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High-Speed Internet and Socioemotional Wellbeing in Uruguayan Youth*

Karina Colombo† Elisa Failache‡ Martina Querejeta §

Abstract

This paper analyses the causal effects of exposure to high-speed internet on socioemotional wellbeing in adolescence and youth. We exploit the geographic and cross-cohort differences in fiber optic accessibility given by the fiber-optic-to-the-home (FTTH) project developed in Uruguay in the period 2011-2018. We identify intention-to-treat effects by combining administrative data on FTTH rollout with large survey data specially designed to collect outcomes in youth. Our results show that access to high-speed internet has mixed effects on mental health. Going from 0 to a 100% probability in FTTH accessibility reduces the incidence of feeling lonely in 9 percentage points (pp) but increases the incidence of feeling worried in 9 pp. We also find an increase in the probability of having a medical visit in 10 pp, without statistically significant effects in visits to a psychologist or psychiatrist. Our results further evidence an increase in the probability of alcohol and marijuana consumption, showing that internet access can also affect risky behaviours. The analysis of heterogeneous effects by gender, age, region of residence, and educational background shows that, while the effect on feeling worried is observed across all sub-samples, the reduction in loneliness is mostly explained by boys, individuals under 18, and with lower educational background. Dissatisfaction with their way of being emerges as the leading mechanism behind the detrimental effect on feeling worried. We do not find any evidence on FTTH access displacing offline recreational activities at the extensive margin.

JEL Classification: I12, L86, J13.

Key words: mental health, adolescents, fiber optic.

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1 Introduction

Adolescence is a particularly vulnerable stage for mental development.[1] During this period of transition, individuals experience several milestones that can impact their lifetime emotional wellbeing, with half of mental health disorders beginning in adolescence (Solmi et al., 2022). Socioemotional wellbeing in youth has become a global issue given the increase in the burden of mental health disorders in recent decades, particularly in relation to anxiety, depressive and conduct disorders (Piao et al., 2022). Currently, one in seven adolescents experience some mental health disorder, and suicide is the fourth cause of death for individuals aged 15 to 29 (UNICEF, 2021; WHO, 2021). In this context it is crucial to understand the drivers behind these changes to design adequate policies to prevent and treat mental health conditions that can affect individuals' capabilities in the long run.

At the same time, in the last decades the world has experienced a digital revolution in information and communication technologies, and with this, the invention and rising of the internet has brought many significant changes to the way in which we communicate, learn, work, buy, spend our free time, and interact with health and government services (CEPAL, 2016; WB, 2016). Exposure to internet connectivity has soared in recent years. Internet users worldwide went from close to 2 billion in 2010 to 5 billions in 2021. Young people are even more connected than rest of the population, where 71% of individuals aged between 15 and 24 are connected to the internet compared to 57% in other age groups (ITU, 2021). The internet has affected countless aspects of our lives, posing potential benefits and risks to people's wellbeing. However, there is still limited evidence concerning the effects on socioemotional wellbeing in youth. This paper studies how high-speed internet connectivity has affected mental wellbeing in adolescence and youth in a Latin American country.

We identify the causal effects of high-speed internet by exploiting the fiber optic deployment in Uruguay in the period 2011-2018. The significant expansion in the Fiber-optic-to-the-home (FTTH) network in this country provides an exogenous source of variation, allowing to overcome the usual endogeneity problems in estimating the effects of internet use (i.e., that internet users and non-users are most likely different in unobservable characteristics). Combining this novel data on FTTH accessibility with a large representative survey on youth during the same period, we provide causal evidence on the impacts of high-speed internet accessibility on symptoms of poor mental health and use of health services for individuals between 15 and 24 years of age.

The particular setting in Uruguay provides an instrument for high-speed internet use in the

[1] We follow the UN definition of adolescence and youth: individuals aged between 15 and 24 (UN, NA).

household, allowing us to estimate the intention-to-treat effects of FTTH accessibility. During our period of analysis, the state-owned telecommunication operator provided FTTH accessibility to all households with a fixed telephone line free of charge. Given the underground work required for the network installation, the FTTH deployment followed a geographical order. By including neighbourhood fixed effects, we ameliorate the threats towards the exogeneity of our instrument. The relevance of this instrument is given by the fact that FTTH is a necessary condition to acquire a fiber optic plan. If the household decides to subscribe to this service, the technological change implied in this type of connectivity incentivizes internet use since it provides a faster and more reliable connection, with larger bandwidth. This enables activities that are more data intensive across multiple devices without any loss in quality, most likely increasing internet consumption of images, videos and audio.

A higher internet consumption can affect mental wellbeing through different channels: crowding-out previous activities with new activities that are now enabled by the internet, and changing the efficiency in how we perform certain tasks and activities. Whether the overall effect in youth is positive or negative will depend on the type of internet use of new generations, and particularly, on the socioemotional implications of the activities facilitated by high-speed internet vs the crowded-out ones (Castellacci and Viñas-Bardolet, 2019).

We assess the effects on emotional wellbeing by analyzing the changes in symptoms of poor mental health and use of health services. Outcomes are taken from the National Adolescence and Youth Survey, editions 2013 and 2018. This survey gathers self-reported information on: having felt lonely, worried, afraid or sad, and also on recent visits to a doctor, psychologist or psychiatrist. Additionally, as secondary outcomes we consider self-reported data on regular consumption of psychoactive substances due to their role as risk factors in mental health issues. Given that these dimensions are assessed towards the beginning and the end of the FTTH deployment, we can exploit the variation across cohorts and neighbourhoods to estimate the effects of high-speed internet accessibility on outcomes that are not usually available in nationally representative surveys.

Our results show that going from 0 to 100% probability in high-speed internet accessibility causes a decrease in 9 pp in the probability of feeling lonely, but also an increase in 9 pp in the probability of feeling worried. Considering the average increase in the probability of FTTH accessibility in the period 2013-2018 (from 30% to 83%), these changes resulted in a 5 pp decrease in the probability of feeling lonely and an increase in the probability of feeling worried of the same magnitude. These effects are large considering the overall incidence of these problems. An analysis of heterogeneous effects by gender, age, region of residence, and

educational background in the household shows that the negative effect on feeling worried is observed across all sub-samples. On the contrary, the reduction in loneliness is mostly explained by boys compared to girls, and by individuals with lower educational background. Additionally, young people living outside the capital are more negatively affected, showing also an increase in the probability of having felt afraid and sad. Our results illustrate the complexities of internet accessibility where the use of new technologies results in both benefits and risks, that also depend on background characteristics. In line with previous studies, girls appear as a particularly vulnerable group (McDool et al., 2020; Golin, 2022; Arenas-Arroyo et al., 2022; Guo, 2022).

Regarding the use of health services, our results indicate an increase in the probability of having a medical visit in 10 pp, without observing any effects in visits to a psychologist or psychiatrist. Considering our findings on mental health, this points to the need of improving access to adequate care and treatment of mental health issues. As stated in previous literature, early detection in primary care could be an effective strategy to reduce the treatment gap (WHO, 2018; UNFPA, 2014). Considering the effects on risky behaviours, we find an increase in the probability of monthly or daily consumption of alcohol by 15 pp and of marijuana by 9 pp. This is in line with previous studies showing that the internet can expose young people to substance-related content from their peers, as well as to advertising and media content portraying consumption of psychoactive substances (Braghieri et al., 2022; Primack et al., 2009).

Considering the mechanisms behind our findings, we observe a clear decrease in young people's satisfaction with their way of being. This is consistent with adolescent years as a time of transition into adulthood where individuals form an independent identity, and highlights the risks arising from new types of social interactions that emerged with the rise of high-speed internet. It also relates to previous findings showing that the internet increases social comparisons altering satisfaction with different aspects of life (Sabatini and Sarracino, 2018; McDool et al., 2020). Regarding alternative activities, we do not find any evidence on internet access reducing the probability of offline leisure activities and sports, nor participation in group activities (such as political parties and students unions). Nonetheless, these results should be taken with caution given that they refer only to the crowding-out at the extensive margin, since time use data for this period and population is not available. Additionally, there is no information available to estimate the effects on the breadth and intensity of social interactions (such as information on time spent with friends and family, and number of friends). Given these data limitations, we cannot evaluate the mechanism through which the decrease in loneliness operates.

Our study contributes to the literature in several ways. First, we provide insights on the effects of the internet on socioemotional wellbeing using an exogenous source of variation in the context of a developing country in Latin America. Hence, we expand the current literature that is focused on the developed world. Furthermore, we exploit a rich dataset combining a large nationally representative survey with novel administrative data on internet accessibility in Uruguay, providing results that go beyond a particular sub-population and can be extrapolated to the general population of youth. Additionally, we take advantage of mental health outcomes that are not usually available in regular household surveys. Finally, we contribute to a better understanding of emotional wellbeing in youth, providing evidence to assess the benefits and risks of internet access in a vulnerable population. This is particularly relevant considering that socioemotional skills remain more malleable than cognitive skills throughout youth, providing a window of opportunity for policy interventions aimed at improving socioemotional wellbeing with long-lasting effects (Dahl, 2004). As far as we know, this is the first study to exploit an exogenous variation in internet access to evaluate the effects on mental health for a Latin-American country. Additionally, we are the first to evaluate the effects of high-speed internet using self-reported measures of mental health, in both early and late adolescence. Given that previous studies focused on hospital diagnoses of mental disorders, our results refer to a broader concept of mental health, including also milder symptoms and undiagnosed conditions.

Related Literature. This study relates to the growing literature on the effects of the internet on wellbeing, which has been approached by different disciplines. Castellacci and Tveito (2018) perform a literature review on this topic by analysing articles from the economic, psychological and computer science literature. Most economic papers study the relation with job or life satisfaction using cross-country analysis based on large global surveys. Conversely, computer science and psychology papers are mostly based on original surveys conducted among university students in the US, and analyze a broader notion of psychological wellbeing. The conclusions obtained from the review indicate mixed results of internet use on wellbeing. However, as the authors point out, many papers are correlational, which generates an endogeneity issue given that internet users and non-users are most likely different in many unobservable characteristics. Considering only the studies that exploit an exogenous variation in internet use, Pénard et al. (2013) and Castellacci and Viñas-Bardolet (2019) use peer effects to instrument for internet use to measure life and job satisfaction in European countries, finding positive effects. Another line of studies uses the differences in internet connection infrastructure to identify the causal effects of internet using. Among these group, Sabatini and Sarracino (2017) find a negative effect of social network use on life satisfaction in Italy. Using the same identification, Sabatini and

Sarracino (2018) also find a negative effect on satisfaction with financial situation given by an increase in social comparisons, specially for younger people. Additionally, McDool et al. (2020) use neighbourhood broadband speed as a proxy for internet use in England, and find negative effects on how children aged 10 to 15 feel about school work, appearance, friends and the school they attend. These effects are worse for girls than for boys. Also, Golin (2022) exploits technological aspects in the telecommunication network to instrument for broadband access, finding a negative effect on self-reported mental health for young women in West Germany. Moreover, Donati et al. (2022) find that high-speed internet increases diagnoses of mental health disorders in Italian hospitals among individuals aged 6 to 16 when the internet started to spread in Italy in 2001. Guo (2022) finds that in the Canadian province of British Columbia high-speed wireless the internet increases mental health special needs in teenage girls as reported by schools, following the rise of visual social media in 2010. Arenas-Arroyo et al. (2022) exploit the exogenous variation in the deployment of optic fiber across Spanish provinces, to evaluate changes in hospital diagnoses of behavioral and mental health cases among adolescents aged 15 to 19. They find an increase in the incidence of mental health disorders only for girls. Finally, some studies have focused on social media use. Braghieri et al. (2022) use Facebook roll-out in US colleges in the mid-2000s and find negative effects on student's mental health. Allcott et al. (2020) induce a one-month Facebook deactivation through a randomized experiment, obtaining small but significant improvements in self-reported mental wellbeing.

2 Socioemotional wellbeing and fiber optic

Mental health is defined by the World Health Organization as "a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (WHO, 2022). Mental wellbeing is a basic human right and a broader concept than the absence of mental disorders. It can be related to Amartya Sen's capabilities approach, given that good mental health increases people's freedom to live the life they have reasons to value (WHO, 2014).

Poor mental health is associated with symptoms of mental health disorders even if they are experienced in a more attenuated way, that is, without reaching the necessary thresholds for the diagnosis of a mental condition. There are many mental health disorders, among which the most important in adolescence are: emotional disorders (e.g. anxiety and depression), behavioural disorders (e.g. attention deficit hyperactivity), eating disorders (e.g. anorexia and

bulimia nervosa) and psychosis. There are many risk factors associated to the development of mental health disorders, such as individual characteristics, like genetics and emotional skills, as well as environmental conditions. Additionally, some behaviours are also considered risk factors, among which the abusive consumption of psychoactive drugs has a relevant role (WHO, 2021). Moreover, given that adolescence is a very sensitive period in terms of development, access and use of health services is also a key determinant in how emotional problems in youth translate into mental health issues in adulthood. This is particularly important considering that many people that experience mental health issues do not receive the necessary support. Estimates show that only one third of individuals with depression receive formal mental health treatment, indicating the existence of a significant treatment gap (Moitra et al., 2022).

In this paper, we analyze how recent changes in the social environment generated by high-speed internet have affected mental health in young generations. The internet has changed how we can satisfy human needs in several ways, potentially affecting socioemotional wellbeing through different channels. First, it has improved the efficiency with which we conduct different activities, either because it has reduced the time involved in certain tasks and/or because it has lowered their costs. For example, accessing and sharing information, communicating, buying goods and services, finding entertainment, and accessing government services, among others, can be conducted more efficiently after the internet revolution. This channel could have a direct effect on wellbeing, or an indirect one by freeing-up time and changing time use patterns. A second channel refers to the fact that the internet has enabled new activities that did not exist before. For example, the type of remote social interaction that is offered through digital social networks, instant messaging or video calls, are innovations derived from the internet. Other examples are online gaming, online gambling, and entertainment on demand. Again, this can have direct effects on wellbeing since social interactions are a key part of our emotional state, and also indirect effects depending on how this complements or substitutes other beneficial or detrimental activities. For example, online interactions could substitute face-to-face interactions leading to a lower wellbeing, or they could increase the overall time we spend interacting with others without crowding-out offline activities that are beneficial for mental health (Castellacci and Tveito, 2018; McDool et al., 2020). The internet has mainly affected three aspects of how we interact with others: the breadth of social interactions, since it can be used to expand an individual's social capital; the frequency of social interactions, by providing fast and low-cost tools to communicate with others; and the type of social interactions, given the availability of new online platforms that allow to interact remotely with close friends, family, distance acquaintances and even strangers. These changes expanded the reference group of individuals

potentially altering self-esteem and social and material aspirations, thus affecting satisfaction with different aspects of life. Additionally, they might have also biased individuals' base for social comparisons, given that online social networks are more used to share positive than negative information (Pénard et al., 2013; Sabatini and Sarracino, 2018). Finally, the endless access to online information and entertainment at marginally zero cost could also promote addictive behaviour, enhancing self-control problems (Scott et al., 2017; Allcott et al., 2022).

Overall, these changes can generate a complex set of alterations in the social environment of teenagers, potentially affecting mental health through changes in symptoms related to depression, anxiety and sleep disorders, and unhealthy behaviour. These effects will ultimately depend on individuals' personal traits and social contexts, which determine: how much time they spent online and for which purposes, the characteristics of their offline life, and how internet consumption has shaped satisfaction with their own life (Castellacci and Tveito, 2018).

Our treatment variable allows to disentangle the causal effects of high-speed internet by providing exogenous variation in fiber optic connectivity. This implies that we estimate the impacts of a shift in internet infrastructure, from the cooper network to the fiber optic network. That is, we provide the marginal effects of increasing internet speed and quality due to FTTH accessibility. This type of technology provides more speed, larger bandwidth and more reliable connections, which implies: an increase in speed in the uploading and downloading of large files, an improvement in the streaming of high-quality videos, a better online gaming experience by eliminating latency issues, and the possibility for several appliances and household members to be connected at the same time without loss in quality (Europe, 2022). Additionally, the uploading and downloading of images and videos embedded in social media also benefits from high-speed internet, giving a smoother experience.

Although we are using accessibility to FTTH at the neighbourhood level as our treatment variable, given that this is provided within a country-wide program in a period of significant increases in internet speed worldwide, our results will reflect the general equilibrium effects of FTTH. The availability of high-speed internet plans at the household level brought along changes on the firm's side, with many companies developing new services that became feasible with new technologies. A clear example of this are companies providing online entertainment services related to music, videos and games. For instance, YouTube launched in 2005 and introduced high definition videos in 2009, and Netflix started operating outside the US with its video on demand service in 2010 (Brennan, 2018; Pacella, 2019). Additionally, the internet and social media evolved from being mostly based on text to being based on images and videos, from blogs and chat rooms to visual social networks involving short-form videos, such as Instagram

and TikTok (launched in 2010 and 2017, respectively) (PRC, 2007, 2022). Because of this, our results will not only reflect the partial effects of FTTH accessibility on the households' side, but also the effects that rise from changes on the firms' side in response to this.

3 Background and data

3.1 The Deployment of the FTTH Network in Uruguay

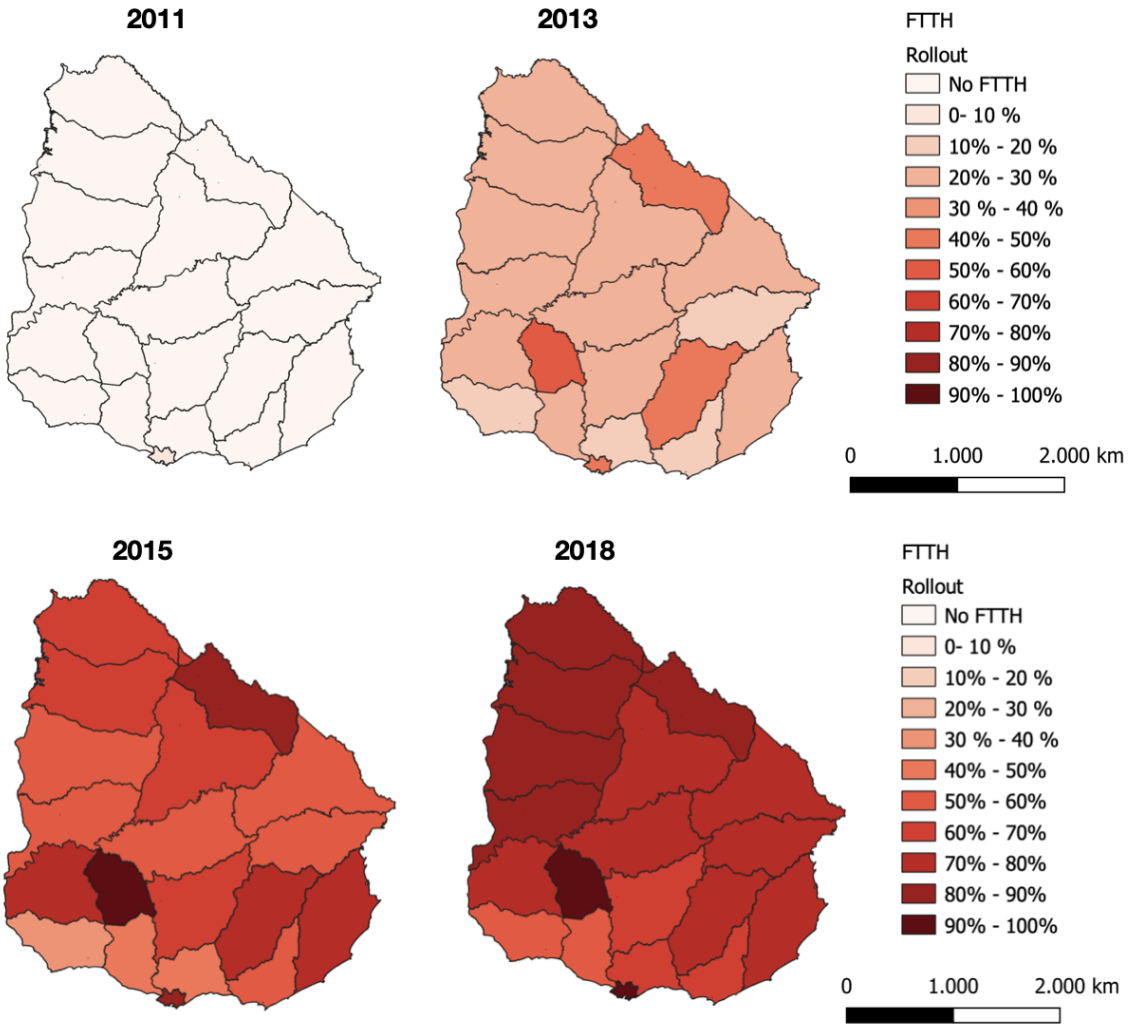
Over the last decades, a wide array of policies were implemented by the Uruguayan government with the aim to foster the ICT sector, provide high-quality internet connection and guarantee digital inclusion. Examples of these policies are: a basic broadband plan that offered entry-level connectivity at no extra cost for households with fixed telephone lines, the one-laptop-per-child program, and the FTTH project. In particular, the FTTH project aimed to provide fiber optic accessibility to all households in the country. To analyze the effects of high-speed internet on socioemotional wellbeing we focus on the implementation of this policy.

The FTTH project started in 2010, led by the state-owned telecommunication operator (ANTEL), which is the only authorized provider for fixed broadband connections in Uruguay (Americas, 2015). The main characteristic of the FTTH network architecture is that fiber optic cables are laid from the provider's central up to the user's dwelling, therefore, the project implied the installation of fiber optic infrastructure to deliver internet connection inside the dwellings. FTTH was added as an alternative to the existing connection through the copper wire telephone network (ADSL). ANTEL provided the base to connect to this new technology free of charge to all households with a fixed telephone line. The goal was to provide fiber optic connectivity to all Uruguayan households, reaching geographical areas that would not have been profitable for private companies. Yearly deployment objectives were set out in terms of the number of households with fiber optic accessibility, regardless of their location.

The deployment was done gradually by geographical areas, and by design of the policy all households within a certain area were reached. Households did not need to register or request the installation in advance. The first fiber optic connection was done in 2011 in the country's capital, quickly expanding to the rest of the country. By the end of 2012, 14% of households with fixed telephone lines had fiber optic accessibility, increasing to 64% by the end of 2014, and to 83% in 2018. The geographic and yearly variation in the FTTH roll-out by administrative units (from now on, departments) is shown in Figure 1.[2]

[2]Uruguay is divided into 19 administrative divisions called departments.

Figure 1: FTTH Rollout by Department



Source: Colombo and Failache (2022)

Once fiber optic cables are connected in the dwelling, clients could choose between staying with their current internet plan or migrating to a fiber optic one. As mentioned, the main advantage of fiber optic is related to its larger bandwidth and speed, together with its higher reliability (lower data loss and interference). In 2011, the FTTH plan with the lowest uploading and downloading speed was two times faster than the best ADSL plan available [3]. This implies an increase in transmission quality allowing users to access services that demand high-quality internet connection, such as high definition video streaming, gaming, etc. Even though the connection was free of charge, migrating to a fiber optic plan implied an increase in the monthly rate paid by the consumers. The comparison of prices is not straightforward given the significant

[3]Information recovered from ANTEL webpage using the Internet Archive Wayback Machine

differences in speed and amount of megabytes between FTTH and ADSL internet plans. To illustrate this point, in 2012 the flat rate FTTH plan was only 5% more expensive than the ADSL flat rate with notorious gains in speed, but the cheapest FTTH plan was four times more expensive than the ADSL one. Because of this fact, treatment take-up is expected to be almost total for consumers with high-end plans. On the other hand, for those with less expensive ADSL contracts, the price difference could refrain them from changing to an FTTH internet plan. Information on treatment take-up is presented in Section 4.

3.2 Internet Data

We obtain information on FTTH accessibility from the database created in Colombo and Failache (2022). This data contains the probability of FTTH accessibility for the period 2012-2018 in urban areas at small geographical units, from now referred as neighbourhoods. The authors combine administrative data provided by ANTEL containing information on the proportion of fixed telephone lines with FTTH accessibility and the deployment of FTTH installation, and Census data provided by the National Institute of Statistics containing information on the number of landlines phones by small geographical areas. The results is a dataset with the yearly probability of FTTH accessibility computed as the ratio between the number of landline phones with access to FTTH in relation to the total number of households with landlines phones per geographical unit.[4]

We then match this data to the survey containing information on socioemotional wellbeing in youth by neighbourhood for the years 2013 and 2018. The matching is done by geographical areas without any loss of information, resulting in 337 neighbourhoods (308 in the capital city and 29 in the rest of the urban country).[5] By using this level of disaggregation we are able to better capture and exploit the geographic variation in fiber optic accessibility over time.

3.3 Youth Data

We obtain data on adolescents and young adults emotional wellbeing from the National Adolescence and Youth Survey (NAYS), which is a large nationally representative sample of young individuals living in Uruguay. This is the main source of information on youth in the country. It has three editions: 1991, 2013 and 2018. In this paper we pooled the cross-sectional data

[4]A detailed description of this data is available in the Data section and Appendix B of Colombo and Failache (2022). Click here to access to the working paper.

[5]The lower level of disaggregation in the rest of the urban country compared to the capital is due to restrictions in the geographic information by region provided by the National Institute of Statistics.

of the 2013 and 2018 editions to analyze changes in adolescents and young adults' emotional wellbeing during the period of the FTTH expansion. The 2013 edition is a probability sample of individuals between 12 and 29 years of age living in urban areas (with 5.000 inhabitants or more), while the 2018 edition is a probability sample of individuals between 12 and 35 years of age living in both urban and rural areas. We follow the UN definition of youth and focus our analysis on individuals between 15 and 24 years of age (UN, NA). For compatibility purposes, we restrict our analysis to individuals living in urban areas. Below we present the number of observations per age and year of the NAYS.

Table 1: Observations per Age and Survey Year

Age in years	2013		2018	
	Obs.	Percentage	Obs.	Percentage
15	249	11.2	267	11.3
16	248	11.2	243	10.7
17	259	11.7	268	11.5
18	250	11.3	279	11.5
19	226	10.2	209	9.5
20	186	8.4	222	8.9
21	199	9.0	225	9.2
22	185	8.3	234	9.1
23	206	9.3	211	9.1
24	209	9.4	213	9.2
Total	2,217	100.0	2,371	100.0

Notes: Columns 2 and 4 report the number of observations per age and NAYS year. Column 3 and 5 report the proportion of observations per age and NAYS year.

Youth socioemotional wellbeing is assessed by using questions in the mental health module and in the use of health services module. Regarding mental health symptoms, individuals were asked if in the last 12 months they felt (a) lonely, (b) so worried they could not sleep, or (c) afraid, with possible answers being: never, rarely, sometimes, often or always. They were also asked about (d) having felt sad or desperate to the point of not being able to do their usual activities, with possible answers yes or no. These answers are taken from the Global Student Health Survey (GSHS) conducted by the World Health Organization (WHO) and the Pan American Health Organization (PAHO), with the technical assistance from the US Centers for Disease Control and Prevention (CDC). The fact that our outcomes are self-reported poses both advantages and disadvantages. On the one hand, it allows us to measure the effects on a broader concept of mental health and not just diagnosed mental health disorders, including also

milder symptoms of poor mental health and undiagnosed conditions. On the other hand, given that these variables are not assessed by a trained professional, they might be more influenced by changes in the likelihood of reporting mental health issues. Nonetheless, most mental health diagnoses are based on subjective outcomes (Braghieri et al., 2022).[6]

In addition, we consider three variables related to use of health services. First, we use an indicator question regarding medical visits in the last year, providing information regarding general medical attention. We additionally use questions related to consultations with mental health professionals, that inquire on having had at least one visit to the psychologist or to the psychiatrist in the last year. Descriptive statistics of these variables are presented in Figure 2 below.[7] Taken together, these questions provide a general sense of self-reported socioemotional wellbeing.[8]

[6]Moreover, given our empirical strategy this would pose a problem if changes in the likelihood to report are correlated with the FTTH deployment.

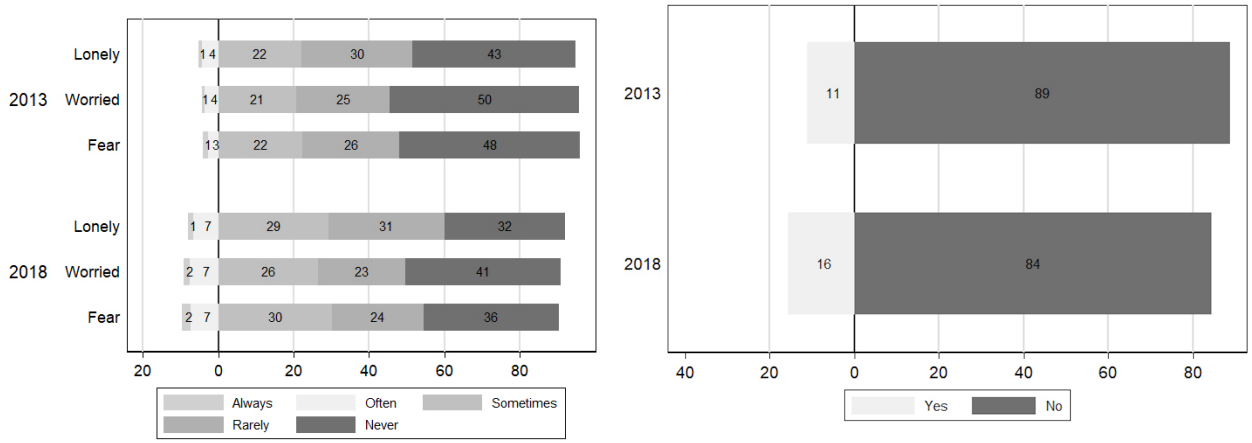
[7]In section A of the Appendix we present the complete phrasing of all questions.

[8]The NAYS also asks about the use of antidepressants, but the phrasing of the question differs between waves. Therefore, we opt to leave it out of the analysis due to comparability issues.

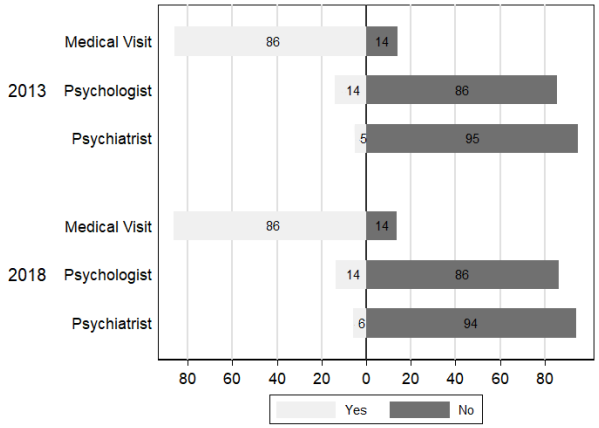
Figure 2: Descriptive Statistics of Mental Health and Use of Health Services

(a) Mental health: lonely, worried, fear.

(b) Mental health: sad.



(c) Use of health services.



Notes: Figures show relative frequencies of questions on mental health and use of health services from the National Adolescence and Youth Survey 2013 and 2018 using sample weights.

Using these questions we define our mental health outcomes as binary variables of potentially problematic situations, categorizing together the two worse categories in each Likert Scale.[9] Outcomes referred to use of health services are left as binary variables considering: medical visits overall, visits to a psychologist and visits to a psychiatrist. Table A.1 in the Appendix presents the details on the construction of our main outcome variables. Overall, we have 4 dimensions on health outcomes, *lonely*, *worried*, *fear* and *sad*, and 3 dimensions on use of health services, *medical visits*, *visits to a psychologist*, and *visits to a psychiatrist*.[10] The descriptive statistics of these variables by year are presented in Table 2 below. Results indicate an increase

[9]The only exception is the variable indicating sadness, given that the original variable is already binary.

[10]We refrain from computing an index for all four mental health outcomes together for two main reasons. First, we did not achieve the Alpha Cronbach's threshold suggesting internal consistency. This threshold is 0.7, and in our setting, this value was 0.6280 when considering the original variables and 0.5634 when considering the binary outcome variables. Second, as we will show in Section 5, the baseline model shows positive effects on loneliness and negative effects on worried, thus, an index would be hiding these mixed individual results.

in all mental health symptoms between 2013 and 2018. Changes range from 2.6 to 6.6 pp, and the difference is significant at the 1% level. Considering the overall incidence of these issues, the worsening of the situation is considerable. Medical visits and visits to psychiatrist also increase in the analyzed period, but the magnitude is smaller (1.6 and 1.8 pp significant at the 10% and 5% level respectively).

Table 2: Descriptive statistics of main outcomes

	2013	**2018**	Diff.	Std. Error
Mental health				
Lonely	0.053	0.081	0.026***	0.008
Worried	0.043	0.091	0.049***	0.007
Fear	0.040	0.097	0.066***	0.008
Sad	0.111	0.156	0.046***	0.010
Use of Health Services				
Medical Visit	0.858	0.862	0.018*	0.010
Psychologist	0.142	0.137	0.004	0.011
Psychiatrist	0.049	0.059	0.016**	0.007

Notes: The table present the means and mean differences of the main outcomes using sample weights. ***significant at the 1% level, **5% level, *10% level.

In addition to the main outcomes, we analyze the consumption of psychoactive substances as secondary outcomes, given their importance as risk factors for mental health issues. The survey asks about drugs consumption of alcohol, marijuana and cocaine.[11] We create three separate indicator variables for the consumption of each of these drugs in a monthly or daily basis.

To understand the mechanisms behind the main results we employ several questions. First, given that internet access may affect self-esteem and social comparisons, we consider satisfaction questions on different domains of life. Young individuals were asked about how they felt with their way of being with possible answers being: very satisfied, satisfied, not satisfied and very dissatisfied. Related to that, the survey has a module on life satisfaction, where individuals were asked how they felt about their relationships with their friends, with their couple and with their family; how they felt about their personal financial situation, their household financial situation and about the house they live in; how they felt about their educational achievements, their work situation and life in general. In this module, answers could take the following values: very satisfied, satisfied, indifferent, dissatisfied, and very unsatisfied. We group the life satisfaction variables regarding personal relationships into one category, as well as the ones referring to personal finances, obtaining six dimensions of satisfaction: way of being,

[11]The survey also asks about cigarettes and other drugs. However, the way in questions are formulated is not comparable.

relationships, finances, education, work and life. Again we compute these as binary variables categorizing together the two worse categories in each Likert Scale.

Second, we consider variables related to participation, offline leisure and sport activities, to evaluate the potential crowding-out of alternative activities with internet access. On one side, we construct an aggregate variable that indicates if the individual is engaged in group activities, such as political parties and students unions, among others.[12] We also create a variable that indicates if the individual went at least once in the last month to recreational spaces such as the cinema or theater.[13] Finally, we use a variable that measures the number of days in a week that the respondent did sports or physical activities.

Given that the NAYS uses the National Household Survey (NHS) as sampling frame we combine both surveys to obtain further information on youth demographic and socioeconomic characteristics. First, as control variables we include the following invariant or pre-treatment individual characteristics: a dummy variable indicating white ethnic origin, the department of birth, and a dummy variable indicating if they attended primary school in the public system. We also include pre-treatment variables at the neighbourhood level, such as the average income per capita and the percentage of households with sanitation by neighbourhood in 2010. Second, educational background computed as a dummy variable indicating whether the average years of education in the respondent's household is less than 9 (lower secondary school), is used to explore potential heterogeneities. Third, daily and weekly use of the internet among the population aged 15 to 24 is used to explore the relevance of the empirical strategy. Fourth, the information regarding the neighbourhood of residence is also obtained from the NHS, which is the basis to merge the NAYS with the database on FTTH accessibility.

We use survey weights provided by the National Institute of Statistics for our different estimations.

4 Empirical Strategy

To analyze the effects of fiber optic accessibility on youth socioemotional wellbeing outcomes we exploit the geographic and cross-cohort differences in fiber optic penetration. The main specification is the following:

$$y_i = \beta \text{FTTH\_Exposure}_i + \gamma_n + \lambda_t + (Z_n \lambda_t)'\psi + X_i'\alpha + \epsilon_i$$

Where y are the outcome variables specified in section 3.3, i refers to the individual, t to

[12]The question asked on participation in activities related to: churches or religious organizations, ethnicity, students, neighbourhood, cultural, workers union, political, youth groups, sports, recreational, charitable or voluntary organizations, professional associations activities, cooperatives or demonstrations in public roads.

[13]The question asks on having been to the following places: cinema, theatre, concert, soccer field, another sport field, exhibitions, shows, museums, fairs, nightclubs or pubs, pool or bowling areas, shopping malls, parks or to the promenade.

the survey year and n to the neighbourhood of residence of the individual[14]. The treatment assignment variable is FTTH_EXPOSURE, and refers to the probability of FTTH accesiblity in the year of the survey and the neighbourhood of residence of individual i, as defined in section 3.2. Our coefficient of interest is β.

We include γ_n as the neighbourhood fixed effects. This allows controlling for unobservable permanent characteristics specific to the region of residence. λ_t indicates the survey year fixed effects, which mainly controls for year-specific shocks common to all individuals, such as changes due to economic growth in the period. Z_n is a vector of pre-treatment neighbourhood level covariates interacted with λ_t, included to control for survey year trends in baseline characteristics. These variables are the average income per capita and the percentage of households with sanitation by neighbourhood in 2010, before the policy started. X_i is a vector of individual level covariates correlated with the outcome of interest and determined before the treatment, included to reduce the standard errors of the estimated coefficients. These are: age, age square, gender, ethnicity, department of birth, if they attended public primary school, and if they repeated school. By controlling for neighbourhood and survey year fixed effects, we are exploiting the variation derived from having individuals living in the same neighbourhood born in different years.[15]

This strategy identifies the intention-to-treat effect of fiber optic, that is, the effect of being assigned to treatment which occurs when fiber optic becomes accessible in the neighbourhood. Treatment assignment is defined by the FTTH rollout strategy of the internet service provider, which is outside the control of the households and most likely uncorrelated with youth's outcomes after we control for neighbourhood fixed characteristics. The specified regression can be interpreted within an IV approach, where identification is based on the conditional exogeneity of assignment to treatment and the relevance condition implied by an increased probability of treatment when assigned to treatment. Colombo and Failache (2022) provide evidence in favour of these two conditions. On one side, the conditional exogeneity assumption implies that there are no omitted variables affecting both FTTH rollout and youth outcomes, after controlling for static differences across neighbourhoods and for overall differences by year of the survey (given the included fixed effects). This is a non-testable assumption, but Colombo and Failache (2022) find that pre-treatment levels of income per capita and sanitation (percentage of households with flush to piped sewer system) were the main relevant variables in explaining FTTH deployment at the neighborhood level. They show that approximately 60% of the total variation in FTTH rollout across years is explained by static variables at the 2010 level, which is controlled for by the inclusion of neighborhood fixed effects. Moreover, as in Colombo and Failache (2022), we regressed treatment assignment on time-varying characteristics of the indi-

[14]Our data is a pool of repeated cross-sections for different years. Therefore, we do not include the subindex t in the specification, as each individual is observed only once

[15]In the Appendix, Table A.2 presents a detailed definition of the variables included as controls in the regressions, and Table A.3 presents summary statistics.

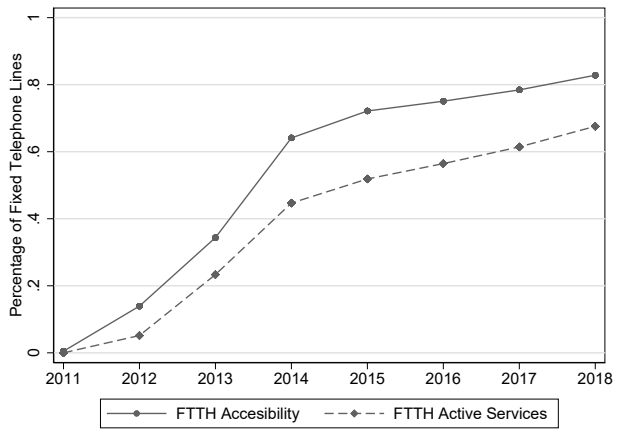
viduals, finding no significant results.[16] In addition, the inclusion of the pre-treatment levels of income per capita and sanitation by neighbourhood interacted with time, allows to control for variation in trends without incurring in the bad controls problem (since the yearly evolution of these variables could be affected by the treatment) (Angrist and Pischke, 2009).

Regarding the relevance condition, the assumption, in this case, is that fiber optic accessibility effectively increases the probability of purchasing a fiber optic plan. If this is not the case, FTTH rollout would not affect internet speed connection and internet consumption decisions. Administrative data from the telecommunications operator -ANTEL- presented in Panel a of Figure 3 shows that the number of fiber optic active plans increased with fiber optic installation. The take-up of the policy was high, with the evolution of FTTH active services closely following the timing of the rollout. By the end of the period, 82% of the clients with fiber optic accessibility had actually purchased a fiber optic plan. In addition, when considering the distribution of copper and FTTH plans among clients with fixed internet contracts, Panel b in Figure 3 shows a clear increasing pattern for fiber optic and a decreasing one for copper plans. Copper internet plans went from representing 100% of the contracts in 2011 to close to 40% in 2018. Regarding internet consumption in youth, survey data for aged 15 to 24 indicates that internet use surged during this period, with the percentage of daily users going from approximately 45% in 2011 to more than 85% in 2018 (Panel c Figure 3). Moreover, the number of hours devoted to the internet increased substantially, going from around 10 hours a week in 2011 to more than 50 in 2018 (Panel d Figure 3).

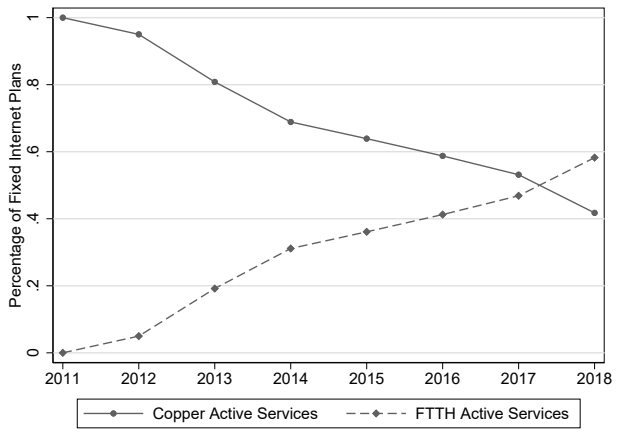
[16] We regressed FTTH exposure on: NBH and survey year fixed effects, survey year trends in pre-treatment assignment variables and varying characteristics of the young individuals. These variable are: income quintile, having children, having a couple, having a job and school attendance.

Figure 3: Internet Access and Use

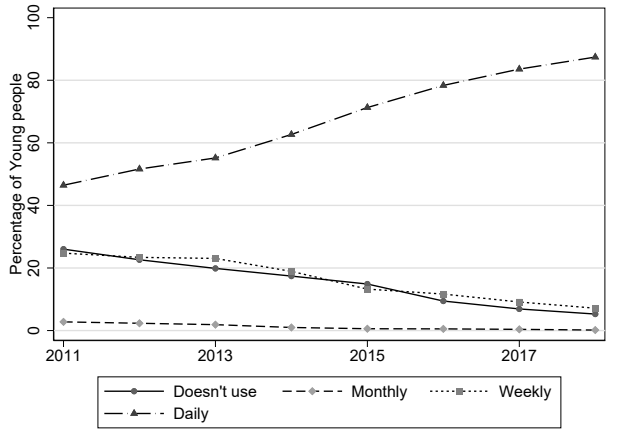
(a) FTTH Accessibility and Active Services.



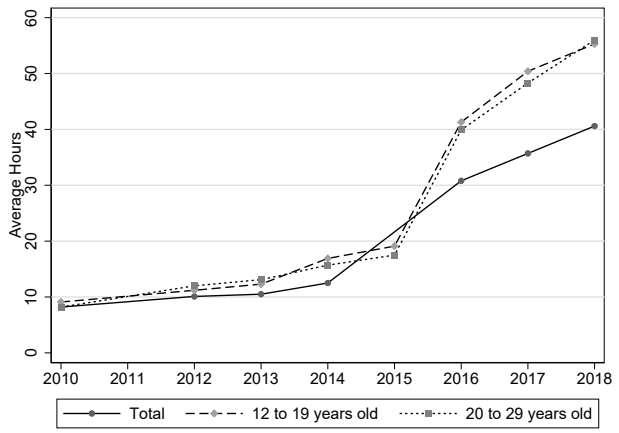
(b) Copper and FTTH Active Services



(c) Youth's Internet Use



(d) Weekly Hours Online



Notes: Figure a is constructed using ANTEL data on FTTH rollout and active services as a proportion of fixed telephone lines given by the 2011 Census. Figure b is constructed using ANTEL data on copper and FTTH active services as a proportion of fixed internet contracts over time. Figure c is constructed using CHS data with survey weights representative for the whole on frequency of internet use for individuals between 15 and 24 years of age. Figure d is constructed using information from the Profile of the Uruguayan Internet Survey collected by RADAR.

In addition, Table 3 shows the effects of FTTH exposure on internet access, daily internet use and weekly internet use un the population aged 15 to 24 using the NHS survey. Results show that, although we do not observe an effect on internet access, FTTH exposure increases internet use. This result is in line with the increase in the intensive margin observed for this population in the period of analysis.

Table 3: Relevance of FTTH exposure

	Internet Access	Daily Use	Weekly use
Panel a: without controls			
FTTH Exposure*	0.06	0.10**	-0.09**
	(0.08)	(0.04)	(0.05)
P-value	0.46	0.03	0.05
P-value WCB	0.57	0.02	0.03
Lower bound WCB	-0.09	0.02	-0.19
Upper bound WCB	0.22	0.19	-0.01
N	4,539	4,537	4,537
Panel b: with controls			
FTTH Exposure*	0.06	0.10**	-0.10**
	(0.08)	(0.05)	(0.05)
P-value	0.45	0.03	0.04
P-value WCB	0.54	0.01	0.03
Lower bound WCB	-0.09	0.02	-0.19
Upper bound WCB	0.23	0.19	-0.01
N	4,536	4,534	4,534

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure* is the probability of having FTTH in the neighborhood the year the individual was surveys in the NHS. *Internetaccess* is a binary variable indicating that the household has internet access. *Daily Use* and *Weekly Use*, are binary variables with value 1 if the individual use internet daily, or weekly, respectively. The three variables are obtained from the NHS.

We estimate our models by using OLS regressions with clustered standard errors at the district level for observations in the capital city, and at the department level for the rest of the country. By using a higher level of aggregation for the clustering of errors compared to the treatment variable, we are being conservatives in trying to avoid correlations within clusters. Standard errors are estimated using the Liang-Zeger cluster robust standard errors. We also present the p-values using Wild Cluster Bootstrap (WCB) to account for potential issues when the number of observations across clusters is substantially different.

5 Results

This section presents the intention-to-treat effects of high-speed internet exposure on youth mental wellbeing. Tables 4 and 5 present the estimated β coefficients associated with going

from 0 to 100% probability of FTTH accessibility as defined in Section 4. Results are reported for the mental health and use of health services outcomes respectively, without (Panel a) and with (Panel b) individual controls. Overall, we provide evidence of mixed effects from the possibility of having FTTH on mental health dimensions.

Table 4 shows, on the one side, that having access to FTTH in the neighbourhood decreases the probability of always or very often feeling lonely during the last year by 9 percentage points (pp). On the other side, having access to FTTH increases the probability of always or very often having problems to sleep because of feeling worried by the same magnitude, indicating a worsening in this symptom of poor mental health. These effects imply that the mean changes in the probability of FTTH accessibility that took place between 2013 and 2018, going from 30% to 83%, resulted in a 5 pp decrease in the probability of feeling lonely and an equal increase in the probability of feeling worried. Effect sizes are large compared to a mean of 5% and 4% in 2013 for each symptom. The coefficients for feeling fear and feeling sad are positive, although not statistically significant. The results remain stable with and without controls.

Our results indicating an increase in symptoms of poor mental health build over previous evidence showing that access to high-speed internet and social media worsens mental health symptoms and increases mental disorders in adolescents and young adults (McDool et al., 2020; Golin, 2022; Donati et al., 2022; Arenas-Arroyo et al., 2022; Allcott et al., 2020; Braghieri et al., 2022). On the contrary, the reduction in self-reported loneliness constitutes a novel result given that it had not been previously explored in the literature.

Table 4: Effects of FTTH exposure on Mental Health

	Lonely	Worried	Fear	Sad
Panel a: without controls				
FTTH Exposure	-0.09*	0.10***	0.03	0.05
	(0.05)	(0.04)	(0.04)	(0.05)
P-value	0.06	0.02	0.50	0.31
P-value WCB	0.09	0.01	0.49	0.32
Lower bound WCB	-0.17	0.04	-0.04	-0.04
Upper bound WCB	-0.00	0.16	0.09	0.14
N	4,539	4,539	4,539	4,530
Panel b: with controls				
FTTH Exposure	-0.09*	0.09***	0.03	0.05
	(0.05)	(0.04)	(0.04)	(0.05)
P-value	0.05	0.02	0.54	0.39
P-value WCB	0.09	0.00	0.53	0.40
Lower bound WCB	-0.17	0.03	-0.04	-0.05
Upper bound WCB	-0.01	0.16	0.09	0.14
N	4,536	4,536	4,536	4,527

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors are reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Value are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure is the probability of having FTTH in the neighborhood. *Lonely*, $Worried$, $Fear$,and *Sad* are binary variables with value 1 indicating a worse situation, as defined in Section 3.3.

Table 5 shows the results for the variables related to use of health services. FTTH accessibility in the neighbourhood increases the probability of attending a medical visit in the last year by 11 pp. This effect size is moderate compared to a mean of 86% in 2013. Considering the mean changes in the probability of FTTH accessibility between 2013 and 2018, this coefficient translates into an effect of 6 pp. We find no effects of FTTH accessibility on having visited a psychologist, although not precisely estimated. The coefficient for having visited a psychiatrist is negative, but not statistically significant. Coefficients are stable with and without controls. The result concerning the increase in medical visits could be interpreted in several ways. On the one hand, it could be taken as a proxy for poor mental health, as it points to an increase in health issues that need medical support. On the other hand, FTTH accessibility could have increased information access and awareness on health issues, reducing the costs of accessing health services, and increasing their use. More data and research is needed to further explore the mechanisms behind this result.

Table 5: Effects of FTTH exposure on Use of Health Services

	Medical Visit	Psychologist	Psychiatrist
Panel a: without controls			
FTTH Exposure	0.10*	-0.01	-0.04
	(0.06)	(0.06)	(0.04)
P-value	0.09	0.92	0.24
P-value WCB	0.09	0.91	0.21
Lower bound WCB	0.00	-0.10	-0.10
Upper bound WCB	0.20	0.10	0.01
N	4,539	4,533	4,533
Panel b: with controls			
FTTH Exposure	0.11*	0.00	-0.04
	(0.06)	(0.06)	(0.04)
P-value	0.05	0.95	0.29
P-value WCB	0.05	0.94	0.26
Lower bound WCB	0.02	-0.09	-0.10
Upper bound WCB	0.21	0.10	0.02
N	4,536	4,530	4,530

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors are reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Value are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure is the probability of having FTTH in the neighborhood. $Medical\ Visit$, $Psychologist$, and $Psychiatrist$ are binary variables with value 1 indicating a worse situation, as defined in Section 3.3

Table A.10 in the Appendix further shows the effects of internet exposure on risky behaviours. We find an increase in 15 pp in the probability of consuming alcohol monthly or daily, and an increase in 9 pp in the monthly or daily consumption of marijuana (although not statistically significant at conventional levels, p-value of 0.13). No effects were found on monthly or daily consumption of cocaine.

5.1 Robustness

To assess the robustness of our results, we first perform a multiple hypothesis testing analysis. Table A.11 shows the traditional p-values estimated using Liang-Zeger cluster robust standard errors, the resample p-values using the same standard errors, and the Romano-Wolf p-values. The results observed for feeling lonely, worried and for medical visits remain statistically different from zero both using the resample and the Romano-Wolf p-values.

In addition, we consider different outcome and treatment variables. First, we modify the mental health outcome variables grouping the responses in a different way. For the outcomes referring to feeling lonely, worried and fear, we added the category "sometimes" as problematic (together with "always" and "often").[17] The results show that the coefficients for feeling lonely and worried are qualitatively similar to our main estimation, but slightly lower in magnitude and non statistically significant (Table A.12). We interpret this result as suggesting that the effect of FTTH on mental health is explained by the extreme negative side of the distribution.

We also re-estimate our results considering the original categorical variables for feeling lonely, worried and fear, while still grouping more extreme categories (often and always) due to the small number of responses observed in each one separately.[18] Table A.13 shows that the coefficient for feeling lonely remains statistically significant, while the one for feeling worried becomes non-significant. We interpret the absence of negative and significant results with this change in the construction of our outcomes variables as evidence of the effects being in the extreme part of the negative distribution, without shifting the overall distribution of mental health symptoms, in line with the previous paragraph.

To conclude our robustness checks, we construct two alternative definitions of our treatment variable. First, we use a cumulative FTTH variable, that considers the cummulative probability of having FTTH during the period of FTTH expansion. To compute this variable we sum the yearly probability of having FTTH in the neighbourhood and divide it by the duration of the FTTH project in our period of analysis (7 years of the FTTH project from 2012 to 2018).[19] This provides a measure of cummulative exposure to the FTTH project in our sample. Table A.14 shows that the effects are qualitatively similar to the contemporaneous variable for mental health outcomes. The coefficient for feeling lonely is of similar magnitude and sign, though non-significant. In addition, the negative effect on feeling worried is higher magnitude than with the contemporaneous FTTH variable, and remains significant. This increase in the size of the coefficient in absolute value could be pointing to an effect that increases with time of exposure to the internet. The outcome on medical visits shows a qualitative similar result but it is not statistically significant (Table A.15).

Second, we estimate the model using a binary treatment variable. To do this, we consider as untreated those observations from percentiles 1 to 35 in the distribution of FTTH exposure, and as treated those observations from percentiles 65 to 100. Observations in the central part of the distribution are excluded, as there in no clear criteria regarding the group they belong, increasing measurement error. The results on mental health outcomes are robust to this modifications as shown in Table A.16. Regarding use of health services, the results are qualitatively similar but again not significant (Table A.17).

[17] We cannot modify the variable on feeling sad nor the ones referring to use of health services because they are collected as binary variables in the survey.

[18] Again, we do not modify the outcomes already defined as binary in the survey questionnaire.

[19] We divide individuals surveyed in 2013 and in 2018 by 7 so that higher values represents both a higher probability of having FTTH in the neighbourhood and more years of exposure.

5.2 Heterogeneous effects

As seen in Tables A.4 and A.5 in the Appendix, there are strong differences in our outcome variables by gender, region of residence, and educational background. In this subsection we focus on whether these characteristics are a source of inequality within youth and, therefore, whether having access to high-speed internet has heterogeneous effects across these subpopulations.

Tables 6 and 7 present the estimated coefficients associated with the probability of FTTH accessibility as defined in Section 4 interacted with the predetermined characteristics mentioned above. Results are reported for our preferred specification with individual controls. We present each group coefficient with its respective WCB p-value, and the WCB p-value for the difference between the group coefficients.[20]

Results in Table 6 show that the effect of FTTH exposure on feeling worried is observed across all subgroups. On the contrary, the reduction in feeling lonely is mostly explained by boys compared to girls, and by individuals from low educational background compared to high one. Additionally, young people living outside the capital city are more negatively affected, showing also an increase in the probability of having felt afraid and sad. Overall, our estimates on the effects of high-speed internet on mental health suggest that girls and people from outside the capital are slightly more affected, while there are no significant differences by age. These results illustrate the complexities of internet accessibility where the use of new technologies results in both benefits and risks, that also depend on background characteristics.

The gendered effects positioning girls as a particular vulnerable group is in line with previous studies (McDool et al., 2020; Golin, 2022; Arenas-Arroyo et al., 2022; Guo, 2022). This is particularly important in our setting, since girls experience higher incidence of mental health symptoms for all analyzed outcomes (Tables A.4 and A.5 in the appendix). This is not likely a mechanical consequence of differential self-reporting as similar patterns are observed for severe mental health outcomes as self-harm or suicide.[21]

[20] The WCB p-value for the reference group, the first reported, is the WCB p-value for the treatment coefficient obtained from the estimation, while the WCB p-value for the non-omitted groups is obtained testing that the treatment coefficient plus the interacted coefficient is different from zero using the WCB procedure. The WCB p-value for the difference between groups is the WCB p-value for the interaction term from the estimation.

[21] In 2018 the NAYS asked respondent if they were thinking of the possibility of taking their life in the last year and 6% of girls answer affirmatively to this questions, while for boys the figure is 3%

Table 6: Heterogeneous Effects of FTTH Exposure on Mental Health Outcomes

	Lonely	Worried	Fear	Sad
Panel a: Gender				
Boys	-0.12**	0.08**	-0.02	0.05
Girls	-0.06	0.11***	0.07	0.04
P-value WCB girls-boys	0.06	0.15	0.00	0.84
N	4,536	4,536	4,536	4,527
Panel b: Age				
Under 18	-0.09*	0.10***	0.02	0.04
18 or more	-0.08	0.08*	0.04	0.06
P-value WCB u18-18+	0.74	0.34	0.59	0.54
N	4,536	4,536	4,536	4,527
Panel c: Region of residence				
Outside Capital	-0.12	0.14*	0.14***	0.22**
Capital	-0.09	0.10***	0.04	0.07
P-value WCB capital-outside	0.57	0.35	0.01	0.02
N	4,536	4,536	4,536	4,527
Panel d: Educational background				
Less 9 years	-0.11**	0.11***	0.02	0.03
9 year or more	-0.07	0.08**	0.03	0.06
P-value WCB <9->=9	0.11	0.21	0.55	0.63
N	4,536	4,536	4,536	4,527

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, FTTH exposure, binary indicators for each group of the variable considered for heterogeneous effects, interactions between these groups and FTTH exposure, and control variables not including the one analyzed as heterogeneous effects (age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school). We use sample weights for the estimation. Standard errors are reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. The WCB p-value for the reference group, the first reported, is the WCB p-value for the treatment coefficient obtained from the estimation, while the WCB p-value for the non-omitted groups is obtained testing that the treatment coefficient plus the interacted coefficient is different from zero using the WCB procedure. The WCB p-value for the difference between groups is the WCB p-value for the interaction term from the estimation. FTTH exposure is the probability of having FTTH in the neighborhood. *Lonely*, $Worried$, $Fear$,and *Sad* are binary variables with value 1 indicating a worse situation, as defined in Section 3.3.

Table 7 suggest there are no significant difference by predetermined characteristics on having attended a medical visit or a psychiatrist in the last year. Results for attending a psychologist show significant differences between young people from low and high educated backgrounds, with a negative point estimate in the former and a positive one in the latter. Nonetheless, the effect for each subgroup is not statistically significant. Although the results are inconclusive due to lack of power, they suggest opposite effects in attendance by educational background.

Table 7: Heterogeneous Effects of FTTH Exposure on Use of Health Services

	Medical Visit	Psychologist	Psychiatrist
Panel a: Gender			
Boys	0.13*	0.02	-0.04
Girls	0.10*	-0.01	-0.04
P-value girls-boys	0.52	0.52	0.82
N	4,536	4,530	4,530
Panel b: Age			
Under 18	0.11**	0.01	-0.03
18 or more	0.11	-0.02	-0.06
P-value u18-18+	0.86	0.37	0.20
N	4,536	4,530	4,530
Panel c: Region of residence			
Outside Capital	0.07	0.02	-0.04
Capital	0.11*	0.01	-0.04
P-value capital-outside	0.72	0.77	0.86
N	4,536	4,530	4,530
Panel d: Educational background			
Less 9 years	0.09	-0.02	-0.05
9 year or more	0.13**	0.02	-0.03
P-value <9->=9	0.21	0.06	0.48
N	4,536	4,530	4,530

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, FTTH exposure, binary indicators for each group of the variable considered for heterogeneous effects, interactions between these groups and FTTH exposure, and control variables not including the one analyzed as heterogeneous effects (age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school). We use sample weights for the estimation. Standard errors are reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. The WCB p-value for the reference group, the first reported, is the WCB p-value for the treatment coefficient obtained from the estimation, while the WCB p-value for the non-omitted groups is obtained testing that the treatment coefficient plus the interacted coefficient is different from zero using the WCB procedure. The WCB p-value for the difference between groups is the WCB p-value for the interaction term from the estimation. For each variable, we report the effects for each group with stars indicating their significance level, and the WCB p-values for the test of equal effects between each group and the base group. FTTH exposure is the probability of having FTTH in the neighborhood. *Medical Visit*, *Psychologist*, and *Psychiatrist* are binary variables with value 1 indicating a worse situation, as defined in Section 3.3.

5.3 Exploring mechanisms

This subsection presents the effects of high-speed internet exposure on diverse outcomes in order to explore the mechanisms behind the main results. Tables 8 and 9 show the estimated β coefficients associated with the probability of FTTH accessibility as defined in Section 4.

Results are reported for life dissatisfaction and offline activities without (Panel a) and with (Panel b) individual controls.

Table 8 shows a clear increase in young people's dissatisfaction with their way of being. This is consistent with adolescent years as a time of transition into adulthood where individuals form an independent identity, and highlights the risks arising from new types of social interactions that emerged with the rise of high-speed internet. It also relates to previous findings showing that the internet increases social comparisons altering satisfaction with different aspects of life (Sabatini and Sarracino, 2018; McDool et al., 2020). Dissatisfaction with other aspects of their lives, such as relationships, finances, education, work, and life in general, do not seem to be affected (although imprecisely estimated).

Table 8: Effects of FTTH exposure on Life Dissatisfaction

	Way of being	Relationships	Finances	Education	Work	Life
Panel a: without controls						
FTTH Exposure	0.08*	-0.02	0.06	-0.02	-0.10	-0.02
	(0.04)	(0.04)	(0.08)	(0.06)	(0.13)	(0.03)
P-value	0.07	0.57	0.45	0.71	0.44	0.37
P-value WCB	0.06	0.58	0.45	0.72	0.46	0.35
Lower bound WCB	0.01	-0.08	-0.07	-0.12	-0.32	-0.07
Upper bound WCB	0.16	0.04	0.18	0.09	0.13	0.02
N	4,539	4,539	4,539	4,532	1,711	4,534
Panel b: with controls						
FTTH Exposure	0.08*	-0.02	0.05	-0.03	-0.11	-0.03
	(0.04)	(0.04)	(0.07)	(0.06)	(0.13)	(0.03)
P-value	0.07	0.55	0.46	0.66	0.39	0.31
P-value WCB	0.07	0.57	0.44	0.66	0.42	0.29
Lower bound WCB	0.01	-0.09	-0.07	-0.13	-0.33	-0.07
Upper bound WCB	0.15	0.04	0.17	0.08	0.12	0.02
N	4,536	4,536	4,536	4,529	1,711	4,531

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure is the probability of having FTTH in the neighborhood. $Wayofbeing$, $Relationships$, $Finances$, $Education$, $Work$ and $Life$ are binary variables with value 1 indication a worse situation.

Table 9 shows the results for the extensive margin in alternative activities. We do not find evidence of internet access crowding-out offline leisure activities and sports, nor participation in group activities (such as political parties and students unions). Previous literature shows mixed results on this dimension, with some studies finding evidence from crowding-out in offline activities due to internet use (McDool et al., 2020; Arenas-Arroyo et al., 2022), while other studies do not (Golin, 2022). Our results should be taken with caution given that they

inquire only on the extensive margin since time use data for this period and population is not available. Additionally, there is no information available to estimate the effects on the breadth and intensity of social interactions (such as information on time spent with friends and family, and number of friends). Given these data limitations, we cannot evaluate the mechanism through which the decrease in loneliness operates.

Table 9: Effects of FTTH exposure on Activities

	Participation	Offline Leisure	Sports
Panel a: without controls			
FTTH Exposure	-0.04	0.03	0.42
	(0.08)	(0.04)	(0.34)
P-value	0.61	0.50	0.21
P-value WCB	0.65	0.55	0.23
Lower bound WCB	-0.19	-0.04	-0.15
Upper bound WCB	0.10	0.10	1.00
N	4,539	4,539	4,539
Panel b: with controls			
FTTH Exposure	-0.04	0.03	0.43
	(0.09)	(0.04)	(0.34)
P-value	0.63	0.47	0.21
P-value WCB	0.66	0.52	0.23
Lower bound WCB	-0.20	-0.04	-0.14
Upper bound WCB	0.11	0.10	1.02
N	4,536	4,536	4,536

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure is the probability of having FTTH in the neighborhood. *Relationships*, *Finances*, *Education*, *Work* and *Life* are categorical variables going from 1 to 4.

6 Final remarks

Worldwide one in seven adolescents experience some mental health disorder, and more than two thirds of young people are internet users. Providing robust causal evidence on the relationship between internet exposure and socioemotional wellbeing becomes crucial in this context. In this paper we estimated the causal effects of exposure to high-speed internet on mental health and life satisfaction in adolescents and young adults in Uruguay. Exploiting the geographic and cross-cohort differences in fiber optic accessibility we identify intention-to-treat effects on

socioemotional wellbeing.

Our results point to somewhat mixed results, reducing the incidence of feeling lonely but increasing the incidence of feeling worried and the probability of having a medical visit. Our results further evidence an increase in the probability of consumption of alcohol and marijuana on a monthly or daily basis, showing that internet access can also affect risky behaviours. Our analysis of heterogeneous effects by gender, age, region of residence, and educational background shows that, while the effect on feeling worried is observed across all sub-samples, the reduction in loneliness is mostly explained by boys, and individuals with lower educational background. Moreover, girls and people from outside the capital are identified as particularly vulnerable groups. No significant heterogeneities were found for medical visits. The dissatisfaction with their way of being emerges as the leading mechanism behind the negative effect on mental health, while we do not find any evidence on internet access crowding-out offline activities. Additionally, there is no information available to analyze the mechanism through which the decrease in loneliness operates.

Young people use the internet as a way of being connected with others, but this may also entail negative consequences in other aspects of life. Our results highlight the benefits and risks arising from new types of social interactions that emerged with the rise of high-speed internet. The evidence provided in this paper is relevant in several ways. Firstly, with the proliferation of internet connectivity in the last decade it has become crucial to understand the potential impact of the internet in our wellbeing. The prevalence of mental disorders in young people has increased considerably in recent years, and our study provides compelling evidence on the role of high-speed internet in this regard. Secondly, our research sheds light from a developing country whereas much of the existing literature has focused on the developed world. Lastly, our study provides novel insights into both the positive and negative effects of internet exposure using a broader concept of mental health, which is useful for the design of policies aiming at alleviating potential risks.

This paper provides useful insights for the design of evidence-based policies aimed at adolescents and young adults. Our results show that high-speed internet has a significant impact on mental health, both as a risk factor and as a beneficial tool to relate with others. Therefore, public policies should take this into account by fostering ways to take advantage of this new tool and, at the same time, diminish their vulnerability to the emerged risks. Preventive actions on this area are essential. On the one hand, educational institutions could work with students addressing the challenges of their relationship with the online world, and strengthening their ability to foster a healthy relationship with it. On the other hand, health institutions should particularly consider certain types of internet use as a risk factor in their protocols, particularly at the primary healthcare level. Given our findings, this initial contact with health professionals proves particularly relevant for the adequate referral to mental health specialists, increasing early detection and reducing the treatment gap. Additionally, policies should consider girls and adolescents living beyond the capital city as particularly vulnerable groups, and adjust their

interventions accordingly.

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7 Appendix

A Survey Questions

Outcome Variables

Mental Health Module

(i) How often have you felt lonely in the last 12 months?

(ii) How often have you felt so worried that you can't sleep at night during the past 12 months?

(iii) How often have you felt fear in the last 12 months?

The possible answers are: (1) Never (2) Rarely (3) Sometimes (4) often or (5) Always.

(iv) During the past 12 months, have you felt so sad or desperate for 2 weeks or longer, that you stopped doing your usual activities?

The possible answers are: (1) Yes (2) No.

Use of Health Services Module

(i) In the last year, have you had at least one medical visit?

The possible answers are: (1) Yes (2) No.

(ii) In the last year, did you go to the psychologist at least once?

The possible answers are: (1) Yes (2) No.

(iii) In the last year, did you go to the psychiatrist at least once?

The possible answers are: (1) Yes (2) No.

B Outcome variables definition

Table A.1: Main outcome variables

Category	Name	Description	Computation
Mental health	Lonely	Indicator variable for feeling lonely in the last year.	We use question (i) of the mental health module and assign value 1 if the answers were (5) Always or (4) Often.
Mental health	Worried	Indicator variable for feeling so worried that they had trouble sleeping in the last year.	We use question (ii) of the mental health module and assign value 1 if the answers were (5) Always or (4) Often.
Mental health	Fear	Indicator variable for feeling fear in the last year.	We use question (iii) of the mental health module and assign value 1 if the answers were (5) Always or (4) Often.
Mental health	Sad	Indicator variable for feeling so sad or desperate for 2 weeks or longer, that they stopped doing their usual activities.	We use the row variable (iv) of the mental health module.
Use of health services	Medical visit	Indicator variable for having at least one medical visit in the last year.	We use the row variable (i) of the use of health services module.
Use of health services	Psychologist visit	Indicator variable for having been to the psychologist at least once in the last year.	We use the row variable (ii) of use of health services module.
Use of health services	Psychiatrist visit	Indicator variable for having been to the psychiatrist at least once in the last year.	We use the row variable (ii) of the use of health Services module.

Table A.2: Control Variables

Category	Name	Description
Fixed Effect	Neighbourhood	Categorical variable indicating the neighbourhood (department) of residence of the individual when the CHS took place. Source: CHS.
Fixed Effect	Year	Categorical variable indicating the year when the survey interview took place. Source: NAYS.
Conditional Exogeneity	Sanitation by neighbourhood	Percentage of household with flush to piped sewer system by neighbourhood in 2010. Source: CHS.
Conditional Exogeneity	Income per capita by neighbourhood	Average of the household income per capita by neighbourhood of residence in 2010. The variable includes income from all available sources (labor, pensions, capital, transfers). It does not include imputed income from owner-occupied housing. Source: CHS.
Individual Control	Age and age squared	Age of the individual and its square. Source: NAYS.
Individual Control	Gender	Indicator variable for the gender of the individual. Source: NAYS.
Individual Control	Ethnicity	Indicator variable for white ethnic origin. Source: NAYS.
Individual Control	Department of birth	Department of birth. If born in another country they are coded together as another department. Source: CHS.
Individual Control	Grade retention in primary	Binary variable indicating repetition in at least one year of primary school. Source: NAYS.
Individual Control	Public primary school	Binary variable indicating having attended primary school in the public system. Source: CHS.

Table A.3: Descriptive statistics of predetermined characteristics

	2013			2018		
	Mean	SD	Obs.	Mean	SD	Obs.
Female	0.51	0.50	2,217	0.52	0.50	2,371
Age	19.23	2.89	2,217	19.28	2.87	2,371
White	0.94	0.23	2,217	0.96	0.21	2,371
Born in capital city	0.40	0.49	2,217	0.45	0.50	2,371
Public primary school	0.84	0.37	2,216	0.80	0.40	2,369
Repeated in primary	0.23	0.42	2,217	0.19	0.40	2,371

Notes: The table present the means and standard deviations of the main characteristics for the total sample. The final dataset is composed of individuals between 15 and 24 years old, and living in urban areas of the country. Sample drawn from National Adolescence and Youth Survey 2013 and 2018.

Table A.4: Means of Outcome Variables by Relevant Characteristics - 2013

	Lonely	Worried	Fear	Sad	Medical visit	Psych-ologist	Psych-iatrist	Alcohol	Mari-huana	Cocaine
Panel a: Gender										
Boys	0.04	0.03	0.02	0.09	0.80	0.11	0.04	0.66	0.14	0.01
Girls	0.07	0.06	0.06	0.13	0.92	0.17	0.06	0.51	0.06	0.00
Panel b: Age										
Under 18	0.05	0.03	0.04	0.10	0.89	0.18	0.06	0.47	0.06	0.00
18 or more	0.05	0.05	0.04	0.11	0.84	0.12	0.04	0.64	0.12	0.01
Panel c: Region of residence										
Outside Capital	0.06	0.04	0.03	0.10	0.85	0.13	0.04	0.59	0.05	0.00
Capital	0.04	0.05	0.05	0.12	0.87	0.16	0.06	0.58	0.16	0.01
Panel d: Average years of education in household										
Less than 9	0.08	0.04	0.05	0.14	0.83	0.13	0.05	0.55	0.08	0.00
9 or more	0.03	0.04	0.03	0.09	0.89	0.16	0.05	0.61	0.12	0.01
Panel e: Ethnicity										
Non-white	0.10	0.09	0.06	0.21	0.82	0.16	0.07	0.47	0.08	0.00
White	0.05	0.04	0.04	0.11	0.86	0.14	0.05	0.59	0.10	0.01
Panel f: Grade repetition in primary										
No repetition	0.04	0.04	0.03	0.10	0.88	0.15	0.05	0.61	0.10	0.01
Repetition	0.08	0.06	0.06	0.15	0.79	0.13	0.06	0.50	0.11	0.00
Panel g: Type of primary school										
Private primary	0.03	0.03	0.05	0.08	0.92	0.21	0.06	0.68	0.17	0.01
Public primary	0.06	0.05	0.04	0.12	0.85	0.13	0.05	0.57	0.09	0.01

Notes: The table presents the means of our outcomes related to mental health, use of health services and consumption of psychoactive substances in 2013, by relevant characteristics. All outcome variables are dichotomous. Section 3.3 and Table A.1 present the details on the construction of outcome variables.

Table A.5: Means of Outcome Variables by Relevant Characteristics - 2018

	Lonely	Worried	Fear	Sad	Medical visit	Psych-ologist	Psych-iatrist	Alcohol	Mari-huana	Cocaine
Panel a: Gender										
Boys	0.05	0.06	0.04	0.13	0.82	0.10	0.05	0.49	0.17	0.01
Girls	0.12	0.12	0.16	0.19	0.91	0.17	0.07	0.41	0.08	0.00
Panel b: Age										
Under 18	0.08	0.08	0.10	0.15	0.91	0.16	0.06	0.27	0.07	0.00
18 or more	0.08	0.10	0.09	0.16	0.84	0.13	0.06	0.53	0.15	0.01
Panel c: Region of residence										
Outside Capital	0.09	0.10	0.10	0.17	0.84	0.12	0.05	0.47	0.10	0.01
Capital	0.07	0.08	0.09	0.13	0.89	0.16	0.07	0.43	0.16	0.00
Panel d: Educational background										
Less than 9	0.10	0.10	0.09	0.17	0.81	0.10	0.05	0.42	0.13	0.00
9 or more	0.07	0.08	0.10	0.15	0.91	0.17	0.07	0.48	0.13	0.01
Panel e: Ethnicity										
Non-white	0.09	0.11	0.10	0.15	0.88	0.14	0.08	0.36	0.15	0.00
White	0.08	0.09	0.10	0.16	0.86	0.14	0.06	0.46	0.13	0.01
Panel f: Grade repetition in primary										
No repetition	0.08	0.09	0.10	0.14	0.89	0.15	0.06	0.47	0.12	0.00
Repetition	0.08	0.10	0.09	0.21	0.77	0.10	0.05	0.38	0.15	0.02
Panel g: Type of primary school										
Private primary	0.06	0.08	0.10	0.11	0.96	0.23	0.09	0.49	0.12	0.00
Public primary	0.09	0.09	0.10	0.17	0.84	0.12	0.05	0.44	0.13	0.01

Notes: The table presents the means of our outcomes related to mental health, use of health services and consumption of psychoactive substances in 2018, by relevant characteristics. All outcome variables are dichotomous. Section 3.3 and Table A.1 present the details on the construction of outcome variables.

Table A.6: Internet Uses by Relevant Characteristics - 2013

	Communication	Information	Learn	Buy	Banking	Paperwork	Entertainment	News	Sexuality
Panel a: Gender									
Boys	0.81	0.75	0.11	0.05	0.02	0.09	0.76	0.62	0.09
Girls	0.81	0.79	0.15	0.06	0.02	0.13	0.72	0.66	0.05
Panel b: Age									
Under 18	0.85	0.81	0.12	0.01	0.00	0.00	0.81	0.64	0.05
18 or more	0.79	0.75	0.13	0.07	0.02	0.16	0.71	0.64	0.08
Panel c: Region of residence									
Outside Capital	0.75	0.72	0.02	0.02	0.01	0.08	0.68	0.65	0.07
Capital	0.88	0.84	0.26	0.08	0.03	0.16	0.81	0.63	0.07
Panel d: Educational background									
Less than 9	0.69	0.64	0.06	0.02	0.01	0.03	0.62	0.55	0.06
9 or more	0.93	0.91	0.20	0.08	0.03	0.20	0.86	0.73	0.08
Panel e: Ethnicity									
Non-white	0.64	0.60	0.04	0.01	0.01	0.08	0.61	0.51	0.08
White	0.82	0.78	0.13	0.05	0.02	0.12	0.75	0.65	0.07
Panel f: Grade repetition in primary									
No repetition	0.89	0.86	0.16	0.06	0.02	0.14	0.81	0.71	0.07
Repetition	0.57	0.51	0.04	0.02	0.00	0.02	0.53	0.43	0.05
Panel g: Type of primary school									
Private primary	0.98	0.97	0.34	0.11	0.05	0.26	0.89	0.71	0.07
Public primary	0.78	0.74	0.09	0.04	0.01	0.09	0.71	0.63	0.07

Notes: The table presents the mean of variables related with internet uses in 2013, by relevant characteristics. All outcome variables are dichotomous.

Table A.7: Internet Uses by Relevant Characteristics - 2018

	Communication	Information	Learn	Buy	Banking	Paperwork	Entertainment	News	Sexuality
Panel a: Gender									
Boys	0.93	0.89	0.21	0.09	0.05	0.13	0.92	0.78	0.28
Girls	0.94	0.89	0.24	0.08	0.05	0.17	0.90	0.80	0.21
Panel b: Age									
Under 18	0.92	0.91	0.22	0.02	0.00	0.02	0.93	0.81	0.17
18 or more	0.94	0.88	0.23	0.11	0.07	0.21	0.90	0.78	0.27
Panel c: Region of residence									
Outside Capital	0.93	0.87	0.16	0.06	0.03	0.11	0.91	0.81	0.25
Capital	0.94	0.91	0.31	0.12	0.07	0.20	0.92	0.75	0.24
Panel d: Educational background									
Less than 9	0.88	0.81	0.14	0.04	0.01	0.05	0.84	0.71	0.19
9 or more	0.98	0.96	0.30	0.12	0.08	0.24	0.97	0.85	0.29
Panel e: Ethnicity									
Non-white	0.92	0.81	0.18	0.05	0.02	0.11	0.89	0.77	0.32
White	0.93	0.89	0.23	0.08	0.05	0.15	0.91	0.79	0.24
Panel f: Grade repetition in primary									
No repetition	0.96	0.93	0.26	0.09	0.06	0.18	0.94	0.83	0.27
Repetition	0.84	0.76	0.10	0.04	0.02	0.06	0.81	0.62	0.14
Panel g: Type of primary school									
Private primary	0.98	0.97	0.34	0.17	0.12	0.29	0.99	0.88	0.26
Public primary	0.92	0.87	0.20	0.06	0.04	0.12	0.89	0.76	0.24

Notes: The table presnts the mean of variables related with internet uses in 2018, by relevant characteristics. All outcome variables are dichotomous.

Table A.8: Online Accounts by Relevant Characteristics - 2013

	Email	Facebook or Twitter	Facebook	Twitter
Panel a: Gender				
Boys	0.83	0.88	0.88	0.24
Girls	0.85	0.91	0.90	0.27
Panel b: Age				
Under 18	0.85	0.93	0.92	0.31
18 or more	0.84	0.88	0.88	0.23
Panel c: Region of residence				
Outside Capital	0.79	0.88	0.87	0.23
Capital	0.90	0.92	0.91	0.28
Panel d: Educational background				
Less than 9	0.74	0.85	0.84	0.18
9 or more	0.94	0.94	0.94	0.32
Panel e: Ethnicity				
Non-white	0.79	0.80	0.80	0.19
White	0.84	0.90	0.90	0.26
Panel f: Grade repetition in primary				
No repetition	0.90	0.93	0.92	0.30
Repetition	0.65	0.80	0.80	0.13
Panel g: Type of primary school				
Private primary	0.98	0.97	0.97	0.43
Public primary	0.82	0.88	0.88	0.22

Notes: The table presents the mean of online social media accounts in 2013, by relevant characteristics. All outcome variables are dichotomous.

Table A.9: Online Accounts by Relevant Characteristics - 2018

	Email	Facebook or Twitter	Facebook, Twitter Instagram or Snapchat	Facebook	Twitter	Instagram	Snapchat
Panel a: Gender							
Boys	0.84	0.91	0.96	0.89	0.34	0.81	0.28
Girls	0.88	0.90	0.96	0.86	0.36	0.83	0.34
Panel b: Age							
Under 18	0.83	0.90	0.97	0.85	0.39	0.86	0.42
18 or more	0.87	0.91	0.95	0.89	0.33	0.80	0.26
Panel c: Region of residence							
Outside Capital	0.84	0.91	0.96	0.88	0.35	0.81	0.33
Capital	0.88	0.90	0.96	0.88	0.36	0.83	0.28
Panel d: Educational background							
Less than 9	0.75	0.89	0.94	0.87	0.24	0.75	0.25
9 or more	0.95	0.92	0.97	0.88	0.45	0.88	0.36
Panel e: Ethnicity							
Non-white	0.79	0.88	0.96	0.85	0.26	0.75	0.22
White	0.86	0.91	0.96	0.88	0.36	0.82	0.31
Panel f: Grade repetition in primary							
No repetition	0.91	0.91	0.97	0.88	0.40	0.85	0.34
Repetition	0.68	0.88	0.92	0.86	0.17	0.70	0.18
Panel g: Type of primary school							
Private primary	0.98	0.93	0.99	0.87	0.52	0.91	0.47
Public primary	0.83	0.90	0.95	0.88	0.32	0.80	0.27

Notes: The table presents the mean of online social media accounts in 2018, by relevant characteristics. All outcome variables are dichotomous.

C Additional results

Table A.10: Effects of FTTH exposure on drugs consumption

	Alcohol	Marijuana	Cocaine
Panel a: without controls			
FTTH Exposure	0.15*	0.09	0.00
	(0.08)	(0.06)	(0.01)
P-value	0.06	0.12	0.95
P-value WCB	0.06	0.13	0.95
Lower bound WCB	0.02	-0.01	-0.02
Upper bound WCB	0.28	0.19	0.02
N	4,539	4,539	4,539
Panel b: with controls			
FTTH Exposure	0.15*	0.09	0.00
	(0.08)	(0.06)	(0.01)
P-value	0.05	0.13	0.98
P-value WCB	0.06	0.15	0.97
Lower bound WCB	0.02	-0.01	-0.02
Upper bound WCB	0.29	0.18	0.02
N	4,536	4,536	4,536

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors are reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Value are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure is the probability of having FTTH in the neighborhood. *Alcohol*, *Marijuana*, and *Cocaine*, are binary variables with value 1 indicating the consumption of that drug monthly or daily in the last year, as defined in Section 3.3.

D Robustness checks

Table A.11: Multiple hypothesis testing

	Model p-value	Resample p-value	Romano-Wolf p-value
Lonely	.052	.038	.097
Worried	.017	.001	.029
Fear	.541	.394	.649
Sad	.392	.274	.587
Medical Visits	.053	.016	.097
Psychologist	.953	.942	.942
Psychiatrist	.288	.194	.488

Table A.12: Effects of FTTH exposure on Mental Health - with alternative outcome definition

	Lonely	Worried	Fear
Panel a: without controls			
FTTH Exposure	-0.07	0.03	-0.07
	(0.08)	(0.09)	(0.10)
P-value	0.38	0.72	0.50
P-value WCB	0.34	0.73	0.48
Lower bound WCB	-0.22	-0.14	-0.25
Upper bound WCB	0.08	0.22	0.14
N	4,539	4,539	4,539
Panel b: with controls			
FTTH Exposure	-0.06	0.03	-0.06
	(0.07)	(0.09)	(0.10)
P-value	0.37	0.73	0.56
P-value WCB	0.34	0.74	0.54
Lower bound WCB	-0.21	-0.14	-0.25
Upper bound WCB	0.08	0.22	0.15
N	4,536	4,536	4,536

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure is the probability of having FTTH in the neighborhood. *Lonely*, *Worried* and *Fear* are binary variables with value 1 indicating a worse situation. The difference with Table **??** is that the middle category is included as indicator of being worse.

Table A.13: Effects of FTTH exposure on Mental Health - Categorical outcomes - OLS

	Lonely	Worried	Fear
Panel a: without controls			
FTTH Exposure	-0.42**	0.03	-0.12
	(0.16)	(0.20)	(0.21)
P-value	0.01	0.90	0.57
P-value WCB	0.02	0.90	0.56
Lower bound WCB	-0.67	-0.30	-0.45
Upper bound WCB	-0.16	0.39	0.23
N	4,529	4,529	4,529
Panel b: with controls			
FTTH Exposure	-0.39**	0.04	-0.09
	(0.16)	(0.20)	(0.21)
P-value	0.02	0.84	0.68
P-value WCB	0.02	0.85	0.65
Lower bound WCB	-0.64	-0.28	-0.43
Upper bound WCB	-0.14	0.41	0.28
N	4,526	4,526	4,526

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth, grade retention in primary, and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 10% level. FTTH exposure is the probability of having FTTH in the neighborhood. *Lonely*, *Worried* and *Fear* are the raw categorical variables.

Table A.14: Effects of FTTH CUMULATIVE exposure on Mental Health

	Lonely	Worried	Fear	Sad
Panel a: without controls				
FTTH Exposure	-0.10	0.20**	0.08	0.21
	(0.13)	(0.08)	(0.08)	(0.10)
P-value	0.44	0.02	0.33	0.04
P-value WCB	0.49	0.02	0.35	0.14
Lower bound WCB	-0.44	0.06	-0.07	-0.03
Upper bound WCB	0.13	0.39	0.22	0.39
N	4,539	4,539	4,539	4,530
Panel b: with controls				
FTTH Exposure	-0.11	0.20**	0.07	0.22
	(0.14)	(0.08)	(0.08)	(0.10)
P-value	0.44	0.02	0.38	0.03
P-value WCB	0.50	0.02	0.41	0.12
Lower bound WCB	-0.46	0.06	-0.08	-0.02
Upper bound WCB	0.13	0.38	0.21	0.40
N	4,536	4,536	4,536	4,527

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 5% level. FTTH exposure is the cumulative probability of having FTTH during the whole period of FTTH expansion. *Lonely*, $Worried$, $Fear$ and *Sad* are binary variables with value 1 indicating a worse situation, as defined in Section 3.3.

Table A.15: Effects of FTTH CUMULATIVE exposure on Use of Health Services

	Medical Visit	Psychologist	Psychiatrist
Panel a: without controls			
FTTH Exposure	0.09	-0.04	-0.06
	(0.15)	(0.12)	(0.06)
P-value	0.52	0.75	0.34
P-value WCB	0.55	0.75	0.43
Lower bound WCB	-0.14	-0.24	-0.16
Upper bound WCB	0.58	0.28	0.10
N	4,539	4,533	4,533
Panel b: with controls			
FTTH Exposure	0.06	-0.04	-0.06
	(0.14)	(0.11)	(0.06)
P-value	0.65	0.71	0.31
P-value WCB	0.65	0.72	0.39
Lower bound WCB	-0.16	-0.23	-0.15
Upper bound WCB	0.55	0.26	0.09
N	4,536	4,530	4,530

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 5% level. FTTH exposure is the cumulative probability of having FTTH during the whole period of FTTH expansion. $Medical\ Visit$, $Psychologist$, and $Psychiatrist$ are binary variables with value 1 indicating a worse situation, as defined in Section 3.3.

Table A.16: Effects of FTTH DUMMY exposure on Mental Health

	Lonely	Worried	Fear	Sad
Panel a: without controls				
FTTH Exposure	-0.10*	0.07**	0.03	0.06
	(0.05)	(0.03)	(0.03)	(0.04)
P-value	0.05	0.06	0.34	0.14
P-value WCB	0.07	0.04	0.36	0.14
Lower bound WCB	-0.19	0.01	-0.02	-0.01
Upper bound WCB	-0.01	0.12	0.08	0.13
N	3,328	3,328	3,328	3,319
Panel b: with controls				
FTTH Exposure	-0.10*	0.06*	0.03	0.05
	(0.05)	(0.03)	(0.03)	(0.04)
P-value	0.05	0.07	0.42	0.21
P-value WCB	0.07	0.06	0.43	0.21
Lower bound WCB	-0.20	0.01	-0.03	-0.01
Upper bound WCB	-0.01	0.12	0.08	0.12
N	3,325	3,325	3,325	3,316

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 5% level. FTTH exposure is an indicator variable that takes de value 1 for the upper 35% percent of the FTTH distribution and 0 for the lower 35% of the FTTH distribution. *Lonely*, *Worried*, *Fear* and *Sad* are binary variables with value 1 indicating a worse situation, as defined in Section 3.3.

Table A.17: Effects of FTTH DUMMY exposure on Use of Health Services

	Medical Visit	Psychologist	Psychiatrist
Panel a: without controls			
FTTH Exposure	0.07	0.02	-0.03
	(0.05)	(0.04)	(0.02)
P-value	0.16	0.65	0.19
P-value WCB	0.17	0.62	0.17
Lower bound WCB	-0.02	-0.04	-0.07
Upper bound WCB	0.15	0.09	0.01
N	4,155	4,149	4,149
Panel b: with controls			
FTTH Exposure	0.07	0.02	-0.03
	(0.05)	(0.04)	(0.02)
P-value	0.14	0.54	0.18
P-value WCB	0.15	0.53	0.15
Lower bound WCB	-0.01	-0.03	-0.07
Upper bound WCB	0.15	0.09	0.00
N	4,152	4,146	4,146

Notes: Reported estimates are obtained from an OLS regression including neighborhood and survey year fixed effects and linear trends in sanitation and income per capita by neighborhood, using sample weights. Panel b also includes controls: age, age squared, sex, ethnicity, department of birth and have attended public school. Standard errors reported in parentheses, clustered at the district level (capital) and department level (rest) using Liang-Zeger cluster robust standard errors. P-Values are obtained using Liang-Zeger cluster robust standard errors. P-value WCB are derived from a Wild Cluster Bootstrap procedure with 999 repetitions, restricted with Rademacher weights. For hypothesis testing we use WCB P-values with significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Lower and upper bounds WCB are confidence intervals at the 5% level. FTTH exposure is an indicator variable that takes de value 1 for the upper 35% percent of the FTTH distribution and 0 for the lower 35% of the FTTH distribution. *Lonely*, $Worried$, *Fear* and *Sad* are binary variables with value 1 indicating a worse situation, as defined in Section 3.3. $Medical\ Visit$, $Psychologist$, and $Psychiatrist$ are binary variables with value 1 indicating a worse situation, as defined in Section 3.3.