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ABSTRACT

Television, Health, and Happiness: A Natural Experiment in West Germany*

Watching television is the most time-consuming human activity besides work but its role for individual well-being is unclear. Negative consequences portrayed in the literature raise the question whether this popular pastime constitutes an economic good or bad, and hence serves as a prime example of irrational behavior reducing individual health and happiness. Using rich panel data, we are the first to comprehensively address this question by exploiting a large-scale natural experiment in West Germany, where people in geographically restricted areas received commercial TV via terrestrial frequencies. Contrary to previous research, we find no health impact when TV consumption increases. For life satisfaction, we even find positive effects. Additional analyses support the notion that TV is not an economic bad and that non-experimental evidence seems to be driven by negative self-selection.

JEL Classification: C26, D12, I31, H12, J22, L82

Keywords: health, happiness, well-being, natural experiment, television consumption, time-use, entertainment, CSPT, ArcGIS, mass media

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1. Introduction

"We know today that television makes you fat, stupid, sad, and violent."
(Ursula von der Leyen)

Television consumption, including its modern forms accessed over the Internet, is one of the most time-consuming daily activities worldwide. Over the lifespan, watching TV even surpasses work under plausible assumptions.[1] Since TV consumption is voluntary, one may hypothesize that spending so much time on this activity yields large individual benefits. On the contrary, a sizable body of research suggests that TV consumption is a threat to both individual health and happiness (Dietz and Gortmaker 1985, Hu et al. 2003, Hancox et al. 2004, Frey et al. 2007, Bruni and Stanca 2008, Benesch et al. 2010, Cuñado and de Gracia 2012). While TV's desirable consequences at the social level are discussed in education and gender research (Gentzkow and Shapiro 2008, Jensen and Oster 2009), numerous detrimental effects of TV consumption are also well documented, including reduced political involvement, destruction of social capital, higher divorce rates, increased household debt, and reductions in cognitive ability (Gentzkow 2006, Olken 2009, Chong and La Ferrara 2009, Baker and George 2010, Hernæs et al. 2019). Consistent with these findings, and exemplified by our introductory quote from the current president of the European Union Commission, there is a wide-held belief that television is generally harmful. However, it is unclear whether television consumption is individually detrimental, and if so, why do individuals watch so much television in the first place?

The puzzling empirical contradiction of individuals engaging in an activity that could be both socially and individually harmful is reconciled in the happiness literature as a self-control problem, with TV watching interpreted as a case of irrational behavior (Frey 2008, 2018). In one of the studies based on survey measures of both happiness and TV viewing, Bruni and Stanca (2008) ask: "Why do rational people allocate their time and resources without maximizing their well-being?" Notably, economists have used happiness data to examine irrational choices not only on the context of television but also in other behaviors, such as smoking, where cigarette taxes and bans have been shown to serve as self-control devices, making smokers happier (e.g. Gruber and Mullainathan 2005, Odermatt and Stutzer 2015).[2]

[1] Assume that an average individual works 40 years, 250 workdays per year, and 8 hours per day. Further assume that the same person watches 3 hours of TV per day, which is below the official numbers in many countries, including the United States. To surpass our lifetime work estimate of 80,000 hours (=40 x 250 x 8), this fictitious person must watch TV for 74 years; or less if the person watches more hours each day. Millions of United States citizens born in the 1940s easily exceed that number.

[2] In other research strands, there are discussions on whether and how reported happiness may reveal individual choices, so that such measures could be interpreted as a production input factor of preferences and, hence, are of

Given the widespread interest in discussing self-control problems in economics (e.g. Laibson et al. 1998, Frederick et al. 2002, Loewenstein et al. 2003), it is not surprising that there are also intense discussions about policy solutions for such phenomena, reaching from asymmetric paternalism to nudges to other types of intervention (e.g. Camerer et al. 2003, Thaler and Sunstein 2009). However, to draw such policy conclusions in the case of television, it is imperative to first clarify whether watching TV falls into the category of irrational behavior with negative individual consequences. If this is not the case, and agents rationally benefit from consuming an economic good, then social consequences are a problem of negative externalities that can be addressed by internalizing those costs. Whereas research appears to be certain that TV consumption is an economic bad, implying that individuals gain nothing from pursuing this activity, there is reason to question this widely held notion, and particularly the empirical evidence provided so far. Arguably, unhappy or unhealthy individuals may sort themselves into higher levels of TV consumption, making it difficult for the empirical researcher to determine whether television consumption is individually harmful with non-experimental data. While we are not the first to recognize this possible sorting problem, we are the first to credibly address it with quasi-representative data from a natural experiment.[3] By doing so, we find evidence that is inconsistent with the idea that television is an economic bad or that individuals behave irrationally.

In our study, we investigate the consequences of television consumption on happiness and health by exploiting the occurrence of a natural experiment in West Germany. We use this unique setting in conjunction with detailed longitudinal information on television provision, individual time-use, and well-being measures obtained from multiple sources of data, thereby providing credible evidence on the individual implications of TV in ways not previously achievable. By discovering a natural experiment with unique historical facets, we add a novel

interest in itself (Benjamin et al. 2014). Evidence indeed shows that happiness is a determinant of economic choices and behavior, be it time preferences (Ifcher and Zarghamee 2011), work effort (Oswald et al. 2015), or voting (Liberini et al. 2017). Note that we treat the terms happiness and life satisfaction synonymously, in line with many contributions in the field of happiness research, while we consider well-being to be a broader term that also incorporates health.

[3] Most of the studies on health and happiness do point out that the identification of the causal effect of TV watching is difficult and practically impossible with the empirical approaches used so far. For example, Frey et al. (2007) mention in their study a lack of a "natural experiment" to study causality. In this context, see Kataria and Regner (2011) for a comment on identification issues in the research on TV and happiness. In regard of health, see DellaVigna and La Ferrara (2015) who point out that studies from outside economics typically "lack a convincing design" to credibly determine the effects of TV. They conclude: "Surprisingly given the interest in health economics, the evidence is limited" (p. 744).

research setting to a number of studies using regional heterogeneity in media provision during periods of implementation or expansion, such as the case of cable TV in the United States (Gentzkow 2006, Baker and George 2010, Campante and Hojman 2013).[4] In contrast to research in economics exploiting variation in terrestrial TV signals from West Germany reaching into East Germany (Hyll and Schneider 2013, Hennighausen 2015, Bursztyn and Cantoni 2016, Slavtchev and Wyrwich 2017, Hornuf et al. 2017, Laudenbach et al. 2018, Friehe et al. 2018, 2019), we are the first to exploit the West German setup with its regional variation in terrestrial signals of private TV, thereby studying individual behavior within a fully developed country at the center of Europe. Arguably, it is not surprising that natural experiments with regional variation in TV consumption rarely present findings from the developed world. For a country like the United States, we would have to return to the mid-20th century, when systematic surveys were far less common than they are today. Due to an overlap of nationwide surveys in West Germany with our historical incidence, the following setup allows us to comprehensively analyze whether TV consumption actually increases after signal reception before we turn to its consequences for health and happiness.

The historic natural experiment on television in West Germany starts with a de facto ban on commercial TV until the early 1980s and, by international standards, low levels of TV consumption with two hours per day for the average German. As a result of a Supreme Court decision in 1981, private television became legal in Germany, and several new channels emerged.[5] Despite new technological opportunities such as cable and satellite, most citizens could not watch any of the new programs for years due to the failure of the responsible and later dismantled public institution (the *Deutsche Bundespost*) to promptly roll out private TV. In consequence, there were several years during which commercial TV providers searched for options other than cable or satellite to reach their potential viewership. They found a cost-effective solution: terrestrial frequencies of public media stations that were, by chance, still available. However, most powerful frequencies were used by public broadcasts in the late 1980s, for which the stations were originally built decades before; thus, this opportunity was

[4] For a review of different settings used in TV research to date, see DellaVigna and La Ferrara (2015). They emphasize the significant methodological developments and list influential papers published in major economics journals in recent years. Apart from research on TV, economists have done work on the impact of media, such as Strömberg (2004), DellaVigna et al. (2014), Adena et al. (2015), and Yanagizawa-Drott (2014) for radio, and Bauernschuster et al. (2014) and Falck et al. (2014) for the internet.

[5] We use the terms private and commercial TV simultaneously. While public TV in Germany is partly financed by mandatory fees, private TV channels do not receive fees but must rely on advertising revenues and are privately owned. For example, during our investigation period, media tycoon and later prime minister of Italy, Silvio Berlusconi was one of the owners of private TV channel, Tele5.

limited. Only a few stations still had open frequencies, enabling them to send out terrestrial signals to millions of households. Due to an earlier Supreme Court ruling, there was no opportunity for commercial TV to expand upon pre-existing terrestrial frequencies since transmitter stations in West Germany could only be built for public media. In consequence, a technically limited transmitter reach created naturally emerging borders that split citizens into receivers and non-receivers of private TV via antenna.[6]

By leveraging technical data on all terrestrial stations transmitting commercial TV in Germany, we determine broadcast signals in a precise fashion to distinguish between TV treatment and control regions. Following recent studies on the impact of media, we use sophisticated software based on the Longley-Rice signal propagation model to identify regions with and without reception by considering not only technical data, such as station power, but also geographical information, such as mountains or valleys. A major benefit of our empirical setting is the fact that two large household studies of the German population were ongoing during our investigation period. First, the German Socio-Economic Panel (SOEP) provides us with detailed survey data on the situation of individuals at the time of the signal introduction, including their county of residence. We merge our technical calculations with SOEP data at the regional level to compare how individual behavior responds in regions where commercial TV via terrestrial frequencies suddenly became available versus regions where it did not. We study the implications of TV access on a set of daily individual time-use activities, allowing us to inspect whether private TV reception increases TV consumption. The SOEP questionnaire also contains several outcome variables of interest capturing the individuals' overall satisfaction with their lives and indicators for their health, including the use of doctor services and a subjective self-assessment of health. By exploiting the data's panel structure, we employ an individual fixed-effects approach to examine how TV consumption changes at the individual level due to commercial TV reception and how well-being is affected as a result of watching more television, without any influence from time-invariant individual or regional characteristics. Second, we merge the signal calculations with the German Income and Expenditure Sample (EVS) at the municipality level.[7] The Federal Statistical Office sample

[6] The success of the TV channel RTLplus, with David Hasselhoff as the channel's first superstar, is a testament of an exogenously triggered increase in TV consumption, as nationwide market shares more than doubled in 1989 due to heavy TV consumption in just a few areas of the country (see Section 2).

[7] The German Federal Statistical Office conducts the EVS for various purposes, especially to inform public policies. For example, the data are used to determine the level of social benefits paid to welfare recipients in Germany. The EVS also has been the basis for numerous studies on savings and consumption (e.g. Fuchs-Schündeln 2008, Friehe and Mechtel 2014).

provides us with household expenses on components relevant to individual health, enabling us to investigate the consequences of TV consumption on health-related purchases.

In line with the historical background, we find that the reception of private TV significantly increases TV consumption. According to our time-use analysis, increased TV consumption due to private TV may reduce time spent on housework, suggesting a substitution effect between those two activities. For our main outcomes, we contradict previous findings on the consequences of TV. Individual happiness improves due to TV consumption in terms of life satisfaction, while individuals do not suffer health impairments from watching TV more often. Television consumption does not reduce health satisfaction nor does it lead to an increase in doctor visits. This main conclusion does not change when we inspect long-run effects in a dynamic treatment analysis by exploiting the longitudinal nature of our empirical setup. In fact, we can rule out negative health effects from television for a treatment period of several years.

Our contributions are multifaceted. First, we provide a textbook example of how a negative result from the literature is completely reversed with a credible empirical setting based on a historical coincidence. By juxtaposing different pieces of evidence, we offer an explanation for previous findings, which suggests there may be a self-selection of unhealthy or unhappy types of individuals among the group of intense TV viewers. In line with this, we can confirm robust negative associations between TV viewing and both health and life satisfaction in more recent data from our own complementary survey from 2015 . Second, we provide a new setting for research on the effects of TV based on a unique natural experiment that took place in a large and fully developed Western country, allowing generalizable findings from the relatively recent past. The setting further allows for longitudinal analyses of the long-run impacts of TV in a time window of several years, until regional disparities in access to private TV due to terrestrial frequencies became irrelevant.[8] Third, the data include information on possible behavioral changes, enabling us to empirically verify whether the new opportunity to watch TV due to technological advancements actually affected media consumption. The available time-use data reveal how individuals re-adjust their daily activities to have more time for watching TV, which is a novelty in the research on the causal impact of television in representative populations of adults. Moreover, consumption data inform us about the possible effects of television on health-

[8] The rise of Germany's No.1 private TV channel RTL ended in 1993, when market shares reached a historic peak (see Figure A1), suggesting that the channel could not substantially benefit from further growth in viewership as a result of increasing proliferation of cable and satellite. As receiving private TV via terrestrial frequencies became relevant for millions of Germans throughout the second half of 1988, our setting provides us with a treatment phase of roughly four years.

related behavior. Fourth, we complement ongoing research on TV consumption with policy-relevant findings on critical outcomes that have not received the attention that they arguably deserve from economists. Thereby, we contribute to the debate about the impact of media on society, which has mainly focused on the social costs and benefits, rather than the well-being of the individual. According to our results, TV watching does not appear to be an economic bad. Individuals seem to make a rational choice in the sense that television provides them with a benefit. This supports the notion of individual welfare maximization. While externalities for societies could be either positive or negative, our findings explain why, despite its possible social costs, TV consumption is one of the most popular activities.

The remainder of our paper is structured as follows. Section 2 illustrates the early phase of private TV in West Germany and describes the natural experiment (with supplementary details on the history in Appendix A). Section 3 explains the different datasets, including technical calculations of local TV signal reach (Appendix B provides supplementary information on technical details and checks). Section 4 presents a replication of earlier findings in the literature, and Section 5 contains the main results, including extensions and further analyses (with Appendix C providing more information on the EVS data and Appendix D offering supplementary output). Section 6 discusses the findings, with a focus on television content, to learn more about external validity. Section 7 concludes by illustrating the implications for public policy and provides alternative interpretations of our evidence, thereby addressing whether the proliferation of television could be seen as a success story or not.

2. Background

The historical development of commercial TV in West Germany involves a variety of different actors, such as media tycoons, politicians, some transmitter stations with limited reach, a TV superstar with a speaking car and Germany's Supreme Court. We focus in the following on the most relevant historical aspects to understand the occurrence of a true and original natural experiment in the center of Europe.[9]

Long before the rise of commercial TV in Europe, Germans were highly skeptical of television as a technology. Many Germans associated TV and its proliferation with the

[9] Harrison and List (2004) provide a nice and not-so-serious definition: "Natural experiments arise when the experimenter simply observes naturally occurring, controlled comparisons of one or more treatments with a baseline. The common feature of these experiments is serendipity: policy makers, nature, or television game-show producers conspire to generate these comparisons." As we document, the history of commercial TV in West Germany appears to contain all three of these ingredients. For a timeline of events (Figure A1) and documentation of the proliferation of TV in Germany based on excerpts from historical media reports, see Appendix A.

stultification of the masses (*Volksverdummung*), which could explain why there was no resistance to the legal ban of private TV for many decades. As a result of this consensus, TV only existed in a limited form, with only a few public TV channels. In contrast to other developed countries at the time, such as the United States, watching TV played a relatively minor role in West German citizens' daily lives, with two hours per day allowing for substantial increases in TV consumption (Oltmanns 1993). The television landscape started to change dramatically in the 1980s. Whereas the ban on private TV was based on the notion that terrestrial broadcasting via frequencies only allowed a limited number of media offers, the emergence of cable and satellite as alternative transmission avenues promised to dissolve this technical bottleneck. The prospect of overcoming the scarcity of transmission avenues due to these modern technological developments resulted in a 1981 decision by Germany's Supreme Court to lift the ban on private TV. Simultaneously, a new conservative federal government led by Chancellor Helmut Kohl decided to proliferate commercial TV in Germany, which contrasted starkly with the policies of the former social-democratic government that was poised to protect the monopoly of public TV.

When the first commercial TV channels debuted in Germany in 1984, only a few thousand households were able to watch the new programs. To quickly change this, the new conservative government tasked the Deutsche Bundespost with implementing commercial TV. However, this public institution failed to provide new TV channels to German households in a timely manner and was ultimately dismantled in 1994. The Bundespost focused on cable as the preferred avenue for reaching potential TV consumers, and invested heavily in what critics called a "billion-dollar grave". In the late 1980s, only a minority of Germans watched private TV via cable, and satellite TV was not yet an option. Consequently, there were several years during which both politicians who supported private TV and officials from emerging TV channels had an incentive to find an alternative way to reach German households. While politicians were interested in having good relations with the media, media companies sought a first-mover advantage in an emerging and growing media landscape in one of Europe's most economically relevant countries. It soon became clear that there was a simple solution: terrestrial frequencies on public-media transmitter stations that were not yet in use.

It was apparent, however, that powerful frequencies were extremely rare, since most of those frequencies were in use by public media broadcasts for which the stations were built. The stations that could be used for private TV in the late 1980s were mainly constructed in the 1960s

to provide the country with a second public TV channel following a 1961 Supreme Court decision. Due to the ban of private TV, it was unforeseeable during the construction phase that there would be a strong commercial desire for more frequencies decades later. Therefore, almost all of the powerful terrestrial frequencies with significant reach were in use by public media broadcasts in the late 1980s. There were only a few stations that coincidentally happened to still have an open slot in the form of a frequency with significant power.

Apart from the technical limitation of the availability of powerful frequencies, there was also a legal constraint on the expansion of terrestrial broadcasting. According to a 1961 Supreme Court decision, the management of Germany's network of transmitter stations was seen as a politically sensitive issue, and hence the building of new stations was a public task that should be organized independently of political influences. In consequence, no commercial TV provider had a legal option to expand on the existing network of transmitter stations.

Powerful frequencies ensured that all TV viewers could watch the program, independent of technical equipment, which was not necessarily the case with low-power frequencies.[10] At the state level, German politicians realized the importance of these frequencies in reaching a significant number of households, and they allowed the use of the remaining public-media frequencies for non-public TV. To illustrate, consider the densely populated federal state of North Rhine-Westphalia (NRW), where available frequencies were called "juicy" by the media due to their extraordinary desirability. Private TV channel representatives applied for those frequencies to the state government, which would decide on frequency usage. Following the allocation of frequencies to TV companies in 1988, millions of citizens in some western regions of NRW were suddenly able to watch commercial TV via antenna because they lived close enough to a transmitting station. At the same time, other citizens – including those in the eastern parts of NRW – were unable to receive the terrestrial signal. Favoritism played a role in our context, as it did in other empirical TV settings, such as in Brazil (see La Ferrara et al. 2012), as media tycoons exerted enormous efforts to convince state officials to receive frequencies. However, such favoritism only influenced *which* commercial TV provider received the "juicy" frequency, not *whether* a powerful frequency was technically available or not. This was determined by ex-ante predetermined factors and the coincidence of still available capacities at

[10] Figure D1 depicts a 1980s TV set with an indoor antenna. Such devices allowed individuals in West Germany to watch television broadcasts via powerful terrestrial signals at the time.

transmitter stations built many years earlier for the sole purpose of public TV and radio broadcasts.

--- Figure 1 about here ---

Figure 1 shows the private TV signal reach across West Germany in 1989.[11] Due to signal reach limitations, naturally emerging borders split the country into potential receiver (colored) and non-receiver (not colored) areas. In addition to the NRW frequencies in the West, there were private TV frequencies in use in the North of Germany, and there were some smaller areas throughout Germany where receiving private TV via terrestrial frequencies was technically possible. In each case, it is an empirical question whether the signals had a significant impact on individual TV consumption.

The year 1989 was pivotal in the proliferation of commercial TV in Germany. Among various competitors, RTLplus became the country's number one private TV channel that year and remained at the top for decades. The channel's market share reached 10% (KEK 1998), which was very high considering that only a minority of German households could watch it.[12] The program organizers behind RTLplus were able to establish their own superstar, David Hasselhoff, with a popular TV show called *Knight Rider*.[13] Sat.1, Germany's number two commercial TV channel, did not do as well. While the owner, Leo Kirch, received some frequencies in northern Germany, he had less success in the state of NRW. The situation in 1989 was even worse for Tele5, the third private TV broadcast owned by Italian media tycoon Silvio Berlusconi. Tele5 did not receive any of the major frequencies (see Table D1).

[11] This graphical illustration is a product of our calculations and the work of a graphic designer. Patterns in this illustration align with those in ad hoc maps for single frequencies drawn by technical experts and shown to us. Through personal communications with leading experts in the topic of terrestrial frequencies in Germany, we discovered that there is no exact calculation of access patterns describing the reach of private TV in Germany so far. As a result, we are the first to complete this laborious task of determining the signal reach for terrestrial frequencies, which were used to broadcast private TV in the late 1980s and early 1990s. Table D1 provides details on the most powerful and hence most relevant active private TV frequencies in 1989 (with at least a power of 10kW). The channels started broadcasting in the months preceding that year's SOEP field work phase. In addition to these powerful frequencies, we collected data on over sixty minor frequencies (with power of less than 10kW). While additional low-power frequencies started broadcasting in the years after 1989, there was little change in terms of powerful frequencies, underlining the importance of 1989 for private TV in Germany.

[12] Based on our calculations using SOEP data, we find that the terrestrial RTLplus signals could reach roughly a third of Germany's population. As documented in Appendix A, satellite and cable TV only played a minor, if any, role at the time.

[13] *Knight Rider*, like many other shows, was produced in the United States and dubbed into German. An intriguing aspect of David Hasselhoff's success story in Germany was that the actor's popularity on RTLplus allowed him to start a music career. Although the public media did not play his music at that time, he reached the top of Germany's music charts in April 1989.

Given the importance of terrestrial frequencies, it is not surprising that media companies demanded more frequencies and even new transmitter stations. However, it was legally impossible to build additional transmitter stations to reach more German households with private TV. The legal framework was clear: the construction of stations was only allowed for public media broadcasts. Given that the Supreme Court justified the revision of the ban on private TV based on new technical developments that made it possible to go beyond terrestrial broadcasting, commercial TV channels could only receive slots on public-media transmitters that were still open. Attempts by these commercial TV providers to expand terrestrial TV in Germany were thus doomed to fail, and they did. In particular, Silvio Berlusconi exerted enormous efforts to expand terrestrial television in Germany for his channel Tele5 but ultimately failed. He sold his shares during the 1990s when he left the German TV market.[14]

3. Data

3.1 TV Signals

We obtained original documents about terrestrial frequencies for West German television and radio from the NDR (*Norddeutscher Rundfunk*), which is located in Hamburg, Germany. We use the Wittsmoor lists as the first source of information. These annual overviews of all active frequencies in West Germany are available throughout our investigation period in the late 1980s and early 1990s, and they include basic facts such as the effective radiated power (ERP) in kilowatts (kW). While related studies have used the 1989 Wittsmoor list for geographically precise investigations into the effects of terrestrial TV signals from Western stations broadcasting public TV to East German households (Crabtree et al. 2015, Bursztyn and Cantoni 2016), we are the first to consider information on private TV channels within West Germany by constructing a longitudinal dataset on signal reach. We benefit from additional information since we could obtain official records of the terrestrial frequencies on which private television was broadcasted. These records contain detailed information on the frequency, including the month when the private TV broadcast started, and on the transmitting station, including height and geographic position. Finally, we are also the first to collect information on antenna patterns of the terrestrial frequencies, which we received from Germany's Federal Network Agency.

[14] As part of our historical documentation (Appendix A), several media reports covered Berlusconi's remarkable role in the German TV market. He first tried to convince officials in NRW to get the powerful frequencies, and then offered to expand Germany's terrestrial frequency network; yet, both attempts were unsuccessful.

Since patterns can differ substantially across stations, this information improves precision when calculating TV signal reach.[15]

To determine TV signal reach, we employ the Communication System Planning Tool (CSPT), which was developed for the U.S. Department of Defense. As an add-on to the geographic analysis software ArcGIS, the CSPT calculates signal reach using the Longley-Rice signal propagation model. To consider geographical information for the entire country of West Germany, we rely on digital maps incorporated in ArcGis version 9.3 with a resolution of 1,000 meters. Thereby, our TV signal calculation takes topographic aspects of the terrain into account, such as mountains and the Earth's curvature.

The signal calculation procedure aims to determine whether or not a TV signal from a transmitter reached a region in West Germany. For this purpose, we obtained additional digital maps that allow us to identify the borders of both counties and municipalities in West Germany.[16] We first determine the signal strength for each square kilometer in West Germany. Then, we aggregate this information at the regional level. We thereby obtain a mean value for each region, be it a municipality or a county. This average signal strength value allows us to determine whether individuals in a given region are likely able to watch a certain TV channel on their TV set.[17]

Two technical thresholds are relevant for distinguishing treatment regions with and without access to terrestrial private TV. The first parameter is the minimum signal strength (dBuV/m) at which a region is considered to be capable of receiving a TV signal. In our analysis, the default value is 50 dBuV/m.[18] The second parameter is the frequency's underlying kW power. In this regard, Bursztyn and Cantoni (2016) consider ERP values of at least 100kW in their analysis of Western public TV signals in East Germany. Arguably, less powerful frequencies could only reach East German areas close to the West German border that already had Western TV on more powerful frequencies. In our case of West Germany, low-power frequencies could in principle reach households, so we pay special attention to the minimum ERP parameter.

[15] For example, a transmitter station can send out its signal with the exact same strength in all directions or the signal can be aimed at a certain direction. See Figure D2 for an exemplary antenna pattern of the Wesel frequency on which RTLplus was broadcast. The signal was mainly directed to the south-east, away from Dutch territory to the North and West of Wesel, and instead targeting parts of the populated Ruhrgebiet area.

[16] We use the German Federal Agency for Cartography and Geodesy's oldest available border files from 1997.

[17] We thereby follow Bursztyn and Cantoni's (2016) procedure. To illustrate the result of this procedure, Figures D3 and D4 depict maps for the signal reach of the most powerful RTLplus frequency (on the transmitter station Wesel) at the county and municipality levels. In addition to averaging all cell values within a region, we also determine the median of all the signal strength values within a region as an alternative measure. Our findings are insensitive to this decision (Table B1).

[18] As discussed in Appendix B, the main results are robust when using alternative threshold values (Table B2).

Based on the historical records, one could consider 20kW of ERP as a suitable threshold for defining a powerful and thus relevant frequency, which would be in line with the media attention paid to NRW's "juicy" frequencies (see Section 2). According to available technical documents, the historic media coverage on the case of NRW referred to transmitting stations in Wesel (200kW) and Düsseldorf (20kW). Given that the power of the latter frequency was below usual ERP levels of public TV broadcasts, for which most TV antennas in the 1980s were configured, we inspect how results change as the ERP threshold increases. By excluding comparatively weaker frequencies, we can ascertain which signals actually did affect TV consumption during our investigation period.

Finally, we consider the start information for any private TV channel on each frequency to establish our longitudinal data on TV signal reach. This dataset includes binary signal variables for each region and year in our main investigation period from 1987 to 1992, indicating whether or not a region-year received a private TV signal.[19] The information on start dates reveals that most of the relevant private TV channels with significant power began broadcasting in 1988 after the annual SOEP fieldwork phase, which establishes 1989 as the first post-treatment year.[20]

3.2 The German Socio-Economic Panel (SOEP)

The main data source is Germany's largest ongoing panel survey: the German Socio-Economic Panel (Wagner et al. 2007). Since 1984, the organizers of the SOEP investigate the lives of thousands of people each year to provide representative data for Germany's adult population. Fieldwork happens primarily in the first few months of each year when interviewers visit participating households at the end of winter.[21] Prior to the reunification, West Germany had over 300 counties, each with varying numbers of SOEP participants. To identify the impact of television on individual outcomes, we combine our longitudinal data on private TV signal reach

[19] We prefer a dummy variable for TV signal reception instead of a linear signal strength. See Appendix B for more information and sensitivity analyses (Table B3).

[20] Table D1 provides information on private TV frequencies with signals of at least 10kW power in the spring of 1989, reflecting the situation following the annual SOEP fieldwork phase of that year. Based on the broadcast start dates, SOEP participants in 1989 could be considered treated if they lived in counties reached by private TV signals, whereas no treatment had occurred when they were interviewed during the 1988 SOEP fieldwork phase. See Appendix B for a discussion of sensitivity analyses, where we consider 1988 as the first treatment year for a few cases of SOEP interviewees who were interviewed extremely late. Assigning these latecomers as treated in both 1988 and 1989 does not change our main results (Table B4).

[21] Given the timing of SOEP interviews, the events surrounding the fall of the Berlin wall in late 1989 have no bearing in our main analysis from 1987 to 1989. Notably, we focus on West Germany, which in our definition always excludes (West) Berlin.

with SOEP data at the county-year level.[22]

The SOEP provides researchers with subjective self-assessments of the respondents who report their health ("How satisfied are you with your health?") and life satisfaction ("How satisfied are you with your life, all things considered?"). We pay particular attention to these two variables, which are routinely asked in each SOEP questionnaire with the same question wording and answer categories. Respondents in the SOEP always assess their satisfaction levels on a scale ranging from 0 ("completely dissatisfied") to 10 ("completely satisfied"). To further examine the implications for individual health, the SOEP includes information on doctor visits by participants in the three months preceding the interview.[23] Another health-specific outcome variable in the SOEP is the number of hospital stays reported by participants for the entire year prior to the annual interview. Because this question was not included in the 1990 questionnaire, we have no information on hospital stays for the crucial year of 1989. This variable is not used in our main analysis, but we provide supplementary analyses in which we adjust the time window of our investigation.

To investigate individual daily time-use changes due to private TV reception, we exploit the SOEP time-use battery. This survey module contains information about the number of hours an individual engages per day in different activities, such as childcare (Table D2). Respondents report the number of hours spent on each activity during a typical workday (including Saturday) and Sundays. We cumulate the hours reported for the workday multiplied by six and add the reported hours for Sunday to obtain weekly time-use measures for all activities. Furthermore, we analyze the time remaining after subtracting the sum of all reported hours spent on all activities from a 24-hour day and interpret this residual as sleeping time.

In contrast to recent SOEP waves, the time-use battery contained an item called "Watching TV, Video" until 1989. We use the responses from this item to establish a manipulation variable called "TV consumption" based on a broad understanding of television that includes watching

[22] Regional identifiers are available for data users after signing a special agreement with the SOEP organizers. Regional data analyses are possible via remote access using SOEPremote and on-site at the DIW Berlin. For the analysis in this paper, we use SOEP version 29 (doi:10.5684/soep.v29). The results are robust when employing a more recent SOEP version.

[23] In 1988, the question on doctor visits in the SOEP was altered. Before 1988, participants could respond that they had visited no doctors or different types of doctors (dentist, etc.). Since 1988, the SOEP has aggregated all doctor visits without distinction between the types of doctors: "Have you visited doctors in the last 3 months? If yes, please indicate how often." For the pre-1988 data, we aggregate all cases of different types of doctor visits to generate a variable that represents the total number of doctor visits. Due to 11 different doctor categories, this exercise leads to a relatively large number of missing values. Using year fixed-effects, ameliorates this issue. Note that we also use the binary indicator for having visited any doctor that is not subject to this missing-value issue.

videos.[24] A potential caveat of the time-use information is its hour-based measurement. Changes of half an hour, for instance, may go unreported. Given the negative views and social stigma attached to watching TV in Germany, especially during the time of our investigation (Appendix A), it is possible that individuals chose to stick to their reported hours of TV consumption from the previous interview and did not increase their self-reports even if they were watching more due to the sudden availability of commercial TV. We believe that merging the workday and Sunday information mitigates this issue somewhat, because reporting on having watched TV on a weekend rather than during the week may be less stigmatizing. However, we still expect changes in TV consumption to be underreported.[25]

Table D2 shows descriptive statistics for the main sample from 1987 to 1989. We expand this period beyond 1989 to allow for additional reduced-form analyses without the TV consumption variable (see Section 5.6). To allow for clustering of standard errors at the regional level, we ensure that our analysis is not affected by individuals moving between regions. Therefore, we exclude cases in which individuals moved between counties during the investigation period and require that each person be observed in the same county in which they lived in 1989. In Appendix B, we discuss this sample restriction and provide robustness checks.[26]

--- Table 1 about here ---

Table 1 shows the characteristics of SOEP respondents across treatment and control regions for the three years of our main investigation phase. For private TV signals with 20kW power or higher, there are a few significant differences. For example, we observe that individuals living in treatment regions appear to be more educated on average than those in control regions (see left-side columns of Table 1). One could argue that differences of about 0.2 education years are small and only reach statistical significance due to large sample sizes. Nevertheless, comparing

[24] At the time, Germans mainly used video recorders to watch self-recorded TV shows and movies, if they had one. According to EVS data, the majority did not own such a device in 1988 (ca. 70% of households).

[25] Self-reported time-use data on TV consumption typically reveal much lower estimates of watching behavior in comparison to electronic measures for the same population (Frey et al. 2007). In contrast, electronic measures may result in over-reporting due to individuals who activate the TV in the background while not actively watching or listening. In Appendix B, we discuss sensitivity analyses for the time-use variable definition, showing that TV consumption is indeed more heavily affected on Sunday than during the workweek.

[26] Selective relocations are not an issue in the context of our natural experiment on private TV signals via terrestrial frequencies. This is because of i) the social stigma associated with (private) TV in Germany (see Appendix A), ii) the uncertainty surrounding private TV on terrestrial frequencies, and iii) the fact that everyone in Germany could eventually expect to be able to watch private TV. To the best of our knowledge, there has never been a case of a person moving from one place to another within Germany to watch private TV.

results for TV signals with at least 20kW versus 200kW (see right-side columns of Table 1) provides a clear picture of which frequencies are more likely exogenous in our setting and hence more useful as an instrument. The empirical evidence in Table 1 conforms to historical circumstances documented in the 1980s media coverage (Appendix A), according to which some low-power frequencies were not used by private TV, albeit being available, due to politically motivated actions. Randomization is more plausible for a high-powered TV signal that provided private TV in some regions either by chance or not. While our t-test results in the last column of Table 1 support this notion, we also acknowledge minor sensitivity concerning the variable definition and test method, which leads us to be cautious about making strong claims regarding perfect balancedness.[27] We exploit the data's existing panel structure to ensure that potential differences in characteristics between individuals living in treatment and control regions do not affect the results.

3.3 German Income and Expenditure Sample and Own Survey

In addition to the SOEP, we use the German Income and Expenditure Sample (*Einkommens- und Verbrauchsstichprobe* [EVS]) from the late 1980s and early 1990s.[28] Every five years, the German Federal Statistical Office requests detailed income and consumption behavior data from tens of thousands of representative German households. The data contain a variety of different expenditure items, including health-related products and services. To investigate possible differences in behavior due to exposure to private TV signals, we merge the EVS data with TV signal information at the municipality level. In Appendix C, we describe the process in detail, including limitations, and discuss the results of a complementary TV signal check, for which we use information on the number of TV sets in the household.

We further conducted a representative telephone survey of the German public on the topic of television in 2015. One goal of this survey was to obtain data from individuals about TV program content perceptions in Germany and to assess differences between public and private TV (see Section 6). Another objective of the survey was to gather fresh evidence on the link

[27] Since there are no children in most of the households (see Table D2), we prefer using a dummy variable for having or not having children in the household in our empirical analysis rather than considering the number of children. Replacing the former with the latter would yield a statistically significant difference in the last column of Table 1 for 1987, but only when employing a t-test, not when using a Kruskal-Wallis test as an alternative that is less susceptible to outlier values. Notably, for the variables in Table 1, the Kruskal-Wallis test generally produces p-values that are rather similar to those from t-tests, especially for the 200kW instrument.

[28] We rely on data from the 1988 EVS wave (*Grundfile* 1) and the 1993 EVS wave (*Grundfile* 7). The Research Data Center of Germany's Federal Statistical Office prepared the 1988 dataset specifically for this project to allow for analyses at the municipality level.

between watching television and well-being. As a complementary analysis, we inspect the recent associations between self-reported hours of TV consumption and life satisfaction as well as health satisfaction as the two dependent variables in the next section.

4. Reproducing Findings From the Literature

4.1 Model

In a first analysis, we use data from our 2015 survey and the SOEP for a preliminary correlational inspection. This allows us to juxtapose the evidence based on SOEP data from the 1980s with recent evidence on the association between well-being and TV consumption. We use the following model to test correlations and also the role of individual fixed-effects:

$$Well\ Being_{it} = \vartheta_0 + \vartheta_i \mathbb{1}(\text{FE}) + \vartheta_1 TV\ Watching_{it} + u_{it} \quad (1)$$

Initially, we employ a simple ordinary least squares (OLS) regression to link TV consumption to outcomes that reflect individual well-being (i.e. health and life satisfaction). For our survey, the fixed-effects indicator $\mathbb{1}(\text{FE})$ is zero. When we use the SOEP's longitudinal structure, we transition to a fixed-effects model with the binary $\mathbb{1}(\text{FE})$ set to one to control for individual time-invariant characteristics.

4.2 Results

Panel A of Table 2 shows the relationship between TV watching and satisfaction outcomes from our 2015 survey (see Table D3 for sample statistics). Consistent with the literature, we find that higher TV consumption is linked to lower health satisfaction and life satisfaction scores on average. The results imply that zero TV consumption is connected to the highest satisfaction scores. Adding covariates does not qualitatively change this finding.

--- Table 2 about here ---

Panel B of Table 2 shows empirical relationships between TV watching and well-being for SOEP participants in the 1980s that are similar to those in our 2015 survey. Again, more TV watching hours correlate with reduced life satisfaction and health satisfaction. Furthermore, this aligns with evidence of increased health problems as captured by doctor visit data. When we add covariates, the results do not change substantially, but they do when fixed-effects are included. Only the effect on health satisfaction remains weakly significant, whereas all other

results are inconsistent with the idea that TV viewing had negative effects on well-being. While this demonstrates the importance of considering time-invariant characteristics when analyzing differences in health and happiness, our findings also indicate a self-selection phenomenon. Accordingly, unhappy and unhealthy types of individuals are overrepresented among more intense TV viewers. Since the endogeneity between TV watching and well-being cannot be addressed by an even more comprehensive set of covariates, we turn to the private TV signal from the natural experiment.

5. Exploiting Exogenous Variation in TV Watching

5.1 Model

To identify the causal effect of TV on well-being, we exploit differential timing and geographical occurrence of new TV signals through an instrumental variable (IV) fixed-effects approach:

$$TV\ Watching_{it} = \rho_0 + \rho_i + \rho_t + \rho_1 Private\ TV_{it} + \epsilon_{it} \quad (2)$$

$$Well\text{-}Being_{it} = \gamma_0 + \gamma_i + \gamma_t + \gamma_1 Private\ TV_{it} + \eta_{it} \quad (3)$$

In the first stage of our model, we regress TV watching on the private TV signal (2), and in the reduced form, we use health and happiness indicators as dependent variables (3). To calculate the local average treatment effect of TV watching on well-being, we only use the exogenous variation of $TV\ \widehat{Watching}_{it}$ from the private TV signal, assuming that the TV signal only affects well-being through TV watching:

$$Well\text{-}Being_{it} = \beta_0 + \beta_i + \beta_t + \beta_1 TV\ \widehat{Watching}_{it} + u_{it} \quad (4)$$

By employing individual fixed-effects ($\rho_i, \gamma_i, \beta_i$), we exploit individual changes in private TV reception, resulting in individuals watching more or less TV. We routinely control for any time trend in well-being or TV watching using time fixed-effects ($\rho_t, \gamma_t, \beta_t$). As a further step, adding covariates to the model allows for a sensitivity check of the results across different specifications.

In the following, we conduct first-stage regressions to examine how different definitions of our instrument affect time-use, before turning to reduced-form and IV results for our main

outcomes. Afterward, we discuss the exclusion restriction underlying the IV analysis and present the results of several sensitivity analyses.

5.2 Time-Use

Table 3 shows the manipulation of TV consumption through potential instruments of access to private TV. In line with historical market shares of German TV channels in the late 1980s, having the opportunity to watch terrestrial private TV channels increases the time spent watching TV. This finding is robust when adding covariates in column two. The first definition of our private TV instrument in row one includes the two big NRW frequencies (see Section 3). Row two presents the results based on all private TV frequencies, including those with very low power. Regions with lower kW receptions are excluded from the definition of the instrument in the rows below. While considering all frequencies shows a significant effect, varying the kW threshold of frequency power sequentially reveals that more power generally increases the hours watched from below 0.9 hours per week for all frequencies to more than 1.5 hours per week for the most powerful frequency of 200kW.[29] As our preferred instrument, we focus in the following on the strongest TV signals of 200kW ERP, which not only allows for the strongest manipulation of TV consumption but is also consistent with our insights from the above check of balancedness (Section 3.2) and with evidence from the EVS based on TV ownership as a manipulation variable (Appendix C).

--- Table 3 about here ---

In Figure 2, we expand our time-use analysis to include other activities. For comparison, we include TV consumption as part of the seven time-use items, with the residual interpreted as hours of sleep. We find no changes in the residual, which contradicts the idea that individuals substitute sleep with increased TV viewing. The same is true for child care, work, training, repairs, and hobbies. This suggests that respondents differentiate between hobbies and TV watching since the latter increases significantly. The second significant finding in Figure 2 is that access to private TV leads to a reduction of about one and a half hours of time spent on

[29] The results of this analysis are similar when we employ the aforementioned month-based instead of year-based treatment identification for private TV. For this purpose, we redefine the treatment status for SOEP respondents who lived in treatment counties and were interviewed extraordinarily late in 1988 after the annual fieldwork phase. Thanks to our longitudinal approach using several waves of SOEP data, we can easily implement this check by shifting the treatment start from 1989 to 1988 for those few respondents (N=10) who could have started watching private TV shortly before their 1988 interview.

housework per week. While TV signals are unlikely to affect this activity other than through the effect of watching TV, the results suggest that housework could be a possible substitute. This interpretation is supported further by the observation of a similar effect size for housework compared to the increase in TV hours.

--- Figure 2 about here ---

5.3 Main Results

Table 4 presents the intent-to-treat effects of TV on individual well-being. We regress well-being indicators on TV signal receipt in an individual fixed effects model as shown in column one. In column two, we add covariates. The results show no evidence of any health impairments from the health satisfaction measure due to the opportunity to watch more TV. Similarly, getting a terrestrial private TV signal has no effect on both visiting the doctor and the number of doctoral visits.

--- Table 4 about here ---

Table 4 also shows the effect of TV signal reception on life satisfaction. Here, we obtain a significantly positive effect that is robust to the inclusion of covariates. Receiving private TV increases individual happiness, which contradicts previous research findings as well as our initial correlates (Section 4.2). Overall, unhappy individuals in poor health seem to self-select themselves into the group of intensive-viewers. When this selection problem is removed, television appears irrelevant for health conditions and even benefits individual happiness.

--- Table 5 about here ---

Table 5 displays local average treatment effects via IV fixed-effects estimations. We use the occurrence of private TV signals via terrestrial frequencies as an instrument for endogenous TV consumption. Across all three health indicators and regardless of specification, we find no effect on individual health from watching more TV, rejecting the expectation of corresponding health impairments. As indicated by the F statistics, this zero result is not due to weak manipulation of TV watching. The life satisfaction result supports the idea that exogenously manipulated increases in TV consumption improve individual happiness; and it is robust to the addition of covariates. One more hour of TV consumption per week increases the score by more than 0.18

points. To put that into perspective, happiness research based on SOEP data shows reductions in life satisfaction when individuals become unemployed, with effect sizes varying roughly between 0.5 and 1 on the 11-point scale (Clark et al. 2008, Kassenboehmer and Haisken-DeNew 2009, Chadi 2010). This suggests that increasing TV consumption by about 3 to 5 weekly hours could compensate the unemployed for their loss of happiness.

5.4 Discussion of Exclusion Restriction and Sensitivity Analyses

The IV results are valid under the assumption that TV consumption is the only channel through which the television signal affects well-being. We discuss possible violations of this exclusion restriction, including ideas that may be to some extent speculative, before we provide a summary of sensitivity analyses for our main results.

First, the program on private TV may be politically biased in favor of those who were more likely to receive a certain channel. Given the historical incidence (Appendix A), one might speculate that people became happier due to political favoritism and hence had more politically convenient news coverage in their region. However, as we point out below in Section 6, politics was certainly not the focus of commercial TV organizers, but instead fiction-based entertainment offers predominated in their programs.[30] Second, there could be a direct health effect linked to TV signals and possible radiation. While research on electro-magnetic radiation is often plagued by endogeneity and data issues, some studies indicate possible health risks (Zamanian and Hardiman 2005). However, even if those health concerns were justified, radiation unlikely plays a role in our findings since individuals are only exposed to additional signals from transmitter stations that already broadcasted public media programs on even more powerful frequencies.[31] Furthermore, our results consistently show that health is not reduced in regions with private TV signal reception via terrestrial frequencies. Third, one might conjecture that the probability of receiving TV signals on powerful frequencies was higher in areas far from East Germany, whereas people living near the border experienced increased uncertainty surrounding the political situation in the neighboring country during our investigation period.

[30] We conduct an empirical test by identifying SOEP respondents who have self-reported preferences for political parties. Subgroup analyses (in the vein of those conducted in Section 5.5) reveal no evidence of effect heterogeneity, which contradicts the idea that political bias plays a role in our findings.

[31] Consider the case of the Wesel transmitter station, which was built during the 1960s construction phase to establish Germany's second public TV channel ZDF (see Figure A1). The Wesel station had more powerful frequencies than the frequency, on which RTLplus was broadcast in the late 1980s. In line with our historical documentation (Appendix A), public media programs had priority, whereas RTLplus received a remaining but still quite powerful 200kW frequency. Given the station's historical relevance, the Wesel transmitter (*Sender* Wesel) is covered on Wikipedia, where additional information can be found.

However, as discussed in Appendix B, our sensitivity analyses show that excluding regions at the border does not lead to different findings, increasing our confidence that the exclusion restriction holds.

We further conduct a series of checks that demonstrate the robustness of our main findings (see Appendix B). First, we employ several methods to calculate TV signals as alternatives to averaging square-kilometer raster values at the county level (Table B1). Second, we increase the signal threshold for counties defined as treatment regions in four steps, from 50 dBuV/m to 65 dBuV/m (Table B2). Third, we examine our decision to use signal strength thresholds for a binary distinction between treatment and control regions by employing a linear signal strength variable (Table B3). Fourth, we replace our year-based treatment assignment with a month-based identification, allowing us to consider particular late interviewees in 1988 as treated by private TV (Table B4). Fifth, we vary the sample definition to minimize the likelihood of households in control regions receiving private TV channels through alternative ways, for example by excluding counties that potentially received television signals on low-powered frequencies for a check with 'clean' control regions (Table B5). Sixth, we inspect our empirical procedure concerning individuals who moved between regions during our investigation period (Table B6). Seventh, we expand our model by adding control variables such as survey factors, including the weekday of the interview and weather conditions (Table B7). Finally, we examine whether the definition of key variables is important and perform quantile-based analyses for TV consumption and both satisfaction variables (Table B8). We conclude from all of the additional analyses that the results are highly robust and confirm our main finding: TV makes people happy, not unhappy.

5.5 Effect Heterogeneity

We further investigate our main finding by examining groups that may be affected differentially by the television treatment. Previous research on well-being considers females and young adults as particular interesting subgroups of TV viewers, since commercial broadcasters target audiences who are potentially more susceptible to advertisements than others (Benesch et al. 2010). Motivated by recent TV research (e.g. Durante et al. 2019), we further examine differences between low and high educated individuals, testing the idea of private TV as light entertainment for the uneducated. We also distinguish between households with children versus those without, given that private TV may be particularly attractive to parents with minors.

--- Table 6 about here ---

Table 6 presents the evidence for possible subsample differences in the effect of television on life satisfaction. A comparison of the point estimates for gender indicates that the happiness effect of private TV access may be driven by females. While such a finding would be informative in light of research on women's empowerment via TV (Jensen and Oster 2009), a direct test using interaction terms yields no statistically significant difference. Similarly, it appears that our main finding is not driven by one specific age group. Due to its target audience of young individuals, it is interesting to observe that the effect of private TV is quite strong for older individuals. In terms of education, our subgroup analysis reveals no clear effect heterogeneity. Higher-educated individuals respond less positively to private TV than lower educated, but the effect is still significant for this subgroup. Thus, the evidence counters the notion that TV is some type of light entertainment and, in turn, only for the poorly educated. This is interesting in light of research on children's cognitive development that shows negative effects of private TV in more educated families (Hernæs et al. 2019). Finally, the happiness effect is especially strong for those living in a household with children, which is consistent with the hypothesis that families with children may benefit from television since they can replace other forms of spending time with their children by watching TV together. However, given that the effect is also significant for households without children, such substitution effect cannot explain the overall improvement in individual life satisfaction caused by TV. Considering that direct tests via interaction terms reject the idea of significant effect heterogeneity in all the cases, we conclude that the happiness-increasing effect of TV is remarkably robust and rather independent of individual background.

5.6 Extension of Time Period

An interesting question is whether the happiness effect is short- or long-term in nature. Recall that we focus on the main phase of 1987 to 1989, since the SOEP time-use battery does not include information on TV consumption beyond 1989. Therefore, we are restricted in our efforts to inspect the long-term effects of private TV exposure via terrestrial frequencies, but we can expand the data for supplementary intent-to-treat analyses using our main outcomes variables as before and private TV access as the independent variable without considering a manipulation variable. By extending the investigation until 1992, we add several treatment years via terrestrial TV signals prior to the time when private TV became universally accessible

across Germany. Furthermore, we add data from the survey waves of 1985 and 1986 to raise the number of treatment-free years without private TV signals for both control and treatment regions, allowing for a balanced number of treatment and control years. In line with our short-run analysis, we also exclude individuals who moved between counties within the investigation period for our long-run analysis.

--- Figure 3 about here ---

Based on a dynamic reduced-form regression analysis, Figure 3 displays the dynamic evolution of intent-to-treat coefficients for the individual well-being measures that are continuously available in the SOEP across years. To allow for an investigation into possible long-run effects of TV, we define intent-to-treat regions as those with a private TV signal in 1989. Panel A shows that receiving private TV has no negative effect on health satisfaction across all four treatment years in comparison to the 1988 baseline. The illustration even suggests minor positive effects that are not instantaneous but seem to grow slowly and reach statistical significance in the final year of the investigation period. In contrast, Panel B shows that the positive life-satisfaction effect of private TV sets in immediately in 1989, which is in line with our short-run results. Except for 1991, the happiness effect is continuously strong and positive, with no evidence for a fading-out, despite the increased availability of private TV via cable and satellite in the control regions.[32]

The results in Figure 3 indicate that the happiness effect of TV is not a short-term phenomenon. Individuals did not appear to just watch private TV simply because it was initially a novel and exciting experience for them. Concerning health, the results are clear evidence against the hypothesis that TV viewing increases individual sickness. Despite a year-long TV treatment effect in our setting, this did not seem to be the case. Conversely, our evidence on health satisfaction raises the question of whether television may even improve individual health. One interpretation is that increases in life satisfaction have a positive spillover impact on health as happier individuals may be more immune to psychological issues such as depression.[33] This

[32] Historical circumstances may be relevant in understanding the life-satisfaction effect of private TV in 1991, a year marked by major conflicts. While tensions in Yugoslavia increased severely, setting the stage for war and, ultimately, the country's disintegration, the Gulf War in Iraq was another major conflict that drew considerable attention in Germany. Given its focus on entertainment (see Section 6), it is possible that the potential of private TV to make people happier was limited during a time when hundreds of thousands of Germans marched in protest, while the SOEP fieldwork phase of 1991 was taking place.

[33] See Argyle (1997) on the idea of happiness as a cause of health by highlighting the role of positive moods.

interpretation is amplified by the visual evidence in Figure 3, which shows that the positive life-satisfaction effect happens first, and positive health-satisfaction effects trail behind.

In a complementary intent-to-treat analysis using a single treatment dummy for living in a region with private TV via terrestrial frequencies, we again find a significant happiness effect. We also find a weakly significant health-satisfaction effect. As shown in Table D4, the effect sizes for both outcome variables are highly similar. In the course of this analysis, we pay special attention to regions potentially receiving private TV on low-powered frequencies, which could be an issue in such a long-run analysis. While only powerful TV signals appear to be relevant for TV consumption in our short-run analysis (see Section 5.2), individuals in low-power signal areas may start watching private TV over time, e.g. by modifying their TV configuration. Nevertheless, the results hardly change when we consider only 'clean' control regions, i.e. control counties without any private TV signals independent of power.[34]

In the same vein, we use other health measures from the SOEP to conduct additional analyses of possible long-run effects, as depicted in Table D5. Panel A reveals that the measures for doctor visits (i.e. visited a doctor, number of doctor visits) remain unaffected when we exploit two additional years of TV treatment. By using our long panel, we can now also analyze information on hospital stays, which are available for two treatment years and may reflect strong disparities in individual health. Panel B shows that television has no significant effects on ill-health, independent of the chosen definition (i.e. incidence of a hospital visit, number of hospital visits). While these findings do not provide additional support for the idea of positive health effects, it is important to consider that going to the hospital or visiting a doctor is usually a consequence of severe health problems. For example, variation in health due to mood changes might not be reflected in such indicators of ill-health. Importantly, we conclude that the evidence against detrimental long-run health effects is now well-grounded on a variety of different indicators. In the following subsection, we further discuss the possibility of positive (or negative) health effects due to television by turning to a different dataset.

[34] In an additional analysis, we only consider individuals as treated when they lived in counties with high-powered private TV signals in 1989. While the long-run analysis in Table D4 (contrary to the analysis in Figure 3) also considers individuals as treated when they lived in counties with high-powered private TV signals starting after 1989, this had no bearing on our findings. In fact, during our investigation period, there was only one such case, namely in Kassel, where a transmitter station started broadcasting 200kW-powered private TV signals in the 1990s, reaching a few rather unpopulated areas not far from the East German border. In another analysis, we prolong the treatment phase for another year. When we add data from 1993, the results hold.

5.7 Health-Related Expenditures

We proceed by investigating the effects of private TV exposure on consumer activities in the EVS data. Using the EVS waves of 1988 and 1993, we analyze potential changes in outcomes reported by individuals in different municipalities over time. Individuals in municipalities receiving private TV on a powerful terrestrial frequency that began broadcasting in the late 1980s are compared to individuals in municipalities that were not receiving such a powerful signal then. Our main outcomes are informative about health-related behaviors and are examined using the following difference-in-differences model:

$$Expenditures_{it} = \delta_0 + \delta_1 Private\ TV + \delta_2 \mathbb{1}(1993)_{it} + \delta_3 Private\ TV \times \mathbb{1}(1993)_{it} + \zeta_{it} \qquad (5)$$

We deviate from the models used in our SOEP analysis since we cannot consider individual fixed-effects when analyzing two waves of the EVS due to its repeated cross-sectional nature. Nevertheless, we examine possible pre-treatment differences between regions and consider them in the regression analysis. Furthermore, we check the robustness of our findings for only 'clean' control regions by excluding municipalities that either received signals from transmitters on less powerful frequencies or only received powerful signals for a part of the time period.[35] To reaffirm the definition of the TV signal regarding power and signal strength, we use information on TV set ownership as an alternative indicator for changes in TV consumption in additional analyses. We find evidence in favor of successful manipulation via terrestrial TV signals (see Tables C1 and C2), as with our analysis of SOEP time-use data.

To understand the possible effects of TV on individual health, we analyze household expenditures on various health-related products and services, such as doctoral services. Assuming that sick individuals pay more to get better, increased expenditures on services by doctors could indicate poor health. However, such expenditures may also reflect increased health awareness. Further expenditure items promise to shed light on these mechanisms. In particular, pharmaceutical products may serve as a health proxy, assuming that individuals primarily pay for pharmaceuticals if they are truly ill.

--- Table 7 about here ---

[35] Excluding low-power frequency regions may be important in the EVS analysis due to the increased geographical precision of TV signal identification. As analyzed in the SOEP, a low-power signal may be insufficient in some cases to affect outcomes countywide, but within counties, at the municipality level, such local frequencies may have an impact.

Table 7's column one demonstrates that annual expenditures for doctoral services were significantly higher in 1993 compared to 5 years earlier (row one), whereas in 1988, there were no visible differences in such expenditures between treatment and control regions of private TV (row two). For the main effect of private TV on services by doctors, we observe a weakly significant effect in the main data (row three), which becomes slightly stronger and significant at the 5% level for the smaller dataset with only clean control regions in column two. Given the zero result for the number of doctor visits in the SOEP, one possible interpretation is that individuals in the treatment regions went to the doctor for more serious health issues and thus had to pay more. However, despite the possibility of underestimation underlying our EVS analysis (see Appendix C), several points contradict such a conclusion in favor of a significant ill-health effect from watching TV. First, the effect size is extremely small. An increase of 60 Deutsche Mark (DM), the currency back then, translates into roughly 45 Euro in 2020, when accounting for inflation, which is not much for expenditures by year. Second, the effect is not particularly robust. Using additional household information from the EVS as covariates in our regression model renders the effect insignificant, and the same is true when we add region fixed-effects using dummy variables for all municipalities. Finally, and most importantly, since most Germans are covered by the social healthcare system, they pay fixed contributions and do not have to pay directly for most doctor services. Hence, instead of increased use of common doctor services, the effect could be due to a change in the type of services requested, as a possible result of higher awareness for specific health concerns advertised on TV.

Further evidence from employing the same approach on other EVS variables in Table 7 supports the notion of increased health awareness rather than health problems, as a consequence of watching private TV. On the one hand, if treated individuals went to the doctor because of severe health issues, we would have expected to see similar evidence for pharmaceutical products. However, the results do not support this. If at all, there seems to be a reduction in expenditures on pharmaceuticals, which even becomes statistically significant when clean control regions are used. On the other hand, individuals in treatment regions spent more on skin and body care products as well as on private health insurance. Both could be influenced by watching more advertisements on private TV than public TV and indicate higher health awareness.

Regarding the evidence on pharmaceutical products, it is worth noting that our starting hypothesis was that TV reduces health. The EVS data analysis did not support this premise,

which is in line with our findings based on the SOEP data. Given our results, another interpretation is that TV increases individual health, for example, by improving mood. Indeed, if we assume that, independent of health status, expenditures on pharmaceuticals rise separately because of increased drug advertising on private TV, we may be underestimating the favorable effects on individual health. In the absence of further evidence, we conclude that positive health impacts of TV are possible.

6. Discussion

To learn more about the generalizability of our results, we discuss the content of TV programs watched by millions of Germans in the late 1980s. One may argue that commercial TV in West Germany differs from other types of television, such as television in the United States, and that it is a very specific form of TV. However, there is a strong similarity to U.S. television for entertainment content, as viewers of channels such as RTLplus often watched movies and series that originated in the United States (e.g. the hit series *A-Team* or the top movie *E.T.*). A more difficult question is whether commercial TV in West Germany differed substantially from public TV, which could aid in understanding our positive result for life satisfaction.

Research on commercial and public TV finds some differences in content analyses for 1980s programming. According to Krüger (1989), information-related programs on the two major public TV channels had a higher share of the total content (ARD: 33.5%, ZDF: 39.8%) than their main competitors in commercial TV (Sat.1: 26.0%, RTLplus: 22.4%). Instead, entertainment offers based on fiction were more prevalent in private TV (Sat.1: 50.6%, RTLplus: 49.3%) than in public TV (ARD: 30.8%, ZDF: 30.0%). This seemed to be what German TV consumers particularly liked about commercial TV, according to research based on early cable-TV projects in the 1980s, which shows how viewers focused on entertainment programs, albeit not solely (Hasebrink 1989).[36] While public broadcasts in Germany follow a mandate to educate the public as justification to collect fees, private TV channels have agreed to include some political content with an educational purpose.[37] As a result, private TV in

[36] Indirect evidence for the claim of very similar program offers between public and private TV, both focusing on light entertainment, can be derived from studies on political protest in East Germany (Kern and Hainmueller 2009, Kern 2011, Crabtree et al. 2015). This research detects no anti-communist propaganda effect from receiving Western public TV in regions close to the Western border, which indicates that the ideological effect was offset by a general reduction in political activity through entertainment television.

[37] Commercial TV providers dedicate parts of their programs to sophisticated political and cultural topics. Apart from image concerns, broadcasters such as RTLplus agreed to air shows such as *Spiegel TV* to convince skeptics in the political sphere who opposed private TV and its proliferation in Germany (see Appendix A).

Germany shares some characteristics with public TV and differs mainly in that it is even more similar to the television offerings that people watch in the United States.

This narrative of private TV as light entertainment with some additional sophisticated content, akin to public TV in Germany, is empirically supported. First, our subgroup analysis in Section 5.5 illustrates that private TV appeal to not just individuals of low educational level in Germany. Second, in our own survey in 2015, Germans provide information about the role of private TV and its program quality compared to public broadcasters. Accordingly, only a minority of 40.8% believe that public broadcasts fulfil their educational mandate. As this mandate is the basis for the compulsory charging of TV license fees in Germany, it is not surprising that many respondents deviate from the actual level of pay when answering a question about the level of justifiable fees. Four out of five respondents consider levels justified that are lower than the actual fees. Around a fifth do not want any fees at all and, therefore, seem to support the abolition of publicly financed TV in Germany. In response to a third survey question on possible differences between public and private TV, half of respondents disagree by saying either "yes" the program quality is similar or that this is the case "more or less" (29.7% and 21.1%, respectively). While we cannot discern which direction the other half of the respondents perceived differences, this provides further credence that many German TV viewers do not perceive a quality premium of public compared to commercial broadcasters.

In summary, our evidence suggests that individual perceptions of private and public TV in Germany do not differ substantially, raising the question of whether there were any specifics in our setting that can explain the positive life satisfaction effect. Given the low expectations and negative attitudes toward commercial TV, a novelty effect seems plausible (see Appendix A). However, our long-run analysis in Section 5.6 rejects this idea, leaving us with the simple explanation that television, in general, can facilitate increases in individual happiness.

7. Conclusion

Despite a considerable body of research on the economic and social impact of television, no study has provided a sufficient answer to the question of why individuals watch so intensely. We reconcile the observation that watching TV is one of the most important activities of humans with the basic idea that individuals make rational decisions that are not to the detriment of their well-being. In fact, our study shows that individuals do not incur health impairments from watching TV, and they certainly do not experience unhappiness as a result. Quite the

contrary, based on our evidence from a natural experiment in West Germany, we can answer the question "Does watching TV make us happy?" (Frey et al. 2007) with a simple "Yes."

Our findings seem to convey a highly positive story. First, we can reject claims that watching TV is necessarily bad for health and hence a major public-policy concern. While we want to be clear that our study does not inform about the lifelong consequences of excessive TV viewing, we argue that increases in TV consumption of one or two hours per week, even for longer periods, do not threaten individual health. Second, our study is the first to provide evidence on a happiness-increasing effect of television, which is good news if one considers maximizing national happiness as a public policy goal. Accordingly, television seems to be an inexpensive and effective policy instrument. Furthermore, the attractiveness of TV, as demonstrated in our study, allows it to be used to influence individual views and behavior, as implied or explicitly suggested in research on edutainment offers (Kearney and Levine, 2019) and development policies (La Ferrara, 2016).

Having said this, one could also draw very different policy conclusions. In fact, given the manipulative nature of TV, as demonstrated in research on political bias (DellaVigna and Kaplan 2007, Enikolopov et al. 2011, Durante et al. 2019), our findings explain why individuals struggle to resist the TV set since it makes them happy without inducing any apparent and immediate costs linked to ill-health. Our results also help us understand the paradox discovered in the research on West German television in East Germany, where viewers of anti-communist West TV were surprisingly not less supportive of their own regime. The term "opium for the masses" chosen by political scientists Kern and Hainmueller (2009), accurately describes how television, according to our results, increases individual happiness to such an extent that it could help stabilize a political system in decline even if it is under ideological attack by the very same TV program. In consequence, there is reason to concur with skeptics of TV, such as Germany's former Chancellor Helmut Schmidt, who once described television as "dangerous" (Appendix A). Therefore, another interpretation of our finding on life satisfaction is that individuals maximize their own welfare, while TV consumption leads to negative externalities. This narrative is reinforced by the variety of findings on TV affecting social outcomes, as listed in the introduction. Moreover, the effects of TV on the family in the form of higher divorce rates and even lower fertility (Boenisch and Hyll 2015) may be particularly important in developed countries such as Germany, which face major demographic and economic challenges as a result of historically low birth rates. Intriguingly, all the examples of possible negative

externalities were pointed out as drawbacks of television by those attempting to defend West Germany's national ban on private TV. While the failure of the proponents of the ban led to a unique and fascinating natural experiment, one may wonder now whether the proliferation of television has made people happier at the expense of the very consequences that TV skeptics warned about long ago.

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Figure 1 Private TV via terrestrial frequencies in West Germany of 1989

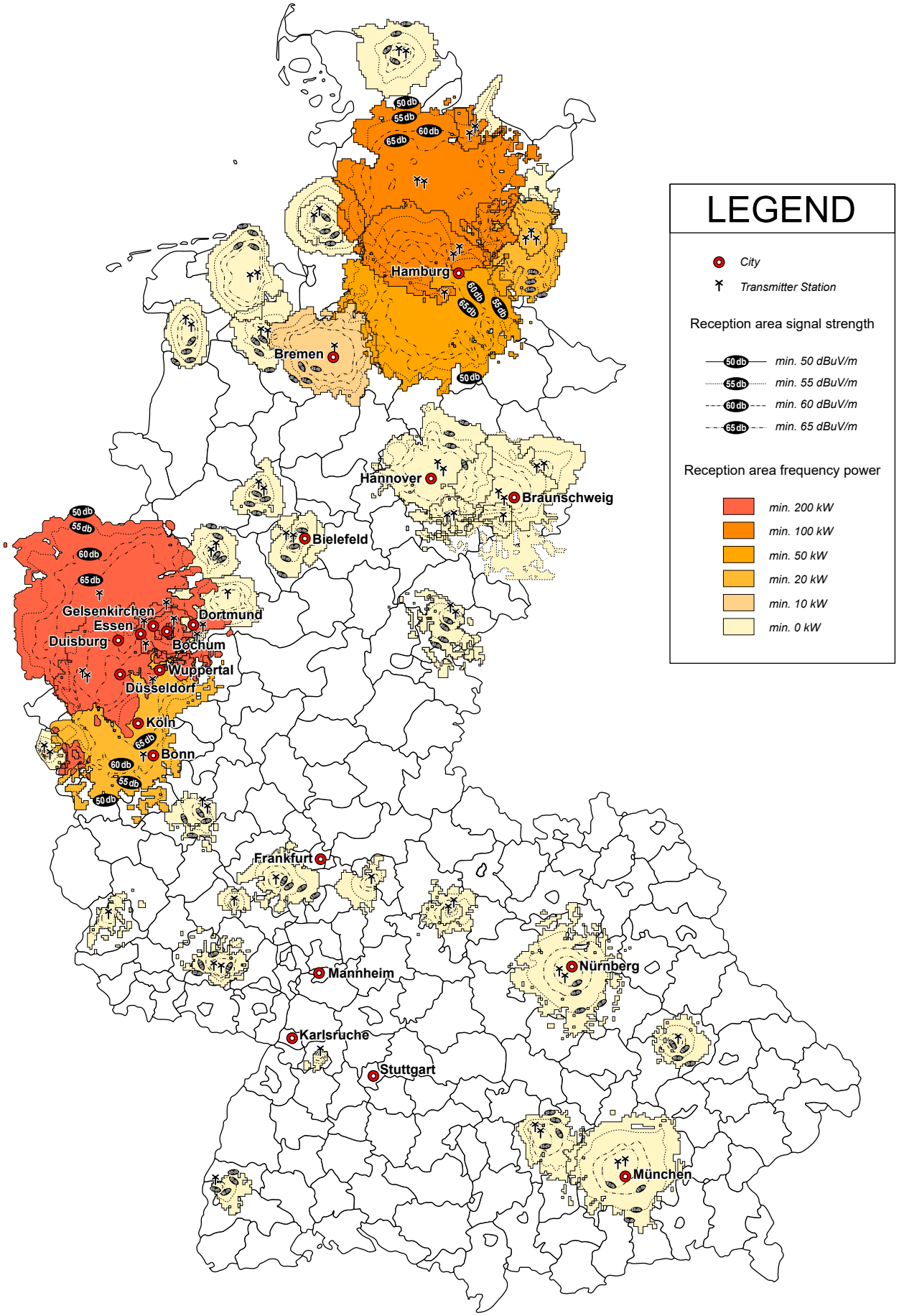
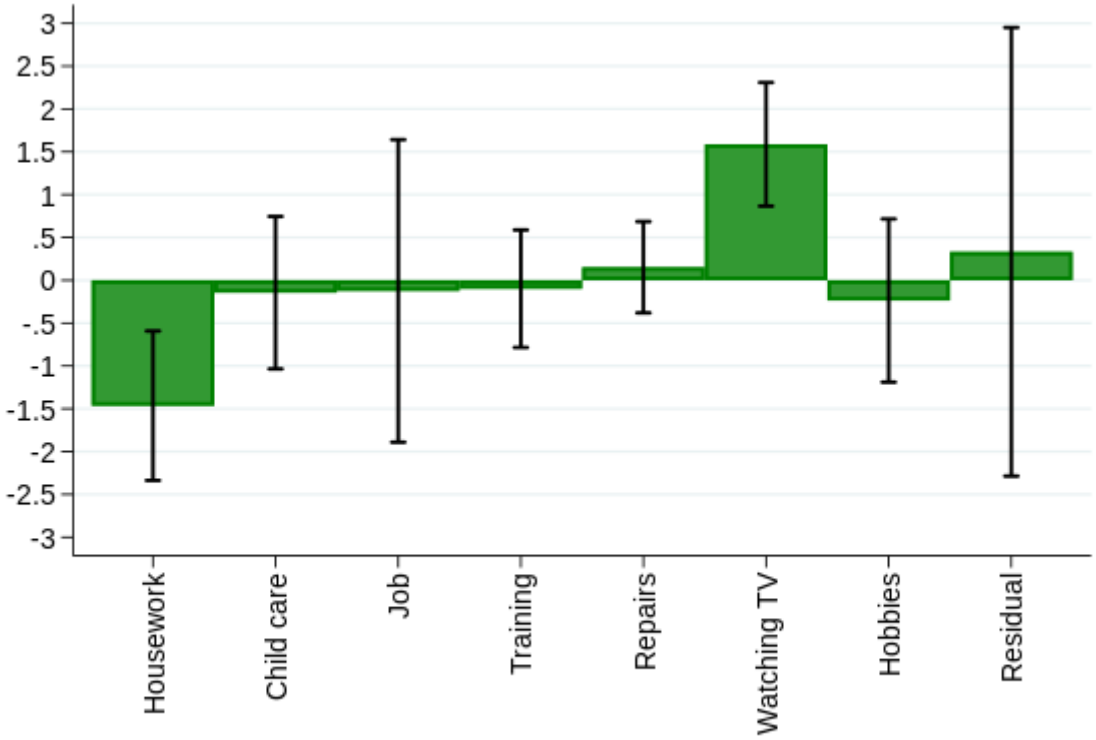


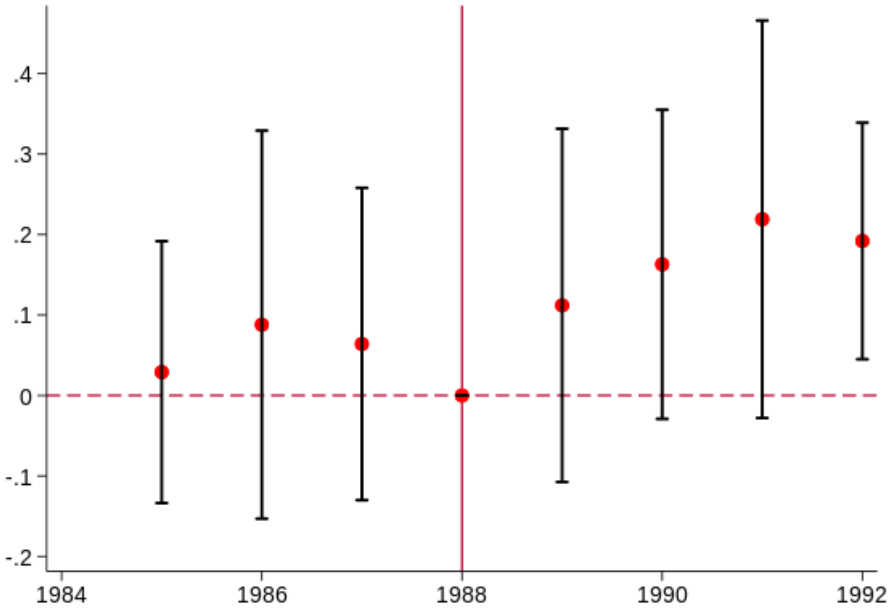
Figure 2 Private TV Signal and Time-Use



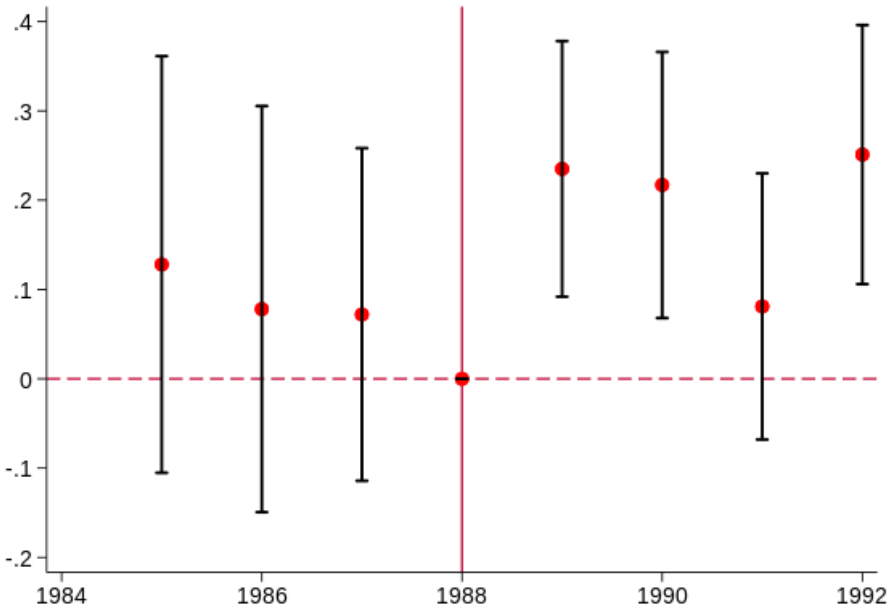
Notes: The figure shows the results of separate linear regressions with individual fixed-effects. The dependent variables reflect time in hours per week that a person spends on various activities taken from the SOEP time-use battery, with the exception of the residual time variable (which is 24 times 7 minus the total sum of all seven activities). The explanatory variable is living in a county with 200kW-powered private TV signals. Each specification includes year fixed-effects. Standard errors are clustered at the county level. 95 percent confidence interval levels are displayed.
Source: SOEP data are from 1987 to 1989.

Figure 3 Dynamic Analysis of Private TV Signal Effects on Well-Being

A. Health satisfaction



B. Life satisfaction



Notes: The illustrations are based on a dynamic effects reduced form model with individual and year fixed-effects that show intent-to-treat coefficients for receiving the 200kW private TV signal in 1989 and onward. Standard errors are clustered at the county level. 95 percent confidence intervals are shown. Life and health satisfaction are both measured on a scale ranging from 0 ("completely dissatisfied") to 10 ("completely satisfied").
Source: SOEP data are from 1985 to 1992.

Table 1 Individual Characteristics in Private TV Regions and Control Regions Across Years

	20kW Private TV			200kW Private TV		
	No Signal	**Signal**	**t-test (p-value)**	**No Signal**	**Signal**	**t-test (p-value)**
1987						
Female	0.50	0.51	0.271	0.50	0.51	0.554
Age	42.24	41.78	0.349	42.24	41.35	0.182
German nationality	0.74	0.77	0.016	0.75	0.73	0.175
Household size	3.30	3.09	0.000	3.26	3.22	0.609
Household with children	0.45	0.43	0.213	0.44	0.47	0.244
Married	0.68	0.64	0.016	0.67	0.67	0.925
Divorced	0.03	0.05	0.000	0.03	0.04	0.394
Widowed	0.05	0.06	0.187	0.05	0.06	0.316
Education	10.53	10.74	0.003	10.58	10.55	0.736
Apprenticeship	0.04	0.04	0.941	0.04	0.04	0.901
Income	7.42	7.38	0.028	7.41	7.41	0.767
1988						
Female	0.50	0.52	0.291	0.50	0.51	0.792
Age	43.18	42.99	0.699	43.20	42.66	0.417
German nationality	0.74	0.78	0.001	0.75	0.75	0.940
Household size	3.25	3.06	0.000	3.21	3.19	0.703
Household with children	0.43	0.40	0.032	0.42	0.44	0.522
Married	0.68	0.65	0.029	0.67	0.69	0.405
Divorced	0.03	0.04	0.008	0.03	0.03	0.948
Widowed	0.06	0.07	0.187	0.06	0.06	0.597
Education	10.57	10.83	0.000	10.62	10.67	0.567
Apprenticeship	0.04	0.05	0.116	0.04	0.04	0.533
Income	7.44	7.43	0.404	7.44	7.45	0.507
1989						
Female	0.50	0.51	0.411	0.50	0.51	0.502
Age	43.34	42.88	0.361	43.33	42.52	0.231
German nationality	0.74	0.78	0.004	0.75	0.74	0.792
Household size	3.24	3.06	0.000	3.21	3.18	0.639
Household with children	0.42	0.39	0.051	0.41	0.43	0.312
Married	0.68	0.65	0.103	0.67	0.68	0.953
Divorced	0.03	0.04	0.038	0.03	0.03	0.664
Widowed	0.06	0.06	0.531	0.06	0.07	0.341
Education	10.59	10.83	0.001	10.64	10.66	0.836
Apprenticeship	0.04	0.04	0.884	0.04	0.04	0.655
Income	7.49	7.46	0.082	7.48	7.47	0.495
N	16,175	4,103		18,230	2,048	

Notes: The table shows mean characteristics and p-values from t-test comparisons of individuals who lived in counties with or without private TV signals in 1989. The minimum power of the frequencies considered in the table's left-side (right-side) columns is 20kW (200kW).
Source: SOEP data are from 1987 to 1989.

Table 2 TV Consumption and Well-Being Associations

Panel A) Own survey (2015)

	Health satisfaction		**Life satisfaction**	
Pooled OLS	-0.040***	-0.027***	-0.032***	-0.030***
	(0.008)	(0.009)	(0.006)	(0.006)
N	511	511	511	511
Covariates		YES		YES

Panel B) SOEP (1987–1989)

	Health satisfaction		**Life satisfaction**	
Pooled OLS	-0.022***	-0.011***	-0.007***	-0.004***
	(0.002)	(0.002)	(0.001)	(0.001)
Individual Fixed Effects	-0.004*	-0.004*	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
N	20,252	20,252	20,234	20,234
	Visited a doctor		**Doctor visits**	
Pooled OLS	0.001***	0.001*	0.029***	0.020***
	(0.000)	(0.000)	(0.004)	(0.004)
Individual Fixed Effects	0.000	0.000	0.005	0.006
	(0.001)	(0.001)	(0.006)	(0.007)
N	20,259	20, 259	16,619	16,619
Covariates		YES		YES

Notes: The explanatory variable is weekly TV consumption in hours. In Panel A, the dependent variables are health and life satisfaction on a 0-to-10 scale. The set of covariates includes gender, age, quadratic age, West German residence, and household size. In Panel B, the dependent variables are health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month in fixed-effects regressions (as well as female and age in pooled OLS regressions). Robust standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Sources: Own survey data are from 2015 (Panel A), and SOEP data are from 1987 to 1989 (Panel B).

Table 3 Effect of Private TV Signal on TV Consumption

	TV consumption	
Private TV: NRW frequencies	1.210*** (0.384)	1.237*** (0.377)
Private TV: all frequencies	0.854*** (0.296)	0.881*** (0.294)
Private TV: min 10kW	0.946*** (0.325)	0.971*** (0.322)
Private TV: min 20kW	0.983*** (0.337)	1.022*** (0.332)
Private TV: min 50kW	1.232*** (0.341)	1.282*** (0.335)
Private TV: min 100kW	1.267*** (0.388)	1.301*** (0.383)
Private TV: min 200kW	1.587*** (0.368)	1.628*** (0.361)
N	20,278	20,278
Covariates		YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variable is weekly TV consumption in hours. The explanatory variable is living in a county with private TV signals based on different definitions across rows. NRW frequencies include Düsseldorf and Wesel (see Table D1). Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table 4 Effect of Private TV on Well-Being

	Health satisfaction		**Life satisfaction**	
Private TV	0.101 (0.104)	0.096 (0.105)	0.291*** (0.078)	0.295*** (0.080)
N	20,252	20,252	20,234	20,234
	Visited a doctor		**Doctor visits**	
Private TV	-0.011 (0.017)	-0.011 (0.017)	0.152 (0.286)	0.140 (0.296)
N	20,259	20,259	16,619	16,619
Covariates		YES		YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table 5 Instrumental-Variable Effects of TV Consumption on Well-Being

	Health satisfaction		**Life satisfaction**	
TV consumption	0.064	0.059	0.184***	0.181***
	(0.063)	(0.063)	(0.065)	(0.064)
F	18.515	20.221	18.583	20.313
N	20,252	20,252	20, 234	20,234
	Visited a doctor		**Doctor visits**	
TV consumption	-0.007	-0.007	0.080	0.071
	(0.011)	(0.011)	(0.155)	(0.153)
F	18.818	20.547	25.561	29.343
N	20,259	20,259	16,619	16,619
Covariates		YES		YES

Notes: The table shows the results of instrumental-variable regressions with individual fixed-effects. The dependent variables are health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The instrumented explanatory variable is weekly TV consumption in hours. The instrument is living in a county with 200kW-powered TV signals. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. County-level clustered standard errors are in parentheses. The F-statistic result indicates the instrument's first stage power. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table 6 Effects of Private TV on Life Satisfaction Across Subgroups

	Life satisfaction			
Group:	Female	Male	Young	Old
Private TV	0.357*** (0.095)	0.221** (0.092)	0.280*** (0.079)	0.383*** (0.129)
N	10,163	10,071	13,381	6,853
Group:	Low education	High education	Household with children	Household without children
Private TV	0.324*** (0.114)	0.256** (0.100)	0.364*** (0.118)	0.240** (0.116)
N	12,840	7,394	8,630	11,604

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variable is life satisfaction on a 0-to-10 scale. Private TV is defined as living in a county with 200kW-powered TV signals. Each specification includes year fixed-effects. Subsamples are generated based on gender (female / male), age (young: <50 years of age / old: >=50 years of age), education (low: <11 years of education / high: >=11 years of education) and children in the household (yes / no). County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: SOEP data are from 1987 to 1989.

Table 7 Health-Related Expenditures

	Doctor services		**Pharmaceutical products**	
1993	158.128**	145.554**	-5.591	6.838
	(11.673)	(14.814)	(7.162)	(8.894)
Private TV	-7.107	17.123	-5.482	6.145
	(22.861)	(22.373)	(11.338)	(11.512)
1993 × Private TV	61.942*	74.516**	-21.229	-33.657**
	(32.521)	(33.778)	(15.670)	(16.534)
N	65,587	38,294	65,587	38,294
	Skin and body care products		**Private health insurance**	
1993	120.851**	115.600**	527.469**	508.630**
	(3.799)	(5.351)	(22.613)	(23.844)
Private TV	-12.124	-6.253	-43.378	-5.681
	(8.298)	(8.505)	(39.875)	(39.054)
1993 × Private TV	49.071**	54.322**	134.160**	152.999**
	(9.083)	(9.834)	(61.760)	(62.225)
N	65,587	38,294	65,587	38,294
Clean control regions		YES		YES

Notes: The table shows the results of difference-in-differences regression analyses. The dependent variables are annual expenditures (in DM): doctor services, pharmaceutical products, skin and body care products, and private health insurance contributions (including full insurance and additional insurance contributions). Private TV is defined as living in a municipality with 200kW-powered private TV signals in the late 1980s and onward. Clean control regions is a sample restriction that excludes from the set of control regions all municipalities with access to private TV on frequencies lower than 200kW or with access to private TV on 200kW-powered private TV signals that began broadcasting in the early 1990s. Municipality-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: EVS data are from 1988 and 1993.

Appendix A – Historical Details

In the following, we provide information on various aspects related to television in Germany, for which we have screened historic news coverage. These reports shed light on a) the German people's (negative) views on television, b) positions and interpretations of the German Supreme Court, and c) the (limited) proliferation of private TV in Germany in the late 1980s and early 1990s. Figure A1 shows a timeline of events and illustrates important phases of historical developments. We provide available online references and links to sources (checked on: September 14, 2019). It should be noted that the original documents are all in German.

a) Perception of (Private) Television in Germany and Political Debate

In our introductory quote, we referred to President Ursula von der Leyen of the European Commission, to illustrate what Germans think about television. This quote was taken from the October 12, 2006 episode of the ZDF TV talk show, *Berlin Mitte*, hosted by Maybrit Illner. At the time, von der Leyen was Germany's federal minister of family affairs. Her statement was well-received by the audience and can be seen on YouTube (www.youtube.com/watch?v=z0LMjPHSoNs).

Evidence for Germans' negative attitudes toward television is ubiquitous and dates back to the mid-20th century. An article in *DER SPIEGEL* on April 13, 1950 (https://www.spiegel.de/spiegel/print/d-44448169.html) entitled "TV Makes Stupid" (*Fernsehen macht dumm*) is an early example of media coverage on TV and its potential societal implications. This article, published in Germany's most widely read news magazine, informs about a severe decline in educational standards in Californian schools, which the article directly linked to the proliferation of television in the United States at the time.

DER SPIEGEL also covered the situation in Europe in the late 1970s, when citizens in countries such as Italy initially experienced private TV. A December 17, 1979 article (https://www.spiegel.de/spiegel/print/d-39685909.html) entitled "Private TV — More Stultification of the Masses?" (*Privatfernsehen: Nur noch Volksverdummung*?) refers to "porn shows with the beauties of the night" on Italian TV and concludes that since the public-media monopoly was lifted, television in Italy has degenerated into a family peep show. The article reporter compares this to how "American TV chains anesthetize their audiences around the clock." The article then continues to discuss the federal government's efforts under social-democratic Chancellor Helmut Schmidt to prevent private TV in Germany, citing, among others, leading social-democrat Egon Bahr, who warned of a "convenient end of democracy." Representatives of the other political camp, including Lower-Saxony's conservative Minister-President Ernst Albrecht (von der Leyen's father), argued for freedom of choice and appeared to disagree with the notion of stultification through the proliferation of private TV.

Another article in *DER SPIEGEL* dated October 10, 1979 (https://www.spiegel.de/spiegel/print/d-39868784.html) covers how the German federal government thought to keep the public-media monopoly intact. Accordingly, Chancellor Helmut Schmidt went so far as to describe private TV as "more acute and more dangerous than atomic energy." Schmidt was convinced that private TV "could change the structures of the

democratic society." Instead of promoting the proliferation of television, the chancellor suggested that a weekly television-free day would be beneficial. Federal government ministers, including Interior Minister Gerhart Baum, followed Schmidt's lead, seeing a need to "protect a humane democratic society against harmful influences of information overload and manipulation of public opinion," for which changes to the German constitution were considered. Concurring with this notion, Justice Minister Hans-Jochen Vogel argued that the freedom of information guaranteed by Article 5 of the Basic Law (Germany's de facto constitution) should be restricted by Article 6, which protects the family. Vogel stated, "We cannot allow information overload to destroy the privacy of the family."

Given all of this, it is no surprise that when private TV first appeared in Germany in the 1980s, the public was not enthusiastic. According to a survey conducted by *DER SPIEGEL* on August 1, 1983 (https://www.spiegel.de/spiegel/print/d-14018801.html), a clear majority of 70% of Germans considered the current public TV offer to be "sufficient," while only 5% regarded it as "necessary". Over the years, however, media coverage of private TV changed from a negative to a more positive tone. For example, *DER SPIEGEL* reported very positively on July 17, 1989 (https://www.spiegel.de/spiegel/print/d-13494730.html) on the success story of RTLplus, covering major sports event, such as Wimbledon with German tennis player Boris Becker, and getting record numbers of viewers. The same article also mentioned that German media corporation Bertelsmann, a partial owner of *DER SPIEGEL*, invested heavily in RTLplus (owning 38.9% of the shares). As a matter of fact, market shares of RTLplus have climbed steadily from almost zero in the mid-1980s to a historical peak of 18.9% in 1993, demonstrating its growing popularity. This is illustrated on the RTL Wikipedia page (https://de.wikipedia.org/wiki/RTL_Television), which also notes that limited access explains the channel's early market share development

b) Supreme Court Decisions and Interpretation

The 1981 Supreme Court Rule (BVerfGE 57, 295) created the "third broadcasting decision" (*3. Rundfunkentscheidung*), which enabled the proliferation of private TV in Germany. According to the original text (http://www.servat.unibe.ch/dfr/bv057295.html), there was a "special situation of broadcasting caused by the scarcity of transmission frequencies" that, in the eyes of the court, justified the public-media monopoly up to that point. During the introduction of private TV, the newspaper *DIE ZEIT* described the lifting of the ban in an article on March 30, 1983 (https://www.zeit.de/1984/01/kabel-frei):

> "Cable and satellite are nevertheless capable of revolutionizing electronic media. Both end the decade-long lack of television transmission. Just this technical bottleneck has always served as a final justification for the public service broadcasting system and for the political imperative to deny private access to this medium."

The Supreme Court's 1981 decision expanded on an earlier landmark decision from 1961 (BVerfGE 12, 205), i.e. the "first broadcasting decision" (*1. Rundfunkentscheidung*). In this decision (http://www.servat.unibe.ch/dfr/bv012205.html), Germany's Supreme Court confirmed the existence of a public-media monopoly. It also required an independent organization of frequencies for new public media outlets. The rule arose due to a heated conflict

in the late 1950s over Germany's second public TV broadcast, ZDF, which added to the first public TV channel, ARD (see Figure A1). One of Germany's major political parties, the social-democratic party, initiated this legal case to fight what was known as "Adenauer-TV" (in reference to the conservative chancellor) and meant federal government-controlled television. The Supreme Court shared the concerns of social democrats and called for the political independence of Germany's media organization. As a direct consequence of the Court rule, a Deutsche Bundespost sub-organization was in charge of the construction of new transmitter stations with the distinct purpose of providing frequencies for public media outlets, while state governments were in charge of frequency usage. Following the Supreme Court decision in 1961, stations for the new public TV channel ZDF were built. During that time, there was also a realistic prospect of additional public broadcasts, such as regional public TV programs at the state level and further radio programs. Given the uncertainty surrounding future public broadcasts, new transmitter stations built after 1961 had varying capacities for additional broadcasts, all of which were expected to be for public media during the construction phase.

When the Court paved the way for private TV in 1981, it stated that broadcasting restrictions could be "eliminated in the course of modern development" due to new technologies. However, the decision did not explicitly rule out the possibility of private TV channels using remaining terrestrial frequencies as an alternative to cable and satellite. Since the Court saw a scarcity of those terrestrial frequencies as the reason for the public monopoly, there was no expectation of many open frequencies. Therefore, for the few frequencies available in the 1980s, broadcasting private TV on them was legally possible as long as i) they were established for broadcasting public TV and ii) the state government, in which the station was located, agreed to allow private TV to be broadcast.

c) Private TV's Limited Reach: Cable, Satellite, and Terrestrial Frequencies

As a result of the legal framework established by Germany's Supreme Court, Helmut Kohl's federal government decided to roll out private TV in Germany via cable. Several pieces of evidence, however, document delays in the expansion of Germany's cable network. In 1984, a few days after the introduction of private TV in Germany, *DER SPIEGEL* reported on January 9 (https://www.spiegel.de/spiegel/print/d-13508379.html) that "Post Minister Schwarz-Schilling has lost track of his cable projects." The news magazine described miscalculations and unexpected costs in the cable rollout. On January 27, 1984, newspaper *DIE ZEIT* (https://www.zeit.de/1984/05/im-kabel-verfangen) headlined a report asking whether Schwarz-Schilling could become the Kohl government's "Minister of Crisis." In this report, a media expert described German cable TV as a "billion-dollar grave" that the Deutsche Bundespost will be unable to handle in the long run (which turned out to be a good prediction since this public institution was dismantled ten years later). On September 3, 1984, *DER SPIEGEL* ran the headline, "Cable TV: The Debacle is Here" (https://www.spiegel.de/spiegel/print/d-13509973.html) and detailed "miscalculation with billions, chaotic charges policy, gadgets with outdated technology: Christian Schwarz-Schilling brings the state-owned company Bundespost with his favorite project—cable global, television total—into financial difficulty." In consequence, from the early 1980s to the mid-1990s, the spread of cable TV across Germany

was extremely slow. As reported by the federal government, in response to a request in the German parliament, cable TV was unavailable in 85.2% of West German households in 1988. This figure included data from West Berlin, which had the highest state-level access rate with 31.6%. The cable access rate in the state of NRW was 11.8%. The German Wikipedia page (https://de.wikipedia.org/wiki/Kabelfernsehen) contains detailed figures for all federal states. Since German households had to pay a non-negligible sum for cable TV, actual use was even lower. On April 6, 1987, *DER SPIEGEL* (https://www.spiegel.de/spiegel/print/d-13521242.html) mentioned the problem of "high connection fees" for German households, of which only a third of those who could order cable TV did so. Two years later, the situation was hardly any different, according to an article from January 9, 1989, in *DER SPIEGEL* (https://www.spiegel.de/spiegel/print/d-13493795.html). According to the above Wikipedia page, in reference to Deutsche Telekom (a successor of the Bundespost), more than a third of all households still did not even have access to cable at the end of 1995.

The other option for private TV was satellite. While millions of German households still lacked access to cable television, watching private TV via their own satellite dishes became the norm for Germans throughout the 1990s. A July 1, 1988 news report in *DIE ZEIT* (https://www.zeit.de/1988/27/mami-hol-pudding) describes the situation in the 1980s and illustrates why satellite TV played practically no role in Germany for many years, again due to the activities of the Deutsche Bundespost. The article reports on a new direct-transmitting satellite that was announced as a possible supplement to cable but turned out "to be a total failure" after being launched and now "floats as a mummy in space" due to technical problems. According to *DIE ZEIT*, a successor satellite was planned for the following year, but it was unlikely to "bring more viewers to private programs" because of "a new transmission standard" that required a special decoder, a technology that was not even on the market at the time. It should be noted that due to large investments in cable, the Bundespost had strong incentives not to foster satellite TV as an alternative. In this context, the above-cited *DER SPIEGEL* article from September 3, 1984, is illuminating, as it describes the concern of the *Bundespost* that satellite could render all cable investments obsolete if it becomes the norm. The article reports Post Minister Schwarz-Schilling's efforts to prevent "satellite reception by anyone" so that Germans need cable to watch private TV.

Because satellite TV was not an option before the 1990s, and cable TV expansion was delayed, a time window of several years was created in which still available terrestrial frequencies were enormously important for private TV channels. However, in this time window there were only a few regions where German households could watch private TV via regular antennas. The limitation of these terrestrial frequencies was a direct result of the legal framework established by Germany's Supreme Court. The news coverage from the late 1980s, such as the above-referenced *DIE ZEIT* report from July 1988, demonstrate how the limitation worked in practice. The article describes how private TV channels in the state of NRW received the right to broadcast on terrestrial frequencies. Silvio Berlusconi, owner of Tele5, "jumped on the bandwagon at the last minute" to apply for the attractive terrestrial frequencies in this state. He realized that the cable network in Germany was "tight" and that terrestrial frequencies were thus essential for TV providers. NRW, with its history as a large, highly populated coal

producer, was the "key region" to determine the winner in the competition for market shares in the new TV landscape. To assuage NRW's social-democrat-run state government, Berlusconi promised a "quality program" and that he would "support the left" if he was given the "juicy" frequencies in NRW. Despite Berlusconi's efforts, the state of NRW preferred the channel RTLplus due to several "concessions" agreed upon by the owners, such as the Bertelsmann corporation. The channel started as a broadcaster from Luxembourg, but then decided to relocate to Cologne, the largest city in NRW. *DIE ZEIT* stated that the agreement "was worth it" since RTLplus could expect to reach "up to six and a half million viewers" as a result of being preferred in the competition for transmission frequencies. *DER SPIEGEL* also covered the NRW deal in a March 27, 1989 article (http://www.spiegel.de/spiegel/print/d-13495757.html), coining the term "juicy" to describe the powerful terrestrial frequencies in NRW (*die leckeren terrestrischen Frequenzen in Nordrhein-Westfalen*). The report emphasizes the importance of these powerful frequencies in reaching a large number of households and sheds light on other facets of the secret deal, which an insider referred to as a "crooked number."

The above-mentioned January 9, 1989, *DER SPIEGEL* article describes Silvio Berlusconi's efforts to overcome the restrictions on terrestrial frequencies . While his channel Tele5 was struggling to get frequencies, for Berlusconi, there was "no question" that an expansion of terrestrial frequencies was technically possible. Based on studies conducted by his technicians, Berlusconi was confident that a new network of transmitter stations could be "covering the entire territory" of Germany, in addition to the existing networks. *DER SPIEGEL* speculated about the prospects of these expansion plans, claiming that they "could suddenly bring the distressed commercial channel the economic breakthrough." Given the legal framework, however, it is not surprising that the German regulatory bureaucracy (*Aufsichtsbürokratie*) stopped such efforts. The Bundespost even tried to prevent Tele5 from getting available low-power frequencies. In consequence, Berlusconi sent a team of technical experts from Italy "on a journey across the Alps" to disprove false claims of the *Bundespost* that there were no available frequencies. While some local frequencies were later given to Tele5, the article further describes Berlusconi's failure to get one of the powerful frequencies. This was attributed to a lack of support for Berlusconi in German politics, especially among conservatives who thought that the Italian could sympathize with social democrats. All this happened as part of what *DER SPIEGEL* referred to as a "battle for the frequencies," a battle in which the Italian media tycoon ultimately conceded defeat.

Figure A1 Timeline: Proliferation of Commercial Television in West Germany

1952	Start of Germany's first public TV channel (ARD)
|	*One network of transmitter stations for terrestrial frequencies, no private TV allowed on stations*
1961	Supreme Court confirms public-media monopoly, requires state-free organization of broadcasting
|	*Construction phase of network of new transmitter stations for the second public TV channel (ZDF)*
1974	Social democrat Helmut Schmidt becomes chancellor
|	*Federal government defends monopoly of public TV and blocks cable TV projects*
1981	Supreme Court paves the way for private TV by referring to new technological developments
|	*Crisis of the federal government: Coalition between social democrats and liberal party falls apart*
1982	Conservative Helmut Kohl becomes chancellor
|	*Federal government pushes private TV and assigns Deutsche Bundespost to roll out private TV*
1984	Start of commercial TV in Germany
|	*Deutsche Bundespost fails to provide private TV to German households according to schedule*
1988	Private TV channels receive powerful terrestrial frequencies on public-media transmitters
|	*Divided country: Reception of private TV via antenna in some regions of Germany, not in others*
1993	RTL (formerly RTLplus) becomes Germany's No.1 TV channel with record market share of 18.9%
|	*Due to lack of cable access, many Germans prefer using satellite dishes to watch private TV*
1994	Deutsche Bundespost dismantled, cable TV still unavailable in many German households

Notes: The following abbreviations for TV channels are used in this table: *Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland* (ARD), *Zweites Deutsches Fernsehen* (ZDF), and *Radio Télévision Luxembourg* (RTL). RTL's organizers dropped the "plus" from the channel's name on November 1, 1992. See KEK (1998, p. 43) for information on market shares of TV channels in Germany.

Appendix B – Sensitivity Analyses

In the following, we discuss the results from a plethora of sensitivity analyses that we conduct for our main analysis based on SOEP data. We shed light on the following aspects: a) determination of regions receiving private TV signals (i.e. calculation method, signal strength thresholds, linear signal strength instrument, and month-based treatment identification), b) sample restrictions (i.e. regions considered in the analysis, and movers exclusion), c) additional covariates, and d) alternative definitions of our main variables.

a) TV Signal Treatment

We start our sensitivity analyses by inspecting whether the method of TV signal calculation could affect the results. Table B1 provides a check for the aggregation method of regional signal strength information. In our main analysis, we use the most precise method by first determining average signal strength values based on a one square kilometer raster calculation and then averaging all of these raster values within a county's territory to establish the county mean. For comparison, this is displayed in column (1). Column (2) shows that switching from the mean to the median of all raster values within a county's territory does not alter the results at all. This is because the set of treatment regions remains the same in this case. We also calculated the signal strength at the municipality and county levels without the raster. For the county level, we determine the signal strength either at the geographical center of the region or at the population center. This information is derived from a geo service and reflects the inner city of a county's largest town. The latter is also used to define signal strength at the municipality level. To use this population-center information on signal strength at the municipality level for our SOEP-based analysis at the county level, we aggregate municipality-based signal values either as the mean (i.e. the average signal strength across all municipalities within a county) or as the median (i.e. median signal strength across all municipalities within a county). Columns (3) and (4) reveal that the results are robust in both cases, whereas switching between mean and median aggregation again makes no difference. Finally, when we employ the least precise calculations based on one signal value per county in columns (5) and (6), we find that the coefficients of the TV signals using the population center are still remarkably robust while using the geographic mean within a county leads to a slightly weaker manipulation of TV consumption. This indicates the importance of considering the population's location when determining TV signal reach at the regional level.

Second, we inspect the role of the minimum signal strength level in defining treatment and control regions. By varying the threshold from 50 dBuV/m to 65 dBuV/m stepwise, we become decreasingly optimistic regarding the reach of TV signals for German households, since higher values in dBuV/m are needed to pass the threshold. Table B2 shows that increasing the signal threshold does not change the results. Closer inspection reveals that the results in columns (1) and (2) are the same. This is because there is no county with an average signal strength between 50 dBuV/m and 55 dBuV/m, whereas some counties drop out of the treatment regions when the threshold in columns (3) and (4) is further increased. Nevertheless, the results are quite

robust, as both TV consumption and life satisfaction are significantly increased in treatment regions for any of the threshold values, while individual health is not impaired in any case.

Third, we inspect the role of using signal strength thresholds in a binary manner as opposed to interpreting signal strength linearly. Given that TV signal quality does not increase linearly with signal strength but rather discontinuously, as pointed out in related research (Bursztyn and Cantoni 2016), one could argue that a household either receives or does not receive a program, with little happening in between. Nevertheless, to assess this empirically, Table B3 shows the results for a linear variable of signal strength in dBuV/m. We also vary the use of our set of covariates, as we do for our main results in the paper. The results in columns (3) and (4) conform qualitatively to the results established via a binary treatment indicator, as shown in columns (1) and (2).

Fourth, we examine our decision to consider 1989 as the first treatment year for all SOEP participants, despite the possibility that some respondents started watching private TV shortly before the 1988 interview. The use of year-based assignment simplifies the analysis and ensures that all treated individuals in our setting received private TV for at least several months. Furthermore, our assignment strategy is insensitive toward possible interview date selectivity. Hypothetically, participants may have been interviewed particularly late because of health problems during the regular fieldwork phase. Using the available information on both the interview month and the start of private TV broadcasts (Table D1), we identify ten cases of latecomers in the main dataset who were interviewed in treatment regions with private TV in July and August of 1988. For comparison, we re-assign those individuals as being treated also in 1988, in addition to receiving private TV treatment in 1989, whereas the survey year of 1987 continues to capture the pre-treatment situation for those re-assigned individuals. Table B4 compares the results of such month-based treatment assignment to our default year-based treatment assignment. We also vary the use of covariates. The month-based analysis in columns (3) and (4) confirms our main year-based treatment assignment results, as shown in columns (1) and (2).

b) Sample Restrictions

We check the robustness of our main findings in light of sample changes. Table B5 presents the results of sensitivity analyses in which we reduce the set of control regions by excluding counties with potential access to additional TV channels. Column (1) shows the results when we condition on clean control regions by excluding those that did not receive 200kW-powered TV signals but could have received TV signals on frequencies with less power if the signal strength determined for the county surpassed the minimum threshold of 50 dBuV/m. In column (2), we further cleanse the control regions by ensuring that no station transmitting private TV broadcasts via terrestrial frequencies is located in the county. Thereby we drop counties in which there were local frequencies for private TV with very low power (close to zero kW), so that the mean signal strength determined for the whole county did not reach the threshold of 50 dBuV/m. In column (3), we exclude all counties with early cable projects in the mid-1980s (Hasebrink 1989). Aside from Berlin (already excluded), these cable projects were carried out in Munich, Dortmund, and Ludwigshafen. The latter city is in the federal state of Rhineland-

Palatinate, which we exclude in column (4). While the government of that state was a strong advocate of private television, some citizens may have received RTLplus for free in the 1980s due to the border with Luxembourg, the channel's original location. In column (5), we drop data from big cities with about a million inhabitants, which includes, apart from Munich in the south, Hamburg in the north, and Cologne in the west of Germany. This test excludes individuals with generally higher chances of cable access. Finally, in column (6) we exclude all border regions where individual TV consumption may have been less affected by private TV because foreign TV was potentially available. By doing so, we exclude a few counties at the Dutch border that received private TV signals from the Wesel transmitter station. The table shows that all of the results are robust.

Table B6 provides checks for our sample restriction regarding individuals who moved between regions during our investigation period. Our main results in the paper are based on a mover restriction, as described in Section 3.2, where we include observations only if the same person is observed in the same county where they lived in 1989. The idea behind using 1989 as the reference year is to maximize the number of treatment observations, which implies having a left-skewed distribution of observations across years in our main sample. In column (1), we shift the reference year and include only individual observations if the person is observed in the same county where they lived in 1988. Column (2) repeats the analysis and adds our standard set of covariates. Column (3) shows the results of the strictest mover restriction, in which each individual is always observed within the same county throughout the investigation period. Balancing the sample in such a way results in a substantial loss of sample size. Furthermore, we consider our set of covariates in column (4). All of the results confirm our main findings.

c) Further Control Variables

Table B7 provides the results of analyses with different sets of covariates. Columns (1) and (2) show the main results with and without the standard control set. Column (3) displays the results when survey factors are considered, which include dummy variables for weekday of the interview and interview mode (i.e. whether the survey was administered orally by an interviewer or filled out by the survey participant). This test addresses possible measurement effects, which could be due to differences in TV consumption across weekdays or social-desirability bias, assuming that the presence of an interviewer affects self-reports of sensitive information (Conti and Pudney 2011). The results confirm our findings.

For another check of possible measurement effects, column (4) of Table B7 shows the results when controlling for weather factors, namely temperature and sunshine hours on the day of the interview as well as average temperature and average sunshine hours in the four weeks preceding the interview. To examine the role of weather influences in our results, we merge the SOEP data with a dataset prepared for a different project (see Chadi 2017, for more details), which was based on data from the German weather service. To combine datasets, we use region identifiers at the regional policy region (*Raumordnungsregion*) level, which is one level higher than the county level in Germany's regional hierarchy. At the time of our investigation, there were over 70 of these regions, each of which included at least one county (and four counties on average). In each regional policy region, there was a weather station for which we have daily

data on weather conditions, allowing us to combine SOEP data with data on regional weather conditions for each (interview) day. Our analysis shows that considering weather factors does not alter the main results, which holds when we also consider survey factors in column (5) and all sets of covariates simultaneously in column (6).

d) Alternative Variable Definitions

Table B8 depicts the results of analyses in which we inspect the definitions of our main dependent variables. We start with television consumption in Panel A. In the first step, we use the raw SOEP time-use variables, which are split into two categories: watching TV on a typical workday (including Saturday) and watching TV on Sunday. While we find that regional access to private TV increases consumption more on Sundays than during the week, reception yields significantly positive effects on TV consumption in both cases. Next, we address the potential role of outliers by limiting weekly television consumption to no more than 70 hours. For this purpose, we truncate values to 70 before completely excluding these observations from the sample. The results remain stable in both cases.

In Panel B of Table B8, we consider quartiles of our main variable distributions in the form of dummy variables as dependent variables. First, we estimate the impact of receiving the private TV signal on very low, rather low, rather high, and very high levels of television consumption. This analysis reveals that neither the lowest nor highest quartiles of the distribution are driving the result, as only the middle categories of TV consumption respond significantly to private TV access. This speaks against outliers playing a strong role. Further findings emerge when we repeat this analysis using satisfaction dummies. While there are no effects for health satisfaction categories, there is a fairly consistent picture when comparing the life satisfaction results from the left column to the right column. The result for the lowest category of life satisfaction is significant at the 5% level, indicating that watching TV reduces the likelihood of experiencing severe unhappiness.

Table B1 TV Signal Calculation Method

	Raster aggregation (mean)	Raster aggregation (median)	Municipality aggregation (mean)	Municipality aggregation (median)	County population center	County geographic center
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
First stage:	**TV consumption**					
Private TV	1.587***	1.587***	1.513***	1.513***	1.596***	1.402***
	(0.368)	(0.368)	(0.374)	(0.374)	(0.360)	(0.419)
N	20,278	20,728	20,728	20,728	20,728	20,728
Reduced form:	**Health satisfaction**					
Private TV	0.101	0.101	0.086	0.086	0.068	-0.018
	(0.104)	(0.104)	(0.104)	(0.104)	(0.102)	(0.083)
N	20,252	20,252	20,252	20,252	20,252	20,252
Reduced form:	**Life satisfaction**					
Private TV	0.291***	0.291***	0.276***	0.276***	0.287***	0.243***
	(0.078)	(0.078)	(0.078)	(0.078)	(0.076)	(0.083)
N	20,234	20,234	20,234	20,234	20,234	20,234
Reduced form:	**Visited a doctor**					
Private TV	-0.011	-0.011	-0.009	-0.009	-0.008	0.000
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.018)
N	20,259	20,259	20,259	20,259	20,259	20,259
Reduced form:	**Doctor visits**					
Private TV	0.152	0.152	0.170	0.170	0.139	0.088
	(0.286)	(0.286)	(0.283)	(0.283)	(0.270)	(0.257)
N	16,619	16,619	16,619	16,619	16,619	16,619

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are weekly TV consumption in hours, health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals, which is based on different signal calculations at the county level across columns. Each specification includes year fixed-effects. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table B2 TV Signal Strength Thresholds

	50	55	60	65
	(1)	**(2)**	**(3)**	**(4)**
First stage:	**TV consumption**			
Private TV	1.587***	1.587***	1.467***	1.599***
	(0.368)	(0.368)	(0.419)	(0.430)
N	20,278	20,278	20,278	20,278
Reduced form:	**Health satisfaction**			
Private TV	0.101	0.101	-0.001	-0.000
	(0.104)	(0.104)	(0.091)	(0.095)
N	20,252	20,252	20,252	20,252
Reduced form:	**Life satisfaction**			
Private TV	0.291***	0.291***	0.304***	0.239***
	(0.078)	(0.078)	(0.081)	(0.064)
N	20,234	20,234	20,234	20,234
Reduced form:	**Visited a doctor**			
Private TV	-0.011	-0.011	-0.016	-0.007
	(0.017)	(0.017)	(0.019)	(0.017)
N	20,259	20,259	20,259	20,259
Reduced form:	**Doctor visits**			
Private TV	0.152	0.152	-0.016	0.091
	(0.286)	(0.286)	(0.287)	(0.288)
N	16,619	16,619	16,619	16,619

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are weekly TV consumption in hours, health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals based on different signal strength thresholds from 50, 55, 60, and 65 dBuV/m. Each specification includes year fixed-effects. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table B3 Binary vs Continuous Signal Variable

	Binary signal variable		Continuous signal variable	
	(1)	**(2)**	**(3)**	**(4)**
First stage:	**TV consumption**			
Private TV	1.587***	1.628***	0.024***	0.024***
	(0.368)	(0.361)	(0.005)	(0.005)
N	20,278	20,278	20,278	20,278
Reduced form:	**Health satisfaction**			
Private TV	0.101	0.096	0.001	0.001
	(0.104)	(0.105)	(0.001)	(0.001)
N	20,252	20,252	20,252	20,252
Reduced form:	**Life satisfaction**			
Private TV	0.291***	0.295***	0.005***	0.005***
	(0.078)	(0.080)	(0.001)	(0.001)
N	20,234	20,234	20,234	20,234
Reduced form:	**Visited a doctor**			
Private TV	-0.011	-0.011	-0.000	-0.000
	(0.017)	(0.017)	(0.000)	(0.000)
N	20,259	20,259	20,259	20,259
Reduced form:	**Doctor visits**			
Private TV	0.152	0.140	0.002	0.002
	(0.286)	(0.296)	(0.003)	(0.004)
N	16,619	16,619	16,619	16,619
Covariates		YES		YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are weekly TV consumption in hours, health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals based on a binary signal variable and continuous signal variable across columns. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table B4 Year- vs Month-Based Treatment Identification of Private TV Signal

	Year-based assignment		Month-based assignment	
	(1)	**(2)**	**(3)**	**(4)**
First stage:	**TV consumption**			
Private TV	1.587*** (0.368)	1.628*** (0.361)	1.593*** (0.344)	1.645*** (0.338)
N	20,278	20,278	20,278	20,278
Reduced form:	**Health satisfaction**			
Private TV	0.101 (0.104)	0.096 (0.105)	0.103 (0.104)	0.098 (0.105)
N	20,252	20,252	20,252	20,252
Reduced form:	**Life satisfaction**			
Private TV	0.291*** (0.078)	0.295*** (0.080)	0.299*** (0.075)	0.300*** (0.077)
N	20,234	20,234	20,234	20,234
Reduced form:	**Visited a doctor**			
Private TV	-0.011 (0.017)	-0.011 (0.017)	-0.008 (0.018)	-0.009 (0.018)
N	20,259	20,259	20,259	20,259
Reduced form:	**Doctor visits**			
Private TV	0.152 (0.286)	0.140 (0.296)	0.168 (0.286)	0.156 (0.297)
N	16,619	16,619	16,619	16,619
Covariates		YES		YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are weekly TV consumption in hours, health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals based on a year-based and month-based treatment assignment across columns. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table B5 Sample Checks: Exclusion of Regions

	(1)	(2)	(3)	(4)	(5)	(6)
First stage:	**TV consumption**					
Private TV	1.655***	1.610***	1.575***	1.632***	1.538***	1.845***
	(0.377)	(0.370)	(0.365)	(4.46)	(0.367)	(0.357)
N	17,667	18,560	19,550	19,058	18,972	17,309
Reduced form:	**Health satisfaction**					
Private TV	0.112	0.071	0.086	0.0886	0.100	0.122
	(0.105)	(0.105)	(0.104)	(0.85)	(0.104)	(0.114)
N	17,642	18,535	19,524	19,036	18,946	17,288
Reduced form:	**Life satisfaction**					
Private TV	0.293***	0.287***	0.284***	0.284***	0.290***	0.268***
	(0.080)	(0.080)	(0.079)	(3.60)	(0.079)	(0.085)
N	17,626	18,519	19,512	19,019	18,932	17,270
Reduced form:	**Visited a doctor**					
Private TV	-0.006	-0.007	-0.012	-0.00967	-0.011	-0.024
	(0.018)	(0.017)	(0.017)	(-0.56)	(0.017)	(0.019)
N	17,652	18,546	19,531	19,040	18,955	17,293
Reduced form:	**Doctor visits**					
Private TV	0.118	0.132	0.175	0.156	0.167	-0.010
	(0.291)	(0.289)	(0.287)	(0.54)	(0.287)	(0.311)
N	14,070	14,939	16,046	15,657	15,611	14,096
Clean control regions	YES					
No minor station		YES				
No cable project			YES			
No Rhineland-Pal.				YES		
No megacity					YES	
No border regions						YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are weekly TV consumption in hours, health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals. The columns show results using different sample restrictions. Each specification includes year fixed-effects. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table B6 Sample Checks: Exclusion of Movers

	(1)	(2)	(3)	(4)
First stage:	**TV consumption**			
Private TV	1.587***	1.628***	1.731***	1.779***
	(0.368)	(0.361)	(0.393)	(0.375)
N	20,903	20,903	15,444	15,444
Reduced form:	**Health satisfaction**			
Private TV	0.101	0.096	0.060	0.054
	(0.104)	(0.105)	(0.124)	(0.124)
N	20,875	20,875	15,423	15,423
Reduced form:	**Life satisfaction**			
Private TV	0.291***	0.295***	0.307***	0.308***
	(0.078)	(0.080)	(0.078)	(0.080)
N	20,858	20,858	15,413	15,413
Reduced form:	**Visited a doctor**			
Private TV	-0.011	-0.011	-0.002	-0.001
	(0.017)	(0.017)	(0.020)	(0.020)
N	20,884	20,884	15,430	15,430
Reduced form:	**Doctor visits**			
Private TV	0.152	0.140	0.056	0.047
	(0.286)	(0.296)	(0.283)	(0.295)
N	16,877	16,877	12,662	12,662
Reference year 1988	YES	YES		
Balanced sample			YES	YES
Covariates		YES		YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are weekly TV consumption in hours, health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals. The columns show results using different sample restrictions. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table B7 Different Sets of Covariates

	(1)	(2)	(3)	(4)	(5)	(6)
First stage:	**TV consumption**					
Private TV	1.587***	1.628***	1.628***	1.674***	1.627***	1.659***
	(0.368)	(0.361)	(0.326)	(0.328)	(0.332)	(0.328)
N	20,278	20,278	19,021	19,282	19,021	19,021
Reduced form:	**Health satisfaction**					
Private TV	0.101	0.096	0.088	0.091	0.093	0.089
	(0.104)	(0.105)	(0.106)	(0.106)	(0.105)	(0.106)
N	20,252	20,252	18,997	19,258	18,997	18,997
Reduced form:	**Life satisfaction**					
Private TV	0.291***	0.295***	0.278***	0.292***	0.295***	0.295***
	(0.078)	(0.080)	(0.083)	(0.085)	(0.085)	(0.087)
N	20,234	20,234	18,990	19,251	18,990	18,990
Reduced form:	**Visited a doctor**					
Private TV	-0.011	-0.011	-0.013	-0.011	-0.011	-0.011
	(0.017)	(0.017)	(0.018)	(0.018)	(0.019)	(0.019)
N	20,259	20,259	19,006	19,267	19,006	19,006
Reduced form:	**Doctor visits**					
Private TV	0.152	0.140	0.029	0.117	0.019	0.015
	(0.286)	(0.296)	(0.265)	(0.276)	(0.266)	(0.274)
N	16,619	16,619	15,604	15,801	15,604	15,604
Standard covariates		YES				YES
Survey factors			YES		YES	YES
Weather factors				YES	YES	YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are weekly TV consumption in hours, health and life satisfaction on a 0-to-10 scale as well as visited a doctor and the number of doctor visits in the last three months. The explanatory variable is living in a county with 200kW-powered private TV signals. Each specification includes year fixed-effects. The standard set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. Survey factors include interview mode and day of the week. Weather factors include temperature and sunshine hours on the day of the interview and over the previous four weeks. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Table B8 Definition of TV Consumption and Quantile Analysis

Panel A)				
	TV Workday	**TV Sunday**	**TV > 70h Truncated**	**TV > 70h Excluded**
Private TV	0.142*** (0.052)	0.241*** (0.057)	1.549*** (0.366)	1.487*** (0.358)
N	20,278	20,278	20,278	20,269
Panel B)				
	TV<p25	**p25≤TV<p50**	**p50≤TV≤ p75**	**p75<TV**
Private TV	-0.013 (0.015)	-0.070*** (0.018)	0.058*** (0.022)	0.025 (0.018)
N	20,278	20,278	20,278	20,278
	HSF<p25	**p25≤HSF<p50**	**p50≤HSF≤p75**	**p75<HSF**
Private TV	-0.032 (0.020)	0.026 (0.020)	0.020 (0.019)	-0.014 (0.020)
N	20,252	20,252	20,252	20,252
	LSF<p25	**p25≤LSF<p50**	**p50≤LSF≤p75**	**p75<LSF**
Private TV	-0.049** (0.020)	-0.007 (0.027)	0.024 (0.019)	0.031* (0.018)
N	20,234	20,234	20,234	20,234

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables change across columns. In Panel A), the dependent variables are hours of television on a typical workday, hours of television on a typical Sunday, weekly hours of television truncated at 70 hours, and weekly hours of television excluding those above 70 hours. In Panel B), the dependent variables are quartile dummies for the hours of TV per week, health satisfaction (HSF) and life satisfaction (LSF). The explanatory variable is living in a county with 200kW-powered private TV signals. Each specification includes year fixed-effects. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1987 to 1989.

Appendix C – Income and Consumption Sample

In this Appendix, we a) describe the income and consumption sample (EVS) that we use for our empirical analyses and b) exploit information on TV set ownership. The latter serves as a complementary test for the plausibility of the calculated TV signals, i.e. whether receiving private TV encourages not only TV watching (as examined in the SOEP) but also TV ownership.

a) Preparation of Data Analysis and Discussion of its Limitations

To merge EVS data with data on TV signals from the late 1980s and early 1990s, we use two waves of this repeated cross-sectional sample of German households. The earliest available EVS data wave with regional identifiers for households below the state level is from 1988. For the subsequent EVS wave of 1993, regional identifiers are also available. This information at the regional level is needed for the merger with our TV signal data. Available municipality indicators allow us to use EVS data at a lower hierarchical level than the SOEP (see Figures D3 and D4 for a visual comparison). Similar to the SOEP analysis, we use the most precise method to distinguish between treatment and control regions, which implies that we aggregate raster-based signal values at the municipality level. After determining the average signal strength values for each square kilometer, we consider all of these raster values within a municipality to establish the municipality mean. Apart from potential increases in precision when using this TV signal information at the municipality level rather than the county level, we have to consider special data regularities and other minor caveats for our EVS data analysis.

Data protection is critical for our EVS data analysis at the municipality level. We work with a restricted-use version that is only available for research on the premises of the Federal Statistical Office of Germany. As researchers, we can differentiate between all the different municipalities where EVS participants reported on their lives, but we cannot identify any municipality uniquely. To maintain anonymity, we searched for possible problem cases when deciding on data restrictions for the territory included in the analysis. When we restrict the EVS data to West Germany, we exclude the two municipalities of West Berlin (as in our SOEP-based analysis) and Helgoland (with its few case numbers) prior to the data merger. According to official records, the island of Helgoland had a separate transmitter station that started broadcasting several private TV channels with low power but exceptionally early in 1987. This would, in principle, allow us to perfectly identify all of the data from interviews with individuals living on this island. Therefore, we exclude Helgoland to ensure data protection.

Representativeness is one of the features of the EVS but the dataset available to us is limited in this respect for the following reasons. First, while the EVS generally covers Germany's entire territory, some municipalities are sparsely populated and hence are not part of our analysis if no one participated in the EVS. Second, while the German Statistical Office could obtain municipality information from most of the official interviewer records, this was not possible for some areas of Germany in the 1988 data wave. As we require for our analysis that all West German municipalities are part of both waves, 1988 and 1993, we exclude such municipalities as well as those that were affected by regional reforms during the investigation period.

Underestimation of effects is a possible issue in our analysis of EVS data from 1988 and 1993. First, EVS data collection occurs throughout the year. Since private TV started broadcasting via powerful terrestrial frequencies in the course of 1988 (see Table D1), this could lead to a weakening of the TV effect on individual behavior in our analysis if behavioral implications were to occur immediately. Second, in 1993, the treatment of private TV exposure had been ongoing for several years in some regions, compared to non-treated regions. Meanwhile, watching private TV via cable or satellite had become an option for an increasing number of individuals across Germany, which could also contribute to an underestimation of effects.

b) Plausibility of TV Signal Identification in the EVS Data

We exploit information on the reported number of TV sets to conduct difference-in-differences analyses as we do in Section 5.7 of the paper. Generally, the share of German households without a TV set is small. In 1988, roughly 96% of households had at least one TV set. However, during our investigation period, a number of households acquired a second or even a third TV set, providing some variation. Table C1 displays the results for the most powerful instrument (200kW ERP) and a less powerful version (min 20kW ERP). We also vary the signal strength threshold from low (50 dBuV/m) to high (65 dBuV/m), similar to Table B2 with the SOEP data. In addition to using the number of TV sets as the dependent variable, we inspect the probability of owning at least a minimum number of TV sets in additional analyses shown in Table C2.

Table C1 reveals an increase in the number of TV sets in treatment regions, suggesting that individuals responded to the availability of private TV via terrestrial frequencies. While this is true for both instrument variants, the effect appears to be slightly stronger in Panel B for the most powerful instrument based on a minimum frequency power of 200kW. According to the results in Panel A, there appears to be some pre-treatment differences in the case of the less powerful instrument with at least 20kW. These observations are in line with the insights from the SOEP-based analysis (see Sections 3.2 and 5.2), and substantiate our preference for the 200kW instrument. The results are quite similar across signal strength thresholds, which also aligns with the findings of the SOEP-based analysis (see Appendix B). Finally, using binary indicators of TV ownership in Table C2, we find that the likelihood of having two or more TV sets in the household increases by more than five percentage points, whereas the likelihood of having three or more TV sets in the household increases by one and a half percentage points. While the results are robust when using clean control regions, the comparison of the effect sizes supports the interpretation that household members, in particular, wanted a second TV set to watch different TV programs at the same time, which could have led to the increases in TV watching observed in the SOEP data.

Table C1 Number of TV Sets and Different Definitions of TV Signals

	Signal strength threshold			
	50	55	60	65
Panel A) 20kW ERP				
1993	0.045**	0.045**	0.048**	0.050**
	(0.008)	(0.008)	(0.007)	(0.008)
Private TV	0.044**	0.040**	0.037**	0.037
	(0.016)	(0.017)	(0.019)	(0.024)
1993 × Private TV	0.043**	0.049**	0.047**	0.053**
	(0.017)	(0.018)	(0.020)	(0.014)
N	65,587	65,587	65,587	65,587
Panel B) 200kW ERP				
1993	0.047**	0.047**	0.048**	0.051**
	(0.007)	(0.007)	(0.007)	(0.007)
Private TV	0.012	0.010	0.006	0.013
	(0.019)	(0.019)	(0.020)	(0.023)
1993 × Private TV	0.076**	0.080**	0.079**	0.066**
	(0.015)	(0.015)	(0.016)	(0.014)
N	65,587	65,587	65,587	65,587

Notes: The table shows the results of difference-in-differences regression analyses. The dependent variable is the number of owned TV sets. Private TV in Panel A (B) is defined as living in a municipality with 20kW- (200kW-) powered private TV signals in the late 1980s and onward based on different signal strength thresholds from 50, 55, 60, and 65 dBuV/m. Municipality-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: EVS data are from 1988 and 1993.

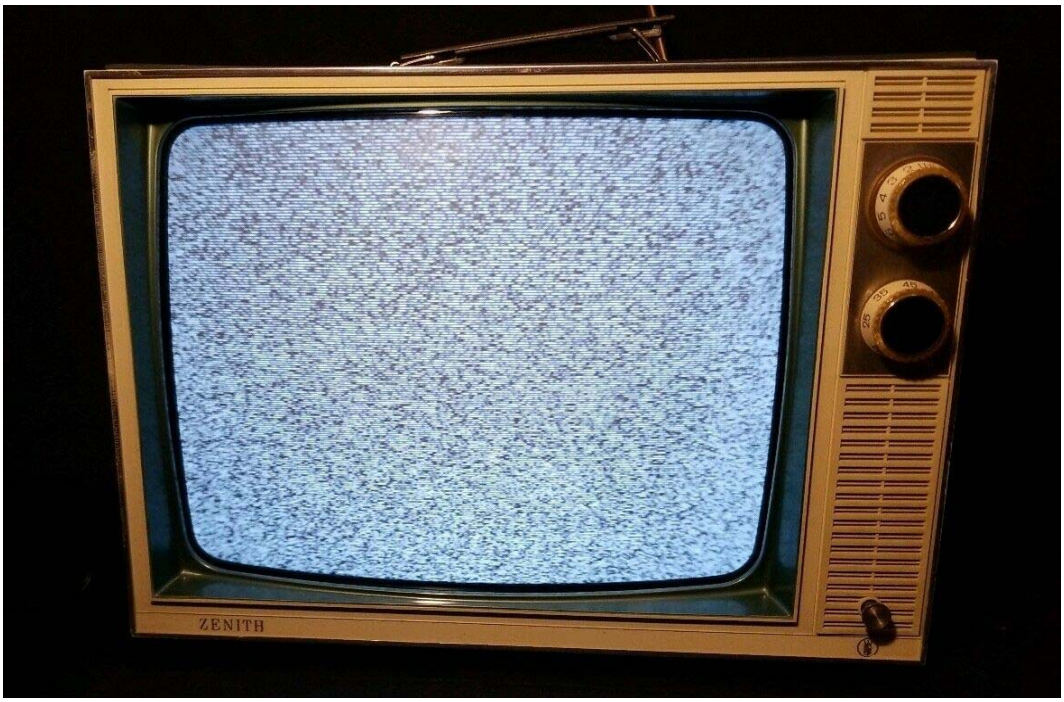
Table C2 Minimum Number of TV Sets

	# of TV sets ≥ 2		# of TV sets ≥ 3	
1993	0.021**	0.024**	0.017**	0.018**
	(0.005)	(0.006)	(0.002)	(0.003)
Private TV	0.006	0.021	-0.006	0.000
	(0.015)	(0.015)	(0.004)	(0.004)
1993 × Private TV	0.058**	0.056**	0.015**	0.014**
	(0.010)	(0.010)	(0.005)	(0.006)
N	65,587	38,294	65,587	38,294
Clean control regions		YES		YES

Notes: The table shows the results of difference-in-differences regression analyses. The dependent variable is owning at least two (three) TV sets. Private TV is defined as living in municipalities with 200kW-powered TV signals in the late 1980s and onward. Clean control regions is a sample restriction that excludes from the set of control regions all municipalities with access to private TV on frequencies lower than 200kW or with access to private TV on 200kW-powered private TV signals that began broadcasting in the early 1990s. Municipality-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: EVS data are from 1988 and 1993.

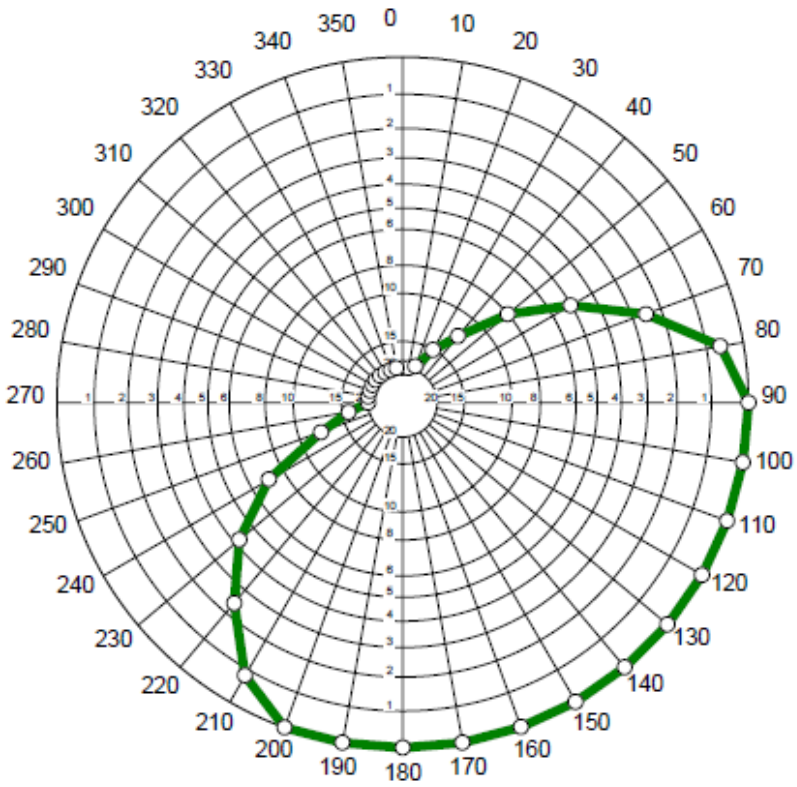
Appendix D – Additional Figures and Tables

Figure D1 Example TV Set From 1988



Notes: This is a 16-inch Zenith TV set. It was one of the television viewing options during the 1980s. The picture was taken from Ebay.com.

Figure D2 Antenna Pattern (Transmitter Wesel)



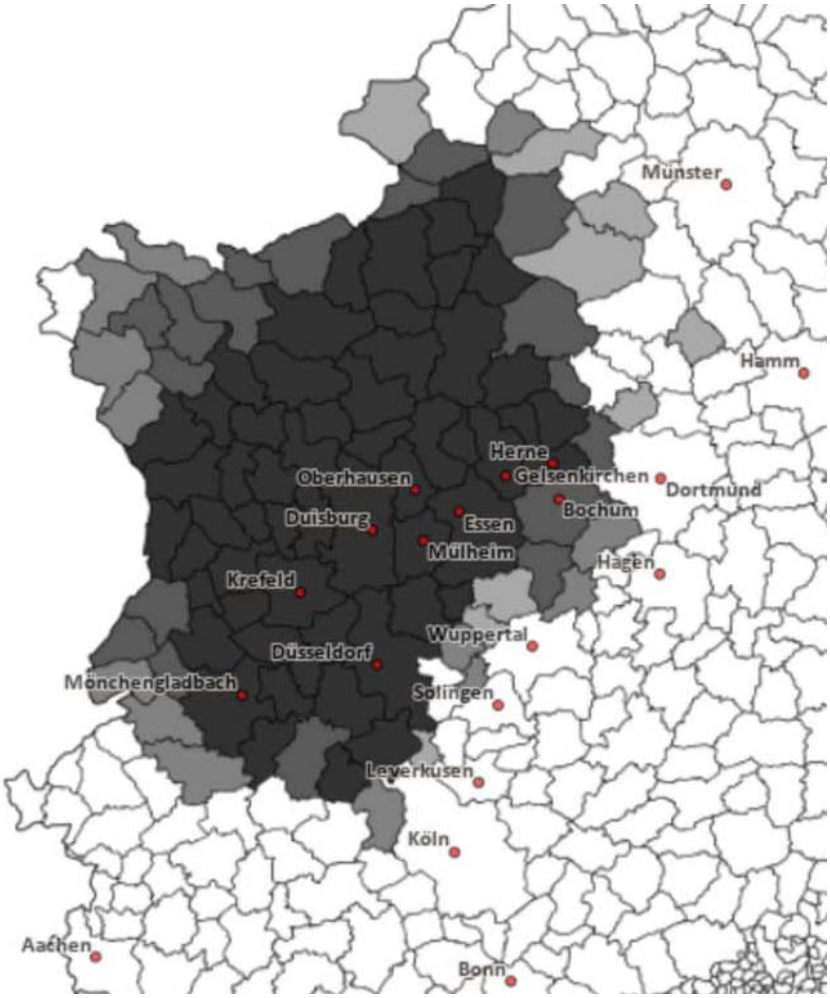
N ü.O	dBW (A	N ü.O	dBW (A)
0	33.0	180	53.0
10	33.0	190	53.0
20	34.0	200	53.0
30	38.0	210	52.2
40	41.0	220	50.6
50	45.0	230	48.8
60	48.0	240	46.0
70	50.5	250	41.0
80	52.4	260	37.0
90	53.0	270	33.0
100	53.0	280	33.0
110	53.0	290	33.0
120	53.0	300	33.0
130	53.0	310	33.0
140	53.0	320	33.0
150	53.0	330	33.0
160	53.0	340	33.0
170	53.0	350	33.0

Notes: The illustration shows the antenna pattern for frequency channel 52 (used by RTLplus in 1989) from the Wesel transmitter station. The table's first and third columns stand for the direction (0 means north, 90 means east, 180 means south, and 270 means west), whereas the second and fourth columns indicate the signal's power in each direction.

Figure D3 County-Level Terrestrial TV Signals of Transmitter Wesel in 1989

Notes: The map illustrates private TV reception via terrestrial signals from the 200kW transmitter station Wesel based on the Longley-Rice propagation model in the spring of 1989 in the Western counties of the federal state of North Rhine-Westphalia. A darker color indicates a stronger signal. In counties without private TV reception (white), the aggregated mean value of all square-kilometer-based signal strength values is below 50 dBuV/m. Counties are colored according to the minimum strength of a signal (dBuV/m), using four intervals (light gray: 50 dBuV/m, medium gray: 55 dBuV/m, gray: 60 dBuV/m, dark gray: 65 dBuV/m).

Figure D4 Municipality-Level Terrestrial TV Signals of Transmitter Wesel



Notes:. The map shows private TV reception via terrestrial signals from the 200kW transmitter station Wesel based on the Longley-Rice propagation model in the spring of 1989 in the Western municipalities of the federal state of North Rhine-Westphalia. A darker color indicates a stronger signal. In municipalities without private TV reception (white), the aggregated mean value of all square-kilometer-based signal strength values is below 50 dBuV/m. Municipalities are colored according to the minimum strength of a signal (dBuV/m), using four intervals (light gray: 50 dBuV/m, medium gray: 55 dBuV/m, gray: 60 dBuV/m, dark gray: 65 dBuV/m).

Table D1 Transmitter Stations Used by Private TV channels in 1989 (min 10kW ERP)

Station	Channel	Frequency	Start-year	Start-month	kW
Wesel	RTLplus	52	1988	7	200
Hennstedt	RTLplus	59	1988	11	100
Hennstedt	SAT1	49	1988	11	100
Rosengarten	SAT1	52	1988	11	80
Luebeck	RTLplus	36	1988	11	34
Düsseldorf	RTLplus	36	1988	6	20
Hamburg	RTLplus	46	1988	4	15
Bremen	SAT1	29	1989	2	10
Hamburg	SAT1	48	1988	12	10

Notes: The table provides information on private TV frequencies with at least 10kW of ERP in the spring of 1989. According to the official records, frequencies from two transmitter stations (Luebeck and Hamburg) had initial phases with low power (<10kW) prior to the start date.

Table D2 Statistics for Main SOEP Data Sample

	Mean	Std. Dev.	Min	Max
Female	0.50	0.50	0	1
Age	42.86	16.51	16	95
German	0.75	0.43	0	1
Household size	3.22	1.50	1	17
Household with children	0.43	0.49	0	1
Married	0.67	0.47	0	1
Divorced	0.03	0.18	0	1
Widowed	0.06	0.23	0	1
Education	10.61	2.31	7	18
Apprenticeship	0.04	0.19	0	1
Income	7.44	0.50	2.48	10.33
Time-use variables				
Housework, errands (hours per week)	17.34	16.71	0	130
Child care (hours per week)	8.72	18.71	0	168
Job, commuting (hours per week)	32.07	28.66	0	168
Schooling and training (hours per week)	4.09	12.70	0	120
Repairs, gardening (hours per week)	5.85	7.31	0	92
Watching TV, video (hours per week)	20.10	10.82	0	96
Hobbies, leisure (hours per week)	11.06	12.99	0	152
Outcome variables				
Health satisfaction	6.79	2.35	0	10
Life satisfaction	7.17	1.88	0	10
Visited a doctor	0.67	0.47	0	1
Doctor visits	2.77	5.27	0	99
N*	20,278			

Notes: The table shows means, standard deviations, minimum and maximum values for covariates, time-use variables, and outcome variables. Female is a dummy that takes the value 1 when a respondent is female. Age expresses the age of the respondent in years. German is a dummy that takes the value 1 when the respondent is of German nationality. Household size refers to the number of household members. Household with children is a dummy that takes the value 1 when there is at least one child living in the household. Married, divorced, and widowed are dummy variables that take the value 1 when the respondent's family status is married, divorced, or widowed, respectively. Education describes the respondent's years of education or training. Apprenticeship is a dummy that takes the value 1 when the respondent recently completed training. Income is the respondent's monthly household income on a logarithmic scale. The time-use variables are based on a module that describes the respondent's average day. The respondents are asked how many hours they devote to each of the activities on each of the six workdays, as well as on Sunday across all seven activities. The activities above are shown as a weighted average in hours per week. *Observation numbers are smaller when using outcome variables due to missing values (Health satisfaction: N=20,252; Life satisfaction: N=20,234; Visited a doctor: N=20,259; Doctor visits: N=16,619).
Source: SOEP data are from 1987 to 1989.

Table D3 Statistics for Own Survey

	Mean	Std. Dev.	Min	Max
Female	0.56	0.50	0	1
Age	53.89	17.60	18	95
West German residence	0.67	0.47	0	1
Household size	1.98	0.85	1	5
Watching TV (hours per week)	14.07	12.61	0	70
Health satisfaction	7.50	2.11	0	10
Life satisfaction	7.91	1.71	0	10
N		511		

Notes: The table shows means, standard deviations, minimum and maximum values for variables from the telephone survey, for which interviewers called households across Germany using phone lists generated based on the Gabler-Häder method. Female is a dummy that takes the value 1 when a respondent is female. Age expresses the age of the respondent in years. West German residence is a dummy that takes the value 1 when the respondent lived West Germany in the late 1980s. Household size refers to the number of household members. Watching TV per week is the reported daily hours of television consumption (wording: "How much time per day (in hours and minutes, respectively) do you spend on average watching TV?") multiplied by seven to obtain a weekly hours measure of television consumption. Health and life satisfaction are reported on an 11-point scale, in the same way as in the SOEP.
Source: Own survey data are from 2015.

Table D4 Long-Run Effects of Private TV on Well-Being

	Health satisfaction		**Health satisfaction**	
Private TV	0.136* (0.070)	0.135* (0.070)	0.141* (0.073)	0.141* (0.073)
N	58,813	58,813	39,504	39,504
	Life satisfaction		**Life satisfaction**	
Private TV	0.128** (0.063)	0.129** (0.064)	0.140** (0.065)	0.144** (0.066)
N	58,734	58,734	39,455	39,455
Covariates		YES		YES
Clean control regions			YES	YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables are health and life satisfaction on a 0-to-10 scale. The explanatory variable is living in a county with 200kW-powered private TV signals. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, income, and interview month. Clean control regions is a sample restriction that excludes from the set of control regions all counties with access to private TV on frequencies lower than 200kW. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1985 to 1992.

Table D5 Long-Run Effects of Private TV on Health

Panel A)	**Visited a doctor**		**Doctor visits**	
Private TV	-0.022 (0.016)	-0.020 (0.016)	-0.208 (0.259)	-0.187 (0.261)
N	51,077	51,077	38,275	38,275
Panel B)	**Stayed in a hospital**		**Hospital stays**	
Private TV	-0.012 (0.009)	-0.008 (0.009)	-0.040 (0.027)	-0.036 (0.028)
N	44,292	44,292	43,931	43,931
Covariates		YES		YES

Notes: The table shows the results of linear regressions with individual fixed-effects. The dependent variables in Panel A are visited a doctor and the number of doctor visits in the last three months. No information on doctor visits is available for the year of 1990. The dependent variables in Panel B are stayed in a hospital and the number of hospital stays in the entire year. No information on hospital stays is available for the years 1989 and 1992. The explanatory variable is living in a county with 200kW-powered private TV signals. Each specification includes year fixed-effects. The set of covariates includes quadratic age, German nationality, household size, household with children, married, divorced, widowed, education, apprenticeship, and income, and interview month. County-level clustered standard errors are in parentheses. Levels of significance are * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: SOEP data are from 1985 to 1992.