

Where We Work and Why: A Joint Model of Work Arrangements, Telework Motivations, and Commute Travel

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ABSTRACT

Telework has become a durable feature of the workplace in the after-COVID era. Work arrangements extend beyond a simple distinction between commuting and working from home. They reflect a bundle of interrelated choices involving work modality, work location, commute frequency, and the motivations underlying remote work. This study seeks to better understand these choices and their implications for commute travel and vehicle miles traveled (VMT). Revealed preference data from the second wave of the Transportation Heartbeat of America Survey, collected between February and March 2026, are used to estimate a joint multivariate econometric model of work arrangement, commute frequency among hybrid workers, and four motivations for working from home. Work arrangements distinguish between fully in-person, hybrid, fully remote home-based, and fully remote third location-based patterns. Model estimates are translated into expected changes in commute frequency and weekly commute VMT. Results indicate that employee control over work schedules and work locations are among the strongest determinants of work arrangements and commute travel. Telework produces the greatest transportation benefits among workers with longer commutes, mobility challenges, and limited vehicle availability. Hybrid work generally reduces commute frequency rather than eliminating workplace travel completely. Home-based and third location-based remote work also exhibit distinct behavioral patterns, underscoring the need to represent remote work location explicitly. Considerable heterogeneity is observed across socio-economic and demographic groups in work arrangements and work-from-home motivations. The results further highlight the role of telework as an accessibility and travel demand management strategy. By jointly modelling work modality, work location, commute frequency, and work-from-home motivations while accounting for shared unobserved influences across outcomes, this study provides new insights into the behavioral processes underlying telework decisions. The findings can inform travel demand modeling, employer telework policies, and targeted transportation demand management programs designed to reduce commute burdens and improve accessibility.

Keywords: Telework, Remote Work, Work Location, Telework Motivations, Employer Constraints, Commute VMT

1. INTRODUCTION AND MOTIVATION

The nature of work in the United States has undergone a major transformation over the past five years. Between July 2025 and June 2026, on average, nearly 12 percent of full-time wage and salary employees worked entirely from home, while nearly 26 percent divided their workweek between home and an employer workplace (WFH Research, 2026). Only about 63 percent worked fully on site at a primary workplace. Viewed across workdays, approximately 26 percent of all full paid workdays in June 2026 were performed from home (Buckman et al. 2025; WFH Research 2026). Before the COVID-19 pandemic, the corresponding share was about seven percent (Barrero et al. 2023; Bick et al. 2023). Work from home has therefore stabilized at nearly four times its pre-pandemic prevalence, representing an increase equivalent to almost four decades of growth under the trajectory that prevailed before 2020 (Barrero et al. 2023). These statistics confirm that remote work is no longer a temporary response to an extraordinary public health emergency. It has become a durable feature of the labor market and a routine element of working life (Asmussen et al. 2024; Barrero et al. 2023). At the same time, the workforce is not converging toward a single model of work. Workers are distributed across fully in-person, hybrid, and fully remote arrangements. Paid work is also increasingly undertaken at third locations such as libraries, cafés, and coworking facilities (Caros et al. 2023; Li et al. 2024), expanding the range of possible of workplace locations beyond the traditional workplace and home-based telework.

This transformation carries important implications for transportation. The journey to work has traditionally served as an organizing force for daily mobility, shaping peak-period traffic, transit ridership, roadway congestion, energy consumption, and emissions. When more than one-quarter of paid workdays occurs at home, substantial amounts of commute travel may be eliminated, shortened, rescheduled, or redirected. Hybrid schedules may concentrate commuting on selected weekdays, while work undertaken at third locations may shift travel away from traditional employment centers without eliminating work-related trips. Evolving work arrangements may therefore alter both the magnitude and the spatial-temporal distribution of transportation demand. These changes present a fundamental challenge for travel demand modeling and forecasting. Models cannot reasonably reproduce current travel patterns or forecast future conditions without adequately representing which workers are most likely to telework, where they perform paid work, and how often they commute. Forecasts of peak-period traffic, transit ridership, vehicle miles traveled (VMT), and transportation emissions are all sensitive to these behavioral processes. The multidimensional nature of the telework phenomenon renders it incredibly challenging to adequately capture the effects of telework through simple adjustment factors, nor can its dimensions be treated as separate and independent decisions. Work modality, work location, commute frequency, and the motivations underlying remote work constitute an interrelated behavioral choice bundle. Unless travel models recognize this joint structure, forecasts may misrepresent both the amount and spatial distribution of work-related travel.

A work arrangement is therefore more than a simple distinction between commuting and teleworking, it represents a multidimensional choice. One dimension concerns work modality: whether an individual works fully in person, combines in-person and remote work, or works fully remotely. A second concerns work location: whether paid work occurs at a conventional workplace, at home, or at a third location. For hybrid workers, commute frequency constitutes another dimension because hybrid work may involve anywhere from one to four workplace commute days during a five-day workweek. Finally, remote work reflects underlying motivations. Workers may telework to avoid a lengthy commute, reduce transportation costs, balance professional and personal responsibilities, or obtain a more suitable work environment (Thompson

et al. 2022; Wang et al. 2023; Wang and Mokhtarian 2024). In turn, these motivations may be strongly linked to socio-economic and demographic characteristics of individuals and households.

These choice dimensions are inherently connected. Two workers may both be classified as hybrid, yet one may commute four days per week while the other commutes only once. One may work from home to manage caregiving responsibilities, while the other may seek relief from a long and costly commute. Likewise, two fully remote workers may generate different travel patterns if one remains home and the other regularly travels to a third workplace. Broad classifications of teleworkers can therefore obscure meaningful differences in constraints, motivations, accessibility needs, and transportation outcomes.

Work arrangements are also shaped by institutional constraints. The nature of an occupation determines whether remote work is feasible, while employer policies influence the control that workers exercise over schedules and locations (Delbosc and Kent 2024; Singh et al. 2012; Wang et al. 2023). Some workers must be present at their workplace every day. Others may telework only on designated days or from approved locations. Still others may exercise broad discretion. Within this feasible set, workers select arrangements that reflect individual preferences, household circumstances, commute burden, residential environment, mobility resources, and competing demands on their time.

Understanding this heterogeneity is essential for assessing the transportation implications of telework. Remote work may eliminate commute trips and reduce VMT, particularly when it replaces long automobile commutes. However, the relationship is not necessarily straightforward. Hybrid work may reduce commute frequency without changing the distance traveled on in-person workdays. Telework may also enable workers to reside farther from employment centers or reallocate time savings to non-work travel, thereby offsetting a portion of the commute-related reduction in travel (Asmussen et al. 2023, 2026; Wang and Mokhtarian 2024). Work from third locations presents another distinct pattern because it may replace a long commute with a shorter local trip rather than eliminate work travel entirely (Asmussen et al. 2024; Caros et al. 2023; Xia et al. 2026).

Although prior research has examined telework adoption, frequency, employer policies, work locations, motivations, and travel impacts, these dimensions are often studied separately. This fragmentation limits the ability to understand work arrangements as integrated behavioral outcomes and constrains their representation in travel forecasting models. This study addresses that limitation by jointly modeling work arrangement, commute frequency, and work-from-home motivations within a unified framework. Workers are classified as engaging in one of the following four work arrangements: (1) fully in person, (2) hybrid¹ (remote and in person), (3) fully remote home-based (HB), and (4) fully remote third location-based (TLB). The model also accounts for worker control over their work schedule and location, and accommodates unobserved factors that may influence multiple outcomes.

The remainder of this paper is organized as follows. The next section presents a brief literature review. The third section offers a description of the data, while the fourth section presents the modeling framework and methodological formulation. The fifth section provides a description

¹ Hybrid workers were not further segmented by remote work location because of the limited number of observations in some location categories. Among the 696 hybrid workers in the sample, 511 (73.4 percent) pursued remote work from home, 119 (17.1 percent) pursued remote work from both home and a third location, and only 66 (9.5 percent) pursued remote work exclusively from a third location. Consequently, a more disaggregate classification was not supported by the available sample. Such a more finely refined classification of hybrid workers by work location is left for future studies.

of model estimation results, the sixth section presents average treatment effects, and conclusions are summarized in the seventh and final section.

2. LITERATURE REVIEW

The literature on teleworking is vast and spans transportation, urban planning, labor economics, organizational behavior, and public policy. A comprehensive review of this extensive body of work is beyond the scope of this paper. Instead, the discussion here is purposefully selective. It focuses on evidence related to the principal dimensions considered in this study: work modality, work location, work-from-home motivations, and associated travel impacts. The review is intended to illustrate the evidence to date, establish the importance of these dimensions, and identify research gaps that warrant further attention.

A substantial body of research has examined work modality, generally distinguishing between fully in-person, hybrid, and fully remote arrangements. Fully in-person work remains dominant, particularly in industries that require physical presence, including retail, transportation, construction, and manufacturing (Anik and Habib 2025; Barrero et al. 2023). Hybrid arrangements are more prevalent among highly educated, higher-income, and full-time workers, while parents often exhibit a greater propensity to combine in-person and remote work (Anik and Habib 2025; Asmussen et al. 2023). Fully remote arrangements are more common among women, particularly among single mothers with young children (Asmussen et al. 2023; Ozbilen et al. 2024). Preferences and practices continue to evolve in the after-COVID era, suggesting that work arrangements remain fluid rather than fully settled (Sweet and Scott 2026). Telework frequency within hybrid arrangements also varies considerably. Longer commute distances, higher educational attainment, and greater household income are generally associated with more frequent telework (Versiggel et al. 2025; Wang and Mokhtarian 2024). These findings reinforce the notion that hybrid work is not a uniform category, but rather a continuum of weekly work patterns. Work arrangements are further shaped by occupational requirements and employer policies. The share of job tasks that can be completed remotely influences telework adoption, while employer requirements may restrict remote work to selected days or approved locations (Barrero et al. 2023; Jones et al. 2023; Wang and Mokhtarian 2024). Team-based coordination and designated in-person workdays can further constrain worker choices (Tan et al. 2023). Schedule flexibility also matters because rigid work hours may limit telework feasibility even when job duties can be performed remotely (Delbosc and Kent 2024; Thompson et al. 2022).

A second stream of research has examined work location. Most studies distinguish between the conventional workplace and home, but a growing literature recognizes the role of third locations such as cafés, libraries, coworking facilities, and other shared environments (Caros et al. 2023; Li et al. 2024; Xia et al. 2026). Remote work from home is more prevalent among younger, highly educated, and higher-income workers, particularly when a suitable workspace is available in the residence (Anik and Habib 2025; Asmussen, Mondal, and Bhat 2024). In contrast, third-location work appears to be more prevalent among part-time workers, urban residents, overtime workers, and individuals whose home environments are less conducive to sustained paid work (Asmussen et al. 2023; Caros et al. 2023). Despite these distinctions, many studies continue to combine remote work from home and remote work from a third-location work into a single telework category, or omit remote work outside the home altogether (Anik and Habib 2025; Barrero et al. 2023; Motte-Baumvol and Schwanen 2026). Consequently, the role of telework location remains understudied, and its implications for travel behavior are not fully understood.

A third body of literature has focused on telework motivations. Common motivations include reducing commute time and cost, balancing work and household responsibilities, improving the work environment, addressing health concerns, and reducing environmental impacts (Kappler and de Abreu e Silva 2025; Thompson et al. 2022; Thulin et al. 2023; Wang et al. 2024). These motivations often operate jointly. A worker may value both the time saved by avoiding a lengthy commute and the flexibility gained for household responsibilities. Motivations also vary across population groups. Commute-related considerations are more salient among individuals with longer travel distances, while work-life balance considerations are particularly important for women and households with children (Thompson et al. 2022; Wang et al. 2024; Wang and Mokhtarian 2024). At the same time, remote work may introduce social isolation, inadequate workspace, and blurred boundaries between work and personal life (Kappler and de Abreu e Silva 2025; Kotýnková Krotká 2025; Thulin et al. 2023).

These dimensions have direct implications for travel. Telework is frequently promoted as a transportation demand management and emissions-reduction strategy because it can eliminate commute trips and reduce VMT (Stefaniec et al. 2024). This potential is especially relevant because commute travel remains heavily oriented toward private automobiles and single-occupancy vehicles (Bricka et al. 2024). However, the net effect is not always straightforward. Hybrid work may reduce commute frequency while preserving long commute distances on in-person days. Telework may also enable workers to reside farther from employment centers, thereby increasing commute length when work-related travel occurs (Asmussen et al. 2023). Time savings may also be reallocated to non-work travel, producing rebound effects that offset part of the commute-related reduction in VMT (Beltran and Erhardt 2026; Obeid et al. 2024; Wang and Mokhtarian 2024). Third-location work may replace a long commute with a shorter local trip rather than eliminate work travel entirely, thereby shifting weekday activity away from traditional employment centers (Asmussen et al. 2024; Caros et al. 2023; Xia et al. 2026).

Overall, the literature provides valuable evidence on modality, location, motivations, and travel impacts of alternative work modalities. However, these dimensions have generally been examined separately. Limited attention has been devoted to their joint determination (as a choice bundle) or to correlations arising from shared unobserved factors that simultaneously influence these interrelated work arrangement choice dimensions. The present study contributes toward addressing this gap by treating work arrangements as an integrated behavioral choice bundle and jointly modeling work arrangement, commute frequency, and work-from-home motivations while explicitly distinguishing between HB and TLB remote work.

3. DATA DESCRIPTION

This section presents a detailed overview of the survey data used in the study together with descriptive statistics of the exogenous and endogenous variables included in the sample.

3.1. Survey Overview and Sample Characteristics

The data used in this study are drawn from the second wave of the Transportation Heartbeat of America (THA) Survey, administered to a national sample in the United States between February and March 2026. The survey was fielded through an online panel assembled by a commercial survey firm. Quotas were established across a broad set of socio-economic and demographic characteristics to ensure adequate representation and variation within key population groups. These quotas covered race, age, gender, educational attainment, household income, area type of residence, and census division.

Eligible respondents were adults aged 18 years or older residing in the United States. The survey instrument incorporated multiple attention checks and quality-control questions to ensure response reliability. Detailed information was collected on transportation attitudes and preferences, safety, autonomous vehicles, transportation infrastructure investment priorities, current travel behavior, micromobility use, work arrangements, and delivery activity.

The original THA survey dataset included 8,567 respondents. For purposes of this study, the sample was restricted to individuals who reported working on all five weekdays during the preceding week and provided the distance to a primary out-of-home workplace. Following data cleaning, the final analysis sample consisted of 2,655 workers.

3.2. Exogenous Variables

The exogenous variables considered in the analysis capture individual, household, residential, commute, and employment-related characteristics. Individual attributes include gender, age, educational attainment, race and ethnicity, and the presence of mobility challenges that make transportation difficult. Household characteristics include income, household size and composition, the presence of children, housing type, homeownership, and vehicle ownership. A vehicle sufficiency measure was also derived by comparing the number of household vehicles with the number of licensed drivers. Several important residential built-environment attributes were appended using respondent ZIP codes and information from the EPA Smart Location Database (Chapman et al. 2021). These measures include the population density (people/acre), employment density (jobs/acre), walkability (measured by the National Walkability Index), and transit accessibility to employment (as a percentage of block group employment within 0.5 miles of a transit stop) in the census block group of each respondent's residence.

Table 1 shows that the analysis sample displays substantial variation across the characteristics of interest. Men constitute nearly two-thirds of the sample, suggesting that there remains a gender difference in the composition of the fulltime workforce. The age distribution is concentrated among workers in the prime working-age categories, with respondents between 35 and 54 years accounting for nearly 60 percent of the sample. Educational attainment is relatively high, as more than one-half hold at least a bachelor's degree. The sample is also overwhelmingly composed of full-time workers, consistent with the study requirement that respondents report work activity on all five weekdays. Commute distances vary considerably; slightly more than one-fifth of the sample report a commute shorter than five miles, while 35.0 percent travel at least 15 miles to their primary workplace. With respect to household characteristics, 44.9 percent of respondents live in households containing four or more people, and nearly 60 percent of reside in households with children. Just over three-quarters of the respondents reside in stand-alone homes. Homeownership is common among this fulltime worker sample with 70.6 percent indicating that they own the home in which they reside. Vehicle access is also widespread, although a small but important share of the sample resides in vehicle deficient households, or households with fewer vehicles than drivers, constituting 31.0 percent of the sample. The sample is geographically diverse in terms of household location, with just over one-half residing in urban areas and more than one-third in suburban areas.

The survey also measured the degree of control that workers exercise over their schedules and work locations. Respondents indicated whether these dimensions were determined entirely by the employer, subject to some employee control, or fully controlled by the employee. Figure 1 reveals a strong association between these flexibility measures and observed work arrangements. Fully in-person workers report the lowest levels of flexibility; 78.3 percent have no schedule

control, and 89.5 percent have no location control. Hybrid workers exhibit greater flexibility, particularly at intermediate levels of control. Fully remote HB workers report the greatest autonomy overall, with 26.9 percent exercising full schedule control and 20.2 percent exercising full location control. The pattern for fully remote TLB workers is more nuanced. Although they work entirely away from a conventional employer workplace, nearly 80 percent report no control over work location. This finding suggests that TLB work may often reflect employer requirements, job-related circumstances, or constrained alternatives rather than unrestricted worker choice. More broadly, the variation observed within each work arrangement indicates that schedule and location flexibility are likely to be strong determinants of work arrangements.

These flexibility measures are treated as exogenous in the modeling framework. Their inclusion allows the analysis to distinguish the effects of worker and household characteristics from the institutional constraints that shape the set of feasible work arrangements. The model can therefore assess differences in work modality, work location, commute frequency, and work-from-home motivations while accounting for the degree of control workers possess over when and where paid work is performed.

TABLE 1 Socio-Economic and Demographic Characteristics of the Sample

Variable	%	Variable	%
Individual Demographics (N=2,655)		Household Characteristics (N=2,655)	
Gender		Household annual income	
Woman	36.8	Less than \$25,000	4.4
Man	63.2	\$25,000 to \$49,999	13.8
Age category		\$50,000 to \$99,999	28.8
18-24	8.3	\$100,000 to \$149,999	29.1
25-34	16.5	\$150,000 to \$199,999	16.7
35-44	37.8	\$200,000 or more	7.2
45-54	20.6	Household composition	
55-64	11.7	Nuclear Family (2 adults and child(ren))	47.1
65+	5.1	Other	52.9
Employment status		Household size	
Full-time worker	90.6	One person	14.2
Part-time worker	9.4	Two people	19.9
Formal education		Three people	21.0
High school or less	21.1	Four or more people	44.9
Some college or technical school	24.4	Presence of children	
Bachelor's degree(s)	21.4	At least one (< 18 years)	59.3
Graduate degree(s)	33.1	None	40.7
Race		Number of workers	
Asian or Pacific Islander	5.9	Single-worker household	42.3
Black	17.9	Multiple-worker household	57.7
White	66.0	Housing unit type	
Other	10.2	Stand-alone home	76.1
Ethnicity		Attached home/apartment	22.3
Hispanic	26.0	Other	1.6
Non-Hispanic	74.0	Home ownership	
Mobility challenges		Own	70.6
Yes	30.5	Rent	27.9
No	69.5	Other	1.5
Work-Related Variables (N=2,655)		Vehicle sufficiency	
Commute distance		Deficient (# vehicles < # drivers)	31.0
< 5 miles	21.1	Sufficient (# vehicles ≥ # drivers)	69.0
≥ 5 miles and < 10 miles	26.3	Location	
≥ 10 miles and < 15 miles	17.6	Urban	51.2
≥ 15 miles	35.0	Suburban	35.7
		Small town	4.7
		Rural	8.4
Geographic Attributes (N=2,655)			
Population density		Walkability	
High (≥ 30 people/acre)	29.9	High (≥ 13 National Walk Index)	29.0
Medium (≥ 4, < 30 people/acre)	58.4	Medium (≥ 8, < 13 National Walk Index)	37.0
Low (< 4 people/acre)	11.7	Low (< 8 National Walk Index)	34.0
Employment density		Transit accessibility to employment	
High (≥ 11 jobs/acre)	28.7	High (≥ 10%)	64.3
Medium (≥ 1, < 11 jobs/acre)	60.4	Medium (> 0%, < 10%)	11.7
Low (< 1 jobs/acre)	10.9	Low (0%)	24.0

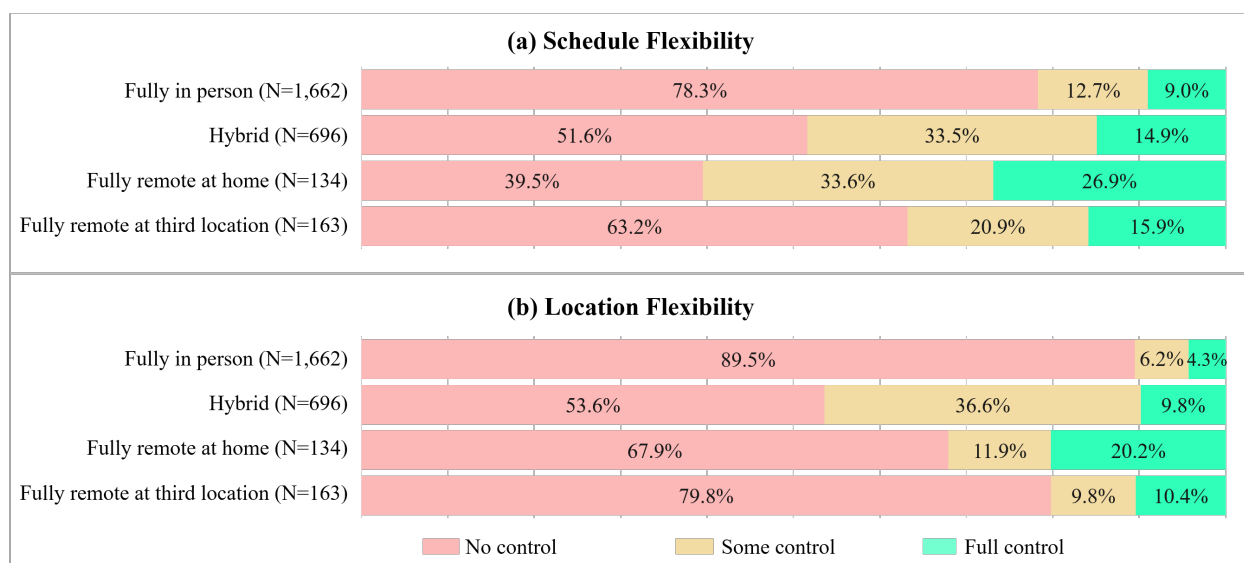


FIGURE 1 Schedule and Location Flexibility by Work Arrangement

3.3. Endogenous Outcomes

The endogenous outcomes capture three related dimensions of weekly work behavior: work arrangement, commute frequency among hybrid workers, and motivations for working from home. Respondents reported the number of hours worked and the location of work on each weekday during the preceding week. Work locations were classified as the primary workplace, home, or a third location. These daily records were used to assign each respondent to one of four work arrangement categories. Fully in-person workers reported commuting to a workplace on all five weekdays. Hybrid workers commuted on one to four days and worked remotely on the remaining days. Respondents who did not commute on any weekday were classified as fully remote. This group was further divided by dominant remote-work location. Those who worked from a third location on fewer than three days were classified as fully remote HB, while those who worked from a third location on three or more days were classified as fully remote TLB. Table 2 shows that fully in-person work remains the dominant arrangement, accounting for 62.6 percent of the sample. Hybrid workers constitute another 26.2 percent, indicating that more than one-quarter of respondents divided the week between their workplace and remote work. Fully remote workers account for the remaining 11.2 percent and are distributed fairly evenly between HB and TLB arrangements. The relatively large TLB share is noteworthy because it suggests that remote work should not be treated as synonymous with working from home.

Commute frequency is modeled as an additional outcome for the 696 hybrid workers. As shown in Table 2, most hybrid workers commute on three or four days per week, with 37.9 percent reporting a commute on three days, while another 30.2 percent report four commute days. Two-day commute schedules are less common, and only 9.6 percent commute once per week. These patterns suggest that hybrid work in this sample generally involves modest rather than extensive substitution of remote work for workplace attendance.

The survey also asked respondents who worked from home on at least one day to identify all applicable reasons for doing so². The original response options were consolidated into four broad motivation categories that reflect distinct behavioral considerations. The first of these categories is “saving time,” which captures the desire to avoid devoting time to commuting, while “saving money” reflects the costs associated with commuting. “Work-life balance” combines motivations related to personal responsibilities, household tasks, appointments, and caregiving. Finally, “work environment” captures preferences for a quieter setting, remaining home on a particular day, or seeking a change in surroundings. Work-life balance is the most widely reported motivation, selected by 68.1 percent of home teleworkers. Saving commuting time ranks second at 44.8 percent, followed by work environment at 35.5 percent and saving money at 24.5 percent. Because respondents could select multiple reasons, these categories are not mutually exclusive and do not sum to 100 percent. The distributions underscore the multidimensional nature of telework decisions. Workers may value remote work simultaneously for household flexibility, commute relief, financial savings, and environmental comfort.

Several original survey responses were excluded from the modeling exercise. Options reflecting external circumstances (e.g., illness or weather conditions) were omitted because they could not be readily explained by respondent characteristics. The response indicating that an individual always works from home was also excluded because that condition is already represented through the fully remote work arrangement categories. The final set of endogenous variables therefore captures the central behavioral dimensions of interest without duplicating information across outcomes.

TABLE 2 Distribution of Endogenous Variables

Variable		%
Work arrangement (N=2,655)		
Fully in-person		62.6
Hybrid		26.2
Fully remote HB		5.1
Fully remote TLB		6.1
Number of commute days in the last week (among hybrid workers only; N=696)		
1 commute day		9.6
2 commute days		22.3
3 commute days		37.9
4 commute days		30.2
Work-from-home motivations (among those who worked from home at least one day; N=799; multiple select)		
Save time	• To save commuting time	44.8
Save money	• To avoid monetary costs from commuting	24.5
Work-life balance	• To better balance work and personal responsibilities	68.1
	• To handle household tasks or appointments	
	• To take care of children or family members	
Work environment	• To have a quieter work environment	35.5
	• I did not feel like leaving home on that day	
	• I wanted a different environment for a change	

² Note that the work-from-home motivations captured in this study pertain specifically to remote work performed at home as opposed to at a third location. Thus, hybrid workers who performed all remote work from third locations were not asked to report work-from-home motivations. Similarly, fully remote workers who worked exclusively from third locations were not asked to provide these motivations

3. MODELING FRAMEWORK AND METHODOLOGY

This section presents a detailed description of the modeling framework and methodology adopted in this study.

3.1. Modeling Framework

Figure 2 presents the conceptual structure of the multivariate modeling framework adopted in this study. The framework is designed to reflect the bundled nature of work arrangements by jointly representing six related endogenous outcomes: work arrangement, commute frequency among hybrid workers, and four motivations for working from home. Rather than treating these dimensions as separate behavioral choices, the model recognizes that they may be shaped by common observed and unobserved factors.

The first outcome is work arrangement, specified as a nominal choice among four alternatives: fully in person, hybrid, fully remote HB, and fully remote TLB. This outcome is modeled for the full sample of 2,655 workers. The second outcome is commute frequency, represented as an ordinal variable indicating the number of workplace commute days during the preceding week. Because this outcome is observed only for workers who divide their week between in-person and remote work, it is modeled for the subset of 696 hybrid workers. The remaining four outcomes capture motivations for working from home: saving commute time, reducing commute costs, improving work-life balance, and obtaining a preferred work environment. Each motivation is represented as a two-level ordinal outcome (equivalent to a binary response) and modeled for the 799 “home teleworkers,” or respondents who worked from home on at least one day during the reference week. Because workers could report more than one motivation, the four outcomes are not mutually exclusive. A worker may, for example, value both the time saved by avoiding a commute and the flexibility gained for managing household responsibilities.

An extensive set of exogenous variables influence the outcome variables. These variables include socio-demographic characteristics, household characteristics, built-environment attributes, and work-related variables (commute distance, work schedule and location flexibility). Their inclusion permits the model to identify how observed differences among workers influence work arrangement, commute frequency, and work-from-home motivations.

The principal strength of the framework lies in its joint treatment of the outcome dimensions. Conventional approaches might estimate separate models for work arrangement, commute frequency, and each work-from-home motivation. Such an approach would implicitly assume that the unobserved factors affecting one outcome are unrelated to those affecting the others. That assumption is difficult to justify in the present context. Attitudes toward commuting, preferences for workplace interaction, caregiving obligations, productivity perceptions, and lifestyle orientations may influence several dimensions of work behavior simultaneously. The joint model accommodates this interdependence through correlations among the stochastic error components of the outcome equations. These correlations capture the effects of unobserved attributes that are not measured directly in the survey but may shape multiple outcomes. For instance, an unobserved caregiving responsibility may increase the likelihood of a HB remote arrangement and the propensity to identify work-life balance as a work-from-home motivation. Similarly, an unobserved aversion to commuting may influence both the choice of a remote work arrangement and the motivation to save time or money. By allowing such correlations, the framework offers a more behaviorally complete representation of how workers assemble their weekly work arrangements. Furthermore, by explicitly modeling the correlations between the error

terms associated with different outcome dimensions, we account for sample selection effects. This allows information contained within the commute frequency and work-from-home motivation outcomes to contribute to behavioral inference across the full sample, including respondents who did not engage in hybrid work or work from home. Consequently, the results offer insights into the broader working population, identifying factors that may influence commute frequency and work-from-home behavior if individuals were to adopt the associated work arrangements.

Overall, the model structure provides a unified representation of work arrangements including work location and modality, commuting frequency, and motivations for working from home. This integrated treatment is especially valuable for transportation demand modeling because it links worker characteristics and institutional constraints to the frequency and location of work travel. It also provides a stronger foundation for estimating the commute VMT implications of alternative work arrangements than would a series of independent models.

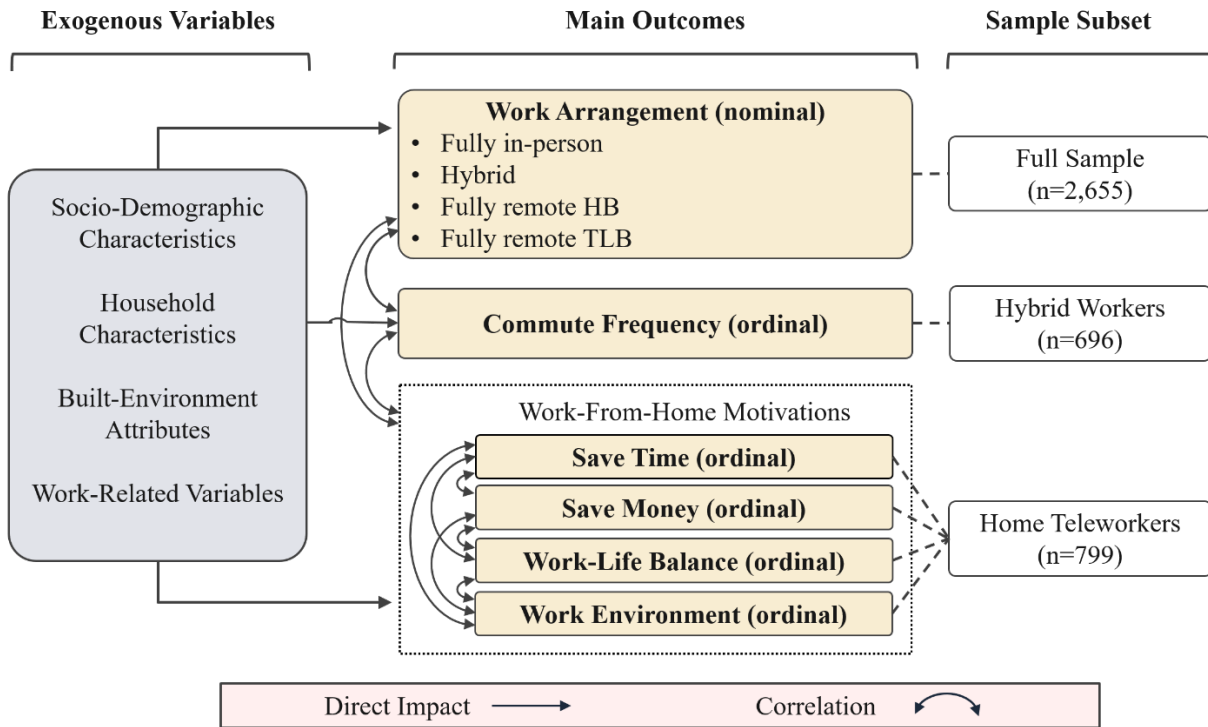


Figure 2 Model Framework

3.2. Methodological Formulation

For the mathematical formulation of the model, we will begin with the nominal variable for the four work arrangement alternatives. Throughout the formulation we will suppress the index q for the decision maker, simply for ease of presentation. For the nominal outcome, let i be the index for the alternatives ($i = 1, 2, 3, \dots, I$) where $I = 4$ in our analysis, as the work arrangement variable has 4 alternatives. Assume the usual underlying random utility structure for each alternative i :

$$U_i = \gamma' \mathbf{x}_i + \zeta_i, \quad (1)$$

where $\mathbf{x}_i$ is an $(A \times 1)$ vector of exogenous variables including a constant, γ' is an $(A \times 1)$ column vector of corresponding coefficients, and ζ_i is a normal error term. For identification purposes, given that all the exogenous variables in our model are individual-specific and do not vary across

alternatives, all elements of $\mathbf{x}_i$ will be uniformly zero for a base alternative; in our empirical analysis later, this base alternative is considered as the “fully in-person” alternative. We assume that ς_i is independent and identically normally distributed across individuals, but allow a covariance structure across alternatives for each individual. Let $\boldsymbol{\varsigma} = (\varsigma_1, \varsigma_2, \dots, \varsigma_I)'$ ($I \times 1$ vector). Then, we assume $\boldsymbol{\varsigma} \sim MVN_I(0, \boldsymbol{\Lambda})$. Appropriate scale and level normalization must be imposed on $\boldsymbol{\Lambda}$ for identifiability. Specifically, only utility differentials matter at each choice occasion. Taking the utility differentials with respect to the first alternative, only the elements of the covariance matrix $\boldsymbol{\Lambda}_1[(I-1) \times (I-1)]$ of $\varsigma_{i1} = \varsigma_i - \varsigma_1$ ($i \neq 1$) are estimable, with the first diagonal element of $\boldsymbol{\Lambda}_1$ also set to one for identifiability. Also, for future use, define the $((I-1) \times 1)$ vector $\boldsymbol{\varsigma}_1 = (\varsigma_{21}, \varsigma_{31}, \dots, \varsigma_{I1})'$ as well as the $(I \times 1)$ vector $\mathbf{U} = (U_1, U_2, \dots, U_I)'$ and the $(I \times A)$ matrix $\mathbf{X} = (\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_I)'$.

Next, we will consider the ordinal outcomes. We consider the commute frequency as an ordered outcome (as discussed in the previous section), as well as the work-from-home motivations (which may be considered as ordinal since binary outcomes are simply a special case of ordinal outcomes with two levels). Denote the index for the ordinal outcomes as n ($n = 1, 2, \dots, N$) with $N = 5$ for the commute frequency and four work-from-home motivations. Note also that each of these ordinal outcomes is only available for a subset of respondents. The commute frequency outcome is available only when the hybrid work arrangement alternative is selected, and the work-from-home motivations are only available for respondents who reported working from home for at least one day. Thus, while the remainder of this section presents the formulation for an individual with this full set of endogenous variables, the relevant vectors/matrices need only be marginalized to include only the relevant data for respondents for whom these outcome are irrelevant. For each ordinal outcome, let J_n be the number of categories (with $J_n \geq 2$) and let j_n be the corresponding index ($j_n = 1, 2, \dots, J_n$). Also, for each ordinal outcome, let y_n^* be the underlying latent variable whose horizontal partitioning leads to the observed outcome. Next, assume that the individual chooses the α_n^{th} ordinal category. Then, we can apply the usual ordered response formulation, for the individual, to write:

$$y_n^* = \boldsymbol{\gamma}_n' \mathbf{w} + \varepsilon_n \quad (2)$$

with $\psi_{n, a_n-1} < y_n^* < \psi_{n, a_n}$, and where $\mathbf{w}$ is an $(B \times 1)$ vector of exogenous variables (not including a constant) and $\boldsymbol{\gamma}_n$ is a vector of corresponding coefficients to be estimated. The $\tilde{\psi}$ terms represent thresholds to be estimated, and $\tilde{\varepsilon}_n$ represents the standard normal random error for the ordinal outcome. For each ordinal outcome, the thresholds must be ordered $\psi_{n,0} < \psi_{n,1} < \psi_{n,2} \dots < \psi_{n,J_n}$, with $\psi_{n,0} = -\infty$, and $\psi_{n,J_n} = +\infty$. Let $\boldsymbol{\psi}_n = (\psi_{n,2}, \psi_{n,3}, \dots, \psi_{n,J_n-1})'$ and $\boldsymbol{\psi} = (\boldsymbol{\psi}_1', \boldsymbol{\psi}_2', \dots, \boldsymbol{\psi}_N)'$. Stack the N underlying continuous variables y_n^* into an $(N \times 1)$ vector $\tilde{\mathbf{y}}^*$ and define the $(N \times B)$ matrix $\boldsymbol{\gamma} = (\boldsymbol{\gamma}_1, \boldsymbol{\gamma}_2, \dots, \boldsymbol{\gamma}_N)'$. Also, stack the N lower thresholds for the decision-maker ψ_{n, a_n-1} into an $(N \times 1)$ vector $\boldsymbol{\psi}_{low}$ and the N upper thresholds ψ_{n, a_n} into another vector $\boldsymbol{\psi}_{up}$. Finally, stack the N error

terms $\tilde{\varepsilon}_n$ into an $(N \times 1)$ vector $\boldsymbol{\varepsilon}$. $\boldsymbol{\varepsilon}$ is multivariate normal distributed with a mean vector of zeros and a general correlation matrix $\boldsymbol{\Sigma}$. The correlation matrix captures unobserved factors that would lead some respondents to be more likely to endorse multiple reasons for working from home or to work more days from home and also select any specific reasons for doing so.

Next, define the $((I + N) \times 1)$ vector $\mathbf{B} = \begin{bmatrix} \boldsymbol{\gamma}'\mathbf{x} \\ \boldsymbol{\gamma}'\mathbf{w} \end{bmatrix}$ and the two $((I + N - 1) \times 1)$ threshold vectors $\boldsymbol{\psi}_{low} = \begin{pmatrix} -\infty_{I-1} \\ \boldsymbol{\psi}_{low} \end{pmatrix}$ and $\boldsymbol{\psi}_{up} = \begin{pmatrix} \mathbf{0}_{I-1} \\ \boldsymbol{\psi}_{up} \end{pmatrix}$, where $-\infty_{I-1}$ represents a $((I - 1) \times 1)$ column vector of negative infinities, and $\mathbf{0}_{I-1}$ represents a $((I - 1) \times 1)$ column vector of zeros. Also define the $((I + N - 1) \times (I + N - 1))$ covariance matrix $\boldsymbol{\Theta} = \begin{bmatrix} \boldsymbol{\Lambda}_1 & \boldsymbol{\Gamma} \\ \boldsymbol{\Gamma}' & \boldsymbol{\Sigma} \end{bmatrix}$, where $\boldsymbol{\Gamma}$ is an $((I - 1) \times N)$ matrix that captures the covariation between each (differenced) nominal alternative and each ordinal outcome. Finally, partition the matrix $\boldsymbol{\Theta}$ as $\boldsymbol{\Theta} = \boldsymbol{\omega}\boldsymbol{\Theta}^*\boldsymbol{\omega}$, where $\boldsymbol{\omega}$ is the diagonal matrix of standard deviations of $\boldsymbol{\Theta}$ (with zero as all off-diagonal entries) and $\boldsymbol{\Theta}^*$ is the corresponding correlation matrix.

For estimation, we will need the correlation matrix corresponding to the error term differences taken with respect to the chosen nominal alternative. To do so, for each individual, we define a contrast matrix $\mathbf{M}$ based on the selected nominal alternative. To get the contrast matrix, begin with an $((I + N - 1) \times (I + N))$ matrix of zeros. Considering the first $(I - 1)$ rows and I columns (corresponding to the nominal outcome), insert an identity matrix of size $(I - 1)$, supplemented by a column of '-1' values in the column corresponding to the chosen alternative. Then, insert another identity matrix of size N in the final N rows and N columns of the contrast matrix (corresponding to the ordinal outcomes). Also, define the $((I + N) \times (I + N - 1))$ matrix $\mathbf{D}$ that is created by supplementing an identity matrix of size $(I + N - 1)$ with an extra row of zeros in the first row.

The final set of parameters is $\boldsymbol{\delta} = (\boldsymbol{\gamma}', \text{Vech}(\boldsymbol{\gamma}), \text{Vech}(\boldsymbol{\psi}), \text{Vechup}(\boldsymbol{\Theta}^*), \text{diag}(\boldsymbol{\omega}))$, where $\text{diag}(\cdot)$ row-vectorizes the diagonal elements of a matrix, $\text{Vech}(\cdot)$ row-vectorizes the unique and non-zero elements of a matrix, and $\text{Vechup}(\cdot)$ row-vectorizes the unique and non-zero upper diagonal elements of a matrix. Then, the likelihood function for the individual may be written as:

$$L(\boldsymbol{\delta}) = \int_{D_r} f_{(I+N-1)}(\mathbf{r}; \mathbf{MB}, \mathbf{MD}(\boldsymbol{\omega}\boldsymbol{\Theta}^*\boldsymbol{\omega})\mathbf{D}'\mathbf{M}') d\mathbf{r} \quad (3)$$

where the integration domain $D_r = \{\mathbf{r} : \boldsymbol{\psi}_{low} \leq \mathbf{r} \leq \boldsymbol{\psi}_{up}\}$ is the multivariate region determined by the utility differences taken with respect to the chosen alternative for the nominal outcome, and the observed ordinal outcomes. $f_{(I+N-1)}(\mathbf{r}; \mathbf{MB}, \mathbf{MD}(\boldsymbol{\omega}\boldsymbol{\Theta}^*\boldsymbol{\omega})\mathbf{D}'\mathbf{M}')$ is the multivariate normal density function of dimension $(I + N - 1)$ with a mean of $\mathbf{MB}$ and covariance of $\mathbf{MD}(\boldsymbol{\omega}\boldsymbol{\Theta}^*\boldsymbol{\omega})\mathbf{D}'\mathbf{M}'$, and evaluated at $\mathbf{r}$. The likelihood function for the entire sample of decision makers is simply the product of the individual level likelihoods, and the likelihood function is evaluated using Bhat's (2018) matrix-based approximation methods for evaluating the multivariate normal cumulative distribution function.

4. MODEL ESTIMATION RESULTS

This section presents the model estimation results and their behavioral interpretation. A wide range of alternative specifications was examined before arriving at the final model reported in Table 3. Variables were retained based on a 90% confidence threshold, with the final specification selected based on considerations of statistical fit, coefficient significance, and behavioral interpretability, while also yielding a meaningful and intuitive correlation structure across the modeled outcomes.

The model includes three types of endogenous variables (see Figure 2). Work arrangement is specified as a nominal outcome with four alternatives: fully in-person, hybrid, fully HB, and fully remote TLB. Commute frequency among hybrid workers is treated as an ordinal outcome reflecting the number of workplace commute days during the preceding week. The four motivations for working from home are represented as two-level ordinal outcomes indicating whether each motivation was selected. Table 3 presents the final parameter estimates, corresponding t-statistics, threshold values, and correlations across the endogenous dimensions. The scale parameters reported at the bottom of Table 3 characterize the covariance structure of the nominal outcome component. The constants and threshold parameters do not have any meaningful interpretation and are included to best match the observed and predicted shares for each outcome.

4.1. Effects of Socio-Demographic Variables

The model reveals meaningful variation in work arrangements, commute frequency, and work-from-home motivations across individual and household characteristics. Age-related effects are concentrated among mid-career workers. Individuals between 25 and 54 years of age are more likely to adopt hybrid work arrangements, while those between 35 and 54 years are more likely to work fully remotely from a third location. These patterns are consistent with evidence that mid-career workers have been especially likely to retain hybrid and remote work practices in the post-pandemic era owing to their work experience and lifecycle stage (Anik and Habib 2025; Sweet and Scott 2026). Workers aged 65 years or older are less likely to identify time savings or work-life balance as reasons for working from home, suggesting that telework may offer fewer benefits along these dimensions for older workers (Scheibe et al. 2024).

Educational attainment differentiates fully remote work from hybrid work. Individuals with at least a bachelor's degree are less likely to adopt fully remote arrangements (either HB or TLB). This finding should not be interpreted as evidence of lower telework propensity among highly educated workers. Rather, it suggests that they may be more likely to combine remote work with continued workplace attendance. Many knowledge-intensive occupations often support telework while still placing value on in-person collaboration, networking, and team interaction (Anik and Habib 2025).

Race and gender effects emerge more selectively through work-from-home motivations. Black workers show a marginally lower propensity to identify commute time savings as a reason for working from home. White workers are more likely to cite the work environment, while Asian men exhibit a similar tendency. These patterns may reflect differences in home workspace, workplace experience, or other unobserved circumstances. The available data do not permit a definitive explanation, and the results should therefore be interpreted cautiously.

Mobility challenges display one of the clearest and most consistent relationships in the model. Workers who experience health conditions or anxieties that make transportation difficult are more likely to adopt all forms of telework arrangements. They also exhibit a tendency to commute fewer days should they choose to engage in hybrid work relative to those without

mobility challenges, with the main motivation for such an arrangement being to improve work-life balance. These findings reinforce the role of telework as an accessibility strategy that can reduce the burden of reaching a conventional workplace, supporting labor-force participation among individuals with mobility limitations (Ameri et al. 2023; Lake and Maidment 2023). They also align with evidence that workers with disabilities often face added challenges in balancing employment and non-work responsibilities (Jammaers and Williams 2021).

Income effects vary across outcomes and do not exhibit a straightforward pattern. Workers in households earning between \$25,000 and \$99,999 are less likely to adopt hybrid arrangements, while those with incomes below \$50,000 exhibit a tendency to commute more frequently should they adopt a hybrid work arrangement. These patterns likely reflect occupational differences between income levels, as many lower- and moderate-income jobs are less amenable to remote work (Anik and Habib 2025; Asmussen et al. 2023). At the same time, commute costs are an important work-from-home motivation among workers in households earning between \$25,000 and \$99,999, and a similar but weaker association appears for those earning between \$100,000 and \$199,999. Workers in households earning at least \$100,000 are more likely to cite work-life balance, while those earning at least \$150,000 are more likely to cite time savings. The latter result is consistent with evidence that the value placed on time tends to increase with income (Huda et al. 2023; Lara-Pulido and Martinez-Cruz 2022; Nagler et al. 2024).

Household composition produces another set of important contrasts. Hybrid workers in nuclear families and households with four or more members commute more frequently. Larger households may create competing demands for space and attention, reducing the attractiveness of working from home on many days (de Abreu e Silva 2022; Tahlyan et al. 2022). Nevertheless, the presence of children increases the likelihood of adopting a hybrid arrangement and strengthens work-life balance as a work-from-home motivation. This pattern is consistent with prior evidence that parents use hybrid work to manage household and caregiving responsibilities while maintaining some workplace presence (Anik and Habib 2025; Asmussen et al. 2023; Asmussen, Mondal, and Bhat 2024). Women with children show a reduced propensity to cite time savings, suggesting that the appeal of working from home for this group may be tied more closely to caregiving flexibility than to commute reduction alone. Often taking on the role of primary caregiver within the home, women with children may be more likely to see commuting time as a reprieve from caregiving responsibilities, valuing this period as a break from household tasks (Asmussen et al. 2022; Craig and Mullan 2010). Workers in single-worker households are also more likely to identify commute cost savings as a motivation, consistent with the notion that such households may be seeking ways to stretch their household budget on one worker's income.

Homeownership increases the likelihood of hybrid and fully remote HB arrangements. Homeowners are also more likely to cite time savings and work-life balance as reasons for working from home. Greater control over the residential environment and the availability of suitable workspace may make HB work more feasible and productive for these households (Anik and Habib 2025; Asmussen, Mondal, and Bhat 2024). Finally, workers in vehicle-deficient households are more likely to adopt all three telework arrangements. Telework may help these households manage limited vehicle availability, although the relationship may also reflect self-selection if households reduce vehicle ownership after adopting remote work (Han et al. 2026; Iogansen et al. 2024; Tahlyan et al. 2022). Overall, the results show that work arrangements reflect the influence of life-cycle stage, mobility capability, income, household composition, housing circumstances, and vehicle availability. Collectively, these factors influence not only the propensity to engage in

telework, but also the frequency of workplace attendance among hybrid workers and the motivations underlying work-from-home behavior.

4.2. Effects of Built Environment Variables

Built-environment attributes are associated primarily with commute frequency and with selected motivations for working from home. Individuals residing in high population-density areas commute more frequently than those living in lower-density settings. One possible explanation is that dense residential environments offer better access to employment and transportation options, thereby reducing the burden associated with workplace travel. Smaller residential units in such areas may also make the conventional workplace more attractive for completing paid work (Rahman Fatmi et al. 2022; Z'Rotz et al. 2026). This result differs from prior findings that generally associate dense urban environments with greater telework activity (Barrero et al. 2023), suggesting that the influence of density may vary based on context and work dimensions. Employment density exhibits the opposite relationship. Individuals residing in areas with medium or high employment density commute less frequently should they adopt a hybrid work arrangement. Workers in high employment-density areas are also more likely to identify commute cost savings as a motivation for working from home. These patterns may reflect the greater congestion, parking costs, and other travel burdens commonly associated with dense employment centers (Asmussen et al. 2023; Sener and Bhat 2011; Wang et al. 2023). The contrasting effects of population and employment density point to distinct built-environment influences. High residential density may make workplace access more convenient or reduce the suitability of the home for paid work, leading workers to commute more often. High employment density, in contrast, may increase the time and monetary costs of workplace travel, encouraging workers to reduce commute frequency. These interpretations should be viewed with some caution because the built-environment measures are based on residential location and may capture several related neighborhood characteristics.

Walkability and transit accessibility are associated with work-from-home motivations rather than work arrangement or commute frequency. Workers residing in highly walkable areas are more likely to cite the work environment as a reason for working from home. Walkability may capture broader neighborhood qualities, including access to nearby services and amenities, that enhance the appeal of working from home (Yang et al. 2025). Workers with low transit accessibility to employment are more likely to identify commute cost savings as a motivation, suggesting that limited access to lower-cost transportation options may increase the financial burden of workplace travel if commuting by private vehicle is the only viable option (Dong 2021; Thakuriah et al. 2013).

4.3. Effects of Work-Related Variables

Control over work schedule and locations plays a central role in shaping work arrangements. Relative to those with no schedule control, workers with some or full control over their schedules are substantially more likely to adopt a hybrid arrangement. In contrast, this group with some or full schedule control is more likely to work fully remotely, whether from home or from a third location. These patterns suggest that schedule flexibility is especially important for sustaining arrangements that reduce or eliminate regular workplace attendance. Location control has an even stronger relationship with work arrangement. Workers with some control over where they perform their jobs are considerably more likely to adopt a hybrid arrangement and are also more likely to work fully remotely from either home or a third location. Full location control produces a similar

pattern, although its association with hybrid work is smaller than that observed for some location control. One possible interpretation is that limited location flexibility often takes the form of a structured hybrid arrangement, whereas workers with complete discretion may distribute themselves more broadly across hybrid and fully remote alternatives.

The influence of schedule and location control on commute frequency is more limited. Workers with full control over work location show a tendency to commute fewer days when they engage in hybrid arrangements. No comparable commute-frequency effects emerge for schedule control or for intermediate levels of location control. Thus, employer and job-related flexibility appears to exert its strongest influence on the type of work arrangement selected, while playing a more modest role in determining the number of commute days within a hybrid arrangement. These results highlight the importance of institutional constraints. Work arrangements do not reflect worker preferences alone. Employers and the nature of the job define whether remote work is permitted and the degree of discretion available to the employee. When workers are granted greater control, they are more likely to take advantage of remote and hybrid arrangements.

Commute distance also shapes work arrangement decisions. Workers with commutes of at least five miles are more likely to adopt each of the three telework arrangements than to work fully in-person. This finding is consistent with previous evidence that the attractiveness of telework increases as the burden of workplace travel rises (Asmussen, Mondal, and Bhat 2024; Versigghel et al. 2025; Wang et al. 2024). For those traveling at least 10 miles, saving money also emerges as a stronger motivation for working from home, reflecting the higher fuel, toll, fare, parking, and vehicle operating costs associated with longer commutes.

The interaction effects provide additional insight into how commute distance and the built environment jointly shape work behavior. Workers with commutes shorter than five miles who reside in highly walkable areas exhibit higher commute frequencies when hybrid work is adopted. Short and accessible workplace trips may make in-person attendance less burdensome, particularly when walking or other convenient travel options are available (Yang et al. 2025). In contrast, workers with commutes of at least five miles who reside in high population-density areas are more likely to identify both time savings and work-life balance as motivations for working from home. Longer travel distances in dense settings may translate into substantial travel-time burdens, making telework valuable not only for avoiding commuting, but also for gaining time for personal and household responsibilities. Taken together, these results illustrate that work arrangements reflect the combined influence of employer flexibility and commute burden. Control over schedule and location largely determines whether remote work is feasible, while commute distance shapes whether workers find telework attractive and the benefits they seek to derive from it.

4.4. Correlations

Several statistically significant correlations emerge across the stochastic components of the outcome equations, confirming that the modeled dimensions are linked through shared unobserved factors. These correlations represent associations among unobserved propensities after accounting for the explanatory variables included in the model. Their significance provides strong support for the joint estimation framework, suggesting that estimating these dimensions independently would overlook important relationships and provide a less complete representation of the behavioral processes underlying work arrangements, telework motivations, and commute behavior.

The scales and correlations corresponding to the work arrangement nominal variable refer to the differentiated error covariance matrix. As such, they are not interpretable, except if one makes the “non-unreasonable” assumptions that (1) the scale of utility for the fully in-person work

arrangement is negligible relative to the scales of the three telework arrangements, and (2) there are no unobserved factors that generate a correlation between the utilities of the fully in-person work arrangement and the utility of the teleworking arrangements. With these assumptions, the positive and strong correlations between the telework arrangements suggest that workers possess underlying orientations toward remote work that are not fully captured by observed socio-economic, household, built environment, and employment characteristics. Such factors may include preferences for autonomy, comfort with remote collaboration, or attitudes toward workplace attendance. The scale ordering (see the row labeled “Scales” in Table 3) indicates the presence of much more unobserved variation in the utilities ascribed to hybrid and fully remote TLB arrangements relative to fully remote HB telework.

The work-from-home motivations also exhibit meaningful interdependence. The propensity to work from home to save time is positively correlated with the propensity to save money, reflecting the close connection between the temporal and financial burdens of commuting. Both motivations are positively correlated with work-life balance. Unobserved circumstances that make commute time or cost especially burdensome may also heighten the value of flexibility in managing personal and household responsibilities. These findings reinforce the notion that work-from-home motivations operate as a bundle rather than as isolated considerations. Negative correlations are observed between the propensity to adopt hybrid work and the motivation to obtain a better work environment, and between fully remote HB work and the same motivation. The first result may reflect an underlying preference among some hybrid workers for elements of the conventional workplace, including in-person interaction and separation between work and home life (Dale 2024; Kotýnková Krotká 2025). For fully remote HB workers, work environment may simply be less salient as a stated motivation because home already serves as their established place of work. A positive correlation between saving time and seeking a better work environment is also present. This pattern suggests that some workers may view the elimination of the commute and the ability to work in a preferred setting as complementary benefits. By contrast, commute frequency does not exhibit statistically meaningful correlations with the other outcome dimensions after accounting for observed characteristics.

4.5. Model Fit

To assess the performance of the proposed joint model, it is compared with an independent specification that does not account for correlations across outcome dimensions. Goodness-of-fit measures for both of these model formulations are presented in the bottom portion of Table 3. Specifically, we compute the log likelihood at convergence, $L(\hat{\theta})$, for both specifications, as well as the log-likelihood of a constants only specification, $L(c)$ which includes only the constants for the nominal work arrangement outcome and the threshold parameters for the remaining outcome dimensions. These values are then used to calculate the Bayesian information criterion (BIC):

$$BIC = -L(\hat{\theta}) + 0.5 (\# \text{ of model parameters}) \log(\text{sample size}), \quad (4)$$

as well as the adjusted likelihood ratio index:

$$\bar{\rho}^2 = 1 - \frac{L(\hat{\theta}) - M}{L(c)} \quad (5)$$

where M is the number of parameters estimated in the model (excluding constants/thresholds). The goodness-of-fit measures further support the inclusion of correlations within the proposed

joint framework, as the joint model exhibits a lower BIC and a higher adjusted likelihood ratio index than the independent model. Additionally, because the independent model is nested within the joint model, we perform a likelihood ratio test. The test statistic, reported in Table 3, is calculated as:

$$-2 \left[L(\hat{\theta})_{\text{Independent}} - L(\hat{\theta})_{\text{Joint}} \right]. \quad (6)$$

The resulting test statistic of 105.72 exceeds the critical chi-squared value for the associated degrees of freedom, indicating that the inclusion of the correlation parameters produces a statistically significant improvement in model fit. Finally, to provide an intuitive measure of predictive performance, we compute the average probability of correct prediction for each model specification. For every respondent, the probability associated with the observed work arrangement outcome, including hybrid commute frequency and the observed work-from-home motivation outcomes is estimated. These probabilities are then averaged across individuals to quantify the probability of correct prediction. As shown in Table 3, the joint model corresponds to a higher average probability of correct prediction than the independent specification. Taken together, these disaggregate fit measures provide statistical support for the proposed joint modeling framework.

TABLE 3 Model Estimation Results

Explanatory Variable (base category)	Work Arrangement						Commute Frequency Ordinal: 1-4 days		Work-From-Home Motivations							
	Hybrid		Fully Remote HB		Fully Remote TLB				Save Time		Save Money		Work-Life Balance		Work Environment	
	Nominal: Fully In-Person (base)								Ordinal: 1 (No), 2 (Yes)							
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat		
Individual Characteristics																
Age 25-54 (18-24 55+)	0.124	2.42	—		—		—		—		—		—		—	
Age 35-54 (18-24 55+)	—		—		0.112	2.03	—		—		—		—		—	
Age 65+ (< 65 years)	—		—		—		—		-0.553	-2.06	—		-0.531	-2.06	—	
Formal education (< bachelor's degree)	—		-0.203	-2.53	-0.203	-2.53	—		—		—		—		—	
Black (White Asian Other)	—		—		—		—		-0.231	-1.78	—		—		—	
White (Black Asian Other)	—		—		—		—		—		—		—		0.330	3.12
Asian × Man (*)	—		—		—		—		—		—		—		0.460	1.85
Have mobility challenges (none)	0.240	4.01	0.181	2.29	0.261	3.16	-0.167	-1.75	—		—		0.195	1.71	—	
Household Characteristics																
Less than \$25,000	—		—		—		0.259	1.66	—		—		—		—	
\$25,000 to \$49,999	-0.229	-3.54	—		—		0.259	1.66	—		0.444	2.36	—		—	
\$50,000 to \$99,999	-0.229	-3.54	—		—		—		—		0.444	2.36	—		—	
\$100,000 to \$149,999	—		—		—		—		—		0.307	1.83	0.249	1.97	—	
\$150,000 to \$199,999	—		—		—		—		0.227	2.09	0.307	1.83	0.249	1.97	—	
\$200,000 or more	—		—		—		—		0.227	2.09	—		0.249	1.97	—	
Nuclear family (all others)	—		—		—		0.395	3.51	—		—		—		—	
Household size 4+ (< 4 members)	—		—		—		0.289	2.90	—		—		—		—	
Child present (not present)	0.250	3.51	—		—		—		—		—		0.272	2.05	—	
Child present × Woman (*)	—		—		—		—		-0.205	-1.76	—		—		—	
Single-worker household (all others)	—		—		—		—		—		0.303	2.99	—		—	
Homeowner (rent other)	0.099	2.13	0.099	2.13	—		—		0.333	2.26	—		0.368	2.65	—	
Vehicle deficient (vehicle sufficient)	0.119	2.34	0.119	2.34	0.119	2.34	—		—		—		—		—	
Built-Environment Attributes (^)																
High pop. density (<30 person/acre)	—		—		—		0.351	2.51	—		—		—		—	
High emp. density (<11 jobs/acre)	—		—		—		-0.608	-3.56	—		0.405	2.53	—		—	
Medium emp. density (<1 ≥11 jobs/acre)	—		—		—		-0.378	-3.595	—		—		—		—	
High walkability (<13)	—		—		—		—		—		—		—		0.206	2.05
Low transit access to emp. (≥10%)	—		—		—		—		—		0.395	3.16	—		—	
Work-Related Variables																
Some schedule control (no control)	0.402	5.76	0.430	3.76	0.430	3.76	—		—		—		—		—	
Full schedule control (no control)	0.402	5.76	0.473	3.64	0.473	3.64	—		—		—		—		—	

Explanatory Variable (base category)	Work Arrangement						Commute Frequency Ordinal: 1-4 days		Work-From-Home Motivations							
	Hybrid		Fully Remote HB		Fully Remote TLB				Save Time		Save Money		Work-Life Balance		Work Environment	
	Nominal: Fully In-Person (base)								Ordinal: 1 (No), 2 (Yes)							
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Some location control (no control)	1.101	13.11	0.465	3.30	0.465	3.30	—	—	—	—	—	—	—	—	—	—
Full location control (no control)	0.589	5.74	0.451	3.38	0.451	3.38	-0.296	-1.89	—	—	—	—	—	—	—	—
Commute distance ≥ 5 mi	0.119	1.99	0.119	1.99	0.119	1.99	—	—	—	—	—	—	—	—	—	—
Commute distance ≥ 10 mi	—	—	—	—	—	—	—	—	—	—	0.228	2.23	—	—	—	—
Com. dist. < 5 mi $\times$ high walk index (*)	—	—	—	—	—	—	0.276	1.84	—	—	—	—	—	—	—	—
Com. dist. ≥ 5 mi $\times$ high pop. den. (*)	—	—	—	—	—	—	—	—	0.409	2.60	—	—	0.358	2.034	—	—
Correlations																
Hybrid	1.000	—	0.743	5.04	0.827	9.84	0.220	1.50	0.036	0.26	0.167	1.13	0.087	0.609	-0.339	-2.80
Fully remote HB			1.000	—	0.803	2.36	0.090	0.12	0.070	0.44	0.160	0.90	0.035	0.214	-0.352	-1.98
Fully remote TLB					1.000	—	0.167	0.34	0.153	0.48	0.170	0.48	0.076	0.190	-0.263	-0.88
Commute frequency							1.000	—	0.036	0.55	-0.074	-1.10	-0.065	-1.009	0.020	0.30
Save time									1.000	—	0.369	5.56	0.239	3.353	0.125	1.82
Save money											1.000	—	0.233	3.275	0.009	0.13
Work-life balance													1.000	—	0.007	0.10
Work environment															1.000	—
Scales	1.000	—	0.687	3.76	0.879	3.89	1.000	—	1.000	—	1.000	—	1.000	—	1.000	—
Constants and Thresholds																
Constants	-0.896	-8.07	-1.166	-4.50	-1.203	-3.72	—	—	—	—	—	—	—	—	—	—
Threshold 1 2	—	—	—	—	—	—	-1.023	-4.58	0.554	2.69	1.578	7.12	0.087	0.41	0.351	2.26
Threshold 2 3	—	—	—	—	—	—	-0.148	-0.76	—	—	—	—	—	—	—	—
Threshold 3 4	—	—	—	—	—	—	0.888	5.07	—	—	—	—	—	—	—	—
Data Fit Measures	Independent Model (without correlations)								Joint Model (proposed)							
Log-likelihood at convergence	-4978.76								-4925.90							
Log-likelihood at constants	-5418.99															
Number of non-constant parameters	48								78							
Bayesian information criterion (BIC)	5078.06								5076.56							
Adjusted likelihood ratio index ($\bar{\rho}^2$)	0.072								0.077							
Likelihood ratio test	105.72 > 82.044 = $\chi^2_{(30,0.0001)}$															
Average probability of correct prediction	0.442								0.444							

Notes: Coef. = coefficient; “—” = statistically insignificant or not applicable. (*) Base category corresponds to omitted categories within interaction terms. (^) Built-environment units: population density (people/acre), employment density (jobs/acre), National Walkability Index (1 = least walkable, 20 = most walkable), and transit accessibility to employment (share of block-group employment within 0.5 miles of a transit stop).

5. AVERAGE TREATMENT EFFECTS

The coefficient estimates reported in Table 3 identify the direction and statistical significance of relationships across the model equations. However, coefficients from nominal, and ordinal response models are not directly comparable, and do not convey effect magnitudes in an easily interpretable fashion. To provide a clearer assessment of effect magnitudes, average treatment effects (ATEs) are computed for a selected set of individual, household, employment, and commute characteristics. These effects translate the model estimates into changes in work arrangement probabilities, expected commute frequency, and expected weekly commute VMT.

The ATEs are obtained through model-based counterfactual comparisons. For each variable, all observations are first assigned the base condition, and the joint model is used to predict the full set of outcome probabilities. The same observations are then assigned the treatment condition, with all other characteristics held unchanged. Differences between the two scenarios are averaged across the sample. For example, the age effect for workers 25 to 34 years compares predicted outcomes when all respondents are assigned to that age group against predictions when all respondents are assigned to the 18-to-24-year base group. An ATE of -0.037 for fully in-person work therefore represents a 3.7 percentage-point reduction in the probability of working fully in-person. That is, in a group of 100 workers 25-34 years of age, we can expect about four fewer individuals to be working fully in-person relative to in a group of 100 workers 18-24 years of age.

Expected commute days are obtained by combining predicted probabilities across the commute-frequency categories. Expected weekly commute VMT is then calculated using predicted work arrangements, expected commute frequency, and reported distance to the primary workplace. Because the survey did not collect travel distances to third work locations, travel associated with those locations is not included in commute VMT estimates.

The age effects indicate a gradual movement away from fully in-person work as workers progress beyond the youngest age group. Relative to workers aged 18 to 24 years, those aged 25 to 34 years are 3.7 percentage points less likely to work fully in-person and 3.4 percentage points more likely to adopt a hybrid arrangement. Workers aged 35 to 54 years exhibit an even larger reduction in fully in-person work, together with increases across all three telework arrangements. These shifts correspond to 0.09 and 0.16 fewer expected commute days per week and reductions of 2.4 and 4.1 miles in weekly commute VMT, respectively.

Educational attainment produces a different pattern. A bachelor's degree or higher increases the predicted probabilities of both fully in-person and hybrid work while reducing both fully remote arrangements. The net effect is an increase of 0.27 commute days and 7.1 weekly commute miles. This result reinforces the distinction between telework participation and fully remote work. Highly educated workers may retain access to telework while continuing to travel to the workplace regularly through hybrid arrangements.

Mobility challenges generate some of the largest demographic effects. Workers with mobility challenges are 8.8 percentage points less likely to work fully in-person, with the probability redistributed across hybrid and fully remote arrangements. This shift reduces expected commute frequency by 0.34 days per week and weekly commute VMT by 9.1 miles. Vehicle deficiency produces a similar, although less powerful, pattern. Workers in households with fewer vehicles than drivers are 4.6 percentage points less likely to work fully in-person and generate 4.3 fewer weekly commute miles. These magnitudes illustrate the role of telework in reducing transportation burdens among workers facing mobility or vehicle-access constraints.

The presence of children has a particularly strong effect on hybrid work. Workers with children are 8.6 percentage points more likely to adopt a hybrid arrangement and 4.9 percentage

points less likely to work fully in-person. The reductions in both fully remote categories indicate that parents may prefer hybrid arrangements, which combine the flexibility of remote work with continued workplace attendance. Despite the sizable shift in work arrangement probabilities, the net effects on commute frequency and VMT are negligible. Homeownership produces a more modest movement toward hybrid and HB remote work, reducing expected weekly commute VMT by 1.8 miles.

The largest treatment effects arise from employee control over work schedules and locations. Relative to schedules determined entirely by the employer, some schedule control reduces the probability of fully in-person work by 17.1 percentage points. Full schedule control produces a comparable reduction of 18.1 percentage points. These changes are distributed across hybrid and both fully remote arrangements, resulting in 0.63 to 0.71 fewer commute days and reductions of 16.6 to 18.7 weekly commute miles. Location control produces even larger shifts. Some location control reduces the probability of fully in-person work by 35.7 percentage points and increases hybrid work by 39.0 percentage points. This result suggests that partial location flexibility often materializes as a structured hybrid arrangement. Full location control reduces fully in-person work by 22.4 percentage points, while increasing hybrid and both fully remote arrangements. Although the probability shift is more broadly distributed, full location control produces the largest reduction in weekly commute VMT of 20.8 miles. Some location control yields a similar reduction of 18.9 miles.

Commute distance also has a meaningful, though smaller, effect. Relative to commutes shorter than five miles, a commute of at least five miles reduces the probability of fully in-person work by 4.4 percentage points and increases the probability of each telework arrangement. The resulting reduction amounts to 0.18 commute days and 4.6 weekly commute miles. This pattern confirms that longer workplace travel makes telework more attractive and translates directly into lower expected commute activity.

Overall, the ATEs show that employer-provided flexibility exerts the largest influence on work arrangements and commute travel. Mobility challenges, vehicle deficiency, and longer commute distances also produce meaningful reductions in workplace travel. Demographic and household characteristics matter, but their effects are generally smaller and often operate by redistributing workers among hybrid and fully remote arrangements. The results provide a clear measure of practical significance and demonstrate how changes in work arrangements translate into tangible differences in commute frequency and weekly VMT.

TABLE 4 Average Treatment Effects (ATEs)

Variable	Base	Treatment	Work Arrangement				Commute Behavior	
			Fully In-Person	Hybrid	Fully Remote HB	Fully Remote TLB	Number of Commute Days	Weekly Commute VMT
Individual and Household Characteristics								
Age	18 to 24 years	25 to 34 years	-0.037	0.034	0.017	-0.014	-0.090	-2.4
		35 to 54 years	-0.045	0.025	0.012	0.008	-0.156	-4.1
Education	< Bachelor's degree	≥ Bachelor's	0.036	0.031	-0.033	-0.034	0.265	7.1
Mobility challenges	No	Yes	-0.088	0.050	0.011	0.027	-0.342	-9.1
Child presence	No	Yes	-0.049	0.086	-0.015	-0.022	-0.005	-0.1
Homeownership	Rent or other	Owner	-0.029	0.028	0.014	-0.013	-0.066	-1.8
Vehicle sufficiency	Sufficient	Deficient	-0.046	0.024	0.012	0.010	-0.162	-4.3
Work-related Variables								
Schedule control	Determined by employer	Some control	-0.171	0.079	0.051	0.041	-0.631	-16.6
		Full control	-0.181	0.070	0.061	0.050	-0.711	-18.7
Location control	Determined by employer	Some control	-0.357	0.390	-0.002	-0.031	-0.720	-18.9
		Full control	-0.224	0.150	0.048	0.026	-0.784	-20.8
Commute distance	< 5 miles	≥ 5 miles	-0.044	0.024	0.011	0.009	-0.175	-4.6

6. DISCUSSION AND CONCLUSIONS

This study examined work arrangements as a bundle of related behavioral outcomes involving work modality, work location, commute frequency, and motivations for working from home. Using revealed preference data from the second wave of the Transportation Heartbeat of America Survey, a joint multivariate model was estimated for four work arrangements: fully in-person, hybrid, fully remote home-based (HB), and fully remote third location-based (TLB). The framework also modeled commute frequency among hybrid workers and four motivations for working from home: saving time, saving money, facilitating work-life balance, and improving the work environment. The model accounted for individual socio-demographics, household characteristics, built-environment attributes, employee control over work schedules and locations, and commute distance. Average treatment effects were subsequently computed to translate model estimates into changes in work arrangement probabilities, commute frequency, and expected weekly commute VMT.

The findings reinforce the view that the future of work will not be defined by a simple transition from conventional workplaces to HB work. Hybrid arrangements appear likely to remain a central feature of working life, with individuals distributing paid activity across employer workplaces, homes, and third locations. This distinction matters because hybrid work changes commute frequency without eliminating commute travel. Many hybrid workers in the sample continue to commute three or four days per week. The transportation consequences of hybrid work will therefore emerge through changes in weekday travel patterns, peak-period demand, and the concentration of workplace attendance on particular days. Transportation planners should anticipate a reorganization of commute travel rather than its disappearance.

These evolving patterns present a fundamental challenge for travel demand modeling and forecasting. Models cannot produce credible forecasts if they continue to assume that workers travel to a fixed workplace on a regular basis. The representation of telework must extend beyond a single binary indicator or aggregate adjustment factor. Forecasting systems need to account for

heterogeneity in the propensity to telework, how frequently workplace attendance occurs, where remote work is performed, and which personal or institutional conditions shape these choices. Failure to represent these dimensions may lead to inaccurate forecasts of traffic volumes, transit ridership, VMT, emissions, and time-of-day travel patterns.

The results also demonstrate the importance of treating work arrangements as an integrated behavioral choice bundle. Work modality, work location, commute frequency, and work-from-home motivations are closely connected. A worker who chooses hybrid work to manage caregiving responsibilities represents a different behavioral case from one who teleworks to avoid a lengthy and expensive commute. Similarly, a fully remote worker who remains home differs from one who regularly travels to a café, library, or coworking facility. The significant correlations across work arrangements and work-from-home motivations confirm that shared unobserved factors influence multiple outcomes. Joint modeling captures these relationships and offers a more behaviorally complete foundation than a sequence of separate models.

Employer policy emerges as one of the most powerful determinants of work arrangements and commute travel. Relative to workers whose schedules are determined by their employers, those with some control over their work schedule are 17.1 percentage points less likely to work fully in-person and generate 16.6 fewer miles of weekly commute VMT. Full schedule control reduces expected weekly commute VMT by 18.7 miles. Location control produces even larger shifts. Some location control increases the probability of hybrid work by 39.0 percentage points and reduces weekly commute VMT by 18.9 miles. Full location control yields the largest VMT reduction as shown in the treatment-effect analysis, at 20.8 miles per week. These findings suggest that employer partnerships should form a central part of transportation demand management strategies. Flexible work policies may produce larger travel reductions than broad efforts that encourage telework without addressing institutional constraints.

The transportation benefits of telework are not distributed uniformly. They are especially pronounced among workers who face substantial commute or mobility burdens. Workers with mobility challenges generate an estimated 9.1 fewer weekly commute miles, while those in vehicle-deficient households generate 4.3 fewer miles. Commutes of at least five miles are associated with a reduction of 4.6 weekly commute miles. These findings suggest that targeted telework programs may be more effective than uniform policies. Transportation agencies and employers could focus on workers with long commutes, limited vehicle access, mobility challenges, or especially burdensome travel conditions.

Telework should also be viewed as an accessibility tool rather than merely an employment benefit. Individuals with mobility challenges are more likely to adopt all three telework arrangements and tend to commute less frequently when working in a hybrid arrangement. Remote work may reduce barriers to employment participation for individuals face travel difficulties (Ameri et al. 2023; Lake and Maidment 2023). However, access to telework remains unequal. Occupation, employer policy, housing conditions, technology, and the availability of suitable workspace all shape whether remote work is feasible. Homeowners in this study were more likely to adopt hybrid and HB remote arrangements, suggesting that housing circumstances may enable or constrain telework participation.

Household and demographic patterns provide further evidence that telework serves different purposes across population groups. Families with children are substantially more likely to adopt hybrid work, but the effect on weekly commute VMT is nearly zero. For these households, hybrid work appears to provide flexibility rather than substitute extensively for workplace attendance. Higher-income workers are more likely to value time savings and work-life balance,

while middle-income workers place greater emphasis on commute costs. Highly educated workers are more likely to adopt hybrid rather than fully remote arrangements and generate an additional 7.1 weekly commute miles relative to workers without a bachelor's degree. Access to telework therefore does not automatically translate into lower VMT.

The results indicate that TLB telework deserves greater attention in future research and planning practice. Libraries, cafés, coworking facilities, and other remote workspaces may function as decentralized employment nodes. They may shorten traditional commutes while generating local work trips and redistributing activity away from major employment centers (Caros et al. 2023; Li et al. 2024; Xia et al. 2026).

Overall, the findings show that telework is neither a uniform behavior nor a universal transportation solution. Its effects depend on employer flexibility, commute burden, household circumstances, mobility resources, work location, and underlying motivations. Travel demand models must represent this heterogeneity to fully account for the changing nature of work and produce reliable forecasts of future travel demand.

AI STATEMENT

Artificial intelligence tools – ChatGPT and Claude – were used to support the preparation of this manuscript, assisting with formatting content and refining language. All AI-assisted output was critically reviewed, revised, and validated by the authors. The study design, analysis, interpretation of results, and conclusions reflect the authors' academic and professional judgment. AI tools improved efficiency and communication but did not substitute for engineering judgment, technical review, or responsibility for the final content. The authors are solely responsible for all content, including any errors or omissions.

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AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: A. Beliveau, D. Robbennolt, M.G. Rodriguez Ocana, I. Batur, R.M. Pendyala, C.R. Bhat; data collection: A. Beliveau, D. Robbennolt, M.G. Rodriguez Ocana, I. Batur, R.M. Pendyala, C.R. Bhat; analysis and interpretation of results: A. Beliveau, D. Robbennolt, M.G. Rodriguez Ocana, I. Batur, R.M. Pendyala, C.R. Bhat; draft manuscript preparation: A. Beliveau, D. Robbennolt, M.G. Rodriguez Ocana, I. Batur, R.M. Pendyala, C.R. Bhat. All authors reviewed the results and approved the final version of the manuscript.

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