see Appendix). Interestingly, the multi-homing result in Proposition 2, that even a completely non-altruistic newspaper might find it optimal to lobby for a reduction of the tax rate paid by its rival, survives also under single-homing. In the multi-homing case this was due to competition in the advertising market, while it is due to competition in the reader market under single-homing. More precisely, if platform i responds to a tax reduction by increasing its price under single-homing, platform j will capture a larger number of readers (and charge a higher price, since prices are strategic complements) and thus make higher profits from both reader and advertiser markets.

[22] For clarity, note that under pure single-homing all readers are exclusive and so all readers have the same value on the ad market.

We can state:

Proposition 6. *Single-homing. Profit is decreasing in own tax rate. The profit of the print platform is, moreover, decreasing in the tax rate of its digital rival. The profit of the digital platform is decreasing in the print platform's tax rate if both prices decrease in that tax rate.*

There have been some concerns that differences in tax rates between print and digital platforms have led to artificial differences in circulation. This might be correct, but perhaps not in the generally perceived direction. Eqs. (16) and (17) show that reducing the digital tax rate leads to higher prices at each platform but that the price increase is larger at the digital platform. The relative price increase has the intuitive effect of increasing printed sales at the expense of digital sales:[23]

Proposition 7. *Single-homing. Reducing the tax rate on the digital platform (τ_D) will increase sales of printed newspapers and reduce sales of digital newspapers.*

5. Robustness

5.1. Uncovered markets

For simplicity, we have chosen a framework such that the number of exclusive readers in the multi-homing case is independent of own price (c.f. the discussion below Fig. 1). In a more general model, where the supply of exclusive readers is elastic, a price decrease at firm i could win it some exclusive consumers in addition to converting some of $j's$ exclusive consumers into shared ones. Our qualitative result of a negative relationship between VAT rates and reader prices would be unaffected by such a change. The core requirement for this finding is that a platform's ad revenues are increasing in readership; whether readership increases come from exclusive or shared consumers does not matter. If this positive indirect network externality is present, then a firm can respond to a VAT increase on the reader market by reducing the subscription fee, increasing readership and increasing ad market profits.

5.2. Disutility of ads

Above we assumed that consumer utility is unaffected by the volume of ads. Now we allow for consumer disutility of ads; platforms need to weigh the ad market benefits of an additional advert against the negative reader market impact of a less attractive product. We normalise the mass of advertisers to 1, and platform i chooses an ad level $A_i \in [0, 1]$.

[23] Full detail in the Appendix. As the profitability of digital newspapers increases with a digital tax reduction, it is possible that some of the reduction in digital circulation would be offset by new entry of digital newspapers. This is not considered in our model.

We provide full details of the model in the Appendix. The key difference is that now the utility of buying only from platform i for a consumer located at point x is given by $u_i = v_i - t|x - x_i| - p_i - \gamma A_i^2$, where $x_D = 0$, $x_P = 1$, and $\gamma > 0$. The utility of buying from both platforms is still $u_{(D+P)} = u_D + u_P - b$ and the incremental utility of multi-homing is specified as $u_{(D+P)} - \max[u_D, u_P]$. We start with the multi-homing model and follow the same methodology as in Section 3.[24] We identify the following equilibrium outcomes at the digital firm[25]

$$p_D = \frac{v_D - d}{2} - \frac{3b^2(1+\tau_D)^2}{8\gamma} \text{ and } A_D = \frac{b(1+\tau_D)}{2\gamma}.$$

The ad level is increasing in the value of the ad market and decreasing in consumer's distaste for ads ($dA_D/d\gamma < 0$).[26] The reader price is decreasing in the value of the ad market ($dp_D/db < 0$) and increasing in consumer's distaste for ads ($dp_D/d\gamma > 0$). The intuition for the latter is that since higher disutility of ads reduces the ad volume, the willingness to pay for the newspaper increases. More interesting for our point of view, is the fact that we still have that the reader price is decreasing in own VAT rate ($dp_D/d\tau_D < 0$).

For the printed platform we find[27]

$$p_P = \frac{v_P - d}{2} - \frac{3b^2(1+\tau_P)^2}{8\gamma} + \frac{c_P(1+\tau_P)}{2} \text{ and } A_P = \frac{b(1+\tau_P)}{2\gamma}.$$

As in the analysis above, we immediately see that the printed newspaper price is decreasing in own VAT if the value of the advertising market is sufficiently large compared to marginal costs. The results in Section 3 were thus not driven by the assumption that readers are indifferent to the ad level.

With single-homing, as with ad neutrality, simulations show that the digital platform responds by increasing its subscription price if the VAT is reduced (and it will reduce the number of ads it sells when consumers dislike ads). It is also still the case that the printed platform responds by increasing its reader price.

5.3. Positive marginal cost at the digital platform

Another simplification we have made is setting the digital platform's marginal cost to zero. This can easily be relaxed. Let the digital platform face a marginal cost c_D,

[24] We focus here on the case when $\sigma = 1$ to achieve tractable solutions. In the Appendix we use numerical methods to relax this assumption. Our principle finding (Proposition 1) is maintained, although our findings on the relation between digital tax rates and the extent of multi-homing and printed profitability are more ambiguous. Full results and intuition are in the Appendix.

[25] At this point we have $\frac{d^2\pi_D}{dp_D^2} = -\frac{2}{t(1+\tau_D)} < 0$, $\frac{d^2\pi_D}{dA_D^2} = -\frac{1}{4t(1+\tau_D)}\left(9b^2(\tau_D+1)^2 + 4\gamma(v_D - d)\right) < 0$ and $\frac{d^2\pi_D}{dp_D^2}\cdot\frac{d^2\pi_D}{dA_D^2} - \left(\frac{d^2\pi_D}{dp_D dA_D}\right)^2 = \frac{b^2}{2t^2} + \frac{4\gamma(v_D-d)}{2t^2(1+\tau_D)^2} > 0$.

[26] We have then implicitly assumed that $A_D < 1$, which amounts to requiring that $\gamma > \frac{b(1+\tau_D)}{2}$. For lower values of γ we can trivially set $A_D = 1$.

[27] At this point we have $\frac{d^2\pi_P}{dp_P^2} = -\frac{2}{t(1+\tau_P)} < 0$, $\frac{d^2\pi_P}{dA_P^2} = -\frac{1}{4t(1+\tau_P)}(9b^2(1+\tau_P)^2 - 4\gamma c_P(1+\tau_P) + 4\gamma(v_P - d))$ and $\frac{d^2\pi_P}{dp_P^2}\cdot\frac{d^2\pi_P}{dA_P^2} - \left(\frac{d^2\pi_P}{dp_P dA_P}\right)^2 = \frac{1}{2t^2(1+\tau_P)^2}\left(b^2(1+\tau_P)^2 - 4\gamma c_P(1+\tau_P) + 4\gamma(v_P - d)\right)$. A necessary and sufficient condition for the second-order conditions to hold is therefore $c_P < \frac{v_P - d}{(1+\tau_P)} + \frac{b^2(1+\tau_P)}{4\gamma}$.

where $c_P > c_D > 0$. The core mechanism underlying Propositions 1 and 5 remains, although now the directional findings are caveated. Mirroring the caveated findings for the printed paper in the main analysis with multi-homing we find that digital prices reduce with higher digital tax rates if the incremental value per consumer of second impressions is higher than the marginal cost of producing an extra copy $(\sigma b > c_D)$. If there is a reduction in the tax rate on the digital platform under single-homing, both platforms will increase consumer prices if $b > c_D$ and both will decrease consumer prices if $b < c_D$ (see the Appendix).

6. Conclusion

We have assessed the impact of VAT policy in a two-sided market with asymmetric news platforms. Reducing the tax rate on digital subscriptions increases the profitability of the digital platform's reader market, but has no direct effect on the advertising market. The downward pressure on the digital subscription price exerted by the ad market is reduced and the price increases. Digital consumption decreases.

This intriguing finding does not depend on whether consumers multi-home. With shared consumers, reader prices are strategically independent, while they are strategic complements when consumers single-home. Both situations yield the same inverse relationship between the tax rate on digital subscriptions and the digital price.

Nor do our results hinge on the asymmetry of costs or tax rates. The models we provide can easily assess the impact of tax on two horizontally differentiated digital platforms by using a common tax rate and setting the marginal cost of the printed platform to zero. The inverse relationship between the tax rate and subscription prices holds.

To highlight the underlying mechanisms we assumed consumers were ad neutral in the main analysis. In Section 5 and the Appendix we showed that this assumption was not crucial for our core result.

Our model suggests an interesting relationship between two media policy goals. We have seen that reducing tax rates on digital news can reduce the degree of multi-homing and harm the media policy goal of pluralism. We note that in a more general setting the increased profitability stemming from the reduced tax rates could stimulate entry. Thus, in a two-sided market VAT reductions could still support a media policy aiming to increase media diversity, albeit by harming media pluralism. We leave formal analysis of this trade-off to future research.

The predictions of the model presented here are strikingly different from the intuition of many policy makers and economists. In Europe, this would matter little if the straight jacket of the VAT Directive was to be maintained. But the European Commission has committed to reforming the restrictive VAT Directive and extending VAT reductions to digital newspapers and ebooks (European Commission, 2016b; 2016c) and the European Council expects agreement in the second half of 2017. Norway has already reduced the

VAT rate on digital newspapers to zero assuming that reader prices will decrease. Our results predict the opposite effect.

For printed newspapers, empirical investigation would be particularly useful to identify whether ad market profits exceed variable costs or whether the incremental advertising profit from an extra reader exceeds the marginal cost of reaching that reader. The existence of free newspapers suggests the former holds and when the latter holds our results would question the effectiveness of the existing beneficial tax rates for printed newspapers. Although too late for the European debate, careful empirical investigation of the VAT change for electronic newspapers in Norway could test our theoretical predictions.

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Supplementary material

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