ESTIMATING THE IMPACT OF HIGH-SPEED INTERNET ON TEEN AND YOUNG ADULT LABOR FORCE PARTICIPATION

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Applied Economics

MONTANA STATE UNIVERSITY
Bozeman, Montana

January 2021

ACKNOWLEDGEMENTS

I would like to thank my thesis committee chair, Dr Gregory Gilpin, for his unwavering support throughout the thesis process as well as the years of mentorship he has offered. I would also like to thank Dr. Isaac Swensen and Dr. Andrew Hill for their dedication and guidance throughout this process. Additionally, I would like to thank my family for their continued love and support.

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ABSTRACT

High-speed residential internet access was rolled out in the United States in the early 2000's. While the advent of high-speed internet brought with it a lot of positive changes, like greater access to information (Dettling 2017) or flexibility in working arrangements for working parents (Dettling 2018), it also ushered in a new era of inexpensive and high-quality leisure activities. During this same period of time, teens and young adults are observed leaving the labor force.

This thesis uses a Bartik or shift share instrument and variation in rollout of high-speed residential internet access to estimate the impact on teen and young adult labor force participation decisions. The results find that both students and non-students younger than 25 are less likely to participate in the labor force, and males were more profoundly impacted than females.

INTRODUCTION

The Internet has had a drastic impact on how individuals live, from conducting business to online shopping, traveling, or finding entertainment. Internet technological advances have changed the way people gain access and search for information and created a new e-sector of the economy. While high-speed Internet has had a multitude of benefits, this thesis will focus on the impact of high-speed residential internet access (HSRIA) on youth and young adult labor force participation rates. During a nine-year period starting with the year 2000, HSRIA grew rapidly from almost no households having access to almost 70% of all households. During this same time period, youth labor force participation rate (LFPR) of those age 16-17 fell approximately 15 percentage points from 41 to 24 percent, while those age 18-25 fell by 6 percentage points from 70 to 64 percent. This paper looks at the relationship between the two and quantifies what portion of the decline can be attributed to HSRIA.

There are several impacts of declining youth LFPR. First, decreases in youth LFPR impacts output, especially sectors that rely on seasonal, low-skilled workers. Second, youth and young adults who do not participate in the labor force do not accumulate important work experience and may not be as equipped for later stages of life. For example, Ruhm (1995) finds that hours worked in high school is positively correlated with future earnings and occupational status. It has also been hypothesized that the declining youth LFPR is a positive thing as it is a sign of increased education Aaronson, Hong, and Park (2006).

Estimates on the relationship between HSRIA and LFPR may be biased due endogeneity concerns between these two variables, i.e., there is a bi-causal relationship. Higher-income families are more likely to have the income to purchase HSRI and this may impact dependents within the household. This project will estimate the causal impact of HSRIA on LFPR using U.S. Current Population Survey data between 2000 and 2009 and a two-stage least squares (2SLS) regression analysis that uses existing instrumental variables identified in the empirical LFPR literature.

In the empirical analysis, I first verify that that HSRIA has no statistically significant impact on the LFPR for those aged 16-59, as shown in the HSRIA LFPR literature. I then estimate the impact of HSRIA on the LFPR of those aged 16-17 and those aged 18-25. The empirical results suggest that HSRIA has a significantly negative impact on the LFPR of those aged 16-17 and those aged 18-25. The results suggest a 14-percentage point decline among high school students, no significant impact on college students aged 18-25, and an approximate 13 percentage point negative impact on non-college bound individuals aged 18-25. In all estimations, the magnitude of effect is larger for males than females.

The structure of this thesis is as follows. The Literature Review section provides a review of adult and youth LFPR literature, including the HSRIA impacts labor-leisure decisions. This section also summarizes existing data sources, variable construction, and empirical strategies in the literature to provide an understanding of how researchers have approached the topic. The literature review will then provide existing literature on youth internet use. Lastly, the literature review will provide an overview on the existing

research that studies the causal impact of high-speed residential internet access on adult LFPR. The Empirical Specification section will provide a general overview of the Bartik instruments, justification of the instrument, and lays out the model specification. The Main Results section summarizes the results and discusses possible problems to identification. The Robustness Section offers possible alternative specifications and confirms the results the Conclusion concludes and provides future research avenues.

LITERATURE REVIEW

This section provides a review of important research related to adult and youth LFPR, how high-speed internet connectivity affects labor-leisure decisions, youth internet use, and existing estimates of the causal impact of high-speed residential internet access on adult LFPR. It finishes with a short explanation of the contributions this paper makes.

Adult Labor Force Participation Rates

The U.S. adult LFPR has been studied extensively over a long period of time. This review focuses on past studies that analyzed labor force participation broadly and primarily focuses on factors that affect labor force decisions.

Krause and Sawhill (2017) study U.S. LFPR between 1990-2017 and identify a modest decrease in prime-age LFPR of 5 percentage points. They suggest long-term structural unemployment occurred due to workers losing their jobs from automation and outsourcing and unable to find work due to a lack of relevant training or ambition. Additionally, a lack of necessary education and training may also cause individuals to never enter the labor force. They study many potential determinants why individuals leave the labor force and find the three most prominent being "a general lack of the right education and skills, too many years of slack labor markets, and high rates of incarceration (in combination with employer reluctance to hire those with a criminal record)." This suggests improvement in prime-age LFPR requires, substantial investments in education, training/retraining, and reentry programs for criminals.

Aaronson, David, and Hu (2012) study the long-term U.S. LFPR for individuals aged 16-79 and remark on a large uptick of labor force participation starting in the mid-1960s through 2000. They contribute the uptick to substantial increases in female labor force participation and a large cohort of babies born in the two decades following World War II reaching their prime working years in the 1970s and 1980s. During the time period of 1960 to 1990, large improvements in health technology along with a transition to less physically demanding work tasks which allowed workers to remain in the labor force for longer periods of time and increase the number of working years.

Kreuger (2017) studies the relationship between declining LFPR and opioid use. He empirically finds a relationship between areas of low labor force participation and high opioid prescription rates but note a causal relationship cannot be found. They do find that declining LFPR is a result of an aging labor force and an increase in school enrollment.

Youth Labor Force Participation

This subsection focuses on young adults LFPR. Although those age 16 to 25 make up a relatively small portion of the overall labor force, they play a crucial role in certain sectors like restaurants and grocery stores. Studies find that youth participating in the labor force have positive effects on their long-term economic outcomes and also increases the number of grades they completed.

Aaronson, Hong, and Park (2006) summarize the downward trend in youth LFPR since the late 1970s. However, from 2000 to 2003, teen LFPR fell 7.5 percentage points, a substantial decrease compared to a decline in the overall rate of only 0.6 percentage

points. They show that people aged 16 to 19 represent 4.2 percent of employment, but accounts for over half of the fall in aggregate LFPR between 2000 and 2003. Interestingly, individuals aged 16 to 17 represent only 1.6 percent of those employed, but account for over one-third of the fall in aggregate labor force participation.

They study various demand and supply side mechanisms. For example, they review youth's responses to the CPS question on whether young adults want a job and find that the expected increase following a recession was much smaller in the 2000 recession then previous recessions in 1980 and 1990. They also looked at sectoral changes and found that the top five industries that employ over half of teens (eating and drinking places, grocery stores, miscellaneous entertainment and services, construction, and department stores) have experienced growth well above the national average. Teens that remained in the labor force have also experienced relative wage increases, which is counterintuitive to a demand-side shock. They extend previous studies by Card (1990), Lewis (2004), and others looking at the Mariel boatlift of 1980, which caused a large increase of low-skilled workers in the labor force and extended the analysis to include teens. They find that large increases in foreign unskilled labor did not affect U.S. youth LFPR.

Ruhm (1995) set out to address previous mixed literature about the effects of part-time employment of students aged 16 to 18. Past literature was largely anecdotal and non-empirical (Steinber, Dornbusch 1991). It also looked at the short-run success of students. It followed students for less than a year and did not make any long-term conclusions. Ruhm used data on individuals 6 to 9 years after graduation and found that

part-time employment never had a negative impact and had some positive impacts for high-school seniors. For seniors who were employed 20 hours per week, they could expect to earn 21% more annually and receive 11% higher hourly wages 6 to 9 years after graduation compared to non-working seniors. They were also more likely to receive benefits like pensions and health insurance.

Leos-Urbel (2014) studied teens and young adults ages 14 to 21 in the Summer Youth Employment Program (SYEP) in New York City. This program randomly selected individuals for summer jobs using a lottery system to identity whether a summer job increased school enrollment. They find being randomly assigned a summer job increased school attendance by 2 to 3 days per school year. The impact was greater for students who might be at greater educational risk (4 to 5 days). They also find that SYEP increased the probability of attempting the Regents examination.

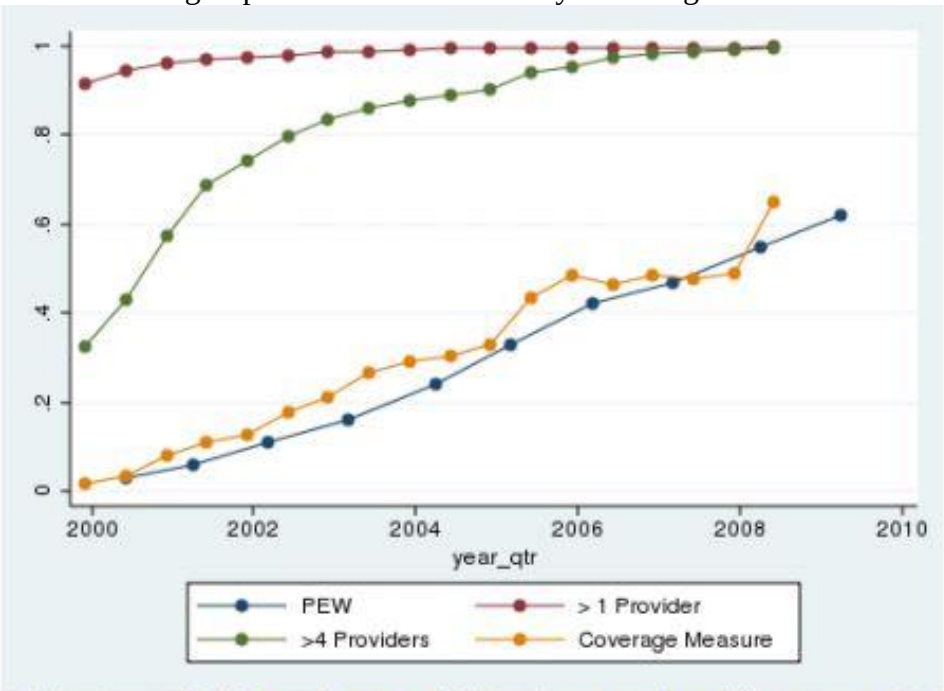
Youth Internet Use

The literature on youth internet is quite sparce. The literature that does exist focuses on how Internet access has impacted access to information, education, socializing, and gaming.

Dettling, Goodman, and Smith (2015) look at how high-speed internet availability in a zip code affects students SAT and PSAT scores. Their measure of internet availability is from the FCC Form 477 that provides biannual number of Internet Service Providers (ISPs) operating in a given zip code. They acknowledge that it is unlikely that all residents of each zip code have equal access to high-speed internet access for a given number of service providers. To improve the measure, they scale the number of

providers in a zip code by its geographic size as a way of estimating how many people in a zip code have access. Specifically, in urban zip codes, they scale providers by number of people and in rural areas by square miles. As shown in their Figure 1 below, by the year 2000 over 90% of zip codes had at least 1 service provider. This does not correlate well with individual level access (Blue). Their scaled measure is in yellow.

Figure 2.1 Measures of High Speed Internet Availability and Usage



Notes: Displayed are trends in high-speed Internet availability and usage according to different measures. PEW refers to survey-reported national usage rates. The two provider measures (>1 and >4) refer to implied aggregate availability rates, if availability is defined as having at least one or at least four providers in the zip code. These rates are weighted by zip code population. The coverage measure refers to our preferred measure of high-speed Internet availability, as described in the text.

Source: Dettling (2017)

The authors also note that while the high-speed internet measure allows a look at whether a test takers zip code had access to high-speed internet access at the time of the test, it is not a measure of whether an individual has access to the internet. Note that the

authors use a different measure of high-speed internet access in a future study (Dettling 2017).

Their estimates find that an increase in the availability of high-speed internet access in their zip code unambiguously improves students' scores. Specifically, their estimates suggest that SAT scores improve by an average of 0.7 points out of 1600. Although this change is small, they find improved outcomes in college applications, matching to four-year selective colleges, and increased application.

Gross (2004) provides interesting descriptive statistics on what adolescents' high-speed internet use was in the early 2000s. He samples 261 students ranging in age from 12 to 15 years old. He identifies 14 students as outliers with Internet use and considered them to be heavy gamers. After removing these outliers, he finds that male respondents reported starting to use the internet sooner, but by 2001 the number of hours of daily use was the same. The primary use of internet was Instant Messaging and Email with no significant difference between genders. Other uses included downloading music and playing games. Analyzing the 14 students labeled heavy gamers found 12 were males and 2 were females. This group's internet usage was substantially more per day and the median playtime was 82.5 minutes per day.

Aguiar, Bils, Charles, and Hurst (2018) study electronic technology and how improvements impact labor outcomes for young adults aged 21 to 30 years old who are also non-students. They infer leisure technology from the American Time User Survey (ATUS) on how individuals shifted leisure toward computer entertainment activity. They find that recreational computer activities, in general, and, specifically, video gaming, are

strong leisure luxuries for younger men. As these leisure luxuries are made cheaper, they conclude that the reservation wage to engage in employment increases. They conclude that "the marginal value of leisure, accounts for 23 to 46 percent of the decline in market work for younger men during the 2000's"

The Effects of HSRIA on Labor Force Participation

Dettling (2017) uses CPS labor force participation data and an instrumental variable approach to estimate the impact of HSRIA on adult female's LFPR. She points out that internet enrollment is likely to be endogenous to labor market outcomes and uses the number of multi-dwelling units as a shift share instrument to overcome this potential bias. She successfully argues that this is a valid instrument as ISPs used percentage of multi-dwelling units to choose rollout of HSRI.

She concludes that HSRIA permits females, and specifically mothers, the ability to telework and it increases their labor force participation. She finds that "that exogenously determined high-speed Internet use leads to a 4.1 percentage point increase in labor force participation for married women". She finds the largest increase is in college-educated, married women with children (1.6 percent point increase). She finds no effect on single women or males age 18-59, in general.

Kuhn and Skuterud (2004) investigate whether having residential internet access impacts job search times. They find no evidence that it decreased search time. They indicate that it is likely people who are using the Internet and anonymous channels likely have worse social networks which suggests sample selection concerns that those using the Internet inherently have lengthier job searches. Thus, no change may suggest

improved search times for a select group of individuals. Interestingly, they also find that younger workers are more quickly reemployed and the most likely individuals to use the internet for job searches.

Expansion of Literature

There is literature that focuses on how HSRIA affects adults labor decisions and ability to apply for work online, and there is literature that looks at how young adults interact with High-Speed internet. This paper finds the middle ground of these two previously established areas and focuses on the affect HSRIA has on youth labor decisions.

DATA STRUCTURE AND SUMMARY

This section provides background information on data sources, a general overview of Bartik instruments, justification of the instruments, and lays out the model specification.

This primary data source is the U.S. Current Population Survey (CPS) for the years 2000, 2001, 2003, 2007, and 2009. The CPS is a monthly survey of approximately 60,000 households. The survey is a joint venture between the Bureau of Labor Statistics (BLS) and the U.S. Census Bureau. The responses to this survey are used by the BLS to estimate the official U.S. employment statistics, including monthly estimates of employment and unemployment rates.

The dependent variable is an indicator variable of whether the individual surveyed is classified as being in the labor force or not. Someone is defined as being in the labor force if they "were either: were at work; held a job but were temporarily absent from work due to factors like vacation or illness; were seeking work; or were temporarily laid off from a job during the reference period" (bls, 2020). This follows the labor economics literature and is in line with the standard definition of labor force participation.

The primary determinant is the household's access to Internet. Since 1984, the Computer and Internet Use supplement has asked questions about technology use as part of the March Education Supplement. Starting in 1997, the Internet Use Supplement asked questions on internet use and starting in 2000 what type of internet connection the household has. The CPS data suggest that in 2000, only 5% of individuals of those aged 16 to 59 had HSIRA, and by 2009 that grew to 69%.

Due to endogeneity concerns between individuals' labor force participation and high-speed internet access decisions, this research uses an established instrumental variable approach. This endogeneity could be a result of non-random assignment of high-speed internet rollout. Internet service providers (ISP) get to choose where they rollout high speed internet service based on their chosen indicators which could include things like employment rate, average wages, etc. The instrument is built using the percent of people living in multi-dwelling units as an instrument for high-speed internet access expansion. The initial roll out of high-speed Internet regularly required an investment in infrastructure from internet service providers (ISP). ISPs install new internet lines to each dwelling at a constant cost (based on distance). Thus, dwellings with multiple units are the same cost as single-family units. Since Internet is charged on a per-unit basis, multi-dwelling units have higher profit-margins than single family units. For example, if it cost $1,000 to install internet into a single-family home, they can recoup this cost at a rate of $50/month, but if it was installed into a multi-Dwelling unit (MDU) with 5 families the initial cost would be recouped at a rate of $250/month. This supply side expansion is documented by Dettling (2017) and the FCC. The definition of a multi-dwelling unit is provided by the FCC as a living structure that has at least 3 units or is a mobile home park. The analysis also includes controls as listed in Table 3.1.

Table 3.1 Additional Controls

Controls	Description	Source
Population Density	People Per Square Mile	U.S. Census Bureau
Housing Price Index	House Pricing Index 1990 Base Year	Federal Housing Agency
Un-Employment Rate	Un-Employment Rate	Bureau of Labor Statistics
Income Per Capita	Income Per Capita	Bureau of Economic Analysis
Average Wages	Average Wages	Bureau of Economic Analysis
Adoption Rate	Percent of firms using internet for any purpose	Forman (2003) and Bureau of Economic Analysis
Enhancement Rate	Percent of firms using internet to enhance business	Forman (2003) and Bureau of Economic Analysis
State	State of Residency	CPS
Year	Calendar Year	CPS
Marital Status	Marital Status	CPS
Number of Children	Number of children in household	CPS
Age of Youngest Child	Age of youngest child living in household	CPS
Gender	Male or Female	CPS
Race	White, Black, or Other	CPS
Age	16-59	CPS
Urbanicity	Lives in metropolitan area?	CPS

Additional controls include adoption and enhancement rates provided by Forman, Goldfarb, and Greenstein (2003) who use a private study of 86,879 establishments with over 100 employees to estimate the connection between North American Industry Classification System (NAICS) codes and internet adoption and enhancement rates for employers in 2000. These estimated rates are combined with state and year information

like the number of people in each state employed in each industry from the Bureau of Economic Analysis to create variables of internet intensive employment.

SUMMARY STATISTICS

Between 2000 and 2009 for the five years that have an available Computer and Internet Use Supplement data, there are 402,145 observations, evenly distributed across years with approximately 70,000 to 80,000 observations per year.

Table 3.2 Distribution of Sample

Year	2000	2001	2003	2007	2009	Total
Number of Observations	73,028	86,202	83,544	79,816	79,555	402,145

Across time within the sample, HSRIA within a state range from 5% to 72%. There is no major difference in HSRIA between the groups of those age 16 to 25 and those age 16 to 59 when it comes to race, gender, and locality. Within the sample, 53% are married and 87% have at least one child. The 16 to 25 age group has a mean age of 20.5 and about half of this group are enrolled in school with a relatively even distribution being enrolled in High school and College.

Table 3.3 Summary Statistics

Age 16-59			Age 16-25		
	Mean	SD		Mean	SD
HighSpeed Internet Use					
2000	0.049	0.217	2000	0.049	0.216
2001	0.104	0.306	2001	0.108	0.311
2003	0.23	0.42	2003	0.244	0.429
2007	0.603	0.489	2007	0.604	0.489
2009	0.728	0.444	2009	0.726	0.445
Individual Characteristics					
Male	0.506	0.499	Male	0.503	0.499
Lives in MSA	0.808	0.393	Lives in MSA	0.809	0.392
Lives in Central City	0.259	0.438	Lives in Central City	0.278	0.448
Age	37.17	12.38	Age	20.43	2.897
Married	0.529	0.499	School Enrollment	0.459	0.498
Number of Children	0.869	1.16	HighSchool Enrollment	0.214	0.41
			College Enrollment	0.244	0.429
Race					
White	0.805	0.395	White	0.782	0.412
Black	0.125	0.331	Black	0.145	0.352
Other	0.068	0.252	Other	0.072	0.258
Observations	402,145		Observations	86,247	

State Level Variables			
	Mean	SD	Data Source
Income Per Capita	34.98	6.275	Bureau of Economic Analysis
Average Wage	49.16	9.083	Bureau of Economic Analysis
Population Density	225.24	420	U.S. Census Bureau
House Price Index	170.42	37.22	Federal Housing Agency
Unemployment Rate	5.775	2.186	Bureau of Labor Statistics
Percent Adopt	0.909	0.004	Forman (2003) and Bureau of Economic
Percent Enhance	0.1309	0.003	Forman (2003) and Bureau of Economic
MDU Rate	0.239	0.057	Dettling (2013)

Empirical Specification

In estimating the effect of high-speed residential internet access on youth LFPRs there is a concern of bias due to a lack of random assignment and due to HSRIA potentially being endogenous with LFPR. I use a two-stage least squares (2SLS) approach in an attempt to identify the true impact.

This study uses a shift share or Bartik instrument (Bartik (1991)). The most common use for Bartik instruments is in the trade and immigration literature (see Goldsmith-Pinkham et al. (2018)). The instrument has two components. The first component is the share portion consisting of certain values within a base year. The second component is the shift portion that consist of time trends that estimate how the instrument evolves over time, i.e., weighting of the instrument. It has been shown that two-stage least squares using a shift-share instrument approach is numerically equivalent to generalized method of moments (GMM) with shares as the instrument and weight matrix constructed from the shift portion (Goldsmith-Pinkham et al. 2018).

This thesis uses the percentage of the population living in a MDU within a state as the share component and year fixed effect interactions as the shift components of the Bartik instrument. Using the instrument, the first stage is as follows:

$$HSI_{ist} = \gamma_1(MDU_s * \theta_t) + \gamma_2 X_i + \gamma_3 S_{st} + \theta_t + \eta_s + V_{ist} \quad (1)$$

where the Bartik instrument is $MDU_s * \theta_t$ and MDU_s represents the share portion of the instrument and is defined as the percent of individuals living in a MDU in state *s* in the year 2000. θ_t is the shift portion of the instrument and defined as year fixed effects with

the base year as 2009. HSI_{ist} is an indicator variable for whether individual *i* in state *s* in year *t* has residential high-speed internet. X_i is a vector of individual-level controls including ethnicity, gender, age, marital status, number of children, and living in a city center. S_{st} is a vector of state level controls that vary across time as listed in Table 3.3, η_s are a state fixed effects, and θ_t are year fixed effects. The fixed effects isolate variation in Internet availability. The first and second stages are estimated using a linear probability models (LPM).

Given the initial push of ISPs to enter markets in states with higher levels of MDUs, it is expected that the effect of MDUs on HSRIA to be to be positive and diminish to zero as telecommunication markets become saturated over time. Table 4.1 provides the estimates of the first-stage and it is noted that the estimates follow this expected pattern. That is, relative to the baseline year 2009, the periods between 2000 and 2003 have a more positive relationship between MDUs and HSI rollout. This diminishes to 8 percent, and not statistically significant, by 2007. The F-test for the baseline specification is 10.38.

For the instrument to be valid it must be uncorrelated with labor metrics. Although there is a correlation at the state level between MDU rates, wages and population these correlations are time invariant, and they will be absorbed by state Fixed Effects. The other concern with instrument validity is a concern with excludability. A valid instrument does not directly affect the outcome variable. Dettling 2013 addressed this concern using a placebo test from 1990-1997 and finds that MDU rates do not predict LFPR in the 1990s. Thus, the instrument appears to be valid.

Table 4.1: First Stage Results

	16-59
MDU*2000	0.302
	(0.195)
MDU*2001	0.397**
	(0.144)
MDU*2003	0.357**
	(0.116)
MDU*2007	0.083
	(0.084)
N	402,145

Asterisks ***,**,*,' indicate significance at the 0.1%, 1%, 5%, 10% statistical levels, respectively.

The second-stage equation estimates whether instrumented HSRIA, HSI_{ist}, impacts the labor force participation of individual *i* in state *s* in year *t*, labelled LF_{ist}. Using the estimated HSI_{ist} from the first stage, the second stage is specified as:

$$LF_{ist} = \beta_1 HSI_{ist} + \beta_2 X_i + \beta_3 S_{st} + \theta_t + \eta_s + \varepsilon_{ist} \quad (2)$$

Equation (2) is also extended using full sets of interaction variables to analyze various subpopulations to estimate differential effects. To do so, HSI_{ist} and the Bartik instruments are both interacted with indicators of the subpopulations in question.

MAIN RESULTS

In trying to estimate the relationship between home high-speed internet access and LFPR, bias is likely to exist because of endogeneity between the two. Running a Wu-Hausman test for endogeneity between HSRIA and LFPR yields a value of 85.9. This is strong evidence of endogeneity and suggests that standard OLS although positive may be biased.

Table 4.2: Initial Estimation Results

	OLS 16-59	IV 16-59	IV 16-59
HSI	0.061***	-0.252	-0.323'
	(0.002)	(0.211)	(0.181)
HIS*Students			-0.07**
			(0.027)
F-Stat HSI	-	5.286	10.383
F-Stat HSI*Students			59.22
N	402,145	402,145	402,145

Asterisks ***,**,*,' indicate significance at the 0.1%, 1%, 5%, 10% statistical levels, respectively.

Column 1 of Table 4.2 provide OLS estimates of the second stage using HSRIA directly on the RHS of equation (2). The results show that having access to HSRIA is associated with a 6.1% increase in LFPR of those age 16 to 59. It is statistically significant at the 1% level but does not account for bias as a result of endogeneity.

Column 2 shows the results of the two-stage least squares estimator allowing for instruments as outlined in the empirical section above. It shows that the bias present in OLS could be in the positive direction. It is worth noting that although the coefficient on

HSI_{ist} is negative, it is statistically insignificant and the F-value of 5.2 suggests a marginally weak instrument.

High-speed internet access can affect subgroups of the population differently. I would assert that students between 16 and 25 years of age might have more flexibility in choosing whether to participate in the labor force when compared to non-students. For example, students typically have access to FAFSA and other assistance.

The estimates on the subgroup of students is provided in Column 3 and includes an interaction for the subgroup of students. The analysis provides estimates on the differential impact of students age 16-25 to the general population of those age 16 to 59. The coefficient on HSI is slightly larger than the baseline 2SLS estimates, but only significant at the 10% level. The coefficient on the interaction term between instrumented HSRIA and students aged 16 to 25 is -0.07 and strongly significant. This coefficient estimate is interpreted as students who have access to HSRI are 7 percent less likely to participate in the labor force than the general population who had HSRIA during the sample period.

Using these baseline results, additional analysis is conducted to identify whether differential impacts occur. The following conducts a series of interactions between the level of schooling and gender.

In all regressions, the impact of HSRIA on the LFPR of those age 16 to 59 is insignificant. While these coefficients are insignificant for the general population, the interactions have differential impacts. The results in Column 1 of Table 4.3 where the interaction of interest is high school students. The coefficient of interest is -0.144 and

significant. In column 2, separate estimates for both genders are estimated for high school students. The results suggest that male high school students have a slightly larger negative coefficient than female high school students, but an F-test between these two coefficients fails to find any difference. In columns 3 to 5, college students are analyzed, including subpopulation by gender. The results suggest no impact on college students. Lastly, Columns 6 and 7 provide results on non-students age 16 to 25. These results suggest a decrease in LFPR of approx. 5%.

In summary, the estimates suggest that HSRIA has a negative relationship with high school students and college-age non-students. In all groups, males have a larger negative effect than females, which is in line with what has been previously proposed about how males and females use internet (Aguiar et al. (2018))

Table 4.3: Estimation Results: % in LFPR as a result of having access to high-speed residential internet

	IV 16-59	IV 16-59	IV 16-59	IV 16-59	IV 16-59	IV 16-59	IV 16-59
HSI	-0.311	-0.293	-0.243	-0.189	-0.31	-0.176	-0.323
	(0.193)	(0.193)	(0.227)	(0.209)	(0.204)	(0.026)	(0.209)
HSI*Students(HighSchool)	-0.14***				-0.150***		
	(0.019)				(0.020)		
HIS*Students(HighSchool)*Male		-0.145***					
		(0.021)					
HIS*Students(HighSchool)*Female		-0.140***					
		(0.033)					
HSI*Students(College)			-0.013		-0.011		
			(0.046)		(0.043)		
HSI*Students(College)*Male				-0.057			
				(0.058)			
HSI*Students(College)*Female				0.017			
				(0.035)			
HSI*group16-25 Non-Students						-0.054*	
						(0.026)	
HSI*group16-25*Male Non-Students							-0.049*
							(0.022)
HSI*group16-25*Female Non-Students							-0.064’
							(0.035)
F-Stat HSI	3.47	3.67	16.23	17.201	12.13	9.11	9.4
F-Stat HSI*Group1	75.81	48.52	30.78	40.84	106.4	12.363	17.557
F-Stat HSI*Group2		71.23		92.47	28.12		15.798
N	402,145	402,145	402,145	402,145	402,145	402,145	402,145

Asterisks ***,**,*,' indicate significance at the 0.1%, 1%, 5%, 10% statistical levels, respectively.

Robustness Checks

In this section I conduct a robustness check using a different instrument. The FCC requires all ISPs that provide service to at least 250 people to file Form 477 to operate in a specific county. In Equation (1), the instrument is replaced with the number of Internet Service Providers as a measure of internet accessibility. Due to an individual's inability to influence ISP's decision to provide access, changes in the number of ISPs can be considered an exogenous shock.

When using this measure of internet availability, we see similar results. This robustness check confirms the results of the main specification. In column 1 and 2 we see a negative effect on high school students with a larger negative affect on males than females. Column 3 and 4 confirms a negative effect on college students. With the FCC specification the results are now highly significant at the .001 level for males in college where it was insignificant in the main specification. The age group of 16 to 25 nonstudents is no longer significant for males but remains significant and negative for females.

Although this does not confirm all the results of the main specification it does confirm the magnitude to be relatively close and direction of impact to be the same with minor differences in significance level.

Table 5.1: Results for robustness specification

	IV 16-59	IV 16-59	IV 16-59	IV 16-59	IV 16-59	IV 16-59	IV 16-59
HSI	-0.098	-0.1	0.026	-0.218	-0.101	-0.135	-0.184
	(0.229)	(0.226)	(0.027)	(0.305)	(0.245)	(0.241)	(0.267)
HSI*Students(HighSchool)	-0.197***				-0.213***		
	(0.025)				(0.003)		
HIS*Students(HighSchool)*Male		-0.206***					
		(0.033)					
HIS*Students(HighSchool)*Female		-0.183***					
		(0.043)					
HSI*Students(College)			-0.054*		-0.109**		
			(0.023)		(0.032)		
HSI*Students(College)*Male				-0.146***			
				(0.033)			
HSI*Students(College)*Female				-0.048			
				(0.046)			
HSI*group16-25 Non-Students						-0.026	
						(0.008)	
HSI*group16-25*Male Non-Students							0.0004
							(0.017)
HSI*group16-25*Female Non-Students							-0.045*
							(0.022)
F-Stat HSI	2.231	2.579	2.775	2.38	2.275	1.465	1.571
F-Stat HSI*Group1	29.09	21.76	13.99	27.88	26.94	33.73	27.184
F-Stat HSI*Group2		23.24		35.99	36.29		38.978
N	322,590	322,590	322,590	322,590	322,590	322,590	322,590

Asterisks ***,**,*,' indicate significance at the 0.1%, 1%, 5%, 10% statistical levels, respectively.

CONCLUSION

This study investigates the relationship between high-speed residential internet access and the youth and young adult labor force participation. Using an instrumental variable approach, the study finds that young adults who have access to high-speed internet at home are less likely to participate in the labor force. These effects are larger for males than females and larger for high school than college students. It is estimated that males who are in high school lowered their LFPR by 14.5%.

As a robustness check, the study estimates the relationship between the number of internet service providers as reported to the FCC and YLFPR from CPS. Although it does not confirm all the results of the MDU instrument approach, it verifies the results for both male and female high school students. The results are less significant when analyzing young adults who are non-students.

High school students are more likely to be financially supported by family members and they have more flexibility when it comes to labor force decisions. Although this study helps explain some of the decline in YLFPRs over the past couple of decades it is not clear if this has a lasting impact on labor force participation decisions once students are no longer receiving financial support.

Although Ruhm 1995, found that early employment plays a positive effect on lifetime earnings, it is unclear whether HSI access could play a positive role in lifetime earnings in a workplace that is rapidly shifting toward online and technology-driven employment. Further

research may look to see how individuals who gained HSI access prior to entering the workforce affects lifetime earnings and whether this technological experience is more important than early career experience.

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