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ABSTRACT

Combining comprehensive data from the Norwegian media market on newspaper circulation, readership, revenues, factor inputs, and product characteristics with plausibly exogenous variation in the availability and adoption of broadband internet, this paper provides causal evidence on how the internet affected the traditional print media market. Household adoption of broadband internet triggered large reductions in print readership and circulation and equally large increases in online news readership. Despite strong substitution from print to online news consumption, newspaper firms' revenues fell by almost 30%. Newspaper firms responded by dramatically cutting costs, either by shedding labor inputs or by reducing the physical size of newspaper sheets, and in doing so avoided meaningful losses in profits. The printed newspaper product available to customers also changed, as newspapers shifted content away from tabloid to more serious news. This paper offers a case study on how an adverse technology shock transmits through firms with multiple margins of adjustment, and provides an explanation for the economic resilience of newspapers.

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1 Introduction

The adoption of new technology often generates bold predictions of rapid demise of existing media products. However, existing media have time and again proved remarkably resilient, raising questions about how firms respond to new technology and whether their products are, or can be made, complements rather than substitutes to new technology. For instance, music sales continued to increase after radio broadcasting began; and radio kept prospering after the launch of television.[1] With the expansion of broadband internet, social commentators and industry experts claimed this time is different: Print newspapers suffer declining readership and revenue because high-speed or broadband internet facilitates online media consumption without excessive waiting time. Yet, there is little causal evidence to substantiate this claim, and print media has been in decline for a lot longer than the internet has been a popular source of media consumption (Gentzkow, 2014).

Estimating how household adoption of new technology, such as broadband internet, affects existing media products has proven challenging for several reasons. It is often difficult to access household data on technology adoption which can be linked with information for a representative set of media firms about their output, revenues, factor inputs, and product characteristics.[2] Another key challenge is to separate true substitutability or complementarity between new technology and existing media products from correlation in consumer preferences (Gentzkow, 2007).[3] For instance, observing that households adopting broadband are less likely to purchase print newspapers might be evidence that the products are substitutes; it might also reflect that unobservable tastes for the products are correlated.

In this paper, we examine how the internet changed the market for print newspapers. Our goal is to understand how the adoption of broadband internet affected the sales of print newspapers and how the newspaper industry responded to this technological change. A number of key questions are addressed: How did household adoption of broadband internet affect sales of print newspapers? Did the substitution from print to online news consumption offset newspaper firms' revenue losses? How much of the loss of revenues came from declining print sales and how much was due to advertisers shifting their spending away from print newspapers? To what extent did print newspapers change their factor inputs and product characteristics in response to the growth in household adoption of broadband internet?

We study these questions in the context of the Norwegian market for print newspapers. Norway provides an attractive context for our study as it offers several data sources that we can link through unique firm and geographic identifiers. Taken together, they give us information over time and across areas on the availability and adoption of broadband internet among households as well as on newspaper firms' output, revenues, factor inputs, and product characteristics. The Norwegian setting also provides a plausibly exogenous variation in the availability and adoption of broadband internet among households. As a source of exogenous variation,

[1] See, e.g., Gentzkow (2007), Lee and Leung (2008), and the references therein.

[2] The data challenges are twofold. First, newspaper directories that are standard sources for research on the media market, provide measures of newspaper circulation but not information on revenues, factor inputs, and product characteristics (see, e.g., Gentzkow et al., 2011). Second, statistical agencies tend to collect data on broad measures of expenditure or usage of information and communication technology (ICT), rather than precise measures of the adoption of specific technologies (Bloom et al., 2016).

[3] Notable exceptions are Gentzkow (2006) and Angelucci et al. (2020) who study how the introduction of television in the US impacted local newspapers, using the quasi-random variation in the rollout of television across areas. Both studies find that the introduction of television led to sharp declines in the readership of local newspapers, and Angelucci et al. (2020) further show that this led to newspapers providing less local content.

we follow Bhuller et al. (2013) in exploiting a public program aimed at ensuring broadband access at a reasonable price to all households throughout the country.[4] Because of limited funding, access to broadband was progressively rolled out, so that the necessary infrastructure (access points) was established in different municipalities at different times. Our study period is for the most part limited to the decade starting in 2000, which is also the period that covers major broadband internet expansions in Norway.

Conditional on year and municipality fixed effects, we argue the spatial and temporal variation in the availability of broadband across municipalities is plausibly exogenous and may serve as an instrument for broadband adoption among households. This allows us to address the problems of simultaneous causality and correlated unobservables in estimating how broadband adoption among households changed the market for print newspapers. Our identification strategy is motivated by two features of the broadband program. First, most of the supply and demand factors tend to vary little over time. Second, the timing of the roll-out across areas is unlikely to co-vary with the key determinants of newspaper demand. We demonstrate that the data is consistent with these program features, and further challenge our identification strategy in a number of ways, finding little cause for worry.

The insights from our analysis can be summarized with four broad conclusions. First, focusing on the trends in newspaper circulation between 2000 and 2010, we document that the overall circulation of printed newspapers declined by 30 % over this decade and we estimate that the adoption of broadband internet alone could explain almost 40 % of this decline. In line with the fall in print circulation, we find large declines in print readership reported in survey data. Interestingly, however, we find similar increases in online news readership. As a result, we find no effect on total newspaper readership. We further uncover that two-thirds of the increase in online readership can be attributed to increased readership of printed newspapers' online versions, while the remainder is due to the rise of online only news sites.

Second, we show that even though total readership did not fall significantly, the losses in print circulation caused large reductions in the overall revenues of the newspaper firms. Market revenue is an essential metric to assess the economic consequences for newspaper firms since this comprises of revenues accrued both from sales of newspapers to customers and from sales of advertisements. The lack of an offsetting effect of increased online readership on newspaper revenues can be potentially explained by newspapers largely offering unlimited news content online free of charge in the early era of broadband expansion, which limited their online sales revenue. In other words, newspapers relied mostly on online advertisement revenues to sustain their online business model. Indeed, while nine out of ten newspapers in our sample had already created an online news website prior to the broadband expansion in 2002, the first recorded instances of online paywall systems occurred in 2011, and these systems were gradually adopted only in later years.[5]

Third, we show that newspaper firms responded in the immediate short-run by dramatically cutting costs, either by reducing labor inputs or the physical size of their newspaper, and in doing so avoided meaningful

[4] Bhuller et al. (2013) use the roll-out of broadband internet to study how internet use affects sex crimes. Other studies using this design include Akerman et al. (2015, 2022), Bhuller et al. (2019) and Hvide et al. (2022).

[5] Høst (2012, p. 26) notes that paywalls for online readers were introduced for the first time in Norway in 2011 by four small newspapers. A few years later, however, nearly all online newspapers had established paywall systems, which gained popularity in the Norwegian media market around 2015 (Høst (2020, p. 46)). This 'death of online free news' was not a development particular to Norway, and as documented in a report by the American Press Institute, the first instances of paywalls even in the US online newspaper market were in 2009 and these technologies were gradually adopted in later years (Williams, 2016).

profit loss. While wage costs accounted for 44 % of total costs in newspaper firms at the start of our study period, 54 % of the decline in total costs could be attributed to a reduction in wage costs. Decomposing newspaper firms' direct salary costs and labor inputs, we find that the reductions for managers and journalists in terms of their salary costs and labor hours are similar in size, while reductions for other personnel (e.g., support and delivery staff) are disproportionately larger. Using data on keyword counts, we find evidence that newspapers altered their news content. In particular, we find that newspapers reduced tabloid content share related to sports and entertainment, and published larger share of serious news content related to politics and finance. These changes may reflect newspapers' efforts to reduce tabloid content that is readily available online, more time-sensitive, and easier for competitors to copy.[6] Newspapers may have also changed their content to align their print products to the changed characteristics of their customers, who we show are more likely to be older. Using detailed data on newspaper characteristics, we also find that newspapers cut costs by reducing the physical format and size of newspaper sheets. Taken together, our third set of results reveal that the newspaper industry was remarkably resilient to the large declines in revenues that followed from the expansion of broadband internet by adjusting across multiple margins.[7]

Finally, we delve deeper into the media landscape and uncover important heterogeneity across different market segments. The print newspaper industry in Norway is characterized by relatively high differentiation comprising distinct market segments: The majority of newspapers are local or regional, serving relatively small geographic markets. By contrast, about fifteen papers, two of which are tabloids and the remaining non-tabloids, have national orientation and nationwide distribution. Local newspapers had a steady decline in print circulation throughout our study period. Our estimates suggest that this decline seems to have been largely due to factors other than the adoption of broadband internet. By contrast, much of the declines in print circulation and readership suffered by the non-tabloids and the two tabloids could be explained by broadband internet adoption. Interestingly, we also find strong evidence of substitution from print to online readership for both of the tabloids, while there is no evidence of such substitution for non-tabloids.

Consistent with the negative impacts on print circulation for tabloids and non-tabloids, we find large reductions in overall market revenues for these newspaper firms. Local newspapers, however, were largely able to mitigate the negative impacts of internet adoption. We document that local newspapers also held a dominant position in their local newspaper markets prior to broadband expansion, and that the bulk of adverse impacts of broadband expansion were concentrated among newspapers with the lowest local market shares. Other explanations include local newspapers' higher reliance on direct public subsidies in Norway and the significant reductions in their tabloid content (e.g., sports, entertainment), which can be readily available in online news outlets, and increased coverage of more serious news topics (e.g., politics, finance). Taken together, these findings suggest significant heterogeneities in the revenue impacts and in the scope of substitutability between online and print sources of news across customers in the different market segments.

The findings in our paper have important implications for ongoing debates regarding the causes and con-

[6] Franceschelli (2011) shows that readers dislike delays in the reporting of news, and studies how the introduction of the internet impacted delays to reporting and the returns to original reporting. Cagé et al. (2020) presents evidence that there is substantial reactivity and copying in online news production, with one quarter of online news stories being copied and reproduced by competitors in under 4 minuntes. They find however that original content receives more viewers.

[7] Notably, none of the newspaper firms we consider went defunct during our study period, despite many having experienced large losses in circulation and revenue.

sequences of the changing media landscape over the past decades (see the review by DellaVigna and Ferrara, 2015). Our paper is closely related to a literature in economics investigating whether online and print media are substitutes or complements. While previous studies have been important in describing the correlations between newspaper circulation and the availability of internet and online news, there is limited causal evidence.[8] Gentzkow (2007) shows the difficulty in drawing causal inferences from correlational studies. In the context of households choosing between the print and online version of the *Washington Post*, he shows that both reduced form OLS regressions and a structural model without heterogeneity suggest the products are complements. In contrast, a model with both observed and unobserved heterogeneity reveals that the print and online editions are significant substitutes. Our paper adds to the case study of Gentzkow (2007) by providing more comprehensive evidence on the patterns of substitution between print and online newspapers and by examining how the growth in broadband adoption changed the market for print newspapers. Existing work has studied the impact of online competition on traditional media's finances (Angelucci and Cagé, 2019; Djourelova et al., 2021) and business strategies (Seamans and Zhu, 2014). However, this research has mainly focused on the effects of changes in advertising revenue, which is only part of the picture. In this paper, we study the entire market for print newspapers, including by studying how newspaper firms responded to this technological change, and the heterogeneous impacts felt by different types of newspaper across all sources of revenue. More broadly, our paper is concerned with how new goods or technologies affect the demand for existing products. Understanding the extent to which new goods or technologies crowd out or complement existing products is important for both firms themselves, economists seeking to understand firm behavior, and debates over market regulation and policies affecting the incentives to bring forth new products (e.g., copyright protection, R&D subsidies and support to start-up firms).

Our paper further relates to a growing literature on how the internet affects voting and other political outcomes (Gentzkow and Shapiro, 2011; Falck et al., 2014; Miner, 2015; Campante et al., 2018; Gavazza et al., 2018), by providing additional support for the potential role of an important mechanism – the displacement of traditional print media – through which the internet has been hypothesized to influence such outcomes (see, e.g., Gavazza et al., 2018; Djourelova et al., 2021).[9] Finally, our paper also relates to studies that have considered several media markets, including the relationship between online file-sharing services and recorded music sales (Adermon and Liang, 2014; Oberholzer-Gee and Strumpf, 2007; Rob and Waldfogel, 2006; Zentner, 2006; Blackburn, 2004), file-sharing services and live concerts (Mortimera et al., 2012), online streamed music and recorded music sales (Aguiar and Waldfogel, 2018), public and private broadcast

[8] The existing evidence is mixed. For example, Filistrucchi (2005) studies the market for daily newspapers in Italy, finding a negative association between newspaper circulation and the availability of internet and online news. Based on a country-level panel dataset, Cho et al. (2016) find that increases in internet adoption can explain a large fraction of the decline in print circulation across countries. More recently, using variation in internet diffusion created by changes in rain intensity across the UK in an IV approach, Gavazza et al. (2018) find evidence indicating large displacement effects of internet on print circulation. In contrast, George (2008) uses zip-code level data from the U.S. and finds little correlation between internet adoption and print circulation. Using survey data from Sweden, Liang and Nordin (2013) find an association between broadband access and online news consumption, but limited evidence for a crowd-out of print media. Gentzkow (2014) highlights that in the U.S. print circulation has been falling at almost the same rate since 1980, and the small acceleration of this trend after the introduction of the internet only accounts for a decline in readership of about 10 percent. However, none of these studies consider how newspaper firms responded to internet adoption.

[9] Strömberg (2004a) provides a conceptual framework relating the incentives of media firms to news provision and discusses implications for public policy. Previous research has also documented the impacts of newspaper coverage on political participation and election outcomes (Snyder and Strömberg, 2010; Gentzkow et al., 2011; Drago et al., 2014), as well as the impacts of radio (Strömberg, 2004b) and television (Gentzkow, 2006; DellaVigna and Kaplan, 2007). See a review by Zhuravskaya et al. (2020).

channels (Prat and Strömberg, 2005; Berry and Waldfogel, 1999), and internet use and television viewing (Liebowitz and Zentner, 2012; Waldfogel, 2009).

The paper unfolds as follows. Section 2 presents our data sources, and describes the trends in the newspaper market and the expansion of broadband internet in Norway. Section 3 presents and critically assesses our identification strategy. Section 4 presents our main findings on sales of printed newspaper, discusses their economic significance, and reports results from a number of robustness checks. Section 5 presents our findings on newspaper firms' balance sheets and their product characteristics. The final section concludes.

2 Data and Setting

2.1 Data Sources

Our analysis is based on data from 420 municipalities and 81 newspapers covering in most cases years 2000-2010.[10] We describe our data sources and sample selection below, while an overview of the newspapers in our sample is provided in Appendix Table A.1 and further details of variables used is in Appendix Table A.2.

Internet Data. For the period 2000–2010, we have municipality-level information on (i) availability of broadband internet to households (independently of whether they take it up), and (ii) subscriptions to broadband internet among households. As explained in detail below, we will use the former to measure broadband availability, using this as our instrumental variable, while the latter will be used to measure broadband usage (or take-up) among households. Throughout the paper, broadband internet is defined as an internet connection with a download speed that exceed 256 kbit/s.[11]

The data on broadband availability are available from the Norwegian Communications Authority (FAD, 2007). This agency monitors the supply of broadband internet to households, and the suppliers of broadband to end-users are therefore required to file annual reports about their availability rates to the agency. The availability rates are based on information on the area signal range of local access points and detailed information on the place of residence of households. For each year and municipality, this allows us to measure the fraction of households for which broadband internet is available, independently of whether they take it up. In computing these availability rates at the municipality level, it is taken into account that multiple suppliers may offer broadband access to households living in the same area, so that double counting is avoided.

The data on broadband subscriptions come from two sources. For 2000–2001, we have data from the state-owned enterprise Telenor, which was the sole provider of broadband internet during this period. For the period 2002–2010, the data on broadband subscriptions are from the Quarterly Internet Survey performed by Statistics Norway (Statistisk sentralbyrå, 2003), surveying all suppliers of broadband access to end-users. The survey contains information on the aggregate number of households with broadband subscriptions in each municipality.

[10] There existed 435 municipalities in Norway at the start of our sample period in 2000. To arrive at a balanced panel of municipalities with stable boundaries, we excluded 14 municipalities that either merged or split during the period of study. We further also excluded Ullensaker municipality, being a clear outlier in print circulation per capita due to Oslo Airport being located there.

[11] Before the expansion of broadband internet, all household with a telephone connection would have dial-up access to internet, but limited to a bitrate of less than 56 kbit/s. Broadband internet facilitated internet use without excessive waiting times.

Newspaper Data. We collected and digitized data for Norwegian newspapers over the period 1991–2014.[12] Our data give annual information about (i) number of printed copies sold per edition for each printed newspaper in each municipality, i.e., print circulation, (ii) printed newspapers' online and print readership in each media district[13], (iii) readership of online only news sites in each media district, (iv) revenues, costs and factor inputs for newspaper firms, (v) printed newspapers' product characteristics, such as newspaper format, number of editions per year, and number of pages per printed edition, as well as listed prices, and finally, for most printed newspapers we also have (v) digitized full text sources of news articles.

The data on newspaper circulation, listed advertisement prices, listed sale prices and other product characteristics are collected by the main trade organization for media firms, the Norwegian Media Businesses' Association (MBL). The MBL has around 200 members—including all of the major newspapers in Norway—and for each member it collects data on number of copies sold in every municipality. Our analysis focuses on all national newspapers and local daily newspapers (i.e., having at least four editions per week), which gives us a sample of 81 newspapers (see Appendix Table A.1 for details). Combined, these newspapers made up more than 90 % of the newspaper market in 2000. We collected circulation data for the years 1991–2014 from a directory of newspapers published by the MBL (Aviskatalogen, 2022). Data on product characteristics (e.g., listed sale prices) was, however, only available in this directory for the years 1997-2010.

We also collected data on newspaper readership based on large-scale surveys carried out by Kantar/TNS Gallup on behalf of MBL. These data provide annual print and online readership rates for each print newspaper in the 105 media districts in Norway from 2000 and onwards.[14] Further, these data also provide comparable information on the readership of online only news outlets. To construct unbiased measures of annual district-wise newspaper readership rates, Kantar/TNS Gallup performs telephone-based surveys with at least 200 respondents in *each* district, representing a random sample of individuals covering individuals aged 12 or above. Using information on whether a respondent (i) has read a particular newspaper in the last 12 months, (ii) when this newspaper was most recently read, and in case of daily newspapers, (iii) how many of the last 6 editions were read, Kantar/TNS Gallup estimates a district-wise readership rate using the Pure Recent Reading method for each newspaper title (see Kantar (2021); Østnes and Futsæter (2003)).

For descriptive purposes, we also use data from a representative sample of individuals at ages 9–79, provided by Statistics Norway's Media User Survey for years 2000–2013. Each year, around 2,700 individuals are asked detailed questions about their media use in this survey, which has a response rate above 70 %. The Media Use Surveys contain information on respondents' overall online and print newspaper readership as well as their combined readership across both platforms, and further allow us to study readership patterns by respondent characteristics such as age and education. However, these latter survey data do not provide information for particular newspaper titles, which limits their use in much of our analysis.

The data on newspaper revenues and costs come from newspaper accounts collected annually by the

[12] Our baseline analysis only pertains to years 2000-2010, when broadband was rolled out. Data before 2000 are used to construct municipality-specific pre-trends in newspaper sales and other outcomes, while data after 2010 are used in a specification where we assess longer term effects.

[13] The media district is a more aggregated geographical classification than the municipality, and a media district on average contains around four municipalities.

[14] For the readership outcomes, we must therefore perform our analysis at the media district level, as Kantar/TNS Gallup does not report readership rates at the municipality level. For comparability, we also analyze circulation outcomes at the media district level.

Norwegian Media Authority (Medietilsynet, 2015). The accounts data contain detailed information from the newspaper firms' balance sheets for the period 1991–2010, including their sales revenues, advertisement revenues (such as revenues from classified ads), and factor inputs (such as labor, intermediates, etc.). We verified total revenues and costs in accounts data reported to the Norwegian Media Authority against firm accounts that were reported for tax purposes to the Norwegian Tax Authority and maintained by Statistics Norway. To distinguish labor inputs by worker types, we used matched employer-employee data from Statistics Norway (Statistisk sentralbyrå, 2010). Using information on workers' education and occupation, and their labor hours and salaries, we classified each firm's labor inputs from (i) managers, (ii) journalists, and (iii) other occupation groups, respectively.

The data on newspaper content comes from a database of digitized Norwegian newspapers maintained by the National Library of Norway. The National Library of Norway has fully digitized a large number of historical printed newspapers and made this information available in an online searchable and downloadable database.[15] Most newspapers in our sample have been fully digitized for our sample years (see Appendix Table A.1 for details). To form our content outcome variables, we chose seven broad categories (Sports; Entertainment; Crime; Health; Politics; Foreign affairs; and Business/Finance) and selected 20 commons words for each category (see Appendix Table A.3 for the complete list of keywords). We then counted the number of times each keyword, and all linguistic paradigms of that keyword, appeared in each newspaper in each year. We then summed the number of words in each category to calculate the share of content associated with each category, which we will use in our analysis.

Finally, note that while the data on newspaper circulation are available for each newspaper, municipality and year, data on newspaper accounts and inputs, product characteristics, listed prices and content are recorded at the newspaper-year level. In order to use the variation in broadband use and availability, which is recorded at the municipality-year level, we take several steps. For the balance sheet outcomes, we first allocate each variable to the municipality-year level based on the fraction of a newspaper's sales in each municipality by year, and then aggregate across newspapers to get municipality-year level measures of newspapers' revenues, costs and labor inputs. For the product characteristics outcomes, we instead focus on the average product characteristic available to consumers in each municipality-year cell. In further analyses, we also provide newspaper-year level evidence, where we rely on newspapers being initially circulated in different locations and thus differently exposed to broadband expansion over time. See Section 5 for details.

Socio-economic Data. We also use socio-economic data at the municipality-year level provided by Statistics Norway. The extract we use relies on a rich longitudinal database which covers every resident from 1991 to 2014. It contains individual demographic information (regarding gender, age, marital status and number of children), socio-economic data (educational attainment, employment status), and geographic identifiers for municipality of residence. The information on educational attainment is based on annual reports from Norwegian educational establishments (Statistisk sentralbyrå, 2001), whereas employment data is derived from administrative employment registers (Statistisk sentralbyrå, 2010) and familiy/household information is from the Central Population Register (Statistisk sentralbyrå, 2000). We also accessed data on local public

[15] This database can be accessed at Nasjonalbibliotektet (2022).

spending from municipal accounts (Statistisk sentralbyrå, 2007). Based on this information, we can include a rich set of demographic controls at the municipality-year level in our analysis (see details in Appendix Table A.2, Panels E-G).

2.2 The Norwegian Newspaper Market

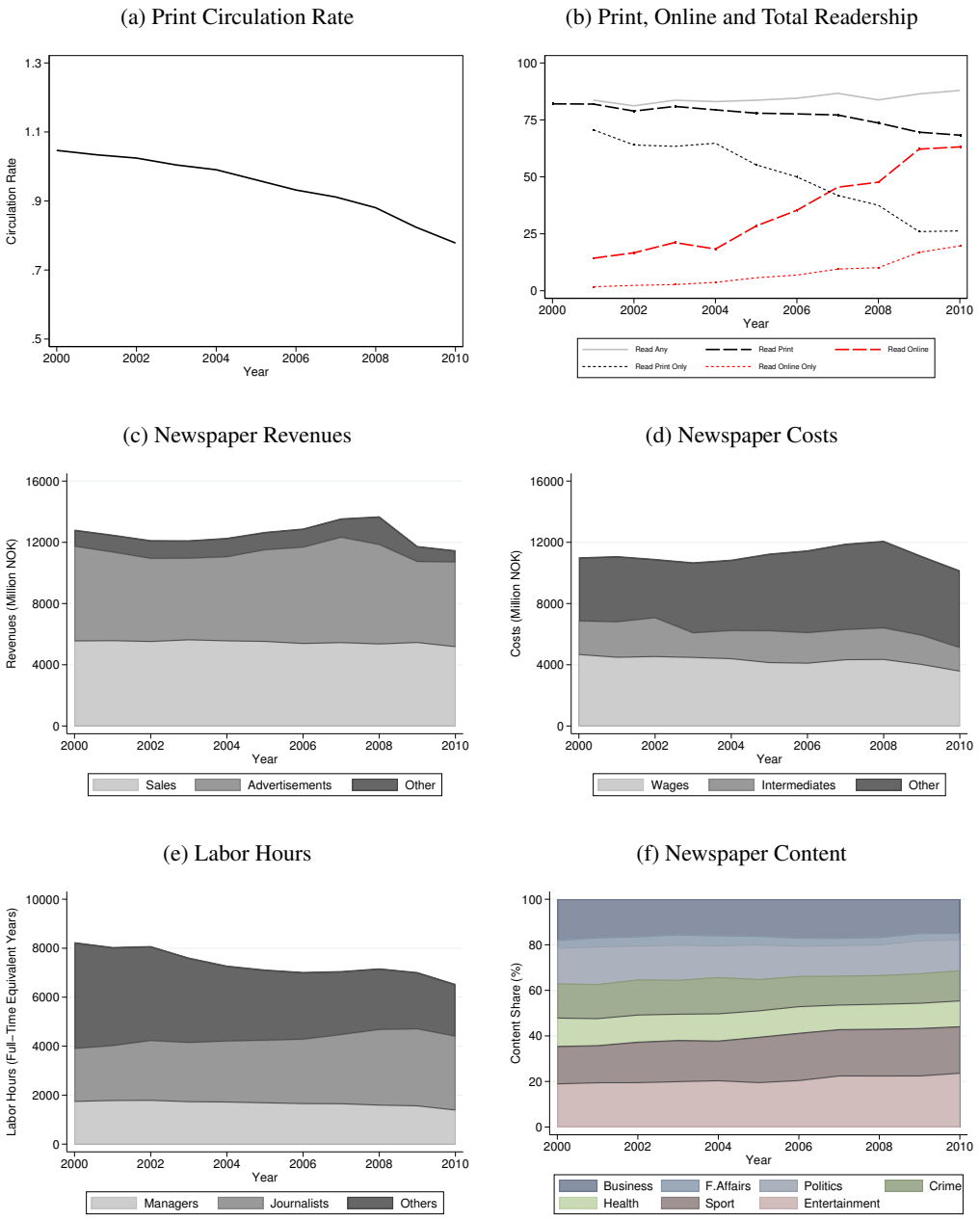
We start by documenting the trends in newspaper sales and readership over time, before we consider newspapers' revenues, costs and product characteristics. Finally, we discuss the trends in sales across three distinct segments of the newspaper market–locals, non-tabloids and tabloids. Detailed descriptive statistics for all variables used in our analysis are provided in the Appendix Tables E.1-E.2.

The market for newspapers in Norway is strong, with a circulation rate of over one newspaper per household at the start of the study period. This puts Norway close to the top of international newspaper readership rankings, alongside Japan, Switzerland and the other Nordic countries. Over time, however, the newspaper print circulation has fallen substantially. As seen clearly in Figure 1a, the newspaper *print circulation rate*, i.e., the number of copies sold per edition divided by the number of households, fell throughout the period, and at an accelerating rate: from 1.05 in 2000 to about 0.75 in 2010, a decline of 30 %. This is associated with a similar fall in *annual print sales volume*, i.e., the total number of copies sold per year divided by the number of households, of around 80 newspapers per year, or about 25 %.

In keeping with this, Figure 1b shows a decline in the fraction of population that read news in print only from almost 3/4 of the population in 2001 to about 1/4 in 2010. Overall, readership of print only and readers of print altogether, decreased by about 63 % and 17 % over this period, respectively. Notably, there is a substantial increase in readership of online news over this period, both in readership of online news only and in readership of online and print news jointly. Together this lead to a slight increase in the overall news readership. In Appendix Figure E.1, we show that while younger adults and more educated groups on average tend to have higher online readership rates, we observe increases in online readership and declines in print readership for nearly all age and education groups. Only among those aged 55 or above do we find a relatively stable share of print readership. Although this group also increases their online readership, but does so without shifting exclusively over to an online platform.

Next, we consider trends in newspapers' revenues and costs. The market for newspapers in Norway is large: Our sample of 81 newspapers collected 12.8 billion NOK in revenues in 2000. While newspapers saw a 30 % decline of their print circulation from 2000 to 2010, their revenues saw a smaller decline of only 11 % over the same period, as shown in Figure 1(d). Figure 1(e) shows that this fall was also met with costs falling by 8 %, from 11 billion NOK in 2000 to 10.1 billion NOK in 2010. Most of the decline in costs came through lower wage costs, as a result of decreasing the total number of labor hours. In 2000, as can be seen in Figure 1(e), there were the equivalent of 8,300 full-time employee hours working in the Norwegian newspaper market. By 2010, that number decreased to 6,500, a fall of 21 %. Finally, Figure 1(f) displays the content share of different types of news across the newspapers in our sample. This figure suggests that content shares are relatively stable across categories, with some increase in Sports and Entertainment content.

Figure 1: Trends in the Norwegian Newspaper Market.

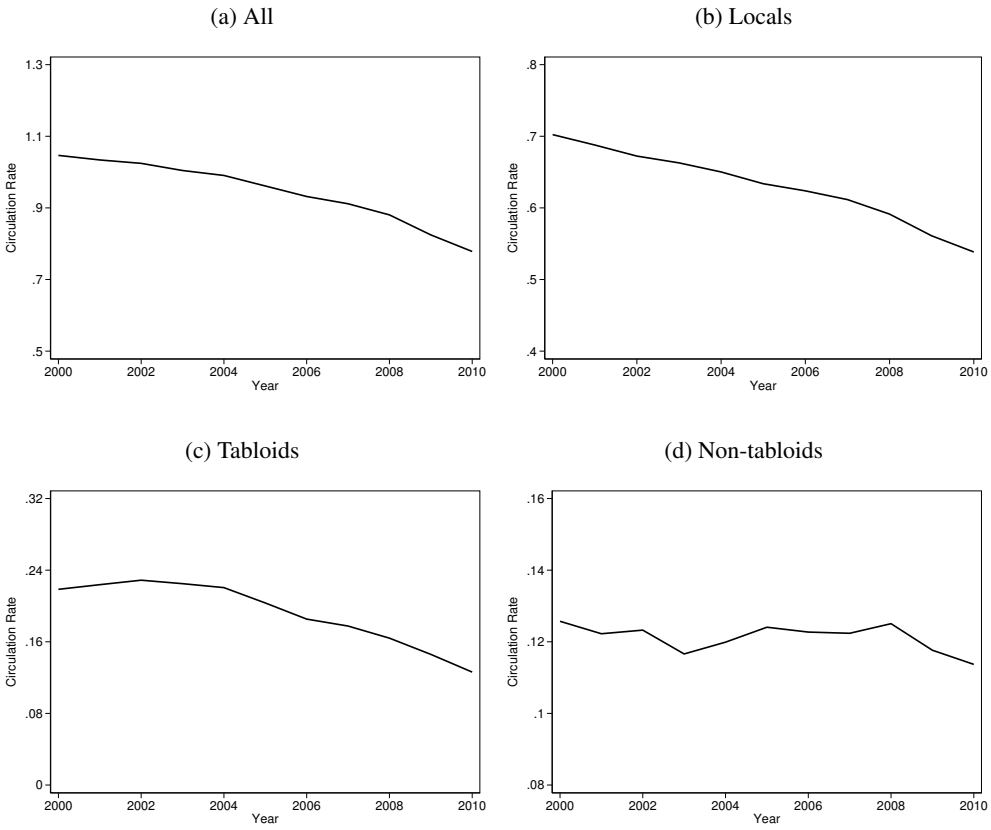


Notes: Panels (a) and (b) show the annual trends in newspaper circulation and readership rates, respectively. The print circulation rates are calculated as the total number of copied sold (per print edition) summed across 81 newspapers in our sample divided by the number of households residing in each municipality at the start of each year. The print, online and total readership rates are constructed for a sample of adult responders in the Norwegian Media User Surveys. Panels (c) and (d) present the revenues and costs summed across 81 newspapers in our sample in million 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK. Panel (e) presents the total number of labor hours summed across 81 newspapers in our sample, presented in the number of Full-Time Equivalent years, where we assume the average full-time worker works 1,950 hours a year. Panel (f) presents the average content shares across our sample. Appendix Table A.1 provides a complete list of the 81 newspapers in our sample.

An important aspect of the newspaper market in Norway is that this market is characterized by relatively high differentiation comprising distinct market segments. Most newspapers are local or regional, and serve

relatively small geographic markets. The newspapers with national orientation and nationwide distribution can be further segmented in two groups; tabloid newspapers (VG and Dagbladet) and about a dozen non-tabloid newspapers. In our analysis, we thus classify the newspaper market into three distinct segments; locals, tabloids and non-tabloids.

Figure 2: Segments of the Norwegian Newspaper Market.



Notes: The figure shows the annual trend in circulation rate, overall and by newspaper segment. The circulation rates are calculated as the total number of copied sold (per release) summed across all newspaper (within type) divided by the number of households residing in each municipality at the start of each year. For a complete list of newspapers in each market segment see Appendix Table A.1.

Figure 2 shows the overall newspaper circulation rate for each year over 2000–2010, as well as for each market segment. Local newspapers are the biggest category, with a circulation rate of around 7 newspapers for every 10 households at the start of the period, while tabloids and non-tabloids had a circulation rate of about 2 and 1 for every 10 households each. We observe large declines in circulation over this period across all segments. While tabloids shed almost half of their initial circulation, non-tabloids fare less poorly, but still lose about 15 % of their initial circulation. In Appendix B, we show that these three segments differ as expected in terms of their geographical distribution patterns, but also their reliance on direct public subsidies (which account on average for around 2% of newspapers' revenues) and their content composition and other

product characteristics.[16]

2.3 Expansion of Broadband Internet in Norway

Over the past two decades, many OECD countries have considerably expanded their services related to information and communications technology. In Norway, the key policy change came with the National Broadband Policy, introduced by the Norwegian parliament in the late 1990s. This section provides details about the program and describes the expansion of broadband internet.

The Program. The National Broadband Policy had two main goals.[17] The first was to ensure supply of broadband internet to every area of the country at a uniform price. The second was to ensure that the public sector quickly adopted broadband internet.

The Norwegian government took several steps to reach these goals. First and foremost, it invested heavily in the necessary infrastructure. The investment in infrastructure was largely channeled through the (state-owned) telecom company Telenor, which was the sole supplier of broadband access to end-users in the early 2000s and continues to be the main supplier today. Second, local governments were required to ensure supply of broadband internet by 2005 to local public institutions, such as administrations, schools, and hospitals (St.meld.nr. 49, 2002–2003). To assist municipalities in rural areas, the federal government provided financial support through a funding program known as *Høykom* from 1999 onwards. Local governments could receive funds from this program by submitting a project plan that had to be reviewed by a program board with expert evaluations. The stated aim was to ensure broadband availability throughout the country. Once approved, financial support was provided in the initial years of broadband access, thus making it possible for public institutions to cover relatively high initial costs.[18]

Supply and Demand Factors. The transmission of broadband signals through fiber-optic cables required installation of local access points. Since 2000, such access points were progressively rolled out, generating considerable spatial and temporal variation in broadband availability. The staggered expansion of access points was in part due to limited public funding, but also because Norway is a large and sparsely populated country. There are often long driving distances between the populated areas, which are mostly far apart or partitioned by mountains or the fjord-gashed shoreline.[19]

[16] We also verify there that the classification in locals, non-tabloids and tabloids is meaningful. First, in Table B.1, we document the geographical dispersion of circulation of newspapers, showing that local newspapers indeed are sold within distinct geographical markets, such as a single municipality or a single county. By contrast, tabloids and non-tabloids are more evenly distributed across geography. Second, we estimate the price elasticity of newspaper sales with respect to (i) the newspaper's own price, (ii) the price of other newspapers within the same segment, and (iii) the price of other newspaper segments. We expect the own-price elasticity to be negative. And, for the segmentation of the market to be economically meaningful, the cross-price elasticity within a segment should be positive, while the cross-price elasticity across segments should be close to zero. Table B.2 confirms this, showing that newspapers within the same segment are close substitutes, while newspaper demand is largely independent across segments.

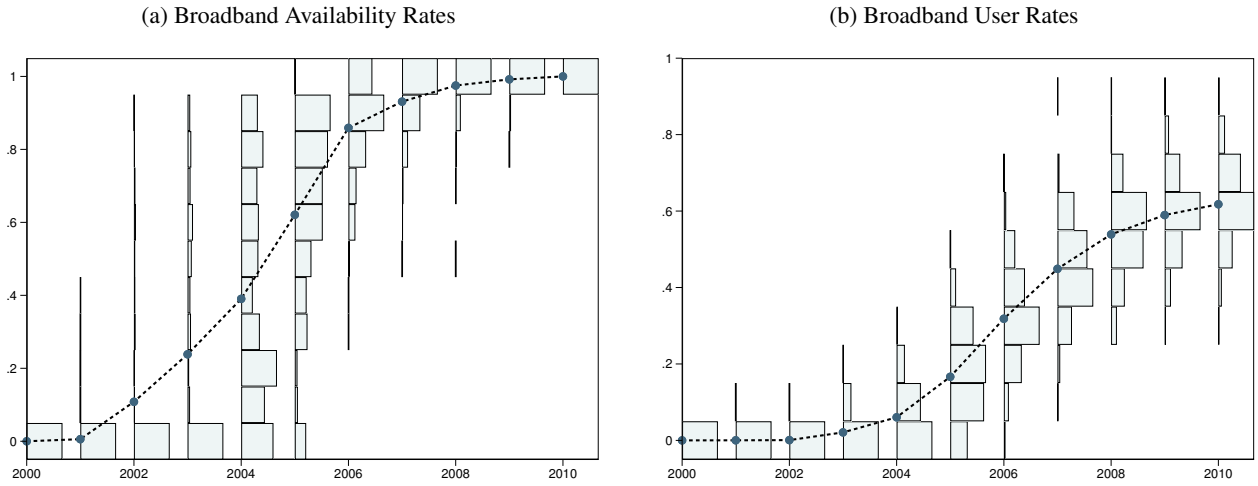
[17] Our discussion draws on Bhuller et al. (2013) and Akerman et al. (2015). These policy goals are outlined in St.meld.nr. 38 (1997–1998), Section 4.5, and St.meld.nr. 49 (2002–2003), page 7.

[18] During the period 1999–2005, the Høykom program received more than 1000 such applications and co-funded nearly 400 projects, allocating a total of NOK 400 million. From 2002, the Ministry of Education and Research co-financed another scheme *(Høykom skole),* providing financial support for broadband infrastructure in public schools. Most schools in Norway are public.

[19] The Norwegian territory covers about 149,400 square miles, an area about the size of California or Germany, with around 13 % and 6 % of those regions' populations (in 2008), respectively. The country is dominated by mountainous or high terrain, as well as

The documents describing the National Broadband Policy and the roll-out of broadband access points (see St.meld.nr. 38, 1997-1998; St.meld.nr. 49 , 2002-2003), suggest the main *supply factors* determining the timing of roll-out are topographical features and existing infrastructure (such as roads, tunnels, and railway routes), that slow down or speed up physical broadband expansion.[20] Based on our reading of the program accounts, we expect the potential *demand factors* to be related to public service provision, income level, educational attainment, and the degree of urbanization in the municipality.

Figure 3: Evolution of Broadband Internet Availability and Usage, 2000–2010.



Notes: Panels (a) and (b) shows the overall mean and distribution of broadband availability and user rates, respectively, across municipalities for each year over 2000–2010.

Evolution of Broadband Availability and Usage. Appendix Figure E.2, Panel (a), shows the variation in our measure of broadband availability to households across municipalities and over time. By 2000, broadband transmission centrals were installed in the cities of Oslo, Stavanger, and Trondheim, as well as in a few neighboring municipalities of Oslo and Trondheim. However, because of limited area signal range, broadband internet was available for less than one-third of the households in each of these municipalities. More generally, the figure illustrates that for a large number of municipalities there was no broadband availability in the first few years, whereas most municipalities had achieved fairly high availability rates in 2010. Moreover, there is considerable variation in availability rates within the municipalities in these years. Indeed, few municipalities experience a complete shift from no availability to full availability in a given year; rather, access points were progressively rolled out within and across municipalities, generating a continuous measure of availability rates that display considerable temporal and spatial variation.

a rugged coastline stretching about 1,650 miles, broken by numerous fjords and thousands of islands.

[20]The reason is that the transmission of broadband signals through fiber-optic cables required installation of local access points. In areas with challenging topography and landscapes, it was more difficult and expensive to install the local access points and the fiber-optic cables. Furthermore, the existing infrastructure mattered for the marginal costs of installing cables to extend the availability of broadband within a municipality and to neighboring areas.

Figure 3 summarizes the evolution of broadband availability and usage between 2000 and 2010. In each year, we report the overall means and the distributions across municipalities. There is considerable variation in both availability and usage, across municipalities and over time. While the time series pattern in availability and user rates suggests that many households quickly adopt broadband when it becomes available, we provide a regression analysis of the link between broadband availability and usage in Section 3.

3 Empirical Design

3.1 Model Specification

Randomizing broadband use is not feasible in our application: We cannot in practice force households to adopt broadband. One can, however, think of a field experiment which randomizes broadband availability at the municipality level. The randomization would break the correlation between broadband availability and unobserved determinants of the outcomes of interest. The intention of our instrumental variables (IV) model is to mimic this ideal experiment.

Our source of exogenous variation comes from the staggered installation of broadband infrastructure, generating spatial and temporal variation in broadband availability and adoption. For each municipality m and every year t, we instrument $d_{m,t}$, the fraction of households that use broadband internet at the start of year, with $z_{m,t-1}$, the fraction of households for which broadband internet is available at the start of previous year. This can be represented by the following first stage equation:

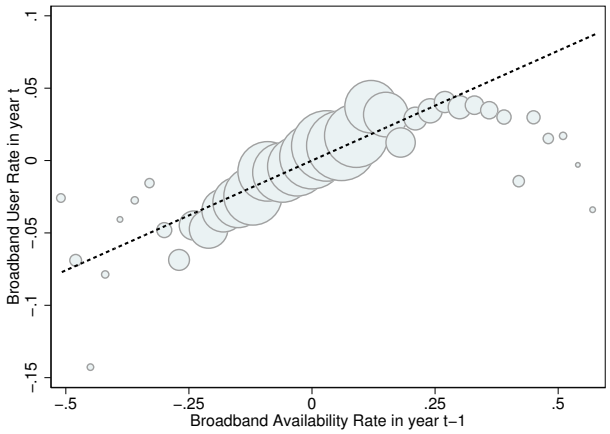
$$d_{m,t} = \delta z_{m,t-1} + x'_{m,t-1}\mu + \gamma_m + \upsilon_t + \eta_{m,t}, \quad (1)$$

where $x_{m,t-1}$ is a set of time-varying covariates (we will show results both with and without these controls). Unobservable determinants that are fixed at the municipality level will be controlled for through the municipality indicators γ_m, just like common time shocks are absorbed by the year indicators υ_t.

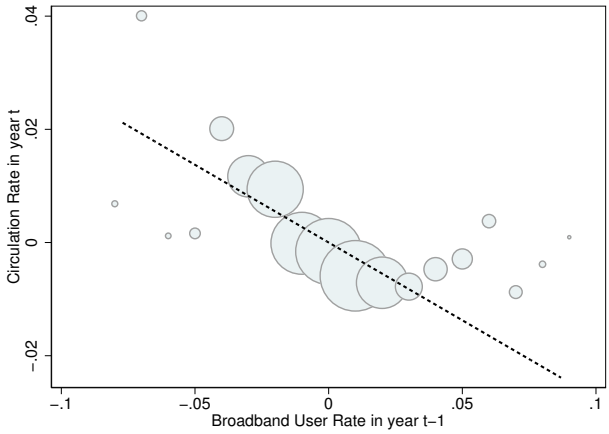
Figure 4a draws a scatter plot of residualized broadband availability rates against broadband user rates, where we remove municipality fixed effects γ_m and common calendar time effects υ_t. We let the size of the circle represent the number of households in each bin. The figure shows a strong association between changes in availability and user rates, suggesting a significant impact on broadband usage of the increase in broadband availability from the previous year. The strong first-stage relationship is confirmed in the estimation results based on equation (1) presented in Table 1, Column (1), with a precisely estimated first-stage coefficient of 0.152 and an F-statistic of 401.8. This coefficient estimate indicates that an increase in the broadband availability rate by 10 percentage points increases broadband user rate by almost 1.5 percentage points in the following year. In Column (2), we also control for a large set of baseline demographic characteristics, including population composition in seven different age bins, and fractions of unemployed, immigrants, low-income households, and students, and average income and years of education. Adding these controls only marginally moves our baseline first-stage estimate to 0.137, and we also acheive some gains in precision.

Figure 4: Scatter Plots of Changes in Broadband Availability, Usage and Newspaper Print Circulation.

(a) Broadband User Rates on Availability Rates



(b) Newspaper Print Circulation Rates on User Rates



Notes: Panel (a) shows scatter plot of broadband user rates against broadband available rates, while panel (b) shows scatter plot of newspaper print circulation rates against broadband user rates instrumented using broadband available rates. In both plots, we show residualized outcomes after removing municipality fixed effects and common calendar time effects, effectively associating within-municipality changes over time in broadband availability rates, broadband usage rates, and newspaper print circulation rates.

Table 1: First-Stage Estimates of Broadband Availability Rate on Broadband User Rate.

	Dependent Variable: Broadband User Rate	
	(1)	(2)
Instrumental Variable:		
Broadband Availability Rate	0.152***	0.137***
Std Error	(0.0076)	(0.0072)
KP F-statistic (instrument)	401.8	358.4
Baseline Demographic Controls		✓
Observations	4,620	4,620

Notes: The estimation results in this table come from the regression equation (1), where the dependent variable is broadband usage rate in year t, $d_{m,t}$, which is regressed on the broadband availability rate in year *t-1*, $z_{m,t-1}$. All regressions includes municipality fixed effects and year dummies, while in Column (2), we add baseline demographic controls, $x_{m,t-1}$, that are measured at the municipality level in year *t-1*, including population composition in seven different age bins, and fractions of unemployed, immigrants, low-income households, and students, and average income and years of education, as detailed in Appendix Table A.2, Panel E. Standard errors are heteroskedasticity robust and clustered at the municipality level. The regression is based on 420 municipalities × 11 years = 4,620 observations.
* p < 0.1, ** < 0.05, *** p < 0.01.

To estimate how instrument-induced changes in broadband usage rates affect an outcome of interest, we use a second stage equation of the following type:

$$y_{m,t+1} = \lambda d_{m,t} + x'_{m,t-1}\beta + \alpha_m + \tau_t + \varepsilon_{m,t+1}, \tag{2}$$

where $y_{m,t+1}$ is the outcome of interest in year $t+1$, e.g., newspaper print circulation rate, and parameter λ captures how an increase in broadband internet usage from 0% to 100% in year t affects this outcome.

By controlling for indicators of municipality α_m and year τ_t, we are looking within municipalities while eliminating other common changes over time in the newspaper market or the economy more generally. For most of our analysis, standard errors are clustered at the municipality level and robust to heteroskedasticity. For readership outcomes, which are observed annually at the media district level, we instead clustered at the media district level. Consistently, for the readership analysis, we also replace municipality fixed effects by media district fixed effects in equations (1) and (2), relying on a more aggregated variation.

To illustrate this IV approach, Figure 4b draws a scatter plot of the predicted user rates from equation (1) against one of our key outcomes, the newspaper print circulation rate. Both variables are residualized on municipality and year fixed effects. The figure shows a strong association between changes in broadband internet use and newspaper print circulation, with a correlation of -0.25. It is also worth noting that the linear functional form gives a fairly good approximation of the observed relationship.

As explained above, in equations (1) and (2), unobservable determinants that are fixed at the municipality level will be controlled for through the municipality indicators α_m, just like common time shocks are absorbed by the year indicators τ_t. To check that the estimated effects are not driven by *time-varying* observable factors, we will report estimates of equations (1) and (2) with and without a large set of time-varying controls $x_{m,t-1}$. Our baseline demographic controls include population composition in seven different age bins, and fractions of unemployed, immigrants, low-income households, and students, and average income and years of education. We will further add two sets of controls. We first control for factors that are likely to correlate with newspaper demand and revenue. To identify such factors, we relied on the existing research (see, e.g., Gentzkow et al., 2011; Gentzkow and Shapiro, 2011). One factor is population size and density. Newspapers have nontrivial fixed costs, so market size is a key determinant of newspaper circulation in a market. A second factor is income, as richer areas can command greater advertising revenue per reader. A third factor is industry composition, which helps explain variation in advertising demand across areas.[21] Second, we include controls for factors that are suspected to influence supply and demand for internet, and are therefore expected to correlate with the broadband expansion, such as road density and infrastructure spending. The full set of control variables is described in Appendix Table A.2, Panels E-G.

Besides a strong first-stage (relevance condition) that we confirmed empirically above, the IV model presented above also relies on an exogeneity condition, an exclusion condition, and under treatment effect heterogeneity, a monotonicity condition. While we discuss validity of the exogeneity and monotonicity conditions in Sections 3.2-3.3 below, we expect both of these conditions to hold in our setting. However, the exclusion condition is more demanding and could be violated, for instance, if changes in household broadband availability rates correlate with newspaper firms' adoption of broadband internet, which could lead to changes in $y_{m,t+1}$ even without affecting household broadband usage rates $d_{m,t}$. As almost 9 out of 10 newspapers in our sample already had an online website in 2002 prior to the broadband expansion (Internet Archive (2022); see Appendix Table A.1), we do not expect this type of a violation of exclusion to be a major concern. However, to remedy such concerns, we will also provide estimates from a reduced form of the IV

[21] An important consideration is that newspapers operate in a two-sided market where advertising demand likely depends on the size and demographics of the readership; but also demand for newspapers by readers may be a function of the amount of advertising (Rysman, 2009; Filistrucchi and Klein, 2015). Argentesi and Filistrucchi (2007) analyze the market for daily newspapers in Italy and estimate an insignificant effect of advertising on circulation and hence assume newspaper demand is independent of advertising.

model as follows:

$$y_{m,t+1} = \varphi z_{m,t-1} + x'_{m,t-1}\rho + \zeta_m + \chi_t + \varsigma_{m,t+1}, \quad (3)$$

where the parameter φ captures the impact on outcome $y_{m,t+1}$ of an increase in broadband availability, which can be interpreted as an intention-to-treat estimate under a milder exogeneity condition that we discuss next in Section 3.2. Following Akerman et al. (2015), we will also provide event study estimates from a flexible dynamic specification around the year when an municipality experiences the largest increase in its broadband availability rate. Further, we will provide additional results from a battery of specification checks to guard against alternative explanations, which we discuss more closely in Section 4.3 and Appendix C-D.

3.2 Exogeneity

Our empirical design is motivated by two features of the program that expanded broadband availability. First, most of the supply and demand factors tend to vary little over time. Second, the timing of broadband roll-out is unlikely to co-vary with key correlates of newspaper sales and revenues. Ultimately, as we control for municipality and year fixed effects in our model specifications, our design relies on the timing of broadband roll-out to be exogenous, conditional on permanent municipality features and common time effects.

To investigate whether the data are consistent with these program features, we first regress $z_{m,t}$ on municipality and year fixed effects as well as time-varying supply and demand factors. We find that 87.5 % of the variation in broadband availability can be attributed to time-invariant municipality characteristics and common time effects, while less than 2.5 % of the remaining variation in broadband availability can be attributed to a large set of time-varying variables (listed in Appendix Table A.2, Panels E-G).

Second, we examine the relationship between the timing of broadband roll-out and baseline municipality characteristics. To this end, we estimate the following equation

$$\Delta z_{m,t} = [\theta_t \times b_m]' \psi_t + \omega_t + \pi_{m,t}, \quad (4)$$

where $\Delta z_{m,t} = z_{m,t} - z_{m,t-1}$, ω_t capture the year fixed effects, and b_m includes municipality-level information from year 2000 about the demand and supply factors of the expansion of broadband internet (discussed in Section 2.3) and key correlates of newspaper sales and revenues, besides municipality-specific growth rates in newspaper sales and revenues between 1999-2000. By interacting b_m with time dummies θ_t, we can explore how these baseline municipality characteristics are correlated with the changes in broadband internet coverage, as captured by coefficient vector ψ_t.

Appendix Figure E.3 plots the estimated coefficients from the vector ψ_t for every t (and the associated 95 % confidence intervals). Our results show that the timing of the broadband roll-out is unrelated to key correlates of newspaper sales and revenues. Nor is the timing correlated with the growth rates in sales and revenues prior to the expansion of broadband. The main noticeable pattern we can find is that broadband expansion is strongly correlated with the level of urbanization (figure L), with more urbanized municipalities experiencing a broadband expansion between 2002-2003 and less urbanized municipalities experiencing a broadband expansion between 2005-2006. Taken together, this evidence suggests that the roll-out of broad-

band availability is unrelated to most baseline municipality characteristics.

3.3 Monotonicity and Compliance

As is well-known, IV estimates under treatment effect heterogeneity may provide local average treatment effects (LATE) for a subpopulation under monotonicity (Imbens and Angrist, 1994). However, since the first-stages reported in Table 1 are estimated using aggregate data on broadband availability and usage at the municipality-year level, these estimates are not directly informative about monotonicity and the characteristics of compliers. To examine testable implications of the monotonicity condition and learn more about compliers in our setting, we can instead estimate the first-stage equation (1) using micro data from the the Media Use Surveys (see Section 2.1 above). To do so, we replace the broadband internet user rate outcome in equation (1) by an indicator for whether an individual uses broadband internet, while using the same instrument as before, i.e., the broadband availability rate in the previous year in the respondent's municipality of residence. The results from this analysis are reported in Appendix Table E.3, Panel A. Our evidence in Column (2) confirms that first-stage coefficient estimates are positive for all age and education groups, consistent with the monotonicity condition in our context. Based on the complier relative likelihoods reported in Column (4), we also note that had we estimated our IV model purely using micro data, then young adults and those with medium level of education would be more likely compliers, i.e., these groups are more likely to be early adopters who would take-up the use of broadband internet solely due to an expansion of broadband availability in their municipality of residence in the previous year. Confirming the descriptive evidence illustrated in Appendix Figure E.1, we further show in Appendix Table E.3, Panel B, that young adults and the more educated are also much less likely to read print newspapers and more likely to read online news. Although these descriptive patterns are only suggestive, one could expect that the impacts of broadband use on readership may be heterogeneous across age-education groups. In Section 4.3, we provide some regression-based evidence of heterogeneous impacts by average municipality characteristics.

4 The Impacts of Internet on Newspaper Sales and Readership

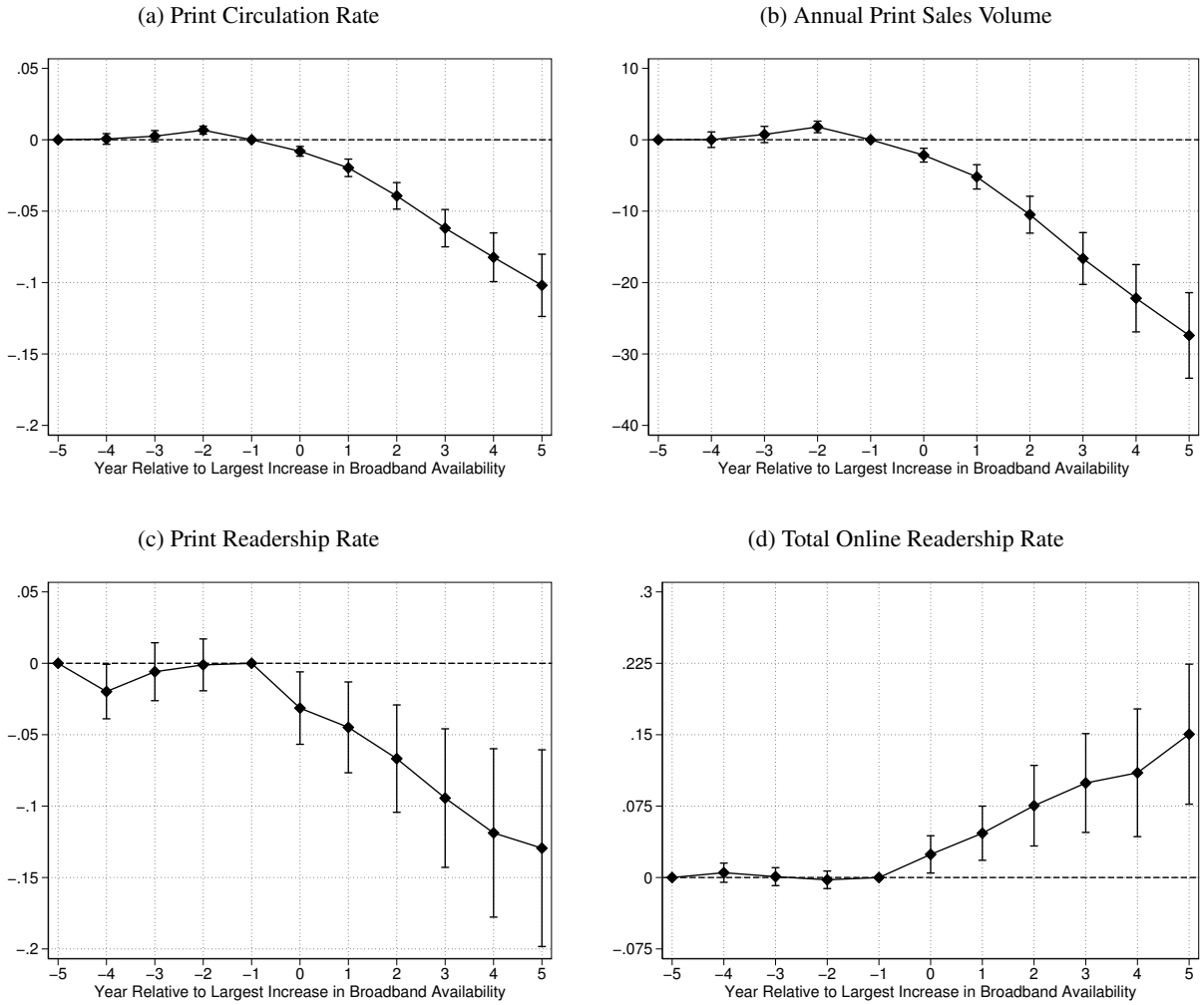
This section presents the main results from our empirical analysis on how household broadband internet availability and usage affected newspaper sales and readership. We start by considering the impacts on total newspaper sales and readership, and further provide evidence on shifts between print and online readership. Next, we consider the three main segments of the newspaper market—local, national tabloid and national non-tabloid newspapers—and study how the impacts differ across these segments. Finally, we discuss results from a battery of specification checks to guard against alternative explanations.

4.1 Newspaper Sales and Readership

We start by presenting graphical evidence on the impacts of broadband availability on market-level aggregate newspaper sales and readership from an event study specification corresponding to the reduced form equation (3). Specifically, following Akerman et al. (2015), we define for each municipality the event year as the year corresponding to the largest increase in broadband availability. Then, we estimate a 'distributed-lag'

specification for each outcome on indicators for the event year and the five following and preceeding years relative to the event year, while controlling for municipality fixed effects and calendar time dummies as in our main specification. Figure 5 provides the regression coefficients on each relative year dummy (with year -1 serving as the comparison year). We first consider the impacts on newspapers' aggregate print circulation and sales at the municipality-year level. Panels (a)-(b) show that both newspapers' print circulation rate and annual print sales volume are affected, with an initial drop observed in the year of event and further declines afterwards, while there are no clear changes in the years prior to the event.

Figure 5: Graphical Evidence – Event Study Design.



Notes: Figures shows changes in print circulation (panel a), annual print sales volume (panel b), print readership (panel c) and total online readership (panel d) in response to the year relative to largest increase in broadband availability in the municipality (panels (a) and (b)) and in the media district (panels (c) and (d)). For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell, while readership rates are constructed as the fraction of positive responses among survey respondents in each media district-year cell. At the municipality level, we define the event year, e_m, as the year corresponding to the largest increase in broadband availability, i.e., $e_m = (t : \max_t \{z_{m,t} - z_{m,t-1}\})$. For each outcome, $y_{m,t}$, we estimate $y_{m,t} = \sum_{k=-5}^{5} \varphi_k d_{m,t}^k + \gamma_m + \upsilon_t + \eta_{m,t}$, where $d_{m,t}^k := 1(t - e_m = k)$ are relative year dummies that equal one at each relative year k and are zero otherwise, γ_m are municipality fixed effects, and υ_t are time dummies. At the media district level, we perform the corresponding analysis with media district fixed effects. Each subfigure plots the coefficients φ_k on the relative year dummies (with year -1 acting as the comparison) obtained from this regression and the associated 95% CIs.

Next, we rely on the survey-based readership data to document shifts between print and online readership. These survey data provide for each newspaper information on the shares of individuals aged 12 or above who have read an average edition per year, differentiating between print and online readership for newspapers that are available on both platforms, and further the fraction that has read an average edition of an online only news site. To construct a measure of the total readership rate, we thus aggregate the number of positive responses across all news outlets in our sample in each year and by location and divide by the corresponding number of survey respondents. Panel (c) confirms our earlier evidence on negative impacts on print circulation by showing a similar pattern of decline in print readership, although the estimates on survey-based readership outcomes have wider confidence intervals. By contrast, panel (d) reveals a strong increase in online readership, consistent with consumers substituting from print to online readership.

Table 2: Impacts on Newspaper Sales and Readership.

	Sales		**Readership**				
	Print Circulation Rate	**Annual Print Sales Volume**	**Print Readership Rate**	**Online Readership Rate**			**Total Readership Rate**
				Print Newspapers' Online Sites	**Online Only News Sites**	**Total Online**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
A. Specification Without Time-Varying Controls							
Reduced Form	-0.042***	-11.32***	-0.104***	0.051*	0.029**	0.079**	-0.025
Std Error	(0.006)	(1.55)	(0.0325)	(0.027)	(0.014)	(0.037)	(0.050)
IV Estimate	-0.275***	-74.61***	-0.775***	0.376*	0.213**	0.589**	-0.186
Std Error	(0.036)	(10.03)	(0.268)	(0.200)	(0.102)	(0.268)	(0.372)
B. Specification With Baseline Demographic Controls							
Reduced Form	-0.028***	-7.45***	-0.082**	0.046	0.024*	0.070**	-0.013
Std Error	(0.005)	(1.48)	(0.035)	(0.028)	(0.014)	(0.037)	(0.052)
IV Estimate	-0.202***	-54.35***	-0.690**	0.381*	0.204*	0.585*	-0.105
Std Error	(0.038)	(10.47)	(0.304)	(0.228)	(0.118)	(0.307)	(0.437)
Baseline Mean	1.047	304.2	1.805	0.187	0.021	0.187	1.992

Notes: The estimates in this table come from the reduced form and second-stage regressions (2), where the coefficient on the dependent variable, $y_{m,t+1}$, is displayed separately for each outcome in each column. The endogenous variable of interest is the broadband user rate in year t, $d_{m,t}$, which has been instrumented using the broadband availability rate in year *t-1*, $z_{m,t-1}$. For a detailed description of each outcome variable see Appendix Table A.2, panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell, while readership rates are constructed as the fraction of positive responses among survey respondents in each media district-year cell. The regressions in columns (1) and (2) are based on 420 municipalities $\times$ 11 years = 4,620 observations. The regressions in columns (3)-(7) are based on 105 media districts $\times$ 11 years = 1,115 observations. Regressions in column (1) and (2) include municipality fixed effects and year dummies, while regressions in columns (3)-(7) include media district fixed effects and year dummies. Panel B further include the demographic controls discussed in Table A.2, panel E. Standard errors are heteroskedasticity robust and clustered at either the municipality (columns (1)-(2)) or media district level (columns (3)-(7)). The mean for each outcome variable from the baseline year, 2000, is displayed.
* p < 0.1, ** < 0.05, *** p < 0.01.

We now turn to our main regression-based evidence. In Table 2 we report both the reduced form estimates

from equation (3) and IV estimates corresponding to equations (1)-(2). We first provide estimates from a specification that only includes controls for municipality fixed effects and year dummies (Panel A), and then from another specification that further includes a set of demographic controls (Panel B), including population composition in seven different age bins, and fractions of unemployed, immigrants, low-income households, and students, and average income and years of education.[22] In the following, the latter specification will serve as our baseline model specification. Our evidence reported in Columns (1)-(2) shows that the availability and take-up of broadband internet had a substantial negative impact on newpapers' print circulation and annual print sales volume. In particular, the IV estimates in Column (1) suggest that newspaper circulation rate declined by 0.2-0.275 points as the broadband internet user rate increased from zero to full coverage, i.e, an almost 20-25 % increase compared to the baseline mean. In Column (2), we see that this corresponds to a decline in the print sales volume of newspapers by about 50-75 copies per household annually.

Further, in Columns (3)-(7), we rely on the survey-based readership to document shifts between print and online readership.[23] In Column (3), we display the effects of broadband internet on readership rates of print newspapers from survey data. As expected, we find a similar negative relationship between broadband internet and reported print readership as found with print sales in Columns (1)-(2). Our IV estimates suggest a decline in print readership by around 40%, as compared to the baseline mean. Next, in Columns (4)-(6), we focus on measures of online readership. We start in Column (4) by considering readership of printed newspapers' online versions, where we find the opposite pattern of what we found for print readership. Moving on, in Column (5), we consider the readership of online only news sites (i.e, outlets without a print counterpart), and, in Column (6), we report estimates for total online readership across all news outlets. Our IV estimates in Columns (4)-(6) suggest that two-thirds of the increase in online readership can be attributed to increased readership of printed newspapers' online versions, while the remaining is due to the rise of online only news sites. Finally, Column (7) suggests that while total news readership declines by 5-10% following the rise of household broadband internet usage, these impacts are not statistically significant.

To better understand the impacts of broadband internet over time, Figure 6a shows the actual and predicted counterfactual trends over the period 2000–2010. To calculate the predicted trends in a counterfactual situation without any broadband internet usage, we take the total predicted impact of the number of broadband internet users in each year using the estimates in column (1) of Table 2. As we saw in Figure 3b, the share of the population using broadband internet increased from zero to about 60 % over this period. Though the newspaper market was declining throughout the period, our estimates suggest that the decline would have been much less dramatic over the mid-2000s if it were not for the expansion of broadband internet. By 2010, our estimates suggest that broadband internet had reduced the sales of print newspapers by about 0.11 points overall, a decline of about 12 % over the baseline mean. As a fraction of the overall decline in

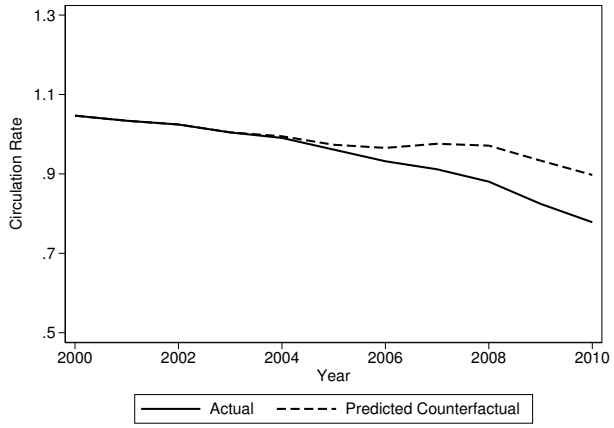
[22] Notably, these demographic controls can be regarded as pre-determined as they are measured at the start of the previous year. Also see Akerman et al. (2015), who provide evidence on the skill complementarity of broadband internet, so that one may expect differential employment and wage effects of broadband internet for different education groups.

[23] Note that these survey data only provide annual readership measures at the media district level, and thus we must aggregate equations (1)-(2) up to this level for the outcomes considered in Table 2, Columns (3)-(7). Consistently, we control for media district fixed effects in Columns (3)-(7) rather than municipality fixed effects. In Appendix Table E.4, Columns (3)-(6), we provide additional evidence for the sales outcomes considered in Table 2, Columns (1)-(2), restricted to the sample of newspapers observed in the readership data and aggregated up to the media district-year level. These estimates confirm that the patterns found in Table 2 are robust to using the circulation or readership samples, and the level of geographic units (municipality vs. media district).

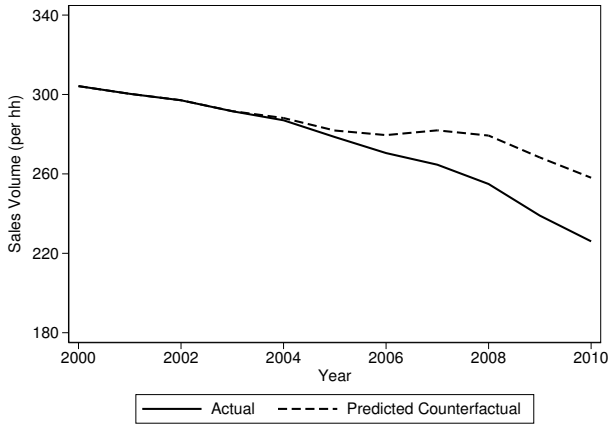
print circulation rate from 1.05 in 2000 to about 0.75 in 2010, our point estimates suggest that the adoption of broadband internet can explain almost 40 % of this decline. Further, Figures 6c-6d suggests that most of the decline in print readership and around one-third of the rise in online readership can be attributed to the increase in households' adoption of broadband internet.[24]

Figure 6: Actual and Predicted Newspaper Sales and Readership.

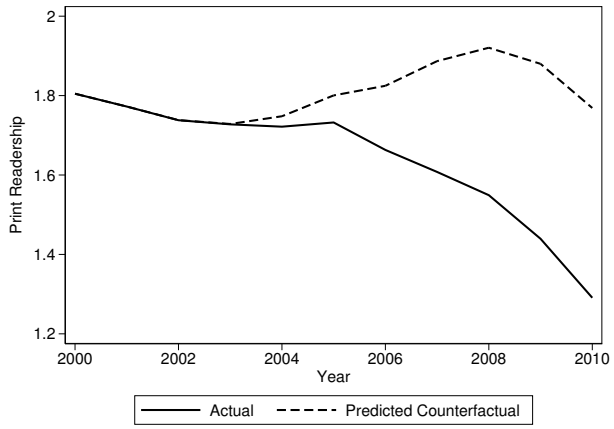
(a) Print Circulation Rate



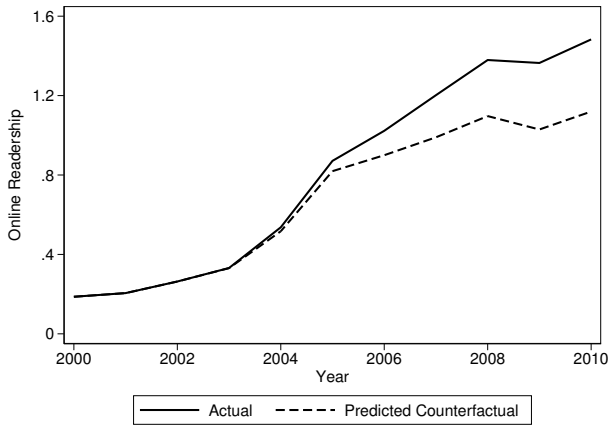
(b) Annual Print Sales Volume



(c) Print Readership Rate



(d) Total Online Readership Rate



Notes: Figures show the overall actual (solid line) and predicted counterfactual (dashed line) newspaper circulation rate (panel a), sales volume per household (panel b), print readership rate (panel c), and online readership rate (panel d). For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell, while readership rates are constructed as the fraction of positive responses among survey respondents in each media district-year cell. The counterfactual is given by the actual outcome minus the predicted effect of internet use on each outcome, and shows the predicted trend in each outcome in the counterfactual without broadband internet usage. In each year, the predicted effect of internet use on the newspaper outcome is calculated as the internet user rate in the previous year multiplied by the estimated effect in Table 2.

[24]Notably, Figure 6d also suggests a substantial rise in online readership in the counterfactual without broadband internet. This may reflects that many individuals could access online news even without their household having a broadband internet connection, for instance, through a slower dial-up connection or at work. Morevoer, 70 out of the 81 print newspapers in our sample already had an online website by 2002 (see Appendix Table A.1), contributing to a pre-broadband online readership rate of around 0.2.

4.2 Heterogeneous Impacts Across Newspaper Segments

As discussed in Section 2.2, the newspaper market in Norway is characterized by relatively high geographic differentiation comprising distinct market segments. We now investigate the impacts of broadband internet adoption across three newspaper types–locals, tabloids and national non-tabloids. Table 3 provides reduced form and IV estimates on sales and readership, separately for each newspaper segment. We start by considering local newspapers in Panel A. Although each local newspaper typically serves a relatively small geographic area, once we aggregate across all local newspapers in our sample, this segment accounts for around two-thirds of the total print circulation. As shown in Columns (1)-(2), we find virtually zero impacts on sales for the segment consisting of local newspaper. And, in Columns (3)-(5), we also do not observe any significant impacts of broadband internet on the print, online or total readership of local newspapers. One potential explanation for this could be related to the degree of local market power that these newspapers hold. In the Appendix Table E.7, we confirm this mechanism by showing that newspapers that had the lowest local market shares (in 2000) experienced the bulk of the negative impacts from the broadband expansion.

Next, we consider the two other segments of the newspaper market–tabloids and non-tabloids. In Panel B, we consider the impacts of household broadband internet adoption on the aggregated sales of the two Norwegian print tabloid newspapers–VG and Dagbladet–that nonetheless at baseline accounted for around one-fifth of the total print circulation. The estimates in Columns (1)-(2) show that this market segment is severely impacted, with broadband internet usage triggering declines of around 60% in their circulation and sales volume. In the Appendix Table E.5, we show that the relative impacts are distributed similarly across each of the two tabloids. Further, in Table 3, Panel B, Columns (3)-(5), we show that the impacts on tabloids' print sales are accompanied by around 40% decline in their print readership, while their online readership increases almost threefold. Indeed, much of the increase in print newspapers' online readership reported in Table 2, Column (3), can be attributed to the rise in tabloids' online readership, while the remaining increase in total online readership comes from online only news outlets.

Finally, in Table 3, Panel C, we consider the impacts on national non-tabloid newspaper segment, which at baseline altogether accounted for around one-tenth of the total print circulation. The impacts on non-tabloids' print circulation and sales reported in Columns (1)-(2) are similar in relative terms to the impacts for tabloids. Interestingly, however, in Columns (3)-(5), we find strong reductions in both non-tabloids' print *and* online readership, which altogether yield a statistically significant decline in their total readership. These latter findings may suggest that the print and online versions of non-tabloids are complements, rather than substitutes. By contrast, our earlier evidence for the market of newspapers as a whole, and for tabloids in particular, suggests strong patterns of substitution between print and online news consumption.

Table 3: Heterogeneous Impacts on Newspaper Sales and Readership.

	Sales		Readership		
	Print Circulation Rate	**Annual Print Sales Volume**	**Print Readership Rate**	**Online Readership Rate**	**Total Readership Rate**
	(1)	**(2)**	**(3)**	**(6)**	**(7)**
A. Locals					
Reduced Form	0.00005	-0.0928	-0.0314	0.0113	-0.0201
Std Error	(0.0034)	(1.039)	(0.0200)	(0.0152)	(0.0245)
IV Estimate	0.0003	-0.677	-0.263	0.0945	-0.168
Std Error	(0.0248)	(7.580)	(0.171)	(0.127)	(0.207)
Baseline Mean	0.702	216.3	1.024	0.010	1.034
B. Tabloids					
Reduced Form	-0.0177***	-4.595***	-0.0252	0.0485***	0.0233
Std Error	(0.0023)	(0.605)	(0.0156)	(0.0171)	(0.0244)
IV Estimate	-0.129***	-33.52***	-0.211*	0.406***	0.195
Std Error	(0.0153)	(3.982)	(0.128)	(0.141)	(0.204)
Baseline Mean	0.219	56.84	0.559	0.147	0.706
C. Non-tabloids					
Reduced Form	-0.0101***	-2.762***	-0.0258*	-0.0143**	-0.0401**
Std Error	(0.0025)	(0.583)	(0.0154)	(0.0067)	(0.0174)
IV Estimate	-0.0734***	-20.15***	-0.216	-0.120**	-0.335**
Std Error	(0.0184)	(4.400)	(0.134)	(0.058)	(0.155)
Baseline Mean	0.126	31.05	0.222	0.0297	0.252

Notes: The estimates in this table come from the reduced form and second-stage regressions (see equation (2)), where the coefficient on the dependent variable, $y_{m,t+1}$, is displayed separately for each outcome in each column and by newspaper type in each panel. The endogenous variable of interest is the broadband user rate in year *t*, $d_{m,t}$, which has been instrumented using the broadband availability rate in year *t-1*, $z_{m,t-1}$. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell, while readership rates are constructed as the fraction of positive responses among survey respondents in each media district-year cell. The regressions in Columns (1)-(2) are based on 420 municipalities $\times$ 11 years = 4,620 observations. The regressions in Columns (3)-(7) are based on 105 media districts $\times$ 11 years = 1,115 observations. Regressions in Columns (1)-(2) include municipality fixed effects and year dummies, while regressions in Columns (3)-(7) include media district fixed effects and year dummies. All regressions include the demographic controls discussed in Appendix Table A.2, Panel E. Standard errors are heteroskedasticity robust and clustered at either the municipality or media district level. The mean for each outcome variable from the baseline year, 2000, is displayed.
* p < 0.1, ** < 0.05, *** p < 0.01.

4.3 Additional Evidence

Robusness. A concern for our analysis can be differential underlying trends in the outcomes of interest across municipalities. To examine whether our estimates are biased because of this concern, we provide a lenghtier discussion and results from a series of robustness checks in Appendix C. Specifically, focusing on newspaper sales in Table C.1, we show that our baseline estimates in Column (1) are robust to controlling for additional time-varying correlates of newspaper demand (e.g., urbanization, municipality size, service sector share) and broadband expansion (e.g., road density, infrastructure spending) in Columns (2)-(3). Next, we check that our estimates are robust to excluding the capital city (Oslo) and the other four biggest cities

in Column (4), providing assurance that differential trends across big cities and other municipalities are not driving our results. Further, we drop the post-2008 years in Column (5) to avoid picking up potential differential effects of the financial crisis. Finally, we explicitly allow for differential municipality-specific time trends. In Columns (6)-(7), this is done by adding linear and quadratic time trends extrapolated based on pre-2000 data. In Column (8), we further allow flexible differential non-linear trends by adding time dummies interacted with baseline values of urbanization, municipality size and average education. All of these analysis show that our sales estimates are robust to concerns about differential trends.[25]

Geographic Spillovers. Our main empirical analysis of newspaper sales uses the municipality as the baseline geographic unit. Implicit in this analysis is an assumption of geographical segmentation of markets. In theory, one could imagine geographic spillovers across municipalities for (at least) two distinct reasons. Firstly, one could imagine spillovers in newspaper demand. For instance, the roll-out of broadband internet in a municipality that facilitates consumers to substitute from print to online news media may trigger (similar) changes in other parts of the same geographic newspaper market through spillovers in demand (i.e., tastes). Secondly, one could also imagine geographic spillovers taking place through newspapers' endogenous response to a local shock. For instance, a newspaper that is being circulated in multiple destinations, when hit by a demand shock in one of its locations due to a local broadband expansion may decide to alter its production (e.g., product characteristics), which in turn may affect its sales in other locations.

In Appendix D, we discuss and shed some light on the nature of geographic spillovers in our setting. We do so in the following steps. First, we aggregate our units of analysis to geographical regions and rely on variation in broadband availability and usage within regions over time, so that we can capture potential spillovers that take place within regional boundaries. Second, we return to our main analysis at the municipality-year level, but allow newspaper sales in a municipality to depend both on broadband usage in the same municipality as well as the average broadband usage rate in the same region (leaving-out own municipality). Both of these analyses suggest a limited role of geographic spillovers in our setting. Finally, we rely on the features of our setting and data that we observe each newspaper's sales in all municipalities and that newspapers are initially circulated in different locations and thus differently exposed to broadband expansion over time. These features allow us to perform alternative analysis at the newspaper-municipality-year and newspaper-year levels, while still using the broadband expansion as an exogenous shock to broadband usage in different newspapers' markets. Our newspaper-level analysis also suggests that newspaper sales decline substantially following an increase in broadband usage in the newspaper's market. As the outcomes are measured at the newspaper level in the latter analysis, this can arguably capture any collateral impact arising from newspapers' endogenous responses to an increase in broadband internet availability in their initial market.

Heterogeneity Across Geography. In further analyses, we consider heterogeneity in the impacts by average characteristics of the geographic areas where newspaper are sold. In the Appendix Table E.6, we categorize municipalities based on their level of urbanization, average education, and average income in the

[25] In Appendix C, we also discuss and illustrate results from placebo tests examining whether current broadband internet coverage "affects" past sales outcomes (Figure C.1) and from another model specification that allows a richer dynamics between broadband internet coverage, take-up and newspaper sales (Figure C.2).

year 2000. These results show that our estimates effects are robust across all subsamples, however, there are somewhat larger responses in municipalities with high or medium average levels of education. Interestingly, these education groups are also more likely to be compliers in our setting (see discussion in Section 3.3). Further, we also find somewhat stronger responses among both high and low average income municipalities, as well as in municipalities with a medium level of urbanization. It is nonetheless worth pointing out that neither of these estimates is statistically distinguishable from our baseline estimates reported in the first row, and thus, there appears to be limited role of heterogeneity in treatment effects across geography per se.

5 The Impacts of Internet on Newspaper Revenues, Costs and Products

So far, we have seen that the arrival of broadband internet had a strong impact on newspaper sales. To understand more about the impacts on the newspaper market, we now consider the evolution of newspaper firms' balance sheets, including their revenues as well as costs and labor inputs. Our analysis can shed light on whether and how newspapers were able to mitigate the negative impacts of the internet. Finally, we study the impact of internet on newspaper product characteristics, like content, format and size, to understand how the printed newspaper product available to readers and advertisers changed after the arrival of internet.

5.1 Revenues and Costs

We start by evaluating how broadband internet affected the market revenues of newspapers. Our objective here is to understand how newspapers' revenues were affected in municipalities where broadband internet was rolled-out. A practical challenge we face is that newspapers' revenues are observed annually only at the level of newspaper firms, whereas the variation in broadband availability and usage in our data is across municipality-year cells. To exploit this variation at the municipality-year level in equation (2), we convert the newspaper revenues to unit measures and then assign the total revenues in accordance with the number of units sold in each municipality. We then sum across all newspapers in each municipality and year to get a measure of, e.g., the total revenue generated from newspaper sales in that municipality–year cell. Our final measure at the municipality-year level for, e.g., revenues, $\mathscr{R}_{m,t}$, is thus defined as the following:

$$\mathscr{R}_{m,t} = \sum_{n} r_{n,t} \cdot Q_{n,m,t} \equiv \sum_{n} \frac{R_{n,t}}{\sum_{m} Q_{n,m,t}} \cdot Q_{n,m,t} \tag{5}$$

where for newspaper n in year t, $R_{n,t}$ is total revenue, $Q_{n,m,t}$ is the annual sales volume in municipality m, and $r_{n,t}$ is the average revenue per unit. For expositional ease, we will divide revenues $\mathscr{R}_{m,t}$ by the number of households residing in municipality m for each year t, and report estimates on revenues per household.

Panel A of Table 4 reports estimates on the total market revenues of newspapers generated in a municipality-year cell as well as a decomposition into the revenues accrued from sales of newspapers to customers and from sales of advertisements. The estimates document the strong negative impact of internet: Newspapers experience a substantial and highly statistically significant fall in revenues with the roll-out of broadband internet, with a 1,375 Norwegian kroner (in 2010, 1 USD $\approx$ 6 NOK) decline in total market revenues per household annually, a decline of 28 % from the baseline mean. This is due to a 33 % and a 23 % decline

in revenues from sales and advertisements, respectively. Notably, the impacts on ads revenues could partly reflect a reduction in print classified ads, which are expected to be particularly hit due to internet adoption.[26]

Table 4: Impacts on Newspaper Revenues, Costs and Labor Inputs.

	Reduced Form		IV		Mean
	Estimate	(SE)	Estimate	(SE)	
	(1)	(2)	(3)	(4)	(5)
A. Balance Sheets					
Total Revenues	-166.4***	(46.02)	-1214.1***	(334.3)	5443.1
Market Revenues	-188.5***	(39.19)	-1375.0***	(383.4)	4935.3
Sales Revenues	-110.9***	(14.54)	-808.9***	(104.9)	2421.3
Ads Revenues	-77.61***	(28.99)	-566.2***	(211.5)	2514.0
Other Revenues	22.06	(26.08)	160.9	(190.5)	507.8
Total Costs	-176.7***	(40.03)	-1289.0***	(290.4)	4687.5
Wage Costs	-95.77***	(21.66)	-698.7***	(157.2)	2054.0
Intermediates	-25.60	(35.25)	-186.7	(256.7)	899.7
Other Costs	-55.32	(38.48)	-403.6	(281.5)	1733.8
Profits (EBITDA)	10.26	(19.99)	74.85	(145.9)	755.6
B. Average Revenue Per Unit					
Market Revenue Per Unit	0.00327	(0.113)	0.0238	(0.738)	16.38
Sales Revenue Per Unit	-0.0947**	(0.0371)	-0.691***	(0.237)	8.072
Ads Revenue Per Unit	0.0980	(0.0906)	0.715	(0.643)	8.305
C. Labor Inputs					
Direct Salary Costs	-114.1***	(28.51)	-832.2***	(209.8)	1612.7
Managers	-23.84***	(7.423)	-173.9***	(54.43)	426.8
Journalists	-26.60**	(12.57)	-194.1**	(92.05)	457.6
Other	-63.63***	(14.00)	-464.2***	(103.2)	728.3
Labor Hours	-0.486***	(0.139)	-3.545***	(1.016)	7.572
Managers	-0.0868***	(0.0247)	-0.633***	(0.181)	1.660
Journalists	-0.103*	(0.0582)	-0.749*	(0.425)	1.984
Other	-0.296***	(0.0856)	-2.162***	(0.627)	3.929
Hourly Wage Rate	2.193*	(1.306)	16.00*	(9.512)	217.7
Managers	2.186**	(1.090)	15.95**	(7.945)	261.0
Journalists	0.532	(1.315)	3.880	(9.591)	235.4
Other	0.811	(1.584)	5.914	(11.54)	191.2

Notes: The estimates in this table come from the reduced form and second-stage regressions (see equation (2)), where the coefficient on the dependent variable, $y_{m,t+1}$, is displayed separately for each outcome in each panel. The endogenous variable of interest is the broadband user rate in year t, $d_{m,t}$, which has been instrumented using the broadband availability rate in year *t-1*, $z_{m,t-1}$. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Revenues, costs and profits are in 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK. Revenues, costs, profits and labor hours are further scaled by the number of households in each municipality-year cell. Other revenues include direct subsidies. All regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. All regressions include the baseline demographic controls discussed in Table A.2, Panel E. Standard errors are heteroskedasticity robust and clustered at the municipality level. The mean for each outcome variable is from the baseline year, 2000.
* p < 0.1, ** < 0.05, *** p < 0.01.

[26]For instance, Bhuller et al. (2019) show that job postings have gradually moved from newspapers to online job portals.

When aggregated across all households our estimates above suggest a total decline in total market revenues nationwide of 1.9 billion kroner annually by 2010 due to the adoption of broadband internet.[27] To further illustrate the economic significance of these estimates, Figure 7a plots the actual time trend in total revenues along with the predicted counterfactual revenues in each year in the absence of broadband internet, by applying our estimates in Table 4, Panel A, Column (3), to the time trend in broadband internet use. The relative importance of losses in revenues from sales and from advertisements are illustrated by coloring the estimated impact on sales revenues in a light shade and the impact on advertisement revenues in a dark shade. Note that both the actual and the predicted counterfactual revenue trends exhibit a fall in the early period, an increase in the mid-period and a fall in the final period. This pattern largely follows the Norwegian business cycle, and can be attributed to pro-cyclical advertisement revenue.

Before we turn to newspapers' costs and factor inputs, we focus on the average revenue per unit sold (ARPU), which can be interpreted as a measure of the per unit value created by newspaper firms. We provide estimates on ARPU in Table 4, Panel B, both overall and separately from sales of newspapers and sales of advertisements. The estimates in the first line of Panel B, shows that the average revenue per unit is unaffected. The following lines show, however, that this hides large heterogeneity in the two revenue streams: While the arrival of broadband internet led to a significant decline in ARPU from sales of around 0.7 NOK, i.e., about 9 percent of the baseline mean, ARPU from advertisements is estimated to increase by about the same amount, albeit statistically insignificant.

It is also interesting to distinguish between the direct impact on sales revenues from a lower volume sold, and the impact on the value of each copy actually sold. To this end, we use the following decomposition:

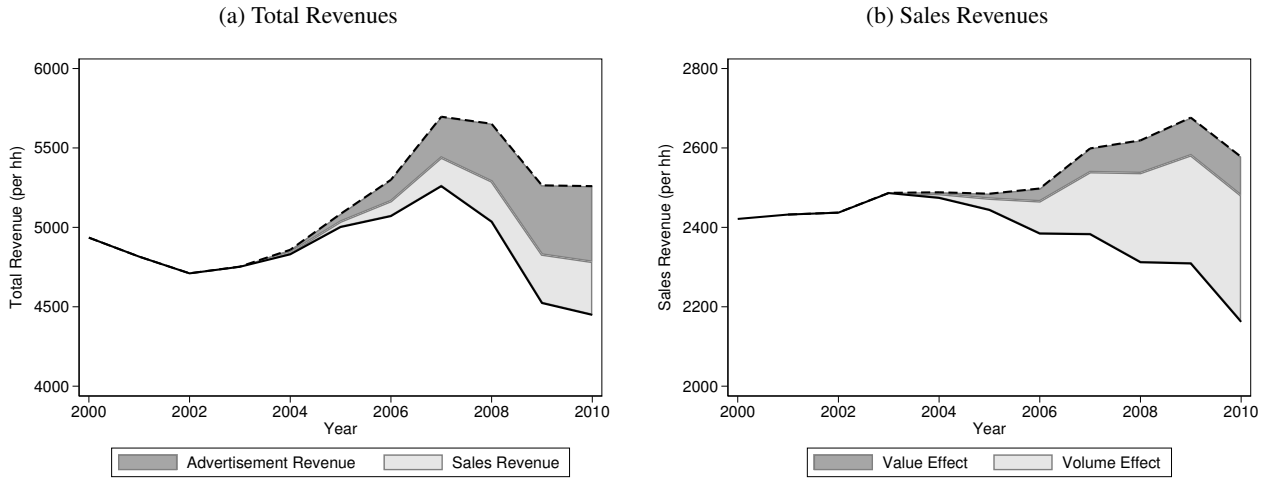
$$\frac{\partial \, Revenue}{\partial d} = \underbrace{Q \cdot \frac{\partial V}{\partial d}}_{\text{value effect}} + \underbrace{V \cdot \frac{\partial Q}{\partial d}}_{\text{volume effect}} \tag{6}$$

where d is the broadband internet usage rate and Q is the sales volume, while $V = Revenue/Q$ is the average revenue per copy sold. The first term after the equality gives the 'value effect' of broadband internet, while the second term gives the 'volume effect'. Relying on equation (6), we find that the decline in volume can account for over 80 % of the fall in sales revenue, while the decline in sales value accounts for less than 20 %.

The economic significance of these estimates is illustrated in Figure 7b, which shows the actual time trend in sales revenues along with the predicted sales revenues in each year in the absence of broadband internet usage, analogous to Figure 7a. We color the predicted volume effect in a light shade, while the value effect is colored in a dark shade. The trend is flat in the early period, before broadband internet starts to become widely available. As the roll-out of broadband internet speeds up, the observed trend for revenues dips down, while the predicted counterfactual trend stays roughly flat, extending the trend in the early period, before increasing somewhat after 2006. In 2010, broadband internet is predicted to have lowered newspaper sales revenues by just over 20 %.

[27] This calculation uses the fact that in 2010 there were 2,266,298 households in Norway and the average internet usage rate had reached 61.7%.

Figure 7: Actual and Predicted Newspaper Revenues.



Notes: Figures show the overall actual (solid line) and predicted counterfactual (dashed line) newspaper circulation rate and revenues per household. The counterfactual is given by the actual outcome minus the predicted effect of internet use on this outcome, and shows the predicted trend in each outcome in the counterfactual without broadband internet usage. In each year, the predicted effect of internet use on the newspaper outcome is calculated as the internet user rate in the previous year multiplied by the estimated effect in Table 2. The volume effect and value effect are the predicted effects on sales volume (times average market revenue per unit) and on average market revenue per unit (times sales volume), respectively. Revenues are in 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK.

Next, we consider the impacts on newspapers' costs and profits. As with revenues, we first allocate each newspaper's costs and profits to each municipality depending on the number of its units that are sold there, then aggregate costs and profits across newspapers operating in each municipality-year cell, and finally divide by the number of resident households. We find that the decline in newspaper revenues is accompanied by a similarly sized decline in their costs. Our IV estimates in Panel A of Table 4 shows that newspapers decreased their total costs by 1,289 kroner per household annually, a decline of 27.5% from the baseline mean. When aggregated across all households, this suggests a decline in total costs nationwide of 1.8 billion kroner annually by 2010 due to the adoption of broadband internet. Decomposing the costs of newspapers into wage costs, intermediates and other costs, we find that more than half of the decline in total costs can be accounted for by a decline in wage costs. Our estimates indicate that newspaper firms' cut their wage costs by almost 700 kroner per household annually, a decline of 34% from the baseline mean. This estimate is both economically substantial and highly statistically significant. Notably, these wage costs include both costs for regular salaried workers and freelancers (e.g., external reporters) who provide services to newspaper firms.[28] Though somewhat imprecise, our point estimates also indicate that spending on intermediates is reduced by 21% and other costs are reduced by 23%, both relative to the baseline mean.[29]

To understand the overall economic impact of internet, we also include a measure of the profitability of the newspaper firms.[30] The estimate suggests that newspaper firms are able to shoulder well the negative impacts of internet on their profitability by cutting their costs, as we find no significant changes in the profits.

[28] Around 19% of journalists in Norway work as freelancers, and thus face a weaker employment protection than regular employees (see Steensen and Kalsnes (2020)). We are not able to distinguish wage costs on freelancers and regular employees.

[29] Spending on intermediates include all costs associated with production, transportation, handling, storage, etc., incurred by newspaper firms, while other costs is a remainder that includes, e.g., administrative costs.

[30] Our profit variable is the widely used EBITDA, which refers to earnings before interest, taxes, depreciation, and amortization.

Given these findings, a remaining question is why newspapers were not able to cut their costs prior to the roll-out and increase profits. Possible explanations could be related to institutional rigidities due to strong employment protection, so that firms can fire workers only when they face economic hardships, and the presence of strong unions that promote profit sharing with between firm owners and employees.[31]

The large drop in wage costs associated with the arrival of broadband internet, motivates a further analysis of the labor inputs in newspaper firms. In Panel C of Table 4 we report estimates on direct salary costs[32], labor hours and hourly wage rates. We find that newspaper firms adjusted their labor inputs swiftly in response to the arrival of broadband internet. Our estimates indicate that direct salary costs are reduced by about 830 kroner, a decline of 51 % relative to the baseline mean. Digging further into the data, we see that the decline in the wage costs of newspaper firms is almost entirely accounted for by a reduction in labor hours, which are reduced by almost 50 % relative to the baseline mean. In contrast, our estimates reveal no impact on the hourly wage rate. All in all, our estimates suggest that the adoption of broadband internet may have caused a decline in the overall employment in newspaper firms by about 2,550 full-time jobs annually by 2010.[33] Decomposing newspaper firms' direct salary costs and labor inputs across managers, journalists and other employees, we find that the reductions for managers and journalists are similar in size, while reductions for other personnel is disproportionately larger for both labor hours and salary costs. This suggests that newspaper firms cut their costs as a response to the arrival of broadband internet mostly by reducing their labor inputs, and by reducing in particular the use of other support personnel, which may include, e.g., administrative staff (e.g., receptionists, office assistants), printing staff, delivery staff.[34]

Further, we provide additional results from a battery of specification checks for revenues, costs and labor inputs in the Appendix E, Table E.9, analogous to the results for newspaper sales discussed in Section 4.3. These additional results indicate that our findings above are robust to the inclusion of additional controls, dropping five larges cities and municipality-specific time trends.

Heterogeneity Across Market Segments. In Appendix E, we also provide additional evidence on heterogeneous impacts across market segments. Specifically, in Table E.10, Panel A, we find that local newspapers (Column 1) again distinguish themselves in being affected less than tabloids (Column 4) and non-tabloids (Column 7). A ten percentage point increase in broadband internet use is estimated to depress total market revenues by about 4 % for tabloids and 8 % for non-tabloids, respectively. In comparison, the impact on local newspapers is small and not statistically significant at conventional levels. In Panel B, we provide es-

[31] Firms' hiring and firing practices are regulated by law in Norway; firms can fire workers only when facing the risk of operating at a loss or if under-performing relative to their peers (see Huttunen et al. (2011) for details). See Bhuller et al. (2022) and Barth et al. (2014) for broader overviews of the labor market institutions and the role of unions in Norway.

[32] The direct salary costs exclude payroll taxes, contributions to social insurance and retirement, etc., which are included in total wage costs. In 2000, direct salary costs accounted for almost 78.5% of total wage costs in newspaper firms.

[33] This assumes an average full-time job is roughly 1,955 hours a year. We estimate the number of full-time workers in newspaper firms in 2000 to be around 8,800 workers. While we don't consider the aggregate consequences of broadband internet in this paper, compared to an overall labor force of 2.5 million employed workers in 2010, these point estimates suggest a reduction in the aggregate employment rate by 0.1 % (also see Bhuller et al. (2019)). Note that this calculation doesn't account for re-employment of workers displaced due to a downsizing of the print media market into other industries or consequences of broadband internet on employment in other sectors of the economy.

[34] Some newspapers outsource printing or delivery services to other firms, in which cases these costs would be reported as intermediates. For tabloids and non-tabloids that experience large sales losses, we also find significant reductions in their intermediate costs, which could be related to a scaling down of print production and delivery (see Appendix Table E.10, Columns (4) and (7)).

timates on average revenue per unit across market segments. We find that the volume effect can account for the entire revenue fall among tabloids, as there was no reduction in the unit values. The volume effect also dominates among non-tabloids, though we also find evidence of a slight reduction in the average revenue per unit across both sales and advertisements. We also report estimates from our IV model for costs, profits and labor input across locals, tabloids and non-tabloids. Consistent with our findings on revenues, we find that tabloids and non-tabloids reduce their costs, while local newspapers' costs do not change significantly. Furthermore, we find that wage costs, intermediates and labor hours are cut significantly for both tabloids and non-tabloids. Overall, our estimates suggest that non-tabloids are able to offset the large loss of revenue completely by reducing costs. Tabloids, meanwhile seem not to be able to fully mitigate the negative effects of internet and are estimated to experience a reduction in their profits.

5.2 Content, Format and Listed Prices

We now consider how broadband internet affected the newspaper product available to readers and advertisers. As for newspapers' balance sheets, our data on newspapers' product characteristics (e.g., content, format, and size) and listed prices are available at the newspaper-year level. To exploit our variation in broadband availability and usage at the municipality-year level in equation (2) to study how broadband internet affected the newspaper product, we proceed in two alternative ways.

First, we consider how the *average* product characteristic available to consumers in a municipality-year cell changed in response to the broadband internet usage.[35] For instance, if there are two newspapers sold in a municipality, then the average newspaper format in the municipality is just the average of formats across these two newspapers, weighted by their market shares. Specifically, we define an average newspaper product characteristic $\mathscr{C}_{m,t}$ as follows:

$$\mathscr{C}_{m,t} = \sum_n w_{n,m,t} \cdot C_{n,t} \equiv \sum_n \frac{Q_{n,m,t}}{\sum_n Q_{n,m,t}} \cdot C_{n,t} \tag{7}$$

where $w_{n,m,t}$ is newspaper n's market share in municipality m, $C_{n,t}$ is a characteristic of this newspaper in year t, and so $\mathscr{C}_{m,t}$ is the average newspaper characteristic faced by consumers in municipality m in year t. Note that this average characteristic in a municipality can be affected both by changes in the newspapers' market shares in the municipality (i.e., $w_{n,m,t}$) and by changes in the newspapers' actual characteristics (i.e., $C_{n,t}$). In order to distinguish between these two channels, we will first provide estimates using equation (7), and then from an alternative measure where we hold newspapers' market shares fixed to year 2000, before the broadband expansion. In the latter case, we replace $w_{n,m,t}$ by $\overline{w}_{n,m} = \frac{Q_{n,m,2000}}{\sum_n Q_{n,m,2000}}$ for all t in equation (7).

Second, rather than considering how the average product characteristic available to consumers in a municipality-year cell changed, we perform a separate newspaper-year level analysis where we can directly use a product characteristic $C_{n,t}$ as an outcome. As described more closely in Appendix D, this analysis allows us to assess how newspapers that are more exposed to an increase in broadband usage in their initial market change their product characteristics in response to this increase (see equations D.3-D.4 and the

[35] Note that the "allocate-and-aggregate" approach we used in Section 5.1 for newspaper balance sheet variables is not meaningful when we consider product characteristics, which cannot easily be understood as being aggregated from individual units.

surrounding discussion). Intuitively, this analysis relies on there to be persistent differences in the spread of newspapers across locations, so that depending on where newspapers were initiated circulated prior to the broadband expansion, they are also differentially affected by the broadband expansion across space and over time. In Appendix D, we find that newspapers appear to operate in geographically segmented markets with sufficient persistence over time, so that changes in broadband availability and usage over time in locations where newspapers were initially circulated has sizeable impacts on their overall print circulation.

We now present our estimation results based on the above-mentioned approaches. In Panel A of Table 5, we report IV estimates of the impact of broadband internet on the share of newspapers' content devoted to different categories (the corresponding reduced form estimates are provided in Appendix Table E.11). Specifically, we consider the occurrence of keywords linked to different news categories in an online full text archive, as discussed in Section 2. We count mentions of keywords within seven broad categories of news content—(i) Entertainment, (i) Sport, (iii) Crime, (iv) Health, (v) Politics, (vi) Foreign Affairs, and (vii) Business/Finance—and divide by the total number of mentions in all categories. All keywords we use in this content analysis are detailed in Appendix Table A.3.

We start by reporting estimates on the average content shares across newspapers available to customers at the municipality-year level in Table 5, Panel A, Column (1). These estimates reveal substantial declines in Sports and Entertainment content available to consumers in print newspapers, and corresponding increases in content related to Politics and Business/Finance, as well as in Crime content. Notably, when we keep newspapers' market shares fixed to their initial circulation in Column (4), we find quite similar impacts those reported in Column (1). These findings can be interpreted as evidence that newspapers focus their contents on hard news in face of competition from online sources, where tabloid content related to Sports and Entertainment is more readily available. Alternatively, this may represent newspapers' efforts to align their products to changes in their customer base. As shown in Appendix Figure E.1, the average print customer in later years is more likely to be older, and possibly be more interested in politics and finance.

We next report estimates on content shares from the newspaper-year level specification in Table 5, Panel A, Column (7). Here, we again find that newspapers exposed to an increase in broadband usage in their market strongly shift their content away from tabloid (e.g., Entertainment) news and over to more serious (e.g., Politics) news, though these estimates are less precisely estimated. Further, in Appendix E, Table E.12, we provide results from specification checks at the municipality-year level that confirm our evidence.

Next, we consider whether newspapers changed their physical appearence through format and size in response to the broadband internet expansion. In Table 4 we showed that the introduction of broadband internet was met by large cost reductions from newspaper firms, achieved mostly by reducing labor hours. Another way to face the negative shock associated with the arrival of broadband internet, may be to alter the physical product. Cutting pages or reducing size may directly lower costs, but may also change the product experience for readers and advertisers. The expected sign is therefore not obvious. Panel B of Table 5 reports estimates for the impacts of broadband internet usage on newspaper format, number of pages and total size per copy. In Column (1), we do find some evidence suggesting reductions in the number of pages and total print newspaper size when we consider the average newspaper product available to customers. These estimates may suggest that newspapers moved towards smaller formats and a reduction in the number

of pages of each copy. While smaller in magnitude, the estimates with a fixed newspaper composition in Column (4) paint a similar picture and demonstrate that the reduction in size was not purely driven only by changes in the newspapers' market shares. This result is consistent with newspapers cutting costs by offering a smaller product. Finally, we provide estimates from the newspaper-year level specification in Column (7), however, these are too imprecise to draw firm conclusions.

Finally, we consider the impacts on broadband internet on newspapers' listed sales and ad prices. In contrast to the negative impacts on average sales revenue per unit we reported in Table 4, Panel B, we do not find significant impacts on listed sales price per unit in Table 5, Panel C, Columns (1) and (4), although the coefficients are also negative. Comparing the listed sales price of 12 kroner per copy to the average sales revenue per unit of about 8 kroner from Table 4, it is clear that many customers are paying less than the listed price. While these two measures are positively correlated, the average sales revenue per unit captures rebates that newspapers can offer through subscriptions or bulk purchases. Our findings could thus be interpreted as suggesting that newspapers might have attempted to retain print customers by offering lower subscription rates, but not necessarily adjusting their listed unit sale prices. Again, the estimates on listed unit sale prices based on our newspaper-year level specification in Column (7) are too imprecise to draw firm conclusions. Further, we observe stronger reductions in the listed advertisement prices. Interpreting the evidence on listed ads prices in particular is not straight-forward. On the one hand, the price of ads is likely linked tightly to the number of ads, such that a reduction in price may be associated with an increase in the quantity and therefore with a substantially lesser reduction in ad revenue. On the other hand, the actual sales price for ads may differ substantially from the actual price, due to extensive bundling and rebating in sales. It is clear however that the reduction in ad prices is consistent with the theory surrounding two-sided markets (Rysman, 2009; Filistrucchi and Klein, 2015). Demand from customers on one side of the market (advertisers) depends on demand from customers on the other side of the market (newspaper readers). Given the large declines in print readership described in Section 4, it is unsurprising to see a corresponding decline in ad prices.

Heterogeneity Across Market Segments. Looking across newspaper market segments in our municipality-year level analysis in Appendix Table E.13, we find that both locals (Column 1) and non-tabloids (Column 7) saw large reductions in their content focused on Sports and Entertainment and corresponding increases in Politics and Business/Finance. While we are not able to quantify the politics content in local newspapers further to underpin the exact mechanisms, it seems reasonable to assume that content related to local politics would find a natural place in these newspapers, allowing them to serve their customers a more differentiated product than available online. Further, for non-tabloids, we also find a reduction in the content share devoted to Foreign Affairs, which one would expect is more readily available online. By contrast, we find limited impacts on the content composition of tabloids (Column 4), which also tend to maintain higher content shares of Sports and Entertainment, and are the newspaper segment that experienced the largest reductions in their print sales. Comparing across the upper and lower panels, however, we find that these conclusions are robust to holding the newspapers' market shares fixed to initial circulation. Focusing on format and size, we see that non-tabloids (Column 7) significantly reduced the size of their newspapers, and to a lesser extent, we also see this among locals (Column 1). By construction, we do not see changes in the format of tabloids.

Table 5: IV Estimates of Internet Use on Content, Format and Listed Prices.

Level of Analysis:	**Municipality-Year Level**						**Newspaper-Year Level**		
	Total Effect			**Fixed Composition**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	(6)	**(7)**	**(8)**	**(9)**
	Estimate	**(SE)**	**Mean**	**Estimate**	**(SE)**	**Mean**	**Estimate**	**(SE)**	**Mean**
A. Content Shares									
Sport and Entertainment	-6.839***	(2.129)	35.38	-6.252***	(2.023)	35.38	-25.03*	(14.02)	35.94
Entertainment	-4.372***	(1.446)	18.95	-4.459***	(1.426)	18.95	-19.09*	(11.56)	19.26
Sport	-2.467**	(1.184)	16.43	-1.794	(1.164)	16.43	-5.939	(6.803)	16.69
Health and Crime	1.704**	(0.814)	27.68	1.316*	(0.768)	27.68	0.470	(7.855)	27.33
Health	2.356***	(0.544)	12.47	2.046***	(0.523)	12.47	5.176	(4.040)	12.27
Crime	-0.652	(0.755)	15.21	-0.729	(0.708)	15.21	-4.706	(6.694)	15.06
Politics, FA and B/F	5.136***	(1.838)	36.94	4.936***	(1.725)	36.94	24.56**	(11.55)	36.73
Politics	3.547***	(1.039)	15.61	2.899***	(1.001)	15.61	16.83**	(6.779)	14.62
Foreign Affairs	-1.149**	(0.471)	3.402	-0.365	(0.379)	3.402	-5.075	(3.117)	3.659
Business/Finance	2.738***	(1.047)	17.93	2.401**	(1.007)	17.93	12.79	(9.521)	18.46
B. Format and Size									
Format (Page Size in cm^2)	-301.5	(190.1)	1447	-228.6	(193.4)	1447	310.2	(1,950)	1,499
No. of Pages	-10.72**	(4.729)	43.43	-7.999*	(4.648)	43.43	-67.5	(44.2)	46.31
Total Size (Format $\times$ No. of Pages)	-25981***	(8894)	62,614	-19132**	(9088)	62,614	-44,856	(122888.1)	67,267
C. Listed Sales Price and Advert Prices									
Sales Price per Copy	-0.459	(0.762)	12.03	-0.432	(0.751)	12.03	-5.684	(8.220)	12.11
Full Page in 4 Colors	-29,641***	(6118)	90,356	-9,115	(5,829)	90,356	-160,462	(108,190)	114,202
Full Page in B/W	-25,380***	(4582)	56,348	-12,516***	(4,467)	56,348	-13,1953*	(70,091)	71,130
Column Ads, per cm	-13.74***	(2.994)	52.85	1.911	(2.605)	52.85	-14.65	(20.27)	63.54

Notes: . Columns (1)-(6) display estimates from our main specification at municipality x year level (4,620 observations). Estimates show the results from the second stage regression equation 2. In the "Fixed Composition" Columns (7)-(9) we fix the composition of newspaper sales in each municipality to the levels they were in 2000, in order to isolate the direct effect of broadband usage from the change in composition effect. Columns (7)-(9) display estimates for outcomes measured at the newspaper x year level (850 observations) as described in Section D. Estimates show the results from the second stage regression equation (D.4) Regressions in all specifications include the demographic controls discussed in Table A.2, Panel E. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Prices are in 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK. The mean for each outcome variable from the baseline year, 2000, is displayed in columns (3). (6) and (9). Regressions in Columns (7)-(9) are weighted by the initial circulation of newspapers. Standard errors are heteroskedasticity robust and in columns (1)-(6) clustered at municipality level.
* p < 0.1, ** < 0.05, *** p < 0.01.

6 Conclusion

Over the past decades, the media landscape has changed dramatically: Print media has experienced a sharp decline, and the internet has become the leading channel of information and entertainment for consumers. These trends raise concerns not only about the future of traditional print media, but also triggered debates over the consequences for the civic society, especially in light of a growing body of work documenting the effects of internet on political participation and electoral outcomes. Using detailed data from Norway on the print newspaper market, and exploiting plausibly exogenous variation in the availability and adoption of broadband internet, our study provides evidence that the internet to some extent displaced traditional print media. Our estimates indicate that 40 % of the reduction in overall print circulation of Norwegian newspapers between 2000 and 2010 was caused by increased broadband internet adoption. This evidence lends support to a mechanism often hypothesized in studies conceptualizing the relationship between internet and political outcomes, i.e., that the internet influences such outcomes through the displacement of traditional print media. However, we also find that internet adoption explained almost none of the decline of local newspapers, which may suggest that these causal linkages are more nuanced.

Despite major technological changes over time, the media market has time and again proved remarkably resilient. Focusing on the economic activities inside newspaper firms and by linking detailed data on their revenues, factor inputs and product characteristics, we are also able to provide novel evidence on how media firms respond to a large scale technological change that threatens a key source of their revenue. Our evidence shows that newspaper firms responded across a variety of margins of adjustment. These firms were largely able to offset the revenue loss by shedding workers and cutting costs. By laying off disproportionately more workers that were less likely to have been directly involved in the production of news, e.g., additional support or delivery staff, these firms were able to continue their business activities. Moreover, newspapers also cut their costs by reducing the physical size or format of newspaper sheets. Local newspapers – which to large extent mitigated the negative impacts of internet adoption – significantly reduced their tabloid content (e.g., sports, entertainment) and shifted coverage to more serious news topics (e.g., politics, finance).

The variety of responses across multiple margins of adjustment that we document draws a picture of newspaper firms as being highly flexible, providing a potential explanation for economic resilience in the media market. A more recent example of technology-driven adjustment among newspapers that took place after our study period, is the near-universal adoption of digital paywalls for online readers. Arguably, this recent development allows newspapers to sustain their business model and extract sizeable revenues from online customers, potentially offsetting some of the initial adverse impacts of broadband internet technology. Future research on the newspaper market should aim to uncover the causes and consequences of this change.

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A Appendix: Details on Data Sources

Table A.1: Data on Newspapers.

	Newspaper Name	Circulation* (2000)	Releases Per Week	Year of Website	Data Availability: Readership	Balance Sheets	Worker Data	Product Data	Content
	Tabloids:								
1.	Dagbladet	182,741	5	1996	✓	✓	✓	✓	✓
2.	VG	343,828	5	1996	✓	✓	✓	✓	✓
	Non-tabloids:								
3.	Aftenposten morgen	258,162	5	1996	✓	✓	✓	✓	✓
4.	Ávvir (Est. 2008)	1,192	5	2008		✓		✓	Partial
5.	Dag og Tid	6,099	1	1999	✓		✓	✓	✓
6.	Dagenmagazinet	8,198	6	2001	✓	✓	✓	✓	
7.	Dagens Næringsliv	63,030	5	2000	✓	✓	✓	✓	✓
8.	Finansavisen	18,419	6	1997	✓		✓	✓	Partial
9.	Fiskaren (Merged 2008)	8,135	3	1998	✓	✓	✓	✓	✓
10.	FiskeribladetFiskaren (Est. 2008)	10,806	3	1999	✓	✓	✓	✓	
11.	Klassekampen	6,911	6	1996	✓	✓	✓	✓	✓
12.	Morgenbladet	5,950	1	2004	✓		✓	Partial	✓
13.	Nationen	17,383	6	1997	✓	✓	✓	✓	✓
14.	Ny Tid	6,223	1	2001	✓		✓	Partial	Partial
15.	Vårt Land	27,650	4	2001	✓	✓	✓	✓	✓
	Daily Locals:								
16.	Adresseavisen	88,084	6	1998	✓	✓	✓	✓	✓
17.	Aftenposten Aften	170,438	5	1996	✓			✓	
18.	Agderposten	12,663	6	1999	✓	✓	✓	✓	✓
19.	Akershus Amtstidende	4,818	5	2000	✓		✓	✓	✓
20.	Altaposten	5,693	6	2001	✓	✓	✓	✓	✓
21.	Asker og Bærum Budstikke (Budstikka)	31,279	6	1998	✓	✓	✓	Partial	✓
22.	Aura Avis	3,687	4	2000	✓	✓	✓	✓	✓
23.	Avisa Nordland (Est. 2002)	26,816	6	2000	✓		✓	✓	✓
24.	Avisa Sør-Trøndelag	7,032	5	2000	✓	✓	✓		✓
25.	Bergens Tidende	92,339	7	1996	✓	✓	✓	Partial	✓
26.	Bergensavisen (BA)	29,576	7	1996	✓	✓	✓	✓	✓
27.	Bladet Vesterålen	10,590	5	2005	✓	✓	✓	✓	Partial
28.	Brønnøysunds Avis	4,776	5	1997	✓	✓	✓	✓	✓
29.	Dagsavisen	37,650	7	1998	✓	✓	✓	✓	✓
30.	Drammens Tidende	46,948	6	2001	✓	✓	✓	✓	✓
31.	Eidsvoll Ullensaker Blad	7,702	5	2005	✓	✓	✓	✓	Partial
32.	Farsunds Avis	6,058	6	2004	✓	✓	✓	✓	Partial
33.	Finnmark Dagblad	7,443	6	2000	✓	✓	✓	✓	✓
34.	Finnmarken	7,634	6	2000	✓	✓	✓	✓	✓
35.	Firda	14,603	6	2000	✓	✓	✓	✓	✓
36.	Fredriksstad Blad	3,033	7	2000	✓	✓	✓	✓	✓
37.	Fremover	9,717	6	1998	✓	✓	✓	✓	✓
38.	Fædrelandsvennen	45,872	6	2004	✓	✓	✓	✓	✓
39.	Gjengangeren	6,105	6	1998	✓		Partial	✓	✓
40.	Glåmdalen	20,748	6	2000	✓	✓	✓	✓	
41.	Gudbrandsdølen Dagningen	28,652	6	2000	✓	✓	✓	✓	✓
42.	Hadeland	7,505	5	1999	✓		✓	✓	✓
43.	Halden Arbeiderblad	9,880	6	1998	✓	✓	✓	✓	✓
44.	Hamar Arbeiderblad	19,166	6	2003	✓		✓	✓	✓
45.	Harstad Tidende	14,992	6	2000	✓	✓	✓	✓	✓
46.	Haugesunds Avis	35,408	6	2006	✓	✓	✓	✓	✓
47.	Helgeland Arbeiderblad	10,221	6	1998	✓	✓	✓	✓	✓
48.	iTromsø	10,550	6	2000	✓	✓	✓	Partial	✓
49.	Laagendalsposten	10,886	6	1999	✓			✓	✓
50.	Lindesnes	6,605	6	2002	✓	✓	✓	✓	✓
51.	Lofotposten	9,413	6	1997	✓	✓	✓	✓	✓
52.	Moss Avis	15,436	7	1996	✓	✓		✓	✓
53.	Namdals-Avisa	13,569	6	2001	✓	✓	✓	✓	✓
54.	Nordlands Framtid (Merged 2002)	19,354	6	2000	✓		✓	✓	✓
55.	Nordlandsposten (Merged 2002)	15,454	6	1998	✓			✓	✓
56.	Nordlys	29,810	6	1997	✓		✓	✓	✓
57.	Oppland Arbeiderblad	29,440	6	1998	✓	✓	✓	✓	✓
58.	Østlandets Blad	18,059	6	1998	✓		✓	✓	✓
59.	Østlands-Posten	14,502	6	1999	✓	✓	✓	✓	✓
60.	Østlendingen/Hamar Dagblad	20,334	6	1999	✓	✓	✓	✓	✓

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	Newspaper Name	Circulation* (2000)	Releases Per Week	Year of Website	Data Availability: Readership	Balance Sheets	Worker Data	Product Data	Content
	Daily Locals (continued):								
61.	Porsgrunns Dagblad	6,391	6	1999	✓	✓	✓	✓	✓
62.	Rana Blad	11,151	6	1999	✓	✓	✓	✓	✓
63.	Ringerikes Blad	13,144	6	2000	✓	✓	✓	✓	✓
64.	Rjukan Arbeiderblad	2,373	5	2007	✓	✓	✓	✓	✓
65.	Rogalands Avis	15,179	6	1998	✓	✓	✓	✓	✓
66.	Romerikes Blad	33,988	4	2000	✓		✓	✓	✓
67.	Romsdals Budstikke	18,767	6	2006	✓	✓	✓	✓	✓
68.	Sandefjords Blad	15,289	6	1999	✓	✓	Partial	✓	✓
69.	Sarpsborg Arbeiderblad	1,189	6	1999	✓	✓	✓	✓	
70.	Smaalenenes Avis	14,260	6	2000	✓		✓	✓	Partial
71.	Stavanger Aftenblad	72,954	6	1996	✓	✓	✓	✓	✓
72.	Sunnhordland	8,464	5	2001	✓		✓	✓	Partial
73.	Sunnmørsposten	38,328	6	1998	✓	✓	✓	✓	✓
74.	Telemarksavisa	22,416	6	2000	✓	✓	✓	✓	✓
75.	Telen	5,840	6	2000	✓	✓	✓	✓	✓
76.	Tidens Krav	7,185	6	2000	✓		✓	✓	✓
77.	Tønsbergs Blad	32,796	6	2001	✓	✓	✓	✓	✓
78.	Troms Folkeblad	7,412	6	1998	✓	✓	✓	✓	✓
79.	Trønder-Avisa	23,615	6	2002	✓	✓	✓	✓	✓
80.	Valdres	9,627	4	2000	✓		Partial	✓	✓
81.	Varden	31,439	6	2000	✓		✓	✓	✓

Notes: Our sample consists of 81 newspapers that operated between 2000-2010 with complete circulation data by municipality and year from the Norwegian Media Businesses' Association, which also provided annual data on product characteristics (e.g. format, ad prices, etc.) for 80 of these newspapers. Further, we accesses detailed annual balance sheets for 60 newspapers in our sample provided by the Norwegian Media Authority. We also match to annual worker data (e.g. wages, hours, etc.) from Statistics Norway's employer-employee registers using newspaper firm IDs for 76 newspapers. And, we were to retrieve content data for 76 newspapers in our sample from the National Library of Norway's online database of historical newspapers. In addition we make use of a readership survey provided by Kantar/TNS Gallup, which has information about readership of 80 newspapers in our sample, as well as the readership of major online only news sites (e.g., nettavisen.no, e24.no, na24.no, side2.no, tv2.no, nrk.no, sol.no, etc.) that do not have a print counterpart. The year of website reported above denotes the first year in which a website for the newspaper can be found on the Internet Archive Wayback Machine (Internet Archive, 2022).

*Circulation figures show total circulation in Norway per released edition as reported by MBL for the municipalities in our sample. For three newspapers that did not exist in the year 2000, namely Ávvir, Avisa Nordland, and FiskeribladetFiskaren, we instead show the newspaper's circulation in the year it was established. Ávvir is the only new entrant to the newspaper market in our sample, being established in 2008. The two other newspapers were formed by mergers of pre-existing newspapers. Avisa Nordland was established in 2002, by a merger of Nordlands Framtid and Nordlandsposten. FiskeribladetFiskaren was established in 2008, by a merger of Fiskaren with a smaller newspaper Fiskeribladet. No newspapers in our sample (apart from the aforementioned ones that merged) went defunct during our sample years 2000-2010.

Table A.2: Descriptions of Variables.

Variable	Description
A. Main Outcomes:	
Newspaper Sales	
Print Circulation Rate	Total newspaper circulation per edition per household in municipality k in year t. This is calculated as the summation of every newspaper's circulation (per edition) within a municipality in a given year, and then dividing by the number of households.
Annual Print Sales Volume	Yearly newspaper circulation per household in municipality k in year t. Yearly circulation is calculated for each newspaper as circulation per edition $\times$ number of releases each week $\times$ 52.
Readership Rate	Yearly newspaper readership rate among surveyed individuals aged 12 or above in media district d in year t. Readership rates are estimated by Kantar/TNS Gallup based on the Pure Recent Reading (PRR) method that uses information on whether a respondent (i) has read a newspaper in the last 12 months, (ii) when a newspaper was most recently read, and for daily newspapers, (iii) how many of the last 6 editions were read. See Østnes and Futsæter (2003) for details. Readership is further distinguished by online and print readership.
Market Revenues	
Sales	Total yearly newspaper revenue per household from sales of newspapers in municipality k in year t (in 2010 NOK). For each newspaper we allocated its sales revenue to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality. Sales revenues include revenues generated from print and online sales.
Advertisement	Total yearly newspaper advertisement revenue per household in municipality k in year t (in 2010 NOK). For each newspaper we allocated its advertisement revenue to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality. Ads revenues include revenues generated from any type of ads (such as classified ads), irrespective of the platform where the ads were displayed.
Average Revenue Per Unit	
Average Sales Revenue Per Unit	Average Sales Revenue Per Unit (ARPU) is a measure of average sales revenue per sold copy in municipality k in year t (in 2010 NOK). For each municipality this is calculated as 'Revenue' divided by 'Sales Volume'.

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B. Balance Sheets and Labor Input Outcomes:

Direct Salary Costs	Total yearly newspaper salary costs per household in municipality *k* in year *t* (in 2010 NOK). For each newspaper we allocated its direct salary costs to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.
Labor Hours	Total yearly newspaper labor hours per household in municipality *k* in year *t* (in 2010 NOK). For each newspaper we allocated its direct salary costs to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.
Hourly Wage Rate	Average hourly wage rate in municipality *k* in year *t* (in 2010 NOK). For each municipality this is calculated as 'Direct Salary Costs' divided by 'Labor Hours'.
Wage Costs	Total yearly newspaper wage costs per household in municipality *k* in year *t* (in 2010 NOK). For each newspaper we allocated its wage costs to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.
Intermediate Costs	Total yearly newspaper intermediate costs per household in municipality *k* in year *t* (in 2010 NOK). For each newspaper we allocated its intermediates costs to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.
Profits (EBITDA)	Total newspaper earnings before interest, taxes, depreciation, and amortization per household in municipality *k* in year *t* (in 2010 NOK). For each newspaper we allocated its profits to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.

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C. Format and Content Outcomes:

Listed Sales Price

Sales Price per Copy	Average listed price of a single copy newspaper in municipality *k* in year *t* (in NOK, deflated to 2010 values). This variable is constructed as a weighted average of the newspapers in the municipality based on their sales in that municipality.

Listed Advertisement Prices

Full Page in 4 Colors	Average price of a full page, 4 color, newspaper advertisement in municipality *k* in year *t* (in NOK, deflated to 2010 values).This variable is constructed as a weighted average of the newspapers in the municipality based on their sales in that municipality.
Full Page in B/W	Average price of a full page, black and white, newspaper advertisement in municipality *k* in year *t* (in 2010 NOK, deflated to 2010 values). This variable is constructed as a weighted average of the newspapers in the municipality based on their sales in that municipality.
Column Ads, Per cm	Average price per centimeter of a column newspaper advertisement in municipality *k* in year *t* (in 2010 NOK, deflated to 2010 values). This variable is constructed as a weighted average of the newspapers in the municipality based on their sales in that municipality.

Format

Format in cm^2	Newspaper format size (page length x page width) in cm^2 in municipality *k* in year *t*. For each newspaper we allocated the size of the format to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.
No. of Pages	Number of pages per copy in municipality *k* in year *t*. For each newspaper we allocated the number of pages per copy to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.
Total Size	Total size per copy (page size in cm^2 x number of pages) of newspaper in municipality *k* in year *t*. For each newspaper we allocated the number of mentions of a keyword to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality.

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C. Format and Content Outcomes (continued):

Content

Keyword Mention Share	We count mentions of keywords in municipality *k* in year *t* within three categories of news – (i) Entertainment; (ii) Sports; (iii) Crime; (iv) Health; (v) Politics; (vi) Foreign Affairs; and (vii) Business/Finance. For each newspaper we allocated the number of mentions of a keyword to a municipality based on the share of its circulation in that municipality. We then aggregate across all newspapers in each municipality. Finally, we divide by the total number of mentions in all categories that were assigned to that municipality to give a 'mention share' to each category. For the list of keywords in each category please see Table A.3.

D. Broadband Usage and Availability:

Usage Rate	Broadband usage rate in municipality *k* in year *t-1*. This is the fraction of households residing in a given municipality at the beginning of year t-1, who are subscribing to broadband internet (with access speed at or above 256 kilobits per second).
Availability Rate	Broadband availability rate in municipality *k* in year *t-2*. This is the fraction of households residing in a given municipality at the beginning of year t-2, who can have access to broadband internet (with access speed at or above 256 kilobits per second). It is used as an instrument for the usage rate (in t-1).

E. Baseline Controls: Demographic Characteristics

Age-groups (%)	Percentage share aged 16–21, 22–24, 25–34, 35–44, 45–54, 55–66, and 67 or above at the beginning of year *t*.
Students (%)	Percentage share aged above 15 registered as students at the beginning of October each year *t*.
Poverty Rate (%)	Percentage share having an annual income below half of the median equivalent after-tax income, when using the OECD equivalence scale to calculate the equivalent income.
Unemployed (%)	Percentage share aged 16–59 registered as fully unemployed at beginning of year *t*.
Immigrants (%)	Percentage share who are foreign-born at the beginning cc
Income (NOK)	Average after-tax disposable income earned during year t by individuals aged 16–59 years.
Years of Education	Average years of schooling among persons aged 16–59 at the beginning of year *t*.

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F. Additional Controls: Newspaper Demand	
Population Size	Number of residents in the municipality at the beginning of year t.
Urban Residence (%)	Percentage share living in a densely populated locality at the beginning of year t.
Public Sector (%)	Percentage share aged 16–59 employed in the public sector at the beginning of year t.
Services Sector (%)	Percentage share aged 16–59 employed in the services sector at the beginning of year t.
Private Services Sector (%)	Percentage share aged 16–59 employed in the private services sector at the beginning of year t.
G. Additional Controls: Broadband Expansion	
Distance (in km)	Average distance in kilometers to the municipal sub-center at the beginning of year t.
Travel Time (in Minutes)	Average travel time per person in minutes to the municipal center at the beginning of year t.
Roads (in km)	Municipal road networks measured in kilometers per 1000 residents at the beginning of year t.
Total Expenditure	Per capita spending on municipal public services in year t (in 1000 NOK, deflated to 2010 values).
Administration Expenditure	Per capita spending on municipal administration in year t (in 1000 NOK, deflated to 2010 values).
Education Expenditure	Per capita spending on municipal schools and other educational institutions in year t (in 1000 NOK, deflated to 2010 values).
Health Expenditure	Per capita spending on municipal health care services in year t (in 1000 NOK, deflated to 2010 values).
Infrastructure Expenditure	Per capita spending on municipal infrastructural maintenance (roads, pipes, tunnels) in year t (in 1000 NOK, deflated to 2010 values).

Table A.3: List of Keywords Used in the Content Analysis.

Topic:	Entertainment		Sports		Crime		Health		Politics		Foreign Affairs		Businnes/Finance	
	Word	*English*	*Word*	*English*	*Word*	*English*	*Word*	*English*	*Word*	*English*	*Word*	*English*	*Word*	*English*
1	bursdag	birthday	ball	ball	beslag	seizure	aktiv	active	arbeiderparti	labor party	ambassadør	ambassador	aksje	stock
2	drama	drama	basket	basketball	bevis	proof	alderdom	old age	avstemning	vote	bilateralt	bilaterally	arbeidsledighet	unemployment
3	dronning	queen	em	European Cup	dom	judgement	bakterie	bacteria	demonstrasjon	demonstration	efta	EFTA	bolig	housing
4	film	film	fotball	soccer	dommer	judge	diabetes	diabetes	formannskap	chairmanship	eøs	EEA	børs	stock exchange
5	fritid	leisure time	friidrett	athletics	drap	murder	ernæring	nutrition	fremskrittsparti	progressive party	eu	EU	eksport	export
6	hollywood	hollywood	hockey	hockey	fengsel	prison	grønnsaker	vegetables	høyre	conservative party	europarådet	the council of europe	fattigdom	poverty
7	komedie	comedy	idrettsgren	sports branch	forbrytelse	felony	helse	health	innvandring	immigration	fn	UN	finans	finance
8	komiker	comedian	kappløping	racing	kriminalitet	crime organized	helsekost	health food	konservativ	conservative	haag	the hague	gjeld	debt
9	konge	king	kaptein	captain	kripos	crime unit	kalori	calorie	liberal	liberal	krig	war	handel	trade
10	kongehuset	the royal house	landslag	national team	lensmann	sheriff	kjøtt	meat	politiker	politician	menneskerettigheter	human rights	import	import
11	kronprins	crown prince	mål	goal	mord	murder	kreft	cancer	politikk	policy	nato	nato	inflasjon	inflation
12	lyrikk	lyrics	mesterskap	championship	narkotika	drugs	lege	doctor	regjering	government	oecd	OECD	lån	loan
13	musikk	music	nm	NM	offer	victim	matvarer	foodstuffs	senterparti	center party	terrorisme	terrorism	næringsliv	business life
14	opptreden	arts performance	offside	offside	overgrep	abuse	mosjon	exercise	statsminister	prime minister	traktat	treaty	overskudd	profit
15	orkester	orchestra	score	score	påtale	prosecution	syk	sick	statsråd	Minister of State	utenriks	abroad	prisindeks	price index
16	show	show	sjakk	chess	politi	police	sykehus	hospital	storting	Parliament	utenriksminister	Foreign Minister	rente	interest
17	skuespiller	actor	ski	ski	ran	robbery	sykepleie	nursing	transport	transportation	utenrikspolitikk	foreign policy	stillinger	positions
18	stjernetegn	star sign	sport	sport	tiltale	indictment	trening	training	vedtak	decision	våpen	guns	streik	strike
19	tv	tv	tennis	tennis	tyveri	theft	ufør	disabled	veibygging	road construction	våpenhvile	truce	ulikhet	inequality
20	underholdning	entertainment	vm	World Cup	varetekt	custody	vekt	weight	velgere	voters	washington	Washington	valuta	currency

B Appendix: Segments of the Norwegian Newspaper Market

The newspaper market in Norway is characterized by relatively high differentiation comprising distinct market segments. Most newspapers are local or regional, and serve relatively small geographic markets. The newspapers with national orientation and nationwide distribution can be further segmented in two groups; tabloid newspapers (VG and Dagbladet) and about a dozen non-tabloid newspapers. In our analysis, we thus rely on a classification the Norwegian newspaper market into three segments; locals, tabloids and non-tabloids, which is often used in Norwegian media policy.

Characterization of Market Segments. We provide here a characterization of the salient dimensions along which newspapers in the three segments tend to differ, namely their (i) geographical distribution patterns, (ii) reliance on public subsidies, and (iii) content and other product characteristics. First, as indicated above, a key distinction between local and national newspapers is that the former serve relatively small geographic markets, while the latter have national orientation and nationwide circulation. We quantify the differences in the geographical distribution across market segments below, finding that local newspapers indeed have a dominant position in their local markets (e.g., their main municipality of distribution), while both tabloids and non-tabloids have a much more balanced spread across geography.

Second, Norway has a system of direct subsidies that are differentially targeted towards print newspapers.[36] Our calculations show that while local newspapers generated around 46% of the total market revenue (excluding subsidies) in the print market in 2000, these newspapers received almost 62% of the overall direct subsidies.[37] The remaining share of subsidies was awarded to national non-tabloids, while tabloids are not eligible for such support. Indeed, the goal of the subsidy system is to maintain a variety of print newspapers across the country, which can represent different ideological/political, geographical, linguistic, or religious/ethnic opinions. Thus, it is not surprising that locals and non-tabloids are the beneficiaries.

Finally, locals, tabloids and non-tabloids also differ significantly in terms of content, format and other product characteristics. We document these differences in Appendix Table E.13, where Columns (3), (6) and (9) show the mean content shares (in 2000) by seven broad categories for locals, tabloids and non-tabloids, respectively. Unsurprisingly, tabloids tend to have a much higher share of content related to Sports, Entertainment, and Crime, and substantially lower shares of content related to Politics and Business/Finance, as compared to national non-tabloids. For most categories, locals tend to lie somewhere between tabloids and non-tabloids, however, they report content related to Politics almost at the same rate as non-tabloids, while non-tabloids stand out in terms of the reporting of Foreign Affairs content. While we are not able to quantify political content in local newspapers further, it seems reasonable to assume that content related to Local Politics would find a natural place in these newspapers. With respect to format and size, locals are much more similar to non-tabloids. Further, we find that listed ads prices for locals (e.g., the price of publishing a full page ad) are often much lower than those for tabloids and non-tabloids.

[36] In addition to the direct subsidies, print newspapers in Norway are exempt from the value added tax (normal goods and services are levied a VAT of 25% on sales). This indirect subsidy, however, is not differentiated across the three market segments we consider.

[37] Direct subsidies accounted for almost 2% of the total revenues of local newspapers. However, the subsidy rates vary considerably across newspapers, with some local newspapers receiving up to one-fifth of their revenue through a direct subsidy.

Geographical Distribution Patterns. To verify that our classification in three segments (locals, tabloids and non-tabloids) is reasonable, we compare the geographical dispersion patterns of these segments. To this end, we define for each newspaper the municipality with the highest level of sales as the main municipality of the newspaper. We then calculate the share of total circulation of each newspaper in four geographical areas: (i) the main municipality, (ii) municipalities neighboring the main municipality, (iii) other municipalities within the same county, and (iv) outside the county. Table B.1 shows the average of these shares within each newspaper type. Because municipalities differ in size, we also report the average circulation rate (i.e., copies sold per edition per household) in each region and for each type.

Table B.1: Geographical Dispersion of Circulation by Newspaper Market Segments.

	Locals	**Tabloids**	**Non-tabloids**
	(1)	(2)	(3)
A. Share of Total Circulation			
Main Municipality	50.7%	16.8%	37.0%
Neighboring Municipalities	25.3%	7.0%	12.8%
Rest of County	17.3%	4.1%	7.5%
Rest of Norway	6.8%	72.1%	42.7%
B. Circulation Rate			
Main Municipality	0.51	0.13	0.20
Neighboring Municipalities	0.35	0.14	0.18
Rest of County	0.14	0.12	0.14
Rest of Norway	0.00	0.12	0.03

Notes: The shares of total circulation (panel A) and circulations rates (panel B) are calculated as weighted averages across all newspapers within each type using data on newspapers' circulation by municipality and year obtained from the Norwegian Media Businesses' Association for years 2000-2010. The weighted averages use each newspaper's total annual circulation as weights to account for size differences across newspapers within each type. The 'main' municipality refers to the municipality with the highest share of a newspaper's circulation. The shares of total circulation sum to 100 % across the four geographical areas. The circulation rates are calculated as the number of copied sold (per edition) divided by the number of households residing in each geographical area at the start of each year. For a complete list of newspapers included see Appendix Table A.1.

The geographical dispersion documented in Table B.1 shows that newspapers differ distinctly by type: Among local newspapers, 51 % of circulation is within the main municipality, and 93 % within a single county. Local newspapers also have a strong position locally, with an average circulation rate of 0.51 in the main municipality and 0.35 in neighboring municipalities. In contrast, among tabloid newspapers, 72.1 % of circulation is outside the county of the main municipality, and the circulation rates are very similar across geographic markets. Non-tabloids stand somewhere between the other two, with 37 % of circulation in the main municipality. Note, however, that this is largely due to the strong urban base of non-tabloids, with high circulation in Oslo and other major cities.

Cross-Price Elasticities Across Newspaper Segments. Another way to assess the classification of newspapers is to estimate the price elasticity of newspaper circulation with respect to (i) their own price, (ii) the price of other newspapers of the same type, and (iii) the price of other types of newspaper types. To assess the cross-price elasticity of demand between newspapers of different types (locals, tabloids, non-tabloids)

within each market (municipality), we calculate the following:

$$p_{c(n),m,t} = \sum_{i \neq n} \frac{1[c(n)=c(i)]Q_{i,m,t}}{\sum_{i \neq n} 1[c(n)=c(i)]Q_{i,m,t}} p_{i,t} = \text{price of same type in municipality } m \quad \text{(B.1)}$$

$$p_{c'(n),m,t} = \sum_{i \neq n} \frac{1[c(n)\neq c(i)]Q_{i,m,t}}{\sum_{i \neq n} 1[c(n)\neq c(i)]Q_{i,m,t}} p_{i,t} = \text{price of other type in municipality } m \quad \text{(B.2)}$$

where $p_{n,t}$ is the price per copy of newspaper n of type $c(n)$ in year t and $Q_{n,m,t}$ is its sales quantity in municipality m. We then estimate the following equation:

$$\ln(Q_{n,m,t}) = a + b_1 \ln(p_{n,t}) + b_2 \ln(p_{c(n),m,t}) + b_3 \ln(p_{c'(n),m,t}) + x_{n,m,t}\beta + g_t + e_{n,m,t}, \quad \text{(B.3)}$$

where $x_{n,m,t}$ includes a full set of municipality-by-newspaper interacted fixed effects and year fixed effects g_t. By controlling for these variables, we use within municipality-newspaper price variation and remove common time effects.

Table B.2: IV Estimates of Own-Price and Cross-Price Elasticities of Newspaper Circulation.

	Estimate	**(SE)**	**Estimate**	**(SE)**
	(1)	**(2)**	**(3)**	**(4)**
Own-Price Elasticity (b_1)	-1.512***	(0.138)	-1.459***	(0.140)
Cross-price Elasticity Within Type (b_2)	1.383***	(0.117)	1.443***	(0.119)
Cross-price Elasticity Across Type (b_3)	-0.131	(0.230)	0.106	(0.253)
Municipality x Newspaper Fixed Effects	✓		✓	
Year Fixed Effects	✓		✓	
All Controls			✓	
No. Observations	110,546		110,546	

Notes: Equation (B.3) is estimated using annual data on newspapers' unit prices and circulation (by municipality) obtained from the Norwegian Media Businesses' Association for years 2000-2010. IV estimates of own- and cross-price elasticities are constructed by instrumenting own price, within-type average price and across-type average price by corresponding measures of per-unit wage costs. Controls include all variables listed in Panel E of Appendix Table A.2.
* p < 0.1, ** < 0.05, *** p < 0.01.

We expect own-price elasticity to be negative, i.e., $b_1 < 0$. For the segmentation into different newspaper categories we should expect that there is substitution within categories, but not much substitution between categories, i.e., $b_2 > 0$, and b_3 is close to zero. To address endogeneity concerns over in prices, we instrument p_n, $p_{c(n),m}$, and $p_{c'(n),m}$ with the corresponding wage costs per unit. Table B.2 shows the own- and cross-price elasticities. Looking at the IV estimates in the first two rows, we can see that newspapers are price elastic and go in the direction that we expect. The point estimates suggest the same type of newspapers are relatively close substitutes, and that newspaper demand is largely independent across the different types.

C Appendix: Specification Checks

In the following, we challenge the assumption of common trends underlying our main identification strategy in a number of ways. First, we assess the robustness of our findings to adding time-varying covariates of newspaper demand and broadband expansion. Second, we drop big cities to to make sure that differential trends across big cities and other municipalities are not driving our results. Third, we drop the post-2008 years from our analysis to avoid picking up potential differential effects of the financial crisis. Fourth, we allow for municipality-specific time trends and provide results from placebo tests. Finally, we verify that our results are robust to alternative specifications of the relationship between broadband availability, broadband adoption and newspaper sales by including lagged responses.

Additional Time-Varying Controls. Our identification strategy rests on the roll-out of broadband internet being unrelated to other drivers of newspaper demand. To test this, we start by including control variables to see to what extent the IV-estimates of internet use on newspaper sales are sensitive to the inclusion of time-varying covarites. It is useful to include control variables in steps, both to guard against potentially bad control variables and to clarify what type of control variables may be influencing the estimates. Our baseline estimates in column (1) of Table C.1 already control for demographic characteristics, including population composition in seven different age bins, and fractions of unemployed, immigrants, low-income households, and students, and average income and years of education. In column (2), we further add controls that account for newspaper demand factors, including population size, urbanization, pubic sector and services sector employment shares. In column (3), we add controls that are expected to correlate with the broadband expansion, such as travel times and distance to municipality center, road density, and local government spending on infrastructure and other public services. The different sets of controls are detailed in Appendix Table A.2, Panels E-G. Our estimates across columns (1)-(3) in Table C.1 are relatively stable.

Municipality-Specific Trends. Next, we perform several additional steps to assure against the concern of differential underlying time trends in the newspaper market across municipalities. In Table C.1, Column (4), we check that our estimates are robust to excluding the five largest cities (Oslo, Bergen, Trondheim, Stavanger and Bærum) across all years from our estimation, providing assurance that differential trends across big cities and other municipalities are not driving our results. Looking across columns, it is reassuring to see that estimates are virtually unchanged both on the first stage and the second stage. Another related concern is that the 2008 Financial Crisis may have hit municipalities differently and thus could potentially confound our estimates of broadband internet expansion. In an attempt to address this concern, we drop all post-2008 years from our analysis. The resulting estimates in column (5) confirm robustness of our findings.

Further, we include municipality-specific trends in our baseline specification, using data covering 1991 to 1999,[38] prior to broadband expansion. For each municipality we obtain a slope estimate $\hat{v}_m$. We then

[38] While for most outcomes we calculate municipality-specific trends using data from 1991-1999, for outcomes relating to product characteristics we lack data before 1997 and therefore calculate municipality-specific trends using data from 1997-1999.

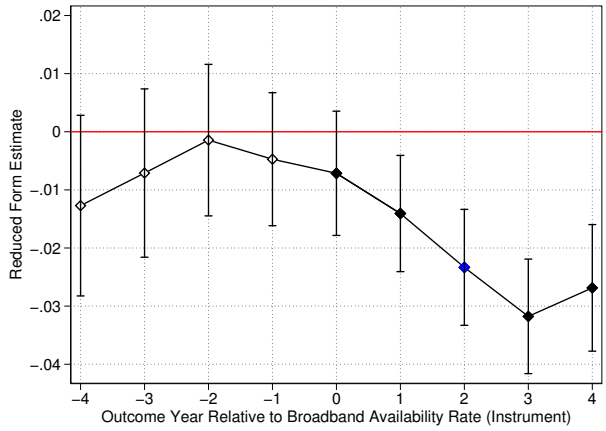
Table C.1: Impacts on Newspaper Sales: Specification Checks.

	Baseline	Additional Controls		Drop Five Largest Cities	Exclude Years 2008-2010	Municipality-Specific Time Trends		
						Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Dependant Variable: Broadband User Rate								
First-Stage Estimate	0.137***	0.137***	0.131***	0.129***	0.149***	0.131***	0.131***	0.081***
	(0.0072)	(0.0072)	(0.0073)	(0.0074)	(0.0073)	(0.0073)	(0.0073)	(0.0097)
Kleibergen-Paap F-stat	358.4	359.0	315.2	302.8	404.7	4620	4620	4620
B. Dependant Variable: Print Circulation Rate								
Reduced Form	-0.028***	-0.028***	-0.023***	-0.022***	-0.039***	-0.0233***	-0.0229***	-0.0138**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)
IV Estimate	-0.202***	-0.202***	-0.178***	-0.171***	-0.261***	-0.178***	-0.175***	-0.170**
	(0.038)	(0.038)	(0.038)	(0.038)	(0.047)	(0.038)	(0.038)	(0.069)
Baseline Mean	1.047	1.047	1.047	1.047	1.047	1.047	1.047	1.047
C. Dependant Variable: Annual Print Sales Volumne								
Reduced Form	-7.45***	-7.44***	-6.36***	-6.02***	-10.37***	-6.341***	-6.238***	-3.602**
	(1.48)	(1.49)	(1.40)	(1.38)	(2.01)	(1.400)	(1.397)	(1.524)
IV Estimate	-54.35***	-54.34***	-48.62***	-46.71***	-69.85***	-48.46***	-47.71***	-44.27**
	(10.47)	(10.58)	(10.56)	(10.70)	(13.39)	(10.57)	(10.55)	(19.56)
Baseline Mean	304.2	304.2	304.2	304.2	304.2	304.2	304.2	304.2
Controls:								
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	2,940	4,620	4,620	4,620

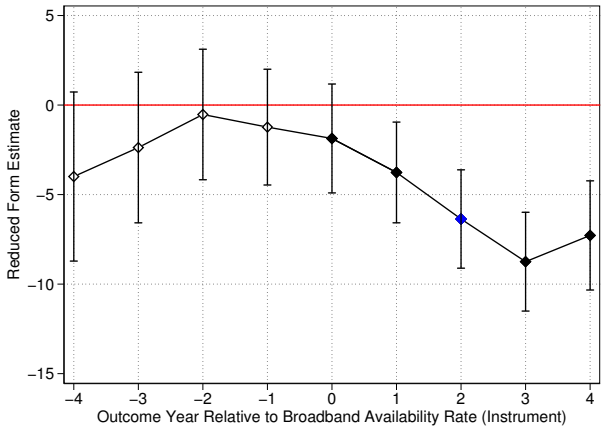
Notes: Columns (1)-(8) display estimates from our main specification at municipality x year level. Panel A shows estimates from the first stage regression equation (1). Panels B-C show results from the second stage regression equation (2), where the dependent variable, $y_{m,t+1}$, is either newspaper print circulation rate (Panel B) or newspaper print annual sales volume (Panel C). The reduced form estimate shows the coefficient on broadband availability rate in year *t-1*, $z_{m,t-1}$, while the IV estimate shows the coefficient on the endogenous variable of interest, the broadband user rate in year *t*, $d_{m,t}$, which has been instrumented using the broadband availability rate in year *t-1*, $z_{m,t-1}$. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell. Regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. Columns (1) displays the same specification as our main results in Table 2, Panel B, with baseline demographic controls. Columns (2) and (3) add additional controls. For a description of all control variables see Table A.2, Panels E-G. In column (4) we exclude the 5 largest municipalities: Oslo, Bergen, Trondheim, Stavanger, and Bærum. In column (5) we exclude the years 2008-2010 as those were the years of the financial crisis. In columns (6) and (7), we first estimate pre-expansion municipality-specific linear and quadratic time trends, respectively, and next extrapolate these into our specification, as shown in equation (C.1). In column (8), in addition to the pre-expansion municipality-specific linear and quadratic time trends, we interact the baselines values of urbanization, population size and education level for each municipality with time fixed effects and include these in the specification, as is shown in equation (C.2). The mean for each outcome variable from the baseline year, 2000, is displayed. Standard errors are heteroskedasticity robust and clustered at the municipality level.
* p < 0.1, ** < 0.05, *** p < 0.01.

Figure C.1: The Effects of Broadband Availability Rate on Past and Future Newspaper Sales.

(a) Print Circulation Rate



(b) Annual Print Sales Volume



Notes: The figures above displays coefficient estimates of $\hat{\delta}_k$ from separate regressions of equation $y_{m,t+k} = \delta_k z_{m,t} + x'_{m,t}\beta_k + \alpha_m + \tau_t + \varepsilon_{m,t+k}$, for each value of $k \in \{-4,4\}$ along with the corresponding 95% confidence intervals. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell. All regressions include municipality fixed effects and year dummies, and the baseline demographic controls discussed in Table A.2, Panel E. Standard errors are heteroskedasticity robust and clustered at the municipality level. In our baseline IV model in equations (1)-(2), there is a two-year lag between the outcome ($y_{m,t+1}$) and the broadband availability instrument ($z_{m,t-1}$), i.e., the coefficient from the above regression at $k = 2$ corresponds to our baseline reduced form estimate, which is marked in blue in the figures.

extrapolate pre-expansion time trends in our specification (both the first and the second stage) as follows

$$y_{m,t+1} = \lambda d_{m,t} + x'_{m,t-1}\beta + \alpha_m + \kappa_1 \hat{v}_m t + \kappa_2 \hat{v}_m t^2 + \tau_t + \varepsilon_{m,t+1} \tag{C.1}$$

This procedure will remove variation in our instrument that coincides with pre-existing trends in the outcome.

A second and related test follows Duflo (2001) in interacting baseline (year 2000) covariates with time dummies, i.e.

$$y_{m,t+1} = \lambda d_{m,t} + x'_{m,t-1}\beta + \alpha_m + \tau_t \textstyle\sum_q \kappa_q x_{(m,2000),q} + \varepsilon_{m,t+1} \tag{C.2}$$

By interacting time with observable characteristics, we allow the expansion of broadband internet to be related to different nonlinear underlying time trends in the newspaper market across municipalities, depending on their pre-reform characteristics. Columns (7)–(8) in Table C.1 report the estimates based on these specifications, which are usually very close to our baseline estimates.

Placebo. We next perform placebo tests to examine whether current year's broadband availability "affects" past outcomes: If it did, this would suggest that some omitted variable might be affecting both the newspaper market and the spread of broadband internet. Specifically, we regress the outcome in year $t+k$ on internet coverage in year t, and vary k between -4 and 4 to capture the correlation between the outcome and the instrument around a four-year window before and after the year when the instrument is measured. For $k = 2$, this regression thus corresponds to the reduced form of our IV model in equations (1)-(2). Figure C.1 presents the results from this placebo test. It is reassuring that we find no effect of current coverage on past circulation and sales (i.e., no sign of a pre-trend), with only future outcomes being significantly impacted.

Alternative Dynamic Structure. Our baseline IV model in equations (1)-(2) specifies the relationship between broadband usage and newspaper sales in the following year, while instrumenting broadband usage with lagged broadband availability. We now assess the stability of our estimates to alternative specifications of the lag structure between broadband availability, broadband usage and newspaper sales.

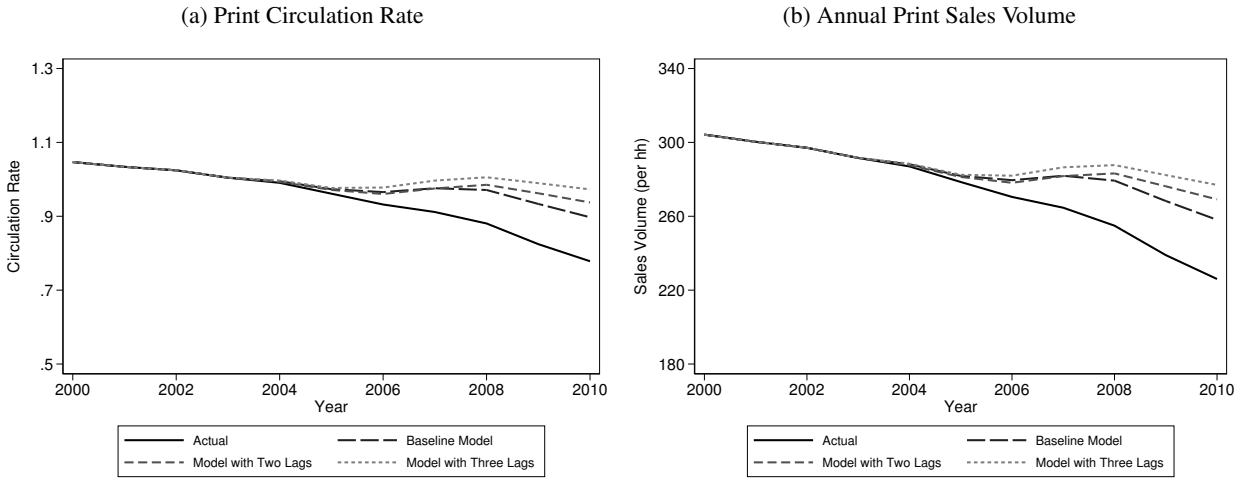
Table C.2: IV Estimates of Internet Use on Newspaper Sales in Future Years.

	Dependent Variable Measured in Year:		
	Year $t+1$ (baseline)	**Year $t+2$**	**Year $t+3$**
	(1)	**(2)**	**(3)**
A. Print Circulation Rate			
Overall	-0.202***	-0.223***	-0.213***
	(0.0379)	(0.0373)	(0.0403)
By Newspaper Segment:			
Locals	0.0003	-0.0239	-0.0319
	(0.0248)	(0.0247)	(0.0264)
Tabloids	-0.129***	-0.136***	-0.150***
	(0.0153)	(0.0154)	(0.0156)
Non-tabloids	-0.0734***	-0.0628***	-0.0307*
	(0.0184)	(0.0150)	(0.0162)
B. Annual Print Sales Volume			
Overall	-54.35***	-60.48***	-56.45***
	(10.47)	(10.38)	(11.19)
By Newspaper Segment:			
Locals	-0.68	-7.83	-10.73
	(7.58)	(7.47)	(8.10)
Tabloids	-33.52***	-35.32***	-39.10***
	(3.98)	(4.01)	(4.06)
Non-tabloids	-20.15***	-17.32***	-6.62*
	(4.40)	(3.71)	(3.83)

Notes: The estimates in this table come from the second stage regression equation (2), where the coefficient on the dependent variable, $y_{m,t+k}$, is displayed separately for each outcome in each row and at different values of k in each column. The endogenous variable of interest is the broadband user rate in year t, $d_{m,t}$, which has been instrumented using the broadband availability rate in year t-1, $z_{m,t-1}$. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell. All regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. The specifications for $k=2$ and $k=3$ include additional data for the years 2011 and 2012. All regressions include municipality fixed effects and year dummies. All regressions include the demographic controls discussed in Table A.2, Panel E. Standard errors are heteroskedasticity robust and clustered at the municipality level.
* p < 0.1, ** < 0.05, *** p < 0.01.

We begin by replacing the outcome of interest in the second-stage equation (2) by the same outcome measured in future periods, and otherwise keeping equations (1)-(2) unchanged. Specifically, rather than newspaper sales in the following year, $y_{m,t+1}$, we now consider the impacts of broadband usage on newspapers sales in two, $y_{m,t+2}$, or three, $y_{m,t+3}$, years ahead. The results are reported in Table C.2, columns (2)-(3), while our baseline estimates are repeated in column (1). Reassuringly, our effect estimates are highly stable to the measurement of newspaper sales at different intervals, suggesting that our results are robust to the lag structure specified in the relationship between broadband usage and newspaper sales. The same is true when we look across different newspaper types in Table C.2.

Figure C.2: The Impacts on Newspaper Sales: Alternative Model Specifications.



Notes: Figures show the overall actual (solid line) and predicted counterfactual (dashed line) newspaper print circulation rate (panel a) and annual print sales volume per household (panel b). For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell. The counterfactual is given by the actual outcome minus the predicted effect of internet use in the past year(s) on each outcome, providing an estimate of the outcome in a counterfactual situation with zero internet use in (all) the past year(s). The counterfactual trends are constructed based on three alternative specifications of equations (C.3)-(C.4): one lag (our baseline model), two lags (J=2) and three lags (J=3).

Next, we assess the robustness of our findings to alternative specifications of both the lag structure between broadband usage and newspaper sales, and the lag structure between broadband availability and broadband usage. Specifically, we estimate a model that at the same time allows lagged responses of broadband usage to broadband availability, and lagged responses of newspaper sales to broadband usage. To capture these responses, we augment our IV-model with $j = 1,2,...,J$ lagged values for broadband availability and user rates as specified in equations (C.3) and (C.4) below:

$$y_{m,t+1} = \sum_{j=1}^{J} \lambda_j d_{m,t+1-j} + x'_{mt-1}\beta + \alpha_m + \tau_t + \varepsilon_{m,t+1}, \tag{C.3}$$

$$d_{m,t+1-j} = \sum_{s=1}^{J} \delta_{s,j} z_{m,t-s} + x'_{mt-1}\mu_j + \gamma_{m,j} + \upsilon_{t,j} + \eta_{m,t+1-j}, \; j = 1,2,...,J, \tag{C.4}$$

where equation (C.3) is the second stage and equation (C.4) represents the J first stages. This gives a system of $J+1$ equations with J endogenous variables and J instruments, which we estimate simultaneously.

Figure C.2 presents the estimated counterfactual trends for newspaper sales using three alternative models: one lag (our baseline model), two lags ($J = 2$) and three lags ($J = 3$) of broadband user rates and of broadband coverage rates. The plots suggest that by allowing lagged responses of take-up to availability and delayed impacts of take-up on sales, one could potentially explain more of the decline in print newspaper circulation and sales volume between 2000 and 2010. However, while the estimated impact of internet use on circulation and sales is larger when we include a longer time to respond, most of the impact of broadband usage is already captured in our baseline. Indeed, the difference from our baseline prediction is relatively small and we can't statistically distinguish predictions from the three models. This again suggests that our baseline model performs well at capturing the main impacts of broadband usage on newspaper sales.

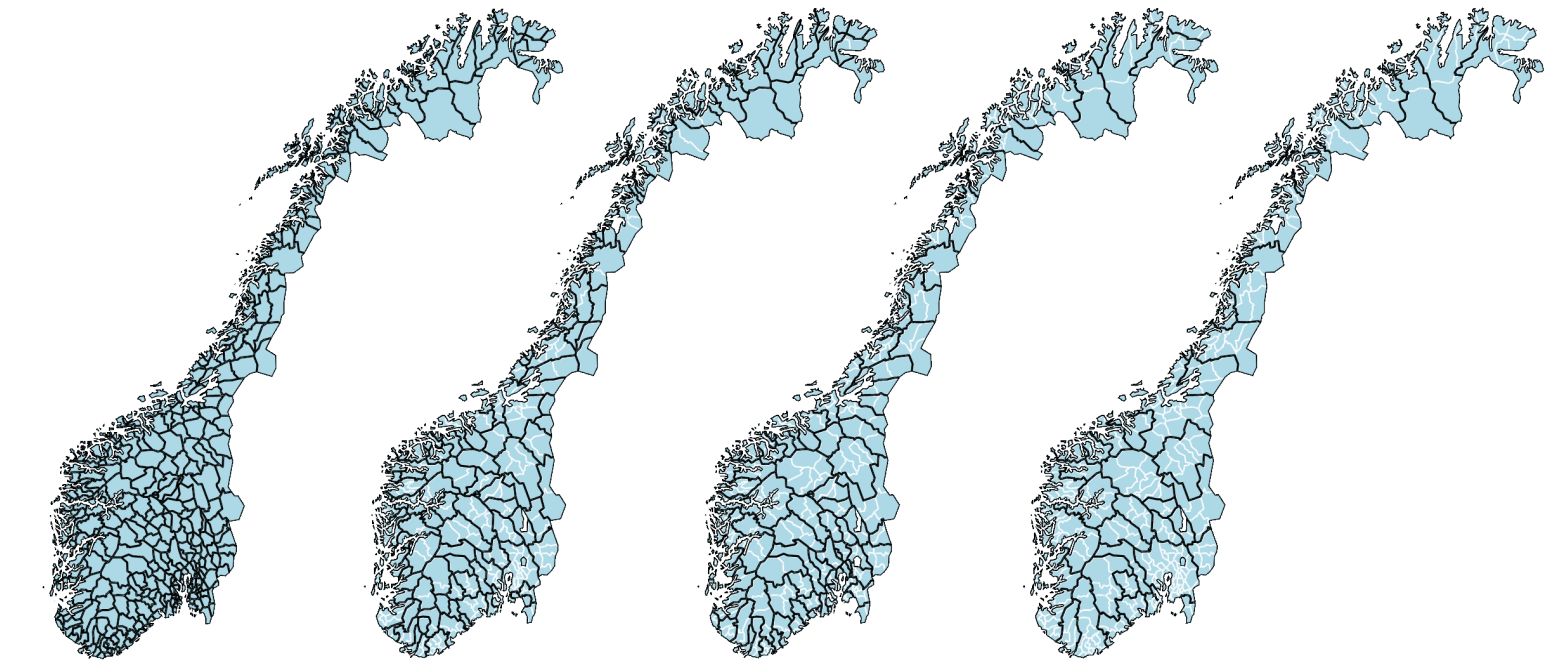
D Appendix: Geographic Spillovers

Our main empirical analysis uses the municipality as the baseline geographic unit. This choice is mainly driven by features of the Norwegian setting, where municipalities are distinct local government units, and moreover reasons of data availability, as broadband availability and usage are measured at this level for each year. We now assess the sensitivity of our findings to an assumption of geographical segmentation of markets implicit in this analysis. In theory, one could imagine geographic spillovers for (at least) two distinct reasons. Firstly, one could imagine spillovers in newspaper demand. For instance, the roll-out of broadband internet in a municipality that facilitates consumers to substitute from print to online news media may trigger (similar) changes in other parts of the same geographic newspaper market through spillovers in demand (i.e., tastes). Secondly, one could also imagine geographic spillovers taking place through newspapers' endogenous response to a local demand shock. For instance, a newspaper that is being circulated in multiple destinations, while being hit by a demand shock in one of its locations through broadband expansion may alter its production (e.g., product characteristics), which in turn may affect its sales in other locations.

In the following, we shed some light on the nature of geographic spillovers in our setting. We do so in the following steps. First, we aggregate our units of analysis to geographical regions and rely on variation in broadband availability and usage within regions over time, so that we can capture spillovers that take place within regional boundaries. Second, we return to our main analysis at the municipality-year level, but allow newspaper sales in a municipality to depend both on broadband usage in the same municipality as well as the average broadband usage rate in the same region (leaving-out own municipality). Third, we rely on the features of our setting and data that we observe each newspaper's sales in all municipalities and that newspapers are initially circulated in different geographical locations and thus differently exposed to broadband expansion over time. These features allow us to perform alternative analysis at the newspaper-municipality-year and newspaper-year levels, while still using the broadband expansion as an exogenous shock to broadband usage in different newspapers' initial markets. In the following, we describe each of these analyses in more detail and provide our findings on geographic spillovers.

Regional Analysis. We start by amending our main specification to consider the larger region to which each municipality belongs. Lacking precise prior knowledge about the geographical extent of spillovers in demand (i.e., tastes), we rely on alternative regional classifications that exist in Norway for this purpose: (i) a classification of 160 commuting areas developed by Gundersen and Juvkam (2013), (ii) a classification of 105 media districts used by the Norwegian Media Businesses' Association (MBL) and Kantar/TNS Gallup for statistical purposes, and (iii) a much more aggregated classification of 46 labor market regions developed by Bhuller (2009). Figure D.1 displays side-by-side maps of Norway with each geographical classification. We start by estimating our main specification at each of the larger geographic units by aggregating for each year all variables in our dataset to each of these levels. Specifically, we aggregate all municipality level variables to the regional level as a weighted average using population size of each municipality as the weight. In columns (2)-(4) of Table D.1, we show that sales effects are similar at the regional level, and are not statistically distinguishable from our baseline estimates.

Figure D.1: Geographical Regions of Norway.



Notes: Each subfigures shows the map of Norway with different geographical boundaries. The left-most subfigure shows the municipality boundaries (in black), while the remaining three subfigures show the geographical boundaries associated with different regional classifications (in black) along with the municipality boundaries (in white). Each regional classification provides a different aggregation of municipalities into unique geographical areas; a region consists of one or more municipalities, and a single municipality is never split between different geographical regions.

Table D.1: Geographic Spillovers in the IV Estimates of Effects of Internet Use on Newspaper Sales.

		Alternative Geographical Level:			**Leave Out Specification:**		
	Baseline	**Commuting Areas**	**Media Districts**	**Labor Market Regions**	**Commuting Areas**	**Media Districts**	**Labor Market Regions**
	(420 Municipalities)	**(160 Regions)**	**(105 Regions)**	**(46 Regions)**	**(160 Regions)**	**(105 Regions)**	**(46 Regions)**
	(1)	**(2)**	**(3)**	(4)	(5)	(6)	(7)
A. Print Circulation Rate							
Own	-0.202***	-0.204***	-0.309***	-0.336***	-0.196***	-0.189***	-0.189***
	(0.038)	(0.066)	(0.085)	(0.099)	(0.0407)	(0.0387)	(0.0385)
Rest of the Region					-0.009	-0.052	-0.061
(Excluding Own)					(0.0421)	(0.0471)	(0.0480)
Base mean	1.047	1.008	1.092	1.111	1.091	1.090	1.120
Own Est/Mean	-19.3 %	-20.2 %	-28.3 %	-30.2 %	-18.0 %	-17.3 %	-16.9 %
B. Annual Print Sales Volume							
Own	-54.35***	-56.37***	-84.63***	-86.92***	-53.30***	-50.80***	-51.44***
	(10.47)	(18.47)	(23.03)	(28.20)	(11.39)	(10.69)	(10.61)
Rest of the Region					-0.407	-13.07	-13.92
(Excluding Own)					(11.94)	(13.09)	(13.49)
Base mean	304.2	294.2	316.2	324.0	316.5	316.2	324.0
Own Est/Mean	-17.9 %	-19.2 %	-26.8 %	-26.8 %	-16.8 %	-16.1 %	-15.9 %
Observations	4,620	1,760	1,155	506	3,817	4,543	4,620

Notes: The regressions in column (1) is based on 420 municipalities × 11 years = 4,620 observations. The regression in columns (2)-(4) aggregates all variables to region-level, weighted by the populations in each municipality in that region. The regressions in columns (5)-(7) is at municipality level but includes average broadband usage in the region the municipality is located in (excluding that municipality) and instruments this with broadband availability (two endogenous variables with two instruments). In column (5), 73 municipalities that were in a region of their own are excluded, and therefore regressions are based on 347 municipalities × 11 years = 3,817 observations. Similarly, in column (6), 7 municipalities that were in a region of their own are excluded, and therefore regressions are based on 413 municipalities × 11 years = 4,543 observations. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each location-year cell. All regressions include municipality or region fixed effects, year dummies and demographic controls. For a description of the demographic control variables see Table A.2, Panel E. The mean for each outcome variable is from the baseline year, 2000. Standard errors are heteroskedasticity robust and clustered at the municipality in columns (1) and at region level in columns (2)-(7).

* p < 0.1, ** < 0.05, *** p < 0.01.

Leave-out Analysis. Next, we check whether newspaper sales in a municipality depend on broadband usage rate in the same region, while controlling for broadband usage in the same municipality. Specifically, consider other municipalities in region $r(m')$ where municipality m is located. We amend equation (2) as follows:

$$y_{m,t+1} = \lambda_1 \hat{d}_{m,t} + \lambda_2 \hat{d}_{r(m'),t} + x'_{m,t-1}\beta + \alpha_m + \tau_t + \varepsilon_{m,t+1} \tag{D.1}$$

where $\hat{d}_{r(m'),t}$ is internet use in the region excluding the municipality m and $\hat{}$ indicates that both $\hat{d}_{m,t}$ and $\hat{d}_{r(m'),t}$ are predicted values using instruments $z_{m,t-1}$ and $z_{r(m'),t-1}$, constructed based on the same regional classification. For instance, if there are no demand spillovers across municipality, then we should expect that sales in a municipality to be affected by local shocks but not shocks that occur in rest of the region once we have controlled for local shocks, i.e., $\lambda_1 > 0$ while $\lambda_2 = 0$. Estimates are reported in columns (4)-(6) of Table D.1: While the effect of the local broadband use is close to our baseline effect, there seems to be no significant effect of broadband use in the rest of the region, suggesting an absence of geographic spillovers.

Newspaper-level Analysis. We now provide two additional sets of estimates for how the internet impacts newspaper sales, respectively, at the newspaper-municipality-year level and at the newspaper-year level, where we rely on differential exposure to broadband internet due to initial differences in the spread of newspapers across locations.

First, we provide evidence from a specification at the newspaper-municipality-year level where we rely on within-newspaper variation in broadband usage across different locations by including a newspaper fixed effect. Specifically, we estimate an IV model with the following second stage equation

$$y_{n,m,t+1} = \lambda d_{m,t} + x'_{m,t-1}\beta + \alpha_m + \tau_t + \phi_n + \varepsilon_{n,m,t+1} \tag{D.2}$$

where $y_{n,m,t+1}$ is newspaper n's circulation in municipality m, divided by the number of households of m. As before, $d_{m,t}$ is the internet usage rate in municipality m. Results presented in columns (1)-(2) of Table D.2 show that our conclusions remain unchanged also conditional on newspaper fixed effects ϕ_n. Effectively, this specification relies on variation in differential exposure to broadband expansion across municipalities, for a given newspaper, while also controlling for common time trends and permanent differences across municipalities. The IV estimate on circulation rate of -0.0038, scaled relative to baseline mean of 0.0207, implies that internet use reduces newspaper-level circulation rate by 18.3%. In relative terms, this is close to the reduction in municipality-level newspaper circulation of 19.3% implied by the point estimate of -0.202 (scaled by baseline mean of 1.047).

As noted above, one mechanism for how geographic spillovers could occur in our setting is through endogenous supply-side changes in newspapers, so that newspapers' reactions to local demand shocks in one location may trigger changes in sales also in other locations. To capture such effects we now also introduce an alternative specification where the dependant variable is aggregated to the newspaper-level.

This analysis provides estimates on the effects of broadband usage on an exposed newspaper's overall sales across all locations as opposed to overall newspaper sales in an exposed municipality.

Table D.2: Impacts on Newspaper Sales: Newspaper-level Analysis.

Level of Analysis:	**Newspaper-Municipality-Year**		**Newspaper-Year**	
	Baseline Controls	**Additional Controls**	**Baseline Controls**	**Additional Controls**
	(1)	**(2)**	**(3)**	**(4)**
A. Dependant Variable: Broadband User Rate				
First-Stage Estimate	0.131***	0.127***	0.114***	0.0981***
	(0.0064)	(0.0064)	(0.0109)	(0.0102)
Kleibergen-Paap F-stat	414.3	388.1	78.3	79.4
B. Dependant Variable: Print Circulation Rate				
Reduced Form	-0.0005***	-0.0004***	-0.0074***	-0.0054**
	(0.0001)	(0.0001)	(0.0025)	(0.0026)
IV Estimate	-0.0038***	-0.0031***	-0.0644***	-0.0547**
	(0.0008)	(0.0008)	(0.0218)	(0.0266)
Baseline Mean	0.0207	0.0207	0.0671	0.0671
C. Dependant Variable: Annual Print Sales Volumne				
Reduced Form	-0.132***	-0.105***	-1.875***	-1.427**
	(0.0292)	(0.0285)	(0.622)	(0.659)
IV Estimate	-1.005***	-0.827***	-16.44***	-14.55**
	(0.222)	(0.224)	(5.53)	(6.76)
Baseline Mean	6.008	6.008	18.18	18.18
Controls:				
Year FEs	✓	✓	✓	✓
Municipality FEs	✓	✓		
Newspaper FEs	✓	✓	✓	✓
Demographics	✓	✓	✓	✓
Newspaper Demand		✓		✓
Broadband Expansion		✓		✓
Observations	233,948	233,948	850	850

Notes: For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Columns (1)-(2) display estimates for outcomes measured at the newspaper x municipality x year level (233,948 observations) as described in equation D.2, with controls for newspaper fixed effects. In Columns (1)-(2), print circulation and sales volume are scaled by the number of households in each municipality-year cell. Standard errors are heteroskedasticity robust and clustered at the newspaper level. Columns (3)-(4) display estimates for outcomes measured at the newspaper x year level (850 observations) as described in equations D.3-D.4. In Columns (3)-(4), print circulation and sales volume are scaled by the number of households in each newspaper's national market in each year. Standard errors are heteroskedasticity robust.
* p < 0.1, ** < 0.05, *** p < 0.01.

This alternative specification can be represented by the following IV model with the first and second stage stage equations:

$$d_{n,t} = \delta z_{n,t-1} + x'_{n,t-1}\mu + \gamma_n + \upsilon_t + \eta_{n,t}, \tag{D.3}$$

$$y_{n,t+1} = \lambda d_{n,t} + x'_{n,t-1}\beta + \tau_t + \phi_n + \varepsilon_{n,t+1}. \tag{D.4}$$

In order to exploit differential exposure to the changes in broadband availability and usage over time across newspapers, we first construct weighted averages of these variables at the newspaper-year level. Specifically, for each newspaper n in year t, we construct the weighted averages of broadband availability rates $z_{m,t}$, usage rates $d_{m,t}$, and municipality covariates $x_{m,t}$ measured in municipality m in year t by the share of newspaper n's total sales in municipality m in year 2000. Specifically,

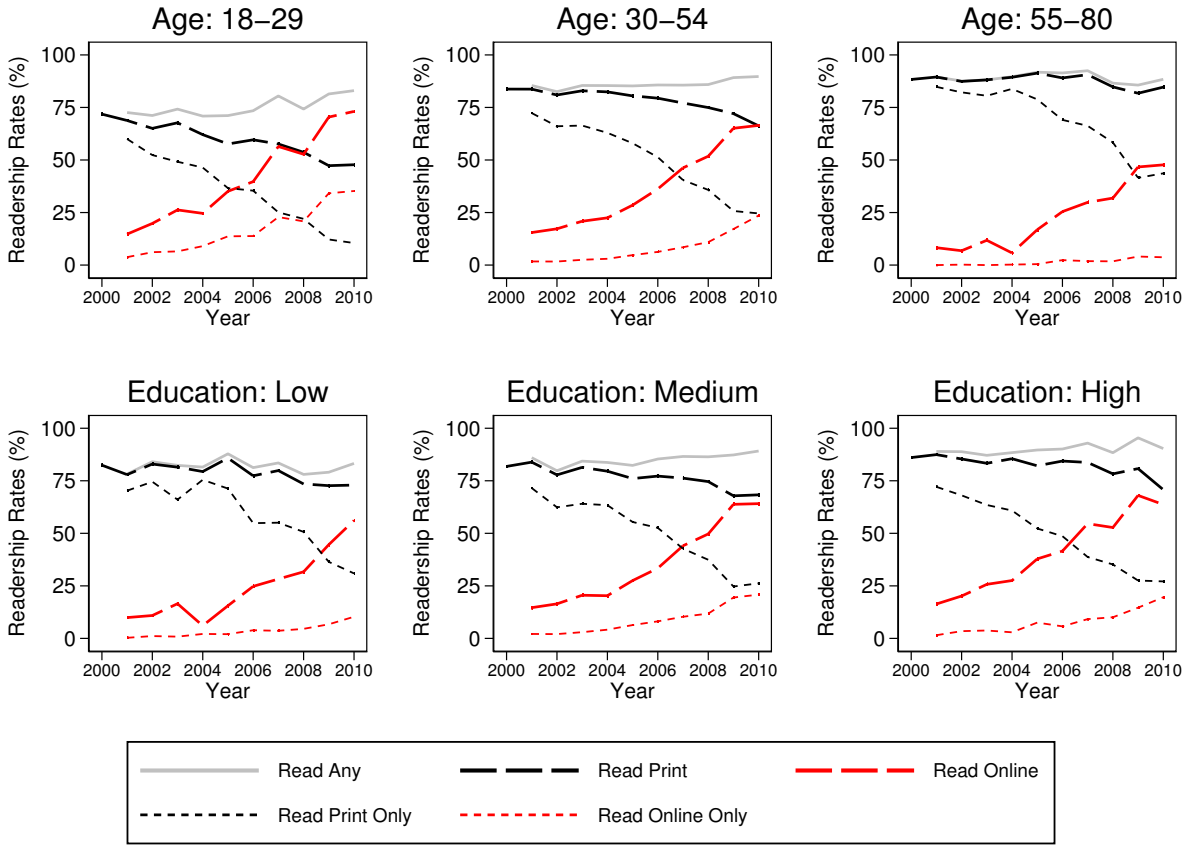
$$\begin{aligned}
z_{n,t} &= \sum_m s_{n,m,2000} \cdot z_{m,t} \equiv \sum_m \frac{Q_{n,m,2000}}{\sum_m Q_{n,m,2000}} \cdot z_{m,t} \\
d_{n,t} &= \sum_m s_{n,m,2000} \cdot d_{m,t} \equiv \sum_m \frac{Q_{n,m,2000}}{\sum_m Q_{n,m,2000}} \cdot d_{m,t} \\
x_{n,t} &= \sum_m s_{n,m,2000} \cdot x_{m,t} \equiv \sum_m \frac{Q_{n,m,2000}}{\sum_m Q_{n,m,2000}} \cdot x_{m,t}
\end{aligned}$$

where $Q_{n,m,2000}$ is newspaper n's annual print sales volume in municipality m in year 2000. Then, $s_{n,m,2000}$ is the share of newspaper n's initial sales volume that occurs in municipality m, which can be seen as a measure of how exposed a newspaper is to broadband expansion in that municipality. Effectively, this procedure allows us to construct annual measures of broadband availability $z_{n,t}$ and usage $d_{n,t}$ in newspaper n's initial market. As shown in the equations above, the underlying variation in these newspaper market-level measures stems from (i) initial differences in newspapers' sales across locations $s_{n,m,2000}$, and (iii) differential exposure to broadband availability $z_{m,t}$ and usage $d_{m,t}$ across locations and time.

Results presented in Table D.2, Panel A, columns (3)-(4), show that there are indeed significant first-stage estimates of broadband availability on usage, also when we aggregate units to the newspaper level. Moreover, considering the impacts on newspaper-level sales in Panels B-C, our conclusions are broadly similar to those from the municipality-level analysis, with significant reductions in sales from increased broadband usage in a newspaper's market. Further, note that the dependent means reported in Columns (3)-(4) are around three times larger compared to those in Columns (1)-(2), which is because we have aggregated outcomes to the newspaper-level. This reflects the difference in variables across specifications: Columns (1)-(2) uses the circulation and sales for a newspaper per household in each municipality; whereas Columns (3)-(4) uses the circulation and sales for a newspaper in their whole national market. In terms of relative impact sizes, we find stronger reductions in Columns (3)-(4) than in Columns (1)-(2), indicating that a newspaper's overall sales are strongly hit when there is an increase in broadband usage in its market as a whole, compared to when there is an increase in broadband usage in one of the locations where the newspaper is circulated. This difference may reflect that newspapers' endogenous supply-side responses to broadband expansion on their sales are captured in the newspaper-year level specification, while the newspaper-municipality-year level specification provides impacts net of such responses that are common across all locations.

E Appendix: Additional Figures and Tables

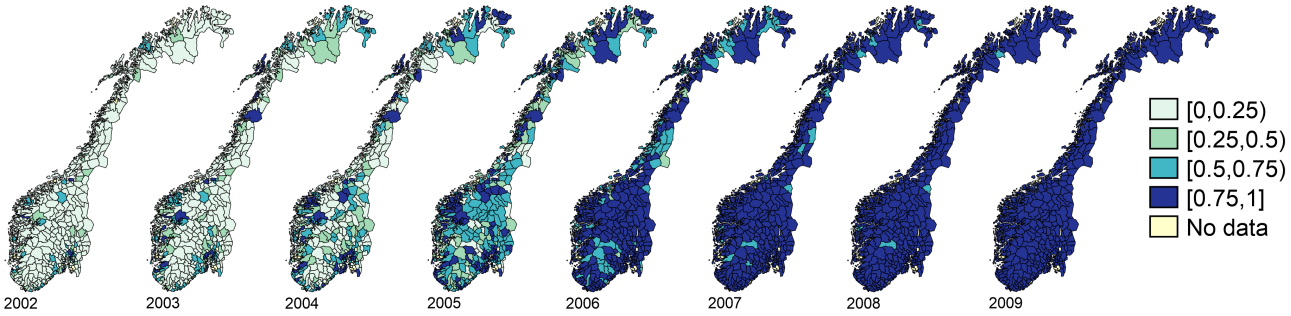
Figure E.1: Trends in Newspaper Readership by by Age and Education.



Notes: Figures show the annual trends in newspaper readership rates by age and education. Appendix Table A.1 provides a complete list of the 81 newspapers in our sample. The online and print readership rates are constructed for a sample of adult responders in the Norwegian Media User Surveys, and measured as the fraction of positive responses scaled by the number of survey respondents.

Figure E.2: Evolution of Broadband Internet Availability and Newspaper Print Circulation across Norway.

(a) Broadband Internet Availability



(b) Print Circulation Rate

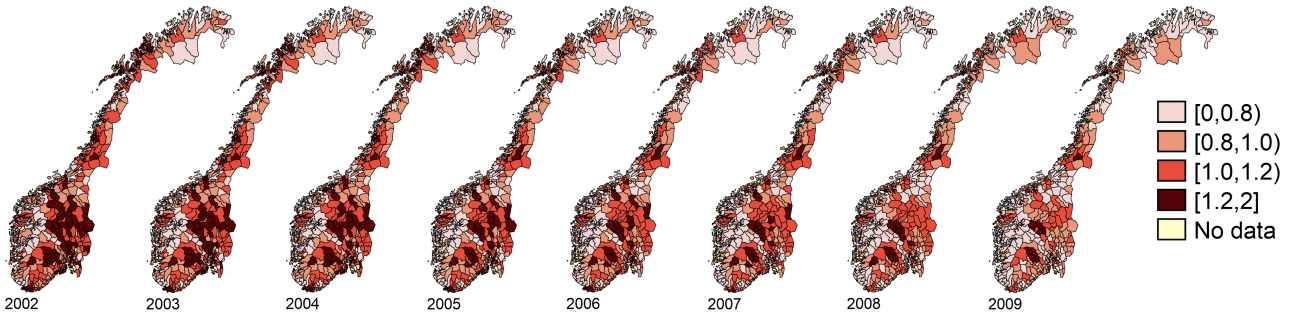
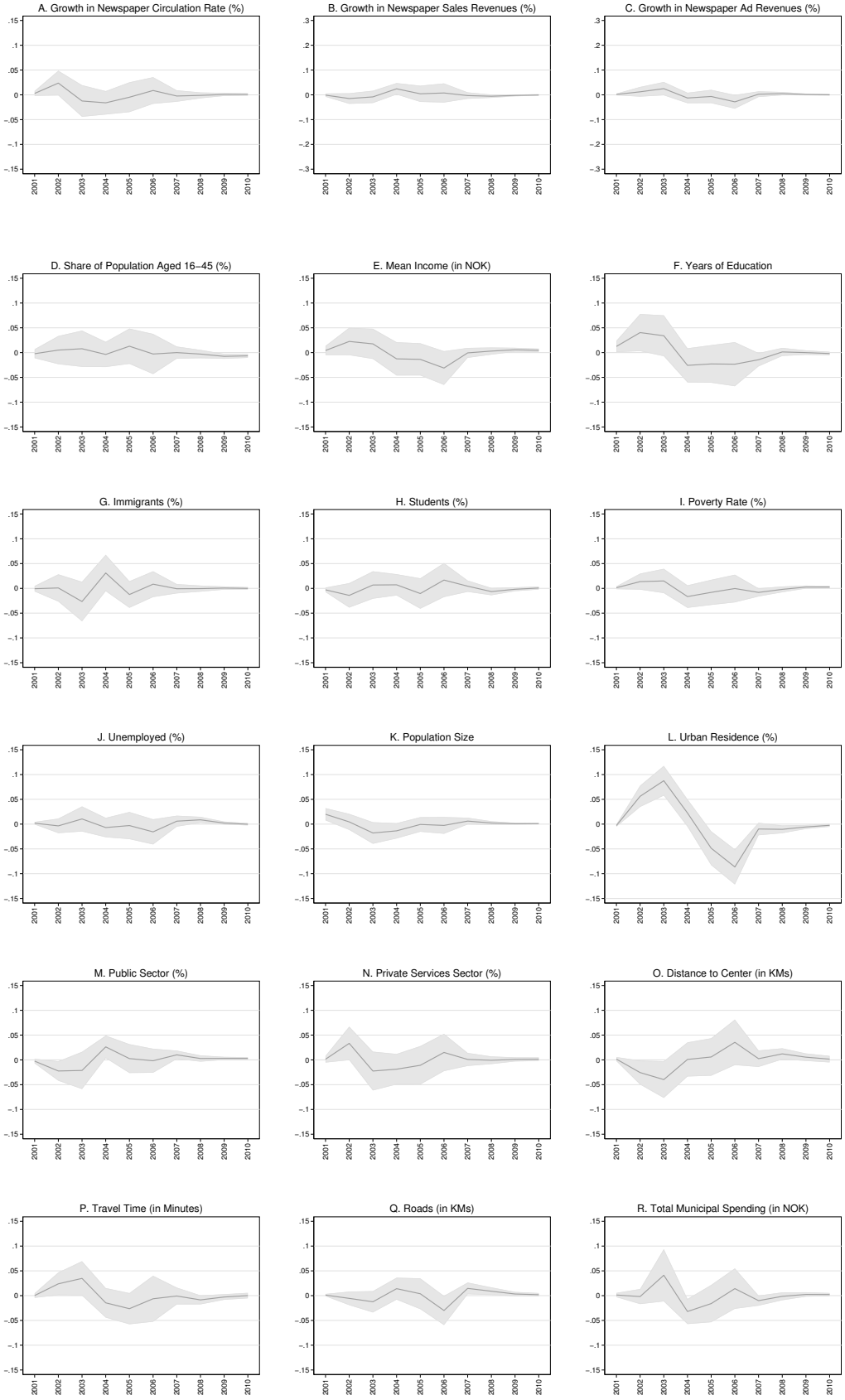


Figure E.3: Expansion of Broadband Internet by Baseline Municipality Characteristics



Notes: Figures display the change in broadband internet coverage rate, Δz_{kt}, regressed on baseline municipality characteristics. As shown in equation (4), we regress changes in coverage rates on municipality specific baseline characteristics interacted with time dummies, while controlling for municipality and year fixed effects. The figures plot the interaction terms for each variable, along with the associated 95 % CIs.

Table E.1: Descriptive Statistics – Control Variables.

Variable	Overall		2000		2005		2010	
A. Demographic Characteristics								
Aged 16–21 (%)	7.97	(0.96)	7.75	(1.02)	7.91	(0.92)	8.34	(0.88)
Aged 22–24 (%)	3.50	(0.50)	3.64	(0.50)	3.49	(0.49)	3.51	(0.49)
Aged 25–34 (%)	11.31	(2.01)	13.10	(1.76)	11.17	(1.61)	10.07	(1.81)
Aged 35–44 (%)	13.72	(1.48)	13.54	(1.28)	13.80	(1.51)	13.56	(1.57)
Aged 45–54 (%)	11.65	(0.99)	13.74	(1.15)	13.59	(0.93)	13.73	(0.97)
Aged 55–66 (%)	14.12	(2.11)	11.76	(1.36)	14.33	(1.65)	15.84	(1.87)
Aged 67– (%)	22.07	(4.73)	16.40	(3.60)	21.92	(2.85)	28.14	(2.35)
Students (%)	11.14	(1.61)	11.56	(1.72)	11.23	(1.46)	10.44	(1.37)
Poverty Rate (%)	5.03	(1.43)	5.68	(1.60)	5.19	(1.40)	4.61	(1.26)
Unemployed (%)	1.44	(0.79)	1.34	(0.69)	1.85	(0.84)	1.21	(0.57)
Immigrants (%)	4.44	(2.79)	3.26	(2.18)	4.13	(2.42)	6.61	(3.32)
Income (1000 NOK)	501.0	(43.1)	482.8	(41.5)	506.2	(38.5)	514.6	(40.5)
Years of Education	11.57	(0.46)	11.27	(0.42)	11.58	(0.42)	11.84	(0.43)
B. Population Size, Density, and Industry Structure								
Population Size	10,386	(31,535)	10,038	(29,835)	10,328	(31,146)	10,891	(34,240)
Urban Residency (%)	49.18	(27.62)	47.71	(27.43)	49.02	(27.73)	50.08	(27.69)
Public Sector (%)	26.91	(5.27)	25.77	(5.42)	26.04	(4.80)	29.25	(5.36)
Services Sector (%)	30.63	(4.88)	28.59	(5.31)	29.66	(4.45)	33.47	(4.39)
Private Services (%)	7.50	(3.37)	6.97	(3.37)	7.15	(3.23)	8.27	(4.39)
C. Geography								
Distance (in km)	8.27	(7.28)	8.69	(7.46)	8.25	(7.07)	8.03	(7.47)
Travel time (in minutes)	9.60	(7.48)	12.17	(9.50)	9.29	(7.19)	9.10	(6.80)
Roads (in km per 1000 residents)	164.5	(105.9)	158.7	(98.3)	165.8	(106.2)	167.7	(110.8)
D. Municipal Expenditures (1000 NOK per Capita)								
Total	55.36	(18.65)	50.69	(14.28)	51.85	(14.87)	79.29	(27.26)
Administration	5.75	(3.42)	4.13	(2.70)	5.59	(3.19)	6.93	(4.08)
Education	14.06	(5.44)	13.35	(2.94)	12.81	(2.57)	25.60	(10.28)
Health	19.89	(7.28)	18.76	(6.30)	18.27	(5.78)	30.43	(8.61)
Infrastructure	6.66	(4.09)	7.06	(3.01)	6.90	(3.97)	2.33	(2.61)

Notes: All variables are constructed as averages at the municipality and year level; means and standard deviations are calculated across municipalities (overall and by year). Detailed descriptions of the variables are given in Table A.2.

Table E.2: Descriptive Statistics – Outcome Variables.

Variable	Overall		2000		2005		2010	
A. Newspaper Circulation and Sales Volume								
Print Circulation Rate	0.94	(0.25)	1.05	(0.26)	0.96	(0.24)	0.78	(0.20)
Locals	0.63	(0.21)	0.70	(0.22)	0.63	(0.20)	0.54	(0.19)
Tabloids	0.19	(0.09)	0.22	(0.10)	0.20	(0.08)	0.13	(0.05)
Non-tabloids	0.12	(0.08)	0.13	(0.08)	0.12	(0.08)	0.11	(0.07)
Annual Print Sales Volume	274	(70.6)	304	(71.51)	279	(67.54)	226	(59.2)
B. Balance Sheets, Average Revenue Per Unit and Labor Inputs								
Total Revenues	5,371	(2,595)	5,443	(2,532)	5,517	(2,719)	4,752	(2,303)
Market Revenues	4,853	(2,345)	4,935	(2,278)	5,002	(2,393)	4,449	(2,238)
Sales Revenues	2,386	(978)	2,421	(962)	2,444	(1,006)	2,162	(899)
Ads Revenues	2,467	(1,425)	2,514	(1,363)	2,558	(1,433)	2,287	(1,386)
Other Revenues	518	(464)	508	(452)	515	(487)	303	(202)
Average Market Revenue Per Unit	8.88	(3.04)	8.07	(2.75)	8.88	(2.94)	9.77	(3.39)
Average Sales Revenue Per Unit	18.02	(7.38)	16.38	(6.60)	18.11	(7.07)	20.02	(8.27)
Average Ads Revenue Per Unit	9.14	(4.60)	8.30	(4.06)	9.23	(4.35)	10.25	(5.17)
Total Costs	4,764	(2,247)	4,687	(2,178)	4,908	(2,351)	4,228	(1,991)
Wage Costs	1,889	(949)	2054	(953)	1,896	(986)	1,560	(800)
Intermediates	864	(616)	900	(688)	927	(732)	652	(340)
Other Costs	2,010	(938)	1734	(658)	2085	(798)	2016	(1079)
Profits (EBITDA)	608	(427)	756	(401)	610	(410)	524	(434)
Direct Salary Costs	1,609	(840)	1613	(721)	1625	(1006)	1456	(781)
Managers	453	(234)	427	(192)	475	(278)	404	(227)
Journalists	586	(342)	458	(216)	590	(380)	652	(376)
Other	570	(338)	728	(370)	559	(378)	400	(216)
Labor Hours	6.87	(3.79)	7.57	(3.67)	6.72	(4.34)	5.99	(3.35)
Managers	1.56	(0.84)	1.66	(0.78)	1.59	(0.98)	1.28	(0.77)
Journalists	2.43	(1.49)	1.98	(1.02)	2.4	(1.67)	2.72	(1.6)
Other	2.88	(1.88)	3.93	(2.21)	2.73	(1.85)	2.00	(1.2)
Hourly Wage Rate	240	(26.46)	218	(19.25)	246	(20.47)	250	(29.35)
Managers	296	(31.2)	261	(21.14)	303	(23.46)	322	(26.13)
Journalists	245	(25.05)	235	(21.36)	250	(23.36)	246	(27.92)
Other	206	(25.73)	191	(19.66)	209	(18.86)	210	(32.78)
C. Content, Format and Listed Prices								
Content: % Sport & Entertainment	39.79	(5.34)	35.38	(4.81)	39.39	(3.89)	44.04	(4.64)
Content: % Health & Crime	25.83	(2.92)	27.68	(2.45)	25.57	(2.16)	24.82	(2.59)
Content: % Politics, FA & B/F	34.37	(3.76)	36.94	(3.87)	35.04	(3.08)	31.14	(3.46)
Format (Page Size in cm^2)	1264	(331)	1447	(363)	1263	(332)	1117	(202)
No. of Pages	47.47	(10.5)	43.43	(6.54)	46.66	(7.4)	51.3	(13.72)
Total Size (Format $\times$ No. of Pages)	59,866	(19,942)	62,613	(17,227)	58,793	(17,465)	58,257	(23,666)
Sales Price Per Copy	14.05	(2.28)	12.03	(0.26)	13.57	(1.05)	18.63	(1.07)
Full Page in 4 Colors	88,978	(27,819)	90,356	(28,325)	91,158	(27,947)	81,240	(25,691)
Full Page in B/W	55,987	(16,536)	56,348	(17,180)	56,063	(16,405)	54,997	(16,768)
Column Ads, Per cm	58.53	(17.31)	52.85	(15.25)	59.84	(17.18)	60.29	(18.29)

Notes: Means and standard deviations are calculated across municipalities (overall and by year). Detailed descriptions of the variables are given in Table A.2. Revenues, profits, costs, wages and prices are in 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK. Descriptive statistics for all other variables used in our analysis as controls can be found in Table E.1 in the appendix.

Table E.3: Compliance and Newspaper Readership by Age and Education.

	A. Complier Characterization				B. Newspaper Readership (2001)			
	$p[X = x]$	First Stage	$P[X = x\|I_{1i} > I_{0i}]$	$\frac{P[X=x\|I_{1i}>I_{0i}]}{p[X=x]}$	Print	Only Print	Online	Only Online
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
By Age								
18-24	0.24	0.25*** (0.07)	0.38	1.61	69%	60%	15%	4%
25-54	0.48	0.17*** (0.05)	0.52	1.09	84%	72%	16%	2%
55-80	0.29	0.04 (0.04)	0.07	0.24	90%	85%	8%	0%
By Education								
Low	0.20	0.05 (0.06)	0.06	0.31	78%	70%	10%	0%
Medium	0.58	0.19*** (0.04)	0.72	1.23	84%	72%	15%	2%
High	0.22	0.07 (0.10)	0.10	0.48	88%	72%	16%	2%
Overall	1.00	0.15*** (0.04)	1.00	1.00	82%	71%	14%	2%

Notes: Column (1) reports the distribution of the population by age and education, $P[X = x]$, based on microdata for respondents from Media User Surveys for the period 2000–2013, with a total of 26,877 observations. The Education groups are categorised as: Low: 10 or less years of education; Medium: between 10 and 16 years of education; High: over 16 years of education. Education groups exclude any individuals aged younger than 21 and anyone with missing years of education, which leaves 20,136 observations. Also using the Media User Surveys, we perform separate estimations of the first-stage equation (1) for each group. The first-stage coefficients are reported in column (2). All regressions include municipality fixed effects and year dummies. Column (3) reports the distribution of compliers by age and education group, $P[X = x|I_{1i} > I_{0i}]$, calculated as (first-stage coefficient for the group × pop. share) divided by the overall first-stage coefficient. Column (4) shows the relative likelihood of compliers belonging to a particular group, compared to the population at large. Columns (5)-(9) reports the print and online readership rates from Media User Surveys in 2001, which is the first year when we can observe print and online readership separately in these surveys.
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.4: Impacts on Newspaper Sales: Circulation vs. Readership Sample.

Sample:	**Circulation Sample**		**Readership Sample**			
	Print Circulation Rate	**Annual Print Sales Volume**	**Print Circulation Rate**	**Annual Print Sales Volume**	**Print Circulation Rate**	**Annual Print Sales Volume**
	(1)	**(2)**	(3)	(4)	(5)	(6)
Reduced Form	-0.028***	-7.45***	-0.027***	-7.15***	-0.0353***	-9.701***
Std Error	(0.005)	(1.48)	(0.005)	(1.46)	(0.0106)	(2.891)
IV Estimate	-0.202***	-54.35***	-0.194***	-52.20***	-0.296***	-81.16***
Std Error	(0.038)	(10.47)	(0.037)	(10.34)	(0.0842)	(22.83)
Observations	4,620	4,620	4,620	4,620	1,115	1,115
Demographic Controls	✓	✓	✓	✓	✓	✓
Municipality-level	✓	✓	✓	✓		
District-Level					✓	✓

Notes: The estimates in Columns (1)-(2) are identical to Table 2, Panel B, Columns (1)-(2). In Columns (3)-(4), we construct municipality-year level circulation and sales measures relying only on newspapers that are included in the Readership Survey, and the regression analysis is performed at municipality-year level, controlling for municipality fixed effects, year dummies and all baseline demographic controls. Further, in Columns (5)-(6), we further aggregate all variables to the media districts that are observed in the Readership Survey, and the regression analysis is performed at media district-year level, controlling for district fixed effects, year dummies and all baseline demographic controls. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Print circulation and sales volume are scaled by the number of households in each municipality-year cell in Columns (1)-(4) and by the number of households in each media district-year cell in Columns (5)-(6).
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.5: Impacts on Newspaper Sales and Readership for Tabloids.

	Circulation		Readership		
	Print Circulation Rate	**Annual Print Sales Volume**	**Print Readership Rate**	**Online Readership Rate**	**Total Readership Rate**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
A. Tabloids					
Reduced Form	-0.0177***	-4.595***	-0.0252*	0.0485***	0.0233
Std Error	(0.00233)	(0.605)	(0.0139)	(0.0143)	(0.0209)
IV Estimate	-0.129***	-33.52***	-0.211*	0.406***	0.195
Std Error	(0.0153)	(3.982)	(0.116)	(0.121)	(0.175)
Baseline Mean	0.219	56.84	0.559	0.147	0.706
B. VG					
Reduced Form	-0.0117***	-3.055***	-0.0241**	0.0278***	0.00370
Std Error	(0.0016)	(0.415)	(0.0106)	(0.00895)	(0.0149)
IV Estimate	-0.0857***	-22.28***	-0.201**	0.232***	0.0309
Std Error	(0.0107)	(2.775)	(0.0888)	(0.0721)	(0.125)
Baseline Mean	0.149	38.64	0.355	0.088	0.444
C. Dagbladet					
Reduced Form	-0.0059***	-1.541***	-0.0012	0.0208**	0.0196
Std Error	(0.0010)	(0.248)	(0.0088)	(0.00942)	(0.0133)
IV Estimate	-0.0432***	-11.24***	-0.010	0.174**	0.164
Std Error	(0.00642)	(1.668)	(0.0736)	(0.0790)	(0.113)
Baseline Mean	0.0700	18.19	0.203	0.059	0.262

Notes: The estimates in Panel A of this table are the same as Table 3, Panel B (see table notes for details). Panels B and C separate the Tabloids into their two newspapers: VG and Dagbladet. The mean for each outcome variable from the baseline year, 2000, is displayed.
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.6: IV Estimates of Internet Use on Newspaper Sales: Geographic Heterogeneity.

		Print Circulation Rate			Annual Print Sales Volume		
	Obs.	Est.	SE	Mean	Est.	SE	Mean
All	4,620	-0.275***	(0.0358)	1.047	-74.61***	(10.03)	304.2
Urbanization							
High	1,540	-0.191**	(0.0930)	1.093	-51.08**	(25.39)	315.0
Medium	1,529	-0.330***	(0.111)	1.041	-86.23***	(31.18)	302.7
Low	1,551	-0.240**	(0.118)	1.007	-67.07**	(34.22)	295.0
Average Education							
High	1,540	-0.320***	(0.0666)	1.113	-84.62***	(17.99)	322.1
Medium	1,529	-0.360***	(0.0670)	1.038	-100.4***	(18.60)	302.7
Low	1,551	-0.271***	(0.0736)	0.989	-71.89***	(20.90)	288.0
Average Income							
High	1,529	-0.318***	(0.0690)	1.050	-87.55***	(18.99)	305.6
Medium	1,551	-0.244***	(0.0545)	1.024	-65.89***	(15.27)	298.7
Low	1,540	-0.310***	(0.0894)	1.066	-83.19***	(25.42)	308.4

Notes: The estimates in this table come from the second stage regression equation (2), where the coefficient on the dependent variable, $y_{m,t+1}$, is displayed separately for each outcome in each row and by newspaper type in each column. The endogenous variable of interest is the broadband user rate in year *t*, $d_{m,t}$, which has been instrumented using the broadband availability rate in year *t-1*, $z_{m,t-1}$. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. All regressions include municipality fixed effects and year dummies. 'High' is categorized as municipalities above the 66th percentile of municipalities in that category in 2000. Similarly, 'Medium' is municipalities between the 33rd and 66th percentile and 'Low' is those below of the 33rd percentile. Standard errors are heteroskedasticity robust and clustered at the municipality level.
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.7: IV Estimates of Internet Use on Newspaper Sales: Newspaper Heterogeneity.

		Print Circulation Rate			Annual Print Sales Volume		
	Obs.	Est.	SE	Mean	Est.	SE	Mean
All	233,948	-0.00382***	(0.000795)	0.0207	-1.005***	(0.222)	6.008
Ad Revenue Share							
High	120,736	0.000941	(0.00121)	0.0168	0.0314	(0.323)	4.912
Medium	56,089	-0.00617***	(0.00166)	0.0193	-1.159***	(0.400)	5.934
Low	57,123	-0.0114***	(0.00168)	0.0302	-2.937***	(0.469)	8.396
Local Market Power							
High	82,687	0.00157	(0.00147)	0.0138	0.00965	(0.416)	4.350
Medium	75,383	-0.00134	(0.00187)	0.0216	-0.230	(0.560)	6.516
Low	75,878	-0.0108***	(0.00148)	0.0272	-2.650***	(0.360)	7.309

Notes: The estimates come from the second stage regression equation (D.2), where the dependent variable is newspaper *j*'s circulation rate in municipality *m* in year *t+1*, $y_{j,m,t+1}$. The endogenous variable of interest is the municipality-level broadband usage rate in year *t*, $d_{m,t}$, which has been instrumented using the municipality-level broadband availability rate in year *t-1*, $z_{m,t-1}$. All regressions include newspaper fixed effects, municipality fixed effects and year dummies, and the demographic controls discussed in Appendix Table A.2, Panel E. 'Ad Revenue Share' is the percentage of total revenue that arises from advertisements. 'Local Market Share' is a newspaper's largest percentage of total circulation in a single municipality. 'High' is categorized as newspapers above the 66th percentile of newspapers in that category in 2000. Similarly, 'Medium' is newspapers between the 33rd and 66th percentile and 'Low' is those below the 33rd percentile. Standard errors are heteroskedasticity robust and clustered at the municipality level.
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.8: Regression Table: IV Estimates of Internet Use on Newspaper Sales and Readership.

	Sales				Readership					
	Print Circulation Rate		Annual Print Sales Volume		Print Readership Rate		Total Online Readership Rate		Total Readership Rate	
	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)	Est.	(SE)
	(1)	**(2)**	(3)	(4)	**(5)**	(6)	**(7)**	(8)	**(9)**	(10)
A. Baseline										
Broadband User Rate	-0.202***	(0.0379)	-54.35***	(10.47)	-0.690**	(0.304)	0.585*	(0.307)	-0.105	(0.437)
Age-groups (%): 0-16	0.0279	(0.439)	50.30	(113.9)	-5.342**	(2.523)	-3.438	(3.460)	-8.780*	(4.810)
Age-groups (%): 16-21	-0.622	(0.424)	-163.8	(115.7)	-1.183	(3.449)	-3.992	(3.551)	-5.175	(5.551)
Age-groups (%): 22-24	-0.640	(0.458)	-200.5	(122.7)	-1.116	(3.115)	-2.346	(3.792)	-3.462	(5.291)
Age-groups (%): 25-34	-1.482***	(0.343)	-435.4***	(92.62)	-1.920	(2.658)	-2.038	(2.440)	-3.957	(4.028)
Age-groups (%): 35-44	-1.066***	(0.290)	-317.5***	(78.96)	-2.006	(2.109)	-4.815**	(2.056)	-6.821**	(3.303)
Age-groups (%): 45-54	–		–		–		–		–	
Age-groups (%): 55-66	-0.0641	(0.332)	-37.28	(88.54)	-4.137*	(2.277)	1.623	(2.009)	-2.514	(3.276)
Age-groups (%): 67-00	-0.606*	(0.357)	-160.3*	(94.74)	-5.500**	(2.442)	1.163	(3.333)	-4.337	(4.784)
Income (10,000 NOK)	0.0120***	(0.00158)	3.243***	(0.429)	0.00564	(0.00800)	-0.0105	(0.00949)	-0.00487	(0.0126)
Years of Education	0.0424	(0.0295)	13.62*	(7.714)	-0.0987	(0.237)	0.842***	(0.199)	0.744**	(0.351)
Unemployed (%)	-0.835***	(0.271)	-204.2***	(70.73)	-1.186	(2.515)	0.633	(1.544)	-0.552	(2.981)
Students (%)	-0.198	(0.177)	-32.01	(48.76)	-2.148*	(1.109)	0.415	(1.124)	-1.733	(1.639)
Poverty Rate (%)	0.206	(0.169)	58.55	(46.61)	0.818	(1.418)	-1.607	(1.333)	-0.789	(2.114)
Immigrants (%)	-1.04***	(0.222)	-283.7***	(59.86)	-2.091**	(1.011)	2.393**	(1.218)	0.302	(1.601)
B. All Controls										
Broadband User Rate	-0.178***	(0.038)	-48.62***	(10.56)	-0.709**	(0.326)	0.768**	(0.331)	0.0591	(0.464)
Population size (000s)	-0.003*	(0.001)	-0.714*	(0.414)	-0.00115	(0.00104)	0.00233	(0.00204)	0.00118	(0.00241)
Age-groups (%): 0-16	-0.333	(0.408)	-90.11	(112.6)	-3.895	(2.456)	-3.880	(3.050)	-7.776*	(4.423)
Age-groups (%): 16-21	-0.253	(0.453)	-96.52	(122.2)	0.566	(3.582)	-5.390	(3.525)	-4.825	(5.371)
Age-groups (%): 22-24	-1.078***	(0.347)	-335.4***	(94.19)	0.433	(3.080)	-4.994	(3.816)	-4.561	(5.359)
Age-groups (%): 25-34	-0.877***	(0.280)	-274.2***	(76.56)	-1.671	(2.656)	-2.186	(2.655)	-3.857	(3.999)
Age-groups (%): 35-44	0.122	(0.444)	80.27	(117.6)	-3.665*	(2.042)	-4.657*	(2.467)	-8.322**	(3.400)
Age-groups (%): 45-54	–		–		–		–		–	
Age-groups (%): 55-66	-0.250	(0.327)	-82.84	(87.88)	-4.105*	(2.232)	1.385	(2.030)	-2.720	(3.145)
Age-groups (%): 67-00	-0.457	(0.356)	-118.9	(95.78)	-4.687**	(2.355)	-0.0656	(3.135)	-4.753	(4.578)
Income (10,000 NOK)	0.0106***	(0.00153)	2.878***	(0.415)	-0.00267	(0.00894)	-0.00327	(0.0107)	-0.00594	(0.0135)
Years of Education	0.0299	(0.0288)	11.06	(7.731)	-0.127	(0.220)	0.761***	(0.187)	0.634*	(0.326)
Unemployed (%)	-0.676**	(0.270)	-166.8**	(70.35)	-1.351	(2.661)	2.541*	(1.474)	1.190	(3.130)
Students (%)	-0.205	(0.163)	-33.17	(45.18)	-1.462	(1.132)	0.322	(1.047)	-1.141	(1.548)
Poverty Rate (%)	0.175	(0.154)	47.51	(42.88)	0.592	(1.475)	-1.256	(1.358)	-0.664	(2.164)
Immigrants (%)	-0.897***	(0.210)	-247.2***	(57.42)	-1.989*	(1.026)	0.858	(1.337)	-1.131	(1.820)
Urban Residence (%)	-0.0943	(0.073)	-21.10	(19.19)	0.128	(0.319)	-0.596	(0.654)	-0.468	(0.693)
Public Sector (%)	0.0295	(0.240)	-4.046	(71.48)	0.286	(1.367)	2.521	(1.710)	2.807	(2.743)
Services Sector (%)	0.192	(0.258)	51.67	(74.93)	-0.275	(1.418)	-3.693**	(1.762)	-3.968	(2.704)
Priv. Services Sector (%)	0.0249	(0.284)	13.19	(82.53)	2.741*	(1.541)	3.752*	(1.984)	6.492**	(3.013)
Total Exp. (1000 NOK)	-0.001**	(0.000)	-0.133	(0.0810)	0.00524	(0.00362)	-0.00747	(0.00626)	-0.00223	(0.00655)
Administration Exp.	0.003***	(0.001)	0.754***	(0.292)	0.00669	(0.00925)	0.00766	(0.0111)	0.0143	(0.0124)
Education Exp.	0.001***	(0.000)	0.304***	(0.0977)	-0.000859	(0.00584)	0.00632	(0.00895)	0.00546	(0.00933)
Health Exp.	0.001	(0.001)	0.123	(0.240)	-0.00764	(0.00737)	0.00801	(0.00962)	0.000370	(0.0109)
Infrastructure Exp.	0.001***	(0.000)	0.313***	(0.121)	-0.00873	(0.00653)	-0.00006	(0.00774)	-0.00880	(0.0132)
Distance (in km)	0.006	(0.013)	1.521	(3.349)	-0.254***	(0.0946)	-0.163	(0.104)	-0.417***	(0.153)
Roads (in km)	4.615**	(2.130)	1191.5**	(584.9)	-16.10*	(8.298)	-4.200	(13.52)	-20.30	(16.02)
Travel Time (mins)	-0.010*	(0.054)	-22.88	(14.89)	-0.0310	(0.204)	-0.268	(0.256)	-0.299	(0.387)
Baseline Mean	1.047		304.2		1.805		0.208		2.013	
Observations	4,620		4,620		1,115		1,115		1,115	

Notes: The estimates in Panel A of this table is the same as Table 2, Panel B (see table notes for more details) with the coefficients on demographic controls listed. Panel B includes all controls. For a description of all control variables see Table A.2, Panels E-G. The mean for each outcome variable from the baseline year, 2000, is displayed.
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.9: IV Estimates of of Internet Use on Revenues, Costs and Labor Inputs: Specification Checks.

	Baseline	Additional Controls		Drop Five Largest Cities	Exclude Years 2008-2010	Municipality-Specific Time Trends		
						Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Balance Sheets								
Total Revenues	-1214.1***	-1219.1***	-1063.9**	-976.1**	-1708.5***	-1241.1***	-1025.2**	-467.5
	(444.9)	(448.0)	(470.2)	(481.6)	(562.5)	(467.8)	(429.2)	(948.6)
Market Revenues	-1375.0***	-1387.9***	-1280.0***	-1221.5***	-1947.0***	-1482.6***	-1326.0***	-1665.8*
	(383.4)	(385.6)	(413.0)	(422.9)	(546.2)	(410.5)	(373.9)	(886.6)
Sales Revenues	-808.9***	-802.9***	-745.5***	-724.3***	-868.8***	-774.7***	-743.9***	-902.8***
	(124.3)	(125.1)	(129.0)	(132.4)	(171.9)	(120.1)	(123.6)	(276.7)
Ads Revenues	-566.2**	-585.1**	-534.4*	-497.2	-1078.3***	-699.3**	-574.0**	-731.2
	(288.3)	(289.6)	(314.1)	(322.4)	(415.1)	(329.7)	(280.2)	(658.5)
Other Revenues	160.9	168.8	216.0	245.4	238.5	285.4	211.0	952.4**
	(225.6)	(224.1)	(229.6)	(241.2)	(244.5)	(222.1)	(214.8)	(430.9)
Total Costs	-1289.0***	-1290.9***	-1147.0***	-1030.4***	-1557.6***	-1263.7***	-1172.3***	-1031.9
	(366.7)	(369.5)	(381.9)	(392.0)	(432.6)	(365.3)	(347.0)	(773.0)
Wage Costs	-698.7***	-695.9***	-625.2***	-550.9***	-572.3***	-707.1***	-702.1***	-581.4
	(182.4)	(182.3)	(188.2)	(192.3)	(197.3)	(185.2)	(186.7)	(390.9)
Intermediates	-186.7	-198.8	-117.9	-20.01	-412.2	-102.5	-119.0	764.2
	(285.0)	(284.4)	(291.9)	(293.7)	(301.4)	(288.0)	(325.4)	(629.1)
Other Costs	-403.6	-396.2	-403.9	-459.5	-573.2**	-421.5	-434.5	-1289.7**
	(285.5)	(284.7)	(298.7)	(306.9)	(273.6)	(293.8)	(295.6)	(549.9)
Profits (EBITDA)	74.85	71.72	83.13	54.28	-150.8	10.35	34.27	419.9
	(178.1)	(180.1)	(190.0)	(192.3)	(182.0)	(204.2)	(201.8)	(403.7)
B. Average Revenue Per Unit (ARPU)								
Market Revenue PU	0.0238	-0.0536	-0.182	-0.0733	-1.484	-1.122	-0.449	1.144
	(0.738)	(0.741)	(0.802)	(0.832)	(1.287)	(0.804)	(0.798)	(1.748)
Sales Revenue PU	-0.691***	-0.705***	-0.799***	-0.786**	-0.782**	-0.879***	-0.822***	-0.323
	(0.237)	(0.243)	(0.244)	(0.253)	(0.313)	(0.241)	(0.257)	(0.497)
Ads Revenue PU	0.715	0.652	0.618	0.713	-0.703	-0.350	0.279	1.345
	(0.643)	(0.643)	(0.704)	(0.731)	(1.061)	(0.731)	(0.705)	(1.562)
C. Labor Inputs								
Direct Salary Costs	-832.2***	-821.2***	-814.9***	-804.9**	-1098.7**	–	–	-1391.3*
	(279.0)	(278.3)	(315.4)	(326.2)	(465.5)			(827.0)
Managers	-173.9**	-169.0**	-166.1**	-172.1**	-255.2**	–	–	-350.8*
	(68.28)	(68.03)	(77.24)	(79.91)	(115.1)			(196.4)
Journalists	-194.1**	-191.3**	-210.5**	-204.7*	-408.6**	–	–	-379.4
	(85.47)	(85.10)	(103.1)	(106.6)	(182.8)			(270.8)
Other	-464.2***	-460.8***	-438.3***	-428.1***	-434.9**	–	–	-661.2*
	(148.6)	(148.5)	(158.3)	(164.0)	(196.3)			(399.5)
Labor Hours	-3.545***	-3.470***	-3.401**	-3.373**	-4.723**	–	–	-5.612
	(1.269)	(1.269)	(1.400)	(1.450)	(2.045)			(3.514)
Managers	-0.633***	-0.616***	-0.600**	-0.617**	-0.783**	–	–	-1.261**
	(0.218)	(0.217)	(0.240)	(0.248)	(0.352)			(0.590)
Journalists	-0.749**	-0.734**	-0.813*	-0.797*	-1.736**	–	–	-1.521
	(0.371)	(0.372)	(0.438)	(0.453)	(0.766)			(1.127)
Other	-2.162***	-2.120**	-1.987**	-1.959**	-2.204*	–	–	-2.829
	(0.830)	(0.830)	(0.881)	(0.915)	(1.161)			(2.097)
Hourly Wage Rate	16.00	14.80	16.81	18.40	27.53**	–	–	34.37
	(10.48)	(10.47)	(10.88)	(11.35)	(12.38)			(21.42)
Managers	15.95	15.24	17.32*	18.64*	18.15*	–	–	49.15**
	(9.894)	(9.836)	(10.18)	(10.63)	(10.72)			(19.76)
Journalists	3.880	3.390	6.286	7.267	5.894	–	–	13.22
	(9.761)	(9.759)	(10.32)	(10.70)	(8.998)			(19.79)
Other	5.914	4.280	4.066	6.227	33.37**	–	–	25.36
	(12.26)	(12.24)	(12.66)	(13.26)	(14.70)			(26.03)
Controls:								
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	2,940	4,620	4,620	4,620

Notes: The estimates in this table come from the second stage regression equation (2), where the coefficient on the dependent variable, $y_{m,t+1}$, is displayed in the each row. The endogenous variable of interest is the broadband user rate in year t, $d_{m,t}$, which has been instrumented using the broadband availability rate in year *t-1*, $z_{m,t-1}$. For a detailed description of each outcome variable see Table A.2, Panel A. Prices are in 2010 NOK. In 2010, 1 USD ≈ 6 NOK. All regressions (excluding columns (4)-(5)) are based on 420 municipalities × 11 years = 4,620 observations, and include municipality fixed effects and year dummies. Column (1) displays the same IV specification as our main results in Table 2, while columns (2)-(3) add additional controls. For a description of all of the various control variables see Table A.2. In column (4), we exclude the 5 largest municipalities: Oslo, Bergen, Trondheim, Stavanger, and Bærum, while in column (5), we exclude post-2008 years from estimation. In columns (6) and (7) we estimate pre-expansion municipality-specific linear and quadratic time trends, as is shown in equation (C.1), and then extrapolate these into our specification. In column (8), in additional to the pre-expansion municipality-specific linear and quadratic time trends, we interact the baselines values of urbanization, population size and education level for each municipality with time fixed effects and include these in the specification, as is shown in equation (C.2).

* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.10: IV Estimates of Internet Use on Revenues, Costs and Labor Inputs By Market Segment.

	Locals			Tabloids			Non-tabloids		
	Est.	(SE)	Mean	Est.	(SE)	Mean	Est.	(SE)	Mean
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. Balance Sheet									
Total Revenues	67.58	(296.5)	3315.4	-509.2***	(81.45)	1257.7	-772.5***	(102.7)	870.0
Market Revenue	-194.3	(245.6)	2895.5	-541.5***	(76.73)	1245.3	-639.3***	(93.22)	794.5
Sales Revenue	-62.09	(76.24)	1172.7	-463.4***	(57.59)	929.9	-283.3***	(32.56)	318.7
Ads Revenue	-132.2	(192.8)	1722.8	-78.02***	(20.98)	315.3	-356.0***	(68.72)	475.9
Other Revenues	261.9	(189.5)	419.9	32.28	(24.53)	12.46	-133.2***	(15.60)	75.46
Total Costs	-155.5	(244.2)	2860.0	-348.7***	(68.34)	1039.0	-784.8***	(125.3)	788.5
Wage Costs	-202.8	(135.1)	1428.3	-128.7***	(18.55)	288.9	-367.1***	(72.53)	336.8
Intermediates	356.6	(251.0)	555.0	-50.22***	(13.17)	169.3	-493.1***	(60.34)	175.3
Other Costs	-309.2	(266.1)	876.6	-169.7***	(39.11)	580.8	75.42	(79.10)	276.4
Profits (EBITDA)	223.1*	(128.0)	455.4	-160.5***	(27.82)	218.7	12.28	(69.55)	81.49
B. Average Revenue Per Unit (ARPU)									
Market Revenue PU	-0.0785	(1.395)	13.85	0.168	(0.109)	21.89	-1.802*	(0.995)	22.77
Sales Revenue PU	-0.337	(0.461)	5.562	0.00640	(0.0729)	16.35	-1.146***	(0.370)	10.01
Ads Revenue PU	0.259	(1.056)	8.289	0.162***	(0.0473)	5.537	-0.656	(0.801)	12.76
C. Labor Inputs									
Direct Salary Costs	-605.2***	(205.5)	1185.7	-88.77***	(13.61)	218.0	-138.3***	(22.00)	209.0
Managers	-124.2**	(53.34)	297.5	-25.26***	(4.925)	76.86	-24.47***	(6.179)	52.46
Journalists	-130.7	(91.23)	328.8	-23.81***	(3.970)	64.10	-39.59***	(8.530)	64.68
Other	-350.3***	(100.4)	559.4	-39.70***	(5.357)	77.04	-74.22***	(12.18)	91.84
Labor Hours	-2.637***	(1.001)	5.957	-0.343***	(0.0426)	0.714	-0.565***	(0.0945)	0.901
Managers	-0.436**	(0.178)	1.234	-0.0989***	(0.0143)	0.234	-0.0981***	(0.0227)	0.191
Journalists	-0.489	(0.423)	1.531	-0.0769***	(0.0124)	0.201	-0.183***	(0.0366)	0.252
Other	-1.712***	(0.616)	3.193	-0.167***	(0.0193)	0.279	-0.283***	(0.0600)	0.457
Hourly Wage Rate	20.15*	(10.67)	202.3	3.218**	(1.372)	305.3	-2.462	(6.034)	226.8
Managers	18.81*	(10.36)	242.5	2.099*	(1.143)	328.3	1.405	(7.875)	269.9
Journalists	7.216	(10.60)	217.8	3.328**	(1.698)	319.2	1.800	(7.764)	246.5
Other	11.70	(12.74)	180.2	3.179**	(1.580)	276.1	-18.33***	(6.458)	194.7

Notes: The estimates in this table are the same as Table 4, but broken down by newspaper segment. For a detailed description of each outcome variable see Table A.2, Panel A. Revenues, costs, profits and wages are in 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK. All regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. All regressions include the demographic controls discussed in Table A.2, Panel E. Standard errors are heteroskedasticity robust and clustered at the municipality level. The mean for each outcome variable is from the baseline year, 2000.
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.11: Reduced Form Estimates of Internet Coverage on Content, Format and Listed Prices.

Level of Analysis:	**Municipality-Year Level**						**Newspaper-Year Level**		
	Total Effect			**Fixed Composition**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	(6)	**(7)**	**(8)**	**(9)**
	Estimate	**(SE)**	**Mean**	**Estimate**	**(SE)**	**Mean**	**Estimate**	**(SE)**	**Mean**
A. Content Shares									
Sport and Entertainment	-0.937***	(0.292)	35.38	-0.857***	(0.276)	35.38	-2.735*	(1.542)	35.94
Entertainment	-0.599***	(0.195)	18.95	-0.611***	(0.192)	18.95	-2.086*	(1.249)	19.26
Sport	-0.338**	(0.164)	16.43	-0.246	(0.161)	16.43	-0.649	(0.755)	16.69
Crime and Health	0.234**	(0.110)	27.68	0.180*	(0.104)	27.68	0.0514	(0.857)	27.33
Crime	0.323***	(0.0731)	12.47	0.280***	(0.0707)	12.47	0.566	(0.432)	12.27
Health	-0.0894	(0.104)	15.21	-0.1000	(0.0974)	15.21	-0.514	(0.738)	15.06
Politics, FA and B/F	0.704***	(0.254)	36.94	0.677***	(0.237)	36.94	2.684**	(1.307)	36.73
Politics	0.486***	(0.143)	15.61	0.397***	(0.137)	15.61	1.839***	(0.708)	14.62
Foreign Affairs	-0.158**	(0.0641)	3.402	-0.0500	(0.0519)	3.402	-0.554	(0.339)	3.659
Business/Finance	0.375***	(0.145)	17.93	0.329**	(0.138)	17.93	1.398	(1.084)	18.46
B. Format and Size									
Format (Page Size in cm^2)	-41.33	(26.31)	1,447	-31.33	(26.73)	1,447	35.33	(221.1)	1,499
No. of Pages	-1.470**	(0.640)	43.43	-1.096*	(0.630)	43.43	-7.589	(4.848)	46.31
Total Size (Format $\times$ No. of Pages)	-3,561***	(1,226)	62,614	-2,622**	(1,253)	62,614	-5,044	(13,857)	67,267
C. Listed Sales Price and Advert Prices									
Sales Price per Copy	-0.0629	(0.104)	12.03	-0.0593	(0.103)	12.03	-0.639	(0.937)	12.11
Full Page in 4 Colors	-4,063***	(861.3)	90,356	-1,249	(807.7)	90,356	-18,275	(12,634)	114,202
Full Page in B/W	-3,479***	(641.1)	56,348	-1715.5***	(622.2)	56,348	-15,028*	(8,293)	71,130
Column Ads, per cm	-1.883***	(0.404)	52.85	0.262	(0.357)	52.85	-1.701	(2.368)	63.54

Notes: This table presents the reduced form estimates corresponding to the IV estimates in Table 5. Columns (1)-(6) display estimates from our main specification at municipality x year level (4,620 observations). In the "Fixed Composition" Columns (7)-(9) we fix the composition of newspaper sales in each municipality to the levels they were in 2000, in order to isolate the direct effect of broadband usage from the change in composition effect. Columns (7)-(9) display estimates for outcomes measured at the newspaper x year level (850 observations) as described in Section D. Regressions in all specifications include the demographic controls discussed in Table A.2. For a detailed description of each outcome variable see Appendix Table A.2, Panel A. Prices are in 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK. The mean for each outcome variable from the baseline year, 2000, is displayed in columns (3). (6) and (9). Regressions in Columns (7)-(9) are weighted by the initial circulation of newspapers. Standard errors are heteroskedasticity robust and in columns (1)-(6) clustered at municipality level.
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.12: IV Estimates of of Internet Use on Content, Format and Listed Prices: Specification Checks.

	Baseline	Additional Controls		Drop Five Largest Cities	Exclude Years 2008-2010	Municipality-Specific Time Trends		
						Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total Effect								
A1. Content Shares								
Sport and Entertainment	-6.839***	-6.688***	-6.700***	-6.858***	-11.20***	-6.943***	-6.730***	-4.989
	(2.129)	(2.133)	(2.212)	(2.320)	(2.887)	(2.183)	(2.168)	(4.163)
Health and Crime	1.704**	1.698**	1.852**	2.028**	1.579*	1.892**	1.991**	2.597
	(0.814)	(0.818)	(0.867)	(0.891)	(0.925)	(0.849)	(0.845)	(1.679)
Politics, FA and B/F	5.136***	4.990***	4.848**	4.830**	9.621***	5.056***	4.644**	2.391
	(1.838)	(1.835)	(1.890)	(1.982)	(2.627)	(1.852)	(1.843)	(3.478)
B1. Format and Size								
Format (Page Size in cm^2)	-301.5	-293.8	-222.0	-269.9	-321.6	-220.6	-245.4	313.7
	(190.1)	(189.3)	(200.2)	(205.6)	(212.7)	(200.5)	(199.0)	(379.7)
No. of Pages	-10.72**	-10.69**	-11.19**	-9.783*	-2.701	-11.32**	-10.76**	-21.01**
	(4.729)	(4.747)	(4.995)	(5.115)	(4.256)	(5.015)	(4.961)	(10.33)
Format × No. of Pages	-25,981***	-25,558***	-22,9340**	-23,466**	-16,599***	-22,992**	-21,035**	-4,588
	(8,894)	(8,732)	(9,240)	(9,449)	(6,150)	(9,257)	(9,175)	(18,943)
A1. Unit Sales Price and Listed Advert Prices								
Sales Price Per Copy	-0.459	-0.432	-0.429	-0.272	0.683	-0.636	-0.559	-2.586*
	(0.762)	(0.764)	(0.795)	(0.826)	(0.853)	(0.806)	(0.809)	(1.442)
Full Page in 4 Colors	-29,641***	-29,231***	-26,816***	-25,123***	-17,560***	-26,645***	-26,694***	-880.9
	(6,118)	(6,100)	(6,354)	(6,329)	(5,952)	(6,366)	(6,362)	(10,869)
Full Page in B/W	-25,380***	-24,967***	-24,044***	-22,664***	-12,612***	-24,039***	-24,119***	-2,274
	(4,582)	(4,557)	(4,746)	(4,635)	(4,419)	(4,759)	(4,758)	(7,556)
Column Ads, Per cm	-13.74***	-13.82***	-14.71***	-14.16***	-5.899**	-14.78***	-14.65***	-19.21***
	(2.994)	(2.954)	(3.138)	(3.230)	(2.762)	(3.150)	(3.154)	(6.664)
Fixed Composition								
A2. Content Shares								
Sport and Entertainment	-6.252***	-6.036***	-6.082***	-6.229***	-10.33***	-6.339***	-6.339***	-4.566
	(2.023)	(2.014)	(2.091)	(2.189)	(2.755)	(2.048)	(2.002)	(3.975)
Health and Crime	1.316*	1.297*	1.438*	1.549*	1.646*	1.527*	1.595**	1.309
	(0.768)	(0.768)	(0.815)	(0.840)	(0.897)	(0.792)	(0.789)	(1.566)
Politics, FA and B/F	4.936***	4.739***	4.644***	4.679**	8.679***	4.789***	4.737***	3.303
	(1.725)	(1.719)	(1.769)	(1.855)	(2.488)	(1.709)	(1.675)	(3.266)
B2. Format and Size								
Format (Page Size in cm^2)	-228.6	-220.2	-163.8	-211.6	-272.3	-163.5	-168.1	496.9
	(193.4)	(192.6)	(203.2)	(208.3)	(215.6)	(203.7)	(203.3)	(398.2)
No. of Pages	-7.999*	-7.963*	-8.449*	-7.163	-1.066	-8.563*	-8.519*	-18.92*
	(4.648)	(4.673)	(4.912)	(5.050)	(4.274)	(4.931)	(4.926)	(10.11)
Format × No. of Pages	-19131.7**	-18701.5**	-16806.8*	-17492.5*	-12228.7*	-16922.3*	-16191.4*	2642.0
	(9088.0)	(8940.7)	(9393.5)	(9605.0)	(6529.9)	(9423.2)	(9314.8)	(19654.2)
C2. Unit Sales Price and Listed Advert Prices								
Sales Price per Copy	-0.432	-0.411	-0.506	-0.370	0.669	-0.767	-0.684	-2.613*
	(0.751)	(0.752)	(0.784)	(0.816)	(0.840)	(0.797)	(0.800)	(1.457)
Full Page in 4 Colors	-9,115	-8,889	-7,364	-6,074	-2,203	-7,314	-6,969	20,618*
	(5,829)	(5,827)	(6,066)	(6,064)	(5,757)	(6,086)	(6,109)	(10,524)
Full Page in B/W	-12,516***	-12,216***	-11,955***	-10,903**	-4,210	-12,033***	-11,193**	12,326
	(4,467)	(4,450)	(4,605)	(4,547)	(4,473)	(4,622)	(4,643)	(7,669)
Column Ads, Per cm	1.911	1.726	0.293	0.622	6.975***	0.0935	0.261	-1.546
	(2.605)	(2.582)	(2.642)	(2.732)	(1.991)	(2.667)	(2.739)	(5.220)
Control:								
Demographics	✓	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	2,940	4,620	4,620	4,620

Notes: The estimates in this table come from the second stage regression equation (2), where the coefficient on the dependent variable, $y_{m,t+1}$, is displayed in the each row. The endogenous variable of interest is the broadband user rate in year t, $d_{m,t}$, which has been instrumented using the broadband availability rate in year *t-1*, $z_{m,t-1}$. For a detailed description of each outcome variable see Table A.2. Prices are in 2010 NOK. In 2010, 1 USD ≈ 6 NOK. All regressions (excluding columns (4)-(5)) are based on 420 municipalities × 11 years = 4,620 observations, and include municipality fixed effects and year dummies. Column (1) displays the same IV specification as our main results in Table 2, while columns (2)-(3) add additional controls. For a description of all of the various control variables see Table A.2. In column (4), we exclude the 5 largest municipalities: Oslo, Bergen, Trondheim, Stavanger, and Bærum, while in column (5), we exclude post-2008 years from estimation. In columns (6) and (7) we estimate pre-expansion municipality-specific linear and quadratic time trends as is shown in equation (C.1), using data from 1991-1991 in the A panels, and 1997-1999 in B and C panels, we then extrapolate these into our specification. For panels A1 and A2 we calcuate pre-trends using data from 1991-1999, while for the rest of the panels (due to lack of data before 1997) we calcuate pre-trends using data from 1997-1999. In column (8), in additional to the pre-expansion municipality-specific linear and quadratic time trends, we interact the baselines values of urbanization, population size and education level for each municipality with time fixed effects and include these in the specification, as is shown in equation (C.2).
* p < 0.1, ** < 0.05, *** p < 0.01.

Table E.13: IV Estimates of Internet Use on Content, Format and Listed Prices By Market Segment.

	Locals			Tabloids			Non-tabloids		
	Est.	(SE)	Mean	Est.	(SE)	Mean	Est.	(SE)	Mean
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Effect									
A1. Content Shares									
Sport and Entertainment	-7.416***	(2.365)	35.19	-0.449**	(0.194)	41.53	-10.25***	(2.811)	23.65
Entertainment	-3.952**	(1.780)	18.48	-0.259***	(0.0904)	22.77	-7.723***	(1.743)	13.84
Sport	-3.464***	(1.150)	16.71	-0.190	(0.217)	18.75	-2.529**	(1.142)	9.806
Health and Crime	2.455**	(1.047)	27.21	0.168	(0.117)	31.23	2.586***	(0.857)	21.93
Health	2.234***	(0.608)	12.60	0.0547***	(0.0154)	11.57	1.312**	(0.658)	12.89
Crime	0.221	(0.777)	14.61	0.113	(0.109)	19.66	1.274**	(0.527)	9.039
Politics, FA and B/F	4.961***	(1.874)	37.61	0.281*	(0.148)	27.24	7.666***	(2.405)	54.42
Politics	2.795**	(1.121)	16.08	0.0903	(0.0647)	12.83	4.867***	(1.176)	18.95
Foreign Affairs	-0.358	(0.457)	3.196	0.0576	(0.0379)	3.165	-6.546***	(1.297)	5.642
Business/Finance	2.523**	(1.233)	18.33	0.133**	(0.0571)	11.24	9.346***	(1.910)	29.83
B1. Format and Size									
Format (Page Size in cm^2)	-452*	(272)	1,576	–	–	1022	-696***	(124.6)	1,386
No. of Pages	-11.74*	(5.612)	39.04	–	–	60	-0.814	(1.435)	38.02
Format $\times$ No. of Pages	-28,955**	(9,247)	61,160	–	–	61,320	-35,503***	(6,215)	54,599
C1. Unit Sales Price and Listed Advert Prices									
Sales Price Per Copy	-0.126	(0.884)	12.10	-0.0748**	(0.0381)	10.98	1.618***	(0.567)	13.88
Full Page, 4 colors	-13,771**	(4,056)	52,232	-1,097	(1,791)	212,182	-62,381***	(10,030)	110,883
Full page in B/W	-14,523***	(3,172)	37,374	-428	(606)	112,376	-56,358***	(7,315)	74,244
Column Ads, Per cm	-4.909	(2.989)	23.85	-0.386	(1.272)	145.4	-8.836***	(3.032)	54.92
Fixed Composition									
A2. Content Shares									
Sport and Entertainment	-6.418***	(2.312)	35.19	-0.377**	(0.181)	41.53	-8.876***	(0.998)	23.65
Entertainment	-3.858**	(1.745)	18.48	-0.166*	(0.0939)	22.77	-6.806***	(0.801)	13.84
Sport	-2.560**	(1.145)	16.71	-0.211	(0.194)	18.75	-2.070***	(0.340)	9.806
Health and Crime	2.225**	(1.040)	27.21	0.163	(0.123)	31.23	3.084***	(0.512)	21.93
Health	1.824***	(0.604)	12.60	0.0458***	(0.0164)	11.57	2.009***	(0.346)	12.89
Crime	0.401	(0.775)	14.61	0.117	(0.114)	19.66	1.075***	(0.354)	9.039
Politics, FA and B/F	4.193**	(1.813)	37.61	0.215**	(0.0887)	27.24	5.792***	(0.841)	54.42
Politics	1.999*	(1.066)	16.08	0.0622	(0.0501)	12.83	3.493***	(0.631)	18.95
Foreign Affairs	-0.0657	(0.457)	3.196	0.0311	(0.0239)	3.165	-4.858***	(1.097)	5.642
Business/Finance	2.260*	(1.213)	18.33	0.122***	(0.0339)	11.24	7.157***	(0.724)	29.83
B2. Format and Size									
Format (Page Size in cm^2)	-286	(204)	1,576	–	–	1022	-855***	(124)	1,386
No. of Pages	-9.753	(5.428)	39.04	–	–	60	2.380***	(0.622)	38.02
Format $\times$ No. of Pages	-20,152*	(9126)	61,160	–	–	61,320	-38,494***	(6,031)	54,599
C2. Unit Sales Price and Listed Advert Prices									
Sales Price Per Copy	-0.0881	(0.874)	12.10	-0.0387	(0.0404)	10.98	0.834	(0.561)	13.88
Full Page, 4 colors	-7,705*	(4,264)	52,232	-965***	(317)	212,182	-63,639***	(7,880)	110,883
Full page in B/W	-9,131***	(3,377)	37,374	-393**	(176)	112,376	-59,822***	(6254.5)	74,244
Column Ads, Per cm	-2.490	(3.247)	23.85	-0.548*	(0.329)	145	-8.239***	(2.614)	54.92

Notes: The estimates in this table are the same as Table 5, but broken down by newspaper segment. For a detailed description of each outcome variable see Table A.2. All regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. All regressions include the demographic controls discussed in Table A.2. Standard errors are heteroskedasticity robust and clustered at the municipality level. The mean for each outcome variable is from the baseline year, 2000.
* p < 0.1, ** < 0.05, *** p < 0.01.