

Time Use During the Pandemic

Differences from the Great Recession and Gender Gaps

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Abstract

This paper analyzes the impact of the pandemic on allocation of time across different working, home production, and leisure categories. The findings are compared against trends during the Great Recession. Additionally, differences among gender groups during the pandemic are evaluated from a time use perspective. Using the American Time Use Survey data from 2003 to 2020 and an instrumental variables approach, I find that about 34 percent of the foregone market work hours are substituted towards non-market work. Leisure absorbs hours from other categories like job search and childcare, and combined with market work, constitute about 126 percent of all foregone market hours during the pandemic period. There are significant decreases in time spent on job search, childcare, socializing, and other civic activities. Overall women spent more time towards childcare, and the difference is significantly higher for single women with younger children. I discuss the implications of my results for business cycle models studying substitution behavior among gender groups and non-separable preferences of people between leisure and market work.

1. Introduction

The 2020 pandemic disrupted lives of people around the globe by introducing practices of social distancing, stay-at-home orders, and work categorization (essential vs non-essential), which confined individuals to limited spaces of their homes. The unemployment rate climbed to 14.8 percent in April 2020, remained over 10 percent until July 2020, and hovered around 6 percent till April 2021 ([Bureau of Labor Statistics \(2021\)](#)). Job losses and stay at home measures altered the overall lifestyles of people. How did people under such circumstances reallocate their time to various daily activities? How did it differ from the another notable recession of the century? Were there any differences in time allocation across genders? These are few of the questions that my research seeks to explore and provide evidence for.

For my thesis, I use the [American Time Use Survey: Microdata Files \(2020\)](#), abbreviated as ATUS, to analyze the impact of the pandemic on time allocation of individuals across various categories. First, I am interested in studying the differences between the Great Recession and the pandemic recession from a time use perspective. This is to distinguish between the lifestyle implications of the two recessions and discuss how the pandemic recession is different than other typical recessions. Second, I want to extend this analysis to research into the variation in time allocation for men and women. Since women were disproportionately affected in the labor market during the pandemic recession ([Alon et al. \(2021\)](#)), I am interested in estimating the difference in their time use against men, as well as other subgroups – single, married, and mothers with young children. I’d expect a greater decline in the market work and job search hours, as well as increased engagement in childcare activities for single mothers.

This paper is an extension of the paper by [Aguiar et al. \(2013\)](#) which focuses on analysis related with time reallocation of the foregone market work hours to other daily activities during the Great Recession. I employ the same definitions of the seven categories as the authors discuss in the paper and use their descriptive statistics for years 2003-2010 for comparison. I define the pandemic period as years from 2017 to 2020 to account for missing observations due to data collection suspension at the beginning of the pandemic, small sample of the pandemic months, and low frequency trends. I calculate the fraction of foregone market work hours allocated to different categories using an instrumental variables approach by instrumenting quarterly averages of market hours on individual work hours to account for measurement error. This methodology is used throughout the paper to compare differences among the two recessions, gender groups, and gender subgroups.

Using the analysis, I show that people reallocated 34 percent of the foregone work hours to non-market work activities during the pandemic recession, an increase from the 30 percent estimate evaluated in [Aguiar et al. \(2013\)](#). Additionally, people devote significantly more time towards leisure, reallocating all of their hours lost working as well as hours from other categories, with sleeping and watching TV accounting for most of the increase. While job search absorbed about 2 to 6 percent of foregone market hours in [Aguiar et al. \(2013\)](#), I note that the responsiveness for this category reduced significantly by 4.9 percent across the two recessionary periods. I also document significant decreases in time spent on childcare, shopping, and civic and religious activities during the pandemic period.

I further conduct separate analysis to investigate differences in time reallocation among gender groups during the pandemic period. Women spent comparatively less time on leisure

and home ownership activities, though they do record increases in both categories. The decrease is absorbed by increased time spent on core home production activities and education. Among female subgroups, I show that single women recorded significant increases in time spent on childcare, by about 11.35 percent as compared to married women, who noted decreases in the hours reallocated to taking care of children. The results are analogous when I control for young children. Childcare absorbs approximately 16 percent of foregone market work hours for single women. Their married counterparts, on the other hand, do not note any significant changes. They do, however, record reductions in time spent on looking for jobs. Finally, time reallocated to categories such as non-market work and leisure observe similar trends as the overall sample.

Studying these differences is important in estimating welfare costs during the two recessions of the 21st century, as well evaluating the substitution behavior among gender groups and subgroups, especially for women who are either single or married. Additionally, it also adds to existing macroeconomic models explaining non-separable preferences of people between leisure and market work. It adds to the studies discussing business cycle movements in aggregate consumption and aggregate market work. My empirical work aims to answer these questions by analyzing the reallocation of the fraction of foregone hours spent working across different categories.

This paper proceeds as follows. Section 1 introduces the background for my research, and provides an overview of the results. Section 2 reviews the related literature. Data and descriptive statistics can be found in Section 3. Section 4 describes the empirical methodology, and Section 5 presents and discusses the corresponding results. Section 6 concludes.

2. Literature Review

The usage of time use survey data to study individual responses to business cycles has been prevalent in the literature. [Aguilar et al. \(2013\)](#) study the allocation of the foregone market work hours during the Great Recession of 2008 using ATUS data from 2003 to 2010. The research suggests that when unemployment rates fell by 5.8-9.6 percent, market work hours fell by 7 percent. Approximately 50 percent of these foregone work hours was absorbed by leisure, which labels activities like time spent watching TV and sleeping, followed by approximately 30 percent for home production, which includes household chores and shopping, as well as increased time allocation across categories such as childcare, education, and self medical care. There exists a greater library of work that focuses on labor market conditions and time allocation. [Burda and Hamermesh \(2009\)](#) use pre-recessionary data from 2003-2006 and find that the unemployed reallocate most of their time toward leisure and personal maintenance rather than household production. The evidence is furthered in [Krueger and Mueller \(2012\)](#), which uses time use data from multiple international sources across 14 countries between an expanded timeline of 1991-2006, and conducts research to estimate job search intensity among unemployed individuals, which is found to be significantly driven by wage dispersions.

Business cycle trends have often been used study gender differences. [Albanesi and Şahin \(2017\)](#) discuss the determinants of gender gaps in unemployment over business cycles and in the long run. Recent literature analyzing the pandemic recession has concentrated on such unemployment differences, particularly focusing on the disproportionate job loss of women in the labor market. [Alon et al. \(2020\)](#) discuss the loss of high contact service industries which

had greater proportions of women employees. [Albanesi and Kim \(2021\)](#) extend upon that analysis and report that both inflexible and flexible, high-contact occupations, the ones which can be seen as most adversely affected by the pandemic, were primarily female dominated. These papers also provide evidence for increase in time spent on childcare activities due to closures of in-person schools and daycare facilities, which further impacted working mothers overall, no matter their marital status, and thus, contracted their labor supply. [Collins et al. \(2021\)](#) further find that even among married heterosexual couples, the share of the burden of childcare was not matched by working fathers as evidenced by their stable work hours while their female partners in the same households rescaled back their work hours. This analysis is mirrored in the paper by [Deryugina et al. \(2021\)](#) which uses survey data focusing on time allocation by research academics. These results are also elaborated upon in [Fairlie et al. \(2021\)](#), which finds additional evidence for decline in working hours especially for women with school-age children.

My paper's contribution is novel to the existing literature as it uses the ATUS data to derive the time use statistics for the pandemic recession. Researchers so far have only used CPS or other survey data since the ATUS data for 2020 was only released in September 2021. Additionally, my paper extends the analysis of time allocation to compare the two recessions of the 21st century with distinctive characteristics – greater unemployment rates, shifts in work modality, varying industry impacts, and sustaining lifestyle changes. Furthermore, I am interested in broadening my analyses to study gender gaps in the allocation of time across different categories, and discussing substitution effects among them, which thus adds to the growing empirical research work evaluating the gendered impact of the recent recession.

3. Data

I use the [American Time Use Survey: Microdata Files \(2020\)](#) (ATUS) published by the Bureau of Labor Statistics (BLS) for the years 2003-2020. The ATUS data is collected by the US Census Bureau and draws randomly from the sample of households who partake in the final month of the Current Population Survey (CPS). There is data for roughly 20,000 respondents in 2003 and 10,000-13,000 respondents in 2004-2019. All these years have contiguous data for all months. The data collection paused during the pandemic from March 18, 2020, to May 9, 2020, and the 2020 dataset thus has approximately 8,700 respondents. I use the ATUS sample weights from 2003 to 2019 to aggregate responses by year. For 2020, adjusted sample weights are used to correct for the missed survey days in the first and second quarters of the year. I limit the respondents in my analysis to the age group of 18 to 65 with complete time use records or no unclassified time use categories. The total number of observations in my dataset is 219,368. There are total 122,710 female and 96,658 male respondents.

I use the time use categories as defined by [Aguiar et al. \(2013\)](#) for my analysis. There are total seven categories: market work, other income generating activities, job search, childcare, non-market work, leisure, and other. All these categories are mutually exclusive and roughly sum up to the total time spent in hours by an individual per week. *Market work* captures the total time spent by an individual in the market sector on formal jobs. *Other income generating activities* encapsulate all other activities which may be hobbies or other performances that also generate income. *Job search* includes all the activities that count as spending time on looking for a job, these may be typing up and sending a resume, browsing

and networking for jobs, and interviewing. *Childcare* category accounts for all activities that relate to spending time caring for, training or educating, and playing with own children. *Nonmarket work*, also referred to as home production (Aguiar et al. (2013)) is inclusive of four subcategories: core home production, home ownership, obtaining goods and services, and caring for others. Core home production includes all activities that count as household chores. Home ownership activities are confined to home repair and improvement activities as well as gardening and lawn care. Obtaining goods and services is simply the time spent on grocery or online shopping and obtaining personal services such as going to the bank or the post office, getting a haircut, and seeking government services. Lastly, caring for others subcategory sums all activities that are helping and caring for other individuals, like helping them clean, making food for others, shopping for others, looking after others, and any time spent on taking others to doctor appointments or shopping. *Leisure* is another category which is further subdivided into five other subcategories: watching TV, socializing, sleeping, eating and personal care, and other leisure. Finally, the main category *Other* includes time spent on education, religious and civic activities, and own medical care. The time allocated to travel for each of these activities is added to their respective categories.

Tables 1, 2, and 3 provide descriptive statistics of the time series analysis for the entire sample as well as samples for men and women for years 2006-2010 and 2017-2020. These statistics are averaged over two years until March 2020 to account for measurement errors across years. The data until 2010 has been replicated and matched with the Table 1 and 2 of Aguilar et al. (2013). I also report the unconditional differences between the periods 2006-2008 and 2009-2010, and 2017-March 2020 and May 2020-December 2020 (there is no data

Table 1: Time Use by Period (All Sample)

Category	Average 2006-2008	Average 2009-2010	Difference	Average 2017-March 2020	Average 2020 (Pandemic)	Difference
Market work	32.53	30.41	-2.12	31.68	27.46	-4.22
Other income-generating activities	0.16	0.24	0.08	0.21	0.17	-0.04
Job search	0.27	0.42	0.15	0.31	0.28	-0.03
Childcare	4.57	4.47	-0.1	4.18	3.98	-0.2
Non-market work	17.78	17.58	-0.2	16.61	18.17	1.56
Core home production	9.38	9.38	0	9.36	10.45	1.09
Home ownership activities	2.17	2.11	-0.06	1.71	2.74	1.03
Obtaining goods and services	5.03	4.84	-0.19	4.42	3.91	-0.51
Others care	1.19	1.24	0.05	1.12	1.08	-0.04
Leisure	107.71	109.55	1.84	109.95	113.98	4.03
TV watching	17.55	18.57	1.02	17.87	19.22	1.35
Socializing	7.59	7.59	0	7.41	7.96	0.55
Sleeping	59.54	60.18	0.64	61.76	63.18	1.42
Eating and personal care	13.26	13.32	0.06	12.96	12.1	-0.86
Other leisure	9.74	9.86	0.12	9.95	11.52	1.57
Other	4.95	5.29	0.34	5.06	3.95	-1.11
Education	2	2.16	0.16	2.45	2.18	-0.27
Civic and religious activities	1.98	2.15	0.17	1.76	1.01	-0.75
Own medical care	0.96	0.97	0.01	0.84	0.77	-0.07

Table 2: Time Use by Period (Men Sample)

Category	Average 2006-2008	Average 2009-2010	Difference	Average 2017-March 2020	Average 2020 (Pandemic)	Difference
Market work	38.16	35.1	-3.06	36.45	32.12	-4.33
Other income-generating activities	0.15	0.25	0.1	0.24	0.24	0
Job search	0.37	0.56	0.19	0.36	0.27	-0.09
Childcare	2.82	2.98	0.16	2.69	2.39	-0.3
Non-market work	13.78	35.1	21.32	13.19	14.6	1.41
Core home production	5.75	5.83	0.08	6.02	7.01	0.99
Home ownership activities	2.95	2.93	-0.02	2.41	3.59	1.18
Obtaining goods and services	3.93	4.05	0.12	3.7	3.08	-0.62
Others care	1.13	1.21	0.08	1.05	0.91	-0.14
Leisure	108.62	110.36	1.74	110.7	115.19	4.49
TV watching	19.29	20.33	1.04	19.15	20.76	1.61
Socializing	7.24	7.23	-0.01	7.63	8.82	1.19
Sleeping	58.88	59.39	0.51	60.99	62.27	1.28
Eating and personal care	12.76	12.84	0.08	12.37	11.68	-0.69
Other leisure	10.43	10.54	0.11	10.55	11.66	1.11
Other	4.07	4.69	0.62	4.38	3.19	-1.19
Education	1.54	1.98	0.44	2.3	1.73	-0.57
Civic and religious activities	1.75	1.88	0.13	1.42	0.86	-0.56
Own medical care	0.77	0.82	0.05	0.66	0.6	-0.06

Table 3: Time Use by Period (Women Sample)

Category	Average 2006-2008	Average 2009-2010	Difference	Average 2017-March 2020	Average 2020 (Pandemic)	Difference
Market work	26.85	25.68	-1.17	26.87	22.73	-4.14
Other income-generating activities	0.18	0.23	0.05	0.17	0.09	-0.08
Job search	0.18	0.29	0.11	0.27	0.3	0.03
Childcare	6.35	5.98	-0.37	5.68	5.59	-0.09
Non-market work	21.82	21.17	-0.65	20.06	21.79	1.73
Core home production	13.04	12.97	-0.07	12.73	13.93	1.2
Home ownership activities	1.38	1.28	-0.1	1	1.87	0.87
Obtaining goods and services	6.14	5.64	-0.5	5.15	4.74	-0.41
Others care	1.26	1.27	0.01	1.18	1.25	0.07
Leisure	106.79	108.73	1.94	109.2	112.76	3.56
TV watching	15.8	16.8	1	16.56	17.66	1.1
Socializing	7.95	7.96	0.01	7.18	7.1	-0.08
Sleeping	60.21	60.99	0.78	62.53	64.1	1.57
Eating and personal care	13.78	13.81	0.03	13.56	12.54	-1.02
Other leisure	9.05	9.17	0.12	9.34	11.37	2.03
Other	5.84	5.9	0.06	5.75	4.73	-1.02
Education	2.47	2.36	-0.11	2.61	2.63	0.02
Civic and religious activities	2.22	2.42	0.2	2.12	1.16	-0.96
Own medical care	1.16	1.13	-0.03	1.03	0.94	-0.09

for April 2020). Figures 1, 3, 4, and 5 are graphical representations of some key categories in the table analysis but are plotted yearly from 2003-2020. Figure 2 shows average weekly hours of market work from January 2019 to December 2020.

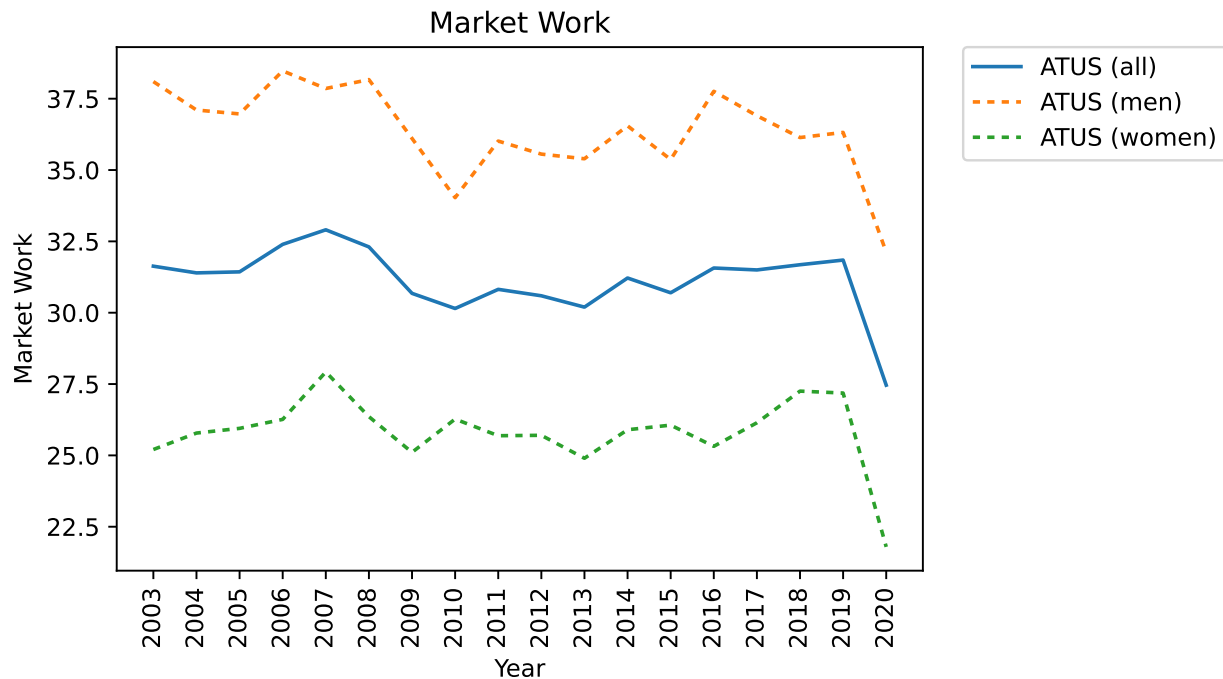


Figure 1: Market Work

The decline in market work between 2008 to 2010 is 6.68 percent (Aguilar et al. (2013)). Figure 1 represents the average market work hours from 2003 to 2020. During the pandemic, total market work hours averaged over all respondents declined by 13.77 percent or fell from 31.85 hours between January 2019 to March 2020 to 27.46 hours in the rest of all 2020. I also show that the market work hours for women have declined more than men during this time period. I find that market work for women decreased by 19.83 percent as compared to 11.56 percent for men. This decline for women is substantial as market work for the same population decreased only 0.32 percent during the Great Recession. The reduction in

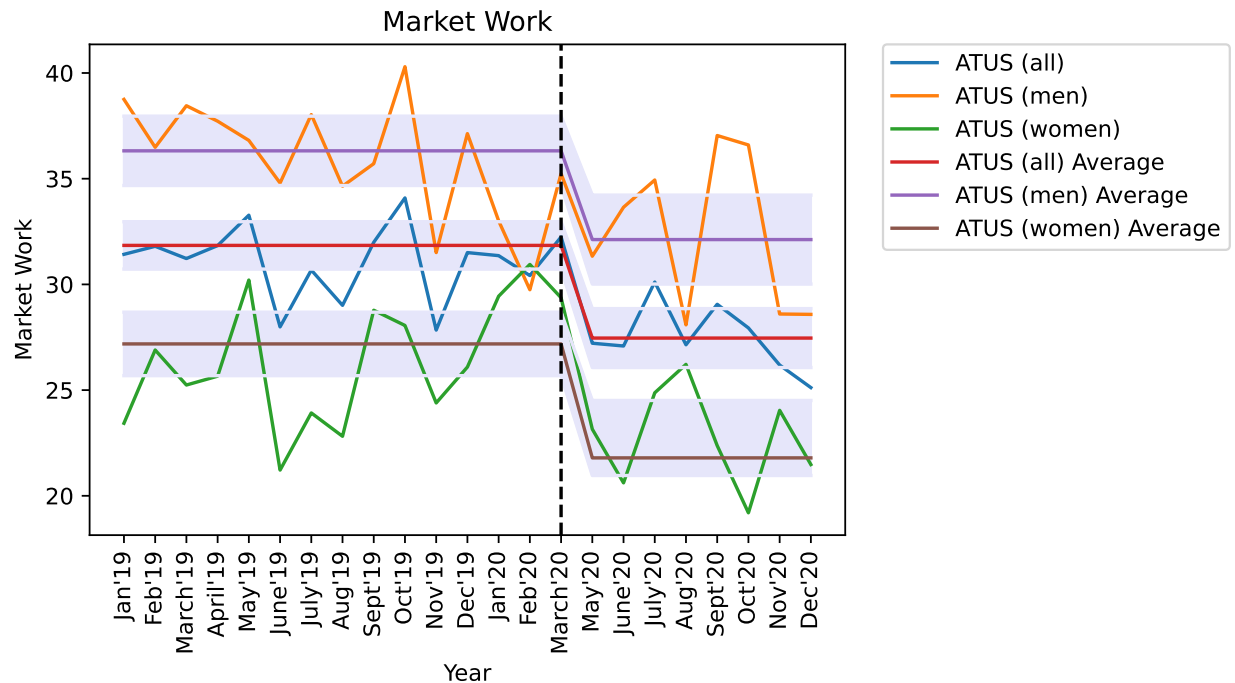


Figure 2: Market Work: January 2019 - December 2020

market work hours for men is only 0.7 percent more than their decline during 2008-2010. Figure 2 provides a closer look at market work hours between January 2019 to December 2020. Market work hours for all dropped by 15.59 percent in May 2020 from its March 2020 level or 10.52 percent from its February 2020 level. Additionally, hours spent on market work dropped by 11.08 percent for men and 21.17 percent for women between March 2020 and May 2020. However, when I compare the May 2020 results with the same in February 2020, I show an increase in market work hours for men by 5.33 percent while there is even a greater decrease for women at 25.18 percent.

While hours spent on market work decline, hours spent both on leisure and home production increase. Figures 3 and 4 represent average hours spent on leisure and nonmarket work respectively. Leisure increased by 3.42 percent overall with highest increases in watching

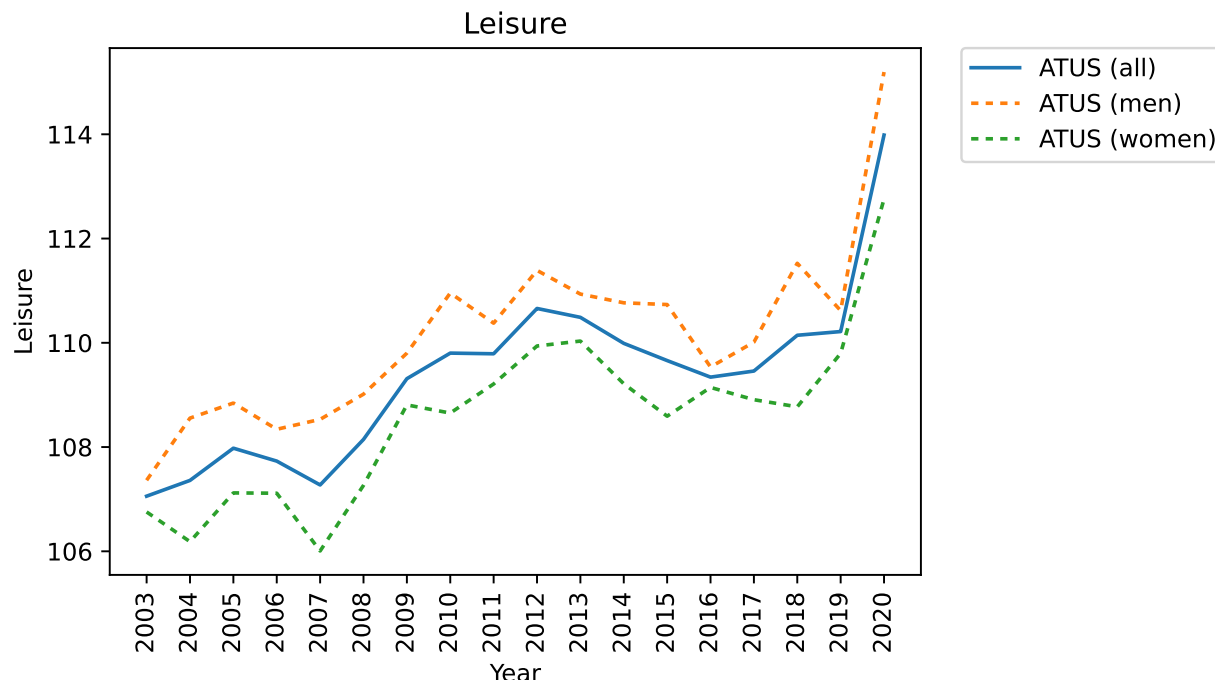


Figure 3: Leisure

TV and sleeping subcategories. Hours spent on leisure increased more for men (4.14 percent) than women (2.7 percent). During the Great Recession, leisure hours increased by only 1.69 percent for the entire sample and only 1.49 percent for men between the pre-recessionary and the recessionary period (Aguiar et al. (2013)). During the pandemic, nonmarket work increased by 11.02 percent overall. Women recorded greater increases in nonmarket work hours than men (17.27 percent vs 8.41 percent). The pandemic results of the nonmarket work category contrasts with its results during the Great Recession where the nonmarket work hours stayed roughly stable between the pre-recessionary and the recessionary period (Aguiar et al. (2013)).

As for childcare, I note a decrease in the number of hours by 1.36 percent overall in our time series analysis between 2019 and 2020. When compared with the averages in Table 1 between 2017-March 2020 and 2020 (Pandemic), the decline is 4.78 percent. Hours spent

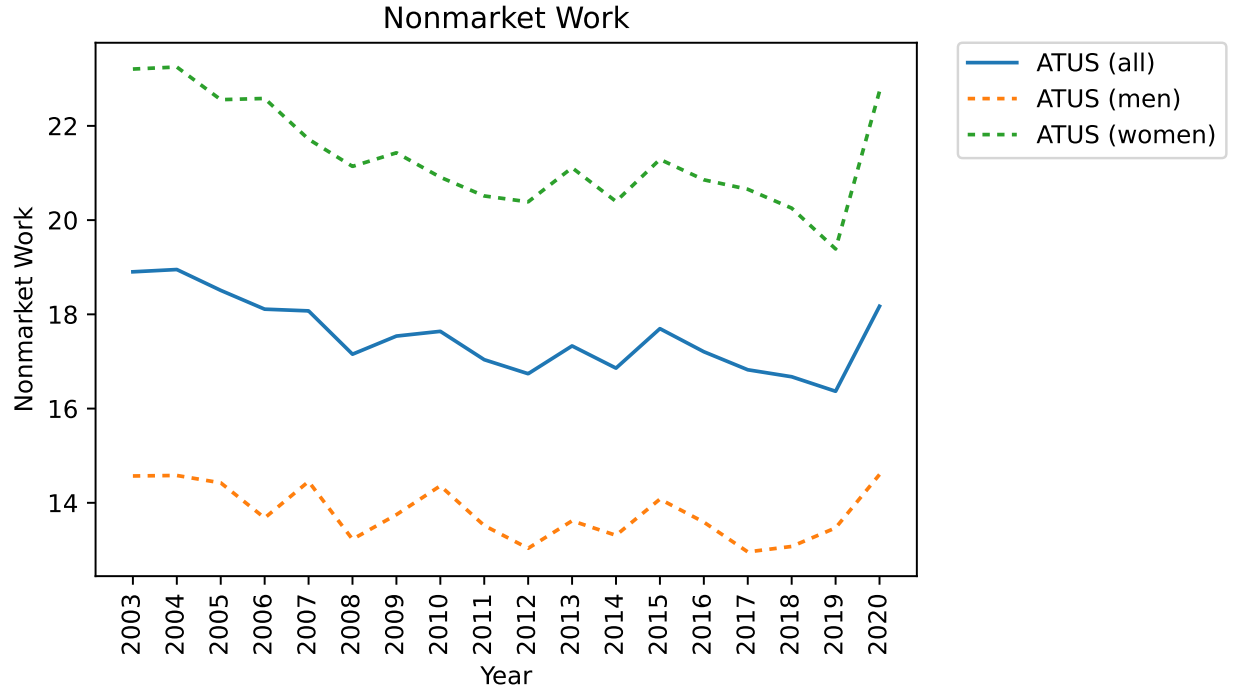


Figure 4: Nonmarket work

on childcare by men decrease by 9.86 percent while women spent 2.13 percent more hours tending to their children. From Figure 5, which represents the time spent on childcare from 2003-2020, I can also infer an inverse relationship between time spent on childcare by men and women. These results are consistent with the recent literature which find empirical evidence of greater time allocation of women in childcare activities.

Another category of interest is job search. Between 2007-2010, time allocated to job search increased by 69.48 percent overall, 78.04 percent for men, and 53.08 percent for women. However, it instead dropped by 6.73 percent when averaged over all respondents between January 2019 to March 2020 and May 2020 to December 2020. The overall decline in job search may be engineered by higher unemployment benefits and/or economic stimulus payments (Krueger and Mueller (2010); Marinescu et al. (2021)). During the same time

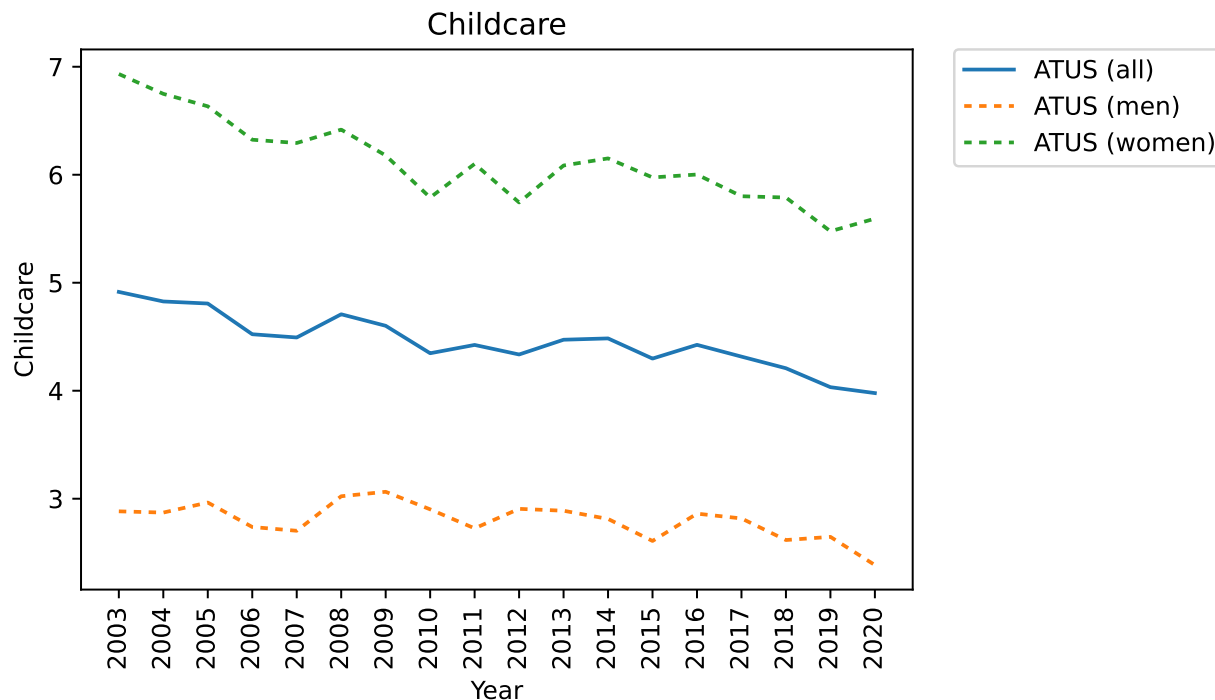


Figure 5: Childcare

period, the sample of men recorded a decrease of 4.21 percent in time spent on job search and it was even a steeper drop for women at 9.10 percent. These results may provide evidence that women substituted more of their job search time to other activities like housework or childcare.

4. Empirical Methodology

I use an instrumental variables approach to estimate the reallocation of the foregone market work hours across different categories. I instrument individual market work hours by the quarterly average of market hours. By isolating the component of average quarterly market hours correlated with individual market hours, I address measurement error issues related with ATUS' data collection during the pandemic. The quarterly aggregates and individual

work hours are strongly correlated as hours worked towards one's primary employment vary substantially across individuals, while measurement error in the quarterly-level data tends to be small as individual-level errors are averaged out to zero when I compute the quarterly market work hour means. Additionally, I use data from 2017 to 2020 to analyze the pandemic period. I define the quarterly level aggregates as follows:

$$\tau_t^{market} = \sum_{i=1}^{N_t} \frac{w_{it}}{\sum_{i=1}^{N_t} w_{it} \tau_{it}^{market}} \quad (1)$$

τ_t^{market} is the hours per week that individual i spends on market work in quarter t . I denote N_t as the number of individuals in our sample during quarter t . The ATUS sampling weights, w_{it} are used. Since the number of individuals may vary by quarter, I report aggregates over a few years. Aggregating data over the periods 2003-2010 and 2017-2020 yield 48 unique quarterly averages. The quarterly averages, τ_t^{market} , show substantial variation in both the whole sample as well as each separate sub-period used for empirical modeling (Appendix: Figure 6). The cross-quarter variation, in this case, is used to estimate individual responses to time reallocation across categories other than market work. The standard errors in the IV regression are clustered at the quarterly levels since the start of the data in 2003. The following two stage least squares regression equations are used:

First Stage:

$$\tau_t^{market} = \alpha_{FS}^j + \beta_{FS}^j \tau_{it}^{market} + \epsilon_t^j \quad (2)$$

Reduced Form:

$$\tau_{it}^j = \alpha^j - \beta^j \tau_t^{market} + \epsilon_{it}^j \quad (3)$$

τ_{it}^j refers to the hours spent per week on time use category j by individual i in time t . $\tau_t'^{market}$ are the predicted values from the first stage regression of τ_t^{market} or quarterly averages of market work hours in time t on τ_{it}^{market} or individual market work hours. The coefficient of interest is β^j which measures the fraction of foregone market hours allocated to time use category j . The time use categories are mutually exclusive and thus the β^j coefficients sum to 1. The β^j s in all the tables are multiplied by 100.

4.1. Comparison with Great Recession

I expand upon the base model (3) by including a dummy variable for pandemic. I use data from 2003-2010 to mark the Great Recession period. The pandemic years are from 2017 to 2020. The grouping is done as such to account for potential measurement errors due to low frequency trends and sampling variations. The following regression equation is used:

$$\tau_{it}^j = \alpha^j - \beta^j \tau_t'^{market} + \gamma Pandemic - \delta^j Pandemic * \tau_t'^{market} + \lambda X + \epsilon_{it}^j \quad (4)$$

The coefficient of interest is δ^j which tests the difference in response to market work during the pandemic recession. The variable X is used to denote the demographic controls of each individual (gender, race, marital status, age, education level, kids, gender interaction with kids). The descriptive statistics of the control variables are shown in Appendix: Table 10.

4.2. Comparison among Gender Groups

I restrict the analysis in these models to the years 2017 to 2020. In the two models that I use in this analysis, I first use the female dummy and its corresponding interaction with

market hours. The control variables used are same as the ones used for model 4.

$$\tau_{it}^j = \alpha^j - \beta^j \tau_t'^{market} + \gamma Female - \delta^j Female * \tau_t'^{market} + \lambda X + \epsilon_{it}^j \quad (5)$$

In the second model, I additionally regress on an individual's marital status and related interactions with gender and market work.

$$\begin{aligned} \tau_{it}^j = & \alpha^j - \beta^j \tau_t'^{market} + \gamma_1 Female + \gamma_2 Married \\ & - \delta_1^j Female * \tau_t'^{market} - \delta_2^j Married * \tau_t'^{market} - \delta_3^j Female * Married * \tau_t'^{market} \\ & + \lambda X + \epsilon_{it}^j \end{aligned} \quad (6)$$

I further restrict the dataset to female respondents to compare the differences among the women subgroups in the years 2017 to 2020, mainly single women, single women with young children (age of children is up to 8 years), married women, and married women with young children. The base regression as outlined in model 3 is used with added controls. There are 11,326 single and 9,386 married female respondents. The control variables used in this regression include age, education, and race.

5. Results and Discussion

5.1. Comparison with the Great Recession

Table 4 presents the results of the estimated coefficients in equation 4. The first column are the coefficients for β^j s which are interpreted as the reallocation of market work hours to category j during the Great Recession. I note significant increases in time spent on job search and leisure activities, especially watching TV and sleeping. People spent 3.25 percent of their hours not working looking for another job. About 57 percent of the foregone market

work hours are spent on leisure, with watching TV taking about 35 percent of the time and sleeping the rest. These results are consistent with [Aguilar et al. \(2013\)](#) which reports 2 percent increase in job search and concentration of leisure hours in TV watching and sleeping. I note that the coefficient on non-market work is negative, but the coefficient is also insignificant. The findings for childcare also lack significance, however, the estimated coefficient carries a positive sign, which translates to more hours spent on child rearing activities.

The second column reports the results of the variable of interest δ^j , which estimates the differences in responses in reallocation between the Great Recession and the pandemic recession. I note significant decreases in categories such as job search, shopping, and other activities like civic involvements and own medical care. Non-market activities like core home production and home ownership recorded significant increases along with greater time spent on leisure. Adding the estimates of the two columns produces estimates for the pandemic period. People spent about 34.28 percent of their foregone market work hours on non-market work activities, especially caring for and producing at their homes. The time spent on shopping reduced significantly to about 16 percent. This can be attributed to the less time spent on commuting and walking on feet for shopping, as online shopping trended due to retail closures and stay-at-home orders. The category leisure accounted for the largest reallocated market hours, as it even squeezed hours from other categories. Time spent on both TV watching and sleeping are comparable. One surprising result is the reallocation of time on socializing, which has a significant positive coefficient, implying that compared to the Great Recession, people spent more time on mingling with friends and family when they are not

Table 4: Base Model with Pandemic Dummy

Category	β	δ	$\beta + \delta$
Other income-generating activities	0.635 (1.23)	-0.444 (1.58)	0.191 (1.009)
Job search	3.252* (1.511)	-4.912* (2.08)	-1.66 (1.443)
Childcare	6.165 (3.876)	-11.458* (5.254)	-5.294 (3.597)
Non-market work	-0.744 (14.258)	35.023 (18.196)	34.279** (11.514)
Core home production	5.831 (5.727)	15.572* (7.436)	21.403*** (4.825)
Home ownership activities	-8.153 (10.458)	39.549** (14.99)	31.395** (10.862)
Obtaining goods and services	-0.299 (5.272)	-16.74* (7.991)	-17.039** (6.056)
Others care	1.877 (3.385)	-3.357 (4.328)	-1.48 (2.742)
Leisure	57.821** (18.904)	68.786* (30.94)	126.607*** (24.701)
TV watching	35.19* (16.167)	8.814 (24.406)	44.004* (18.491)
Socializing	-1.386 (8.257)	16.775 (10.545)	15.39* (6.689)
Sleeping	29.495*** (7.62)	12.977 (9.507)	42.472*** (5.791)
Eating and personal care	-3.348 (2.676)	-19.733** (7.542)	-23.081** (7.09)
Other leisure	-2.129 (14.977)	49.952 (30.177)	47.822 (26.331)
Other	32.871 (17.466)	-86.994** (32.114)	-54.123* (-7.118)
Education	11.066 (12.717)	-33.177 (27.943)	-22.111 (25.01)
Civic and religious activities	0.795 (4.08)	-20.508*** (5.916)	-19.713*** (4.35)
Own medical care	1.017 (1.93)	-7.632* (3.376)	6.615* (2.788)

* $p < .10$, ** $p < .05$, *** $p < .01$

working. This might be due to greater time spent on social media applications. I will further explore this result when comparing gender subgroups. Only eating and personal care activities among leisure observed a decrease by 23 percent. Among subcategories listed under *Other*, I note significant decreases in reallocation of market hours towards civic and religious activities. Due to social distancing measures in place, many volunteering and religious activities were canceled and/or took place over online platforms. The absence of a social aspect of these activities might have overall reduced engagement. Lastly, people seemed to have spent more time on their own medical care, which replicates the effects of the infection as well as safety concerns towards the potential contraction of the coronavirus.

5.2. Comparison among Gender Demographics

I present multiple iterations of the base model outlined in equation 3 with interaction variables to study differences among gender subgroups in our pandemic period defined from 2017 to 2020. The two models used in this context focus on differences between men and women, single and married women, and mothers with young children.

5.2.1 Model with Female Dummy

I report the results for the model outlined in equation 5. I note significant differences among men and women in categories such as non-market work, including home ownership activities, socializing, and education. Males overall spent more time on leisure, and recorded significant increases in reallocation of foregone market hours towards watching TV, sleeping, socializing, and other leisure activities. The time spent on watching TV was about 54 percent of their foregone market work hours, and it surpassed the percentage of time devoted to

Table 5: Model with Female Dummy

Category	β	δ	$\beta + \delta$
Other income-generating activities	-1.59 (2.21)	3.39 (2.906)	1.801 (1.175)
Job search	-3.248 (2.558)	2.824 (3.172)	-0.424 (1.615)
Childcare	-6.952 (4.717)	2.777 (9.704)	-4.175 (7.01)
Non-market work	41.821*** (11.293)	-14.431* (6.309)	27.391* (12.082)
Core home production	19.118* (7.726)	4.089 (10.673)	23.206** (7.144)
Home ownership activities	41.436** (14.572)	-18.265* (9.071)	23.171** (8.115)
Obtaining goods and services	-15.788* (7.077)	-2.893 (6.769)	-18.682** (7.175)
Others care	-2.944 (2.877)	2.639 (4.269)	-0.305 (4.035)
Leisure	143.041*** (16.038)	-29.567 (28.212)	113.475** (36.137)
TV watching	54.896* (23.418)	-22.3 (22.064)	32.597 (20.217)
Socializing	32.423*** (8.724)	-31.81** (10.054)	0.612 (8.244)
Sleeping	35.819*** (7.793)	13.655 (8.852)	49.475*** (7.127)
Eating and personal care	-26.152** (9.126)	5.927 (9.27)	-20.225* (8.276)
Other leisure	46.055* (22.311)	4.961 (17.538)	51.016 (31.764)
Other	-73.074*** (21.088)	35.007 (22.366)	-38.067 (34.601)
Education	-42.007 (21.515)	37.883** (13.464)	-4.124 (29.805)
Civic and religious activities	-18.807*** (3.95)	-1.929 (5.589)	-20.735** (6.495)
Own medical care	-8.105*** (2.112)	2.582 (4.959)	-5.522 (4.726)

* $p < .10$, ** $p < .05$, *** $p < .01$

sleeping which averaged at 36 percent. Men increasingly contributed to non-market work activities, especially home ownership activities of about 41 percent of their foregone market hours. Home ownership activities relate to chores such as home repair and maintenance, lawn care, etc. They spent less time on shopping and taking care for others. The group also experienced decreases in civic and religious participation, and self medical care, which is similar to the estimates of the entire sample.

Compared to men, women spent less time on non-market work activities. They spent 14 percent less of their foregone market hours on this category, with 18 percent less reallocation towards home ownership activities. Women still spent more time than men on household chores like cleaning. The estimates for these subcategories are similar to Table 7 in [Aguiar et al. \(2013\)](#), where men spent about 8 percent of their time to household chores compared to 13 hours spent by women. In this paper, I find that women overall reallocated about 27 percent of their total foregone market work hours, with equal contributions across core home production and home ownership activities. They did, however, spent 37 percent more time than men on education. As discussed earlier about socializing, I note here that women experienced a decline in time spent on socializing, about 31.9 percent less than men. The estimate is significant at the 5 percent level. I also show that women reallocated more time to childcare than men, about 2.78 percent from the given estimate. The coefficient is, however, insignificant. I further explore the differences in childcare by comparing subgroups of women based on their marital status and age of children. Women comparatively also spent less time on leisure activities, though they noted significant increase in time spent on sleeping, which accounted for about 49 percent of the time spent not working. The reduction

in time reallocated to civic and religious activities is also observed for this gender group.

5.2.2 Model with Female and Married Dummy

The results of the regression equation outlined in 6 are in Table 6. The model looks at women, if they are married, and their respective interactions with market work. I look at the coefficient of the interaction terms in this model. The first column is the estimate for β^j , which is the coefficient on market work. This column will be an estimate for when the other dummy variables are 0, which means it estimates the reallocation of the foregone market hours by single men across different categories. I note significant increases in categories such as non-market work, especially home production which accounts for about 21 percent of the reallocated hours. This group also saw significant increases in time across leisure categories, with greater hours allocated towards watching TV than socializing or sleeping. There were also significant reductions in the time spent on own medical care by about 5.7 percent.

The second column reports the estimates of market work hours interacted with the dummy variable for female. The estimate tests the difference of the response for women as compared to men when the dummy variable on married is 0. In the estimates, I find an increase in the working time reallocated by women on childcare. The difference in childcare is about 16.09 percent and it is significant at the 10 percent level. I will further discuss this estimate in the next subsection about female subgroups. Additionally, I note an increase in the time spent on sleeping by about 35 percent. There are decreases in the differences for non-market work, by about 50 percent less reallocated hours, and other categories such as shopping and socializing.

Table 6: Model with Female and Married Dummy

Category	β	δ_1	δ_2	δ_3
Other income-generating activities	-1.206 (3.184)	0.67 (4.24)	-1.175 (4.272)	5.277 (6.041)
Job search	-3.404 (2.845)	4.27 (4.514)	0.478 (4.29)	-2.745 (3.82)
Childcare	-4.635 (3.136)	16.09* (7.398)	-7.223 (21.805)	-20.382 (22.983)
Non-market work	33.612* (14.648)	-50.45* (21.735)	25.547 (37.468)	52.622 (50.514)
Core home production	20.955** (6.953)	-16.113 (9.069)	-5.593 (35.59)	37.874 (37.327)
Home ownership activities	18.417 (11.169)	0.619 (6.686)	71.107 (37.264)	-63.052 (40.713)
Obtaining goods and services	-4.669 (4.938)	-31.681* (12.628)	-34.263 (32.092)	65.006 (40.241)
Others care	-1.091 (2.514)	-3.275 (6.487)	-5.704 (6.519)	12.794 (7.234)
Leisure	150.847*** (29.451)	3.169 (67.841)	-24.281 (63.219)	-47.378 (90.125)
TV watching	62.135*** (17.568)	-31.002 (34.331)	-22.347 (46.001)	24.682 (48.712)
Socializing	44.1*** (8.797)	-35.923* (14.955)	-36.094 (21.252)	22.38 (32.969)
Sleeping	32.7*** (9.391)	35.187* (15.215)	9.554 (36.77)	-41.876 (38.633)
Eating and personal care	-25.59*** (7.373)	4.776 (13.852)	-1.735 (18.027)	2.753 (21.598)
Other leisure	37.502 (23.18)	30.13 (32.668)	26.341 (42.071)	-55.317 (49.992)
Other	-75.213 (41.034)	26.251 (45.849)	6.655 (71.492)	12.606 (61.771)
Education	-56.842 (37.751)	43.268 (32.917)	45.855 (36.226)	-28.715 (32.551)
Civic and religious activities	-5.125 (3.953)	-14.296 (9.197)	-42.258 (29.597)	39.485 (35.442)
Own medical care	-5.706* (2.236)	-4.282 (10.994)	-7.386 (6.329)	15.171 (13.472)

* $p < .10$, ** $p < .05$, *** $p < .01$

The third column contains the results of the interaction of market work and the dummy variable married. The fourth column adds to that interaction with the inclusion of the dummy variable for female. None of the results in these two columns yield any significant results. I therefore conduct further analysis on subgroups within female demographics and look at differences between single and married women.

5.2.3 Model with Female Subgroups

Table 7 reports results of estimates of reallocated foregone market work hours among four female subgroups: single women, married women, single women with young children, and married women with young children. The age baseline for young children is taken to be less than 8 years as used in [Deryugina et al. \(2021\)](#). The sample is first restricted to female respondents and their marital statuses. The regression model 3 is run with the added controls.

Single women recorded significant increases in the time spent on childcare, home ownership activities, and sleeping. The most interesting result is the positive coefficient on childcare, which can be interpreted as single women spent 11.35 percent of their foregone market work hours towards caring for their children. This can be contrasted with the results I looked at overall for women, which had a negative estimate for the category childcare with no statistical significance. This subgroup also spent more time on sleeping, by allocating about 66.43 percent of their foregone market work hours.

The results for single women with young children are somewhat comparable with the results for single women overall, as this subgroup also experienced significant increases across

Table 7: Differences among Female Subgroups

Category	Singles	Married	Singles with young kids	Married with young kids
Other income-generating activities	-0.557 (2.811)	3.6 (2.443)	-2.258 (1.922)	3.046 (2.153)
Job search	0.8 (4.017)	-1.387* (0.831)	-0.62 (3.608)	-2.16 (1.959)
Childcare	11.346* (5.85)	-15.626* (9.375)	16.384* (9.056)	-24.351 (15.065)
Non-market work	-16.224 (23.293)	60.005*** (14.645)	-28.148 (24.035)	89.201** (40.534)
Core home production	5.518 (9.187)	36.684*** (11.014)	4.821 (9.013)	45.766*** (15.193)
Home ownership activities	18.04*** (6.465)	26.182*** (9.68)	13.446** (5.81)	21.968** (9.702)
Obtaining goods and services	-35.473*** (13.676)	-5.556 (6.816)	-36.809*** (12.592)	10.93 (23.729)
Others care	-4.309 (6.335)	2.695 (4.495)	-9.606* (5.35)	10.536 (8.526)
Leisure	153.6 (80.409)	82.314*** (14.159)	95.451** (41.672)	66.983*** (13.348)
TV watching	31.503 (24.278)	33.498* (19.323)	17.704 (24.936)	32.083* (32.916)
Socializing	8.401 (16.006)	-6.411 (8.618)	6.407 (12.437)	-3.644 (9.773)
Sleeping	67.433*** (18.418)	35.883*** (11.061)	44.105*** (13.071)	31.859 (11.669)
Eating and personal care	-20.493** (9.661)	-19.519** (8.695)	-16.862** (7.009)	-19.016 (10.253)
Other leisure	66.757 (50.972)	38.863** (19.042)	44.097 (34.32)	25.701 (19.135)
Other	-48.965 (72.25)	-28.906** (13.044)	19.191 (36.229)	-32.718 (31.695)
Education	-14.255 (61.619)	4.337 (6.679)	47.157 (31.652)	0.895 (18.5)
Civic and religious activities	-18.691** (9.347)	-22.163*** (7.747)	-16.427** (7.222)	-19.114** (9.414)
Own medical care	-9.835 (10.131)	-2.104 (4.253)	-9.809 (10.845)	-4.611 (7.662)

* $p < .10$, ** $p < .05$, *** $p < .01$

categories such as childcare, home ownership, and sleeping, in addition to significant increase in the leisure category overall. Single women with young children spent about 16.38 percent of their foregone work hours towards childcare, which is greater than the population of single women overall with children. Single women with young children spend less time sleeping and on home ownership activities too, though they experience an increase overall. The time spent on eating and personal care decreased for this subgroup, although it decreased less than the group of single women overall.

Among married women, I note significant decreases in categories such as job search, childcare, and other activities. Married women reallocated 15.63 percent less hours of their foregone market work hours. The decrease in time spent on childcare is captured by the increase in time spent on non-market work or home caring activities. This may be due to the fact that married couples are able to share household responsibilities among each other. This subgroup also spent less time searching for jobs. The decrease can again be attributed to employed spouses which helped them in taking some time off the workforce. These findings are similar to those of [Collins et al. \(2021\)](#), which discuss reductions in labor supply for female partners in heterosexual relationships. Married women recorded increases in time spent on leisure, especially watching TV and sleeping, though they recorded less sleeping hours as compared to their single counterparts.

The fourth column of the table reports estimates for married women with young kids. This subgroup noted significant increases in time spent on non-market work, similar to the estimate generated for the overall population of married women. The coefficient for childcare, in this case, is negative but insignificant. This can be attributed to married couples jointly

taking care of their young children. The time reallocated to leisure is significant, but it notes the least increase as compared to other subgroups. The only subcategory with a significant increase is watching TV. The distribution for married women with children is reverse, as time spent on leisure accounted for a lesser increase than time spent on home caring activities.

The results also show that increase in childcare was supplemented by decrease in non-market work and increase in leisure, particularly sleeping, and vice versa. All four subgroups, noted significant decreases in time spent on civic and religious activities, which is also consistent with the estimates generated in the regression run over the entire population of males and females.

5.3. Robustness Checks

To demonstrate the validity of our results, I run certain robustness checks to account for changes across intensive and extensive margins of employment. First, I re-run the regression in model 4 on the sample from employed respondents from 2003-2010 and 2017-2020. The results of the regression are tabulated in Table 8 as below.

Among employed individuals in the Great Recession, I show a significant substitution of time spent not working on leisure activities, especially across activities such as watching TV and sleeping. People spent about 42 percent and 37 percent of their foregone work hours on watching TV and sleeping, respectively. There is a greater substitution towards leisure in the pandemic period with additional significant increases in time spent on socializing, as well as overall substitution towards non-market work. People spent about 20 percent of their foregone market work hours towards home production activities, and 30 percent to

Table 8: Intensive Margins: 2003-2010 and 2017-2020

Category	β	δ	$\beta + \delta$
Other income-generating activities	0.263 (1.104)	0.619 (1.455)	0.882 (1.011)
Job search	1.048 (0.727)	0.494 (1.112)	1.542 (0.873)
Childcare	5.156 (5.205)	-10.873 (6.399)	-5.717 (4.054)
Non-market work	-5.381 (19.415)	36.87 (22.258)	31.489* (12.3)
Core home production	4.393 (7.58)	15.602 (9.021)	19.995*** (5.391)
Home ownership activities	-9.787 (13.2)	40.41* (17.763)	30.623* (12.629)
Obtaining goods and services	-1.9 (6.584)	-16.139 (9.563)	-18.04* (7.286)
Others care	1.913 (4.416)	-3.003 (5.11)	-1.09 (2.881)
Leisure	69.918** (22.317)	55.618 (34.577)	125.536*** (27.603)
TV watching	42.402* (20.713)	1.971 (26.891)	44.373* (18.41)
Socializing	-2.967 (10.274)	19.571 (11.609)	16.604** (6.203)
Sleeping	37.639*** (9.06)	4.579 (11.407)	42.218*** (7.488)
Eating and personal care	-3.595 (3.625)	-19.666* (8.132)	-23.261** (7.505)
Other leisure	-3.56 (18.242)	49.162 (31.239)	45.602 (26.287)
Other	28.996 (21.726)	-82.728* (36.346)	-53.732 (30.248)
Education	6.158 (15.075)	-26.896 (29)	-20.738 (25.567)
Civic and religious activities	0.988 (5.068)	-21.585** (7.171)	-20.596*** (5.372)
Own medical care	1.79 (2.429)	-7.979* (4.046)	-6.189 (3.359)

* $p < .10$, ** $p < .05$, *** $p < .01$

other home-caring chores. The group also spent significantly less time on shopping, eating and personal care, and civic and religious activities. The results are comparable to the ones reported in Table 4, where I note comparable distribution of foregone market work hours across the categories with statistically significant estimates.

Next, I look specifically at the dataset from 2017 to 2020 and re-run model 3 with controls on the full sample as well the sample with only employed respondents. The results for this regression are shown in Table 9.

I note that the estimates of the two groups are very similar. Overall for the employed sample, people spent significantly more time on non-market work activities, like home production and home ownership, and leisure, especially watching TV, socializing and sleeping. Respondents who were employed in the pandemic period spent more time sleeping than watching TV, in fact, they spent comparatively more time on leisure activities. They, however, substituted the increase with spending less time on non-market work. While the overall sample noted significant decrease in reallocation of their market work hours towards other categories, the employed group only marginally missed the significance. The two groups did note significant reductions in time spent on shopping and civic and religious activities, which is consistent with all the results discussed so far.

The comparisons across the intensive margins show that the reallocation of market work time is stable across different labor market states across both the recession periods as well as during the pandemic period. Thus, the changes in responsiveness of market work hours when conditioned on employment status reveal comparable estimates.

Table 9: Intensive Margins: 2017-2020

Category	Unemp + Emp	Emp
Other income-generating activities	0.187 (1.015)	0.904 (1.051)
Job search	-1.768 (1.403)	1.538 (0.906)
Childcare	-5.496 (3.531)	-6.293 (4.265)
Non-market work	34.259** (11.25)	32.416** (12.299)
Core home production	21.26*** (5.101)	20.263*** (5.878)
Home ownership activities	31.864** (10.565)	32.191* (12.891)
Obtaining goods and services	-17.305** (6.266)	-18.811* (7.871)
Others care	-1.561 (2.811)	-1.227 (3.066)
Leisure	127.546*** (24.3)	128.08*** (28.558)
TV watching	43.21* (18.893)	43.631* (19.308)
Socializing	15.752* (6.69)	17.508** (6.165)
Sleeping	42.976*** (5.957)	43.022*** (7.985)
Eating and personal care	-23.046** (7.413)	-23.822** (8.259)
Other leisure	48.655 (26.302)	47.74 (27.169)
Other	-54.728* (26.373)	-56.645 (30.772)
Education	-22.154 (24.756)	-21.461 (26.019)
Civic and religious activities	-19.817*** (4.626)	-21.349*** (5.978)
Own medical care	-6.751* (2.75)	-6.548 (3.455)

* $p < .10$, ** $p < .05$, *** $p < .01$

6. Conclusion

The paper supplies rich information for economic models explaining substitution behavior to market work during the COVID-19 pandemic. The analysis shows that people in the pandemic recession substituted more of their foregone market work hours towards leisure activities, especially watching TV and sleeping, followed by non-market work, which is inclusive of subcategories related to household chores and maintenance. There is a consistent decrease in hours spent on outdoor activities, like shopping, and civic and religious activities, which evidences the effect of containment policies of the pandemic. Socializing, however, saw a notable increase, which could be interpreted as greater interactions online through social media applications. Comparisons of the gender groups reveal differences in time allocated on the two main categories of non-market work and leisure, with females substituting less time overall to each, though noting significant increases in fraction of time substitution overall. Among females, single women reallocated more time towards childcare by making corresponding reductions home caring activities. The substitution effect is stronger for women with young children. Married women not only substituted less time towards childcare, but also spent less time searching for jobs. This may be due to spousal support, which helped them share responsibilities of children and providing for the family.

Additionally, these results add as evidence to macroeconomic models studying elastic substitution margins between home production and market consumption during recessionary periods. Increases in time spent on leisure activities serve as useful data inputs for business cycle models studying welfare costs of recessions. Gender comparisons further feed labor and behavioral economics models studying such differences. It also helps in evaluating non-

separable preferences that exist among gender subgroups, particularly among single women with young children over spending time taking care of their children and sparing leisure time for themselves. Analysis on job search and other income-generating activities contributes to research studying unemployment trends during recessionary business cycles.

My analysis was limited due to a small sample size of the pandemic dataset. It will be interesting to reevaluate the results by adding data from 2021. In this setting, the pandemic period can be further trimmed to years 2019-2021 for comparison. Though my paper focused on gender gaps, racial differences may be another avenue for research to compare such substitution effects. Lastly, incorporating COVID data, such as family infection, receipt of stimulus payment, remote work, industry impact, etc. may enhance analysis of the pandemic period.

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8. Appendix

- Below is the table of descriptive statistics for the control variables used in the empirical models, unless otherwise explicitly used.

Table 10: Descriptive Statistics: Control Variables

Variable	2003-2010	2017-2020
Male	0.5654 (0.4957) <i>N</i> = 63,351	0.5446 (0.4980) <i>N</i> = 20,712
Married	0.4860 (0.4998) <i>N</i> = 54,453	0.5119 (0.4999) <i>N</i> = 19,471
Black	0.1284 (0.3345) <i>N</i> = 14,381	0.1346 (0.3413) <i>N</i> = 5,118
Age	46.191 (17.581)	50.652 (18.150)
Some school education	0.1691 (0.3748) <i>N</i> = 18,943	0.1102 (0.3132) <i>N</i> = 4,193
High school graduates	0.2690 (0.4434) <i>N</i> = 30,137	0.2317 (0.4219) <i>N</i> = 8,811
Bachelor's degree	0.2665 (0.4421) <i>N</i> = 29,858	0.2675 (0.4427) <i>N</i> = 10,175
Bachelor's and higher	0.2954 (0.4562) <i>N</i> = 33,100	0.3906 (0.4879) <i>N</i> = 14,854
Have Child	0.4778 (0.4995) <i>N</i> = 53,530	0.3759 (0.4843) <i>N</i> = 14,296
Num of children	0.9011 (1.1549)	0.7029 (1.081)
Age of youngest child	7.551 (5.337)	7.5421 (5.259)
Total Sample Size, <i>N</i>	112,038	38,033

2. The quarterly variation of the quarterly averages:

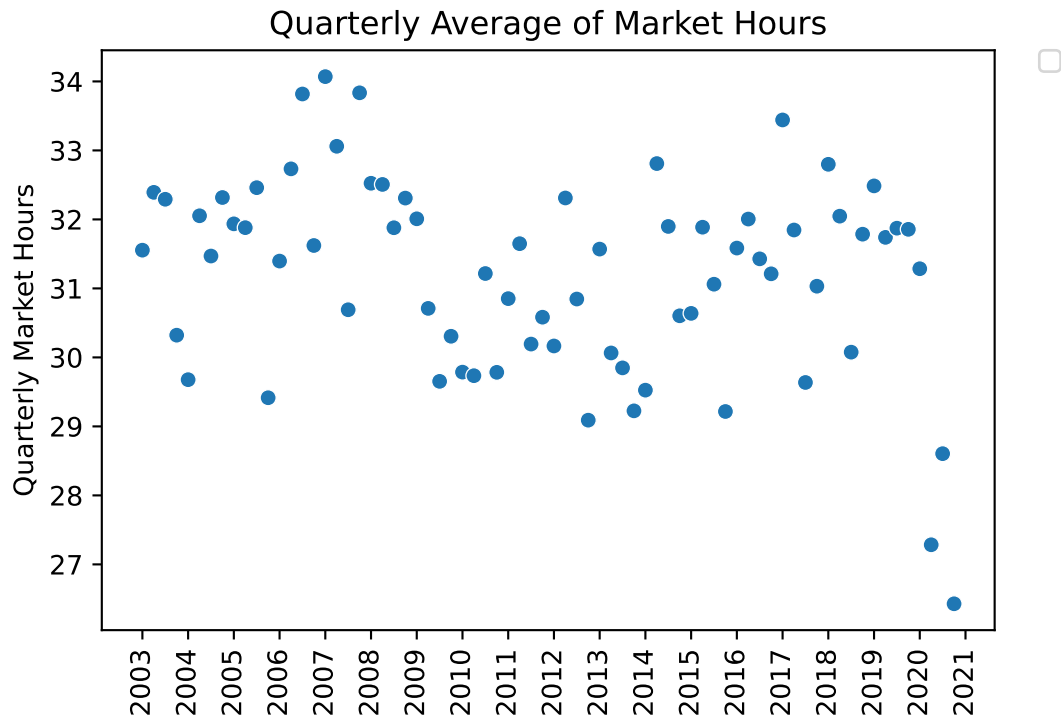


Figure 6: Quarterly Averages of Market Hours