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ABSTRACT: This paper examines the impact of changes in commuting time on welfare and labor supply in the aftermath of the COVID-19 pandemic. Utilizing data from the American Time Use Survey, we observe a shift in commuting time and working hours across occupations with varying ability of telework after the pandemic. We develop a household model of labor supply that accounts for commuting time, and we characterize how changes in commuting time impact individuals' and spouses' labor supply. We calibrate the model to the data. Our findings reveal that the observed post-pandemic decline in commuting time yields significant welfare gains: between 1.5 to 4.5 percent of consumption equivalents for households where at least one spouse experiences reduced commuting.

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The Impact of Reduced Commuting on Labor Supply and Household Welfare: A Post-Pandemic Analysis

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April 3, 2024

Abstract

This paper examines the impact of changes in commuting time on welfare and labor supply in the aftermath of the COVID-19 pandemic. Utilizing data from the American Time Use Survey, we observe a shift in commuting time and working hours across occupations with varying telework capacities after the pandemic. We develop a household model of labor supply that accounts for commuting time, and we characterize how changes in commuting time impact individuals' and spouses' labor supply. We calibrate the model to the data. Our findings reveal that the observed post-pandemic decline in commuting time yields significant welfare gains: between 1.5 to 4.5 percent of consumption equivalents for households where at least one spouse experiences reduced commuting.

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1 Introduction

The COVID-19 pandemic has reshaped the world of work in unprecedented ways, with "telework" or remote work emerging as an important force. This rapid transition has transformed how and where work is conducted and structured, challenging traditional norms around work time, commuting, and work-life balance. The ability to work remotely substantially reduces, if not entirely eliminates, commuting time, a previously almost non-negotiable component of the workday, freeing up precious hours during the day that could be reallocated to other activities.

These shifts in work and commuting patterns do not impact workers in isolation, but they can reshape the entire household's decisions. One spouse's transition to remote work can significantly affect the other's time allocation, depending on how the spouse who is saving in commuting time spends this time saved. Despite many studies about the changes in work patterns and time allocation due to the pandemic, the interconnected dynamics between spouses and the broader welfare implications remain relatively unexplored.

In this paper, we aim to contribute to this underdeveloped area of study by analyzing how time allocation has changed in the post-pandemic era, considering variations based on individuals' gender and occupation. We use data from the American Time Use Survey (ATUS), a comprehensive survey conducted by the U.S. Bureau of Labor Statistics that tracks how individuals in the U.S. allocate their time across various activities. ATUS data reveals noticeable pre-pandemic differences in time allocation between men and women, with men working more hours and commuting more than women. After the pandemic, we identify significant reductions in commuting time for workers in teleworkable occupations, amounting to 1.7 hours per week for men and 1.2 hours per week for women. Furthermore, we find a more than 1 hour per week decline in men's working hours and no significant change in women's working hours.

To rationalize these findings, we build a household model of labor supply where spouses differ in their ability to telework. In this model, workers must commute to work, and commuting time is unpaid. The model accounts for variations in returns to work based on workers' occupations and gender. Under a plausible parameterization, our model reveals that a decline in one spouse's commuting time leads to an increase in this individual's labor supply because it reduces the marginal utility cost of working, and a decline in their spouse's labor supply because the family income increases and the household wants to equalize the marginal cost of working across spouses. Conversely, an increase in the preference for leisure leads to a decline in the worker's labor supply and a rise in their spouse's labor supply because of the decline in the family's income.

We calibrate our model to replicate married households' labor supply and commuting time patterns across occupations before the COVID-19 pandemic. In the calibrated model, we simulate the impact of two different separated shocks: (i) a decline in commuting time that impacts individuals working in occupations that have the ability to work remotely, and (ii) a increase in men's preference for leisure. Last, we estimate the impact of a combined (i) commuting time and (ii) leisure shock.

The model-based simulations provide essential insights into the impact of the commuting time shock, the leisure shock, and the interaction between these two shocks. A decline in commuting time leads to an increase in both working hours and leisure for individuals working in occupations that can telework. This effect is particularly pronounced for married men due to their historically longer commuting times. The final impact on hours worked depends on the spouse's occupation. Specifically, men's working hours increase by 2.12 hours when both spouses work in teleworkable occupations and by 1.89 hours when the husband works in teleworkable occupations but the wife does not. The effect is larger when both spouses work in teleworkable occupations because families maximize their welfare by equalizing the marginal cost of working across spouses. Conversely, the model predicts a slight decrease of 0.17 in the husband's worked hours when the husband works in an occupation that does not allow remote work and the wife works in a teleworkable occupation. For women, the pattern is similar: hours worked increase by 0.78 hours when both spouses work in teleworkable occupations and by 1.07 hours when only the wife works in teleworkable occupations. Like men, women in non-teleworkable occupations married to a husband who works in a teleworkable occupation experience a decline of 0.28 hours. Last, hours stay the same in a couple where husband and wife work in a non-teleworkable occupation.

Our analysis uncovers substantial welfare gains associated with a decline in commuting time, and the gains are larger for families that experience a larger decline. When at least one spouse works in a teleworkable occupation, the total welfare gain ranges from 1.5 to 4.5 percent in consumption equivalents, similar to results found in surveys (Barrero et al., 2021). This gain is particularly pronounced for couples where both partners work in teleworkable occupations, as both the husband and wife benefit from this change. The second-largest gain is observed in couples where the husband works in a teleworkable occupation, and the lowest gain is experienced when the wife works in a teleworkable occupation.

While our main objective is to quantify the welfare impact of reduced commuting time, our model presents certain limitations on reproducing the changes in hours worked observed in the data after the pandemic. The model predicts almost all the observed increases in married women's working hours in teleworkable roles, but does not account for changes in married men's hours worked; the model predicts that men's working hours should increase while we observe an average decline in the data. To align our model's predictions with the data, we incorporate a preference shock for men that increases men's preference for leisure. This accounts, for example, for an acceleration in the decline of hours worked, a long-term trend well-documented in Bick et al. (2022), or for other effects like the impact of long-COVID-19 on individuals' ability to work, documented in Bach (2022). With this adjustment, our model successfully mirrors the data on changes in women's and men's working hours across occupations after the pandemic.

Our paper is divided in five sections. Section 2 outlines the literature review. Section 3 presents some stylized facts from the ATUS. Section 4 presents the theoretical model and derives key analytical results. Section 5 describes the model calibration and Section 6 presents the quantitative results. Section 7 concludes the paper.

2 Literature Review

This paper contributes to three stands of the literature. First, it contributes to the large literature documenting the impact of changes in time allocation in the aftermath of the pandemic. For instance, Aksoy et al. (2023), drawing on survey data from 27 countries, estimate that working from home saved on average two hours per week per worker in 2021 and 2022 and find that those time savings were allocated mainly to primary and secondary jobs. Cowan (2023), using data from the ATUS, documents that time allocation changes in the wake of the COVID-19 pandemic are concentrated among college-aged individuals. Pabilonia and Vernon (2023) also use ATUS to document changes in time use within couples, focusing on couples where one partner works fully from home. Our paper differentiates itself through two key contributions within this sphere of literature.[1] Akin to Pabilonia and Vernon (2023), we focus on the changes in time allocation within couples and, importantly, controlling for long-term trends in hours worked, which helps to isolate the specific impacts attributable to the pandemic.

[1] A non-exhaustive list of papers documenting the increase in remote work around the world includes Barrero et al. (2021), Aksoy et al. (2022), (Barrero et al., 2022), Draca et al. (2022), Martinez et al. (2023) Hansen et al. (2023), among others.

This study also contributes to a growing literature that attempts to estimate the value workers attribute to working remotely. Barrero et al. (2021), using a large survey, attempt to quantify the value of working from home and find that amenity gains can range from 1.5 percent of earnings at the low end of the earnings distribution to 7.3 percent at the high end.[2]. Stutzer and Frey (2008) using data from the German Socio-economic panel find that people with longer commuting time report systematically lower subjective well-being. Our contribution to this strand of literature is noteworthy: unlike existing studies that focus solely on individual workers' welfare implications, our analysis ventures beyond this limitation to estimate the household-level welfare impacts of remote work. This enables us to capture the broader family benefits that accrue when one spouse reduces commuting time, thereby providing a more comprehensive understanding of the advantages associated with remote working arrangements.

Finally, this paper joins an expanding literature that investigates the impact of gender disparities in occupational choices and their subsequent effects on wages and hours worked. This includes works by Erosa et al. (2022), Keller (2019), Cortes and Pan (2017) Goldin (2014), and Bertrand et al. (2010). Of particular note are Keller (2019) and Erosa et al. (2022). Keller (2019) delves into the evolution of women's preferences for analytically intensive tasks, attributing this shift to labor supply dynamics and an increased valuation of skills within these occupations over time. Erosa et al. (2022) present a comprehensive model characterizing gender asymmetries in both occupational choices and labor supply, rooted in differential home production responsibilities. Their model outlines the significant repercussions these disparities have on the gender wage gap and the broader allocation of talent across occupations. Our paper extends this literature by introducing an often-overlooked factor—teleworkability—and its associated reduction in commuting time as influential variables affecting changes in hours worked. Unlike existing studies, we argue that the capacity for remote work serves as a pivotal occupational characteristic that can introduce a new layer of complexity to our understanding of gender disparities in the labor market.

3 Stylized Facts

We start our paper by describing some important stylized facts about the changes in time use before and after the pandemic. We use data from the American Time Use Survey

[2]Additional evidence suggests that these amenity gains may partly explain the "missing" wage growth puzzle in the aftermath of the pandemic, namely the lack of steeper wage growth after the pandemic in Advanced Economies despite the high levels of labor market tightness, as workers may have substituted pay rises for flexibility and the implicit gains associated with working from home (Barrero et al., 2022)

(ATUS), which is conducted annually by the Bureau of Labor Statistics (BLS) and provides detailed information on how individuals in the U.S. spend their time. The ATUS collects data on a wide range of activities, including work, household chores, childcare, and leisure activities. The survey employs a combination of telephone interviews and self-administered online diaries, ensuring comprehensive coverage, and the survey sample is designed to be nationally representative. We first restrict the sample to those in prime age, 25 to 54 years old and working.

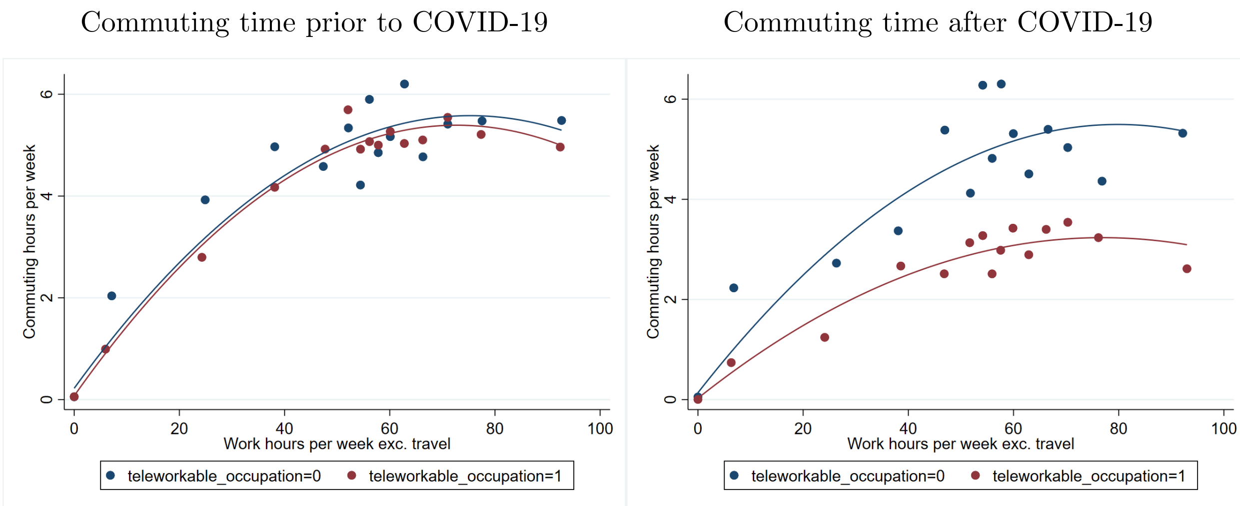
Figure 1 plots the average weekly hours spent commuting prior to COVID-19 (from 2016 to 2019) and after COVID-19 (2021) across teleworkable and non-teleworkable occupations. Teleworkable occupations are defined as those that can be done from home, following the classification of Dingel and Neiman (2020). As a robustness test, we also confirm the occupations classified by Dingel and Neiman (2020) using the responses to the new Current Population Survey question, introduced in April 2020 "At any time in the last 4 weeks, did you telework or work at home for pay because of the coronavirus pandemic?" Precisely, for ATUS, we classify the following occupations to be teleworkable: (i) management, business, and financial occupations, (ii) professional and related occupations, and (iii) office and administrative support occupations.

Two key facts emerge: (i) before the pandemic, the difference in commuting time between workers in teleworkable and non-teleworkable occupations was minimal, and (ii) after the pandemic, there is a large difference in commuting time between workers in teleworkable and non-teleworkable occupations. After the pandemic, on average, workers in teleworkable occupations save two hours a week by commuting less than workers in non-teleworkable occupations. In contrast, workers in non-teleworkable occupations did not report significant changes in commuting time relative to their pre-pandemic commuting time.

Next, we delve into the implications of shifts in time allocation across distinct categories for prime-age employed individuals. Our analysis primarily concentrates on five main categories. First, market work, which encompasses both work-related travel and actual work hours excluding commute time. Second, child care. Third, non-market work which captures a wide array of domestic responsibilities, including but not limited to cooking, cleaning, and shopping for groceries and other goods. Lastly, the leisure category encapsulates activities such as watching television, socializing, sleeping, and other recreational pursuits.

To ensure that our analysis captures the specific impact of the pandemic, we detrend the data to control for long-term trends in hours worked. These trends include the well-

Figure 1: Commuting time changes by teleworkability status



Notes: The figure plots the average weekly hours spent in commuting prior to COVID-19 (left panel) and after COVID-19 (right panel). The blue dots capture commuting times for non-teleworkable occupations and the red dots for teleworkable occupations.
Source: ATUS and authors' calculations .

documented decline in men's working hours and the rise in women's working hours over time. By controlling for these long-term trends, we can focus on the differential effects of the pandemic on time use patterns, particularly with regard to changes in market work, non-market work, and leisure activities. Table 1 shows the summary statistics of time use for (1) pre-COVID-19 (2016-2019), (2) post-COVID-19 (2021), (3) difference between pre and post-COVID-19 and (4) deviations from the long-run trend, where the long-run trend is defined for the period between 2010 and 2019 by gender and the ability to telework.

For men in teleworkable occupations, there was a notable decrease in average market work time from 46.46 hours per week in the pre-COVID period to 44.78 hours per week in the post-COVID-19 period. This decline in market work time is primarily attributed to a reduction in work-related travel time, which decreased from 3.97 to 2.20 hours, while work time excluding travel remained relatively stable. Additionally, the analysis reveals a significant increase in the amount of time spent on leisure activities, with an average increase of 2.05 hours, and childcare, with an average increase of 0.62 hours. Other time use categories exhibited minor changes. Importantly, when the data is detrended to account for long-term trends, the findings remain consistent, indicating that the changes in commuting time, leisure, and childcare were unexpected and cannot be solely attributed to pre-existing trends.

Table 1: Changes in Time-Use Prime Wage Employed Workers

Time Use Category	(1) Pre-COVID (2016-2019)	(2) Post-COVID (2021)	(3) ΔPost-Pre	(4) Dev. from LR Trend
Men Telework				
Market Work	46.46	44.78	–1.68	–1.30
Work related travel	3.97	2.20	–1.77	–1.79
Work excl. travel	42.49	42.58	0.09	0.49
Child care	3.64	4.27	0.62	0.73
Nonmarket work	12.47	12.22	–0.25	–0.41
Leisure	101.83	103.88	2.04	1.22
Men Non-Telework				
Market Work	47.16	45.42	–1.74	–2.33
Work related travel	4.06	3.81	–0.25	–0.37
Work excl. travel	43.10	41.61	–1.49	–1.97
Child Care	2.49	2.30	–0.19	–0.11
Nonmarket work	12.23	12.40	0.17	0.40
Leisure	102.76	104.47	1.71	1.85
Women Telework				
Market work	39.90	38.75	–1.16	–1.18
Work related travel	2.96	1.73	–1.23	–1.27
Work excl. travel	36.94	37.02	0.08	0.10
Child care	4.89	5.11	0.22	0.10
Nonmarket work	17.02	15.72	–1.29	–1.07
Leisure	100.80	103.80	2.99	2.69
Women Non-Telework				
Market work	36.29	36.16	–0.13	0.01
Work related travel	2.75	2.61	–0.13	–0.19
Work excl. travel	33.54	33.54	–0.00	0.20
Child care	5.04	4.90	–0.14	–0.47
Nonmarket work	18.59	20.30	1.71	2.08
Leisure	102.47	103.20	0.72	1.05

Notes: The table presents variations in weekly time use across specific categories for individuals aged 25 to 54 years who are employed. Column (1) displays the average time usage per category from 2016 to 2019. Column (2) provides analogous data for 2021. Column (3) enumerates the simple difference between the figures from columns (1) and (2). Column (4) quantifies the deviation in 2021 from a linear trend predicted using data spanning 2016 to 2019.
Source: American Time Use Survey and authors' calculations.

In contrast, men in non-teleworkable occupations did not experience a pronounced decline in work-related travel, which slightly declined from 4.06 to 3.81 hours. However, they did experience a notable decrease in work excluding travel, moving from 47.16 hours in the pre-COVID-19 period to 45.42 hours in the post-COVID-19 period. Similar to men in teleworkable occupations, time spent on leisure activities shows a significant increase, rising from 102.76 to 104.47 hours. In contrast to men in teleworkable occupations, men in non-teleworkable occupations did not experience an increase in childcare time, but rather experienced a small increase in non-market work activities of 0.17 hours per week. Importantly, when the data is detrended to account for long-term trends, the overall conclusions remain unchanged.

Turning to women in teleworkable occupations, there was a small decrease in market work time from 39.90 hours in the pre-COVID-19 period to 38.75 hours in the post-COVID-19 period. Similar to men, this decline in market work time was driven by a decrease in work-related travel time, which decreased from 2.96 to 1.73 hours. However, work time excluding travel showed only a minor increase of 0.08 hours. Additionally, women in teleworkable occupations, like their male counterparts, experienced a significant increase in leisure time, rising from 100.80 to 103.80 hours. Interestingly, women in teleworkable occupations also exhibited a notable decline in non-market work time, while childcare time increased slightly. Similar to men, when the data is detrended, the overall conclusions remain unchanged.

For women in non-teleworkable occupations, the average market work time remained almost unchanged moving from 36.29 hours in the pre-COVID-19 period to 39.16 hours in the post-COVID-19 period. This decline was driven by a small decline in work related travel, moving from 2.75 to 2.61 hours. Interestingly, women in non-teleworkable jobs experienced the largest increase in non-market work time and the smallest increase in leisure time. When the data is detrended to account for long-term trends, the main results do not change.

3.1 Married Individuals

We now shift our focus to variations in time allocation across different activities for married individuals in prime age. The rationale for emphasizing married individuals lies in the broader ramifications of teleworking; the benefits extend not only to the teleworking spouse but also reverberate through their partner's experience. Notably, married workers comprise approximately 60% of the entire workforce. The detailed findings are catalogued in Table 2, and the structure parallels that of Table 1. Specifically, Column (1) displays the average time allocation for each activity in the pre-COVID-19 era (2016-2019). Column

(2) delineates the average time allocated post-COVID-19 in 2021. Column (3) showcases the simple difference between the pre- and post-COVID-19 durations, while Column (4) highlights deviations from the long-term trend. This trend is estimated using data from 2010 to 2019 and is differentiated based on gender and telework capabilities.

Before the pandemic, the difference in market work hours between the samples of married and all employed individuals was typically minimal, ranging from 1.5 hours to just 0.10 hours. The most pronounced discrepancy, close to 1.5 hours, was observed among women in non-teleworkable occupations; those in the broader sample worked more than their married counterparts. In contrast, married men historically clocked slightly more hours than men in the general employed population. However, the pandemic shifted these dynamics. Post-pandemic, married men in teleworkable roles started working fewer hours than their broader sample peers. On the other hand, married men in non-teleworkable roles began to outpace the working hours of their counterparts in the larger sample. For women, post-pandemic trends reveal that married women in teleworkable positions started logging more hours than those in the broader sample, while married women in non-teleworkable roles continued to work fewer hours than their general sample counterparts.

Furthermore, mirroring the overall sample, the pandemic induced a sharp decline in work-related travel for married individuals, especially for those in telework positions. Among married men in teleworkable roles, the decrease amounted to 1.97 hours weekly, which is slightly more pronounced than the 1.70-hour dip observed in the general sample. For women in similar telework roles, the decrease hovered around 1 hour per week, aligning closely with the broader sample.

Analyzing the subset of married individuals specifically, two distinct patterns emerge concerning the pandemic's impact. First, married men with teleworkable roles experienced a stark contrast in work hours excluding travel relative to the overall male population. While the broader male demographic saw a minor uptick of 0.09 hours per week, married men in teleworking roles faced a significant drop of 1.77 hours. This decline moderates to 1.29 hours when historical trends are taken into consideration, given the pre-existing, secular decrease in this group's work hours. Conversely, married men in non-teleworkable roles reported a modest weekly increase of 0.28 hours. In the larger sample, this metric transformed into a 1.49-hour decrease. When benchmarked against historical trends, both categories showcase reductions in hours worked, with the broader sample's contraction more pronounced than that of just prime-age married men.

Table 2: Summary Statistics Married Individuals

Time Use Category	(1) Pre-COVID (2016-2019)	(2) Post-COVID (2021)	(3) ΔPost-Pre	(4) Dev. from LR Trend
Men Telework				
MarketWork	46.56	42.81	–3.74	–3.39
Work related travel	4.09	2.12	–1.97	–2.09
Work excl. travel	42.46	40.69	–1.77	–1.29
Child care	5.33	6.55	1.23	1.31
Nonmarket work	13.34	14.14	0.80	0.46
Leisure	98.73	101.53	2.81	2.38
Men Non-Telework				
Market work	47.86	48.27	0.41	–0.91
Work related travel	4.33	4.46	0.13	–0.04
Work excl. travel	43.53	43.81	0.28	–0.87
Child care	3.67	3.45	–0.22	–0.20
Nonmarket work	13.20	13.12	–0.08	–0.04
Leisure	99.28	100.62	1.34	2.54
Women Telework				
Market work	38.48	39.09	0.61	0.31
Work related travel	2.88	1.81	–1.07	–1.20
Work excl. travel	35.60	37.28	1.68	1.51
Child care	6.31	7.20	0.89	0.61
Nonmarket work	18.62	16.18	–2.45	–2.16
Leisure	98.97	101.14	2.17	2.10
Women Non-Telework				
MarketWork	34.67	35.44	0.77	0.79
Work related travel	2.53	2.59	0.06	0.02
Work excl. travel	32.14	32.86	0.71	0.78
Child care	6.34	6.13	–0.21	–0.77
Nonmarket work	21.19	21.16	–0.04	0.63
Leisure	100.74	102.21	1.46	1.19

Notes: The table presents variations in weekly time use across specific categories for married individuals aged 25 to 54 years who are employed. Column (1) displays the average time usage per category from 2016 to 2019. Column (2) provides analogous data for 2021. Column (3) enumerates the simple difference between the figures from columns (1) and (2). Column (4) quantifies the deviation in 2021 from a linear trend predicted using data spanning 2016 to 2019.
Source: American Time Use Survey and authors' calculations.

Moving on to females, married women in teleworkable occupations report an increase of 1.68 market worked hours excluding travel per week post-pandemic, while the aggregate sample reveals a modest 0.08-hour weekly decrease. Trend-adjusted analysis uncovers a 1.51-hour surge for married women in teleworkable occupations, juxtaposed against a 0.10-hour weekly increase for the broader female sample. Outcomes for women in non-teleworkable jobs are more harmonized across samples. Specifically, the entire female sample observes no change in market workd excluding travel vis-a-vis the pre-pandemic period, while married women register a 0.71-hour rise. Trend-adjusted data showcases an increase in 0.20 hours per week for the prime-age sample, while married women in non-teleworkable jobs experience a 0.78 increase relative to the trend.

In synthesis, two primary deviations surface when juxtaposing the married demographic against the entire sample. Firstly, prime-age married men in teleworkable occupations experience a larger decline in hours worked relative to the broader male prime-working-age population. Secondly, women in teleworkable occupations exhibit a large increase in hours worked compared to their counterparts in the entire sample.

The presence of children can significantly influence the dynamics of time allocation, especially in the wake of the pandemic which required school closures and imposed childcare challenges upon parents.[3] While it remains beyond the scope of this study to rigorously investigate the implications of children's presence on time-use shifts, we supplement our analysis from Table 2 by restricting the sample to married households with at least one child under the age of 12. Detailed results can be found in Annex A.1, Table 7. A salient distinction arises when comparing time-use patterns between married individuals with and without children: those engaged in teleworkable occupations with children tend to reallocate a larger portion of the time saved from commuting towards childcare, with this trend being particularly pronounced among men in teleworkable roles.

Collectively, these findings demonstrate the varied impact of the COVID-19 pandemic on individuals' time allocations across different occupational categories. The pandemic-induced transition to a hybrid work environment reduced commuting time for both men and women in teleworkable occupations. Conversely, individuals in non-teleworkable professions exhibited divergent patterns: married and single men experienced a decline in market work, while married women marked a modest uptick. These changes underscore the profound impact that the pandemic had on time allocation.

[3]See Fabrizio et al. (2021) and Russell and Sun (2020) for a discussion about the impact of school closure on female labor force participation and hours worked.

4 Model

We present a household model of labor supply that aims to characterize the long-term impact of a reduction in commuting time on labor supply. The model considers the time saved from commuting to work that working from home often provides. A typical household consists of a husband m and a wife f, who jointly maximize their utility over consumption c and hours worked l. The husband and wife differ in their disutility of work ϕ, wages w, and commuting time T. In our model, households differ in the ability of each spouse to work from home, which depends on their occupation. We denote teleworkable occupations as r and occupations that don't offer the ability to telework c.

Households maximize joint utility by choosing the husband's and wife's consumption, c_i^m and c_j^f respectively, and the husband's and wife's hours worked, l_i^m and l_j^f. The optimization problem is subject to the budget constraint, the sum of the husband's and wife's consumption cannot exceed the sum of their wages multiplied by their respective hours worked. The model assumes that commuting time for each occupation, T_i^f and T_j^m, is known, and it is modeled as a fixed time cost that increases household's disutility of work and is not compensated by firms.[4] The household problem is given by:

$$\max_{c_i^m c_j^f, l_i^m, l_j^f} \log(c_i^m) + \log(c_j^f) - \phi_i^m \frac{(l_i^m + T_i^m)^{1+\gamma}}{1+\gamma} - \phi_j^f \frac{(l_j^f + T_j^f)^{1+\gamma}}{1+\gamma}$$

subject to:

$$\begin{aligned} c_i^m + c_j^f \leq l_i^m w_i^m + l_j^f w_j^f \\ c_i^m, c_j^f, l_i^m, l_j^f \geq 0 \\ l_i^m, l_j^f \leq 1 \\ i, j \in \{r, c\} \end{aligned}$$

[4]Although individuals' leisure is not modeled explicitly, it can be easily defined as the one unit endowment time minus the time individuals spend working and commuting $(1 - l - T)$.

Husband's and wife's labor supply are pinned down by the two equations below:

$$\phi_i^m (T_i^m + l_i^m)^\gamma = \frac{2w_i^m}{w_i^m l_i^m + w_j^f l_j^f},$$
$$\phi_j^f (T_j^f + l_j^f)^\gamma = \frac{2w_j^f}{w_i^m l_i^m + w_j^f l_j^f}.$$

After some algebraic manipulation, a workers' labor supply can be rewritten as a function of their own commuting time, their spouse's commuting time, their own disutility of work, their spouse's disutility of work, and their spouse's working time, as below:

$$l_j^f = \left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f} \right)^{1/\gamma} (T_i^m + l_i^m) - T_j^f \tag{1}$$

It is evident from equation (1) that a decrease in the individual's commuting time directly increases their labor supply. However, the final effect is contingent upon the responsiveness of the spouse's labor supply to changes in the individual's labor supply. Using the household's first order condition and budget constraint, we obtain an equation solely dependent on l_i^m:

$$\underbrace{\frac{2w_i^m}{\phi_i^m (l_i^m + T_i^m)^\gamma}}_{f(l_i^m)} = \underbrace{\left(\left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f} \right)^{1/\gamma} (l_i^m + T_i^m) - T_j^f \right) w_j^f + l_i^m w_i^m}_{g(l_i^m)} \tag{2}$$

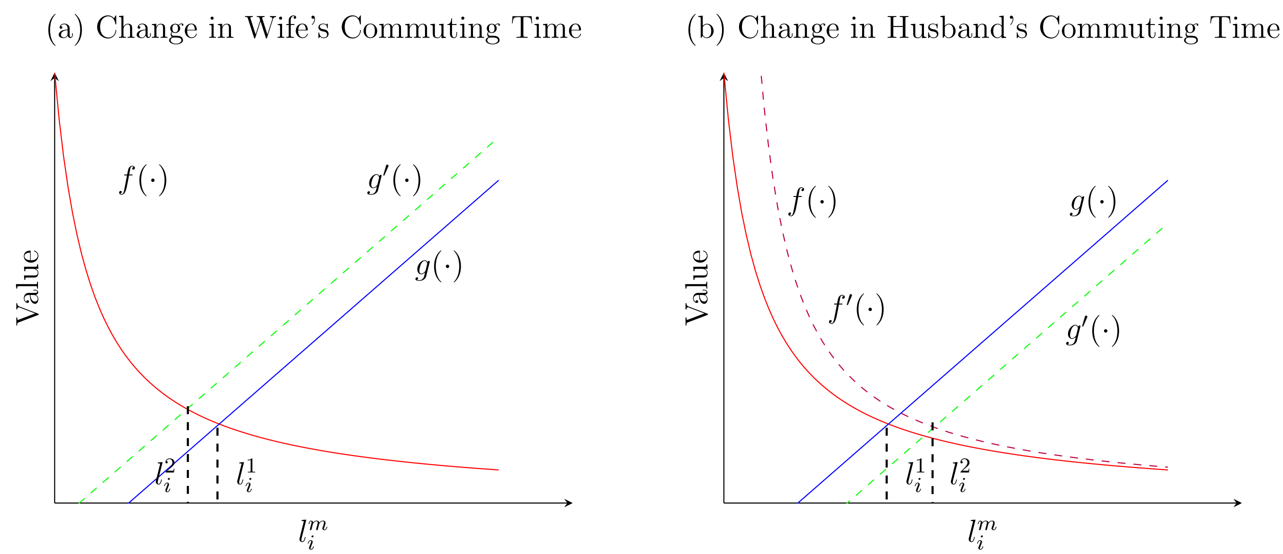
In order to determine the labor supply of the husband, we need to solve the non-linear equation (2). It is clear that $f(\cdot)$ is decreasing with respect to the husband's labor supply, while $g(\cdot)$ is increasing with respect to the husband's labor supply because wages and the disutility of work ϕ are always positive. An essential consideration is whether these curves intersect. In Annex A.2.1, we characterize the conditions and parametrizations under which equation (2) yields a unique solution.

To fully grasp the implications of changes in commuting time on labor supply, it is important to understand the responsiveness of the $f(\cdot)$ and $g(\cdot)$ functions to such changes. In Lemma 1, we provide a detailed characterization of these dynamics. It delineates how a change in commuting time directly impacts the agent experiencing the change, and how it indirectly affects their spouse.

Lemma 1 (Commuting Time and Labor Supply)**.** *A reduction in an agent's commuting time leads to a decrease in the spouse's labor supply and an increase in the agent's labor supply.*

For clarity and to distill the economic intuition of our results, we initially focus on changes in the husband's labor supply, l_i^m, resulting from shifts in his wife's commuting time, T_j^f. Subsequently, we analyze the impact stemming from changes in his own commuting time, T_j^m. We begin with the wife's commuting time, T_j^f, primarily because changes in her commute don't directly impact the husband's labor supply. Yet, they do so indirectly via the family income. This indirect mechanism is evident from equation (2), where the $f(\cdot)$ function remains invariant to changes in T_j^f. However, a decrease in the wife's commuting time causes an upward shift in the $g(\cdot)$ function, leading to a reduction in the husband's labor supply as depicted in Figure 2. Specifically, the contraction in the wife's commute prompts the $g(\cdot)$ curve to shift upwards, causing the husband's labor supply to drop from l_i^1 to l_i^2.

Figure 2: The Impact of Changes in Commuting Time



Note: The two charts illustrate the implications on the husband's labor supply, l_i^m, due to shifts in commuting time. Panel (a) focuses on the effects arising from a reduction in the wife's commuting time, T_j^f, whereas panel (b) examines those arising from a reduction in the husband's own commuting time T_i^m. In both panels, the starting point is illustrated by the intersection of $f(\cdot)$ (depicted by the red line) and $g(\cdot)$ (the blue line) at l_i^1. In left panel (a), the decrease in the wife's commuting time, T_j^f, prompts the $g(\cdot)$ function to shift upwards, leading to a reduction of the husband's hours worked to l_i^2. Conversely, the right panel (b) showcases the repercussions of a decline in the husband's commuting time, T_i^m. This reduction makes the $f(\cdot)$ function more steep, and pushes the $g(\cdot)$ function downwards. As an outcome, a new equilibrium emerges at the intersection of the modified $f'(\cdot)$ and $g'(\cdot)$ curves in l_i^2.

Moving our attention to the impact of a decrease in the husband's commuting time on his labor supply, it becomes evident that such a reduction directly augments his labor supply by lessening disutility related to labor, thereby leading to an increase in working hours. This dynamic can be observed in the steepening slope of the $f(\cdot)$ function in equation (2) as the commuting time, T_i^m, diminishes. Concurrently, the surge in the husband's working hours increases the family income, which in turn curtails the spouse's labor supply. This contraction bolsters the husband's work hours further, a phenomenon underscored by the corresponding shift in the $g(\cdot)$ function. A formal proof of this lemma can be found in Annex A.2.1. Next, we discuss the consequences of changes in preference for leisure.

We first focus on changes in the husband's labor supply, l_i^m, that arise from variations in his wife's preference for leisure, ϕ_j^f. Subsequently, we consider the impact of shifts in his own preference for leisure, ϕ_i^m. We start with the wife's preference for leisure, ϕ_j^f, primarily because its changes don't directly affect the husband's labor supply. However, they do so indirectly, through the family income. This indirect relationship is evident in equation (2), where the $f(\cdot)$ function remains unaffected by changes in ϕ_i^f. However, an increase in wife's preference for leisure, leads them to supply less labor thus reducing the family income and resulting in the flattening of the $g(\cdot)$ function. This leads to an increase in the husband's labor supply, which shifts from l_i^1 to l_i^2, as illustrated in Figure 3.

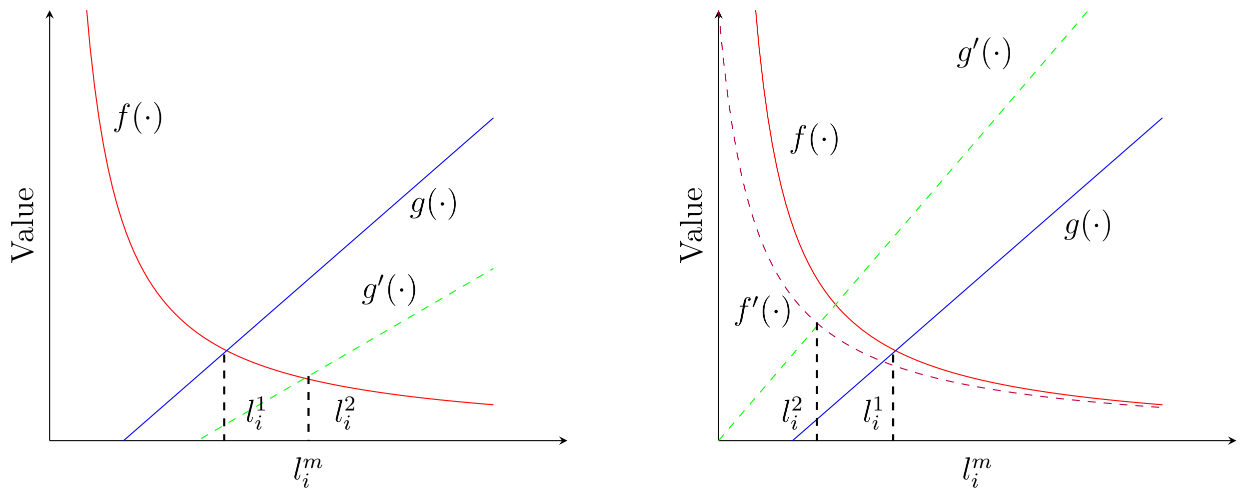
Shifting our attention to the husband's preference for leisure, ϕ_j^m, an increase in his preference for leisure directly reduces his labor supply. This dynamic is evident in the slope of the $f(\cdot)$ function in equation (2): as the husband's preference for leisure rises, the function becomes flatter. Moreover, an increased husband's leisure preference decreases his labor supply reducing the family income. This reduction indirectly affects the wife's labor supply, as depicted in equation (2). As the husband's leisure preference rises the family income reduces. The wife's labor supply increases in response to lower family income which results in its partial rebound and the steepening of the $g(\cdot)$ function. This leads to a further decrease in the husband's labor supply, which shifts from l_i^1 to l_i^2. We elaborate on this observation in Lemma 2.

Lemma 2 (Utility for Leisure and Labor Supply)**.** *An increase in an agent's utility for leisure leads to a decrease in the agent's labor supply and an increase in the spouse's labor supply.*

We leave the formal proof of this lemma to Annex A.2.2.

Figure 3: The Impact of Changes in the Preference for Leisure

(a) Change in Wife's Preference for Leisure (b) Change in Husband's Preference for Leisure



Note: The two charts depict the theoretical relationship between the husband's labor market hours l_i^m and husband's and wife's preference for leisure ϕ. In both cases, the initial conditions are represented by the intersection of the $f(\cdot)$ (red line) and $g(\cdot)$ (blue line) curves at l_i^1. The left panel shows the impact of a change in the wife's preference for leisure ϕ_j^f. The $g(\cdot)$ function shifts downwards, resulting in an increase in the husband's hours worked from l_i^1 to l_i^2. The right panel shows the effect of a reduction in the husband's preference for leisure ϕ_i^m. This change affects both functions: $f(\cdot)$ function becomes less steep, while $g(\cdot)$ becomes steeper. As a result, a new equilibrium is established, represented by the intersection of the shifted $f'(\cdot)$ and $g'(\cdot)$ curves at l_i^2 where the husband's hours worked are lower than initially.

5 Calibration

In this paper, we calibrate our household model of labor supply using data from the American Time Use Survey (ATUS).[5] We use data that is detrended to control for long-term trends in hours worked, such as the well-documented decline in men's working hours and the rise in women's working hours over time, because our analysis aims to isolate the consequences of the decline in commuting time due to the pandemic. We focus on four household types which depend on each individual's ability to work remotely, as this is a key determinant of the potential impact of working from home on labor supply.

The model has 13 parameters. Nine are chosen exogenously, while four are calibrated endogenously. We start by describing the exogenous parameters. First, we choose γ to

[5] In this analysis, the sample is restricted to heterosexual married couples primarily due to historical consistency of the data. Heterosexual married couples have been a consistent demographic within the American Time Use Survey, allowing for robust longitudinal analysis. Notably, the legalization of same-sex marriage in all fifty states only occurred in 2015. Including same-sex married couples in the dataset prior to this year could introduce potential challenges in accounting for long-term trends, as there could be discrepancies in reporting and data collection methods across states and years.

Table 3: Calibration

Parameter	Symbol	Value
Exogenous Parameters		
Frish Elasticity of Labor Supply	γ	3.00
Husband's Commuting Time - Teleworkable	T_r^m	0.035
Husband's Commuting Time - Non-Teleworkable	T_c^m	0.034
Wife's Commuting Time - Teleworkable Occupation	T_r^f	0.020
Wife's Commuting Time - Non-Teleworkable Occupation	T_c^f	0.024
Husband's Wage - Teleworkable Occupation	w_r^m	1.23
Husband's Wage - Non-Teleworkable Occupation	w_c^m	1.10
Wife's Wage - Teleworkable Occupation	w_r^f	1.06
Wife's Wage - Non-Teleworkable Occupation	w_c^f	1.00
Endogenous Parameters		
Wife's Disutility of Work Teleworkable Occupation	ϕ_r^f	55
Wife's Disutility of Work Non-Teleworkable Occupation	ϕ_c^f	50
Husband's Disutility Work Teleworkable Occupation	ϕ_r^m	85
Husband's Disulity of Work Non-Teleworkable Occupation	ϕ_c^m	125

deliver a Frisch elasticity of labor supply $1/\gamma$ equal to 0.33, a value consistent with Domeij and Floden (2006) when households face borrowing constraints. Second, the average men's T^m and women's T^f commuting time are chosen from the ATUS, to match the average time each spouse spent commuting before the pandemic, as described in Table 3. The wage for each occupation is calibrated to match the wage premium between men and women in teleworkable and non-teleworkable occupations from the Current Population Survey (CPS) in 2019. We first restrict the sample to those who are employed and between 25 and 54 years old. We calculate the real hourly wages by deflating nominal hourly wages by the US CPI (indexed to 2015 US dollars). We calculate the average real wages for men vs women $\times$ teleworkable vs non-teleworkable (contact-intensive) occupations. We then normalize the real hourly wage of women's wage for contact-intensive (non-teleworkable) occupations to 1.

The last four parameters are the husbands' and wives' disutility of work. They are calibrated to match the average hours worked in each occupation by gender before the pandemic, as described in Table 4.

The model is able to replicate the labor supply before the pandemic including two key facts: (i) men work almost 10 hours more than women on average; and (ii) men in teleworkable and non-teleworkable occupations work more than women independently of their occupation. Within men and women, workers in teleworkable occupations on average

Table 4: Calibrated Moments and Targets

Parameter	Data	Model
Wife's Disutility of Work Telework Occupation ϕ_r^f	35.5	35.5
Wife's Disutility of Work Non-Telework Occupation ϕ_c^f	30.6	30.7
Husband's Disutility Work Telework Occupation ϕ_r^m	43.2	43.2
Husband's Disulity of Work Non-Telework Occupation ϕ_c^m	42.4	42.4

work more hours and this difference is much larger for women than for men. Women in non-teleworkable occupations are the category working less hours. By construction, in the model on average men spend more time commuting than women independently of their occupation. Within occupations, individuals in teleworkable occupations tend to spend more time commuting than individuals in non-teleworkable occupations.

6 Quantitative Analysis

We start the quantitative analysis by examining the effect of a decline in commuting time, mirroring what is observed in the data, on individuals' hours worked and leisure time. Subsequently, we proceed to quantify the welfare benefits derived from the reduction in commuting time on household welfare. To account for the observed changes in hours worked after the pandemic, we also investigate the impact of an increase in men's preference for leisure on both hours worked and leisure time. Finally, the quantitative section concludes by analyzing the joint effects of the two shocks: the decline in commuting time and the increase in men's leisure preference, on individuals' hours worked and leisure time.

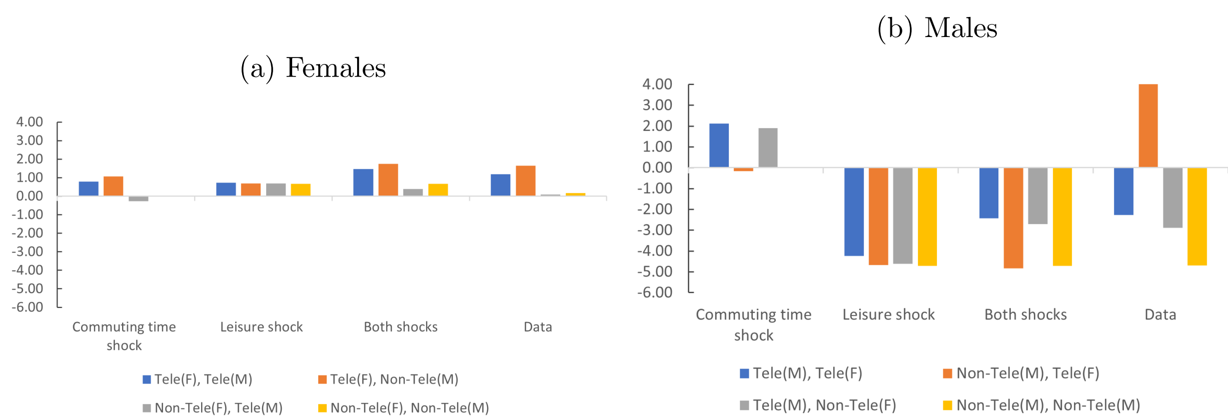
6.1 Commuting Time Shock

To replicate the impact of the decline in commuting time, we reduce the commuting time cost parameter for men and women working in teleworkable occupations as observed in Table 2 for the sample of married individuals. Men's commuting time is reduced by 60 percent while women's commuting time is reduced by 40 percent. In Figure 4, we present the impact of the reduction in commuting time in hours worked.

Our analysis reveals that the decline in commuting time leads to a rise in hours worked for individuals employed in teleworkable occupations. This increase is more pronounced for men, as they typically spent more time commuting prior to the pandemic and experienced a greater reduction in commuting time. In the case of men, the increase in hours worked varies depending on their spouse's occupation: 2.12 hours for couples where both work in teleworkable occupations (Tele(M), Tele(F)), 1.89 hours for couples with the husband in a teleworkable occupation and the wife in a non-teleworkable one (Tele(M), Non-Tele(F)), and a decrease of 0.17 hours when the husband works in a non-teleworkable occupation and the wife in a teleworkable one (Non-Tele(M), Tele(F)). No change is observed for men in couples where both work in non-teleworkable occupations (Non-Tele(M), Non-Tele(M)) since this couple is not impacted by changes in commuting time.

The time saved from commuting also leads to an increase in women's hours worked. For women, the changes in hours worked are as follows: an increase of 0.78 hours when both spouses work in teleworkable occupations (Tele(F), Tele(M)), a larger increase of 1.07 hours when the wife works in a teleworkable occupation and the husband in a non-teleworkable one (Tele(F), Non-Tele(M)), and a decrease of 0.28 hours when the wife works in a non-teleworkable occupation and the husband in a teleworkable one (Non-Tele(F), Tele(M)). No change is observed for women in couples where both work in non-teleworkable occupations (Non-Tele(F), NoTele(M)).

Figure 4: Changes in Hours Worked by Occupation and Spousal Occupation



Notes: Panel (a) outlines the changes in hours worked relative to the baseline for women, while Panel (b) details those for men. In each panel, changes in hours worked is plotted relative to the baseline under three distinct scenarios: (i) a shock that reduces the commuting time for employees in teleworkable occupations, (ii) a leisure shock that amplifies men's preference for leisure activities, and (iii) a scenario that incorporates both of these shocks concurrently. The last column shows the changes in hours worked observed in the data relative to the long-term trend.
Source: ATUS and authors' calculations.

In addition to the changes in hours worked, the decline in commuting time also impacts men's leisure time, albeit to varying degrees across different spousal occupation combinations. Leisure is computed as total hours available to individuals, which is normalized to one, minus the time spend working and commuting. Men experience a modest increase in leisure time of 0.16 hours when both spouses work in teleworkable occupations (Tele(M), Tele(F)), and an increase of 0.17 hours when the husband works in a non-teleworkable occupation and the wife in a teleworkable one (Non-Tele(M), Tele(F)). A larger increase of 0.38 hours is observed when the husband works in a teleworkable occupation and the wife in a non-teleworkable one (Tele(M), Non-Tele(F)). No change in leisure time is found for men in couples where both work in non-teleworkable occupations (Non-Tele(M), Non-Tele(M)).

Our findings reveal that women's leisure time increases in various scenarios, albeit to a lesser extent than the changes observed in hours worked. Specifically, women experience a leisure time increase of 0.42 hours when both spouses work in teleworkable occupations (Tele(F), Tele(M)), a smaller increase of 0.13 hours when the wife works in a teleworkable occupation and the husband in a non-teleworkable one (Tele(F), Non-Tele(M)), and an increase of 0.28 hours when the wife works in a non-teleworkable occupation and the husband in a teleworkable one (Non-Tele(F), Tele(M)). No change in leisure time is observed for women in couples where both work in non-teleworkable occupations (Non-Tele(F), NoTele(M)).

Figure 5: Changes in Leisure by Occupation and Spousal Occupation

(a) Females (b) Males

Notes: Panel (a) outlines the changes in leisure relative to the baseline for women, while Panel (b) details those for men. Leisure is computed as total hours available which is normalized to one minus the time spend working and commuting. In each panel, the changes in leisure relative to the baseline are plotted under three distinct scenarios: (i) a shock that reduces the commuting time for employees in teleworkable occupations, (ii) a leisure shock that amplifies men's preference for leisure activities, and (iii) a scenario that incorporates both of these shocks concurrently.
Source: Authors' calculations.

Examining the welfare implications of working from home, our analysis reveals substantial welfare gains, with the total welfare gain ranging from 1.5 to 4.5 percent in consumption equivalents when at least one spouse works in a teleworkable occupation, as shown in

Table 5: Welfare Gains by Spousal Occupation Combinations

Households	Welfare Gains (%)
Teleworkable husband and wife	4.54
Non-teleworkable husband and teleworkable wife	1.48
Teleworkable husband and non-teleworkable wife	3.31
Non-teleworkable husband and wife	0.00

Notes: Welfare gains in consumption equivalents. Results based on values for each household type, accounting for changes in consumption, hours worked, and leisure due to changes in commuting time in teleworkable occupations.

Table 5. These gains are most pronounced for couples where both partners work in teleworkable occupations, as both the husband and wife benefit from the change. The second-largest gains are observed for couples in which the husband works in a teleworkable occupation, since men in such occupations experience the most significant increase in benefits, and last is the couple where only the wife works in teleworkable occupations.

In summary, the reduction in commuting time resulted in an increase in hours worked for individuals who were affected by this decline. Notably, the benefits of this decrease were more pronounced for men, primarily due to their higher pre-pandemic commuting times and the subsequent larger decline. Furthermore, our analysis shows that spouses who were not employed in teleworkable occupations themselves but were married to individuals working in such occupations also experienced benefits from the reduction in commuting time, as shown in Annex A.2 (Table 9 shows the wife's welfare changes, while Table 10 shows the husband's welfare changes).

6.2 Leisure Shock

While the primary focus of our paper is to estimate the welfare impact of the reduction in commuting time, we acknowledge some limitations in the analysis. The comparison of the model's predictions of the impact of a reduction in commuting time on hours worked with the data in Figure 4 (which shows the changes in hours worked post-pandemic relative to the long-term trend) reveals that the model explains almost all of the observed increase in women's working hours for those in teleworkable occupations. However, the model fails to capture the changes in hours worked by men observed in the data. Specifically, the model predicts an increase in men's hours worked, while the data indicates a decline. To address this discrepancy, we augment the model with a preference shock for men.

We calibrate the preference shock to replicate the observed decline in hours worked by men in non-teleworkable occupations married to women in non-teleworkable occupations. The focus on these couples stems from the fact that they remain unaffected by the commuting time shock, thus providing a clearer identification strategy. We adjust men's disutility of labor to align with the observed decline in working hours for men in non-teleworkable occupations married to women in non-teleworkable occupations and we assume that the leisure shock influences all men in the economy. Figure 4 presents the impact of the leisure shock alone on men's and women's working hours, relative to the baseline.

The leisure shock results in an average 10 percent reduction in men's hours worked across all occupations. The decline in men's hours worked varies, ranging from -4.58 to -4.70 hours. The smallest decrease is observed for men in teleworkable occupations married to women in teleworkable occupations (-4.58 hours), while the largest reduction is experienced by men in non-teleworkable occupations married to women in non-teleworkable occupations (-4.70 hours).

In reaction to the reduced hours worked by men and the consequent decline in family income, women's hours worked increase across all spousal occupation combinations, with increases ranging from 0.67 to 0.72 hours. Women in non-teleworkable occupations married to men in non-teleworkable occupations exhibit the smallest increase (0.67 hours), while the largest increase is seen for women in teleworkable occupations married to men in teleworkable occupations (0.72 hours).

As a consequence of the leisure shock, men's leisure time increases by a similar magnitude, with an average rise of 10 percent. Conversely, women experience a reduction in leisure time on average, as they dedicate more hours to work. This highlights the different leisure allocation trends between men and women in response to the shock.

The comparison of the welfare impact of this shock presents inherent challenges, as it involves a direct alteration of the utility function. To provide a comprehensive assessment, we undertake a calculation of welfare changes in terms of consumption equivalence. The detailed results of this analysis can be found in Annex A.3, Table 6. Our findings reveal that the isolated increase of the leisure shock has a significant adverse impact on welfare, with a reduction of more than 5 percent observed across the board. This effect is particularly pronounced among spouses characterized by higher wage disparity between husband and wife, specifically in the case where the husband is engaged in a teleworkable occupation and the wife in a non-teleworkable occupation. Conversely, the welfare impact is comparatively lower for couples with small wage difference between spouses, as the case where the husband is employed in a non-teleworkable occupation while the wife works in a teleworkable occupation.

6.3 Combined Shock

Lastly, we examine the combined impact of the commuting time and leisure shocks. Compared to the results with only the commuting time or leisure shock, the two-shock scenario replicates the data more closely. For men in teleworkable occupations, the model predicts a -2.44 percent change in hours worked, which is close to the observed -2.26 percent in the data. The leisure shock alone overestimates the decline in men's hours worked in teleworkable occupations, while the commuting time shock partially offsets these effects, resulting in a closer approximation of the observed changes.

By design, the model with both shocks accurately captures the changes in hours worked for men in non-teleworkable occupations married to women in non-teleworkable occupations, with a -4.70 percent change in the model compared to the -4.69 percent in the data. However, the model falls short in explaining the changes in hours worked by men in non-teleworkable occupations married to women in teleworkable occupations, where the predicted -4.84 percent decrease in men's hours worked contrasts with the observed 4.66 percent increase in the data. Possible explanations for this discrepancy include an increase in labor supply driven by relatively higher wages for low-skilled workers in contact-intensive occupations, a phenomenon well-documented by Autor et al. (2023).[6]

For women in teleworkable occupations married to men in teleworkable occupations, the model predicts a 1.46 percent increase in hours worked, which is close to the observed 1.18 percent in the data. The model with both shocks replicates the changes in hours worked across women in all occupations better than the model with only the commuting time shock or the men's leisure shock, highlighting the importance of incorporating these two shocks.

The combined shock results in a decline in welfare compared to the baseline, mainly due to the negative impact of the increased leisure shock, as shown in Table 6.

Couples, especially those where both partners work in occupations without telework options, experience the most significant negative effect. Their welfare declines by 5.70 percent in consumption equivalent. This is because this couple does not benefit from the reduced commuting time. Conversely, couples where both spouses work in teleworkable occupations

[6] A couple where one spouse works in a non-telework occupation and the other spouse works in the telework occupation is more likely to experience an increase in hours worked due to the increase in non-telework worker wages than a couple where both spouses work in the non-telework occupations because in the first case, the changes in wages change the relative marginal benefit of working between spouses.

encounter a minor negative impact since they gain the most from the reduced commuting time. Their welfare only declines in 0.09 percent of consumption equivalent.

Additionally, a more equitable comparison is to evaluate the welfare impact of both shocks relative to the sole influence of the increased leisure shock. Utilizing a consistent utility function for this comparison allows for a more meaningful estimation of the welfare gains stemming from the reduction in commuting time. These results are shown in Table 6, in the last column.

Our analysis reveals that, in this context, the welfare impact of the commuting time shock is slightly greater compared to the baseline scenario. This effect is more prominent among couples with a wider wage disparity between husband and wife, which occurs when the husband works in a telework occupation and the wife does not. In this case, the husband's income comprises a larger portion of the family's total income, and the commuting time shock mitigates the adverse impact of the increased leisure on overall family income. This leads to a slight amplification of the welfare impact attributed to the commuting time shock. The welfare benefits increase from 3.31 consumption equivalent in the baseline to 3.52 in the case where the welfare is calculated relative to the leisure shock scenario.

Table 6: Welfare Gains (%)

Households	Leisure Shock	Both Shocks	Both Shocks Relative to Leisure Shock
Teleworkable husband and wife	-5.52	-0.09	4.80
Non-teleworkable husband and teleworkable wife	-5.23	-3.76	1.56
Teleworkable husband and non-teleworkable wife	-5.97	-2.67	3.52
Non-teleworkable husband and wife	-5.70	-5.70	0.00

Notes: Welfare gains in consumption equivalents. Results based on values for each household type, accounting for changes in work, and leisure due to changes in commuting time in teleworkable occupations and men's leisure shock (first column), changes in commuting time and men's preference for leisure (second column), and changes in commuting time and men preference for leisure relative to changes in men preference for leisure (third column).

7 Conclusion

This study examines the impact of shifts in commuting time on both welfare and labor supply in the wake of the COVID-19 pandemic. Drawing on data from the American Time Use Survey, we document notable changes in commuting time and working hours across occupations with varying ability to work remotely. To provide a comprehensive analysis, we develop a household model that successfully replicates the disparities in telework possibilities among married partners, and we characterize how changes in commuting time and leisure impact spouses' hours worked. This model is subsequently calibrated using data from the ATUS, allowing us to quantitatively assess the welfare implications arising from the observed changes in commuting time and hours worked.

Our analysis reveals that the decline of the commuting time which could be attributed partially to shift to hybrid work has led to substantial changes in hours worked for workers in teleworkable occupations, and to welfare gains, particularly for couples where both partners work in teleworkable occupations. Furthermore, the reduction in commuting time has far-reaching implications on overall welfare and work-life balance both for workers directly benefiting from it and for their spouses.

By incorporating both commuting time and leisure shocks, our model is able to more accurately replicate the observed changes in hours worked for men and women across different occupation and spousal combinations, highlighting the importance of accounting for these factors when studying labor market dynamics. However, some discrepancies remain between the model's predictions and the data, suggesting that other factors, such as wage changes for low-skilled workers in non-teleworkable occupations, may also play a role in driving the observed labor market outcomes.

In conclusion, our study offers new insights into the changes in commuting time in the post-pandemic labor market and their subsequent impact on household welfare and labor supply. An interesting avenue for future research would be to investigate further the location choices that dual-earner households make, as our findings may add a nuanced layer to this existing body of work (e.g., Black et al., 2014; Costa and Kahn, 2000). Specifically, the observed reductions in commuting time could have broader implications, potentially alleviating some of the location pressures faced by dual-earner households and stimulating labor force participation.

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A Annex

A.1 Annex: Data Analysis

This section documents additional results from our data analysis, with a focus on married couples with children under 12 years old (Table 7) and on the entire sample restricted to the working age population (Table 8).

Table 7: Prime-age Married with Children under 12 years old

Time Use Category	(1) Pre-COVID (2016-2019)	(2) Post-COVID (2021)	(3) ΔPost-Pre	(4) Dev. from LR Trend
Men Telework				
Market work	46.49	42.05	–4.44	–3.80
Work related travel	3.80	1.91	–1.89	–1.80
Work excl. travel	42.70	40.14	–2.55	–2.00
Child care	8.71	11.49	2.78	2.91
Nonmarket work	12.43	13.06	0.63	0.26
Leisure	95.76	98.01	2.25	1.45
Men Non-Telework				
Market work	47.76	49.31	1.55	0.10
Work related travel	4.07	4.99	0.92	0.88
Work excl. travel	43.70	44.33	0.63	–0.78
Child care	5.96	6.04	0.08	0.26
Nonmarket work	13.47	13.46	–0.01	–0.21
Leisure	96.52	96.39	–0.13	1.52
Women Telework				
Market work	35.42	37.54	2.12	1.79
Work related travel	2.50	1.75	–0.75	–0.86
Work excl. travel	32.92	35.79	2.87	2.64
Child care	11.88	13.77	1.89	1.58
Nonmarket work	18.95	16.49	–2.46	–2.17
Leisure	95.50	95.88	0.38	0.28
Women Non-Telework				
MarketWork	32.21	30.38	–1.83	–1.09
Work related travel	2.36	1.96	–0.40	–0.35
Work excl. travel	29.85	28.42	–1.43	–0.74
Child care	12.42	11.62	–0.80	–1.87
Nonmarket work	22.26	22.64	0.38	0.36
Leisure	95.64	98.70	3.06	2.80

Notes: The table presents variations in weekly time use across specific categories for employed married individuals aged 25 to 54 years in a household where a child under 12 reside. Column (1) displays the average time usage per category from 2016 to 2019. Column (2) provides analogous data for 2021. Column (3) enumerates the simple difference between the figures from columns (1) and (2). Column (4) quantifies the deviation in 2021 from a linear trend predicted using data spanning 2016 to 2019.
Source: American Time Use Survey

Table 8: Summary Statistics Working Age - Average Hours per Week

Time Use Category	(1) Pre-COVID (2016-2019)	(2) Post-COVID (2021)	(3) ΔPost-Pre	(4) Dev. from LR Trend
Men Telework				
Market work	45.81	44.13	-1.69	-1.11
Work related travel	3.81	2.16	-1.65	-1.66
Work excl. travel	42.00	41.96	-0.04	0.56
Child care	2.81	3.28	0.47	0.58
Nonmarket work	12.44	12.49	0.05	-0.15
Leisure	103.01	104.91	1.90	1.00
Men Non-Telework				
Market work	44.54	43.51	-1.03	-1.39
Work related travel	3.71	3.55	-0.16	-0.21
Work excl. travel	40.83	39.96	-0.87	-1.18
Child care	1.85	1.75	-0.10	0.02
Nonmarket work	11.98	11.46	-0.51	-0.42
Leisure	105.76	106.81	1.05	1.04
Women Telework				
Market work	39.29	37.78	-1.52	-1.47
Work related travel	2.90	1.74	-1.16	-1.14
Work excl. travel	36.39	36.03	-0.36	-0.33
Child care	3.84	4.14	0.31	0.32
Nonmarket work	17.32	16.45	-0.87	-0.68
Leisure	102.07	105.14	3.07	2.65
Women Non-Telework				
Market work	33.83	34.65	0.83	1.27
Work related travel	2.61	2.52	-0.09	-0.14
Work excl. travel	31.21	32.13	0.92	1.42
Child care	3.65	3.29	-0.37	-0.34
Nonmarket work	17.23	18.51	1.28	1.38
Leisure	105.80	106.46	0.66	0.83

Notes: The table presents variations in weekly time use across specific categories for individuals aged 18 to 65 years who are employed. Column (1) displays the average time usage per category from 2016 to 2019. Column (2) provides analogous data for 2021. Column (3) enumerates the simple difference between the figures from columns (1) and (2). Column (4) quantifies the deviation in 2021 from a linear trend predicted using data spanning 2016 to 2019.
Source: American Time Use Survey

A.2 Mathematical Proofs

This annex contains the proof of Lemma 1 and Lemma 2.

A.2.1 Lemma 1

The first-order condition (f.o.c) derived from the household problem in equation **??** can be solved as follows:

$$\begin{aligned} \frac{1}{c_j^f} &= \lambda && (3) \\ \frac{1}{c_i^m} &= \lambda && (4) \\ \phi_j^f (l_j^f + T_j^f)^\gamma &= \lambda w_j^f && (5) \\ \phi_i^m (l_i^m + T_i^m)^\gamma &= \lambda w_i^m && (6) \\ c_i^m + c_j^f &\leq l_i^m w_i^m + l_j^f w_j^f && (7) \end{aligned}$$

From equations (3) and (4), we can deduce that consumption is equalized between households. By dividing equation (5) by (6), we can derive an expression for the wife's labor supply, l_j^f, as a function of the husband's labor supply, l_i^m.

Starting from the expression for l_j^f:

$$l_j^f = \left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f} \right)^{1/\gamma} (l_i^m + T_i^m) - T_j^f \tag{8}$$

We can substitute the wife's labor supply into the household's borrowing constraint in equation (7). By replacing consumption in the household borrowing constraint with the Lagrangian multiplier λ from equation (3) into equation (5), and then into the household budget constraint (7), we obtain an equation solely dependent on l_i^m:

$$\underbrace{\frac{2w_i^m}{\phi_i^m (l_i^m + T_i^m)^\gamma}}_{f(l_i^m)} = \underbrace{\left(\left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f} \right)^{1/\gamma} (l_i^m + T_i^m) - T_j^f \right) w_j^f + l_i^m w_i^m}_{g(l_i^m)} \tag{9}$$

Our goal is to examine how changes in the husband's and wife's commuting time affect the husband's labor supply l_i^m that solves the above equation. We first characterize the left-hand-side equation $f(l_i^m)$, then turn to the right-hand-side expression $g(l_i^m)$. Finally, we analyze how the solution for the above equation varies with the husband's and wife's commuting time.

Observe that the function $f(l_i^m)$ decreases with respect to the husband's labor supply l_i^m, while the function $g(l_i^m)$ increases with l_i^m, as shown in Figure **??**. To obtain an interior solution, it is necessary for $f(0) > g(0)$ when $l_i^m = 0$ and $f(1) < g(1)$ when $l_i^m = 1$.

Case 1: $f(0) > g(0)$ Note that $f(0) = \frac{2w_i^m}{\phi_i^m (T_i^m)^\gamma}$ and $g(0) = \left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f}\right)^{1/\gamma} T_i^m w_j^f - T_j^f w_j^f$. Hence, for the inequality to hold for a specific T_i^m, T_j^f must be adequately large, specifically $T_j^f > \left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f}\right)^{1/\gamma} T_i^m - \frac{2w_i^m}{w_j^f \phi_i^m (T_i^m)^\gamma}$.

Case 2: $f(1) < g(1)$ Note that $f(1) = \frac{2w_i^m}{\phi_i^m (1+T_i^m)^\gamma}$ and $g(1) = \left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f}\right)^{1/\gamma} (1 + T_i^m) w_j^f - T_j^f w_j^f + w_i^m$. Hence, for the inequality to hold for a specific T_i^m, T_j^f must be sufficiently small, specifically $T_j^f < \left(\frac{w_j^f \phi_i^m}{w_i^m \phi_j^f}\right)^{1/\gamma} (T_i^m + 1) - \frac{2w_i^m}{w_j^f \phi_i^m (1+T_i^m)^\gamma} + w_i^m$.

Now, having established the conditions under which the solution is interior, it is straightforward to see how changes in commuting time affect individual labor supply. Note that a change in the wife's commuting time does not affect the $f(\cdot)$ function, but it does shift the intercept of the $g(\cdot)$. Consequently, a decline in the wife's commuting time results in a decline in the husband's labor supply, as illustrated in Figure 2 in the main text. A decline in the husband's commuting time, however, steepens $g(\cdot)$, leading to an increase in his labor supply. In addition, the decline in the spouse's labor supply indirectly shifts the $f(\cdot)$ function downwards, leading to a further increase in the husband's labor supply.

A.2.2 Lemma 2

The proof of Lemma 2 closely resembles the proof of Lemma 1, and the conditions for the existence of equilibrium are the same. Drawing on equation (9). The impact of a change in the spouse's leisure parameter ϕ_i^f is such that it does not affect the $f(\cdot)$ function, but it does influence the $g(\cdot)$ function. Specifically, an increase in ϕ_i^f flattens the $g(\cdot)$ curve resulting in an increase in the husband's labor supply, as visually demonstrated in the left panel of Figure 3 in the main text. Shifting our focus to the effect of a change in the husband's preference for leisure, denoted as ϕ_i^m, an increase in this parameter leads to a flattening of the $f(\cdot)$ curve, thereby reducing the husband's hours worked. Furthermore, the increased preference for leisure steepens the $g(\cdot)$ curve, resulting in a steeper function leading to further declines in the husband's labor supply. The left panel of Figure 3 provides a graphical representation of these effects, showcasing the changes in the $f(\cdot)$ and $g(\cdot)$ functions in response to variations in the leisure parameters.

A.3 Additional Modeling Results

This annex contains additional modeling results regarding the husband's and wife's welfare impact of the leisure shock, the combined leisure shock and commuting shock, and the welfare impact of the combined leisure and commuting shock relative to an economy where men have a larger preference for leisure (leisure shock economy).

Table 9: Wife's Welfare Gains (%)

Households	Commuting Time Shock	Leisure Shock	Both Shocks	Both Shocks Relative to Leisure Shock
Tele(M)-Tele(F)	2.14	-3.58	-1.36	2.31
Tele(M)-Non-Tele(F)	1.52	-3.77	-2.19	1.65
Non-Tele(M)-Tele(F)	0.07	-3.44	-2.71	0.07
Non-Tele(M)-Non-Tele(F)	0.00	-3.65	-3.65	0.00

Notes: Wife's welfare gains in consumption equivalents. Results based on values for each household type, accounting for changes in work, and leisure due to changes in commuting time in teleworkable occupations and men's leisure shock (first column), changes in commuting time and men's preference for leisure (second column), and changes in commuting time and men preference for leisure relative to changes in men preference for leisure (third column).

Table 10: Husband's Welfare Gains (%)

Households	Commuting Time Shock	Leisure Shock	Both Shocks	Both Shocks Relative to Leisure Shock
Tele(M)-Tele(F)	2.34	-2.01	0.38	2.44
Tele(M)-Non-Tele(F)	1.76	-2.29	-0.49	1.84
Non-Tele(M)-Tele(F)	0.07	-1.85	-1.08	0.07
Non-Tele(M)-Non-Tele(F)	0.00	-2.13	-2.13	0.00

Notes: Husband's welfare gains in consumption equivalents. Results based on values for each household type, accounting for changes in work, and leisure due to changes in commuting time in teleworkable occupations and men's leisure shock (first column), changes in commuting time and men's preference for leisure (second column), and changes in commuting time and men preference for leisure relative to changes in men preference for leisure (third column).