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The Internet, News Consumption, and Political Attitudes

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Abstract: We investigate the effects of the rise of the Internet as an additional mass medium on news consumption patterns and political attitudes. We use Swedish survey data from 2002 to 2007, the period during which online news media emerged. We find that broadband access is associated with online media consumption which, to some extent, crowds out offline consumption. Furthermore, these altered news consumption patterns have no or small effects on political attitudes.

Keywords: news, the Internet, political attitudes

JEL classification: D72, D83

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1. Introduction

In the last century, mass media have become an increasingly important part of peoples' lives. In some developed countries, individuals spend, on average, nearly 8 hours a day consuming various mass media, such as newspapers, radio, television, and the Internet (see, e.g., Nielsen, 2011; Ipsos OTX, 2011). Notably, mass media is the primary source of political news for the majority of citizens, and this has lead economists to study the political and economic effects of mass media. Prat and Strömberg (2011) provide a survey of this emerging literature.

In this paper, we investigate if and how the emergence of the Internet (more specifically, the expansion of high-speed Internet, i.e., broadband services) has affected citizens' news consumption and, in turn, their political attitudes. To accomplish this, we use Swedish survey data from 2002 to 2007, the period during which broadband access grew from approximately 20% to approximately 70%. We find that broadband access is associated with online media consumption and that its prevalence has crowded out a portion of offline media consumption. The effect is largest for tabloid newspapers. Furthermore, more people are consuming newspaper media, online or offline, every day. However, the average time spent per reader on newspaper consumption is lower. On the other hand, these altered patterns have no effects on political interest, ideological polarization, and opinion formation, but it is possible that these altered patterns have a small effect on one's likelihood of having right-leaning political attitudes.

Several studies in the media literature have investigated the effects that previous introductions of new mass media, such as newspapers, radio or television, had on political outcomes. Two important lessons emerge. First, the introduction of a new mass medium can have large effects on voter knowledge, on voter turnout, and ultimately on economic policy. Second, the size and direction of these effects crucially depend on the existing media environment. For example, Gentzkow (2006) finds that the introduction of television suppressed voter turnout. His interpretation is that television contains less political information compared to radio and newspapers, which caused political knowledge and turnout to decrease when consumers switched to television.

In a similar spirit, Gentzkow et al. (2011) estimate the effect of the introduction of newspapers on voter turnout. They find that the addition of a newspaper to a market increased voter turnout. However, they find that most of the effect can be attributed to the first newspaper. Newly added newspapers added little to the effect on voter turnout. Similarly, Strömberg (2004) finds that the introduction of radio had its greatest impact in rural areas where additional news sources (newspapers) were difficult to obtain. Additional evidence shows that the introduction of a new mass medium can have different effects depending on its ideological leaning (DellaVigna and Kaplan, 2007; Enikolopov et al., 2011) or the targeted demographic group (Prat and Strömberg, 2005; Oberholzer-Gee and Waldfogel, 2009).

The Internet is the latest innovation in mass media, and it has features distinguishing it from traditional mass media. For example, the emergence of the Internet has decreased consumers' cost for news while also giving them increased levels of discretion over the type of news they will consume. As Prat and Strömberg (2011) note, an interesting research

question that merits additional analysis is the effect the Internet has on the links between mass media, politics, and policy.

There are theories and evidence for if and how the Internet crowds out traditional media. For example, Gentzkow (2007) develops a model for estimating whether online and offline newspapers are complements or substitutes and finds that the online version of the Washington Post crowds out its printed version. Furthermore, George (2008) finds that the Internet attracts young, highly educated, urban whites, which causes them to read less printed newspapers. This, in turn, means that the share of newspaper consumers that are blacks and Hispanics increases and, as a result, the newspapers are beginning to cater more to these groups.

An important aspect of Internet news is that the production cost is much smaller when compared with that of offline news media. Nie et al. (2010) argue that this should lead to an increased supply of ideologically extreme news outlets. Furthermore, Nie et al. argue that individuals are likely to self-select into media that align with their political views, and they find some evidence of self-selection in this direction.[1] Gentzkow and Shapiro (2011) investigate whether online news consumption is more ideologically segregated than offline news consumption by investigating the entire range of news an individual consumes. They find some evidence that online news is more segregated than offline news, but the difference between them is relatively small.

There are not many studies on whether the Internet alters citizens' political attitudes. An exception is Golde and Nie (2010), who find that online news readership increases political interest but has no effects on voter registration, voter turnout, or on ideological polarization. A potential caveat to their approach is that online news consumption is likely to co-vary with other news consumption variables (such as the amount of offline news consumption and the type of online news consumption), in which case it is difficult to argue that the effect can be traced solely to online news readership. For example, as noted above, the negative effect television has on voter turnout and political knowledge discussed by Gentzkow (2006) is explained by television's displacement of radio and newspapers as sources of information.

In this paper, we investigate how the Internet affects citizens' media consumption, both online and offline. We then investigate the subsequent effects that news consumption has on political attitudes, such as preferences and opinions. Because the supply and demand for online news first exploded with the expansion of high speed Internet infrastructure (i.e., broadband), in our analysis, we focus on the availability of broadband service.

We make two contributions to the literature. First, to our knowledge, Golde and Nie (2010) is the only other study that investigates the effect of the Internet on citizens' political attitudes. Second, in contrast to Golde and Nie, we investigate the total array of media consumption rather than just online news consumption. This is important because the Internet's effect on political attitudes may go through altering both online and offline media consumption. We can accomplish this by exploiting broadband access as a taste-shifter in a reduced-form approach. This approach is similar to using the introduction of a media to identify the effect of that media. We formalize this point in Section 2. To address the potential

[1] See Mullainathan and Shleifer (2005) for a discussion on how this type of self-selection bias affects the media market.

endogeneity of the decision to acquire broadband access, we also have a complementary analysis that instruments broadband access using broadband coverage, defined as the share of the population at the municipal level that lives in homes with the technological capability of having a broadband connection.

The remainder of this paper is structured as follows. In the next section, we introduce a simple theoretical model, outlining our reduced-form approach. In Section 3, we describe the data we use and the institutional background. Section 4 has a discussion of our empirical strategy, and Section 5 is a report of our results. In Section 6, we provide our concluding remarks.

2. Model

The emergence of a new mass medium is likely to affect not only consumption of the new medium but also consumption of the previously existing media. Subsequent effects on political attitudes might be attributed to either the consumption of the new media or to changes in the previously existing media. In this paper, we investigate the effects of a technological innovation, broadband, which makes online news consumption substantially more attractive. To show what effects we can and cannot identify, we outline a simple model of media consumption.

An individual chooses to allocate time on a total of n_l various online media, $\boldsymbol{x}_l$ indexed by $i \in I$, a total of n_f various offline media, $\boldsymbol{x}_f$ indexed by $j \in J$, and leisure, l. The various media can be newspapers, radio, or television, which can each exist in offline and online forms. The individual's utility from the consumption of these media and leisure depends on the consumed quantities, her political attitudes, $\boldsymbol{y}$ indexed by $k \in K$, and other individual characteristics, $\boldsymbol{\gamma}$. There are also two taste shifters, z_l and z_f, which affect the utility obtained from online and offline consumption, respectively. These can reflect the quantity and quality of the supplied information online and offline, respectively, which can depend on technological or supply side factors.

Individuals solve the following optimization problem:

$$\max_{\boldsymbol{x}_l, \boldsymbol{x}_f, l} U = u_l(\boldsymbol{x}_l, z_l, \boldsymbol{\gamma}) + u_f(\boldsymbol{x}_f, z_f, \boldsymbol{\gamma}) + u_x(\boldsymbol{x}_l, \boldsymbol{x}_f, \boldsymbol{y}, l, \boldsymbol{\gamma})$$
$$s.t. T = \sum_{a \in I} x_{f,a} + \sum_{b \in J} x_{f,b} + l. \quad (1)$$

The utility function contains three parts: u_l is the utility of online consumption that depends on the online taste shifter; u_f is the utility of offline consumption that depends on the offline taste shifter; and u_x is the utility of online and offline consumption that is independent of the taste shifters. The last term also contains the utility of leisure. Political attitudes, which can be variables such as interest in politics and political knowledge, enter directly only in the part of the utility function that do not depend on the taste shifters. Other individual characteristics are

unconstrained.[2] This specification of the utility function is completely general in all variables and parameters except the taste shifters; we require the taste shifter of each type of media to have a direct effect on the utility of consuming only its own type of media. In our empirical investigation, we consider broadband access to be an online taste shifter. This specification of the utility function means that broadband access has a direct effect only on the utility of online news consumption but does not affect offline news consumption or political attitudes. Indirect effects may, however, arise from optimization (i.e., broadband access can affect online news consumption, which in turn affects offline news consumption and political attitudes). The budget constraint is a time constraint with T being the time endowment.

Once media consumption choices have been determined, they affect the political variables according to the following equation:

$$y_k = y_k(\boldsymbol{x}_l, \boldsymbol{x}_f, \boldsymbol{y}_{-k}, \boldsymbol{\gamma}), \qquad \forall k \in K, \tag{2}$$

where $-k$ refers to elements in the vector other than k. Again, this is general in all variables except that we prohibit the taste shifters from having any direct effects on the political variables. Any effects must be indirect through media consumption. Given K equations and unknowns, we can implicitly solve for

$$\boldsymbol{y} = \boldsymbol{y}(\boldsymbol{x}_l, \boldsymbol{x}_f, \boldsymbol{\gamma}). \tag{3}$$

Plugging this into the objective function in Equation (1), and substituting in the time constraint, we obtain the following equation:

$$\max_{\boldsymbol{x}_l, \boldsymbol{x}_f} U = u_l(\boldsymbol{x}_l, z_l, \boldsymbol{\gamma}) + u_f(\boldsymbol{x}_f, z_f, \boldsymbol{\gamma}) + u_x(\boldsymbol{x}_l, \boldsymbol{x}_f, \boldsymbol{\gamma}). \tag{4}$$

First-order conditions together with the usual quasi-concavity assumption on the utility function give the interior solution. There are $I + J$ first-order conditions and unknowns. We can then implicitly solve for the demand functions and obtain the resulting political outcomes using Equation (3) as follows:

$$x_{l,i} = x_{l,i}(\boldsymbol{x}_{l,-i}(z_l), \boldsymbol{x}_f(z_f), z_l, \boldsymbol{\gamma}) = x_{l,i}(z_l, z_f, \boldsymbol{\gamma}), \qquad \forall i \in I, \tag{5}$$

$$x_{f,j} = x_{l,i}(\boldsymbol{x}_{f,-j}(z_f), \boldsymbol{x}_l(z_l), z_f, \boldsymbol{\gamma}) = x_{f,i}(z_l, z_f, \boldsymbol{\gamma}), \qquad \forall j \in J, \tag{6}$$

$$y_k = y_k(\boldsymbol{x}_l(z_l), \boldsymbol{x}_f(z_f), \boldsymbol{\gamma}) = y_k(z_l, z_f, \boldsymbol{\gamma}), \qquad \forall k \in K. \tag{7}$$

We see that the online taste shifter affects both online and offline consumption. However, while the online taste shifter directly affects online consumption, there is only an indirect effect on offline consumption. The reverse is true for the offline taste shifter.

The group of parameters of interest include the displacement effects between online and offline consumption, $dx_{f,j}/dx_{l,i}$ as well as the effects of online media on political attitudes, $dy_k/dx_{l,i}$. One caveat to investigating the parameters directly is the reverse causality problem. Online and offline media consumption are choice variables that are simultaneously

[2] This utility function resembles the specification in Gentzkow (2007), and the u_x term allows for any patterns of substitutability and complementarity between the different types of media.

determined according to Equations (5) and (6), and political attitudes are parameters in the utility function in Equation (1) that influence media consumption and, hence, are involved in the preferences for media.

A way to solve the reverse causality problem is to use the taste shifters; we focus on the online taste shifter. In this regard, comparative statics obtain the following equations:

$$\frac{dx_{l,i}}{dz_l} = \sum_{a \in I} \frac{\partial x_{l,i}}{\partial x_{l,a}} \frac{\partial x_{l,a}}{\partial z_l}, \qquad \forall i \in I, \tag{8}$$

$$\frac{dx_{f,j}}{dz_l} = \sum_{b \in J} \frac{\partial x_{f,j}}{\partial x_{f,b}} \frac{\partial x_{f,b}}{\partial z_l} + \sum_{a \in I} \frac{\partial x_{f,j}}{\partial x_{l,a}} \frac{\partial x_{l,a}}{\partial z_l}, \qquad \forall j \in J, \tag{9}$$

$$\frac{dy_k}{dz_l} = \sum_{a \in I} \frac{\partial y_k}{\partial x_{l,a}} \frac{\partial x_{l,a}}{\partial z_l} + \sum_{b \in J} \frac{\partial y_k}{\partial x_{f,b}} \frac{dx_{f,b}}{dz_l}, \qquad \forall k \in K. \tag{10}$$

Let us begin with the case of one online media, x_l, and one offline media, x_f. Equation (9) then gives $dx_f/dx_l = (dx_f/dz_l)/(dx_l/dz_l)$. This is essentially an instrumental variable (IV) estimator where dx_f/dx_l is the structural relationship; dx_f/dz_l is the reduced form between offline media and the taste shifter; and dx_l/dz_l is the first-stage relationship between online consumption and the taste shifter. To the extent that the online taste shifter only affects the utility of online consumption, it is a valid instrument. This approach can be extended to the investigation of the effects on political attitudes. In the case of one media, x, Equation (10) gives $dy_k/dx = (dy_k/dz)/(dx/dz)$.

With several media and with possibly several of each type of media, there are complications in recovering the structural parameters. To illustrate this point, consider the case with only one offline media but with two online media, x_{l1} and x_{l2}. Furthermore, suppose the structural relationship of interest is $dx_f/dx_{l,1}$. Using the IV approach, we obtain $(dx_f/dz_l)/(dx_{l,1}/dz_l) = dx_f/dx_{l1} + (dx_f/dx_{l,2})(dx_{l,2}/dz_l)/(dx_{l,1}/dz_l)$. From this, we can observe that it is impossible to recover the structural relationship unless offline media consumption is uncorrelated with the second online media ($dx_f/dx_{l,2} = 0$), or if the second online media is uncorrelated with the taste shifter ($dx_{l,2}/dz_l = 0$). More generally, the IV approach cannot identify displacement effects because there are, as observed in Equation (9), J equations, but $J^2/2$ unknown $dx_{f,j}/dx_{f,b}$ and $I * J$ unknown $dx_{f,j}/dx_{l,c}$, once the reduced-form parameters have been estimated.

Often the taste shifter is of intrinsic interest. It may then be more natural to look directly at the reduced-form estimates of the effect of the taste shifter rather than at the structural estimates using IV. This is the approach we adopt in this paper. Equations (8) to (10) provide the interpretation of those parameters. In Equation (8), we identify the first-stage effects of the taste shifter on various online media (i.e., $dx_{l,i}/dz_l$), allowing for the substitution effects between those media. Then, in Equation (9), we identify subsequent effects of the taste-shifter on various offline media ($dx_{f,j}/dz_l$), allowing for substitution effects between all media. Finally, in Equation (10), we identify the subsequent effects of the taste-shifter on political

attitudes (dy_k/dz_i) allowing for effects working through the different online and offline media.

It is illustrative to relate our taste-shifter, reduced-form approach to the previous literature. The literature investigating the displacement effects typically investigates the structural parameter directly (e.g., Kaiser, 2003; Filistruchhi, 2005; Simon, 2005). Gentzkow (2007) emphasizes the need for an online taste shifter and uses Internet access at work for this. George (2008) uses the same reduced-form approach as is used in this paper and investigates the effects of Internet coverage at the zip code level. The literature studying effects of online file-sharing of entertainment goods on legal sales frequently uses the online taste shifter high-speed Internet coverage as an instrumental variable (e.g., Rob and Waldfogel, 2006; Zentner, 2006). Nie et al. (2010) also use such a strategy to investigate the effect of online newspapers on political attitudes with the number of Internet providers in an area as the online taste shifter. The literature on the political effects of the introduction of a new medium to a market, which was reviewed in the introduction to this paper, typically uses a media technology taste shifter in a reduced-form approach. Bhuller et al. (2011) also use this approach to investigate the relationship between broadband coverage at the municipal level and sex-related crimes.

This paper provides a new contribution relative to the previous literature by allowing for many media, online and offline. This provides a more complete picture of how broadband has affected news consumption because we allow for cross-effects between different media. A complete picture is necessary for the interpretation of subsequent effects on political attitudes because the effect of one medium may be offset by counteracting effects of other media.

The online taste shifter that we use is broadband access. This is similar to the taste shifters used in the previous literature. We focus on this variable because it has intrinsic interest, and it contains a large amount of variation. Unlike media consumption variables, broadband access can also be viewed as a taste shifter. However, as in the previous literature, it is difficult to claim that this is an ideal taste shifter given to individuals free from elements of choice. By treating the offline taste shifter as a constant in Equations (8) to (10), we also need a strategy to separate the effects of the taste shifter from those of other individual characteristics that affect media consumption and political attitudes. We discuss these empirical difficulties and our attempts to estimate a causal effect in Section 4.

3. Data and Background

The introduction of a new mass medium changes the market for news on both the demand and supply sides. The manner in which the market structure and the news supply change is an interesting issue that has been studied by researchers, such as George (2008). We will, however, only examine the demand side. Several studies investigate the effect of online newspaper consumption on offline consumption for the same newspaper (e.g., Gentzkow, 2007) or at the outlet level (Filistrucchi, 2005). We are interested in consumption at the individual level, and we examine the entire range of media consumed. Only individual level survey data can provide this type of information.

We use Swedish data from three different sources in our analysis. For news consumption patterns, we use data from Mediebarometern, which is an annual survey that has been conducted since 1979. Approximately 3,500 randomly selected individuals are interviewed by telephone every year concerning their media consumption for the previous day, and from the survey, we also have data regarding respondents' access to broadband at home.

In the analysis of political attitudes, we use data from Samhälle Opinion Medier (SOM), which is an annual survey that has been conducted since 1986. Every year, approximately 3,000 individuals are randomly selected and interviewed about their habits and attitudes on various subjects, such as politics, media, and lifestyle. The sample is randomly divided into two subsamples; the respondents in the first subsample receive additional questions about media consumption, and the other subsample receives additional questions about politics. This survey also contains a question regarding broadband availability at home. There is no duplication in survey respondents between this survey and the Mediebarometern survey; therefore, it is impossible to link the individuals from these two surveys.

In our instrumental variables analysis (described in Subsection 4.2), we also construct a broadband coverage instrumental variable using data from The Swedish Post and Telecom Authority (PTS). These data are from an annual survey that has been conducted since 1998. Approximately 2,000 citizens are questioned every year regarding their Internet and telephone habits.

The available surveys cover the period during which the Internet was commercialized to a broader public as telecom companies around the world began to offer dial-up Internet connections in the mid-1990s. Sweden was at the technological forefront in this respect. By the end of the decade, a majority of families had Internet access. In the year 2000, the government laid out plans for the coming decade. The goal was to make high-speed Internet available to everyone. In the following years, the infrastructure for permanent high-speed connections expanded heavily with the aid of governmental subsidies. DSL-techniques (such as ADSL) that could supply high-speed connections through the existing telephone copper network were the technique that expanded first and that offered the greatest ranges of coverage. The only requirement for this technique was for the existing telephone masts to be upgraded. Later, fiber-based, cable-based, or satellite-based networks (sometimes referred to as broadband networks) were built and expanded to supply even higher speeds. In this paper, we call all permanent (as opposed to dial-up) connections broadband connections.

We focus on the effects of broadband access rather than Internet access for several reasons (see, e.g., Bhuller et al. 2011). High speed streaming is essential for the use of many Internet media such as radio and television. Broadband access is, hence, a much stronger online taste shifter in the theoretical model presented in the previous section of this paper. It also allows for the use of the broadband infrastructure expansion, which lead to different rates of broadband coverage across the country, to address the endogeneity issues in the taste shifter. This strategy is outlined in Subsection 4.2.

We investigate the period from 2002 to 2007 during which broadband infrastructure expanded and broadband access rose from low to high levels. These exact years were chosen because this is the period for which we have data to construct the broadband coverage instrumental variable. We also restrict the sample to respondents aged 18–80 years old.

We construct our broadband access dummy variable using several different questions concerning the respondents' access to various types of Internet connections at home. The exact questions and formulations vary slightly across the years and between the surveys. In some cases, the respondents were asked if they had a dial-up connection, a permanent connection via the phone network, or a fiber-based, satellite-based, or cable-based network. We then construct broadband access as having any of the non-dial-up connections. In other cases, the respondents were simply asked if they had access to broadband without further clarification, in which case our access variable follows the respondents' interpretation of what constitutes 'broadband'. Given these inconsistencies and given that respondents may have different interpretations of the term 'broadband', we have a measurement error in our broadband variable.

The development of average Internet and broadband access rates over time in Mediebarometern and SOM are plotted in Figure 1. We see that 65% already had Internet access in 2002 and that this rate grew to 83% in 2007. However, only 20% had broadband access in 2002, and there was a large increase to approximately 70% in 2007. Most Internet connections were, therefore, not high-speed connections at the beginning of the period, whereas they became high-speed connections by the end of the period. There is a discrepancy between the surveys and non-smooth changes over the years, possibly due to differences and changes in the wording of the broadband question. However, the approximate levels and the overall trend are similar between the surveys.

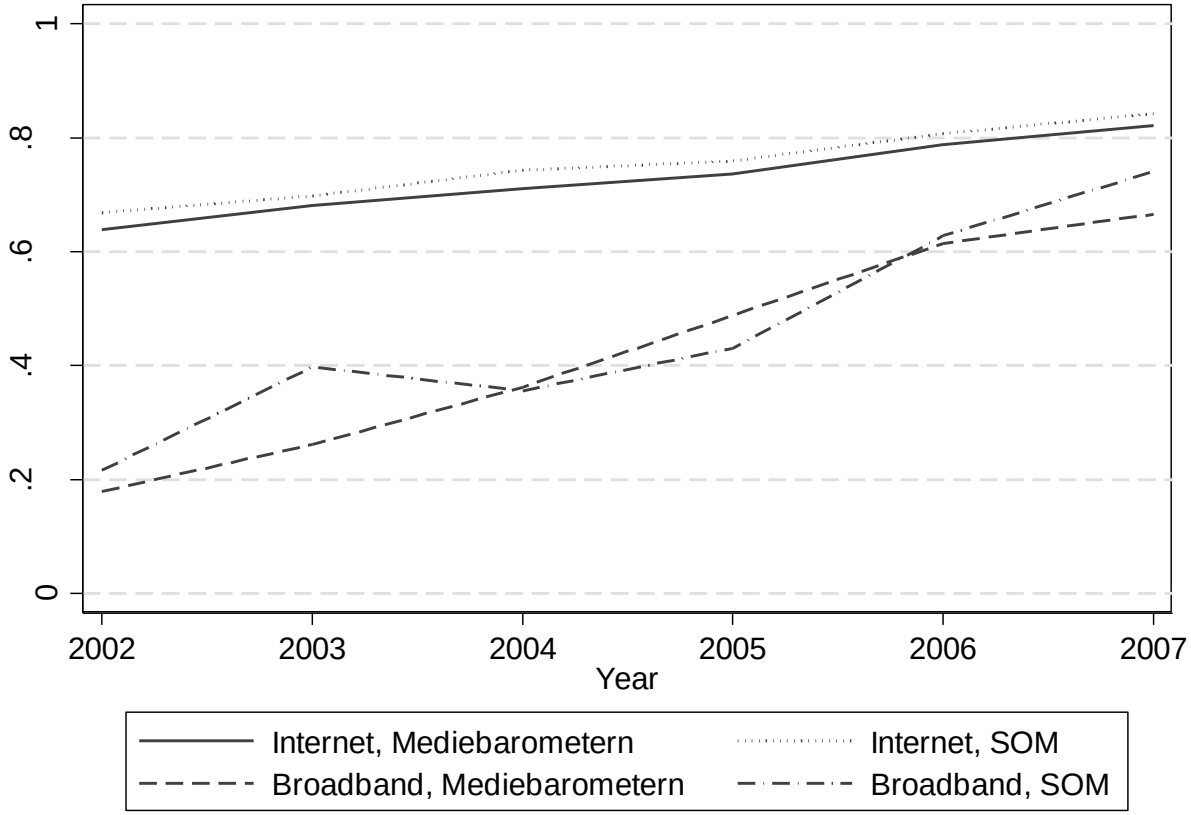

Figure 1. Share of individuals with Internet and Broadband access over time

A potential complication with broadband access at home is that individuals may also consume online media at places other than at home, such as at work. We do not have data on Internet access at work; therefore, we use the variation in online media consumption induced by a home connection. To the extent that access at work substitutes or complements media consumption at home, these effects are captured by our investigation of broadband access at home (see the model section of this paper for effects that can be identified from a change in the taste-shifter).[3]

For media consumption outcomes, we create dummy variables to represent whether the respondent consumed morning papers, tabloids, television, or radio the previous day. These variables are available for the online and offline versions of the medium separately as well as jointly. We also create continuous time variables for the number of minutes spent on the joint online and offline versions of the media. There is also a time variable for how many minutes the respondents spent on the Internet that includes all online media, and therefore partly overlaps with the other time variables.

Note that we are not able to distinguish between news consumption and non-news consumption for the various media. For newspapers, this may not be an important issue because their contents are news-related for the most part. For television or radio, this is more problematic because many television programs and radio shows contain no or small amounts of news. However, this is only a problem if broadband has a different effect on the consumption of news programs on television and radio than on other types of programs.

Our political attitude outcomes include interest in politics, ideological leanings (i.e., "right-wing"), ideological polarization, trust in politicians, and three opinion variables. The interest in politics variable is measured on a four-point scale with answers ranging from 1 ("not at all interested") to 4 ("very interested"). The right-wing variable is measured on a five-point ideological scale ranging from 1 ("clearly to the left") to 5 ("clearly to the right"). The polarization variable is constructed as the absolute difference form of the right-wing variable from 3 ("neither to the left nor right"). A high value indicates that the respondent is either strongly to the left or strongly to the right. The trust variable is measured on a four-point scale ranging from 1 ("very little trust") to 4 ("very high trust").

The opinion variables are dummy variables for whether the respondent expressed an opinion about any of the parties in the parliament, about the party leaders, or on a number of issues that had been prominent in political debates. The party and leader variables are constructed from questions asking the respondents to rate each of the seven parties and party leaders in the parliament on a scale from -5 to +5. The opinion issue variables are constructed from questions asking the respondents to give their opinions on a number of proposals that had been prevalent in the public debate at the time. The answers could range from "very bad proposal" to "very good proposal". Our opinion variables are dummy variables taking the value 1 if the respondent gave an opinion on all parties/leaders/issues and 0 otherwise. We use these variables as proxies for information and political knowledge, following Snyder and Strömberg (2010), who argue that the respondent's expression of political opinions is an indication of being informed.

[3] Notably, the outcome variables, such as news consumption, are registered regardless of where they are consumed (at home, work, or any other place).

The demographic variables include the age of the respondent (for which we construct a full set of dummy variables in the regression analysis) and a number of dummy variables for gender, education level, and occupation group.

Descriptive statistics for our outcome and demographic control variables are reported in Table 1. First, we report the media consumption outcome variables from Mediebarometern. Then, we report the political attitude outcome variables from SOM. Finally, we report the control variables from Mediebarometern (the same control variables for the SOM sample show similar statistics and are omitted). We report the means for the whole sample as well as for the subsamples of those with and without broadband access at home. This provides a simple correlation analysis between the variables and the independent variable of interest.

We observe that the most commonly used of the four online media were tabloids. During the period of study, approximately 10.1% of the respondents read a tabloid online on any given day, while approximately 3.6% read a morning paper online. Very few respondents reported streaming television programs (0.49%) or radio programs (0.91%) online. As expected, there was a very large difference in online consumption between those who had access to broadband at home and those who did not. For example, among the respondents with broadband access, 18.1% reads a tabloid online on any given day, while only 3.8% of the respondents without broadband access reported doing so.

The offline media were used more often than their online versions. A large majority of the respondents read a printed morning paper (75.6%), watched television (84.7%) and listened to radio (78.3%). The readership of printed tabloids was much lower: 23.9% read a tabloid on a typical day. For all of these offline media, respondents without broadband access constituted a larger share of consumers than those with broadband access.

We also include dummy variables that take the value of 1 for a given media if the respondent either consumes it online or offline and 0 otherwise.[4] Aside from the tabloids, the patterns for consumption of either the online or offline version of a given media follow the patterns for offline media. This is because the offline versions of these media were used far more than their online versions.

We see from the time variables that respondents spent the majority of time spent on media for any given day listening to radio (120 minutes) and watching television (101 minutes). Much less time was spent reading morning papers (23 minutes) and tabloids (8 minutes). The time spent on the Internet was, on average, 37 minutes. As expected, regarding time spent on the Internet, the difference between those with broadband access (62 minutes) and those without broadband access (17 minutes) is large. The fact that broadband access at home is a strong indicator of time spent on the Internet is reassuring because it suggests that broadband at home does not only crowd out Internet usage at other places, such as at work.

For the political attitude variables, we see that respondents with broadband access were more likely to be interested in politics. They were also more right-wing and more ideologically polarized, and they had a greater confidence in politicians. Furthermore, they were more likely to have opinions on different aspects of politics.

[4] This variable is not just the sum of the offline and online variables for a given media. This is because some individual consumes both the online and offline versions of a media.

Table 1. Descriptive statistics of the variables

	Total	Broadband	No Broadband	Difference	Obs.
Online, Morning Paper	0.0362	0.0647	0.0136	0.0511**	18904
Online, Tabloid	0.101	0.181	0.0381	0.143**	18904
Online, Television	0.00492	0.0102	0.000759	0.00940**	18904
Online, Radio	0.00905	0.0186	0.00142	0.0172**	18904
Offline, Morning Paper	0.756	0.738	0.769	-0.0307**	18904
Offline, Tabloid	0.239	0.209	0.263	-0.0535**	18904
Offline, Television	0.847	0.832	0.859	-0.0269**	18904
Offline, Radio	0.783	0.760	0.801	-0.0405**	18904
Both, Morning Paper	0.768	0.760	0.774	-0.0135*	18904
Both, Tabloid	0.325	0.363	0.294	0.0693**	18904
Both, Television	0.848	0.834	0.859	-0.0248**	18904
Both, Radio	0.784	0.763	0.801	-0.0380**	18904
Time, Morning Paper	23.48	21.00	25.44	-4.435**	18904
Time, Tabloid	7.935	7.892	7.969	-0.0773	18904
Time, TV	101.3	91.96	108.8	-16.82**	18904
Time, Radio	120.3	103.3	133.8	-30.44**	18904
Time, Internet	37.17	62.37	17.15	45.22**	18904
Interest in Politics	2.581	2.610	2.556	0.0544**	16253
Right-wing	2.988	3.057	2.929	0.128**	16047
Polarization	0.882	0.927	0.845	0.0825**	16047
Trust in Politicians	2.231	2.266	2.199	0.0676**	7192
Opinion Parties	0.918	0.934	0.904	0.0297**	7321
Opinion Party Leaders	0.680	0.695	0.667	0.0279**	7321
Opinion Issues	0.899	0.921	0.880	0.0413**	16522
Age	48.32	42.95	52.58	-9.627**	18904
Female	0.519	0.483	0.548	-0.0645**	18904
Education: Elementary School	0.236	0.121	0.327	-0.206**	18904
Education: Secondary School	0.390	0.419	0.367	0.0521**	18904
Education: Higher School	0.364	0.452	0.293	0.160**	18904
Education: Unsure	0.0103	0.00717	0.0128	-0.00564**	18904
Worker: Blue Collar	0.412	0.362	0.452	-0.0902**	18904
Worker: Self-employed	0.101	0.110	0.0937	0.0168**	18904
Worker: Academic	0.143	0.192	0.104	0.0878**	18904
Worker: Farmer	0.0174	0.00598	0.0264	-0.0204**	18904
Worker: White Collar	0.295	0.306	0.287	0.0191*	18904
Worker: Unsure	0.0309	0.0237	0.0367	-0.0131**	18904

The stars denote significant differences allowing for cluster effects at the municipal level. * $p<0.05$, ** $p<0.01$.

For the demographic variables, we see that those with broadband access were, on average, 10 years younger. Furthermore, they were more likely to be male and academics with a high education; they were much less likely to be blue collar workers. Because demographic characteristics are likely to affect consumption habits, these are important control variables.

To investigate how media consumption has developed over time, the yearly means of the online and offline variables are plotted in Figures 2 and 3, respectively. Online consumption increased over time for all four types of media together with broadband access rates. For offline consumption, the pattern is less clear. However, for tabloids, there seems to

have been a steady decline; in 2007, the share of respondents who read tabloids online (15.1%) was close to the share who read printed tabloids (20.9%).

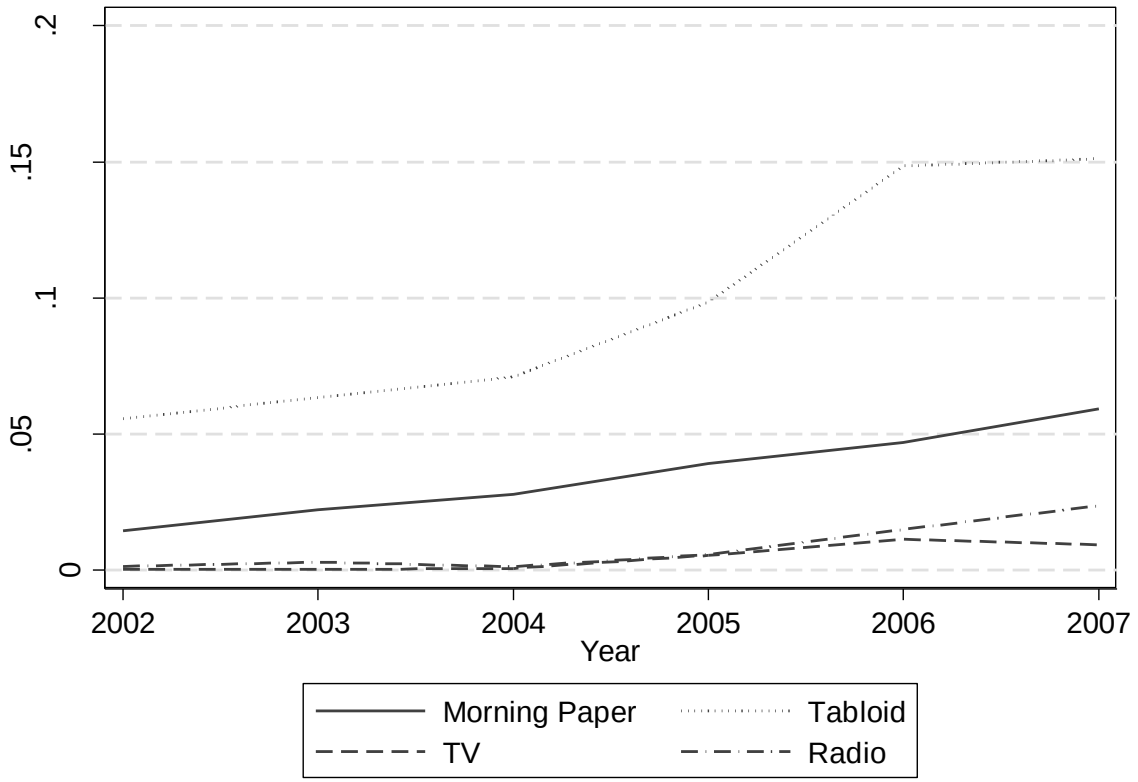

Figure 2. Shares who consume a given media online for any given day over time

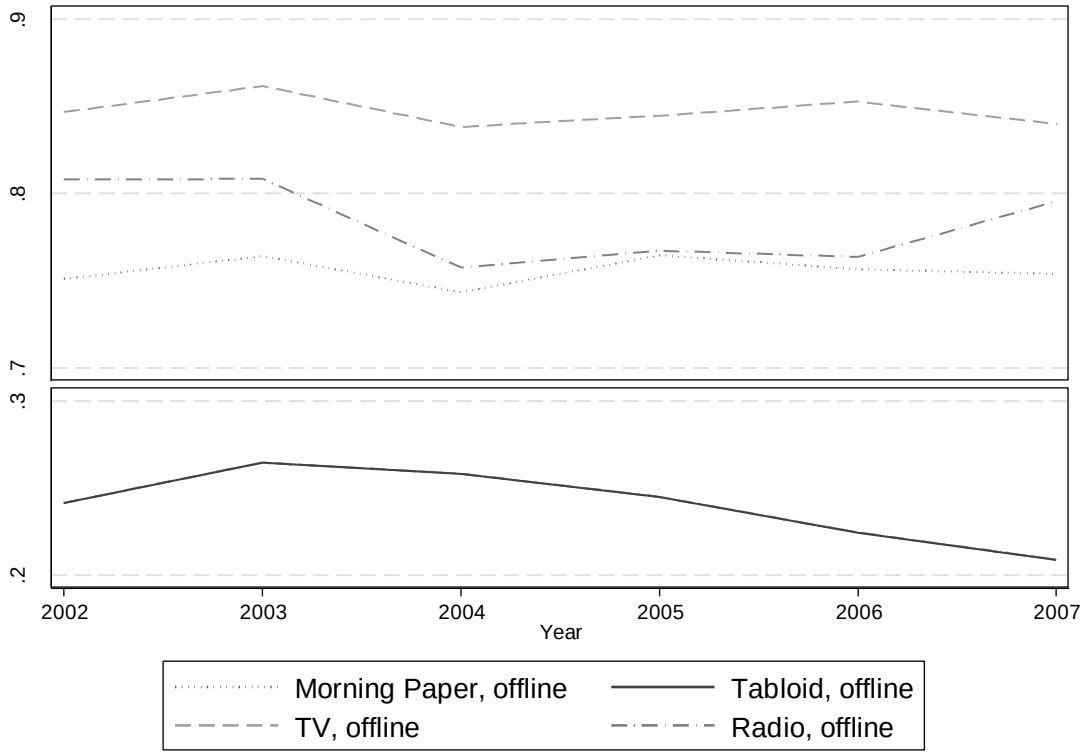

Figure 3. Shares who consume a given media offline for any given day over time

4. Empirical Strategy

4.1 OLS Approach

In this section, we describe our strategy for identifying the reduced-form effects of broadband access on media consumption and political attitudes that are derived in Equations (8) to (10). There are several difficulties in finding the causal effects. Although broadband access can be seen as a taste shifter, it may be endogenous for several reasons. The most important determinant is the availability of a broadband connection. The broadband coverage rate depends, however, on geographical factors such as population density. Infrastructure has also expanded over time, leading to higher access rates. Furthermore, acquiring a broadband connection is also an individual choice that to a great extent likely depends on individual characteristics, such as age and education, because different groups have different needs and levels of knowledge. If these factors have effects on an outcome variable and are not accounted for, the estimates of the effects of broadband access will be biased. We therefore estimate the following equation, using OLS, for different outcome variables:

$$Outcome_{i,m,t} = \beta_B Broadband_{i,m,t} + \boldsymbol{\beta}_M \boldsymbol{M}_{m,t} + \boldsymbol{\beta}_X \boldsymbol{X}_{i,m,t} + \alpha_m + \tau_t + \varepsilon_{i,m,t}. \qquad (11)$$

i is used to index individuals, m is used to index municipalities, and t is used to index years. $Broadband_{i,m,t}$ is our independent variable of interest. $\boldsymbol{M}_{m,t}$ is a set of municipal level controls that include the following variables: the tax base, log of population size, population density, tax rate, employment and unemployment rates, share on social benefits, share of foreign-born individuals, net migration rate and (a set of variables for) the share having different education levels. $\boldsymbol{X}_{i,m,t}$ is a set of individual-level controls and consists of dummy variables for age, sex, education, and working status. α_m is a municipal-specific intercept, τ_t is a year-specific intercept, and $\varepsilon_{i,m,t}$ is an idiosyncratic error term. For causal inference of β_B, we require broadband access to be uncorrelated with the error term conditional on the control variables.

Part of the variation in broadband access comes from differences in broadband infrastructure between municipalities. This is driven by differences in the timing and pace of infrastructure expansion between municipalities. This variation is reasonably exogenous unless either the exact timing of the expansion across municipalities systematically depends on unobservables affecting the outcomes or individuals migrate between municipalities based on the stage of infrastructural expansion.

Because our fixed effects are only at the municipal level, there may be individual-level unobservables related to broadband access, e.g., unobservables affecting individual-level media consumption preferences. Because we use repeated cross-sections, we cannot use individual-level fixed effects to account for them. If individuals choose their places of residence to avoid those places where it is technically impossible to obtain broadband, this choice might make broadband access endogenous. Given place of residence and technical possibilities, the decision to acquire a subscription and broadband access is also an individual

choice that may depend on media preferences. We find this to be the most likely threat to identification.

Our study is affected by the omitted variables problem depending on which outcome we examine. For effects on online consumption, the problem is likely unimportant. Because the consumption of many online media is difficult without broadband access, preferences are likely to affect online consumption patterns through acquiring broadband access. The correlation with the outcome would then go through the broadband variable and not give rise to a bias. If the effects are heterogeneous in the population, our estimate would be an average effect for the group with broadband (i.e., the treatment effect on the treated). Media preferences are, however, more likely to have direct effects on offline consumption. Such effects may also feed into political attitudes. For these outcomes, there might also be a reverse causality problem as political attitudes might affect media preferences, and the identification is less likely to be satisfactory. We therefore also consider an instrumental variable (IV) approach.

4.2 IV Approach

A possible solution to the potential endogeneity bias is to isolate the variation in broadband access that stems from exogenous sources. The differential pace of infrastructure expansion in different parts of Sweden can be exploited for this purpose. The technical possibilities to acquire a broadband connection differed not only between municipalities but also within municipalities between different neighborhoods during the years of study. To fully use this variation, we would need data at the individual level to determine whether the individuals lived in a home that was technically capable of acquiring broadband access. Assuming that individuals did not move due to broadband coverage, such data can be used to construct the ideal instrument for broadband access because it is a strong determinant of access and outside the individuals' control.

We have individual coverage data from the PTS study in which respondents reported their reasons for not having broadband access; one of the answers was that it was not technologically possible because their home was not covered by a broadband network. We have these data from 2002 to 2007, which is the time period when broadband infrastructure expanded in Sweden. Unfortunately, we do not have such data for the respondents to the Mediebarometern and SOM surveys, for which we have the outcome variables. Therefore, as an alternative, we aggregate the PTS individual coverage data to the municipal level and only make use of the variation in broadband coverage rate between municipalities. This aggregate variable is then matched by municipalities with the other variables from Mediebarometern and SOM and used as an instrumental variable.[5] One advantage to this aggregation at the municipal level (compared to not aggregating) is that broadband-based migration within municipalities is no longer a problem.

[5] Note that another way to exploit the coverage variable would be to directly use it as a taste shifter and to investigate the effects of this variable. We find the reduced-form effects of our coverage rate variable to be of less intrinsic interest and, therefore, continue to use an access variable as the taste shifter as in the previous literature.

The spatial variation in our coverage instrument across municipalities is shown on the left side of Figure 4. The variation is not obviously systematic. For example, it is not the case that the northern, less populated municipalities were always less covered, that coastal areas were more covered, and that coverage was clustered. City municipalities, however, were generally more covered. In comparison, the right side of Figure 4 shows the broadband access variable from the Mediebarometern survey. The correlation between coverage and access appears to be fairly high. The distribution of the coverage instrument is shown in Figure 5. We observe that most municipalities were well-covered on average, indicating that the expansion started early in the period of study and was quite fast in most municipalities.

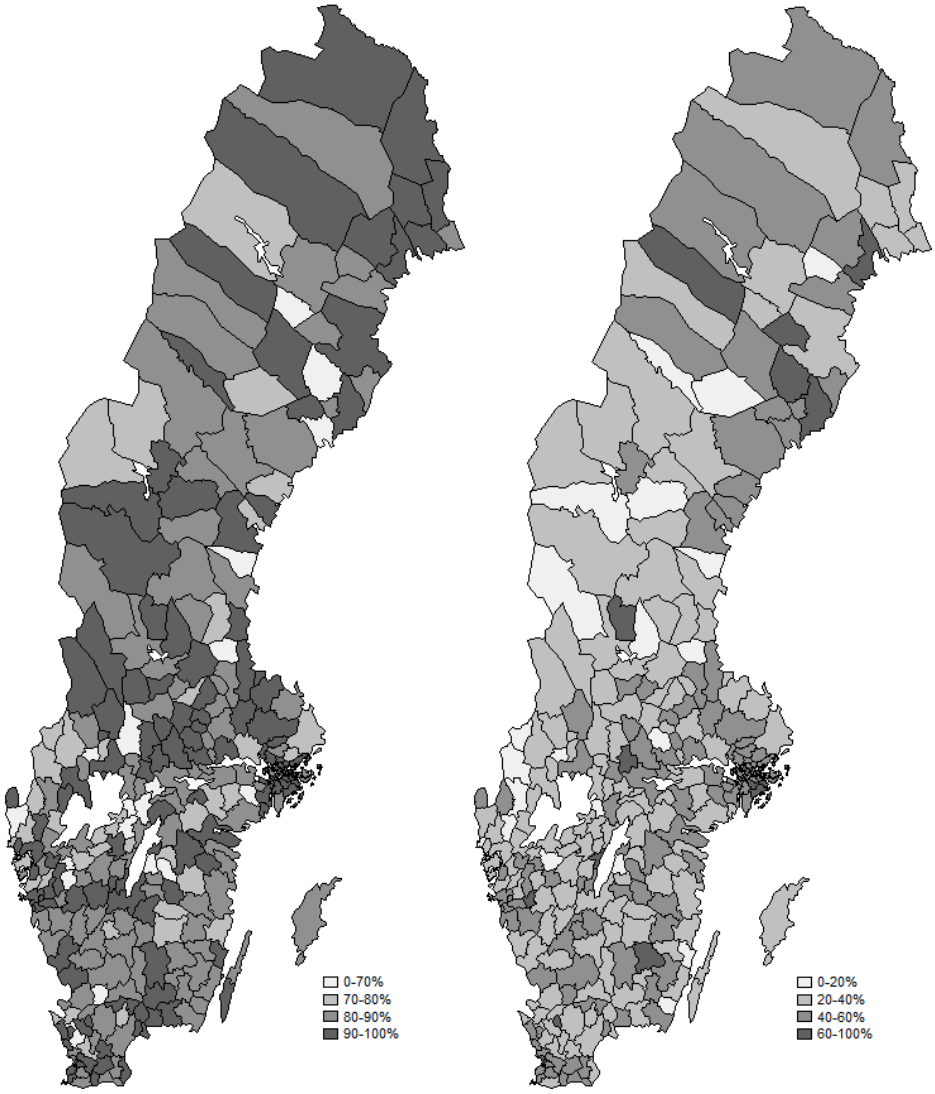

Figure 4. Broadband coverage rate (left, aggregated from the PTS survey) and access rate (right, aggregated from the Mediebarometern survey) at the municipal level 2002–2007.

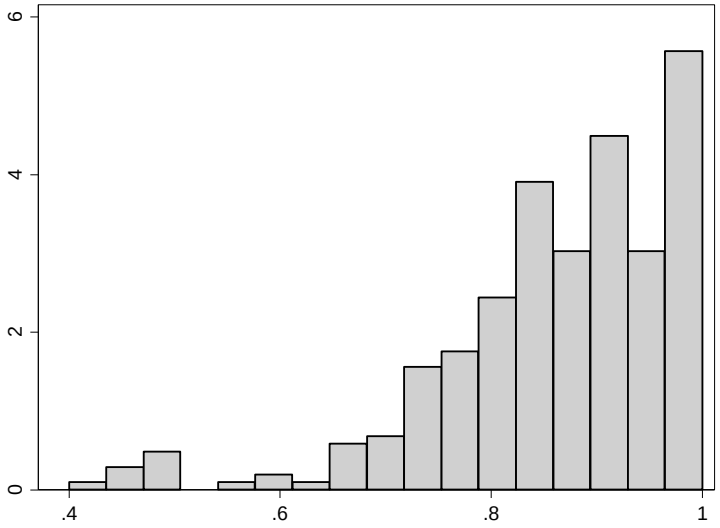

Figure 5. Distribution of the share of individuals with broadband coverage at the municipal level.

It is possible to aggregate by municipality and year and use the joint municipality-year variation to eliminate both municipality and time effects. This type of variation is used successfully by Bhuller et al. (2011) with Norwegian municipal data to trace the effect of broadband access on sex crimes. However, in our study, that causes the coverage rate to become a weak predictor of the broadband access rate. There is little variation left once controlling for municipality fixed effects. The number of individual observations used per municipality and year would also become very small. We would then have only 6 observations on average, whereas we now have 30 observations. This is still a low number, resulting in measurement errors in the instrument. Furthermore, the adjustment of access rates to coverage rates is a dynamic process and it is not clear how to model this.[6] Our municipal variation reflects the variation in average broadband coverage (which arises due to the differential pace of expansion) during the entire period, and the effects on access rates will capture most of the dynamic effects.

Although municipal coverage is exogenous to the individuals, aside from migration between municipalities to acquire coverage, the infrastructure expansion may have been determined based on demographics and other municipal characteristics, which may have effects on the outcomes. We therefore retain the control variables used in the OLS control variable approach, including the municipal control variables; however, we omit the municipal fixed effects, which would eliminate all variation in the instrument.

Our instrumental variable regressions are as follows, estimating the equations with two-stage least squares (2-SLS):

$$Outcome_{i,m,t} = \beta_B Broadband_{i,m,t} + \boldsymbol{\beta}_M \boldsymbol{M}_{m,t} + \boldsymbol{\beta}_X \boldsymbol{X}_{i,m,t} + \tau_t + \varepsilon_{i,m,t}, \quad (12)$$

$$Broadband_{i,m,t} = \alpha_B Coverage_m + \boldsymbol{\alpha}_M \boldsymbol{M}_{m,t} + \boldsymbol{\alpha}_X \boldsymbol{X}_{i,m,t} + \tau_t + e_{i,m,t}, \quad (13)$$

[6] Specifically, it could take some time for coverage to affect access, which would require a model including lags; it is not clear how such a model should be specified.

$Coverage_m$ is our instrument. Equation (12) is the second-stage, structural equation, and equation (13) is the first-stage equation. Because the instrument only varies by municipality, we cluster the standard errors at that level. To make the OLS and IV results comparable, we also cluster the standard errors at the municipal level when estimating Equation (11) with OLS.

The identifying assumption is that coverage is validly excluded from the second-stage equation. Formally, we assume that $Coverage_m$ is uncorrelated with $\varepsilon_{i,m,t}$ conditional on the other regressors. This requires that coverage does not have any own effect on the outcome and that any effect on the outcome goes through broadband access. Municipal level characteristics that are not captured by the municipal controls, which are correlated with our coverage variable and which affect the outcome directly, are the biggest threat to identification. If the broadband infrastructure expansion is based on municipal factors for which we do not control and those municipal factors affect our outcomes, then our estimates will be biased. We also need our coverage variable to be correlated strongly enough with broadband access. We will formally test this, and we will find this requirement to be fulfilled in most cases.

5. Results

5.1 OLS results

The estimates of the effect of broadband access on online media consumption, estimated using equation (11), are reported in Table 2. Media outcomes are varied vertically, and we report the effects on morning papers, tabloids, television, and radio separately for the online and offline versions as well as jointly for both versions. The set of control variables is varied horizontally. In the first column, only year fixed effects are included. For raw correlations between broadband access and the outcomes, see Table 1. In the second column, a full set of dummy variables for age, which correlate strongly with broadband access and the outcome variables, are added. In the third column, gender, education, and occupation categories are also added. In the fourth column, we include municipality fixed effects and municipal controls. Each cell reports the estimate of the broadband access variable from a separate regression. The result tables are organized in this way throughout the paper.

Table 2. Broadband access and media consumption

		(1)	(2)	(3)	(4)
Online	Morning Paper	0.0461**	0.0439**	0.0373**	0.0360**
		(0.00322)	(0.00347)	(0.00343)	(0.00345)
	Tabloid	0.132**	0.111**	0.104**	0.104**
		(0.00601)	(0.00626)	(0.00611)	(0.00597)
	TV	0.00725**	0.00630**	0.00608**	0.00607**
		(0.00105)	(0.00104)	(0.00104)	(0.00104)
	Radio	0.0135**	0.0109**	0.0104**	0.0103**
		(0.00121)	(0.00132)	(0.00131)	(0.00141)
Offline	Morning Paper	-0.0358**	0.0194**	-0.00107	0.00604
		(0.00701)	(0.00715)	(0.00693)	(0.00718)
	Tabloid	-0.0485**	-0.0485**	-0.0339**	-0.0334**
		(0.00655)	(0.00698)	(0.00655)	(0.00682)
	TV	-0.0289**	-0.00278	0.00360	0.00395
		(0.00542)	(0.00571)	(0.00561)	(0.00554)
	Radio	-0.0391**	-0.0103	-0.0104	-0.00378
		(0.00763)	(0.00750)	(0.00760)	(0.00724)
Both	Morning Paper	-0.0200**	0.0335**	0.0120	0.0185**
		(0.00711)	(0.00697)	(0.00668)	(0.00705)
	Tabloid	0.0663**	0.0489**	0.0562**	0.0577**
		(0.00821)	(0.00846)	(0.00785)	(0.00765)
	TV	-0.0272**	-0.00135	0.00496	0.00524
		(0.00542)	(0.00570)	(0.00564)	(0.00558)
	Radio	-0.0366**	-0.00804	-0.00832	-0.00159
		(0.00779)	(0.00764)	(0.00772)	(0.00730)
Year dummies		Yes	Yes	Yes	Yes
Age dummies		No	Yes	Yes	Yes
Individual controls		No	No	Yes	Yes
Municipality controls and FE		No	No	No	Yes

Standard errors are clustered on the municipal level. * p<0.05, ** p<0.01. The independent variable of interest is broadband access at home. The outcome variable is a dummy for whether the respondent consumed a given media the day before the interview. Each cell shows the result from a single regression.

For online media, we see that broadband access has positive effects on consumption. The effects are all significant at the 1% level. The effects decrease only slightly when controls are added. The controls that most severely change the estimates are year and individual, non-age controls for morning papers and year and age controls for the other media. The small effects of the controls suggest that a causal interpretation of the estimates is reasonable. Furthermore, the estimates change only slightly when municipality fixed effects and time-varying controls are added. In the specification with the full set of controls, which is our focus, respondents with broadband access at home are, on a given day, 3.6 percentage points more likely to read morning papers online, 10.4 percentage points more likely to read tabloids online, 0.6 percentage points more likely to watch television online, and 1.0 percentage points more likely to listen to radio online. Hence, the effects are largest for the newspapers,

particularly the tabloids, and are economically significant. Given that very few respondents consume online media without broadband access at home, as shown in Table 1, the proportional effects are very large. Broadband access increases online newspaper consumption by 250-300%, and the percentage effects on television and radio consumption are even larger. Standard errors are generally small throughout the table.

Turning to the question regarding the displacement of traditional offline media, it appears that broadband has crowded out these media when only year controls are included (a similar picture emerges when only observing raw correlations, as in Table 1). When age controls are included, the picture shifts. For the consumption of morning papers, the original negative correlation is observed because young people have more broadband access and read morning papers less than older people. Once age has been controlled for, a positive relationship is observed between a preference for reading online morning papers and broadband access, while for television and radio consumption, the negative relationship disappears. As additional individual controls are added, the effect on the consumption of morning papers becomes statistically insignificant, and there are few changes observed when municipal controls and fixed effects are added. The only negative effects observed are on the consumption of tabloids offline, where the readership decreases by 3.3 percentage points. In combination with the results for online media, we draw the conclusion that the consumption of online tabloids primarily crowd out the consumption of offline tabloids. For every third person that begins to read tabloids online, one person stops reading printed tabloids.

For the consumption of either online or offline media, the pattern of change as controls are added follows the online results for tabloids but follows the offline results for the other media. This reflects the fact that broadband access has the largest effect on the consumption of tabloids. The effects lie between the online and offline effects with the full set of controls, with positive and statistically significant effects on morning papers and on tabloids of 1.9 and 5.8 percentage points respectively. Considering that tabloids are the least consumed media type overall, the relative effect on the consumption of tabloids is even larger. The 5.8 percentage points' increase corresponds to a 19.6% increase in the share of respondents reading tabloids,[7] whereas the relative increase is only 2.4% for morning papers. Broadband access is hence associated with more people reading some form of newspaper every day. The sum of the effects of broadband access on the online and offline consumption of newspapers jointly is less than the sum of the effects of broadband access on online and offline consumption of newspapers separately; this suggests that some people with broadband access who read newspapers online also read them offline.

The estimates of the effects of broadband access on time spent on different media are reported in Table 3. All media, aside from the Internet, include both online and offline versions. When only controlling for year effects, the effects are negative and statistically significant on the consumption of morning papers, television, and radio but positive for the Internet. The size of the effects decreases as controls are added, aside from the case of tabloids. With the full set of controls, the effects on morning papers are no longer significant, whereas the effects on tabloids become positive and statistically significant at the 5% level.

[7] From Table 1 we see that the share without broadband access who reads tabloids either online or offline a given day is 29.4%. The percentage increase with broadband is then, approximately, 0.0577/0.294≈19.6%

Table 3. Broadband access and time spent on different media

	(1)	(2)	(3)	(4)
Morning Paper	-5.134**	1.530**	-0.123	-0.327
	(0.394)	(0.386)	(0.324)	(0.333)
Tabloid	-0.204	0.316	0.604*	0.611*
	(0.283)	(0.287)	(0.278)	(0.290)
TV	-18.20**	-8.913**	-4.599**	-4.989**
	(1.200)	(1.265)	(1.259)	(1.313)
Radio	-29.01**	-19.96**	-10.66**	-8.235**
	(2.096)	(2.196)	(2.041)	(2.011)
Internet	40.28**	31.18**	26.67**	26.01**
	(1.141)	(1.078)	(1.067)	(1.065)
Year dummies	Yes	Yes	Yes	Yes
Age dummies	No	Yes	Yes	Yes
Individual controls	No	No	Yes	Yes
Municipality controls and FE	No	No	No	Yes

Standard errors are clustered on the municipal level. * p<0.05, ** p<0.01. The independent variable of interest is broadband access at home. The outcome variable is a variable for the time the respondent spent consuming a given media the day before the interview. Each cell shows the result from a single regression.

The lack of effects on time spent on morning papers together with the positive effects on the share of individuals reading morning papers suggests that the average time per reader decreases with broadband access. The positive effects of 0.6 minutes on tabloids correspond to a 7.7% increase in the time spent on tabloids. Together with the 18% increase in the share of respondents who read tabloids, this again suggests that the average time per reader decreases with broadband. The negative effects on television and radio consumption correspond to a 4.6% decrease and a 6.2% decrease, respectively. We find no effects on the share of individuals who watch television and listen to radio, indicating that the effect of broadband for these media goes only through less time spent by the users. Regarding the Internet, the effect, as expected, is large. On average, broadband increases consumption by 26 minutes, which corresponds to an increase of 152%.

We turn to the investigation of subsequent effects on political attitudes; the estimates of the effect of broadband access on these outcomes, estimated using equation (11), are reported in Table 4. Beginning with the non-opinion variables, we observe that broadband is positively correlated with all of them (the results with year controls are close to the raw correlations in Table 1). Adding age controls increases the effects on interest in politics and on being right-wing leaning, reflecting the fact that the original correlation partly captures that young people have more broadband access and are, at the same time, less interested in politics and more left-wing leaning. As additional controls are added, the effects gradually decrease. With the full set of controls, only the effect on the right-wing outcome remains statistically significant at the 5% level.

Table 4. Broadband access and political attitudes and opinions

	(1)	(2)	(3)	(4)
Interest in Politics	0.0475**	0.142**	0.0315*	0.0206
	(0.0173)	(0.0155)	(0.0126)	(0.0126)
Right-wing	0.110**	0.157**	0.0374*	0.0436*
	(0.0202)	(0.0210)	(0.0188)	(0.0176)
Polarization	0.0802**	0.0703**	0.0203	0.0113
	(0.0130)	(0.0134)	(0.0135)	(0.0143)
Trust in Politicians	0.0615**	0.0641**	0.0186	0.0168
	(0.0175)	(0.0196)	(0.0191)	(0.0202)
Opinion Parties	0.0280**	0.0114	-0.000540	0.00230
	(0.00722)	(0.00815)	(0.00762)	(0.00802)
Opinion Party Leaders	-0.0110	0.0295*	-0.000175	0.00736
	(0.0122)	(0.0125)	(0.0123)	(0.0126)
Opinion Issues	0.0360**	0.0230**	0.00654	0.00830
	(0.00492)	(0.00486)	(0.00487)	(0.00498)
Year dummies	Yes	Yes	Yes	Yes
Age dummies	No	Yes	Yes	Yes
Individual controls	No	No	Yes	Yes
Municipality controls and FE	No	No	No	Yes

Standard errors are clustered on the municipal level. * $p<0.05$, ** $p<0.01$. The independent variable of interest is broadband access at home. Each cell shows the result from a single regression. Each cell shows the result from a single regression.

The point estimate implies that those with broadband access at home are 0.04 points more to the right on a five-point, left–right scale, which is a fairly small effect. One explanation for this could be that for most of the study period, there was an increasingly unpopular, left-wing government in power that eventually lost the election in 2006. If broadband access increased media consumption, it is possible that this coincided with negative political reporting that contributed to individuals' right-wing inclinations. However, the effect is small, and the large variation in the up-and-down point estimate as controls are added stepwise warns against an over-interpretation of the results. In contrast, we are more confident in interpreting the insignificant estimates of the other outcomes as a genuine lack of effects because of the gradual convergence as controls are added stepwise.

For the opinion variables, we obtain significant and positive correlations for two out of three variables. This appears to be driven more by the background characteristics of the respondents than by a causal effect of broadband access. In the two final specifications, no statistically significant effects remain, and the point estimates are close to zero.

5.2 IV Results

In this section, we report the results from the instrumental variables strategy. The estimates of the effect of broadband access on media consumption, estimated using equations (12) and (13), are reported in Table 5. The same sets of controls are added stepwise as in the previous section; however, we do not include municipality fixed effects in the last column.

Table 5. Broadband access and media consumption, IV estimates

		(1)	(2)	(3)	(4)
First-stage		0.714**	0.655**	0.522**	0.180**
		(0.0815)	(0.0829)	(0.0649)	(0.0519)
Online	Morning Paper	0.102**	0.103**	0.0786*	-0.0241
		(0.0228)	(0.0247)	(0.0319)	(0.120)
	Tabloid	0.139**	0.106*	0.0641	0.0626
		(0.0407)	(0.0444)	(0.0566)	(0.180)
	TV	0.00639	0.00371	0.00518	-0.0178
		(0.00886)	(0.00989)	(0.0123)	(0.0426)
	Radio	0.0265**	0.0244*	0.0296*	0.0391
		(0.00968)	(0.0107)	(0.0137)	(0.0544)
Offline	Morning Paper	-0.00618	0.0858	-0.0659	-0.0481
		(0.0926)	(0.105)	(0.140)	(0.346)
	Tabloid	-0.265**	-0.271**	-0.182	-0.225
		(0.0783)	(0.0875)	(0.107)	(0.341)
	TV	-0.0669	-0.0462	0.0148	0.346
		(0.0522)	(0.0570)	(0.0653)	(0.199)
	Radio	-0.234**	-0.215**	-0.238*	0.446
		(0.0739)	(0.0772)	(0.0987)	(0.262)
Both	Morning Paper	0.0250	0.114	-0.0386	-0.0830
		(0.0888)	(0.101)	(0.134)	(0.343)
	Tabloid	-0.108	-0.142	-0.0901	-0.0869
		(0.0894)	(0.0995)	(0.123)	(0.370)
	TV	-0.0627	-0.0426	0.0188	0.345
		(0.0518)	(0.0567)	(0.0652)	(0.200)
	Radio	-0.226**	-0.206**	-0.228*	0.472
		(0.0741)	(0.0779)	(0.0994)	(0.266)
Year dummies		Yes	Yes	Yes	Yes
Age dummies		No	Yes	Yes	Yes
Individual controls		No	No	Yes	Yes
Municipality controls and FE		No	No	No	Yes

Standard errors are clustered on the municipal level. * p<0.05, ** p<0.01. The independent variable of interest is broadband access at home. The outcome variable is a dummy for whether the respondent consumed a given media the day before the interview. Each cell shows the result from a single regression.

We report the first-stage estimates of broadband coverage on broadband access in row 1. As expected, the raw correlation is positive and highly significant. When individual

controls are added in columns 2 and 3, the first-stage effect drops slightly. When municipal controls are added, the effect drops dramatically but remains significant. Municipal broadband coverage hence co-varies with other municipal characteristics that also affect broadband access. The estimates in columns 1 to 3 should therefore be interpreted with caution because the variation is driven to a large extent by municipal characteristics. With the full set of controls, the first-stage effect remains positive and significant. The F-statistic of instrument strength is 12 and hence just above the critical conventional requirement of 10. Including the municipal controls therefore also present some drawbacks. We therefore view the different specifications as complements to each other and to the OLS results.

We observe from the specifications without municipal controls that the effects are positive for all online media aside from television. The effects are quite similar to the OLS results. The standard errors are roughly one digit larger than the OLS standard errors. The effects decrease slightly as more controls are added, and the standard errors increase. When municipal controls are added, the point estimates become more variable, and the standard errors increase drastically to a level that is two digits larger than the OLS standard errors. The estimates then become too imprecise for any conclusions to be drawn. The confidence intervals cover the confidence intervals of the equivalent OLS estimates from column 4 in Table 2.

For offline media, we find strong negative effects that are statistically significant, but have large standard errors, on tabloids and radio until more controls are added. For the full set of controls, the effects become very imprecise. Overall, the results cannot refute the OLS estimates. For online and offline media jointly, we obtain a similar result.

The estimates of the effects of broadband access on time spent on various media are reported in Table 6. The point estimates are suspiciously large and sometimes statistically significant before municipal controls are added. For example, the effect on time spent on the Internet is close to the population average of 62 minutes for those with access to broadband at home. However, when municipal control variables are added, none of the effects are statistically significant, and the result is not inconsistent with the OLS results in Table 2.

Table 6. Broadband access and time spent on different media, IV estimates

	(1)	(2)	(3)	(4)
First-stage	0.714**	0.655**	0.522**	0.180**
	(0.0815)	(0.0829)	(0.0649)	(0.0519)
Morning Paper	14.46**	22.28**	15.15**	6.419
	(4.738)	(4.788)	(5.551)	(15.94)
Tabloid	-3.878	-3.690	-0.573	-2.062
	(3.122)	(3.383)	(4.116)	(12.25)
TV	-22.03*	-18.59	16.41	5.557
	(10.48)	(10.89)	(13.16)	(44.15)
Radio	-129.7**	-133.9**	-86.37**	178.8
	(26.84)	(28.07)	(30.65)	(92.21)
Internet	82.57**	77.74**	63.06**	41.25
	(9.234)	(9.649)	(11.34)	(40.32)
Year dummies	Yes	Yes	Yes	Yes
Age dummies	No	Yes	Yes	Yes
Individual controls	No	No	Yes	Yes
Municipality controls and FE	No	No	No	Yes

Standard errors are clustered on the municipal level. * p<0.05, ** p<0.01. The independent variable of interest is broadband access at home. The outcome variable is a variable for the time the respondent spent consuming a given media the day before the interview. Each cell shows the result from a single regression.

Turning to the political attitude outcomes, the estimates of the effect of broadband access on these outcomes, again estimated using equations (12) and (13), are reported in Table 7. The first-stage effect is now altered because it is estimated on a different sample, but the pattern is similar. Without municipal controls, the first-stage effect is large and statistically significant. However, with municipal controls, the first-stage is no longer significant. We therefore conclude that we have an instrument that is too weak in column 4.[8]

[8] The first-stage estimates correspond to the estimate on the entire sample, i.e. 16,522 observations. As seen in Table 2, for some of the outcome variables, the sample is smaller and the first stage is therefore different from the estimates of the entire sample. On the other hand, this difference is never large enough to alter the conclusions about the first-stage effect: the instrument is always strong enough without municipal controls and never strong enough with them.

Table 7. Broadband access and political attitudes and opinions, IV estimates

	(1)	(2)	(3)	(4)
First-stage	0.622**	0.551**	0.396**	0.101
	(0.0870)	(0.0776)	(0.0583)	(0.0524)
Interest in Politics	1.253**	1.555**	0.981**	0.0935
	(0.208)	(0.250)	(0.273)	(0.827)
Right-wing	0.292	0.344	-0.290	-1.864
	(0.271)	(0.298)	(0.314)	(1.419)
Polarization	0.572**	0.607**	0.349	0.297
	(0.129)	(0.142)	(0.183)	(0.737)
Trust in Politicians	0.737**	0.764**	0.475*	0.880
	(0.188)	(0.194)	(0.239)	(1.011)
Opinion Parties	0.00384	-0.00480	-0.106	-0.0650
	(0.0645)	(0.0676)	(0.0898)	(0.333)
Opinion Party Leaders	0.142	0.191	-0.0140	0.692
	(0.0969)	(0.101)	(0.138)	(0.657)
Opinion Issues	0.0604	0.0478	-0.102	-0.309
	(0.0443)	(0.0497)	(0.0748)	(0.418)
Year dummies	Yes	Yes	Yes	Yes
Age dummies	No	Yes	Yes	Yes
Individual controls	No	No	Yes	Yes
Municipality controls and FE	No	No	No	Yes

Standard errors are clustered on the municipal level. * p<0.05, ** p<0.01. The independent variable of interest is broadband access at home. Each cell shows the result from a single regression.

Without municipal controls, we find large significant effects on political interest, ideological polarization and trust in politicians. However, there is a large variability between specifications, and the standard errors are large. With municipal controls, the effects become statistically insignificant.

Overall, when we include municipal control variables in the estimations, the confidence intervals are too large for the estimates to be meaningful, and in the case of the political attitude variables, the first-stage effect is too weak. Without municipal controls, we sometimes obtain unreasonably large estimates, which may indicate problems with omitted variables. We therefore conclude that the OLS estimates are more trustworthy than the IV estimates. The IV results cannot reject the OLS results and, in some cases, they provide additional support for them.

6. Concluding Discussion

We investigate the effects of the rise of the Internet as an additional mass medium on news consumption patterns and political attitudes. We use Swedish survey data from 2002 to 2007, a period during which online news media emerged. Specifically, we estimate the effect of the introduction of high-speed Internet (broadband) and find that broadband access is highly associated with online media consumption that crowds out a portion of offline media consumption. Overall, broadband access at home increases the share of individuals who read newspapers (especially tabloids) while decreasing the time people spends watching television or listening to radio. Furthermore, more people consume newspapers, online or offline, on any given day. The average time spent per reader is, however, lower. This may indicate a new way of reading news that focuses on shorter articles. The changes in media consumption patterns do, however, result in little to no change in citizens' political attitudes. We find no effects on political interest, ideological polarization, and opinion formation, and we find a small right-wing ideological shift.

This result might not be surprising for several reasons. The main effect that we find is a shift from offline to online media. However, the main online actors are basically the main offline actors that have simply created online editions with similar content. Media penetration was also high in Sweden prior to the emergence of the Internet. The political effects of one additional source in a sea of sources of information might be marginal.

We have focused on the largest mainstream, online mass media. Today, the Internet increasingly offers new non-traditional types of interactive communication, such as blogs and social networks, which are often tailored toward specific groups. In many aspects, these media differ more from traditional media than the media we discuss in this paper. A study of the political effects of these media would be a fruitful area of research. Furthermore, we have investigated the effects on the general population; however, it is possible that the effects are more pronounced among some groups, such as young people, who may be more inclined to make use of new technologies.

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