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Dante Donati, Ruben Durante, Francesco Sobbrio, Dijana Zejcirovic

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Lost in the Net? Broadband Internet and Youth Mental Health

Abstract

How does the internet affect young people's mental health? We study this question in the context of Italy using administrative data on the universe of cases of mental disorders diagnosed in Italian hospitals between 2001 and 2013, which we combine with information on the availability of high-speed internet at the municipal level. Our identification strategy exploits differences in the proximity of municipalities to the pre-existing voice telecommunication infrastructure, which was previously irrelevant but became salient after the advent of the internet. We find that access to high-speed internet has a harmful effect on mental health for young cohorts but not for older ones. In particular, internet access is associated with an increase in diagnoses of depression, anxiety, drug abuse, and personality disorders– for both males and females - and of eating and sleep disorders - for females only. We find similar results for urgent and compulsory hospitalizations and self-harm episodes. These results suggest that the effect of broadband is driven by a rise in the underlying prevalence of mental disorders and not merely by increased awareness about these pathologies.

JEL-Codes: I120, I310, L820, L860.

Keywords: mental health, internet, ADSL, 3G.

Dante Donati
Columbia Business School
New York / NY / USA
dd3137@gsb.columbia.edu

Ruben Durante
Universitat Pompeu Fabra
Barcelona / Spain
ruben.durante@upf.edu

Francesco Sobbrio
The Vergata University of Rome / Italy
francesco.sobbrio@uniroma2.it

Dijana Zejcirovic
University of Vienna / Austria
dijana.zejcirovic@univie.ac.at

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1 Introduction

As of 2017, about 11% of the world population suffered from some kind of mental disorder (Ritchie and Roser, 2018). Such disorders cause mortality and morbidity, and affect many aspects of life such as decision-making, educational and labor market outcomes, and criminal behavior (Currie and Stabile, 2006; Biasi et al., 2019; Shapiro, 2022; Anderson et al., 2015; Haushofer and Fehr, 2014).[1]

The incidence of mental disorders has sharply increased over the past decades, especially among younger people (Patel et al., 2016). Many commentators have ascribed this trend to the diffusion of the internet and social media, which have dramatically changed the way individuals spend their time and interact with each other (Castellacci and Tveito, 2018). Public concerns about the potentially detrimental effect of digital technologies on mental health are reinforced by information from industry insiders such as Frances Haugen, former Facebook employee, who, testifying in front of the US Congress stated that "[Facebook] is generating self-harm and self-hate, especially for vulnerable groups, like teenage girls".[2]

The potential impact of the internet on (youth) mental health has also attracted the interest of academics from various fields, from medicine to psychology and, more recently, economics. Yet, empirical evidence in this regard is still limited and rather mixed with some studies documenting a significant negative effect (Allcott et al., 2020; Braghieri et al., 2021) and others finding no clear evidence in this direction (George et al., 2020; Odgers and Jensen, 2020). One of the main limitations of most previous studies is the reliance on self-reported measures of mental well-being, which are potentially problematic for at least two reasons. First, individuals' perception of their own mental health can be biased and inaccurate (Braghieri et al., 2021). Second, it may be directly influenced by the use of digital technologies, above and beyond the impact of the latter on actual health conditions (Podsakoff et al., 2003).[3]

[1] Bloom et al. (2012) estimate the global cost of mental disorders in 2010 at USD 2.5 trillion. Mental health conditions are among the leading causes of Disability Adjusted Life Years (DALYs) globally and have the highest impact on individuals in early-to-mid-adulthood (Patel et al., 2016).

[2] "Protecting Kids Online: Testimony from a Facebook Whistleblower, US Senate, Subcommittee on Consumer Protection, Product Safety, and Data Security Hearing, October 5, 2021.

[3] For journalistic accounts on how digital platforms may directly affect self-

Our paper overcomes these limitations using novel administrative data from Italy on the universe of young patients admitted to any Italian hospital between 2001 and 2013 who were diagnosed with a mental health disorder. Combining this information with data on access to broadband internet at the municipal level over the same period, we can study how the advent of the internet affected mental health outcomes, and how this effect varied by cohort (i.e., older vs. younger) and by type of disorder (i.e., depression, anxiety, substance abuse, eating, personality, and sleep disorders).

Our empirical strategy exploits differences across Italian municipalities in the timing of the introduction of broadband technology (ADSL) due to the relative position in the pre-existing voice telecommunications infrastructure. Specifically, since ADSL-based internet services could only be offered in municipalities connected to high-order telecommunication exchanges (Urban Group Stage, UGS) via optic fiber, we use the distance of a municipality to the closest UGS as a source of variation for the availability of high-speed internet. Since the pre-existing infrastructure was not randomly distributed, our identification strategy - which follows Campante et al. (2017) - relies on interacting this distance with the time variation between the period before and after broadband became available (while also controlling for municipality and region-year fixed effects and for a rich set of observables in Census year 2001 interacted with year dummies). This strategy relies on the assumption that the correlation between the distance from the closest UGS and unobserved municipal characteristics did not change at that point in time other than through the introduction of high-speed internet.

Using this approach, we document no significant impact of the introduction of broadband internet on the overall occurrence of mental disorders. However, when differentiating between age groups, we find that high-speed internet access has harmful and significant effects on the incidence of mental disorders among younger individuals, i.e., those born between 1985 and 1995 and aged 6 to 16 years old in 2001 when the internet started to spread in Italy. In particular, access to the internet is associated with a higher occurrence of cases of depression/anxiety, drug

perceived mental health, see https://www.vox.com/the-goods/2021/9/30/22696338/pathologizing-adhd-autism-anxiety-internet-tiktok-twitter.

abuse, and personality disorder for all individuals in this cohort and, for females only, also of eating and sleep disorders. The effect is rather sizeable: for example, a 10 percentage point increase in access to ADSL is associated with a 3.7 percentage point increase in the probability of a case of depression/anxiety being diagnosed among males.[4] Differences in the use of the internet across birth cohorts may be a potential reason behind the observed differential effects. Our analysis focuses on a period when the use of social media was still limited. As such, our findings highlight that the deteriorating impact of the internet on mental health may be driven not only by social media such as Facebook, Instagram or Twitter, as it precedes the advent of these platforms.

Our rich data allow us to explore whether the effect we document is driven by a mere increase in awareness or also by an actual change in the prevalence of mental disorders. In this regard, we find that access to the internet is also associated with an increase in the probability of i) suicide attempts and episodes of self-harm, and ii) compulsory hospitalizations due to mental health conditions posing a threat to the patient or others. Unlike for milder disorders, finding an effect on such extreme outcomes can hardly be explained by better access to mental health information. We also find a similar effect on both planned and urgent hospitalizations. Again, this result is inconsistent with an explanation based only on increased awareness, and supports the view that the prevalence of mental disorders in the population actually increased.

Our paper contributes to a growing literature in economics and social sciences on the impact of the internet on mental health.[5] McDool et al. (2020) find that faster internet connection in the UK is associated with children feeling worse about their appearance, an effect that is especially pronounced for girls. In a randomized trial, Allcott et al. (2020) find that individuals who deactivated their Facebook account for a month spent more time with family and friends

[4]This effect is similar in magnitude to that documented by Farré et al. (2018) who study the impact of unemployment on mental disorders in Spain.

[5]Regarding the effect of the internet on physical health, DiNardi et al. (2019) find that the roll-out of broadband internet in the US was associated with an increase in body weight, while looking at Germany Billari et al. (2018) document a negative effect of the internet on the number of hours slept. Relatedly, Amaral-Garcia et al. (2021) examine how access to (online) information affects health care choices in the UK and find it is associated with an increase in the number of c-sections.

and experienced a small but significant increase in subjective well-being.[6] These findings suggest that the use of social media affects actual mental health conditions - and not just individuals' awareness of them. Braghieri et al. (2021) show that access to Facebook is associated with a deterioration in mental health status among college students in the US, arguably due to Facebook facilitating unfavorable social comparisons. Another reason why social media use can be detrimental to mental health is its addictive nature. Allcott et al. (2022) develop a model of digital addiction and estimate that 31% of social media use is caused by self-control problems. Finally, Golin (2021) studies the effect of high-speed internet on mental health in Germany using survey data from the German Socio-Economic Panel. In line with our results, she finds that broadband access negatively affects self-reported mental well-being among female respondents only, and that this effect is larger for younger cohorts.

Our study aims to estimate the causal impact of broadband internet on mental health disorders diagnosed by doctors in the entire population of a large country like Italy. As such, it innovates and expands upon previous work in several ways. First, we study how being able to access the internet - rather than a specific social media platform - affects mental health not just for college students but for the entire population of children, teenagers, and young adults. This is important since pre-college cohorts (i.e., aged 14 to 17) may be especially vulnerable to the effect of the internet. Second, our data allows us to estimate the effect of the internet on different disorders and types of hospitalizations and for different segments of the population. Such disaggregated results contribute to a deeper understanding of the various ways in which the internet may affect different groups, and to the design of targeted policy interventions. Third, the use of data on doctors' diagnoses strengthens the validity of our findings. Indeed, diagnoses by certified health professionals provide a more objective measure of mental health disorders than those based on self-reported data, which are harder to compare across time and space and are more likely to "suffer from measurement error for reasons related to recall bias and lack of incentive" (Braghieri et al. 2021).[7] Finally, our analysis focuses on an early period in the

[6]Similar evidence is available from Mosquera et al. (2020).

[7]Doctors' assessment is also imperfect and may be influenced by implicit biases related to the patient's gender, race, and sexual orientation (Snowden, 2003). Also, doctors' evaluation of a given disorder may be affected by

diffusion of the internet in Italy, when the use of social media was very limited. In this regard, our findings provide intriguing evidence that other online activities, beyond the use of social media, can also have significant implications for mental health.

Finally, our paper contributes to a vast literature on the influence of the internet on emotional well-being. In this context, several studies find a positive association between problematic internet use and suicidal behavior, depression/anxiety, personality disorders, and drug abuse (Kaess et al., 2014; Zadra et al., 2016; Ho et al., 2014). Relatedly, evidence from psychology indicates that adolescents are especially susceptible to problematic internet and mobile phone use since they are developmentally more vulnerable (Sohn et al., 2019). Our results provide empirical support to this correlational evidence by showing a causal impact of broadband internet on mental health disorders.

2 Background and study setting

2.1 Health care provision in Italy

The Italian national healthcare system is funded through general taxation and provides universal and virtually free access to health care services to all residents. Patients are only required to pay a fixed access fee for specific services - e.g., non-urgent access to the ER, specialists visits, instrumental and laboratory diagnostic examinations - ranging from ten to a few hundred euros for the most complex tests, which is waived for low-income individuals and for patients with severe medical conditions. Public hospitals account for 80% of total hospital beds and private hospitals for the remainder (ASSS, 2020). The cost of health services to patients does not vary between public and private hospitals. While the key guidelines of the healthcare system are set at the national level, public health provision is managed by regional governments which, among other things, are in charge of setting the fee payment levels, hiring personnel, and investing in infrastructures.

medical information they can access online, though arguably less so than that of patients who have little or no medical training and are hence more impressionable.

2.2 Fixed and mobile Internet in Italy

Fixed-line broadband internet connection was first introduced in Italy in 1999 through Asymmetric Digital Subscriber Line (ADSL) technology.[8] Yet, the broadband infrastructure experienced a slow development in its early phase. By the end of 2000, only 117 out of 8,100 Italian municipalities had ADSL access. After 2001, the broadband roll-out experienced a more steady growth and by the end of 2005 ADSL was available in about half of all Italian municipalities. As explained in detail by Campante et al. (2017), a key parameter driving the timing of the broadband infrastructure diffusion across Italian municipalities was the distance between the municipality and the closest higher-order telecommunication exchange: the Urban Group Stage (henceforth UGS) whose location was pre-determined long before the advent of the internet. In particular, in order to provide ADSL services in a municipality, telecommunication operators had to bear the cost of connecting the municipality to the closest UGS via optical fiber. Accordingly, all else equal, "the closer a municipality happened to be to a UGS when ADSL came into the picture, the more likely that municipality would get ADSL access earlier on (Campante et al. 2017, p. 1103).

Mobile internet connections arrived at a later stage. At the end of 2004, only 4% of mobile phones in Italy had a UMTS/3G technology (Between, 2008). By the end of 2006, this percentage increased to around 21%. As for the fixed-line broadband, the mobile internet network also had to be connected to the backbone of the telecommunication infrastructure (*core network*). As such, the distance of a municipality to the higher order nodes of the telecommunication network (Urban Group Stages, UGS, or Optical Packet Backbones, OPB) also was highly relevant in the timing of 3G coverage across Italian municipalities (Guerrieri, 2009; TIM, 2019).

[8] Alternative broadband technologies, such as cable and satellite, have been negligible in Italy (OECD, 2001; Between, 2008).

3 Data

3.1 Health outcomes

Data on patients' mental health diagnoses come from the discharge reports issued by all Italian hospitals, both public and private ("Schede di dimissione ospedaliera", i.e., SDO). For each case, the report includes the diagnosis code(s), and basic socio-demographic information of the patient (i.e., age, gender, municipality of residence). In particular, our dataset covers the universe of individuals born between 1974 and 1995 who were admitted to any Italian hospital between 2001 and 2013, and who were diagnosed with any mental health condition by medical personnel.

Hospital discharge reports typically contain up to three diagnosis codes, with one being the "primary diagnoses", and the others the "secondary or concomitant" ones. The primary diagnosis refers to the pathology that led to the greatest consumption of medical resources, and does not necessarily coincide with the cause of hospitalization. The secondary or concomitant diagnoses, when present, specify additional pathologies and provide a more complete clinical picture. Some secondary diagnoses qualify as complicating diagnoses, i.e., specific pathologies that, together with the main one, require a greater burden of care.[9]

Starting from the individual data, we construct a balanced panel at the municipality-year level for each diagnosis. Specifically, we count, for example, the number of females born in 1974 resident in municipality m who were admitted to a hospital in year t and were later discharged with a diagnosis for mental health condition k (e.g., eating disorders).

We focus on five types of health conditions: i) depression/anxiety disorders, ii) drug abuse/addiction, iii) eating disorders, iv) personality disorders, and v) sleep disorders. Specifically, we group diagnoses according to the WHO (2016) classification as follows. The depression/anxiety category includes all diagnoses involving depression, anxieties, or neurotic disorders (ICD-10 codes: F32, F33, F40, F41, F43.21-23). The Drug abuse/addiction category encompasses all drug-related diagnoses (ICD-10 codes: F10-F19). Eating disorders include anorexia, bulimia, and other eating disorders (ICD-10-CM code: F50). Personality disorders include

[9]Source: http://www.salute.gov.it/portale/p5_1_2.jsp?lingua=italiano&id=126

schizophrenia (ICD-10-CM codes: F20, F21, F25) and bipolar disorders (ICD-10-CM code: F31), and other personality disorders (ICD-10-CM code: F60). Finally, sleep disorders correspond to code F51 in the ICD-10-CM classification.[10]

3.2 Fixed and mobile Internet Data

Our dataset on broadband access provides information on the percentage of households with access to ADSL in each Italian municipality for each year between 2005 and 2011. The data were provided by *"Osservatorio Banda Larga-Between"*, a joint venture between the main Italian telecommunications operators, the Italian Ministry for Telecommunications, and other private and public stakeholders. Specifically, the measure of broadband access is defined on an asymmetric six-point scale corresponding to the following brackets: 0%, 1-50%, 51-75%, 76-85%, 86-95%, and above 95%. We linearize this measure by considering the midpoint of each interval, to make it comparable with our measures of 3G access defined continuously over the interval 0-100%. For the purpose of robustness, we also consider alternative measures of ADSL access such as "*Years Since Good Broadband*", defined as the number of years since at least 50% of households in a municipality have had ADSL access. While this measure has the advantage to capture the cumulative effect of broadband internet, it may contain measurement error since we are forced to set 2005 as the first year of good broadband access for all municipalities with coverage of 51% and above in 2005, as that is the first year for which data are available. As explained in Section 2.2, broadband coverage was still minimal in 2001 in Italy. Accordingly, we set our measure of ADSL equal to zero for all municipalities in 2001. Moreover, as no data are available for the period 2002-2004, we drop these years from the analysis.[11]

We consider mobile internet, in addition to broadband, to assess whether our results vary

[10] It is worth noting that in the period under consideration (2005-2013), the number of Italian hospitals admitting patients affected by mental health disorders for long-term hospitalization dropped from 1064 to 930. Such reduction affected all Italian regions with only very few exceptions (e.g., in Lombardy, the number of such hospitals increased by 47 units). Source: http://dati.istat.it/Index.aspx?DataSetCode=DCIS_OSPDISTPSICHRIC. As explained in Section 4, the inclusion of region-year fixed effects allows to control flexibly for any region-specific trend in the supply (or demand) of mental health services.

[11] Results are robust to including the period 2002-2004 for municipalities with zero ADSL 2005, i.e., the ones for which we can safely impute a zero ADSL also for the years 2002-2004 (see Table A.8).

depending on the type of connection. Specifically, we use data on 3G coverage as reported by mobile operators (Collins Mobile Coverage Explorer), covering the period 2007-2013.[12] These data come in GIS vector format and assign the value 1 to each 1×1km-cell that is reached by 3G signal. Following Donati (2023), we use the spatial mean of these values to compute the average share of land covered by 3G for every municipality-year. The resulting measure spans the continuous interval 0-1, where 1 indicates that the entire area in the municipality is covered by 3G. Similarly to ADSL, we set 3G coverage equal to 0 for all municipalities in 2001 (as the technology was absent in that year) and drop the period 2002-2006 (as no data is available).

Finally, we collect information on municipal characteristics in census year 2001 as well as population estimates by age groups between 2002 and 2013 from the Italian National Institute of Statistics (ISTAT). Our final sample consists of 7,937 municipalities. Summary statistics on all variables are reported in Table A.1.

4 Empirical strategy

Broadband access may be spuriously correlated with the incidence of mental health disorders. For example, urban municipalities may get access to broadband earlier on due to higher demand factors and, at the same time, may experience a higher incidence of mental health among younger generations. To address this concerns, we adopt an instrumental variable approach using cost-level factors to instrument for broadband internet coverage at the municipal level. As explained in Section 2.2, a key determinant of the cost of providing broadband services in a municipality, from the standpoint of telecom operators, was its distance from the closest UGS since connecting a more distant municipality would require higher investments. Hence, we can exploit variation in this distance across municipalities to gauge the causal impact of broadband access. Specifically, to control for time-invariant municipal characteristics, following Campante et al. (2017), we instrument broadband access with the interaction between the distance to the closest UGS and a dummy for the post-2001 period, since this distance should only be relevant after the

[12] http://www.collinsbartholomew.com/mobile-coverage-maps/mobile-coverage-explorer/

introduction of high-speed internet.

The identification assumption is therefore that, whatever correlation existed between the distance to the closest UGS and relevant municipality characteristics did not change at the time the ADSL technology was introduced, so that any change in the impact of distance on the outcome of interest is only due to the introduction of the broadband internet.

The following two-stage specification summarizes our econometric strategy:

$$Y^k_{m,t} = \gamma Broadband_{m,t} + \beta X_{m,t} + \alpha_m + \tau_t + \epsilon_{m,t} \tag{1}$$

$$Broadband_{m,t} = \phi Distance\_UGS_m \times \textit{Post-2001} + \sigma X_{m,t} + \zeta_m + \theta_t + \eta_{m,t} \tag{2}$$

where subscripts m and t indicate respectively municipality and year; $Y^k_{m,t}$ represents the outcome of interest (e.g., occurrence of cases of mental health pathology k in municipality m in year t); α and ζ are municipality fixed effects; τ and θ are region-year fixed effects; and X is a set of municipal controls.

Broadband denotes one of the measures of broadband access described in Section 3.2, while *Distance_UGS* is the (time-invariant) distance of a municipality's centroid to the closest UGS. We interact this variable with a dummy (*Post-2001*) that takes value 1 for years after 2001, i.e., after the advent of broadband internet.[13]

We include municipality fixed effects to rule out the possibility that our results are driven by particular municipality characteristics, such as access to health care infrastructure, distance to urban areas or economic development. Hence, we exploit variation in broadband access due to the proximity to the telecommunication infrastructure purged from any municipal time-invariant characteristics. The inclusion of region-year fixed-effects allows, instead, to control for any time-variant differences across regions. This aspect is especially important since, as mentioned in Section 2, healthcare is managed at the regional level in Italy.

[13]Figure A.2 shows the first stage relationship between our instrument –distance to the telecommunication infrastructure UGS– and our independent variable –access to ADSL– over time. The further the municipality is located from the network, the lower the ADSL coverage. While the predictive power is consistent throughout our study period, it is strongest in the early years of the broadband roll-out.

Our identification assumption would be violated by the presence of subjacent trends in the outcomes related to factors correlated with $Distance\_UGS \times Post\text{-}2001$. This would be the case, for example, if mental health cases were becoming more frequent in municipalities with higher educational attainment, which also happened to be closer to UGS, precisely around the time internet was introduced. To account for this possibility, we control flexibly for a number of economic and socio-demographic municipal characteristics. Specifically, we include the following variables available at a yearly frequency: log population, shares of population aged 20 or less, between 20 and 39 year-old, between 40 and 59 year-old, and between 60 and 79 year-old. In addition, we control for a range of other municipal characteristics in baseline Census year 2001, which we interact with year fixed effects. These include: population density, terrain ruggedness, unemployment rate, share of population with a university degree, number of firms per capita, number of non-profit organizations per capita, and distance of the municipality's centroid to the closest provincial capital. It is important to note that, by including population, size of the municipality, and distance to the closest provincial capital, we are controlling in multiple ways for the possibility that small, isolated, rural towns, which are more likely to be far from a UGS, may have differential trends relative to larger urban centers. Accordingly, our identification strategy requires that there is no change in the correlation between distance to UGS and the outcomes of interest around the time of broadband introduction, once we account for these potential trends. Finally, to account for possible serial correlation in the error terms, we cluster standard errors at the municipality level.[14]

5 Results

5.1 Mental health diagnoses

We first present the results aggregating outcomes across all age groups (Table 1).

In our main specification, our dependent variables are dummies indicating the occurrence

[14]For purpose of robustness, in Appendix tables A.11 and A.12 we show the results clustering by province and by region-year, respectively).

Table 1: IV and OLS estimates: internet and all mental health hospitalization

	Depression or anxiety	Drug abuse or addiction	Eating disorder	Personality disorder	Sleep disorder
	(1)	(2)	(3)	(4)	(5)
Panel A: 2SLS					
ADSL	-0.085	0.105	0.051	0.021	-0.101
	(0.122)	(0.122)	(0.105)	(0.141)	(0.075)
Panel B: OLS					
ADSL	0.001	-0.001	-0.000	0.013*	0.008**
	(0.007)	(0.007)	(0.005)	(0.007)	(0.004)
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y
Mean	0.414	0.287	0.170	0.340	0.062
Observations	63496	63496	63496	63496	63496
$\phi^{1stStage}$	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
1st stage Wald F-stat	63.97	63.97	63.97	63.97	63.97

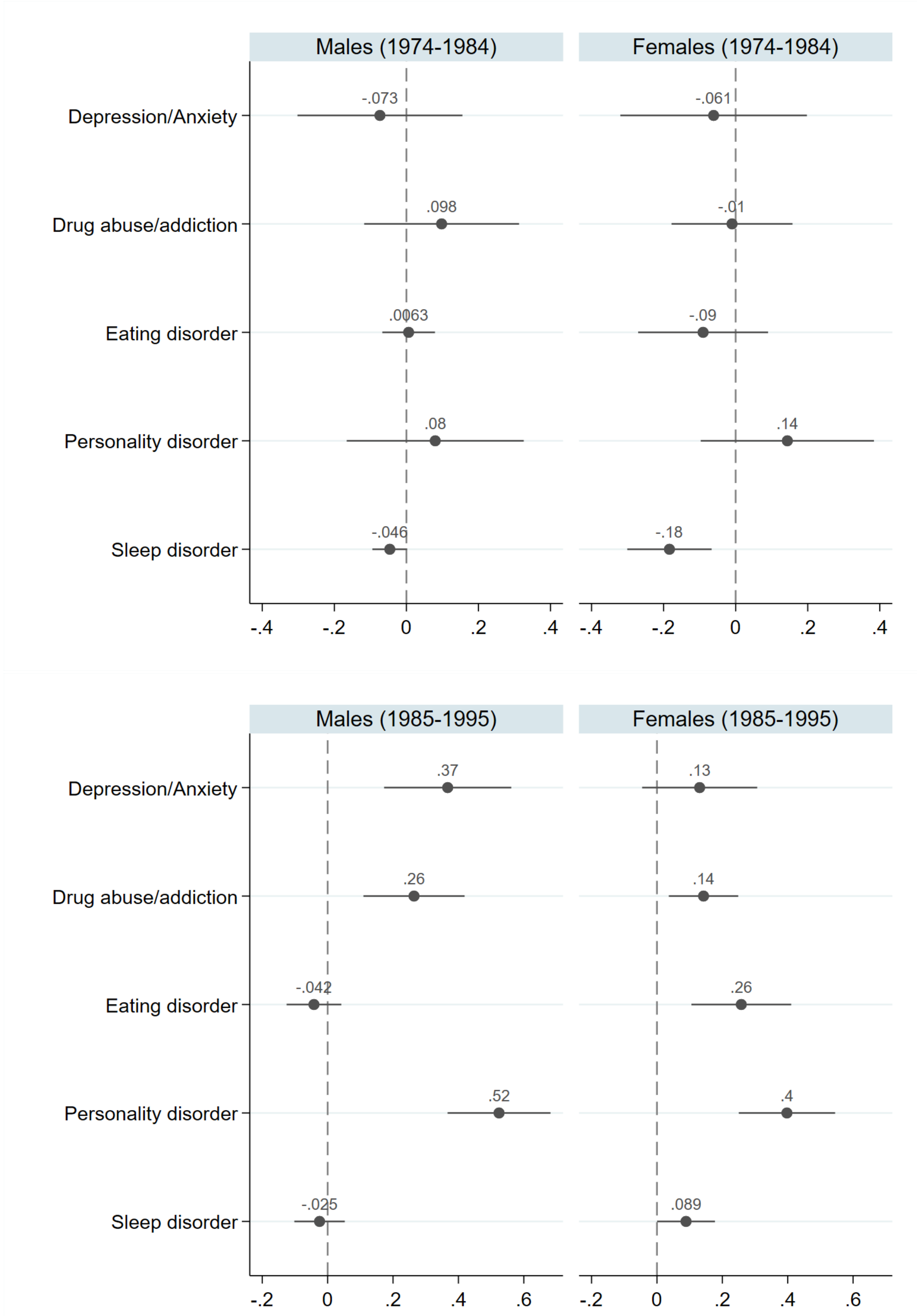
Notes: Contemporaneous municipality controls include: population size, share of age groups (0-19, 20-39, 40-59, 60-79, >80 residual category). Baseline characteristics at the municipal level (in census year 2001) interacted with year dummies are: population density, distance to closest provincial capital, ruggedness, unemployment rate, share of university graduates, number of firms per capita, and number of non-profits organizations per capita. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

of any case of a specific mental disorder in a given municipality-year. The first stage regressions works in the expected direction: the distance to the UGS is negatively correlated with ADSL coverage. We observe a strong first stage with a partial F-value of 63.97 (see last two rows of Table 1). Panel A shows the second stage regression results of broadband coverage and occurrence for each type of mental disorder category. We can see no statistically significant relationship between internet availability and mental disorders when looking at all age groups and genders together.

The picture changes substantially when we decompose the mental disorders by age-cohorts and gender. Figure 1 provides a visual representation of our baseline estimates.[15]

[15]Results in this Figure and in the following Tables refer to the second stage coefficient γ on ADSL access from Equation (1), unless indicated otherwise.

Figure 1: IV estimates: Internet and mental health hospitalization incidence



Notes: The figures depict the main regression results (coefficients and corresponding standard errors) of Table 2 for the birth cohorts 1974-1984 and 1985-1995. The coefficients refer to increases in hospitalization incidences (the outcomes are dummy variables at the municipality level) when ADSL access goes from 0 to 100%. We estimate equations (1) and (2) via 2SLS. For a complete list of municipality controls, see the footnote in Table 1.

While the results for the 1974-1984 birth cohort show no statistically significant relationship between ADSL access and mental health disorders, a different picture emerges for younger patients. The presence of broadband internet leads to a statistically significant increase in the likelihood of observing the occurrence of all types of mental health disorders for females born between 1985 and 1995, including drug abuse/addiction, eating and personality disorders, and sleep disorder, with the exception of depression/anxiety. For males in the 1985-1995 cohort, broadband internet increases the likelihood of observing cases of depression/anxiety, drug abuse/addiction, and personality disorders. Table 2 shows the corresponding regression estimates, which suggest that expanding ADSL coverage from 0 to 100% increases the probability of depression/anxiety for males by 37 percentage points, and it raises the probability of drug abuse/addiction by about 26 and 14 percentage points for males and females, respectively (the average coverage is 65%, see Table A.1).

Such effects appear rather sizeable when contrasted with the sample averages over the 2001-2013 period (see Table A.2). For example, the estimated impact of ADSL coverage on the probability of observing at least one young female hospitalized because of drug abuse/addiction in a municipality is almost three times the average probability in the 2001-2013 period or, alternatively, 0.66 standard deviation units.[16]

Table 2 also shows the regression results of the corresponding OLS regression, with ADSL access as the independent variable of interest. Zooming into the cohorts where we do find a significant relationship between internet access and mental health (cohort: 1985-1995), we see that the signs of the OLS and 2SLS are generally in line, but with larger magnitudes in the 2SLS regressions. The differences between OLS and 2SLS may be explained by the fact that the IV approach measures the Local Average Treatment Effect (LATE) of broadband. Specifically, while the OLS regressions may reflect the impact of the internet on mental health outcomes

[16] For the sake of comparison, Braghieri et al. (2021) estimate that the Facebook roll-out increased by 0.085 standard deviation units the index of poor mental health among US college students. One potential reason for these differences is that our IV approach measures the LATE, which is usually larger than the ATE estimated via OLS. Their coefficient size consists of people who use Facebook and people who do not, while our coefficient captures the effect of the complying municipalities. Additionally, our analysis investigates the overall impact of internet access beyond giving access to social media only.

Table 2: IV estimates: split by gender and cohort

	Depression or anxiety	Drug abuse or addiction	Eating disorder	Personality disorder	Sleep disorder
	(1)	(2)	(3)	(4)	(5)
Panel A: 2SLS					
Males 1974-1984	-0.073	0.098	0.006	0.080	-0.046*
	(0.117)	(0.110)	(0.037)	(0.125)	(0.025)
Females 1974-1984	-0.061	-0.010	-0.090	0.143	-0.184***
	(0.132)	(0.086)	(0.092)	(0.123)	(0.060)
Males 1985-1995	0.367***	0.264***	-0.042	0.524***	-0.025
	(0.099)	(0.079)	(0.043)	(0.080)	(0.039)
Females 1985-1995	0.131	0.142***	0.258***	0.398***	0.089**
	(0.090)	(0.054)	(0.078)	(0.075)	(0.045)
Panel B: OLS					
Males 1974-1984	-0.003	-0.011**	-0.001	0.003	0.000
	(0.006)	(0.005)	(0.001)	(0.005)	(0.001)
Females 1974-1984	-0.002	0.000	0.005	0.003	0.004*
	(0.006)	(0.004)	(0.004)	(0.005)	(0.002)
Males 1985-1995	0.002	0.003	-0.001	-0.005	0.001
	(0.004)	(0.004)	(0.002)	(0.004)	(0.001)
Females 1985-1995	0.013***	0.008***	-0.000	0.003	0.003
	(0.005)	(0.003)	(0.004)	(0.004)	(0.002)
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: Results in Panel A refer to the second stage coefficient γ on ADSL access from Equation (1). The outcome variables denote dummies for at least one hospitalization incidence in the corresponding municipality. For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

across all localities (in the absence of an omitted variable bias), the LATE measures the effect on the subset of municipalities where the arrival of the new broadband technology was induced by closer proximity to existing telecommunication infrastructure. Mental health outcomes in these two sets of municipalities are likely to respond differently to internet arrival (e.g., higher technology adoption in places closer to old infrastructure), and this could explain the sizes of the coefficients.

Another reason why the IV estimates may differ is that the OLS regression may suffer from omitted variable bias that could bias the coefficients towards zero. For example, wealthier and/or more urban municipalities are likely to have adopted ADSL earlier. At the same time growing up in such places might be associated with lower incidence of mental disorders relative to poorer or more segregated municipalities. Looking at the incidence of mental health disorders in the OLS specification, one might then incorrectly conclude that there is a negative or much smaller relationship between internet access and these pathologies.

6 Robustness and placebo regressions

6.1 Specification checks

We perform a variety of robustness checks to show that our results do not depend on the choice of the specification. First, we study whether the effect on mental health conditions operates only on the extensive or also on the intensive margin. We repeat the main analysis for the youngest cohort but now use the natural log of total hospitalizations as our dependent variables.[17] Table A.3 shows that higher fixed internet coverage increases the number of mental health disorders for females across all categories. Again, the results point out the presence of sizeable effects. For example, increasing the ADSL coverage from 0 to 100% leads to a 45.5% rise in the number of males diagnosed with depression/anxiety, and a 16.5% increase in the number of females with drug-addictive behavior. The results are qualitatively similar those on the extensive margins of Figure 1 and Table 2.

While our main specification captures the immediate effect of internet availability on mental health, it is plausible that such effect takes time to fully materialize. To explore this aspect, we define our independent variable as the total number of years since the municipality had good coverage, which we define as more than 50%. Results are depicted in Table A.4. We observe

[17]We use the natural log due to the skewed distribution in our dependent variable.

that an additional year of good internet coverage in the municipality increases the probability of episodes of mental health disorders involving females (for all types of disorders, except depression/anxiety) and involving males for depression/anxiety, drug abuse/addiction, personality disorder, or self-harm. For example, an additional year of good ADSL coverage increases the incidence of depression/anxiety among young males by 10 percentage points (0.33 standard deviation units).

Whether or not internet access influences well-being may depend on how people use it. For example, having access on smartphones rather than on fixed devices may further increase the risk of addictive behaviors due to the portability of the technology. We use data on 3G coverage to explicitly investigate the relationship between mobile internet and mental health. In this analysis, we use the minimum distance to the UGS or OPB network as an instrument for mobile coverage (see Section 2). Table A.5 reports the results. The first stage is strong (F-value: 107.91) and indicates the further a municipality centroid is from one of these networks, the lower is the municipality's 3G coverage. Despite focusing on a different broadband technology and time-span (the 3G coverage data ranges from 2007-2013), the coefficients are fairly comparable to our main specification (Table 2).[18] The only differences from the results on fixed broadband are for the female subgroup, for which we find a positive effect of 3G on depression/anxiety but no significant effect on sleep disorders. Overall, our results suggest that the specific type of internet connection/device does not matter.

In our main specification, we define our dependent variable using the presence of mental disorders in any of the three diagnoses reported in the hospital records. As explained in Section 3.1, the first diagnosis does not need to coincide with the cause of hospitalization. The order in which diagnoses are reported reflects which pathology requires the highest resource consumption. Yet, as a robustness check, we also investigate whether we observe similar patterns in the youngest cohort when we construct our outcome variables by focusing on the primary diagnosis only (i.e., including a case of mental disorder only if recorded as the primary diagnosis). Table

[18] The results remain unchanged when we harmonize the time-spans of the two analyses. Results are available upon request.

A.6 indicates that the results focusing on the primary diagnosis are very similar to those of our main specification.

Furthermore, we provide evidence suggesting that the results are not driven by a general association between early internet access and the likelihood of being hospitalized (e.g., for physical problems). Table A.7 shows that the results omitting any physical diagnosis from the sample (i.e., keeping only those cases where all three diagnoses refer to mental disorders) are indistinguishable from the baseline coefficients depicted in Table 2.

Additionally, Table A.9 shows that our results are not driven by urban areas only. The table reports results when focusing only on the subset of rural municipalities.[19] The coefficient estimates are smaller compared to the baseline specification but qualitatively similar. The coefficient on ADSL coverage for female drug abuse/addiction is statistically insignificant in the rural sub-sample. These findings speak against the interpretation that our results are driven by differential trends in urban areas, such as, for example, a higher supply of mental health treatments.

Finally, Table A.10 shows that our estimates are robust to the exclusion of the municipality controls. The results are quantitatively similar to our preferred specification with higher precision due to a stronger first stage relationship (F-value: 139.47). We also cluster the standard errors at a higher geographic unit than municipalities. Results are displayed in Tables A.11 (province-level) and A.12 (region-year-level). We have 110 provinces and 220 region-year pairs. The partial F-values of the first stages are lower (28.71 and 21.23), but the qualitative conclusions remain unchanged. We do not lose statistical precision in the second stage despite clustering at a higher geographic unit.

6.2 Placebo regressions

We conduct a series of placebo exercises to provide evidence in support of our identifying assumption, i.e. the instrumental variable $Distance\_UGS \times Post\text{-}2001$ not affecting the outcomes

[19] The urbanization index is provided by ISTAT. All municipalities with the highest urbanization index in 2001 (3) are excluded in this analysis.

other than throughout its impact on broadband internet availability. To provide evidence on the plausibility of the exclusion restriction, we examine the reduced-form relationships between our IV and the outcomes under different scenarios.

First, to benchmark our placebo exercises, we show the results of the reduced-form relationships estimated on the same sample used in the main analysis (i.e., the one including all municipalities in years 2001 and 2005-2011). Table A.13 shows that the incidence of mental disorders for the younger cohort increases more after 2001 in municipalities closer to the UGS. Together with the 2SLS estimates reported in Table 2 and the first-stage relationship depicted in Figure A.2, these results suggest that the interaction between the distance to the UGS and a post-2001 dummy affects the outcomes and ADSL availability is the likely mediator of such effect.

Second, we replicate the reduced-form regressions for all years between 2001 and 2005 on two distinct subsamples of municipalities: those with no ADSL and those with some positive ADSL access in 2005. The regression on the first subsample represents a placebo analysis: if the exclusion restriction holds, one should expect that the interaction between the distance to the UGS and a post-2001 dummy should not affect mental health outcomes in municipalities with no ADSL in the 2002-2005 period. Vice versa, it should have an impact on the second subsample (municipalities where ADSL became available sometime between 2002 and 2005). Indeed, Panel A of Table A.14 shows that the IV does not predict mental health outcomes in municipalities without ADSL: coefficients are generally small in magnitude and not statistically significant. By contrast, Panel B shows a stronger relationship between the IV and mental disorders in the subsample of municipalities with ADLS access. In this case, both coefficients' magnitude and significance are closer to the reduced-form results of Table A.13. Overall, these results speak in favor of the exclusion restriction, as they suggest that ADLS access is a necessary condition for the IV to have an impact on the outcomes.

Finally, we extend the exercise to years after 2005 to show that the previous results are not driven by our focus on a particular period of time (i.e., 2001-2005). To conduct placebo regressions, we focus on the years 2001 and 2005-2011, and study the relationship between the

IV and mental health outcomes on an imbalanced panel of municipalities/years with no ADSL access. This represents a generalization of the placebo exercise present in Panel A of Table A.14. If the exclusion restriction holds, one should expect that the interaction between the distance to the UGS and a post-2001 dummy should not affect mental health outcomes in municipalities with no ADSL in the post-2001 period (i.e., up to the year when ADSL becomes available in that municipality). Figure A.3 compares these placebo estimates with the reduced-form relationships on the full sample (as reported in Table A.13). The estimated coefficients on the subsample with no ADSL are not statistically significant and generally smaller compared to the reduced-form coefficients estimated on the entire sample. These results indicate that in the absence of broadband internet, the IV does not significantly affect the outcomes. Altogether, this evidence reassures the validity of our instrument and, therefore, of the identification strategy.

6.3 Potential mechanisms

One way to interpret our results is that internet availability increases information access about mental health diagnoses and resources. Instead of causing these disorders, internet could enable users to better understand their problems and seek help.[20] While this may partially explain our results, three observations speak against this interpretation as the main driver.

First, we only observe a detrimental effect on mental health for individuals born between 1985-1995 but not for the cohorts born before. This would imply that only the youngest make use of the additional information on mental health. Instead, using survey data from ISTAT, we observe that the 1974-1984 cohort is more likely to seek health advice on the internet in the study period (see Figure A.1). By contrast, the younger cohort is more likely to participate in social networks, play or download games, films or music.

Second, we find increases in the likelihood of observing episodes that are hardly connected with a simple awareness mechanism. Specifically, Table 3 shows the impact of broadband internet on the likelihood of observing episodes of self-harm (column (1)) or compulsory hospitalization (column (2)) in the 1985-1995 cohort.

[20]Similarly, doctors may now be better informed and more likely to diagnose a mental disorder.

Table 3: IV estimates: self-harm and compulsory hospitalizations

	Self harm (1)	Compulsory hospitalization (2)
Males 1985-1995	0.083***	0.143***
	(0.016)	(0.029)
Females 1985-1995	0.046*	0.047***
	(0.024)	(0.018)
Observations	63496	63496
1st stage Wald F-stat	63.97	63.97
Municipality controls	Y	Y
Municipality FE	Y	Y
Region-Year FE	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Self-harm refers to cases where hospital doctors registered the presence of suicide attempts or self-inflicted trauma. Expanding the ADSL coverage from 0 to 100% increases the probability of observing a case of a young male inflicting self-harm by 8.3 percentage points, while for females it increases by 4.6 percentage points. The observed increase in the incidence of self-inflicted trauma cannot be rationalized with better access to resources and mental health information only. Similarly, we observe an increase in the occurrence of compulsory hospitalizations (i.e., forced hospitalization due to the possible threat that a patient posed to herself or others).[21] Here again, the coefficient is larger for young male patients (14.3 pp) than for young females (4.7 pp). As in the case of self-inflicted trauma, it is difficult to explain an increase in compulsory hospitalization simply based on an information mechanism.

Finally, we can use the information on whether a hospitalization in our dataset was planned or whether someone was hospitalized urgently. We repeat our main exercise splitting the sample into urgent vs. planned hospitalizations. We hypothesize that if using the internet only improves information access and the matching between patients and providers, only planned hospitalizations should be growing with early internet access. Instead, we can see in Table 4 that the increases are fairly similar in urgent compared to planned hospitalizations. These three

[21] In Italy compulsory hospitalizations are defined as TSO ("Trattamento Sanitario Obbligatorio") by Law 833/1978.

Table 4: IV estimates: split by hospitalization type

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Panel A: urgent hospitalizations					
Males 1985-1995	0.232***	0.230***	-0.002	0.390***	-0.044**
	(0.063)	(0.075)	(0.018)	(0.057)	(0.021)
Females 1985-1995	0.176**	0.097*	0.075*	0.368***	-0.012
	(0.073)	(0.050)	(0.044)	(0.056)	(0.023)
Panel B: planned hospitalizations					
Males 1985-1995	0.251***	0.095***	-0.046	0.300***	0.019
	(0.086)	(0.035)	(0.041)	(0.060)	(0.034)
Females 1985-1995	0.147*	0.072***	0.242***	0.211***	0.101**
	(0.076)	(0.026)	(0.073)	(0.057)	(0.042)
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

findings together suggest a real increase in the actual incidence of mental health symptoms and not merely in the rates of detection.

7 Discussion

While the advantages of digital technologies are undisputed, studies providing causal evidence on the harmful effects on mental health remain rare. This paper provides the first causal estimation of the relationship between internet access and specific mental disorders diagnosed by doctors. We document economically and statistically significant increases in depression/anxiety disorders, drug abuse/addiction, and personality disorders among patients born after 1985. The affected population was thus 10-28 years old during our study period. In addition, we find significant raises in eating and sleep disorders among female patients in the same cohort. We find no impact among the older cohort, born before 1984.

From a conceptual standpoint access to the internet can influence mental health in various ways, both positively and negatively (Castellacci and Tveito, 2018). On the negative side, internet use can crowd out activities that are beneficial to mental health, such as spending time with family and friends, exercising, or sleeping (Twenge, 2017; Giuntella et al., 2021). Also, certain online activities, such as the use of social media or gambling, can lead to addictive behavior (Allcott et al., 2022; WHO, 2018; Zastrow, 2017), and repeated media exposure to collective traumas can trigger psychological distress (Holman et al., 2014). People may also behave in more impulsive, narcissistic, and aggressive ways when they are online (Suler, 2004), which can translate into worse socializing behavior offline (Aboujaoude, 2016).

On the positive side, the internet makes it easier for individuals experiencing mental disorders to access information about these pathologies, learn about potential treatments, and seek the help of health professionals (Powell and Clarke, 2006). Such increased awareness could, on the one hand, lead to a higher number of diagnoses even if the underlying prevalence of the disorders remains unchanged. On the other hand, better information can allow patients to treat their disorders earlier on, preventing more severe symptoms, and reducing the need for hospitalization.

Our results speak in favor of a true increase in mental disorder prevalence—rather than just increased awareness—as we also identify raises in self-inflicted harm, compulsory, and urgent mental health hospitalizations. Finally, as we focus on a period of early penetration of social media, our findings highlight that the deteriorating impact of the internet on mental health may be driven by several factors besides these specific digital platforms.

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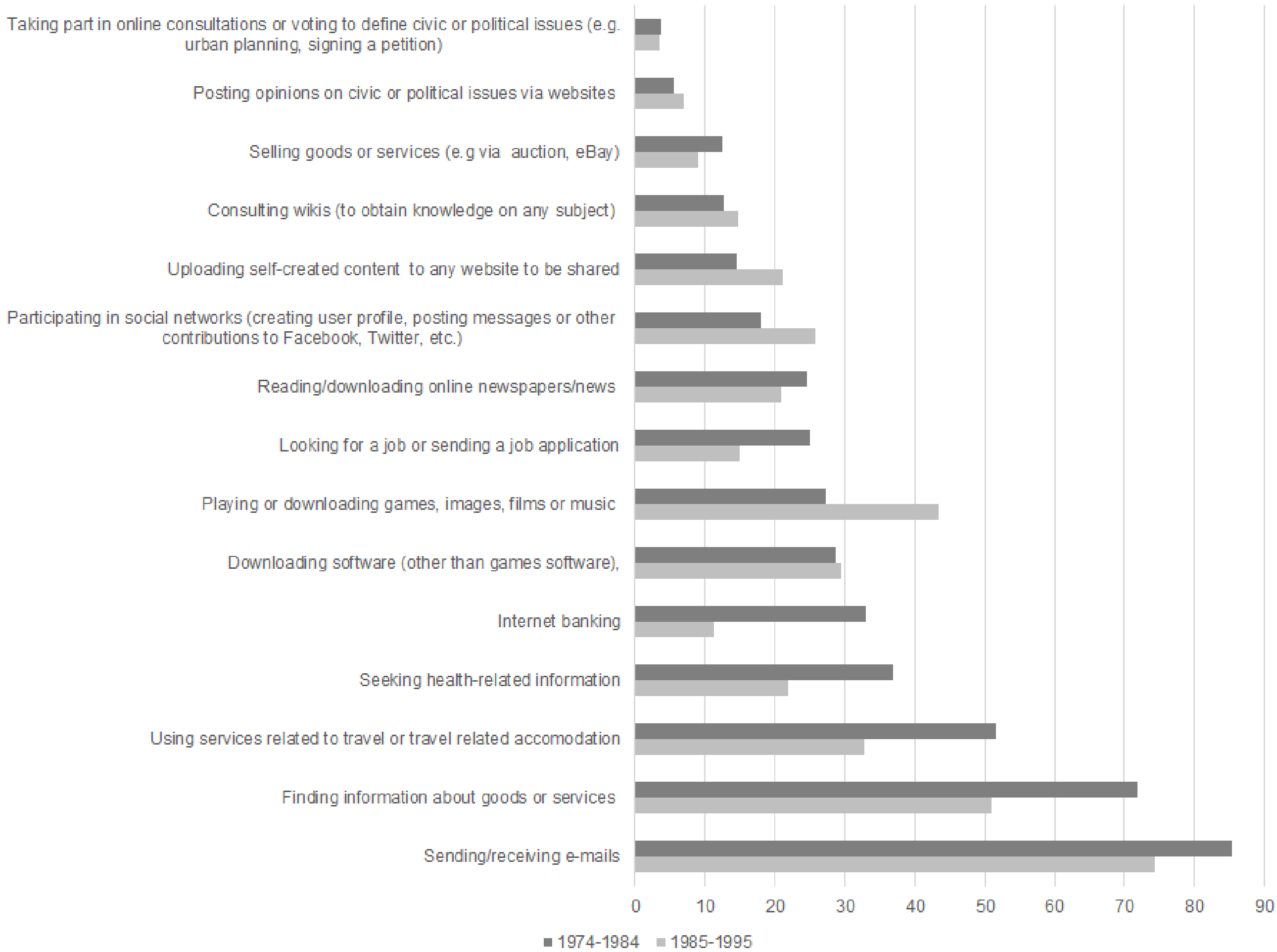
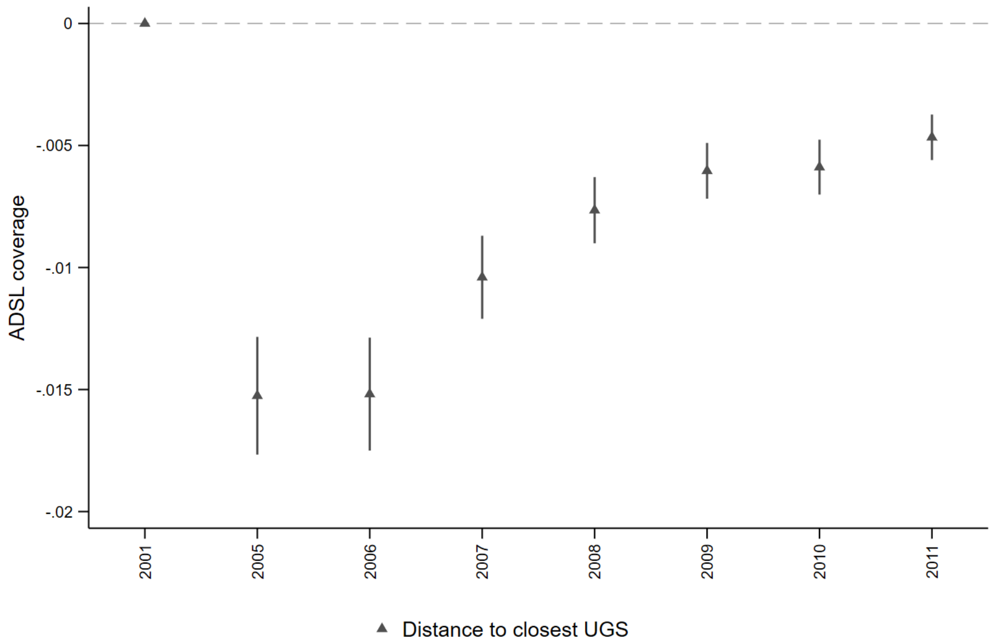
Appendix Figures and Tables

Figure A.1: Share of individuals by birth cohort who accessed the internet in the last three months by activities (2005-2013)



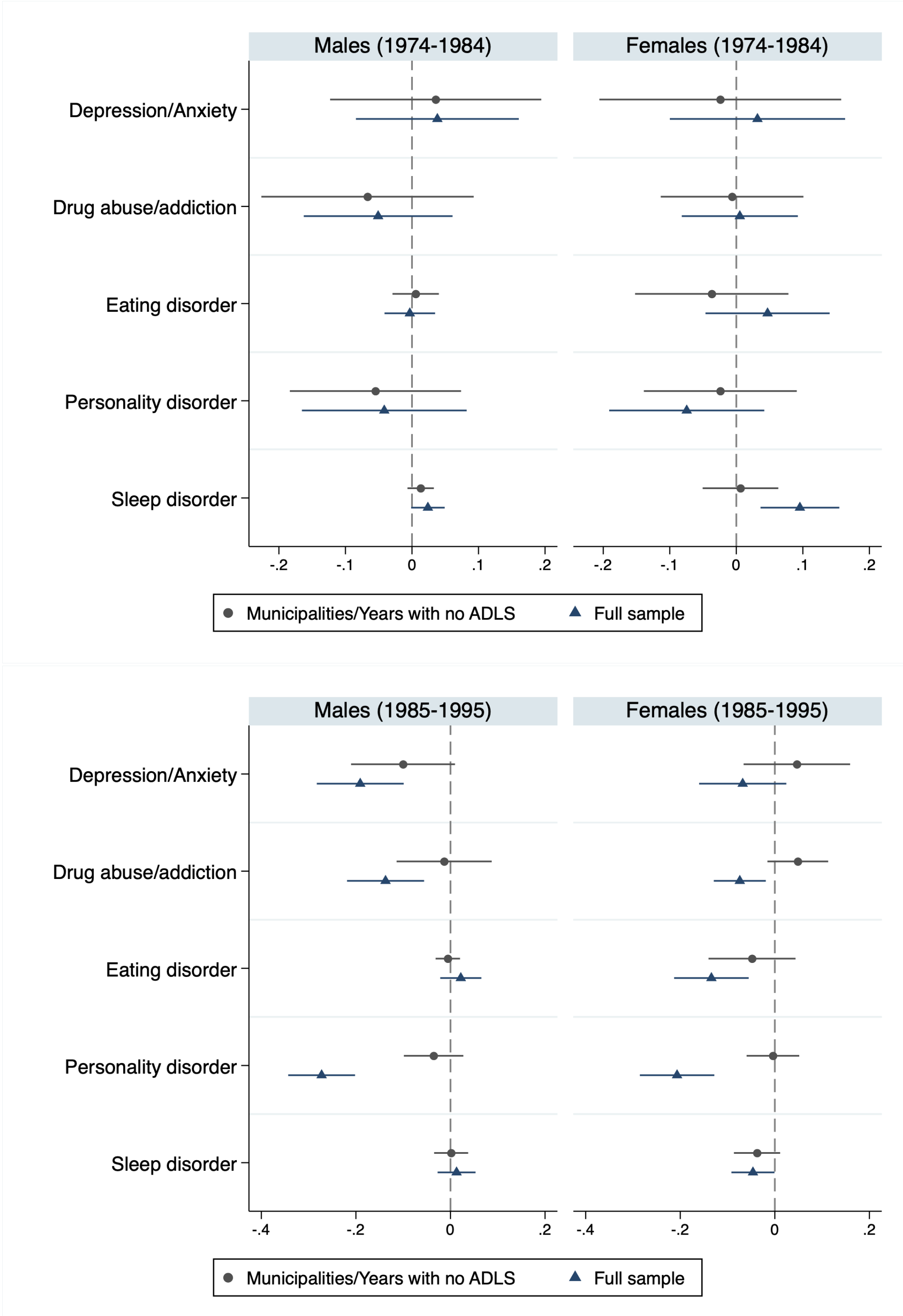
Source: ISTAT Multipurpose survey on households: aspects of daily life (2005-2013).

Figure A.2: First stage relationship: distance to UGS and ADSL coverage by year



Source: Data on fixed broadband was provided by "Osservatorio Banda Larga-Between".

Figure A.3: Reduced-form relationships with and without ADSL penetration



Notes: The figures depict the results (coefficients and 95% confidence intervals) from the regressions of each outcomes on the distance to the closest UGS (in hundreds Km)×Post2001 (i.e., the IV) for two sets of data: (i) the full sample (all municipalities in years 2001 and 2005 to 2011) and (ii) a subset of it containing an imbalanced panel of municipalities/years with no ADSL penetration. The latter is used to run placebo regressions and inspect the relationship between the outcomes and the IV in places/years with no ADLS. All regressions include controls reported in Table 1.

Table A.1: Summary statistics (years covered: 2001, 2005-2011)

	Observations	Mean	SD	Min	Max
Hospitalizations					
Depression/anxiety	63496	0.43	0.49	0.00	1.00
Substance abuse/addiction	63496	0.30	0.46	0.00	1.00
Eating disorder	63496	0.17	0.38	0.00	1.00
Personality disorder	63496	0.35	0.48	0.00	1.00
Sleep disorder	63496	0.07	0.25	0.00	1.00
Self harm	63496	0.05	0.21	0.00	1.00
Compulsory hospitalization	63496	0.09	0.29	0.00	1.00
Municipality characteristics					
ADSL Internet (midpoints)	63496	0.65	0.45	0.00	0.98
Number of years with good ADSL (>50%)	63496	2.44	2.32	0.00	7.00
3G Internet Coverage	46882	0.62	0.43	0.00	1.00
Distance to closest capital city (km)	63496	23.39	13.24	0.00	209.80
Distance to closest SGU (km)	63496	14.03	8.89	0.00	212.02
Population aged 0-19	63496	0.18	0.04	0.00	1.00
Population aged 20-39	63496	0.26	0.03	0.00	0.45
Population aged 40-59	63496	0.28	0.02	0.00	0.57
Population aged 60-79	63496	0.22	0.04	0.00	0.55
Population aged 80 above	63496	0.06	0.03	0.00	0.31
Population	63496	7451	40933	33	2752637

Notes: information on 3G Internet Coverage is missing for years 2005 and 2006.

Table A.2: Summary statistics hospitalizations by birth cohorts and gender (2001-2013)

	Depression or anxiety	Drug abuse or addiction	Eating disorder	Personality disorder	Sleep disorder	Self-harm	Compulsory hospitalization
N	105105	105105	105105	105105	105105	105105	105105
Males 1974-1984							
Mean	0.18	0.18	0.01	0.18	0.01	0.01	0.05
SD	0.39	0.38	0.10	0.39	0.08	0.12	0.22
Females 1974-1984							
Mean	0.25	0.09	0.09	0.17	0.03	0.02	0.03
SD	0.43	0.28	0.28	0.37	0.17	0.14	0.17
Males 1985-1995							
Mean	0.10	0.08	0.02	0.08	0.01	0.01	0.02
SD	0.30	0.27	0.13	0.28	0.10	0.08	0.13
Females 1985-1995							
Mean	0.14	0.05	0.10	0.08	0.03	0.01	0.01
SD	0.35	0.21	0.30	0.27	0.16	0.10	0.09

Table A.3: IV estimates: total hospitalizations (log)

Dep. var.: log	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995	0.455***	0.335***	-0.030	0.632***	-0.025
	(0.097)	(0.075)	(0.035)	(0.088)	(0.030)
Females 1985-1995	0.391***	0.165***	0.363***	0.540***	0.071**
	(0.099)	(0.046)	(0.088)	(0.086)	(0.035)
Observations	63496	63496	63496	63496	63496
1st stage Wald F-stat	63.97	63.97	63.97	63.97	63.97
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.4: IV estimates: number of years since good coverage

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995					
Number of years	0.100***	0.072***	-0.011	0.143***	-0.007
	(0.028)	(0.022)	(0.012)	(0.023)	(0.011)
Females 1985-1995					
Number of years	0.036	0.039***	0.071***	0.109***	0.024*
	(0.025)	(0.015)	(0.022)	(0.021)	(0.012)
Observations	63496	63496	63496	63496	63496
1st stage Wald F-stat	54.35	54.35	54.35	54.35	54.35
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.5: 3G estimates (years covered: 2001, 2007-2013)

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995					
3G	0.295***	0.269***	-0.051	0.528***	-0.046
	(0.079)	(0.064)	(0.034)	(0.065)	(0.032)
Females 1985-1995					
3G	0.152**	0.116***	0.183***	0.354***	0.030
	(0.075)	(0.043)	(0.062)	(0.064)	(0.035)
Observations	62312	62312	62312	62312	62312
1st stage Wald F-stat	107.97	107.97	107.97	107.97	107.97
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.6: IV estimates: using primary diagnosis only

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995	0.313***	0.183**	-0.062	0.540***	-0.065*
	(0.073)	(0.074)	(0.041)	(0.078)	(0.036)
Females 1985-1995	0.181**	0.084*	0.210***	0.404***	0.084**
	(0.084)	(0.051)	(0.075)	(0.072)	(0.042)
Observations	63496	63496	63496	63496	63496
1st stage Wald F-stat	63.97	63.97	63.97	63.97	63.97
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.7: IV estimates: using hospitalizations with mental health diagnoses only

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995	0.368***	0.264***	-0.042	0.524***	-0.025
	(0.099)	(0.079)	(0.043)	(0.080)	(0.039)
Females 1985-1995	0.128	0.143***	0.258***	0.397***	0.089**
	(0.090)	(0.054)	(0.078)	(0.075)	(0.045)
Observations	63496	63496	63496	63496	63496
1st stage Wald F-stat	63.97	63.97	63.97	63.97	63.97
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.8: IV estimates: impute zeros for missing years

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995	0.409***	0.323***	-0.049	0.597***	-0.020
	(0.113)	(0.091)	(0.049)	(0.091)	(0.045)
Females 1985-1995	0.173*	0.169***	0.281***	0.459***	0.110**
	(0.103)	(0.0619)	(0.0886)	(0.0850)	(0.0518)
Observations	75451	75451	75451	75451	75451
1st stage Wald F-stat	62.86	62.86	62.86	62.86	62.86
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.9: IV estimates: exclude urban areas

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995	0.334**	0.186*	-0.065	0.481***	-0.057
	(0.138)	(0.109)	(0.055)	(0.112)	(0.054)
Females 1985-1995	0.052	0.048	0.215**	0.323***	0.121**
	(0.126)	(0.075)	(0.107)	(0.103)	(0.060)
Observations	56280	56280	56280	56280	56280
1st stage Wald F-stat	40.43	40.43	40.43	40.43	40.43
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.10: IV estimates: drop municipality controls

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995	0.242***	0.299***	-0.030	0.428***	-0.013
	(0.043)	(0.037)	(0.023)	(0.034)	(0.019)
Females 1985-1995	0.247***	0.208***	0.329***	0.420***	0.117***
	(0.041)	(0.026)	(0.037)	(0.036)	(0.023)
Observations	64680	64680	64680	64680	64680
1st stage Wald F-stat	139.47	139.47	139.47	139.47	139.47
Municipality controls	N	N	N	N	N
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.11: IV estimates: cluster province level

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Males 1985-1995	0.367***	0.264***	-0.042	0.524***	-0.025
	(0.113)	(0.077)	(0.044)	(0.089)	(0.038)
Females 1985-1995	0.131	0.142**	0.258***	0.398***	0.089*
	(0.105)	(0.060)	(0.087)	(0.083)	(0.049)
Observations	63496	63496	63496	63496	63496
1st stage Wald F-stat	28.71	28.71	28.71	28.71	28.71
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.12: IV estimates: cluster region-year level

	Depression or anxiety	Drug abuse or addiction	Eating disorder	Personality disorder	Sleep disorder
	(1)	(2)	(3)	(4)	(5)
Males 1985-1995	0.367***	0.264***	-0.042	0.524***	-0.025
	(0.109)	(0.061)	(0.052)	(0.116)	(0.033)
Females 1985-1995	0.131	0.142**	0.258***	0.398***	0.089**
	(0.107)	(0.070)	(0.096)	(0.088)	(0.045)
Observations	63496	63496	63496	63496	63496
1st stage Wald F-stat	21.23	21.23	21.23	21.23	21.23
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: For a list of municipality controls, see the footnote in Table 1. * Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.13: Reduced-form relationships: years 2001 and 2005-2011.

	Depression or anxiety (1)	Drug abuse or addiction (2)	Eating disorder (3)	Personality disorder (4)	Sleep disorder (5)
Panel A: 1974-1984					
Males	0.038	-0.051	-0.003	-0.042	0.024*
	(0.062)	(0.057)	(0.019)	(0.063)	(0.013)
Females	0.032	0.005	0.047	-0.075	0.096***
	(0.067)	(0.045)	(0.048)	(0.059)	(0.030)
Panel B: 1985-1995					
Males	-0.191***	-0.137***	0.022	-0.273***	0.013
	(0.047)	(0.042)	(0.022)	(0.036)	(0.020)
Females	-0.068	-0.074***	-0.134***	-0.207***	-0.046**
	(0.047)	(0.028)	(0.040)	(0.040)	(0.023)
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: The independent variable is the distance to the closest UGS (in hundreds Km)×Post2001 (i.e., the IV). For a list of municipality controls, see the footnote in Table 1. Significant at 10%, ** significant at 5%, and *** significant at 1%.

Table A.14: Placebo estimates: years 2001 to 2005.

	Depression or anxiety	Drug abuse or addiction	Eating disorder	Personality disorder	Sleep disorder
	(1)	(2)	(3)	(4)	(5)
Panel A: Municipalities without ADSL in 2005					
Males (1974-1984)	0.113	0.021	0.008	-0.106*	0.012
	(0.070)	(0.073)	(0.016)	(0.057)	(0.010)
Females (1974-1984)	-0.129	-0.024	0.022	-0.034	0.004
	(0.084)	(0.049)	(0.054)	(0.049)	(0.027)
Males (1985-1995)	-0.012	-0.034	0.007	-0.031	-0.010
	(0.047)	(0.043)	(0.014)	(0.021)	(0.018)
Females (1985-1995)	0.005	0.016	0.003	-0.005	-0.035
	(0.048)	(0.027)	(0.039)	(0.021)	(0.022)
Observations	19925	19925	19925	19925	19925
Panel B: Municipalities with ADSL in 2005					
Males 1974-1984	-0.059	-0.033	-0.015	-0.062	0.028
	(0.099)	(0.084)	(0.036)	(0.088)	(0.025)
Females 1974-1984	0.209**	-0.004	-0.042	0.055	0.095*
	(0.103)	(0.075)	(0.076)	(0.089)	(0.054)
Males 1985-1995	-0.155**	-0.121*	0.006	-0.145***	-0.015
	(0.073)	(0.063)	(0.043)	(0.055)	(0.040)
Females 1985-1995	-0.075	-0.020	-0.035	-0.153***	-0.114**
	(0.071)	(0.047)	(0.065)	(0.047)	(0.045)
Observations	19760	19760	19760	19760	19760
Municipality controls	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y
Region-Year FE	Y	Y	Y	Y	Y

Notes: The independent variable is the distance to the closest UGS (in hundreds Km)×Post2001 (i.e., the IV). Only municipalities with no ADLS penetration in 2005 are included in Panel A. Both Panels A and B focus on the period between 2001 and 2005. For a list of municipality controls, see the footnote in Table 1. Significant at 10%, ** significant at 5%, and *** significant at 1%.