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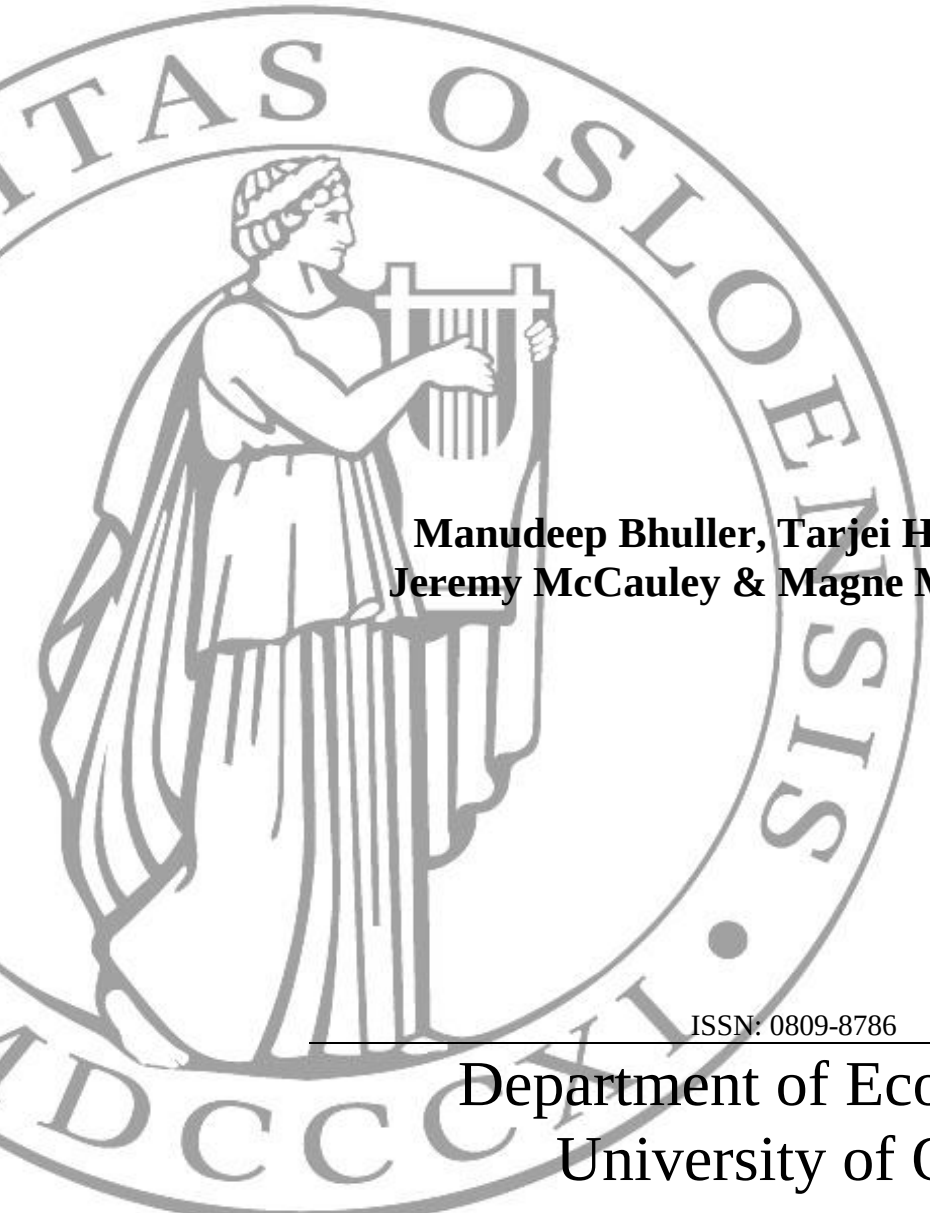
How the Internet Changed the Market for Print Media



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How the Internet Changed the Market for Print Media

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Abstract: This paper analyzes how household adoption of broadband internet affected traditional print media, using data from the Norwegian media market over the past two decades. This setting offers unusually rich data on newspaper firms and consumption of print media combined with a plausibly exogenous variation in the availability and adoption of broadband internet. The overall print circulation of newspapers in Norway fell by 30 % between 2000 and 2010. Our estimates indicate that 40 % of this reduction was caused by increased internet adoption. However, we uncover important heterogeneity in the impacts across different segments of the newspaper market. While most of the decline in sales suffered by tabloid and non-tabloid national newspapers is attributable to increased internet adoption, none of the decline of local newspapers can be explained by increased internet adoption. We further show that newspaper firms responded by dramatically cutting costs, either by reducing labor inputs or the physical size of their newspaper, and in doing so avoided profit loss. Local newspapers moreover responded by reducing tabloid content and publishing more serious news, which appears to have mitigated the negative impacts on their sales. Our study provides some of the first causal evidence on how newspaper firms respond to a major technological change that threatens their revenue.

Keywords: Internet, Print Media, Technological Change, Market Structure
JEL codes: L11, L82, L86, O33, R22

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1 Introduction

The adoption of new technology often provokes predictions regarding the rapid demise of existing media products. However, existing media have time and again proved remarkably resilient, raising questions about whether their products are 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 claim this time is different: Print newspapers are suffering 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, prices, product characteristics, and factor inputs.[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). 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 does household adoption of broadband internet affect the sales and revenues of different types of newspapers? How much of the loss of revenues comes from declining print sales and how much is due to advertisers shifting their spending away from print newspapers? To what extent do print newspapers change their content, prices and factor inputs 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 over the past two decades. The print newspaper industry in Norway is characterized by relatively high geographic differentiation comprising distinct market segments: About fifteen papers have national orientation and nationwide distribution, while the majority of newspapers are local or regional, serving relatively small geographic markets. Norway provides an attractive context for our study as it offers several data sources that we can link through unique firm and individual 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, prices, product characteristics, and use of factor inputs. 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, we follow Bhuller et al. (2013) in exploiting a public program

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

[2] The data challenges are twofold. First, newspaper directories are standard sources for research on the market for print newspaper, providing measures of newspaper circulation but not information on revenues, prices, and factor inputs (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, rather than precise measures of the adoption of specific technologies (Bloom et al., 2016).

aimed at ensuring broadband access at a reasonable price to all households throughout the country.[3] 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.

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. These estimated impacts are based on an IV model exploiting the aforementioned spatial and temporal variation in the broadband availability and controlling for calendar year and municipality fixed effects. These estimates are highly robust to inclusion of a large set of time-varying characteristics as controls, specifications with differential time trends across locations, geographic spillovers and newspaper fixed effects, and pass a battery of placebo tests.

Second, we uncover important heterogeneity across different segments of the media market. Local newspapers – which comprise the bulk of newspaper market in Norway – had a steady decline in 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 comparison, tabloid newspapers – accounting for one-fifth of the overall print newspaper circulation – lost almost half of their circulation. Our estimates suggest that internet adoption could explain about 85 % of this drop. The remaining non-tabloid national newspapers also experienced losses in circulation, and our estimates suggest that in the absence of internet adoption, these newspapers would have had a growth in their sales. Taken together, these findings suggest differences in the scope of substitutability between online and offline sources of news across customers adhering to different segments of the print media market.

Third, we show that the losses in circulation cause 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, including any revenues from online subscription sales or advertisements. 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. In contrast, revenues in local newspapers remained unaffected. Decomposing losses in revenues accrued from sales and advertisements, we find that 85 % of the revenue loss in tabloids can be attributed to a reduction in sales revenue, while reductions in sales and ads revenue

[3] Bhuller et al. (2013) use the roll-out of broadband internet to study how internet use affects sex crimes.

contributed more evenly to revenue loss for non-tabloids.[4] Decomposing sales revenue in average sales revenue per sold unit and sales volume, we find that the volume effect can account for over 80 % of the fall in sales revenue.

Finally, we show that the negatively affected newspaper firms responded by dramatically cutting costs, either by reducing labor inputs or the physical size of their newspaper, and in doing so avoided profit loss. While wage costs accounted for 44 % of total costs in newspaper firms at the start of our study period, 54 % of the drop in total costs could be attributed to a reduction in wage costs. Using matched employer-employee data to further decompose 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 (e.g., support staff) are disproportionately larger for both labor hours and salary costs. Using detailed data on newspaper characteristics, we also find that newspapers cut costs by reducing the physical format and size of newspaper sheets. Using data on keyword counts, we find evidence that newspapers alter the content of news articles. In particular, local newspapers – which to large extent were able to mitigate the negative impacts of internet adoption – significantly reduced their tabloid content (e.g., sports, entertainment) and shifted coverage to more serious news topic (e.g., politics, foreign affairs). Underlying the resilient nature of media market, our findings suggest that such firms are largely able to respond to adverse market developments across multiple margins of adjustment.[5]

Taken together, our findings have important implications for ongoing debates regarding the causes and consequences 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.[6] 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 complements the case study of Gentzkow (2007) by examining how the growth in broadband adoption changed the entire market for print newspapers, including the heterogeneous impacts felt by different types of newspapers, and by studying how newspaper firms responded to this technological change. More broadly, our paper is concerned with how new goods

[4]This may imply that tabloids and non-tabloids fare differently in two-sided markets with heterogeneous customers and/or heterogeneous advertisers (Rysman, 2009; Filistrucchi and Klein, 2015).

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

[6]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 drop 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 if any 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 drop in readership of about 10 percent. However, none of these studies consider how newspaper firms responded to internet adoption.

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., 2017; 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).[7] 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 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 collected from several different sources, which we can link through unique identifiers for households, newspapers, and firms.[8] We describe our data sources and our sample selection below, while further details about variables are provided 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

[7] 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).

[8] 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 here.

(or take-up) among households. Throughout the paper, broadband internet is defined as internet connections with download speeds that exceed 256 kbit/s.[9]

The data on broadband availability are available from the Norwegian Communications Authority. 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, 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.

Newspaper Data. We collected and digitized data for Norwegian newspapers over the period 1997–2012. Our data give information for each newspaper and every calendar year about (i) number of copies sold per edition in each municipality, i.e., newspaper circulation, (ii) revenues and factor inputs, (iii) listed prices and other product characteristics, such as newspaper format, number of editions per year, and number of pages per printed edition, and finally, for a subset of newspapers, (iv) digitized full text sources of news articles.

The data on newspaper circulation, listed advertisement prices, listed sale prices and 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, which gives us a sample of 81 newspapers.[10] Combined, these newspapers made up more than 90 % of the newspaper market in 2000. Data for years 2001–2012 are provided by MBL, while data for years 1997–2000 come from records in the National Library of Norway.

For descriptive purposes, we also use data on media use for a representative sample of individuals at ages 9–79, provided by Statistics Norway's Media User Survey for years 2000–2010. Each year, around 2,700 individuals are asked detailed questions about their media use, with a response rate above 70 %. Importantly, the survey contains information on respondents' online and print newspaper readership.

The data on newspaper revenues and costs come from newspaper accounts collected annually by the Norwegian Media Authority. The accounts data contain detailed information from the newspaper firms' balance sheets for the period 1997–2012, including their sales revenues, advertisement revenues, 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

[9] 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.

[10] We classify newspapers as daily if they have at least four editions per week.

Tax Authority and maintained by Statistics Norway. To distinguish labor inputs by worker types, we merged accounts data to matched employer-employee data from Statistics Norway. 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 occupational groups, respectively.

The data on newspaper content come from *Retriever*, the leading supplier of media monitoring in Norway, and from a database of digitized Norwegian newspapers maintained by the National Library of Norway. Retriever daily receives full text data on all published material from a large number of Norwegian media outlets, and historical data are available for a subset of newspapers over 2000–2010. More recently, the National Library of Norway fully digitized a subset of historical printed newspapers and made this information available in an online searchable and downloadable database.[11] To form our content outcome variables, we counted the number of hits in these databases on searches for keywords associated to three different news categories; (i) Sports and Entertainment, (ii) Crime, and (iii) Politics and Foreign affairs. We refer to Appendix Table A.2 for details.

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 these data in our analysis below, we need to link them to municipal variation in broadband use and availability, see Section 5 for details.

Socio-economic Data. Most of our socio-economic data come from administrative registers provided by Statistics Norway. Specifically, we use a rich longitudinal database which covers every resident from 2000 to 2010. It contains individual demographic information (regarding gender, age, marital status and number of children), socio-economic data (educational attainment, income, employment status), and geographic identifiers for municipality of residence. The information on educational attainment is based on annual reports from Norwegian educational establishments, whereas the income data and employment data are collected from tax records and other administrative registers. The household information is from the Central Population Register.

2.2 Trends in the Newspaper Market in Norway

We start by documenting the trends in newspaper circulation and readership over time, before we consider newspapers' revenues, costs and product characteristics. Note that detailed descriptive statistics for all variables used in our analysis are provided in the Appendix Tables B.1.1-B.1.2.

Trends in Newspaper Circulation and Readership. 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 (that is, 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

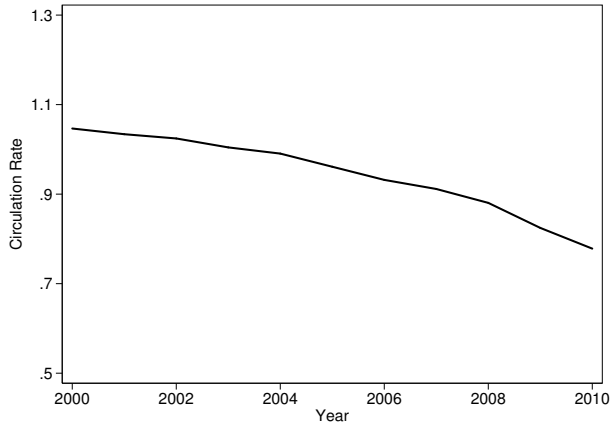
[11] This database can be accessed at https://www.nb.no/search?q=aviser&mediatype=aviser.

2000 to about 0.75 in 2010, a decline of 30 %. This is associated with a similar fall in sales volume (that is, the total number of copies sold per year divided by the number of households) of around 80 newspapers per year, or about 25 %.

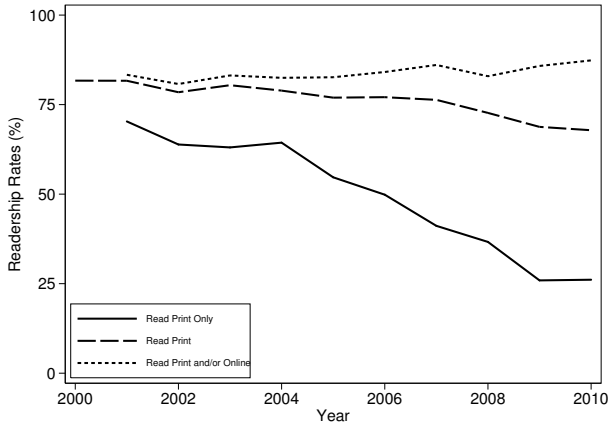
In keeping with this, Figure 1b shows a decline in the fraction of population that read news in print only from almost 3/4 of the population in 2001 to about 1/4 in 2010. Overall, readership of print only and readers of print altogether, decreased by about 63 % and 17 % over this period, respectively. Notably, there is a substantial increase in readership of online news over this period, both in readership of online news online and in readership of online and print news jointly. Together this lead to a slight increase in the overall news readership.

Figure 1: Trends in Newspaper Circulation and Readership.

(a) Newspaper Circulation



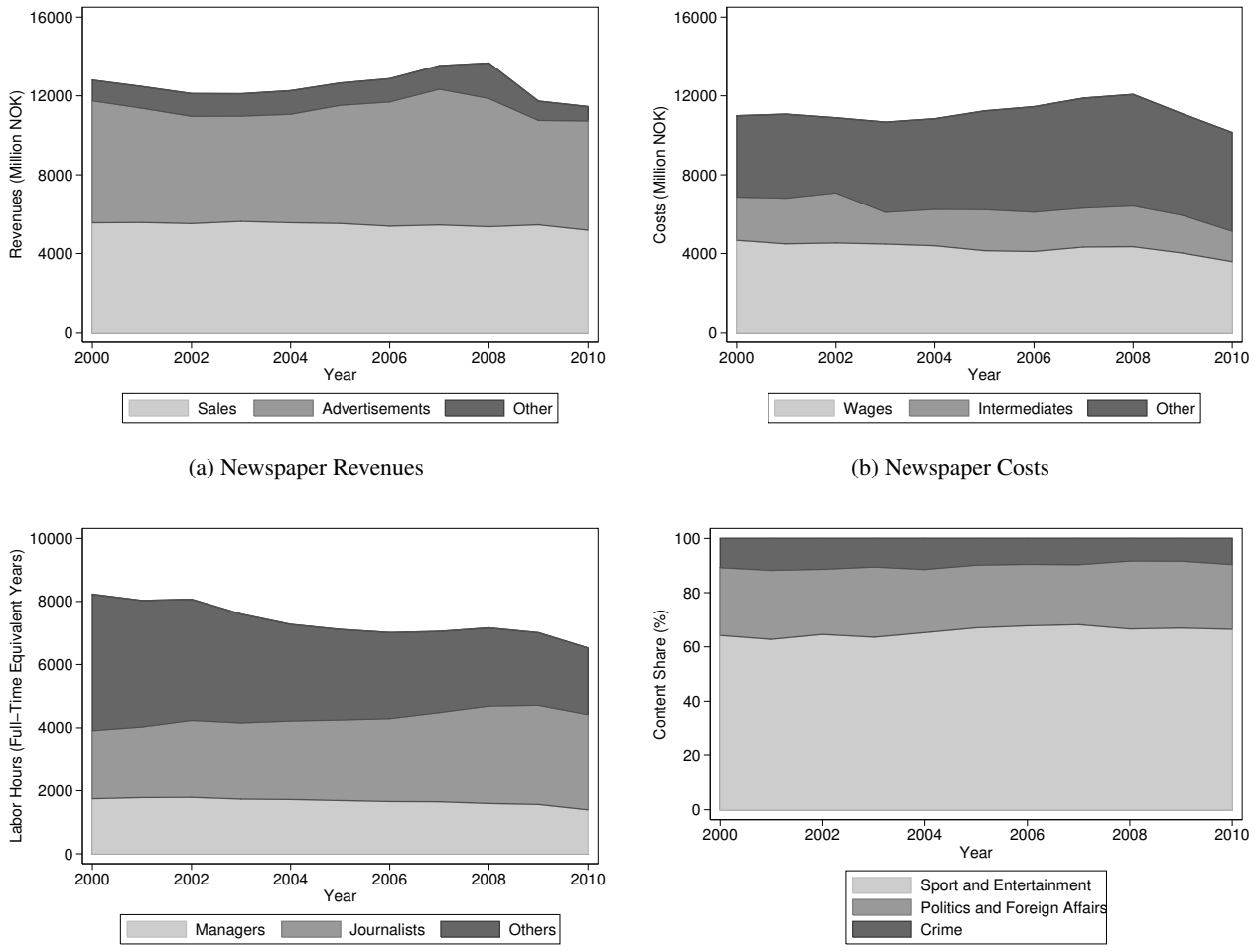
(b) Newspaper Readership



Notes: Panels (a) and (b) show the annual trends in newspaper circulation and readership rates, respectively. The circulation rates are calculated as the total number of copied sold (per edition) summed across 81 newspapers in our sample divided by the number of households residing in each municipality at the start of each year. 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.

Trends in Newspaper Revenues, Costs, Labor Inputs and Content. 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 2(a). Figure 2(b) 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 2(c), 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 %. Figure 2(d) displays the content share of different types of news across the newspapers in our sample. The largest category is Sports and Entertainment, accounting for two-thirds of newspaper content.

Figure 2: Trends in Newspaper Revenues, Costs, Labor Inputs and Content.



(a) Newspaper Revenues

(b) Newspaper Costs

(c) Labor Hours

(d) Newspaper Content

Notes: Panels (a) and (b) present the revenues and costs summed across 81 newspapers in our sample in million 2010 NOK. In 2010, 1 USD $\approx$ 6 NOK. Panel (c) 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 (d) presents the average content shares across our sample. Appendix Table A.1 provides a complete list of the 81 newspapers in our sample.

2.3 Segmentation of the Newspaper Market in Norway

The newspaper market in Norway is characterized by relatively high geographic 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; tabloid newspapers (VG and Dagbladet) and about a dozen non-tabloid newspapers.[12]

Below, we first verify that this anecdotal segmentation of the Norwegian newspaper market, which is used widely in Norwegian media policy, is meaningful economically. We then documents trends in newspaper

[12]See Appendix Table A.1 for a complete list of the newspapers included in our sample along with their main characteristics.

circulation separately for each market segment.

Newspaper Classification and Geographic Markets. To verify that the widely used segmentation of the newspaper market into local, national tabloid and national non-tabloid is reasonable, we compare the three types of newspapers by their geographical dispersion. 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) in the main municipality, (ii) in municipalities neighboring the main municipality, (iii) in other municipalities within the same county, and (iv) outside the county. Table 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 1: Geographical Dispersion of Circulation by Newspaper Types.

	Locals	**Tabloids**	**Non-tabloids**
	(1)	(2)	(3)
A. Share of Total Circulation			
Main Municipality	51.0 %	15.5 %	35.2 %
Neighboring Municipalities	25.3 %	6.4 %	12.3 %
Rest of County	17.0 %	6.5 %	8.6 %
Rest of Norway	6.7 %	71.6 %	43.9 %
B. Circulation Rate			
Main Municipality	.52	.14	.20
Neighboring Municipalities	.35	.14	.18
Rest of County	.14	.17	.14
Rest of Norway	.00	.12	.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.

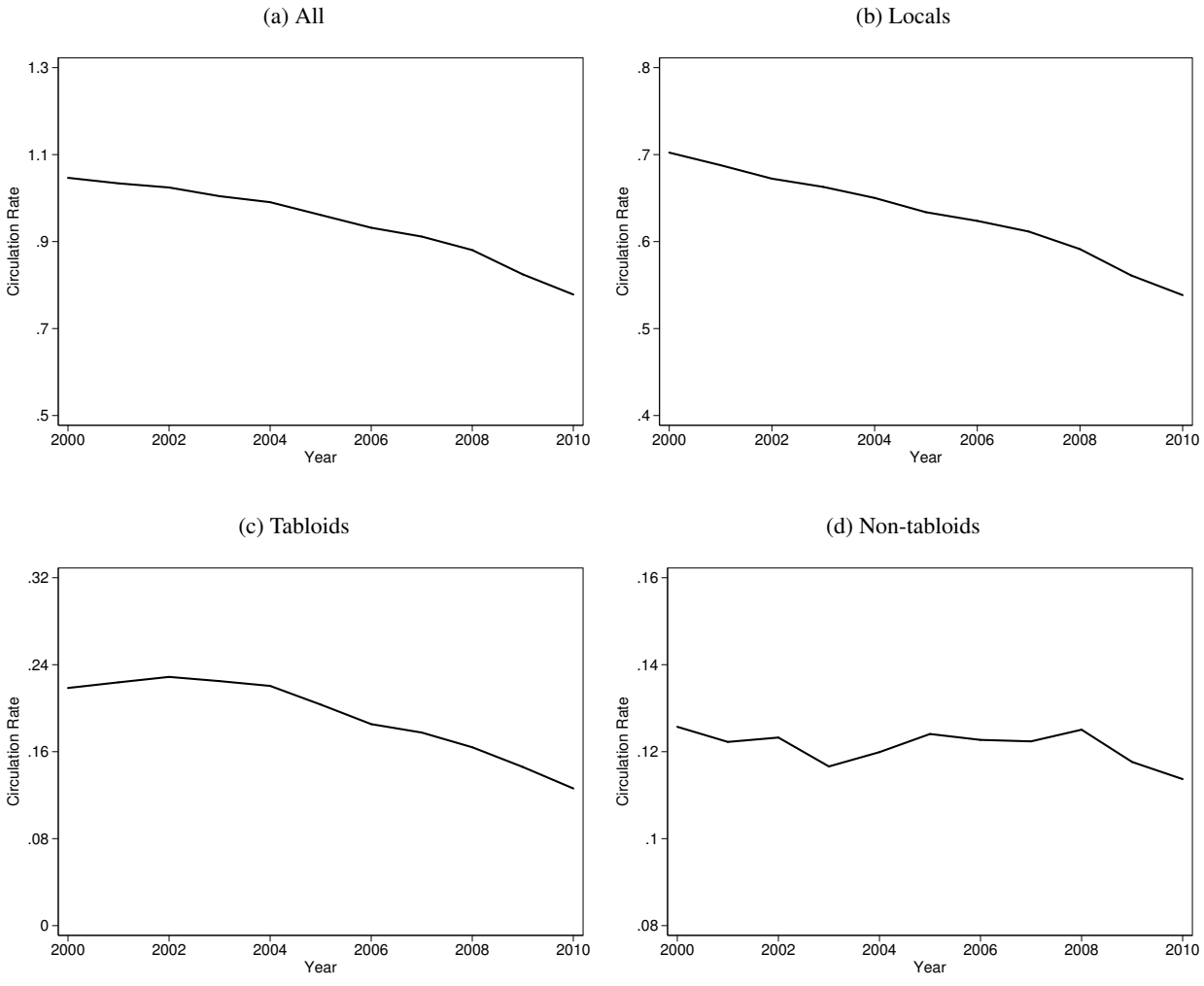
The geographical dispersion documented in Table 1 shows that newspapers differ distinctly by type: Among local newspapers, 51 % of circulation is within the main municipality, and 93 % within a single county. Local newspapers also have a strong position locally, with an average circulation rate of 0.52 in the main municipality and 0.35 in neighboring municipalities. In contrast, among tabloid newspapers, 84.5 % 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 35 % 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.[13]

Another way to assess the classification of newspapers is to estimate the price elasticity of newspaper sales with respect to (i) their own price, (ii) the price of other newspapers of the same type, and (iii) the price

[13]Non-tabloids have 42 % of their sales in the three biggest municipalities, compared to 25 % for tabloids and 19 % for locals.

of other types of newspapers. 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. In Appendix Section B.3, we implement an IV-procedure that suggests that this holds well for the segmentation into local, national tabloid and national non-tabloid: The estimates suggest that the same type of newspapers are relatively close substitutes, and that newspaper demand is largely independent across different types of newspapers.

Figure 3: Segments of the Norwegian Newspaper Market.



Notes: The figure shows the annual trend in circulation rate, overall and by newspaper type. 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 included see Appendix Table A.1.

Trends in Newspaper Circulation Across Types. Figure 3 shows the overall newspaper circulation rate for each year over 2000–2010, as well as the circulation rates for daily locals, tabloids and non-tabloids.[14] 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. Figure 3 shows a large drop in circulation over the period. Overall, printed newspapers fall by about 30 %, with tabloids shedding almost half of their circulation. Non-tabloids fare less poorly, but still lose about 15 % of their initial circulation.

2.4 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 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.[15] 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.[16]

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 staged expansion of access points was in part due to limited public funding, but also because Norway is a large and sparsely populated country.

[14] Non-daily local newspapers (i.e., having less than 4 print releases per week in 2000) were dropped from our sample due to concerns of data quality.

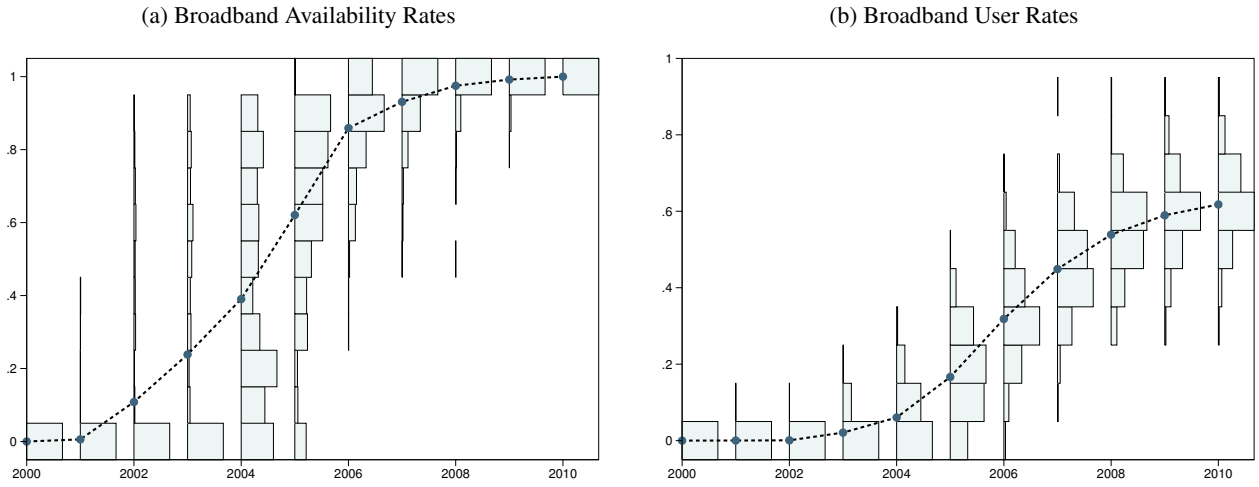
[15] Our discussion draws on Bhuller et al. (2013). These policy goals are outlined in St.meld.nr. 38 (1997–1998), Section 4.5, and St.meld.nr. 49 (2002–2003), page 7.

[16] 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. There are virtually no private schools in Norway.

There are often long driving distances between the populated areas, which are mostly far apart or partitioned by mountains or the fjord-gashed shoreline.[17]

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.[18] 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 4: 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 B.2.1 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

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

[18] 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.

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 (even conditional on year and municipality fixed effects).

Figure 4 summarizes the evolution of broadband availability and usage of households 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 this 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 Identification Strategy

3.1 Instrumental Variables Model

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, independently of whether they take it up. This can be represented by the following first stage equation:

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

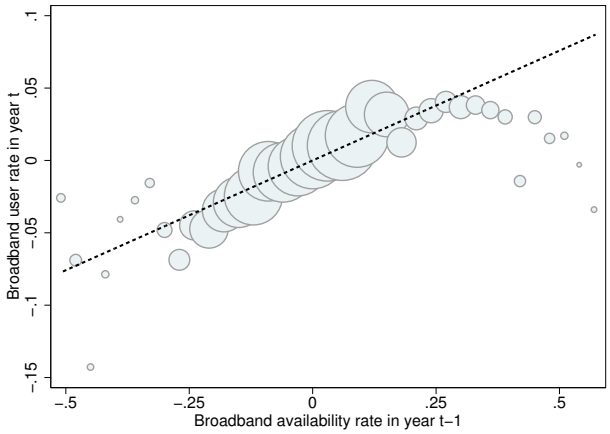
where $x_{m,t-1}$ is a set of time-varying covariates. Unobservable determinants that are fixed at the municipality level will be controlled for through the municipality indicators (γ_m), just like common time shocks are absorbed by the year indicators (υ_t). Throughout the paper, all standard errors are clustered at the municipality level and robust to heteroskedasticity.

Figure 5a draws a scatter plot of broadband availability rates against broadband user rates, after taking out the municipality and year fixed effects. We let the size of the circle represent the number of households in each bin. The figure shows a strong association between the 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 2, with a precisely estimated first-stage coefficient of 0.137 and a F-statistic of 361. This coefficient estimate

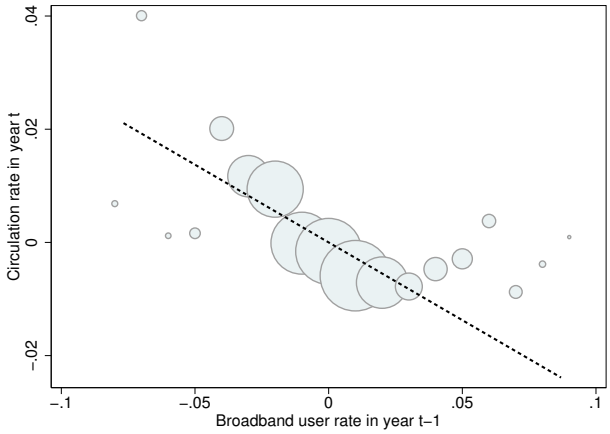
indicates that an increase in the broadband availability rate by 10 percentage points increases broadband user rate by almost 1.4 percentage points in the following year.

Figure 5: Scatter Plots of Broadband Internet Usage and Newspaper Circulation.

(a) User Rates on Availability Rates



(b) Newspaper Circulation Rates on User Rates



Notes: Panel (a) show scatter plots of broadband user rates against broadband available rates, after removing time and municipality fixed effects, while panel (b) show similar scatter plots of newspaper circulation against broadband user rates instrumented using broadband available rates.

Table 2: First-Stage Estimates of Broadband Availability Rate on Broadband User Rate.

	Dependent Variable:
	Broadband User Rate
Instrumental Variable:	
Broadband Availability Rate	0.137***
Std Error	(0.0072)
F-statistic (instrument)	361.0
Observations	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*, $z_{m,t-1}$. The regression includes municipality fixed effects and year dummies, and the demographic controls discussed in 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 adoption affect an outcome of interest, we use a second stage equation of the following type:

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

where $y_{m,t+1}$ is the outcome of interest in year $t+1$ and parameter λ captures how an increase in broadband internet use 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 secular changes over time

in the newspaper market or the economy more generally.

To illustrate this IV approach, Figure 5b draws a scatter plot of the predicted user rates from equation (1) against one of our key outcomes, the newspaper circulation rate. Both variables are residualized on municipality and year fixed effects. The figure shows a strong association between internet use and newspaper 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.

In Section 4, we estimate several specifications of the IV model represented by equations (1) and (2). By changing the dependent variable in equation (2), we can examine how broadband usage affects the market for print newspapers. In our main analysis in Section 4, we consider how internet affects newspaper circulation and sales volume, as well as the revenues overall and separately from sales and advertisements.

Unobservable determinants that are fixed at the municipality level will be controlled for through the municipality indicators, just like common time shocks are absorbed by the year indicators. 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 $x_{m,t}$. We will add two sets of control variables. We first include controls for factors that are suspected to influence supply and demand for internet, and are therefore expected to correlate with the broadband expansion. Next, we 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. The full set of control variables are listed and described in Appendix Table A.2.

3.2 Assessing the IV-model

Our identification strategy – which controls for municipality and year fixed effects – 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 the roll-out is unlikely to co-vary with key correlates of newspaper sales and revenues.

To investigate whether the data is consistent with these program features, we first regress z_{kt} 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.[19]

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

$$\Delta z_{m,t} = [\theta_t \times b_m]' \psi_t + \omega_t + \varepsilon_{m,t}, \tag{3}$$

[19]These include all controls listed in Appendix Table A.2, panels E-G.

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 2.4) 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 B.2.2 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 broadband availability is unrelated to most baseline municipality characteristics. Nevertheless, in Section 4.3, we perform a series of specification checks to further assess the validity of our results.

4 Main Results: Internet and the Sales of Printed Newspapers

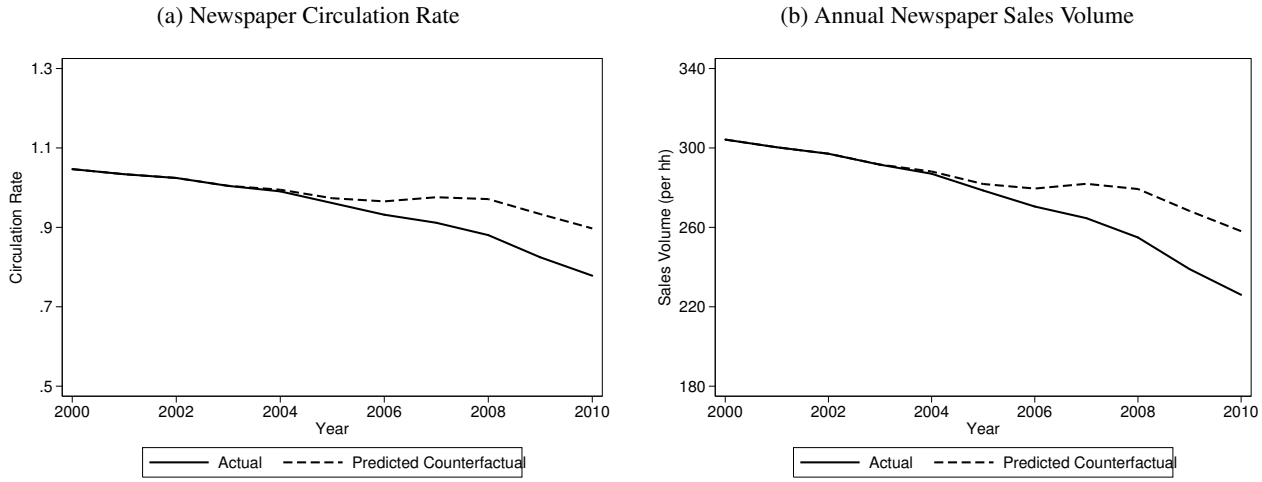
This section presents the main results from our analysis of how internet affects the sales of print newspapers. We start by considering how the take-up of broadband internet affected overall newspaper sales, then we consider the three main segments of the newspaper market in Norway that we identified above—local, national tabloid and national non-tabloid newspapers—and study how effects differ across these segments. Finally, we subject our main results to a battery of specification checks to guard against alternative explanations.

4.1 Newspaper Sales

In Table 3 we report the main estimates from our IV-model. In Panel A, we see first that broadband internet has a substantial negative impact on the sale of printed newspapers. Our estimates suggest that the newspaper circulation rate drops by 0.2 points as households adopt broadband internet, or almost 20 % of the baseline mean. This drop in circulation rates corresponds to a drop in the overall sales volume of newspapers by about 54 copies per household annually, or about 18 % of the baseline mean.

To better understand the economic impact of broadband internet, Figure 6a shows the actual and predicted counterfactual trends over the period 2000–2010. To calculate the predicted counterfactual trends, we take the total predicted impact of the number of broadband internet users in each year using the estimates in column (1) of Table 3. As we saw in Figure 4b, 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 drop 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 drop of about 12 % over the baseline mean. As a fraction of the overall decline in print circulation rate from 1.05 in 2000 to about 0.75 in 2010, our point

Figure 6: Actual and Predicted Newspaper Sales.



Notes: Figures show the overall actual (solid line) and predicted counterfactual (dashed line) newspaper circulation rate (panel a) and sales volume per household (panel b). The counterfactual is given by the actual outcome minus the predicted effect of internet use on each outcome. 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 3.

estimates suggest that the adoption of broadband internet can explain almost 40 % of this decline.

Table 3: IV Estimates of Internet Use on Newspaper Circulation and Sales Volume.

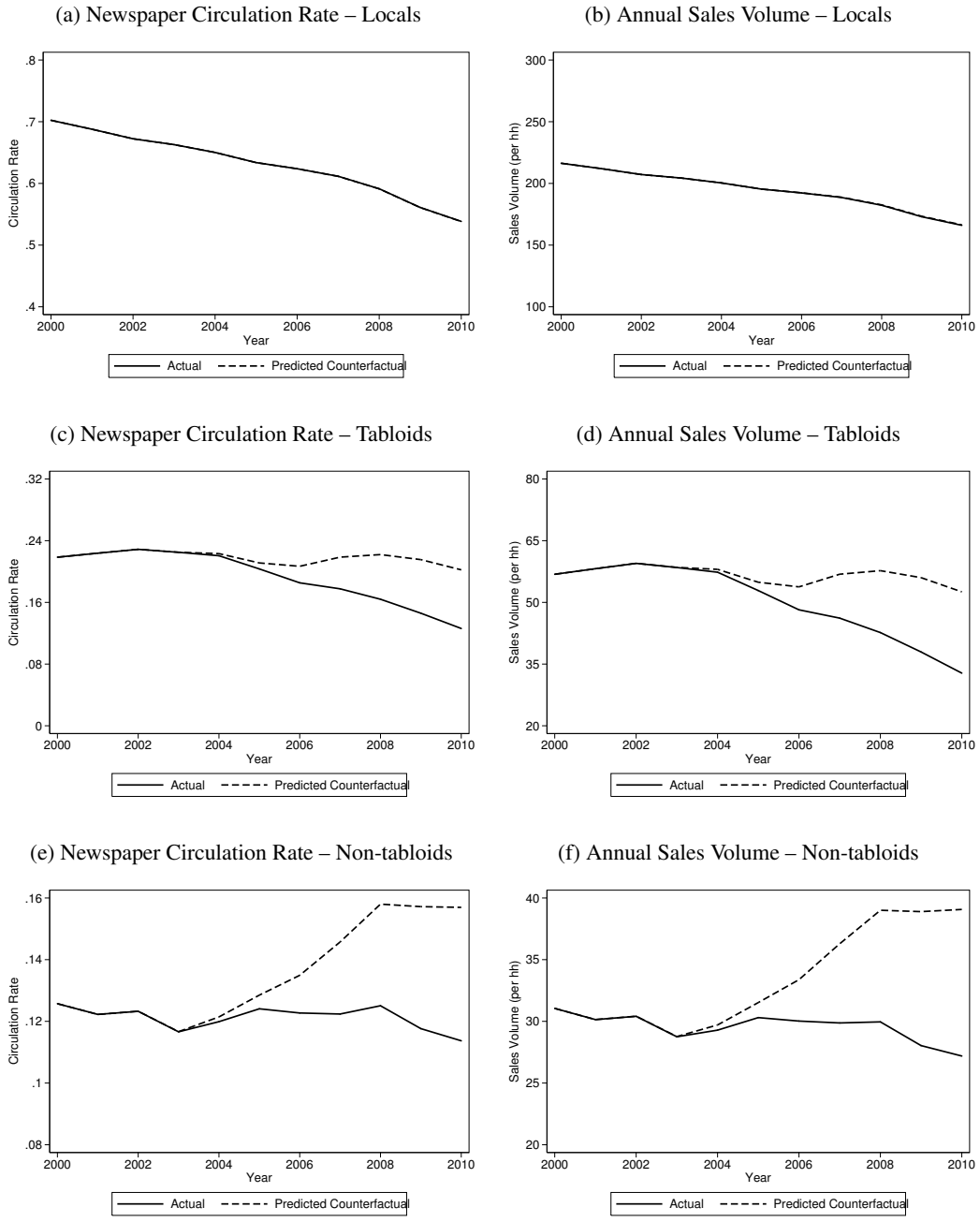
	All	**Locals**	**Tabloids**	**Non-tabloids**
	(1)	**(2)**	**(3)**	**(4)**
Circulation Rate	-0.202***	0.0003	-0.129***	-0.0734***
Std Error	(0.0379)	(0.0248)	(0.0153)	(0.0184)
Baseline Mean	1.047	0.702	0.219	0.126
Annual Sales Volume	-54.35***	-0.677	-33.52***	-20.15***
Std Error	(10.47)	(7.580)	(3.982)	(4.400)
Baseline Mean	304.2	216.3	56.84	31.05

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 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 from the baseline year, 2000, is displayed.
* p < 0.1, ** < 0.05, *** p < 0.01.

4.2 Heterogeneous Impacts Across Newspaper Markets

As discussed in Section 2.3, the newspaper market in Norway is characterized by relatively high geographic differentiation comprising distinct market segments. In Section 2.3, we verified that the classification into locals, tabloids and national non-tabloids, which is widely used in Norwegian media policy, is economically sensible. In this section, we investigate if and how the arrival of broadband internet may have differential effects across these newspaper types.

Figure 7: Actual and Predicted Newspaper Sales – By Newspaper Type.



Notes: Figures show the overall actual (solid line) and predicted counterfactual (dashed line) newspaper circulation rate (panels a, c and e) and sales volume per household (panels b, d and f). The counterfactual is given by the actual outcome minus the predicted effect of internet use on each outcome. 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 3.

In columns (2)–(4) of Table 3, we report estimates on the impact of broadband internet on newspaper sales from our IV-model estimated separately across newspaper markets. We find relatively large heterogeneity across market segments. While the estimates suggests that a ten percentage point increase in broadband internet use cuts sales losses for tabloids and non-tabloids by about 6 % of their baseline sales, the loss for

local newspapers is estimated to be essentially zero.

In Figure 7, we illustrate the actual and the counterfactual trends in circulation rates and annual sales by newspaper types, again finding substantial heterogeneity across market segments. This mirrors a difference in the time trends between markets: While the sale of local newspapers was on a relatively strong downward trajectory throughout the period, it seems to have been largely unaffected by the spread of broadband internet. In contrast, tabloids experienced a halving of sales over the period, and our estimates suggest that internet was responsible for about 85 % of that drop. Non-tabloids also experienced losses in sales over the period, and would have otherwise been predicted to see a growth in sales, as displayed in Figures 7e and 7f.

4.3 Specification Checks

In this section, we challenge our identification strategy in a number of ways. First, we test the assumption that the roll-out of broadband internet is unrelated to other drivers of newspaper demand by adding a large set of controls for broadband roll-out and newspaper demand and by estimating our main effect on newspaper sales at with fixed effects for newspaper. Second, we challenge the assumption of common trends, by allowing for municipality-specific time shocks and by performing placebo experiments. Third, we document that the geographical segmentation of markets implicit in our municipal specification is meaningful and does not drive our estimates. Finally, we verify that our results are robust to alternative specifications of the relationship between broadband availability, broadband adoption and newspaper sales.

Compositional Changes. 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 observables. 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. We start by adding demographic controls in column (1) of Table 4. In column (2), we then add controls that account for newspaper supply and demand factors that are expected to correlate with changes in the newspaper market that are unrelated to internet. In column (3), we add controls that account for supply and demand factors that are expected to correlate with the broadband expansion. The different sets of controls are detailed in Appendix Table A.2. Finally, in column (4), we drop observations for the five largest cities (Oslo, Bergen, Trondheim, Stavanger and Bærum) across all years from our estimation. Looking across columns, it is reassuring to see that estimates are virtually unchanged both on the first stage and the second stage.

Next, we account for any differences in the composition of newspapers by estimating our main specification on the newspaper-municipality-year level where we include a newspaper fixed effect. Further details on this estimation are provided in Appendix Section B.4. It is comforting to note that the estimated coefficient, compared to the average newspaper-level baseline mean circulation, indicates virtually the same impact as we found on overall circulation rates in the municipality-year level analysis (cf. Appendix Table B.4.1).

Table 4: Specification Checks – Newspaper Circulation and Sales Volume.

	Baseline	Additional Controls		Drop 5 Largest Cities	Municipality-Specific Time Trends		
					Linear	Quadratic	Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. First-Stage Estimates:							
Broadband User Rate	0.137***	0.137***	0.131***	0.129***	0.130***	0.130***	0.0819***
	(0.0072)	(0.0072)	(0.0073)	(0.0074)	(0.0073)	(0.0073)	(0.0097)
F-statistic (instrument)	361.0	362.1	318.4	305.9	315.1	316.4	71.62
B. IV Estimates:							
Circulation Rate	-0.202***	-0.202***	-0.178***	-0.171***	-0.176***	-0.176***	-0.181**
	(0.0379)	(0.0384)	(0.0382)	(0.0387)	(0.0388)	(0.0385)	(0.0697)
Annual Sales Volume	-54.35***	-54.34***	-48.62***	-46.71***	-48.61***	-48.87***	-49.64*
	(10.47)	(10.58)	(10.56)	(10.70)	(10.77)	(10.59)	(19.68)
Controls:							
Demographics	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	4,620	4,620	4,620

Notes: The estimates in Panel B of 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. 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*, $z_{m,t-1}$. The estimates in Panel A of this table show the corresponding estimates from the first stage regression equation (1). For a detailed description of each outcome variable see Table A.2. All regressions are based on 420 municipalities × 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. Column (1) displays the same specification as our main results in Table 3, 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. In columns (5) and (6), we first estimate pre-expansion municipality-specific linear and quadratic time trends, respectively, and next extrapolate these into our specification, as shown in equation (4). In column (7), 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 (5).
* p < 0.1, ** < 0.05, *** p < 0.01.

Common Trend Assumption. An important requirement for our IV-approach to be valid is that the expansion of broadband internet is unrelated to different underlying time trends in the newspaper market across municipalities. As a first check for this possibility we include municipality-specific trends in our baseline specification, using data covering 1997–2000, prior to the expansion of broadband internet. For each municipality we obtain a slope estimate $\hat{v}_m$. We then extrapolate pre-expansion time trends in our specification (both the first and the second stage) as follows

$$y_{m,t+1} = \lambda d_{m,t} + x'_{m,t-1}\beta + \alpha_m + \kappa_1 \hat{v}_m t + \kappa_2 \hat{v}_m t^2 + \tau_t + \varepsilon_{m,t+1} \tag{4}$$

This procedure will account for 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.

$$y_{m,t+1} = \lambda d_{m,t} + x'_{m,t-1}\beta + \alpha_m + \tau_t \sum_j \kappa_j x_{(m,2000),j} + \varepsilon_{m,t+1} \tag{5}$$

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 (5)–(7) in Table 4 report the estimates based on these specifications, which are usually very close to our baseline estimates.

Table 5: Placebo Test – The Effects of Future Broadband Availability on Circulation and Sales Volume.

	Broadband Availability Rate (Instrument) is Measured in Year *t+j* and the Outcome is Measured in Year *t*:						
	Past Availability		**Current Availability**	**Future Availability (Placebo)**			
	$j=-2$ **(1)**	$j=-1$ **(2)**	$j=0$ **(3)**	$j=1$ **(4)**	$j=2$ **(5)**	$j=3$ **(6)**	$j=4$ **(7)**
A. Circulation Rate							
	-0.0233***	-0.0134***	-0.0060	-0.0025	0.0031	-0.0020	-0.0045
	(0.0051)	(0.0051)	(0.0054)	(0.0058)	(0.0063)	(0.0066)	(0.0071)
B. Annual Sales Volume							
	-6.364***	-3.550**	-1.510	-0.526	0.808	-0.911	-1.534
	(1.401)	(1.429)	(1.541)	(1.644)	(1.750)	(1.917)	(2.092)
Controls:							
Demographics	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand	✓	✓	✓	✓	✓	✓	✓
Broadband Expansion	✓	✓	✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,620	4,620	4,620	4,620

Notes: The placebo test above displays coefficient estimates of $\hat{\delta}_j$ from the reduced form regression $y_{m,t} = \delta_j z_{m,t+j} + x'_{m,t}\beta + \alpha_m + \tau_t + \varepsilon_{m,t}$, along with their corresponding standard errors. Regressions are based on 420 municipalities × 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. Standard errors are heteroskedasticity robust and clustered at the municipality level. Each column presents the reduced form corresponding to our baseline IV model in equations (1)-(2) where we regress outcomes $y_{m,t}$ in year t on broadband availability rate in year $t+j$, $z_{m,t+j}$. In our baseline specification used in rest of the paper, broadband availability (our instrument) is measured at $j=-2$. Since the placebo tests include additional controls for correlates of newspaper demand and broadband expansion, numbers reported in column (1) above are the reduced form estimates that correspond to the IV estimates reported in Table 4, column (3).
* p < 0.1, ** < 0.05, *** p < 0.01.

We also perform a placebo test where we examine whether future year's internet coverage affects current

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 on internet coverage in the year $t+j$, to ensure that we are indeed estimating the effect of next year's internet use and not the effect of any future variation internet coverage.[20] For $j=-2$, this regression thus corresponds to the reduced form of our IV model in equations (1)-(2). Table 5 reports the results from this placebo test. It is reassuring that we find no effect of future coverage on newspaper circulation and sales, with only past internet coverage having statistically significant effects.

Geographic Spillovers. In our main analysis, we use the municipality as our geographic unit. This seems reasonable because the municipalities are distinct local government units, and because the data on newspaper sales and on broadband use and coverage are all available at this level. At the same time, municipalities may be part of a common newspaper market, such that shocks in one municipality may affect sales in another municipality.

To investigate whether the geographical unit that we use above is reasonable, we have amended our main specification to consider the larger region to which each municipality belongs.[21] This reduces the number of geographical units from 420 to 160. We start by estimating our main specification at this larger geographic unit by aggregating for each year all variables in our dataset to this level. 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 column (2) of Table 6, we see that our estimates at the regional level barely move compared to our baseline.

Next, we check whether the municipality operates as a distinct newspaper market by studying how increased internet usage in the region outside of the municipality impacts the municipal-level circulation. Specifically, consider municipalities $n \in r$. We amend equation (2) as follows:

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

where $\hat{d}_{r(n\neq m),t}$ is internet use in the region excluding the municipality m and $\hat{}$ indicates that both $\hat{d}_{m,t}$ and $\hat{d}_{r(n\neq m),t}$ are predicted values using instruments $z_{m,t-1}$ and $z_{r(n\neq m),t-1}$, constructed based on the same regional classification. If the municipality is a distinct market, then we should expect that circulation in a municipality is affected by local shocks, but not by 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 column (3) of Table 6: While the effect of the local broadband use is close to the one in the baseline model, there seems to be no effect of broadband use in the rest of the region. This confirms that our baseline specification is sound.

[20] Since the coverage rate is cumulative, not controlling for coverage rates in the previous year would raise the concern that we are incorporating variation that precedes the outcome.

[21] Specifically, we adopt the classification from Gundersen and Juvkam (2013).

Table 6: Geographic Spillovers in the Effects of Internet Use on Newspaper Circulation and Sales Volume.

	Geographical Level: Baseline	Geographical Level: 160 Regions	Leave Out Specification
	(1)	(2)	(3)
A. Circulation Rate			
Own	-0.202***	-0.204***	-0.196***
	(0.038)	(0.066)	(0.041)
Rest of the Region			-0.009
(Excluding Own)			(0.042)
Base mean	1.047	1.008	1.091
Own Est/Mean	-19.3 %	-20.2 %	-18.0 %
B. Annual Sales Volume			
Own	-54.35***	-56.37***	-53.30***
	(10.47)	(18.47)	(11.39)
Rest of the Region			-0.407
(Excluding Own)			(11.94)
Base mean	304.2	294.2	316.5
Own Est/Mean	-17.9 %	-19.2 %	-16.8 %
Observations	4,620	1,760	3,817

Notes: The regressions in column (1) is based on 420 municipalities × 11 years = 4,620 observations. The regression in column (2) aggregates all variables to region-level, weighted by the populations in each municipality in that region. The regression in column (3) 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 (3), 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. 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. The mean for each outcome variable is from the baseline year, 2000. Standard errors are heteroskedasticity robust and clustered at the municipality or region level in each column.
* p < 0.1, ** < 0.05, *** p < 0.01.

Alternative Model Specifications. 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.

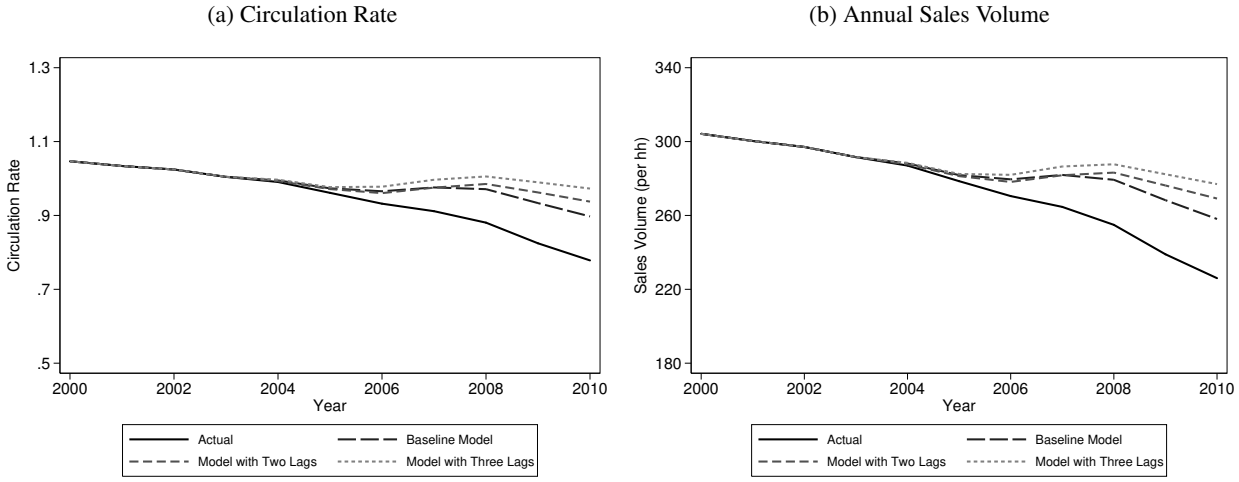
We begin by replacing the outcome of interest in the second-stage equation (2) by the same outcome measured in future periods, and otherwise keeping equations (1)-(2) unchanged. Specifically, rather than newspaper sales in the following year, $y_{m,t+1}$, we now consider the impacts of broadband usage on newspapers sales in two, $y_{m,t+2}$, or three, $y_{m,t+3}$, years ahead. The results are reported in Table 7, 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.

Table 7: IV Estimates of Internet Use on Newspaper Circulation and Sales Volume in Future Years.

	Dependent Variable Measured in Year:		
	Year $t+1$ (baseline)	**Year $t+2$**	**Year $t+3$**
	(1)	**(2)**	**(3)**
Circulation Rate	-0.202***	-0.223***	-0.213***
Std Error	(0.0379)	(0.0373)	(0.0403)
Annual Sales Volume	-54.35***	-60.48***	-56.45***
Std Error	(10.47)	(10.38)	(11.19)

Notes: The estimates in this table come from the second stage regression equation (2), where the coefficient on the dependent variable, $y_{m,t+j}$, is displayed separately for each outcome in each row and at different values of j 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 are based on 420 municipalities $\times$ 11 years = 4,620 observations. The specifications for $j=2$ and $j=3$ 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.

Figure 8: The Impacts on Newspaper Circulation and Sales Volume With Alternative Model Specifications.



Notes: Figures show the overall actual (solid line) and predicted counterfactual (dashed line) newspaper circulation rate (panel a) and annual sales volume per household (panel b). 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 (6)-(7): 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 (6) and (7) below:

$$y_{m,t+1} = \sum_{j=1}^{J} \lambda_j d_{m,t+1-j} + x'_{mt-1}\beta + \alpha_m + \tau_t + \varepsilon_{m,t+1}, \tag{6}$$

$$d_{m,t+1-j} = \sum_{k=1}^{J} \delta_{k,j} z_{m,t-k} + x'_{mt-1}\mu + \gamma_m + \upsilon_t + \eta_{m,t+1-j},\ j = 1,2,...,J, \tag{7}$$

where equation (6) is the second stage and equation (7) 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 8 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 suggests 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 model. Indeed, the difference from our baseline prediction is relatively small and we can't statistically distinguish counterfactual 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.

5 The Impact of Internet on Newspaper Firms and Products

So far, we have seen that the arrival of broadband internet had a strong impact on the newspaper sales. To understand more about how internet affected this market, in this section, we first consider in some detail the evolution of market revenues for newspaper firms. We then exploit data on the balance sheets of newspaper firms, including all revenues as well as costs, in order to delve deeper into how changes in market revenues are spread throughout the firm. This may 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 characteristics, like listed prices, formats and types of content, to understand how the newspaper product available to readers and advertisers changed after the arrival of broadband internet.

5.1 Market Revenues

We start by evaluating how broadband internet affected the market revenues of newspaper firms. In order to use these firm-level data in our analysis below, we need to link them to municipal variation in broadband use and availability. To this end, we convert the firm measures 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.[22] Our final measure for, e.g., revenues, $R_{m,t}$, will then be the following:

$$R_{m,t} = \sum_i r_{i,t} \cdot Q_{i,m,t} \equiv \sum_i \frac{R_{i,t}}{\sum_m Q_{i,m,t}} \cdot Q_{i,m,t} \tag{8}$$

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

Panel A of Table 8 reports estimates on the overall market revenues of newspaper firms 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) drop in total market revenues per household annually, a decline of 28 % from the baseline mean. This is due to a 33 % and a 23 % drop in revenues from sales and advertisements, respectively. When aggregated across all households this suggests a total drop in total market revenues nationwide of 1.9 billion kroner annually by 2010 due to the adoption of broadband internet.[23]

Table 8: IV Estimates of Internet Use on Market Revenues and Average Revenue Per Unit.

	(1) All	(2) Locals	(3) Tabloids	(4) Non-tabloids
A. Market Revenues				
Total	-1375.0***	-194.3	-541.5***	-639.3***
Std Error	(383.4)	(308.1)	(86.52)	(137.9)
Base Mean	4935.3	2895.5	1245.3	794.5
Sales	-808.9***	-62.09	-463.4***	-283.3***
Std Error	(124.3)	(80.47)	(62.44)	(55.26)
Base Mean	2421.3	1172.7	929.9	318.7
Advertisement	-566.2**	-132.2	-78.02***	-356.0***
Std Error	(288.3)	(250.1)	(27.63)	(86.54)
Base Mean	2514.0	1722.8	315.3	475.9
B. Average Revenue Per Unit				
Total	0.0238	-0.0785	0.168	-1.802
Std Error	(0.738)	(2.066)	(0.131)	(1.212)
Base Mean	16.38	13.85	21.89	22.77
Sales	-0.691***	-0.337	0.00640	-1.146***
Std Error	(0.237)	(0.570)	(0.0596)	(0.409)
Base Mean	8.072	5.562	16.35	10.01
Advertisement	0.715	0.259	0.162**	-0.656
Std Error	(0.643)	(1.591)	(0.0824)	(0.937)
Base Mean	8.305	8.289	5.537	12.76

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. Revenues 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. 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.

Looking across newspaper types in columns (2)–(4) of Table 8, we see that local newspapers again

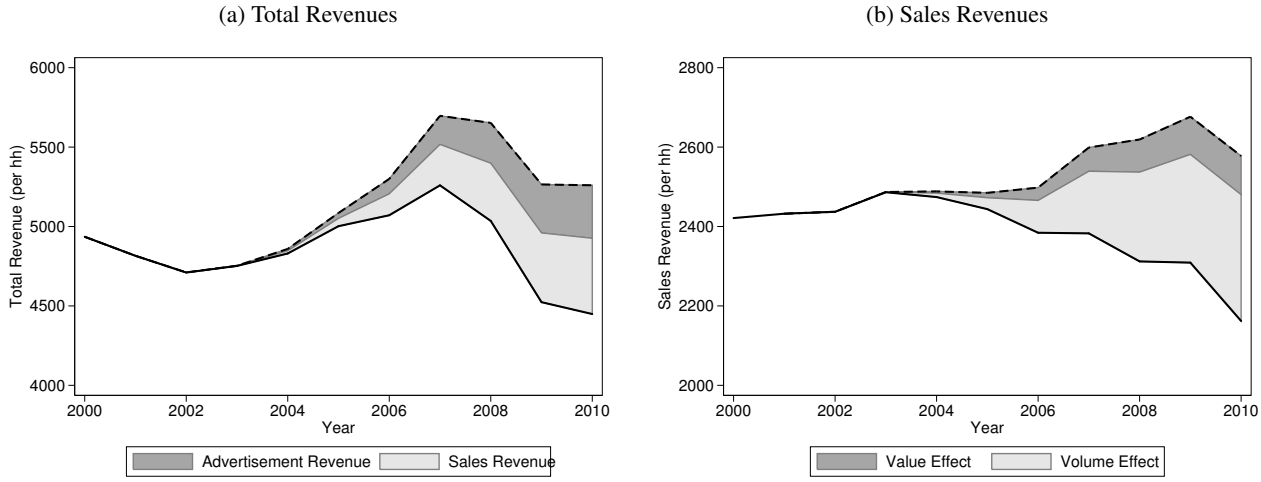
[22] Note that no newspapers in our sample went defunct during our sample years 2000-2010.

[23] 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%.

distinguish themselves in being affected less than tabloids and non-tabloids. A ten percentage point increase in broadband internet use is estimated to depress total market revenues by about 4 % and 8 % for tabloids and non-tabloids, respectively. In comparison, the impact on local newspapers is small and not statistically significant at conventional levels.

Analogous to Figure 6a above, Figure 9a draws the actual time trend in market revenues along with the predicted revenues in each year in the absence of broadband internet, by applying our estimates in Panel A of Table 8 to the time trend in internet use. To clarify the relative importance of losses in revenues from sales and from advertisements, we color the estimated impact on newspaper sales revenues in a light shade, while the impact on advertisement revenues is colored 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.

Figure 9: Actual and Predicted Newspaper Sales and 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. 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 3. 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.

Given the substantial negative estimates of internet on newspaper sales documented above, it comes as no surprise that the estimated impact on sales revenues is negative. It is interesting, however, to distinguish between the direct impact on revenues from a lower volume sold, and the impact on the value of each copy actually sold. To this end, we exploit the following straight-forward decomposition.

$$\frac{d\,Revenue}{di} = \underbrace{Q \cdot \frac{dV}{di}}_{\text{value effect}} + \underbrace{V \cdot \frac{dQ}{di}}_{\text{volume effect}} \tag{9}$$

where i is the internet user share and Q is the sales volume, while $V = Revenue/Q$ is the average market revenue per copy sold, which we will refer to as the unit value below. The first term after the equality gives

the 'value effect' of broadband internet, while the second term gives the 'volume effect'.

In Panel B of Table 8, we report estimates from our main IV-model, where the dependent variable is the average revenue per unit sold (ARPU), overall and separately from sales of newspapers and sales of advertisements. The estimate in the first line of Panel C, shows that the average revenue per unit is unaffected by internet. The following lines show, however, that this hides large heterogeneity in the two revenue streams: While the arrival of broadband internet leads at the same time to a significant drop 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.

Note that by applying these estimates in Equation (9), we can construct a new estimate of the effect on sales revenue. It is reassuring to note that this estimate corresponds well to the one reported in Panel B. When we decompose this estimate by way of Equation (9) we find that the drop in volume can account for over 80 % of the fall in sales revenue, while the drop in sales value can account for less than 20 %.

Looking across newspaper types, 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. It is reassuring to note that the estimates on sales revenues mirror the ones on newspaper demand reported in panel A, with strong and significant negative impacts on tabloids and non-tabloids, and modest and insignificant negative impact on local newspapers.

The economic significance of these estimates is pictured in Figure 9b, which draws the actual time trend in sales revenues along with the predicted sales revenues in each year in absence of broadband internet, analogous to Figure 9a. 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 %.

We provide additional results from a battery of specification checks for market revenues and average revenue per unit in the Appendix Table B.6.1, 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. Similarly, we provide additional results from specification checks in the Appendix Section B.6, Tables B.6.2-B.6.5, for costs, labor inputs, prices and other product characteristics that we discuss below.

5.2 Costs and Labor Inputs

In Panel A of Table 9 we report estimates from our IV model on some key elements of newspaper firms' balance sheets reflecting the firms' revenues, costs and profits. For completeness, we repeat the estimates on revenue from sales and advertisements discussed in the previous section. As with revenues, we divide newspapers' costs and profits by the number of households resident in each municipality for each year. We find that the decline in newspaper revenues is accompanied by a similarly sized decline in costs. Our point

estimates indicate 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 drop in wage costs. Our estimates indicate that newspaper firms' cut their wage costs 670 kroner per household annually, a decline of 34% from the baseline mean.[24] This estimate is both economically substantial and highly statistically significant. 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.[25]

Table 9: IV Estimates of Internet Use on Newspaper Firms' Balance Sheets and Labor Inputs.

	Estimate (1)	**(SE)** (2)	**Mean** (3)
A. Balance Sheets			
A.1 Total Revenues	-1214.1**	(444.9)	5443.1
Sales Revenue	-808.9***	(124.3)	2421.3
Advertisements	-566.2**	(288.3)	2514.0
Other Revenues (incl. Direct Subsidies)	160.9	(225.6)	507.8
A.2 Total Costs	-1289.0***	(366.7)	4687.5
Wage Costs	-698.7***	(182.4)	2054.0
Intermediates	-186.7	(285.0)	899.7
Other Costs	-403.6	(285.5)	1733.8
A.3 Profits (EBITDA)	74.85	(178.1)	755.6
B. Labor Inputs			
B.1 Direct Salary Costs	-832.2***	(279.0)	1612.7
Managers	-173.9**	(68.28)	426.8
Journalists	-194.1**	(85.47)	457.6
Other	-464.2***	(148.6)	728.3
B.2 Labor Hours	-3.545***	(1.269)	7.572
Managers	-0.633***	(0.218)	1.660
Journalists	-0.749**	(0.371)	1.984
Other	-2.162***	(0.830)	3.929
B.3 Hourly Wage Rate	16.00	(10.48)	217.7
Managers	15.95	(9.894)	261.0
Journalists	3.880	(9.761)	235.4
Other	5.914	(12.26)	191.2

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. Revenues, profits, costs 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. Standard errors are heteroskedasticity robust and clustered at the municipality level. The mean for each outcome variable from the baseline year, 2000, is displayed in column (3).
* p < 0.1, ** < 0.05, *** p < 0.01.

To understand the overall economic impact of internet, we also include a measure of the profitability of the newspaper firms.[26] The estimate suggests that newspaper firms are able to shoulder well the negative impacts of internet on their profitability by cutting their costs: The estimated impact on profits is positive,

[24] Firms' hiring and firing practices are regulated by law in Norway; firms can fire workers when facing the risk of operating at a loss or if under-performing relative to their peers (see Huttunen et al., 2011, for details).

[25] 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.

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

albeit somewhat imprecise.

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 B of Table 9 we report estimates from our IV model on direct salary costs[27], 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.[28]

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 that were perhaps less directly involved in the production of newspapers.

As above, we may be interested in whether there are differences between the newspaper types. In Appendix Table B.5.1, we report estimates from our IV model for newspaper firms' balance sheets and labor input across locals, tabloids and non-tabloids. Consistent with our findings on market revenues in Section 5.1, 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.

5.3 Listed Prices and Product Characteristics

Finally, we consider how broadband internet affected the printed newspaper product available to readers and advertisers. Specifically, we consider the impact on listed sales and ad prices, newspaper format and the types of content provided by studying the average product available in each municipality and year, as discussed in Section 2.1.

As above, we need to link these firm-level data to municipal variation in broadband use and availability. The bottom-up approach we employ above is, however, less meaningful for these variables, which cannot easily be understood as being aggregated from individual units. Rather, we want to study the product that the

[27] 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.

[28] 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 %. 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.

average consumer faces in each municipality. For instance, if there are two newspapers sold in a municipality, then the average tabloid content in the municipality is just the average tabloid content across these two newspapers, weighted by their market shares. Specifically, this suggests the following weighted average for each municipality,

$$C_{m,t} = \sum_i w_{i,m,t} \cdot C_{i,t} \equiv \sum_i \frac{Q_{i,m,t}}{\sum_i Q_{i,m,t}} \cdot C_{i,t} \tag{10}$$

where $w_{i,m,t}$ is newspaper i's market share in municipality m, $C_{i,t}$ is a characteristic of this newspaper in year t, and so $C_{m,t}$ is the average newspaper characteristic faced by consumers in municipality m in year t.

Note that the average characteristic in a municipality can be affected both by changes in the composition of newspapers in the municipality and by changes in the actual characteristic. In order to distinguish between these two channels, we estimate our IV-model using the average first based on the actual composition in each year, and then based on the composition in year 2000, before broadband expansion.[29]

Table 10: IV Estimates of Internet Use on Prices, Newspaper Format and Content.

	Total Effect		**Fixed Composition**		
	(1) Estimate	**(2) (SE)**	**(3) Estimate**	**(4) (SE)**	**(5) Mean**
A. Listed Sales Price and Advert Prices					
Sales Price per Copy	-0.459	(0.762)	-0.432	(0.751)	12.03
Full Page in 4 Colors	-29640.7***	(6118.1)	-9115.1	(5828.8)	90356.4
Full Page in B/W	-25379.6***	(4582.2)	-12515.7***	(4466.9)	56348.2
Column Ads, per cm	-13.74***	(2.994)	1.911	(2.605)	52.85
B. Newspaper Format and Size					
Format (Page Size in cm^2)	-301.5	(190)	-228.6	(193.4)	1447
No. of Pages	-10.72**	(4.729)	-7.999*	(4.648)	43.43
Total Size (Format $\times$ No. of Pages)	-25981***	(8894)	-19132**	(9088)	62614
C. Newspaper Content					
Sport and Entertainment	-7.365***	(1.799)	-5.002***	(1.543)	64.23
Crime	0.650	(0.766)	0.881	(0.747)	10.74
Politics and Foreign Affairs	6.715***	(1.703)	4.121***	(1.387)	25.03

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 $\approx$ 6 NOK. In the "Fixed Composition" column 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. 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 in column (2) and (4) are heteroskedasticity robust and clustered at the municipality level. The mean for each outcome variable from the baseline year, 2000, is displayed in column (5).
* p < 0.1, ** < 0.05, *** p < 0.01.

In Panel A of Table 10, we report estimates of the impact of broadband internet on the listed sales price per copy and listed advertisement prices. In column (1) we find that increased internet use is associated with a decrease in the average listed sales price of newspapers, however, this result is not statistically significant. We find declines in the listed advertisement prices: The listed price for a column advertisement in the newspaper falls by 1.4 kroner per cm as a result of a 10 percentage point increase in broadband internet use, which is equivalent to a 3 % decline from the baseline mean. In relative terms, we find similar sized declines in the listed prices for full page colored or black/white advertisements. An important feature of the estimates in

[29] Specifically, in the latter analysis, we fix $w_{i,m,t} = \frac{Q_{i,m,2000}}{\sum_i Q_{i,m,2000}}$ for all t in equation (10).

column (1) is that they not only capture the direct effects of broadband internet, but also an indirect effect caused by the changing composition of newspapers in each municipality.

Comparing the estimates in column (3) of panel A to those in column (1), while still statistically insignificant, the estimate on sales price per copy remains very similar, which suggests there were no large composition effects influencing the sales price. Looking at advertisement prices we see a different story: The estimates suggest a large decrease in magnitude and in one instance the point estimate is of the opposite sign. This indicates that the decline in advertisement prices observed in column (1) is largely driven by the change in composition of newspapers in areas, rather than by newspapers actually decreasing their advertisement prices.[30]

Next, we document the impact of broadband internet on the physical newspaper product. In Table 9 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 10 reports estimates for the impacts of broadband internet usage on newspaper format, number of pages and total size per copy. The estimates suggest that newspapers moved towards smaller formats and a reduction in the number of pages of each copy. The estimates in column (1) imply a 10 percentage point increase in broadband internet use reduces the physical size of newspapers by 4 % from the baseline mean. While smaller in magnitude, the estimates with fixed newspaper composition in column (3), paint a similar picture and demonstrate that the reduction in size was not driven only by changes in the composition of newspapers in the municipal market. This result is consistent with newspapers cutting costs by offering a smaller product. Looking across newspaper types, we see that non-tabloids reduced the size of their papers considerably more than locals, cf. Appendix Table B.5.2.

Finally, we focus on the impact of broadband internet on the content of newspapers, by considering the occurrence of keywords linked to different news categories in online full text archives, as discussed in Section 2. We count mentions of keywords within three categories of news—(i) Sport and Entertainment, (ii) Crime, and (iii) Politics and Foreign affairs—and divide by the total number of mentions in all categories.

The estimates in Panel C of Table 10 indicate that broadband internet caused a decrease in the Sport and Entertainment share of content: A 10 percentage point increase in broadband internet use is estimated to give a reduction in the the Sport and Entertainment share of about 0.75 percentage points, or about 1 % of the baseline mean. The shift away from this content was met with an increase in content related to Politics and Foreign Affairs: A 10 percentage point increase in broadband internet use is estimated to increase the content share of Politics and Foreign Affairs by about 0.67 percentage points, or about 2.7 % of the baseline

[30]Note that these refer to listed prices. Comparing the listed sales price of 12 kroner per copy to the average sales revenue per unit of about 8 kroner from Table 8, it is clear that many customers are paying less than the listed price. This should not be surprising, due to the high prevalence of subscriptions and the existence of large buyers like airlines and hotels. Interpreting the listed advertisement 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 of advertisements.

mean. This may be interpreted as evidence that newspapers focus their contents on hard news in face of competition from online sources. We find no effect on the amount of content focused on Crime. Looking across newspaper types, we see that the internet has no effect on the content of tabloids, however, both locals and non-tabloids saw large reductions in their content focused on Sports and Entertainment, cf. Appendix Table B.5.2. The reduction in Sports and Entertainment for non-tabloids though appears to be almost entirely driven by compositional changes in the market, as opposed to newspapers themselves changing their content.

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 force us to consider consequences for the civic society, in view of a growing scholarship documenting the effects of internet on political participation and electoral outcomes. Using detailed data from Norway on circulation of printed newspapers, 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 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 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 topic (e.g., politics, foreign affairs). This variety of responses across different adjustment margins draws a picture of newspaper firms as being highly flexible, providing a potential explanation for economic resilience in the media market.

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A Appendix: Details on Data Sources

Table A.1: Data on Newspapers.

	Newspaper Name	Circulation* (2000)	Releases Per Week	Data Availability: Characteristics	Balance Sheets	Worker Data	Content
	Tabloids:						
1.	Dagbladet	195,389	5	✓	✓	✓	✓
2.	VG	377,718	5	✓	✓	✓	✓
	Non-tabloids:						
3.	Aftenposten morgen	270,026	5	✓	✓	✓	✓
4.	Ávvir (Est. 2008)	1,203	5	✓	✓		Partial
5.	Dag og Tid	6,245	1	✓		✓	✓
6.	Dagen	8,403	6	✓	✓		Partial
7.	Dagens Næringsliv	69,993	5	✓	✓	✓	✓
8.	Finansavisen	19,579	6	✓		✓	Partial
9.	Fiskaren (Merged 2008)	8,484	3	✓	✓	✓	Partial
10.	FiskeribladetFiskaren (Est. 2008)	11,199	3	✓			Partial
11.	Klassekampen	7,132	6	✓	✓	✓	✓
12.	Morgenbladet	6,021	1	✓	✓	✓	✓
13.	Nationen	18,092	6	✓	✓	✓	Partial
14.	Ny Tid	6,488	1		✓	✓	Partial
15.	Vårt Land	29,065	4	✓	✓	✓	Partial
	Daily Locals:						
16.	Adresseavisen	88,911	6	✓	✓	✓	✓
17.	Aftenposten Aften	172,169	5	✓			
18.	Agderposten	25,847	6	✓	✓	✓	Partial
19.	Akershus Amtstidende	4,832	5	✓		✓	Partial
20.	Altaposten	5,755	6	✓	✓	✓	✓
21.	Aura Avis	3,724	4	✓	✓	✓	Partial
22.	Avisa Nordland (Est. 2002)	26,896	6	✓			Partial
23.	Bergens Tidende	92,652	7	✓	✓	✓	✓
24.	Bergensavisen	29,607	7	✓	✓	✓	Partial
25.	Bladet Vesterålen	10,646	5	✓	✓	✓	Partial
26.	Brønnøysunds Avis	4,804	5	✓	✓	✓	Partial
27.	Budstikka	31,285	6	✓	✓	✓	Partial
28.	Dagsavisen	38,089	7	✓	✓	✓	Partial
29.	Drammens Tidende	46,993	6	✓	✓	✓	Partial
30.	Eidsvoll Ullensaker Blad	9,083	5	✓	✓	✓	Partial
31.	Fædrelandsvennen	46,238	6	✓	✓	✓	✓
32.	Farsunds Avis	6,080	6	✓	✓	✓	Partial
33.	Finnmark Dagblad	10,034	6	✓	✓	✓	✓
34.	Finnmarken	7,702	6	✓	✓	✓	Partial
35.	Firda	14,635	6	✓	✓	✓	Partial
36.	Fredriksstad Blad	24,180	7	✓	✓	✓	Partial
37.	Fremover	9,747	6	✓	✓	✓	Partial
38.	Gjengangeren	6,115	6	✓	✓	✓	Partial
39.	Glåmdalen	20,885	6	✓	✓	✓	
40.	Gudbrandsdølen Dagningen	28,896	6	✓	✓	✓	Partial
41.	Hadeland	7,534	5	✓		✓	Partial
42.	Halden Arbeiderblad	10,034	6	✓	✓	✓	Partial
43.	Hamar Arbeiderblad	28,759	6	✓	✓	✓	Partial
44.	Harstad Tidende	15,052	6	✓	✓	✓	Partial
45.	Haugesunds Avis	37,888	6	✓	✓	✓	Partial
46.	Helgeland Arbeiderblad	10,239	6	✓	✓	✓	Partial
47.	iTromsø	10,576	6	✓	✓	✓	Partial
48.	Laagendalsposten	10,904	6	✓	✓		Partial
49.	Lindesnes	6,622	6	✓	✓	✓	Partial
50.	Lofotposten	9,446	6	✓	✓	✓	Partial
51.	Moss Avis	15,592	7	✓	✓		✓
52.	Namdals-Avisa	13,622	6	✓	✓	✓	Partial
53.	Nordlands Framtid (Merged 2002)	19,354	6	✓	✓	✓	Partial
54.	Nordlandsposten (Merged 2002)	15,454	6	✓	✓		Partial
55.	Nordlys	30,031	6	✓		✓	✓
56.	Oppland Arbeiderblad	29,552	6	✓	✓	✓	Partial
57.	Østlandets Blad	18,088	6	✓	✓	✓	Partial
58.	Østlands-Posten	14,519	6	✓	✓	✓	Partial
59.	Østlendingen/Hamar Dagblad	20,567	6	✓	✓	✓	Partial
60.	Porsgrunns Dagblad	6,407	6	✓	✓	✓	Partial

(continued on the next page)

	Newspaper Name	Circulation* (2000)	Releases Per Week	Data Availability: Characteristics	Balance Sheets	Worker Data	Content
	Daily Locals (continued):						
61.	Rana Blad	11,165	6	✓	✓	✓	✓
62.	Ringerikes Blad	13,158	6	✓	✓	✓	Partial
63.	Rjukan Arbeiderblad	2,379	5	✓	✓	✓	Partial
64.	Rogalands Avis	15,203	6	✓	✓	✓	Partial
65.	Romerikes Blad	38,972	4	✓	✓	✓	Partial
66.	Romsdals Budstikke	18,920	6	✓	✓	✓	Partial
67.	Sandefjords Blad	15,318	6	✓	✓	✓	Partial
68.	Sarpsborg Arbeiderblad	16,748	6	✓	✓	✓	Partial
69.	Smaalenenes Avis	14,374	6	✓		✓	Partial
70.	Sør-Trøndelag	7,074	5		✓	✓	Partial
71.	Stavanger Aftenblad	73,163	6	✓	✓	✓	✓
72.	Sunnhordland	8,493	5	✓		✓	Partial
73.	Sunnmørsposten	38,473	6	✓	✓	✓	Partial
74.	Telemarksavisa	22,432	6	✓	✓	✓	Partial
75.	Telen	5,845	6	✓	✓	✓	Partial
76.	Tidens Krav	15,864	6	✓		✓	Partial
77.	Tønsbergs Blad	32,826	6	✓	✓	✓	✓
78.	Troms Folkeblad	7,437	6	✓	✓	✓	Partial
79.	Trønder-Avisa	23,652	6	✓	✓	✓	✓
80.	Valdres	9,717	4	✓	✓	✓	Partial
81.	Varden	31,476	6	✓		✓	Partial

Notes: Our sample consists of 81 newspapers that operated between 2000-2010 with complete circulation data by municipality and year, of which we were able to access annual data on characteristics (e.g. format, ad prices, etc.) for 79 newspapers and detailed annual balance sheets for 69 newspapers, besides match to annual worker data (e.g. wages, hours, etc.) from employer-employee registers using newspaper firm IDs for 73 newspapers, and content data from N-words for 79 newspapers.

*Circulation figures show total circulation in Norway per released edition as reported by MBL. 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	
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 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.
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. We have this data for 75 out of 81 newspapers in our sample.
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. We have this data for 75 out of 81 newspapers in our sample.
Average Revenue Per Unit	
Average Revenue Per Unit	Average Revenue Per Unit (ARPU) is a measure of average 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'. We have this data for 75 out of 81 newspapers in our sample.

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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. We have this data for 75 out of 81 newspapers in our sample.
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. We have this data for 75 out of 81 newspapers in our sample.
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'. We have this data for 75 out of 81 newspapers in our sample.
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. We have this data for 75 out of 81 newspapers in our sample.
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. We have this data for 75 out of 81 newspapers in our sample.
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. We have this data for 75 out of 81 newspapers in our sample.

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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. We have this data for 76 out of 81 newspapers in our sample.

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. We have this data for 76 out of 81 newspapers in our sample.
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. We have this data for 76 out of 81 newspapers in our sample.
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. We have this data for 76 out of 81 newspapers in our sample.

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. We have this data for 76 out of 81 newspapers in our sample.
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. We have this data for 76 out of 81 newspapers in our sample.
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. We have this data for 76 out of 81 newspapers in our sample.

(continued on the next page)

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) Sports and Entertainment, (ii) Crime, and (iii) Politics and Foreign affairs. 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.
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. Main 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*.

(continued on the next page)

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).

B Appendix: Additional Results

B.1 Additional Descriptive Statistics

Table B.1.1: 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)	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 B.1.2: Descriptive Statistics – Outcome Variables.

Variable	Overall		2000		2005		2010	
A. Newspaper Circulation and Sales Volume								
Circulation Rate	0.94	(0.25)	1.05	(0.26)	0.96	(0.24)	0 .78	(0.2)
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 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	5371	(2595)	5443	(2532)	5517	(2719)	4752	(2303)
Total Market Revenues	4853	(2345)	4935	(2278)	5002	(2393)	4449	(2238)
Sales Revenues	2386	(978)	2421	(962)	2444	(1006)	2162	(899)
Advertisement Revenues	2467	(1425)	2514	(1363)	2558	(1433)	2287	(1386)
Other Revenues (incl. Dir. Subsidies)	518	(464)	508	(452)	515	(487)	303	(202)
Average Total 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 Advert Revenue Per Unit	9.14	(4.60)	8.30	(4.06)	9.23	(4.35)	10.25	(5.17)
Total Costs	4764	(2247)	4687	(2178)	4908	(2351)	4228	(1991)
Wage Costs	1889	(949)	2054	(953)	1896	(986)	1560	(800)
Intermediates	864	(616)	900	(688)	927	(732)	652	(340)
Other Costs	2010	(938)	1734	(658)	2085	(798)	2016	(1079)
Profits (EBITDA)	608	(427)	756	(401)	610	(410)	524	(434)
Direct Salary Costs	1609	(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	(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. Listed Prices, Product Characteristics and Content								
Sales Price Per Copy	14.05	(2.28)	12.03	(.26)	13.57	(1.05)	18.63	(1.07)
Full Page in 4 Colors	88978	(27819)	90356	(28325)	91158	(27947)	81240	(25691)
Full Page in B/W	55987	(16536)	56348	(17180)	56063	(16405)	54997	(16768)
Column Ads, Per cm	58.53	(17.31)	52.85	(15.25)	59.84	(17.18)	60.29	(18.29)
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)	59866	(19942)	62613	(17227)	58793	(17465)	58257	(23666)
Content: % Sport & Entertainment	65.79	(3.19)	64.23	(2.36)	67.05	(1.84)	66.49	(3.91)
Content: % Crime	10.09	(1.6)	10.74	(.91)	9.81	(0.82)	9.58	(1.71)
Content: % Politics & Foreign Affairs	24.13	(3.01)	25.03	(2.5)	23.14	(2.24)	23.93	(3.73)

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 B.1.1 in the appendix.

B.2 Broadband Expansion

Figure B.2.1: Expansion of Broadband Internet across Norway.

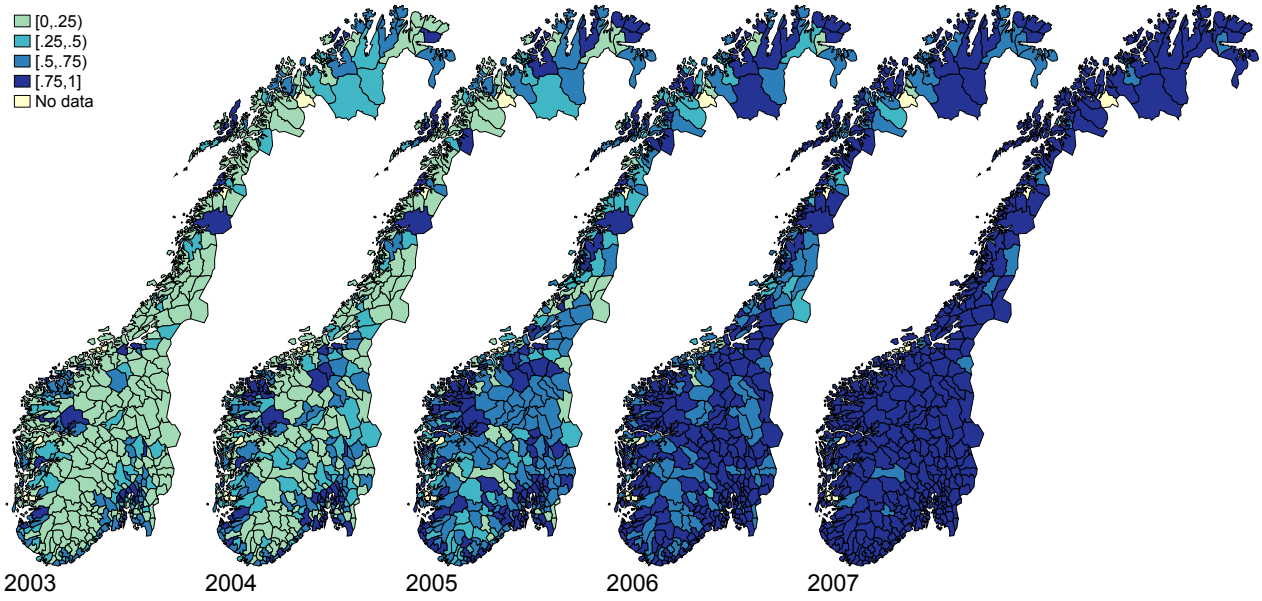
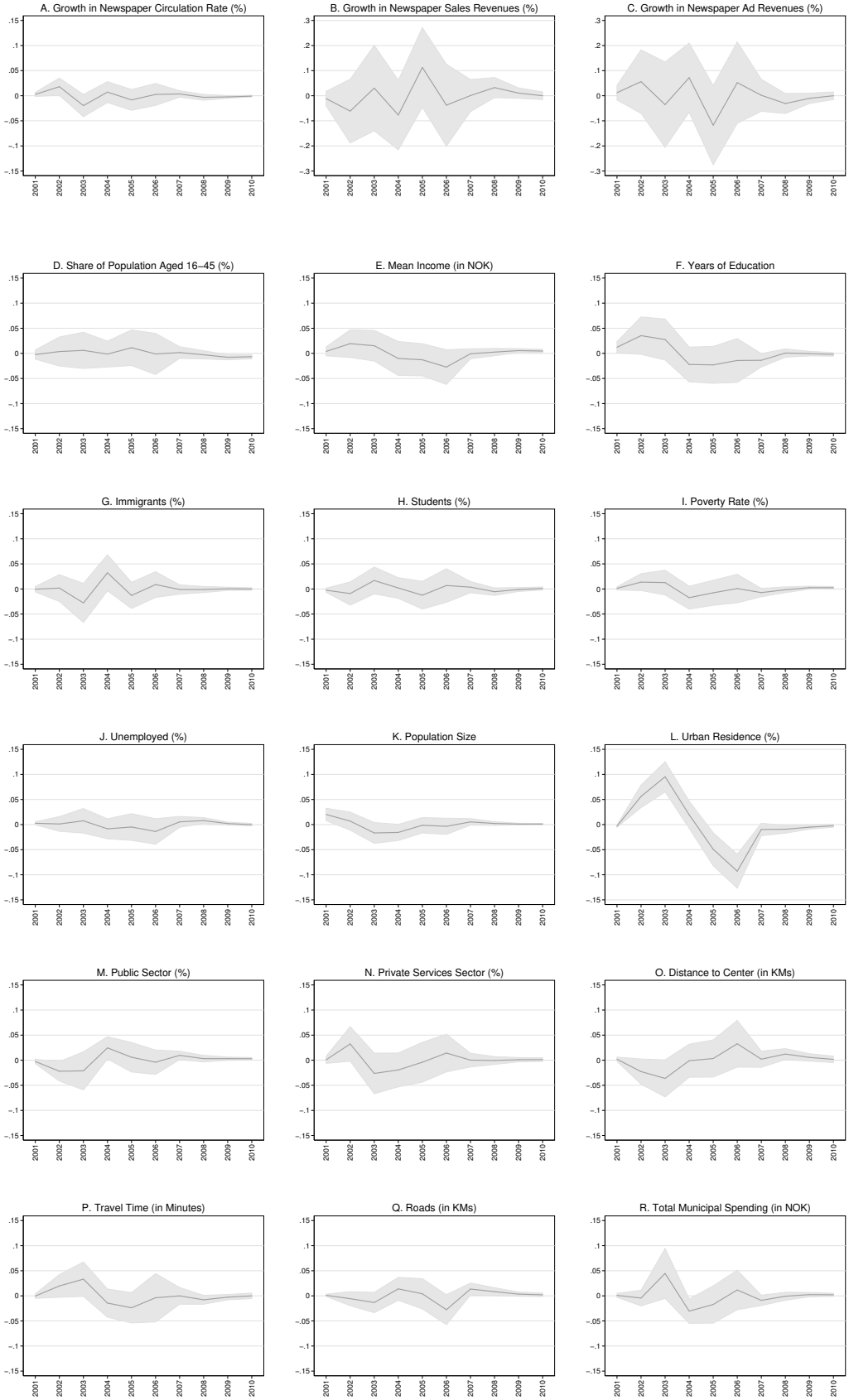


Figure B.2.2: Expansion of Broadband Internet by Baseline Municipality Characteristics



Notes: Figures display the change in broadband internet coverage rate, Δz_{kt}, regressed on baseline municipality characteristics. As shown in equation (3), we regress changes in coverage rates on municipality specific baseline characteristics interacted with time dummies, while controlling for the overall time effects. The figures plot the interaction terms for each variable, along with the associated 95 % CIs.

B.3 Newspaper Classification and Price Elasticities

One 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:

$$p_{i',mc} = \sum_{j \neq i} \frac{S_{jmc}}{\sum_{j \neq i} S_{jmc}} p_{jc} = \text{price of same type in municipality } m \tag{11}$$

$$p_{m,c'} = \sum_{r \neq c} \sum_{j} \frac{S_{jmr}}{\sum_{r \neq c} \sum_{j} S_{jmr}} p_{jr} = \text{price of other type in municipality } m \tag{12}$$

where p_{ic} is the price per copy of newspaper i of type c and S_{imc} is the circulation of this newspaper in municipality m. We then estimate the following equation:

$$\ln(S_{imc}) = \alpha + b_1 \ln(p_{ic}) + b_2 \ln(p_{i',mc}) + b_3 \ln(p_{m,c'}) + x_{imc}\beta + \varepsilon_{imc}, \tag{13}$$

where x_{imc} includes a full set of municipality-by-newspaper interacted fixed effects and year fixed effects (for notational ease, time subscripts on newspaper prices and circulation are suppressed). By controlling for these variables, we use within municipality-newspaper price variation and remove common time effects.

Table B.3.1: Own-Price and Cross-Price Elasticities of Newspaper Circulation.

	Estimate	**(Standard Error)**	**Estimate**	**(Standard Error)**
	(1)	**(2)**	**(3)**	**(4)**
Own-Price Elasticity (b_1)	-1.486***	(.135)	-1.412***	(.139)
Cross-price Elasticity Within Type (b_2)	1.372***	(.116)	1.430***	(.118)
Cross-price Elasticity Across Type (b_3)	-0.139	(.232)	0.060	(.256)
Municipality x Newspaper Fixed Effects	✓		✓	
Year Fixed Effects	✓		✓	
Demographic Controls			✓	
No. Observations	113,807		113,807	

Notes: Equation (13) 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. Demographic 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_{ic}, $p_{i',mc}$, and $p_{m,c'}$ with the corresponding wage costs per unit. Table B.3.1 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 different types of newspapers.

B.4 Newspaper-level Estimates

In Section 4.3 on page 19, we discuss how we account for any differences related to the composition of newspapers by estimating our main specification on the newspaper level where we include a newspaper fixed effect. In this section, we provide details on the estimation and results, and interpret the estimates.

Specifically, we specify the following equation for the second stage,

$$y_{j,m,t+1} = \lambda d_{m,t} + x'_{m,t-1}\beta + \alpha_m + \tau_t + n_j + \varepsilon_{j,m,t+1} \tag{14}$$

where $y_{j,m,t+1}$ is newspaper j'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 Appendix Table B.4.1 show that our conclusions remain unchanged also conditional on newspaper fixed effects n_j and are thus robust to changes in the composition of newspapers across municipalities over time. The IV estimate on circulation rate in column (2) of -0.0038, scaled relative to baseline mean of 0.0207, implies that internet use reduces newspaper-level circulation rate by 18.4%. 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) reported in our main specification in Table 3, column (1). We reach the same conclusion using IV estimates on newspaper-level sales volume in column (3).

Table B.4.1: Newspaper-level IV Estimates of Internet Use on Newspaper Circulation.

	First-Stage Estimates	**IV Estimates**	
	Broadband User Rate	**Circulation Rate**	**Annual Sales Volume**
	(1)	**(2)**	**(3)**
Point Estimate	0.131***	-0.004***	-1.005***
(Standard Error)	(0.0064)	(0.0008)	(0.222)
F-value (instrument)	414.31		
Baseline Dependent Mean	–	0.0207	6.008
Estimate Scaled Relative to Baseline Mean	–	-18.36%	-16.73%
No. Observations	233,948	233,948	233,948

Notes: The estimates come from the second stage regression equation (14), 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 Panel E of Appendix Table A.2. Standard errors are heteroskedasticity robust and clustered at the municipality level. The mean for each outcome variable from the baseline year, 2000.
* p < 0.1, ** < 0.05, *** p < 0.01.

B.5 Additional Heterogeneity Results

Table B.5.1: IV Estimates of Internet Use on Newspaper Firms' Balance Sheets and Labor Inputs By Type.

	Locals			Tabloids			Non-tabloids		
	Est. (1)	(SE) (2)	Mean (3)	Est. (4)	(SE) (5)	Mean (6)	Est. (7)	(SE) (8)	Mean (9)
A. Balance Sheet									
Total Revenues	67.58	(382.5)	3315.4	-509.2***	(85.97)	1257.7	-772.5***	(147.4)	870.0
Sales Revenue	-62.09	(80.47)	1172.7	-463.4***	(62.44)	929.9	-283.3***	(55.26)	318.7
Advertisements	-132.2	(250.1)	1722.8	-78.02**	(27.63)	315.3	-356.0***	(86.54)	475.9
Other Revenues	261.9	(225.7)	419.9	32.28	(17.66)	12.46	-133.2***	(17.19)	75.46
Total Costs	-155.5	(300.4)	2860.0	-348.7***	(85.52)	1039.0	-784.8***	(154.2)	788.5
Wage Costs	-202.8	(170.3)	1428.3	-128.7***	(21.58)	288.9	-367.1***	(79.09)	336.8
Intermediates	356.6	(257.8)	555.0	-50.22**	(16.54)	169.3	-493.1***	(105.7)	175.3
Other Costs	-309.2	(229.3)	876.6	-169.7***	(49.72)	580.8	75.42	(141.6)	276.4
Profits (EBITDA)	223.1	(172.9)	455.4	-160.5***	(30.63)	218.7	12.28	(56.71)	81.49
B. Labor Inputs									
Direct Salary Costs	-605.2**	(270.8)	1185.7	-88.77***	(16.04)	218.0	-138.3***	(32.26)	209.0
Managers	-124.2*	(65.34)	297.5	-25.26***	(6.076)	76.86	-24.47***	(8.307)	52.46
Journalists	-130.7	(83.11)	328.8	-23.81***	(4.797)	64.10	-39.59***	(11.90)	64.68
Other	-350.3**	(146.0)	559.4	-39.70***	(5.644)	77.04	-74.22***	(14.76)	91.84
Labor Hours	-2.637**	(1.243)	5.957	-0.343***	(0.0467)	0.714	-0.565***	(0.125)	0.901
Managers	-0.436**	(0.211)	1.234	-0.0989***	(0.0157)	0.234	-0.0981***	(0.0261)	0.191
Journalists	-0.489	(0.361)	1.531	-0.0769***	(0.0142)	0.201	-0.183***	(0.0500)	0.252
Other	-1.712**	(0.822)	3.193	-0.167***	(0.0192)	0.279	-0.283***	(0.0581)	0.457
Hourly Wage Rate	20.15*	(11.28)	202.3	3.218***	(1.085)	305.3	-2.462	(8.375)	226.8
Managers	18.81*	(11.31)	242.5	2.099**	(0.873)	328.3	1.405	(10.12)	269.9
Journalists	7.216	(10.49)	217.8	3.328***	(1.206)	319.2	1.800	(8.030)	246.5
Other	11.70	(12.88)	180.2	3.179**	(1.327)	276.1	-18.33*	(9.837)	194.7

Notes: The estimates in this table are the same as Table 9, but broken down by newspaper type. For a detailed description of each outcome variable see Table A.2. 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. 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 B.5.2: IV Estimates of Internet Use on Prices, Newspaper Format and Content By Type.

	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. Unit Sales Price and Listed Advert Prices									
Sales Price Per Copy	-0.126	(1.054)	12.10	-0.0748***	(0.0213)	10.98	1.618**	(0.655)	13.88
Ad price: Full Page, 4 colors	-13771.0**	(5999.8)	52232.3	-1097.4	(1985.6)	212181.8	-62381.4***	(12625.4)	110883.1
Full page in B/W	-14522.9***	(4605.0)	37373.9	-428.4	(670.6)	112376.3	-56358.3***	(9119.2)	74243.5
Column Ads, per cm	-4.909	(3.190)	23.85	-0.386	(1.358)	145.4	-8.836***	(3.119)	54.92
B1. Format and Size									
Format	-452*	(273)	1576	–		1022	-696***	(162)	1386
No. of Pages	-11.74*	(6.576)	39.04	–		60	-0.814	(1.625)	38.02
Total Size	-28955**	(12028)	61160	–		61320	-35503***	(8297)	54599
C1. Content Shares									
Sport & Entertainment	-8.013***	(2.815)	63.08	-0.303*	(0.171)	68.40	-10.27**	(4.028)	50.16
Crime	2.476***	(0.923)	9.269	0.0532	(0.0693)	12.61	-0.436	(0.671)	8.429
Politics & Foreign Affairs	5.537**	(2.229)	27.65	0.250*	(0.133)	18.99	10.70***	(4.014)	41.41
					Fixed Composition				
A2. Unit Sales Price and Listed Advert Prices									
Sales Price per Copy	-0.0881	(1.046)	12.10	-0.0387*	(0.0214)	10.98	0.834	(0.540)	13.88
Ad price: Full Page, 4 colors	-7705.2	(6234.9)	52232.3	-965.4*	(548.4)	212181.8	-63639.0***	(11780.4)	110883.1
Full page in B/W	-9130.9*	(4815.5)	37373.9	-392.7*	(238.0)	112376.3	-59822.4***	(8663.9)	74243.5
Column Ads, per cm	-2.490	(3.371)	23.85	-0.548	(0.346)	145.4	-8.239***	(2.086)	54.92
B2. Format and Size									
Format	-285.8	(272.9)	1576.4	–			-854.7***	(172.2)	1385.9
No. of Pages	-9.753	(6.435)	39.04	–			2.380***	(0.579)	38.02
Total Size	-20152.0*	(11936.5)	61159.7	–			-38493.6***	(8158.2)	54598.7
C2. Content Shares									
Sport & Entertainment	-5.573**	(2.825)	9.269	-0.232	(0.197)	68.40	2.885	(2.316)	50.16
Crime	1.953**	(0.928)	9.269	0.0766	(0.0727)	12.61	-1.011**	(0.488)	8.429
Politics & Foreign Affairs	3.620	(2.225)	63.08	0.156	(0.134)	18.99	-1.874	(2.190)	41.41

Notes: The estimates in this table are the same as Table 10, but broken down by newspaper type. 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.

B.6 Additional Specification Checks

Table B.6.1: Specification Checks – Newspaper Revenues and Average Revenue Per Unit.

	Baseline	Additional Controls		Drop Five Largest Cities	Municipality-Specific Time Trends		
					Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Market Revenues							
Total	-1375.0***	-1387.9***	-1280.0***	-1221.5**	-1535.2***	-1327.1***	-1686.1
	(383.4)	(385.6)	(413.0)	(422.9)	(408.0)	(369.8)	(876.7)
Sales	-808.9***	-802.9***	-745.5***	-724.3***	-781.9***	-743.6***	-905.7***
	(124.3)	(125.1)	(129.0)	(132.4)	(119.1)	(123.6)	(273.8)
Advertisements	-566.2**	-585.1**	-534.4	-497.2	-744.2**	-572.0**	-749.1
	(288.3)	(289.6)	(314.1)	(322.4)	(331.0)	(277.2)	(654.2)
B. Average Revenue Per Unit							
Total	0.0238	-0.0536	-0.182	-0.0733	-1.799*	-1.065	0.130
	(0.738)	(0.741)	(0.802)	(0.832)	(0.905)	(0.860)	(1.904)
Sales	-0.691***	-0.705***	-0.799***	-0.786**	-1.194***	-1.106***	-0.869
	(0.237)	(0.243)	(0.244)	(0.253)	(0.262)	(0.296)	(0.603)
Advertisements	0.715	0.652	0.618	0.713	-0.510	0.0848	1.102
	(0.643)	(0.643)	(0.704)	(0.731)	(0.766)	(0.705)	(1.586)
Controls:							
Demographics	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	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. All regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. Column (1) displays the same specification as our main results in Table 3, 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. In columns (5) and (6) we estimate pre-expansion municipality-specific linear and quadratic time trends as shown in equation and then extrapolate these into our specification, as is shown in equation (4). In column (7), 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 (5).
* p < 0.1, ** < 0.05, *** p < 0.01.

Table B.6.2: Specification Checks – Balance Sheets.

	Baseline	Additional Controls		Drop Five Largest Cities	Municipality-Specific Time Trends		
					Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Balance Sheets							
A.1 Total Revenues	-1214.1***	-1219.1***	-1063.9**	-976.1**	-1216.8***	-1028.1**	-477.2
	(444.9)	(448.0)	(470.2)	(481.6)	(467.3)	(440.1)	(967.1)
Sales Revenue	-808.9***	-802.9***	-745.5***	-724.3***	-781.9***	-743.6***	-905.7***
	(124.3)	(125.1)	(129.0)	(132.4)	(119.1)	(123.6)	(273.8)
Advertisements	-566.2**	-585.1**	-534.4*	-497.2	-744.2**	-572.0**	-749.1
	(288.3)	(289.6)	(314.1)	(322.4)	(331.0)	(277.2)	(654.2)
Other Revenues	160.9	168.8	216.0	245.4	260.6	156.1	925.3**
	(225.6)	(224.1)	(229.6)	(241.2)	(227.4)	(215.5)	(434.3)
A.2 Total Costs	-1289.0***	-1290.9***	-1147.0***	-1030.4***	-1245.2***	-1160.4***	-1016.4
	(366.7)	(369.5)	(381.9)	(392.0)	(367.4)	(358.4)	(796.7)
Wage Costs	-698.7***	-695.9***	-625.2***	-550.9***	-686.3***	-675.2***	-530.2
	(182.4)	(182.3)	(188.2)	(192.3)	(183.8)	(185.8)	(391.0)
Intermediates	-186.7	-198.8	-117.9	-20.01	-113.2	-141.0	754.6
	(285.0)	(284.4)	(291.9)	(293.7)	(289.5)	(333.4)	(646.1)
Other Costs	-403.6	-396.2	-403.9	-459.5	-402.4	-423.9	-1293.1**
	(285.5)	(284.7)	(298.7)	(306.9)	(295.9)	(295.1)	(540.8)
A.3 Profits (EBITDA)	74.85	71.72	83.13	54.28	16.02	42.92	424.6
	(178.1)	(180.1)	(190.0)	(192.3)	(205.9)	(202.2)	(407.3)
Controls:							
Demographics	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	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. All regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. Column (1) displays the same specification as our main results in Table 3, 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. In columns (5) and (6) we estimate pre-expansion municipality-specific linear and quadratic time trends, as is shown in equation (4), and then extrapolate these into our specification. In column (7), 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 (5).

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

Table B.6.3: Specification Checks – Labor Inputs.

	Baseline	Additional Controls		Drop Five Largest Cities	Municipality-Specific Time Trends		
					Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Labor Inputs							
A.1 Direct Salary Costs	-832.2***	-821.2***	-814.9***	-804.9**	–	–	-1391.3*
	(279.0)	(278.3)	(315.4)	(326.2)			(827.0)
Managers	-173.9**	-169.0**	-166.1**	-172.1**	–	–	-350.8*
	(68.28)	(68.03)	(77.24)	(79.91)			(196.4)
Journalists	-194.1**	-191.3**	-210.5**	-204.7*	–	–	-379.4
	(85.47)	(85.10)	(103.1)	(106.6)			(270.8)
Other	-464.2***	-460.8***	-438.3***	-428.1***	–	–	-661.2*
	(148.6)	(148.5)	(158.3)	(164.0)			(399.5)
A.2 Labor Hours	-3.545***	-3.470***	-3.401**	-3.373**	–	–	-5.612
	(1.269)	(1.269)	(1.400)	(1.450)			(3.514)
Managers	-0.633***	-0.616***	-0.600**	-0.617**	–	–	-1.261**
	(0.218)	(0.217)	(0.240)	(0.248)			(0.590)
Journalists	-0.749**	-0.734**	-0.813*	-0.797*	–	–	-1.521
	(0.371)	(0.372)	(0.438)	(0.453)			(1.127)
Other	-2.162***	-2.120**	-1.987**	-1.959**	–	–	-2.829
	(0.830)	(0.830)	(0.881)	(0.915)			(2.097)
A.3 Hourly Wage Rate	16.00	14.80	16.81	18.40	–	–	34.37
	(10.48)	(10.47)	(10.88)	(11.35)			(21.42)
Managers	15.95	15.24	17.32*	18.64*	–	–	49.15**
	(9.894)	(9.836)	(10.18)	(10.63)			(19.76)
Journalists	3.880	3.390	6.286	7.267	–	–	13.22
	(9.761)	(9.759)	(10.32)	(10.70)			(19.79)
Other	5.914	4.280	4.066	6.227	–	–	25.36
	(12.26)	(12.24)	(12.66)	(13.26)			(26.03)
Controls:							
Demographics	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	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 $\approx$ 6 NOK. All regressions are based on 420 municipalities $\times$ 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. Column (1) displays the same specification as our main results in Table 3, 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. In columns (5) and (6) we estimate pre-expansion municipality-specific linear and quadratic time trends, as is shown in equation (4), and then extrapolate these into our specification. '$-$' indicates that there was not enough data from before 2000 to estimate pre-reform trends. In column (7), 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 (5).

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

Table B.6.4: Specification Checks – Prices, Newspaper Format and Content – Total Effect.

	Baseline	Additional Controls		Drop Five Largest Cities	Municipality-Specific Time Trends		
					Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Total Effect						
A. Listed Sales Price and Advert Prices							
Sales Price per Copy	-0.459	-0.432	-0.429	-0.272	-0.660	-0.537	-2.524*
	(0.762)	(0.764)	(0.795)	(0.826)	(0.806)	(0.809)	(1.439)
Full Page in 4 Colors	-29640.7***	-29230.7***	-26816.0***	-25122.7***	-22904.9***	-24403.7***	4246.6
	(6118.1)	(6100.0)	(6354.4)	(6328.8)	(6659.7)	(6544.2)	(10980.9)
Full Page in B/W	-25379.6***	-24967.2***	-24043.8***	-22664.3***	-21871.7***	-22607.2***	1078.1
	(4582.2)	(4557.4)	(4746.0)	(4635.3)	(4924.7)	(4856.5)	(7530.4)
Column Ads, per cm	-13.74***	-13.82***	-14.71***	-14.16***	-14.77***	-14.49***	-18.61***
	(2.994)	(2.954)	(3.138)	(3.230)	(3.303)	(3.243)	(6.747)
B. Newspaper Format and Size							
Format (Page Size in cm^2)	-301.5	-293.8	-222.0	-269.9	-58.64	-59.31	610.9*
	(190.1)	(189.3)	(200.2)	(205.6)	(193.7)	(197.5)	(359.6)
No. of Pages	-10.72**	-10.69**	-11.19**	-9.783*	-12.22**	-12.16**	-21.79**
	(4.729)	(4.747)	(4.995)	(5.115)	(5.068)	(5.017)	(10.35)
Total Size (Format × No. of Pages)	-25980.8***	-25557.5***	-22939.6**	-23465.5**	-22981.3**	-23285.8**	-5749.6
	(8893.8)	(8731.8)	(9239.7)	(9448.9)	(9434.2)	(9393.8)	(19719.3)
C. Newspaper Content							
Sport and Entertainment	-7.365***	-7.219***	-7.681***	-7.572***	-7.276***	-7.344***	-7.025*
	(1.799)	(1.797)	(1.923)	(1.988)	(1.926)	(1.912)	(4.083)
Crime	0.650	0.643	0.631	0.707	0.373	0.213	-0.325
	(0.766)	(0.765)	(0.794)	(0.815)	(0.811)	(0.812)	(1.556)
Politics and Foreign Affairs	6.715***	6.576***	7.050***	6.865***	6.979***	6.949***	6.702*
	(1.703)	(1.701)	(1.842)	(1.908)	(1.828)	(1.828)	(3.891)
Control Sets (Xs):							
Demographics	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	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 are based on 420 municipalities × 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. Column (1) displays the same specification as our main results in Table 3, 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. In columns (5) and (6) we estimate pre-expansion municipality-specific linear and quadratic time trends as shown in equation and then extrapolate these into our specification, as is shown in equation (4). In column (7), 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 (5).
* p < 0.1, ** < 0.05, *** p < 0.01.

Table B.6.5: Specification Checks – Prices, Newspaper Format and Content – Fixed Composition.

	Baseline	Additional Controls		Drop Five Largest Cities	Municipality-Specific Time Trends		
					Linear Slope	Quadratic Slope	Covariate Interacted Time FEs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Fixed Composition						
A. Listed Sales Price and Advert Prices							
Sales Price per Copy	-0.432	-0.411	-0.506	-0.370	-0.767	-0.684	-2.613*
	(0.751)	(0.752)	(0.784)	(0.816)	(0.797)	(0.800)	(1.457)
Full Page in 4 Colors	-9115.1	-8888.8	-7363.9	-6073.9	-3517.6	-4651.3	26948.9**
	(5828.8)	(5826.8)	(6066.2)	(6063.5)	(6310.4)	(6266.3)	(10941.6)
Full Page in B/W	-12515.7***	-12216.1***	-11955.2***	-10903.1**	-9634.4**	-10261.3**	15142.1*
	(4466.9)	(4450.1)	(4605.3)	(4547.1)	(4747.2)	(4719.4)	(7850.8)
Column Ads, per cm	1.911	1.726	0.293	0.622	-0.283	0.372	-1.967
	(2.605)	(2.582)	(2.642)	(2.732)	(2.712)	(2.694)	(5.173)
B. Newspaper Format and Size							
Format (Page Size in cm^2)	-228.6	-220.2	-163.8	-211.6	6.771	6.217	745.7**
	(193.4)	(192.6)	(203.2)	(208.3)	(197.2)	(201.5)	(378.0)
No. of Pages	-7.999*	-7.963*	-8.449*	-7.163	-9.206*	-8.835*	-19.98**
	(4.648)	(4.673)	(4.912)	(5.050)	(4.972)	(4.932)	(10.12)
Total Size (Format × No. of Pages)	-19131.7**	-18701.5**	-16806.8*	-17492.5*	-16390.0*	-16715.7*	2363.5
	(9088.0)	(8940.7)	(9393.5)	(9605.0)	(9617.0)	(9585.6)	(20484.6)
C. Newspaper Content							
Sport and Entertainment	-5.002***	-4.840***	-5.061***	-4.930***	-4.381***	-4.613***	-5.565
	(1.543)	(1.556)	(1.635)	(1.690)	(1.644)	(1.631)	(3.608)
Crime	0.881	0.876	0.851	0.936	0.580	0.422	0.290
	(0.747)	(0.745)	(0.778)	(0.800)	(0.793)	(0.791)	(1.518)
Politics and Foreign Affairs	4.121***	3.964***	4.211***	3.994***	3.880***	4.212***	5.161
	(1.387)	(1.399)	(1.489)	(1.545)	(1.483)	(1.489)	(3.316)
Controls:							
Demographics	✓	✓	✓	✓	✓	✓	✓
Newspaper Demand		✓	✓	✓	✓	✓	✓
Broadband Expansion			✓	✓	✓	✓	✓
Observations	4,620	4,620	4,620	4,565	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 are based on 420 municipalities × 11 years = 4,620 observations. All regressions include municipality fixed effects and year dummies. Column (1) displays the same specification as our main results in Table 3, 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. In columns (5) and (6) we estimate pre-expansion municipality-specific linear and quadratic time trends as shown in equation and then extrapolate these into our specification, as is shown in equation (4). In column (7), 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 (5).
* p < 0.1, ** < 0.05, *** p < 0.01.