Impacts of COVID-19 on Future Preferences Toward Telework

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Abstract
This paper presents a study in capturing the impacts of the mandatory pandemic-induced telework practice on workers’ perceptions of the benefits, challenges, and difficulties associated with telecommuting and how those might influence their preference for telework in the future. Data was collected through an online survey conducted in South Florida in May 2020. Survey data showed that telework indices (either measured through actual behavior or stated preference) before, during, and after the pandemic were heterogeneous across socio-economic, demographic, and attitudinal segments. Before the outbreak, males, full-time students, those with PhD degrees, and high-income people showed higher percentages of involvement in jobs with a telework option. They also had higher pro-technology, pro-online education, workaholic, and pro-telework attitudes. During the pandemic, professional/managerial/technical jobs as well as jobs with lower physical-proximity measures showed the highest telework frequency. In view of future telework preferences, our analysis showed that those who were more pro-telework, pro-technology, and showed less dislike of telework dislike preferred higher telework frequency. A structural equation model was developed to assess the impacts of different predictors on telework behavior before the pandemic and preferences after the pandemic. While telework frequency before the pandemic was highly affected by the pro-telework attitude, the after-pandemic preferences were influenced by several other attitudes such as dislike telework, enjoy interaction, workaholic, as well as productivity factors. This might confirm the assumption that the mandatory practice through the pandemic has provided employees more experiences with work-from-home arrangements, which could reshape decisions and expectations around telework adoption in the future.

Keywords
planning and analysis, effects of information and communication technologies (ICT) on travel choices, ICT, telecommuting, traveler behavior and values, attitudes/attitudinal data, behavior analysis

The COVID-19 outbreak was certainly the most adverse and unexpected event in recent years, one which threatened our lives in. As of April 2022, the death toll from COVID-19 stands at 6.23 million with more than 513 million confirmed cases worldwide (1), which makes it comparable to the Spanish Flu, the most dangerous pandemic the world has ever experienced. The situation was quickly counteracted by the adoption of preventive actions across the globe. Countermeasures included macro-level decisions such as boarder closures, travel restrictions, school shutdowns, and remote working, as well as micro-level individual safety actions such as self-isolation, social distancing, and a drastic increase in personal hygiene and sanitization standards (2).

One of the most effective strategies in hindering the spread of COVID-19 and tackling further economic loss was switching to work-from-home (also referred to as remote work or telework) (3). On March 16, 2020, the White House officially recommended that anyone able to work from home should do so. The basic idea was to avoid in-person contact while maintaining productivity and minimizing long-term economic losses. In this regard, different statistics documented a steady growth of remote work in 2020. A study showed that approximately 35.2% of the U.S. workforce worked

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entirely from home as of May 2020, showing a significant increase from 8.2% in February (4). Another study found that around 35% of U.S. workers switched to working from home during the pandemic, while an additional 15% were already working from home before COVID-19, suggesting that a total of approximately half of the workforce was entirely teleworking (5). In view of telework feasibility, a study showed that 37% of jobs in the United States could offer full-time telework option to their employees, and this was subject to significant geographical and industrial heterogeneity. These jobs were typically classified as high-paid jobs and accounted for 46% of all U.S. wages (6).

But there are certain ambiguities with regard to the long-term impacts on the future of telework. For example, will workers or businesses continue to practice telework even after the pandemic is over? If so, at what scale? Can work-from-home become the new norm? There are mixed opinions at this time. Some believe that telework has the potential to become a viable alternative to the daily commute even when the pandemic is over (7–9). This expectation mainly stems from the hypothesis that after many workers have now experienced the practical benefits of telework including work-life balance, financial and time savings, and higher productivity, they may potentially resist going back to conventional offices and seek out employment opportunities that offer telework options. Some others believe that there may not be a sudden drastic surge in telework adoption following the pandemic. Companies might allow one or two days work-from-home practice per week but the true proliferation and normalization of telework (as a regular alternative to office work) will probably take longer as businesses start perceiving benefits in increases in productivity, employee satisfaction, and other relevant business outcomes (10, 11). In addition, it should be noticed that telework adoption is subject to certain limitations, including the availability of telecommunication infrastructure (12) and job suitability (13–15).

In parallel with the ongoing research trend in view of pandemic-induced telework, the study here intends to add to the literature by predicting pandemic-related telework adoption (or preference) in a before-after scenario and by identifying factors contributing to the decisions in a disaggregate modeling structure. In particular, we focus on what factors affect telecommuting at different frequency levels, ranging from socio-economic and demographic attributes to job characteristics and personal attitudes. Since there is no real data for a post-pandemic scenario, we use workers’ preferences instead. The fundamental essence of this research is to understand how pandemic restrictions have reshaped individuals’ perceptions of actual telework adoption and how this new mindset will characterize future telework adoption in the U.S. market.

It should be noted that our exploratory data analysis in this study deals with two different measures of the unseen post-pandemic telework frequency, namely the “preferred frequency” versus the “expected frequency.” Though the latter (i.e., expected telework frequency) might be more accurate in view of the actual behavior, our model focuses on the “preferred frequency.” The main reason is that our survey explicitly targets employee behavior and attitudes and the experience gained through the pandemic on the employee side. This is expected to be more realistically manifested in employees’ preference to work from home, regardless of the effects imposed by the business policies and managerial perspectives, which are not the essence of this study. In addition, this investigation on preferences also shed light on the work arrangements desired by the labor force, which may help policy makers in developing future teleworking policies and programs.

The remainder of this paper is laid out as follows: In the next section, we present a summary of the telework modeling literature both under normal and pandemic conditions. We then give a brief elaboration of our survey and data collection approach. Exploratory data analysis comes next. Finally, we present a structural equation model to simultaneously predict two endogenous variables (telework frequency before the pandemic and telework frequency preference after the pandemic). Model results are presented and analyzed. Finally, we discuss the potential policy implications, and conclude the paper by suggesting further research avenues.

**Literature Review**

In general, a quick review of the literature suggests that there is an abundance of research effort that has focused on different aspects of telework (also known as telecommute), including pros and cons (16–19), modeling and forecast of telework adoption (20–32), and evaluating travel-related impacts of teleworking (33–41). With the continuous progress in information and communication technologies, and the evolution of concepts such as smart cities, telework has gained special attention by planners and researchers. There have been enormous efforts to identify and assess the factors that contribute to or hinder the adoption of teleworking among workers. In more detail, while telework could be measured in different dimensions such as option, stated preference, revealed choice, and/or frequency, the literature suggests that certain personal, household, and job-related attributes can help determine the propensity to telework. Accordingly, age (28, 42), gender (28, 42, 43, 44), education level (43, 45, 46), income (43, 44, 47, 48), and job-related attributes such as commute distance (43, 49, 50) have been documented as significant contributing factors in telework.
adoption. Other studies have highlighted the role of personal attitudes (23, 51–53).

In addition to a plethora of qualitative discussions (54–56), some studies have stepped further and provided quantitative analysis on telework behavior during the outbreak and how it may be attributed to workers’ characteristics in a predictive manner. For example, Brynjolfsson et al. (5) developed regression models at aggregate level and showed that work-from-home adoption during the pandemic could be predicted based on a log of the number of confirmed cases in 100,000 population and a portion of management, professional and related occupations (MPR) but was not significantly affected by pre-COVID telework engagement. Bick et al. (4) showed that telework adoption during the pandemic was highly heterogeneous across different socioeconomic groups. Accordingly, telework was much more prevalent among highly educated, high income, and white workers, and much less among minorities, lower income individuals, and workers with high school degrees (4). Dingel and Neiman (6) developed an algorithm to predict the feasibility of different occupations for telework based on two different sets of questions on work context and generalized work activities. They then used data from the Bureau of Labor Statistics (BLS) to merge their prediction with the number of workers across the country. They reported a positive correlation of telework feasibility with hourly wages. Their analysis also showed that at the metropolitan level, work-from-home feasibility was significantly and positively correlated with median household income and percentage of college degree holders and negatively correlated with home ownership rate and percentage of white residents. Mongey et al. (57) conducted a statistical analysis based on work-from-home and physical-proximity measures and showed that lower work-from-home rates were observed across workers who were less educated, of lower income, had fewer liquid assets relative to income, and were less likely to own their residences.

Nguyen (58) explored three different aspects of telework during the pandemic, including full telework adoption during the pandemic, efficiency of telework as a practical solution, and respondent’s preference toward post-pandemic telework. Separate binary logit models were developed. Findings showed that firm policies on restrictions and telework frequency before the pandemic were among the primary determinants of exclusive home-based working. In view of the respondents’ perceptions of telework, distractions and data access issues were negative factors. With regard to preferences toward future telework adoption, gender, commute distance, presence of children in the household, and attitudinal factors were the main predictors. The presence of more than one child negatively affected the perception of telework but positively affected the attitude toward establishing the hybrid work mechanism. In a similar study and using the same data set, Nguyen and Armoogum (59) highlighted gender-based dissimilarities of telework preferences and perceptions in view of the pandemic. Accordingly, females were more likely to have a positive perception of telework and were more likely to prefer home-based working in the future. In addition, females’ perceptions were mostly based on family-related factors as opposed to males’ perceptions which were highly influenced by work-related attributes.

In a survey conducted across social workers during the state of pandemic alarm in Spain, Morilla-Luchena et al. (60) showed that telework was more prevalent among older people, married or divorced, those with children, and public institution employees. Based on their factor analysis on employee perceptions, it was inferred that although telework was a practical approach to maintaining social distancing, it might present several disadvantages in tasks becoming overwhelming or service to the vulnerable populations being inadequate. A study by Sostero et al. (61) in five European countries revealed that telework during the outbreak was highly skewed toward high income and white-collar employment. However, the obligatory nature of telework during the pandemic resulted in new teleworkers among low and mid-level clerical and administrative workers. In a similar study among remote workers in Lithuania (62), Raišienė et al. (62) focused on three different type of attitude, namely motivational factors of telework, factors negatively affecting telework efficiency, and required qualities for telework. Their comprehensive exploratory analysis showed that the most satisfied teleworkers were highly educated female millennials, holding a managerial or administrative position with 4 to 10 years of professional experience, and working from home two days a week. On the other hand, the most dissatisfied teleworkers would be educated male baby boomers, with 20 years or more of professional experience, and with no previous telework experience. Papageorge et al. (63) conducted a sociodemographic analysis of different types of self-protective behaviors during the pandemic and reported that younger individuals as well as higher-income employees were more likely to switch to working from home.

In addition to socio-demographics and personal attitudes, some studies have focused on organizational attributes and pandemic-related stressors. Shao et al. (64) developed a list of different stressors associated with work-from-home adoption and classified them as work-family, workload, work coordination, technology, and covid-related stressors. The researchers then developed a binary logistic regression model to predict an employee’s work location for the next day (home versus office). Their analysis showed that covid-related stressors moderated
the impacts of technology and workload stressors on the work location choice. In addition, married individuals and females were more likely to work from home. In a similar study, Chong et al. (65) developed a two-stage moderated-mediation model and showed that covid-related task setbacks combined with task interdependence (with other coworkers) had a positive impact on end-of-day exhaustion of employees, which in turn resulted in a higher rate of next-day work withdrawal behavior. However, telework opportunities provided by the employer can alleviate the withdrawal situation. In a study in Italy, Tokarchuk et al. (66) explored the role of organizational attributes in telework adoption by employees during the pandemic. Their path model showed that the presence of organizational, technological, and human resources had a positive impact on telework adoption. In addition, the impacts of organizational and technological resources were mediated by the concept of organizational e-readiness, indicated by the familiarity/previous experience of telework. In a pre-pandemic study conducted by Lebopo et al. (67) in South Africa, researchers focused on a variety of different organizational factors and their impacts on telework adoption. Their model results showed that job characteristics, communication, senior management support, and organizational culture (fit) had strong influence on telework adoption.

**Data Collection and Survey Implementation**

To understand how the pandemic has affected people’s daily activities and perhaps their attitudes toward telecommunication technologies, an online survey was conducted in the month of May, 2020 just before South Florida initiated the reopening phases. The survey collected information on personal attributes, as well as activities, experiences, preferences, and attitudes related to teleworking, online shopping, and remote learning. In addition to their past and current experiences with online activities, the survey also asked about their expected behavior after COVID-19 was no longer a threat. This information would provide additional insights on how much of the observed patterns during the pandemic may influence individual behavior in the long term.

The survey targeted adults (18+) in South Florida. The survey was implemented through an online platform provided by Qualtrics. Survey recruitment was also done through Qualtrics service between May 19 and May 29. A total of over 2,000 attempts were recorded. 1,028 complete responses were collected and used for the purpose of this study. The sampling plan was developed based on 2018 five-year American Community Survey (ACS) data for the three counties in South Florida (Miami-Dade, Broward, and Palm Beach) for age, gender, household income, race, and ethnicity.

Table 1 below presents the survey sample composition compared with the ACS data in South Florida. The population attributes at the Florida and national levels are also provided in the table as a reference. The right column in Table 1 shows the major demographic attributes of the survey sample, which match the population attributes in South Florida very well.

|                     | National (ACS) (%) | Florida (ACS) (%) | Miami-Dade county (ACS) (%) | Broward county (ACS) (%) | Palm Beach county (ACS) (%) | South Florida (3-county) (ACS) (%) | South Florida survey sample (%) |
|---------------------|---------------------|-------------------|-----------------------------|--------------------------|-----------------------------|-----------------------------------|---------------------------------|
| **Age**             |                     |                   |                             |                          |                             |                                   |                                 |
| 18–34               | 30                  | 27                | 29                          | 28                       | 24                          | 27                                | 31                              |
| 35–54               | 33                  | 32                | 36                          | 35                       | 31                          | 35                                | 37                              |
| 55+                 | 37                  | 41                | 35                          | 37                       | 45                          | 45                                | 38                              |
| **Gender**          |                     |                   |                             |                          |                             |                                   |                                 |
| Male                | 48                  | 48                | 48                          | 48                       | 48                          | 48                                | 44                              |
| Female              |                     |                   |                             |                          |                             |                                   |                                 |
| **Income**          |                     |                   |                             |                          |                             |                                   |                                 |
| <$50K               | 40                  | 47                | 51                          | 44                       | 42                          | 46                                | 50                              |
| $50–100K            | 30                  | 30                | 27                          | 29                       | 30                          | 29                                | 29                              |
| >$100K              | 30                  | 23                | 22                          | 26                       | 29                          | 25                                | 21                              |
| **Race**            |                     |                   |                             |                          |                             |                                   |                                 |
| White               | 76                  | 77                | 76                          | 64                       | 77                          | 72                                | 72                              |
| Black               | 14                  | 15                | 17                          | 27                       | 17                          | 20                                | 17                              |
| Asian               | 7                   | 3                 | 2                           | 4                        | 3                           | 3                                 | 2                               |
| Others              | 3                   | 5                 | 5                           | 6                        | 4                           | 5                                 | 9                               |
| **Ethnicity**       |                     |                   |                             |                          |                             |                                   |                                 |
| Hispanic            | 18                  | 24                | 69                          | 28                       | 20                          | 45                                | 48                              |

Note: ACS = American Community Survey.
Descriptive Statistics

Work Status
Among the 1,028 observations in the sample, 706 were employed before the pandemic, with only 617 still being employed during the time of the survey. About 14% of workers had lost jobs, while another 16% had changed jobs as a result of the pandemic. Among the 617 who were still employed, about 11.5% were furloughed without pay. This shows the significance of the impacts on employment and the economy.

Figure 1 presents the employment status at the time of the survey for those who were employed before the pandemic. It also shows a breakdown by occupation, education, income, and gender for those who lost their jobs during the pandemic. Compared with the demographic attributes of all respondents, it shows that higher shares of females, low-income individuals, those with lower levels of education, and those employed in sales or service industries lost their jobs during the pandemic.

Telework Status
Focusing on the 509 workers who were still employed full-time or part-time (excluding those furloughed with or without pay), Figure 2 presents the number of respondents by work-from-home frequency before and during the pandemic. Before the pandemic, about 50% of the workers had the option to work from home, almost 60% never telecommuted, 25% worked from home once a week or more, and only 12% worked from home three or more days a week. Chi-square tests results indicate that males, individuals with PhD degrees, and high-income people were more likely to have the option to work from home.

Figure 2 shows that during the pandemic almost 50% of the workers were working from home three or more days a week (around mid-May). Still, about 30% of the workers did not work from home at all during the pandemic. This probably indicates the limit of telecommuting—some work by nature requires presence in person.

Figure 3 presents the breakdown by gender, income, education, and occupation for workers who did not work from home during the pandemic. Chi-square tests indicate that telework frequencies during the pandemic statistically differ by gender, marital status, Hispanic origins, race, education, income, and employment attributes. Professional/managerial/technical jobs as well as jobs with lower physical-proximity measures had higher telework frequency.

Expectations and Preferences of WFH After the Pandemic
Those who did telecommute during the pandemic were asked how often they would expect to telework once the pandemic is no longer a threat. As Figure 4 shows, about 18% indicated that they would not expect to be able to work from home, while about 18% expected to be able
to work from home a few times week and another 18% expected to work from home every day after the pandemic. The results imply that we may see about the same number of frequent telecommuters (a few times a week) compared with before the pandemic, but we can expect more infrequent telecommuters (a few times a month).

Considering that expectations might be constrained by company policies, work responsibilities, or other factors, the survey also asked the respondents how often they would prefer to work from home after the pandemic is no longer a threat. Figure 5 shows that 50% of workers would prefer to telecommute as frequently as now or even more, while only 8% would prefer to telecommute even less frequently than before the pandemic. This indicates a desire to be able to telecommute among the workers.

Figure 2. Number of workers by work-from-home frequency before and during the pandemic (sample size = 509).

Figure 3. Work-from-home frequency during the pandemic and demographic attributes for those who did not work from home.
In view of productivity, Figure 6 shows that about 19% of workers experienced significantly lower productivity during the pandemic compared with before while working at the office/workplace, while 5% indicated significantly higher productivity. About 35% experienced similar productivity. In general, full-time workers were more likely to feel higher productivity, while those who worked from home less frequently were more likely to have a lower productivity at home. These statistics come from a sample of 353 valid (not null) responses to productivity questions.

In view of the positive and negative factors that contributed to their productivity at home, Figures 7 and 8 present the results. These show that the top negative factors cited include more distractions and housekeeping at home, lack of comfortable workspace or equipment or technology, difficult to communicate with coworkers, and childcare or care for other dependents. It should be noted that many of the factors may only reflect the unique situation that people experienced during the pandemic and may not represent determinant obstacles for long-term telework programs.

The top positive factors included no commute time, more efficient resting time, more efficient time management, more casual environment, more comfortable workspace, and more energetic environment.

**Attitude Analysis**

Four different sets of attitudinal questions were asked, and individual responses were measured on a 5-scale range (strongly disagree, disagree, neutral, agree, strongly agree). An exploratory factor analysis (EFA) was then applied separately for each set to extract latent factors. Table 2 presents the results of the EFA. Eleven factors were identified including attitudes toward telecommuting, technology, general lifestyle, and well-being. The defining attitude statements for each factor are presented, along with the cumulative percentage of variance explained and the eigenvalues.

To assess the relationship between attitudinal factors and telework indices, and considering the continuous nature of the factors, analysis of variance (ANOVA) tests were conducted to compare the means of factors across different groups and to measure the statistical significance of the differences based on p-values. In summary, our analysis shows that:

- People who already had the option to telecommute before the pandemic had higher pro-technology (P-value = 0.013), pro-online learning (P-value = 0.0071), workaholic (P-value = 0.0475), and pro-telework (P-value = 0.022) scores.
- For telecommuting frequency before the pandemic, there was significant association with
Figure 6. Productivity change during the pandemic (sample size = 353).

Figure 7. Negative factors to productivity for work at home (sample size = 353).

Figure 8. Positive factors to productivity for work at home (sample size = 353).
pro-telework (P-value = 0.0208), short distance (P-value = 0.016), and green and open mind (P-value = 0.0204). In particular, those who telecommuted more frequently before the pandemic showed higher scores for pro-telework. While those who telecommuted at either high frequency level (six or seven days a week) or never were more likely to prefer short distance. For green lifestyle, there is no specific trend, though the scores are different across different telework frequencies.

- There is a significant association between workload opinions and pro-technology. Interestingly, those who were more pro-technology (P-value = 0.0072) were also more likely to feel significant increases in their workload during the pandemic.

- The survey also asked the respondents how they compare their productivity in the past 14 days during the pandemic to their productivity before the pandemic while working at their office or workplace. It seems that productivity change was highly associated with green lifestyle (P-value = 0.038), short distance (P-value = 0.0018), telework dislike (P-value = 0), and team-worker (P-value = 0.0014). Interestingly, those who indicated higher productivity during the pandemic were more likely to prefer short distance and team-work, and less likely to be telework dislike.

- Respondents' preferences on telework frequency after the pandemic were significantly correlated with pro-technology (P-value = 0.04), enjoy interaction (P-value = 0.03), telework dislike (P-value = 0.001), and pro-telework (P-value = 0.046) attitudes. As expected, people with higher pro-telework, lower telework dislike, and higher pro-technology attitudes preferred to telework more frequently even after the pandemic was no longer a threat.
Methodology and Model Structure

A structural equation model (SEM) was used in this study. SEMs enable analysts to predict multiple endogenous variables in a simultaneous manner and also allow for incorporating latent factors into the model (68). SEMs have been widely used in capturing direct and indirect causal effects in a variety of behavioral studies (36, 37, 69–76). A sample path diagram demonstrating potential causal relationships is presented in Figure 9.

The structural equation establishes the causal effects between endogenous variables (variables to be predicted) and their predictors as exogenous variables (77, 78). In the presence of ordinal endogenous variables, the structural equation could be written as shown in Equation 1 below.

\[ \eta^* = \beta \eta^* + \Gamma X + \varepsilon \]  

where \( \eta^* = m \times 1 \) vector of endogenous variables, here including latent functions of telework frequency before and preferred telework frequency after the pandemic, \( m = 2 \)
\( X = q \times 1 \) vector of observed exogenous variables, including socio-economic and demographic attributes, and attitudinal factors,
\( \varepsilon = m \times 1 \) vector of error terms,
\( \beta = m \times m \) coefficient matrix of direct effects among endogenous variables,
\( \Gamma = m \times q \) coefficient matrix of direct regression effects of \( X \) on \( \eta^* \).

SEMs are usually estimated using a simple maximum likelihood (ML) approach to minimize the difference between observed and estimated correlation matrices (68, 79, 80). However, this calls for the endogenous vector to follow a multivariate normal distribution. In the presence of ordinal endogenous variables, a modified approach known as the diagonally weighted least squares (DWLS) is suggested in the literature (76, 79–81).

The DWLS approach follows multiple steps. First, ordinal endogenous variables \( \eta \) are separately converted into latent continuous variables \( \eta^* \), with their associated thresholds and polychoric correlations being estimated (68). The SEM model parameters are then estimated by minimizing the weighted least squares fit function \( F_{WLS} \) (82):

\[ F_{WLS} = (S - \sigma(\theta))^T W^{-1} (S - \sigma(\theta)) \]  

where
\( \theta = \) model parameters,
\( S = \) vector of sample statistics (i.e., threshold and polychoric correlation estimates),
\( \sigma = \) vector containing model-implied elements of \( \Sigma(\theta) \),
\( W = \) weight matrix.

The Latent Variable Analysis (Lavaan) library in R was used to estimate the model. It should be noted that Lavaan automatically considers a mean and variance adjustment to create robust standard errors for the parameter estimates (83–84). This is done by using a DWLS method during the iterations to estimate the parameters but using a full weight matrix to create standard errors. This avoids the inflation of standard error values and results in more robust results. Application of the DWLS method with robust mean and variance adjustment, also referred to as WLSMV, has been well supported by the literature (79, 80, 85).

Model Results

As explained in the methodology section, the SEM model tries to predict telework frequencies before the pandemic as well as to forecast people’s preferences toward telework in the future. Such analysis allows us to examine whether and how the unexpected (mandatory) telework experience during the COVID-19 outbreak may have influenced people’s preferences in the long run. This helps us better estimate telecommuting adoption behavior and plan for long-term strategies. The model results are presented in Table 3.

In view of telework frequency before the pandemic, the model suggests a positive role of pro-telework attitude, along with significant impacts of marital status and household structure. Interestingly, none of the job-related attributes such as industry category or work flexibility in location/hours showed significant effects in the model. In other words, one might infer that telework frequency is highly (and only) encouraged through personal preferences, which could further be adjusted by work–family conflicts. Interestingly, our model shows that widowed and married individuals telecommuted...
### Table 3. SEM Model Results

| Variables                        | Telecommuting frequency before the pandemic | Telecommuting preference after the pandemic |
|----------------------------------|--------------------------------------------|---------------------------------------------|
|                                  | Coeff.  | p-value  | Coeff.  | p-value  |
| Marital status                   |         |          |         |          |
| Married                          | −0.75   | 0.021    | na      | na       |
| Divorced                         | −0.981  | 0.01     | na      | na       |
| Separated                        | −0.552  | 0.211    | na      | na       |
| Never married                    | −0.858  | 0.009    | na      | na       |
| Household structure              |         |          |         |          |
| Living with children and parents | −0.746  | 0.039    | na      | na       |
| Education                        |         |          |         |          |
| Associate degree                 | na      | na       | 0.329   | 0.056    |
| Master’s degree                  | na      | na       | −0.265  | 0.049    |
| Doctorate degree                 | na      | na       | −0.46   | 0.053    |
| Income                           |         |          |         |          |
| Annual income: $10–15k           | na      | na       | 0.334   | 0.095    |
| Factors affecting productivity   |         |          |         |          |
| Negative effects: childcare      | na      | na       | 0.385   | 0.008    |
| Positive effects: more casual environment at home | na | na | 0.259 | 0.021 |
| Productivity significantly increased comparing to before | na | na | 0.512 | 0.015 |
| Attitudes                        |         |          |         |          |
| Pro-technology                   | na      | na       | 0.220   | 0.004    |
| Green lifestyle                  | −0.17   | 0.015    | na      | na       |
| telework dislike                 | na      | na       | −0.301  | 0.000    |
| Pro-telework                     | 0.14    | 0.032    | 0.157   | 0.013    |
| Pro-online learning              | na      | na       | 0.145   | 0.027    |
| Enjoy interaction                | na      | na       | −0.202  | 0.002    |
| Workaholic                       | na      | na       | −0.149  | 0.026    |
| Telework                         |         |          |         |          |
| Telecommuting frequency before the pandemic | na | na | 0.213 | 0.000 |
| Thresholds                       |         |          |         |          |
| wfh_pre_a few times per year     | −0.947  | 0.002    | na      | na       |
| wfh_pre_a few times per month    | −0.535  | 0.08     | na      | na       |
| wfh_pre_once a week              | −0.322  | 0.292    | na      | na       |
| wfh_pre_twice a week             | −0.036  | 0.906    | na      | na       |
| wfh_pre_3 days a week            | 0.25    | 0.413    | na      | na       |
| wfh_pre_4 days a week            | 0.394   | 0.198    | na      | na       |
| wfh_pre_5 days a week            | 0.48    | 0.116    | na      | na       |
| wfh_pre_6 days a week            | 0.813   | 0.008    | na      | na       |
| wfh_pre_7 days a week            | 0.878   | 0.004    | na      | na       |
| wfh_preference_as frequent as before | na | na | −1.734 | 0.000 |
| wfh_preference_more frequent than before | na | na | −0.946 | 0.036 |
| wfh_preference_as frequent as now | na      | na       | −0.078  | 0.864    |
| wfh_preference_even more frequent than now | na | na | 0.77   | 0.091    |

**Goodness of fit**

*chi-sq* = 13.203, df = 18, *cfi* = 1.00, *rmsea* = 0.00

**Note:** SEM = structural equation model; Coeff. = coefficient; *chi-sq* = chi-square; df = degree of freedom; *rmsea* = root mean square error of approximation; na = not applicable.
more frequently (i.e., a less negative effect) compared with divorced and never married individuals. Frequent telecommuting among married individuals might be adjusted through the flexibilities brought by telework in a work–family conflict environment, while the lower telecommute frequency across the latter group might be related to the fear of isolation or the desire for social interactions among young professionals or divorced individuals.

The role of marital status and its impact on telework adoption has been well documented in the literature. While most of the previous works reported that married individuals were more likely to telecommute (25, 28, 60, 64), few studies reported a negative impact (86). More recent research has inferred that it was not the marital status by itself but its interaction with gender and the presence of children as well as household structure that resulted in different telework behaviors (29, 87).

Among different household structures, our model indicates that teleworking was less frequent in families involving children and grandparents, an inference that seems reasonable considering that both groups may call for extra care or attention that could interfere with work duties in the home environment.

Our model also indicates a negative impact of a green lifestyle on telework frequency. This might be related to the potential correlation between a green lifestyle and other factors. However, the analysis showed that the green lifestyle factor was only weakly correlated with enjoy interaction ($r = 0.306$) and further removal of the enjoy interaction factor from the predictors did not affect the sign associated with green lifestyle. While telework is generally referred to as a green alternative, this inference might call for further investigation. One reason could be the lack of knowledge and familiarity among the public about the positive environmental impacts of telework.

Looking at the preferred frequency for telecommuting after the pandemic, it is interesting to note a variety of attitudinal factors with significant impacts on the preferences. One quick inference could be that many of these attitudes have been formed, or at least strengthened, by the practical telework experience gained during the mandatory quarantine situation. In addition, the results generally comply with expectations. Our model suggests that pro-technology people as well as those who were pro-online learning preferred higher telework frequency in the future. Also, the pro-telework attitude played a positive role in the preference for future telework frequency. This is also the only attitude that influenced both decisions of previous telecommuting frequency and future preferences. Attitudes that showed negative impacts on preferred telework frequency include workaholic, enjoy interaction, and telework dislike. These are people who perceive work in its conventional form at regular workplaces, potentially combined with routine hours and clear boundaries from the home environment, as well as those who enjoy social interactions (including those at the workplace). They would not prefer telework at high frequency levels.

Considering the COVID-19 pandemic as an experiment for workers and employers to obtain actual experiences with full-scale telecommuting practice, we are also interested to know how their experiences during the pandemic might have affected their future preferences for telecommuting. We explored the impacts of productivity change itself, as well as a set of factors that may positively or negatively affect workers’ productivity during the pandemic. The model shows that those who experienced significant increase in productivity during the pandemic (compared with before the outbreak while working at the office/workplace) were much more likely to prefer more frequent telecommuting in the future. This indicates that good experiences during the pandemic may to some degree have translated into the desire to continue this new way of working. Looking into the set of factors that contributed to the productivity changes either positively or negatively, the model results show that those who felt that a more casual environment at home contributed to more productive work were more likely to prefer frequent telework in the future. One noticeable inference is the role of childcare as a factor that negatively influenced productivity at home. However, it showed a positive effect on preferences for telework frequency. This might imply that workers believed that the need for childcare at home is temporary (sooner or later the children will go back to school once the outbreak is over), so they did not see it as a permanent obstacle against their telework productivity in the future.

The concept of productivity has been widely discussed in the telework literature. However, the concept is usually viewed as an impact of telework and not as a predictor for future telework adoption. The pre-pandemic literature mostly reported a positive impact of telework on productivity (88, 89). However, this can be attributed to telework being mainly regarded as an option and it was, therefore, mostly adopted by employees who found it aligned with their personal situation, family-life balance, and work attitudes. However, recent literature has suggested that our previous knowledge of the impact of telework on productivity may not apply to the exceptional teleworking conditions during the pandemic (90). In particular, the pandemic experience showed that positive or negative impacts of telework on productivity cannot be determined unless other situational, individual, or household attributes are considered (91–95).

Additional variables that influenced only the preference for future telework arrangement include education attainment and household income. In view of education,
highly educated people with graduate degrees were less likely to prefer higher telecommuting frequencies than before. This could imply that considering the nature of their work they were probably already telecommuting at certain levels during normal conditions before the pandemic, and there was a desire to recover some of the in-person interactions outside of home once the pandemic is over. A similar but opposite effect was observed for those workers whose jobs might not have provided them with full telework opportunities, for example, low-income people or those with professional/associate degrees. These individuals expressed their interest in more frequent telework opportunities in the future. The higher telework adoption rates (both before and during the pandemic) have been supported by the literature for individuals with higher education and higher-income individuals (4, 6, 25, 27, 57, 61, 62, 86, 96, 97).

While the role of gender has been documented on telework adoption/frequency measures in the literature, the variable did not turn out to be significant in the final model. Based on the experience gained during the modeling process on our data, the authors believe that this might be a result of the significant role of attitudes in the model, which outperforms some of the personal attributes including gender, ethnicity, and some of the work-related attributes.

**Policy Implications**

The exploratory data analysis along with the predictive model presented in this study provide us with valuable insights on how workers have gained more knowledge of different pros and cons of telework in a practical obligatory experience, and furthermore, how they would prefer their work arrangement (in view of their desired telework frequency) in the future. Assuming that it is unrealistic to implement drastic changes in work-from-home policies, it is of the essence to plan for effective strategies to maintain employee satisfaction as well as to avoid potential productivity plummets.

Our analysis showed that different segments of workers had different expectations. For instance, workers with an associate degree or low-income workers were likely to prefer more telework in the future. This probably stems from their being mainly involved in jobs requiring physical presence and they potentially did not have the opportunity to telework compared with other occupations. Alternative work arrangements such as shift rotations, flexible work hours, or compressed work schedules (with additional off days) could be a potential solution for these types of worker. On the other hand, telework may not be suitable for all people, such as workaholics, those who enjoy social interactions, or those who do not see the home environment as motivative or suitable for work. For these employees, companies are recommended to hold periodic virtual or physical meetings to avoid isolation should the quarantine continue. In the long run, work centers near residential locations that provide a more professional environment and create better boundaries between work and home may be a good option, as this approach provides the opportunity for social interaction while reducing commute travel and congestion.

While productivity probably plays a decisive role in any alternative work arrangement, the practical experiences gained during the pandemic may help both employees and employers to get a better sense of the implications of full-scale teleworking. It is worth mentioning that none of the negative factors played significant roles in workers’ preferences for future telework frequency, except for childcare which actually showed positive effects. This implies that most of the hardships experienced during the pandemic were temporary, a result of the unique situation and they did not influence workers’ future preferences. Interestingly, only one positive factor of telework (more casual environment at home) showed significant influence on future preferences.

**Conclusion**

The research presented and discussed in this paper was the result of an attempt to capture the impacts of the mandatory telework practice induced by the COVID-19 pandemic on individuals’ perceptions and preferences toward telework. Data was collected through an online survey conducted in South Florida at the end of May, 2020. While the survey targeted different aspects of induced changes on people’s lifestyles during the quarantine, this paper specifically focused on workers’ telework behavior.

The fundamental assumption in this study is that the actual practice during the quarantine has provided a real-life experience for a large portion of the labor force who may not have had experience with full-scale work-from-home opportunities. This might shed light on many of the challenges, benefits, and obstacles of work-from-home arrangements as a long-term alternative to working at offices. As people tend to adapt themselves to the new norm, they may develop new attitudes and perceptions toward telework, which might have remained hidden given the lack of a practical and full-scale experience.

Survey results showed that around 52% of the workers were already engaged in a job that offered them a telework option, out of which around 19% never used the opportunity, while 15% teleworked every single day. During the outbreak, and as expected, telework activities surged significantly. The survey data showed that around 43% were teleworking every day, with another 30%
working from home partially during the week. With regard to future preferences, only 16% mentioned that they did not expect to telework after the pandemic was over. Furthermore, around 77% of the respondents preferred to telework more frequently compared with before the pandemic, which points to the need for companies to consider long-term telecommuting policies that provide the flexibility to meet workers’ preferences and needs.

Different statistical tests were conducted and, in many cases, there was statistical evidence that telework behavior (regardless of pre-, during, or post-pandemic conditions) was heterogeneous and varied across different socio-economic, demographic, and attitudinal segments. For instance, males, full-time students, PhD degree holders, and high-income people showed higher percentages of involvement in jobs with a telework option before the outbreak. They also had higher pro-technology, pro-online education, workaholic, and pro-telework attitudes. Interestingly, telework frequency before the pandemic, though being heterogeneous, did not show any specific trends across different socio-economic and demographic attributes and attitudinal factors except for the pro-telework attitude, which showed a positive correlation. In view of future telework preferences, the survey data showed that those who preferred higher telework frequencies had higher pro-telework and pro-technology attitudes, and lower telework dislike attitude.

Finally, an SEM was developed to simultaneously predict telework behavior before and after the pandemic. Accordingly, telework in normal conditions before the pandemic was highly encouraged by the pro-telework attitude and hindered by potential family conflict or lack of motivation associated with telework. For the preferences in the long term, it seems that a variety of additional attitudes came into play, including pro-technology and pro-online learning with positive influence, and telework dislike, enjoy interaction, and workaholic with negative impacts. In addition, productivity increase during the pandemic showed a significant encouraging impact on future telework decisions. Also, there is a direct positive causal effect from telework frequency in normal conditions to the preference after the pandemic, indicating that frequent teleworkers welcome the idea of continuing telework as the new norm even after the pandemic is over.

As this study focused on workers’ preferences for future telework frequency, it should be noted that, preferences do not directly translate into actual telework adoption. As discussed earlier, the main objective of this study was to explore how the pandemic experience may have reshaped worker behavior, perceptions of, and attitudes toward the concept of telework. We are not trying to accurately predict the post-pandemic telework intensity but provide insights into workers’ preferences as well as the motivators and obstacles faced by the employees, which are also important factors that should be considered when developing future telework policies and programs. Nonetheless, this is noted as a limitation of this study, as workers’ preferences might be overoptimistic compares with actual telework adoption, which would also depend on company culture, organizational structure, occupation, and so forth. This aspect is yet to be discussed from the employer’s side, which could form future research avenues with regard to telework in post-pandemic conditions. Another limitation corresponds to the design of the before/after telework intensity questions, where authors assumed that the telework intensity during the pandemic would remain at least as equal to the telework frequency under normal pre-pandemic conditions (i.e., no decreased telework given the pandemic). While this stands true for the majority of the workers, there are still exceptions, such as the health care occupations or workers who changed to another role/job with less frequent telework options.

Author Contributions
The authors confirm contribution to the paper as follows: study conception and design: Hamidreza Asgari, Xia Jin; data collection: Xia Jin; analysis and interpretation of results: Hamidreza Asgari, Rajesh Gupta; draft manuscript preparation: Hamidreza Asgari, Rajesh Gupta, Xia Jin. All authors reviewed the results and approved the final version of the manuscript.

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