

Work Schedule Flexibility and Work Time Choices

Abstract

This literature review explores the concepts of Work Schedule Flexibility, primarily encompassing telecommuting and staggered work hours, examining their definitions, benefits, challenges, and impacts on various aspects of work, life, and commuting. The objective of this review is to provide a comprehensive understanding of the current research and trends in telecommuting and staggered work hours and to identify strategies for enhancing their effectiveness and addressing associated challenges. Telecommuting refers to the practice of working remotely, often from home, using information technology to communicate with the workplace. Staggered work hours, on the other hand, involve flexible start and end times for employees, providing them with greater control over their work schedules. The objectives of this literature review are then outlined, which include analyzing the benefits, challenges, and impacts of these flexible work arrangements. The scope of the review is also defined, focusing on the relationship between telecommuting and staggered work hours with commuting patterns, and the related mathematical modeling and analysis. Ultimately, this paper seeks to guide the increasingly complex and uncertain urban transportation issues caused by changes in work habits, such as telecommuting and flexible working systems.

Keywords: Telecommuting; Staggered work hours; Flexible work arrangements; Urban commuting.

Introduction

Transportation issues are a ubiquitous problem faced by modern cities, often confounding policymakers. In recent years, due to technological advancements and shifts in perspectives, especially changes in work habits, urban transportation problems have become further complicated. Particularly, the widespread implementation of telecommuting and staggered work hours have introduced new uncertainties to the evolution of urban transportation. Since the COVID-19 pandemic (Sinclair et al., 2020), this trend has become even more pronounced. Hence, it becomes imperative to study the impact of Work Schedule Flexibility on the short-run behavioral impacts and long-run implications of these challenges on urban mobility and city structure. The concept of Work Schedule Flexibility or Flexible Work Arrangements predominantly contemplates two scenarios: flexibility in the location of work and flexibility in working hours. The former is primarily achieved through telecommuting, while the latter is realized predominantly through staggered work hours. The core focus of this study revolves around these two elements. This article initially presents the theoretical background of telecommuting and staggered work hours, as well as the array of benefits they offer. In the second section, the paper concentrates on the impact of telecommuting and staggered work hours on traffic issues.

Theoretical background

The concept of telecommuting (TLC) originated in the 1970s (Nilles, 1974) when the oil crisis forced organizations to develop strategies for reducing commuting, and the idea has evolved. The term "telecommuting" was introduced to describe the practice of partially or completely replacing the traditional twice-daily work commute with telecommunications, which may or may not involve the use of computers. Telecommuting is a specific category within the broader concept of "teleworking," a term that similarly encompasses all replacements of work-related travel with telecommunications and associated information technologies. This can range from using telephone calls or electronic mail in place of face-to-face meetings to adopting full-motion videoconferencing as an alternative to traveling for executive purposes (Nilles, 1988). Telecommuting, the practice of working remotely, has gained significant attention in recent years, especially following the COVID-19 pandemic (Sinclair et al., 2020). It offers employees the flexibility to work from home and choose their work hours. This shift in work arrangements has led to various studies exploring the effects of telecommuting on different aspects of work life. Staggered work hours (SWH) are another flexible work arrangement that aims to reduce congestion and improve work-life balance by allowing employees to start and end their workdays at different times. Henderson (1981) pioneered the investigation of the relationship between corporate profits and employee attendance under a staggered work hours system. He derived the equilibrium conditions in the context of staggered work hours. Research has shown that SWH, along with other flexible scheduling options, can increase job satisfaction and productivity by providing employees with a sense of autonomy and responsibility over their work schedules (McGuire and Liro, 1986). Overall, both TLC (Telecommuting) and SWH (Scheduling Work Hours) fall under the category of Flexible Work Arrangements (FWA). Shifrin and Michel (2022) conducted a meta-analytic review to understand the relationship between FWA and health outcomes, highlighting the positive impact of FWA on physical health, absenteeism, and overall well-being. Their findings underscore the potential benefits of offering flexible work options to employees. Generally, Flexible Work Arrangements can be categorized according to the location (flexplace) and timing (flextime) of work execution (Kossek and Michel, 2011; Rau and Hyland, 2002). Regarding the aforementioned factors, our primary focus lies on the impact of location flexibility on employees' workplace choices caused by TLC, as well as the effect of work time flexibility brought about by SWH.

The adoption of Flexible Work Arrangements (FWA) can yield a multitude of benefits. Halpern's (2005) research reveals that FWA is linked with favorable financial outcomes for organizations, manifested through reduced absenteeism, decreased instances of taking time off, and a decline in the frequency of employees arriving late or departing early from work. FWA can affect various resources such as time, energy, and money, making it a useful strategy for employees to control their resources and reduce further stress and strain (Grawitch et al., 2010). Voydanoff (2004)

characterizes FWA as a resource that extends beyond the workplace, impacting the balance between professional and personal life. The presence of FWA supports the management of duties related to both work and life, primarily by decreasing demands that consume time and energy. This, in turn, provides individuals with additional time, energy, and concentration to meet responsibilities in various areas of their lives. From an alternative perspective, FWA can enhance health outcomes by affording individuals additional time to partake in health-promoting activities, such as physical exercise or meal preparation (Grzywacz et al., 2007; Moen et al., 2013). The corpus of research about the impact of FWA on the health of workers or employees is extensive. A myriad of empirical investigations has delineated that FWA exerts influence on a multitude of factors, encompassing sleep patterns, mental health, physical symptoms, absenteeism, and exercise regimens (Pagnan et al., 2017; Treiber and Davis, 2012). Research has indicated that TLC can impact the distribution of workers, potentially leading them to move away from the CBD. This movement can result in the conservation of office space and the selection of work locations that are more distant from the CBD, contributing to a city with a wider spread (Janelle, 1986; Nilles, 1991; Rhee, 2009).

Work schedule flexibility and urban mobility

Salomon (1986) pioneered the study of the influence of telecommuting from the perspective of travel. This paper suggests that travel patterns will be modified rather than reduced due to the relationship between transportation and telecommunications. It also emphasizes the importance of considering both the cost and benefits of information in analyzing mode choice. Studies have indicated that TLC can significantly lower the need for daily travel, which in turn helps to lessen traffic jams, conserves energy, and enhances the quality of the air (Delventhal et al., 2022; Safirova, 2002). SWH contributes to the temporal dispersion of traffic demand by encouraging off-peak travel. This dispersion supports a more balanced distribution of traffic throughout the day, which consequently leads to a noticeable decrease in congestion during traditionally busy periods. The implementation of SWH can thus be an effective measure in alleviating peak-hour traffic pressure and promoting smoother flow on road networks (Ben-Akiva et al., 1984; Fosgerau and Small, 2017; Mun and Yonekawa, 2006; Takayama, 2015).

Since Nilles (1988) pioneeringly introduced the concept of TLC and explored the definition, forms, influencing factors, and possible future development trends of telecommuting, emphasizing its role as an alternative to commuting, numerous scholars have investigated the impacts of TLC on residential location patterns, transportation modes, and other social phenomena. Higano and Orishimo (1990) investigate the effects of geographically separated workplaces on urban residential location selection, consumption, and time allocation behaviors by employing a fresh urban economics model factoring in constraints related to time and money, enhancements in labor efficiency, and equilibrium in the land market. Significant findings indicate that commuting time could enhance utility, however, office work reduces it; also, as households shift away from the central business district, office work and consumption of composite goods decrease, while homework and land input increase. Lund and Mokhtarian (1994) used a basic partial equilibrium model to estimate the long-term impact of telecommuting on work commute distance and residential location in a metropolitan center, suggesting that while telecommuting reduces work trips, it may lead to households moving farther from the workplace, thereby offsetting the reduction in commute distance, particularly in metropolitan areas with flatter spatial variation in land prices. Safirova (2002) explores the impact of telecommuting on various aspects of a monocentric city through a general equilibrium model, suggesting the effects depend on the balance between input diversity and agglomeration economies. It concludes that while telecommuting can improve welfare and expand the city under certain conditions, it can also cause welfare losses and city contraction under different circumstances, with congestion tolls potentially not improving social welfare due to their impact on agglomeration and welfare levels. The research also highlights the need to consider the agglomeration effects of telecommuting in future research. The aforementioned studies have all demonstrated model-based analysis for the long-term impacts of telecommuting on residential location patterns. Delventhal et al. (2022) investigate the substantial long-term effects of telecommuting on city structure, wages, real estate prices, and commuting patterns in Los Angeles, suggesting that it may cause job and residential redistribution, impact urban dynamics, alter real estate demand, and potentially offer welfare benefits. Primarily empirical studies have been used to gauge the influence of TLC on dynamic

traffic congestion. These studies (Asgari and Jin, 2018; Lachapelle et al., 2018; Ory and Mokhtarian, 2006; Shabanpour et al., 2018) have dedicated their efforts to understanding how this element influences the ebb and flow of traffic, providing valuable insights into its role in transportation systems management. Furthermore, they have paved the way for identifying potential strategies to alleviate traffic congestion and improve overall transport efficiency. Many **empirical studies** have delved into the repercussions of applying TLC during the COVID-19 pandemic. They revealed that the introduction of TLC has been instrumental in mitigating the impact of the pandemic across various domains (Loo and Huang, 2022; Tahlyan et al., 2022; Wöhner, 2022; Zhu and Guo, 2022). Gubins and Verhoef (2011) analyze the economic impacts of part-day teleworking on congestion using a dynamic bottleneck model, showing that the value of teleworking technology drops as more people telework due to congestion externalities, but under optimal road pricing, teleworking becomes a standard good, lessens social costs by half, and eliminates the need for further policy interventions. The TLC will not only affect urban transportation but also the housing market. Brueckner et al. (2023) explore the effects of working from home on the housing market, showing that it lowers housing prices and rents in high-productivity areas due to workers relocating to cheaper areas without sacrificing job quality, and it also reduces the price premium for properties with good job access.

Contrary to TLC's emphasis on the flexibility of the workplace, SWH primarily focuses on the flexibility of working hours. Henderson (1981) explores commuter equilibrium conditions, particularly under scenarios with and without production effects, studying the impact of varying work schedules on productivity, the correlation between firm profits and staggered work hours, and the challenges of upholding production equilibria. It underscores the equilibrium conditions for work staggering scenarios with production effects, highlighting the interaction between firm decisions on start times and worker preferences for a stable equilibrium. Ben-Akiva et al. (1984) focus on analyzing alternative methods to relieve peak-period traffic congestion using a dynamic model of queues and delays and investigate the effects of changes in capacity, demand, work start time, and traffic control. Although increasing capacity reduces congestion duration, it doesn't significantly improve maximum delays. Mun and Yonekawa (2006) explore the impact of firms adopting flextime in a city to address traffic congestion and its effect on urban productivity, concluding that while some firms may adopt flextime, a situation where all firms do is unlikely without policy intervention, and suggests peak-load tolls as an alternative policy to eliminate congestion. Takayama (2015) delves into developing a model for work start time choice concerning bottleneck congestion, examining equilibria and work start time distributions, the influence of tolls and capacity expansion on traffic, and the stability of equilibria under various scenarios, concluding that capacity expansion can worsen traffic while boosting total utility, and its analytical approach can be broadly applied, opening the door for more research on bottleneck congestion. Fosgerau and Small (2017) analyze the Nash equilibrium existence and properties in departure time choices within a transportation system, exploring utility functions, agglomeration effects, and scheduling preferences, and study the impact of tolls on equilibrium and the influence of externalities and productivity on scheduling choices, concluding that relaxing certain simplifying assumptions could provide a more nuanced comprehension of travel behavior and equilibrium outcomes. Hendrickson and Kocur (1981) analyze schedule delay and departure time decisions within a deterministic model. The study investigates the impact of schedule delays on departure time choices. The work of Hendrickson and Kocur (1981) represents an alternative approach in SWH research, namely, the properties of bottleneck congestion with SWH can also be characterized by the investigation of bottleneck models that take into account the heterogeneity of preferred arrival times. Daganzo (1985) conducts a focused analysis of the uniqueness of a time-dependent equilibrium distribution of arrivals at a single bottleneck during peak morning hours, establishing one definitive equilibrium order of arrivals under certain conditions, and explores the differentiability properties of this equilibrium. Furthermore, the study delves into the smoothness of the arrival curve, indicating that the function relating the arrival times to the departure order is differentiable at certain points. While the studies have explored the impact of TLC and SWH on commuting patterns in detail, research on how Work Schedule Flexibility influences urban evolution and residential distribution, and how this impact dynamically affects urban transportation modes, is still relatively scarce.

The reciprocal influences and contradictions between housing and commuting issues warrant our attention. Islam and Saphores (2022) disentangles the effect of housing expenses on commuting by formulating a comprehensive model that simultaneously elucidates commuting time and distance. Mokhtarian and Cao (2008) utilized a quasi-longitudinal approach to investigate the impact of residential self-selection on travel behavior and explored seven different methods to address this issue. The research found that changes in built environment elements have separate influences on changes in travel behaviors, even though self-selection is important. Utilizing empirical analysis methodologies, numerous studies have evaluated how urban residential location choices impact travel and housing demand along with corresponding expenses (Andersson et al., 2018; Plaut, 2006; Rehman and Jamil, 2021). Economic theory posits every household as a rational entity, constrained by rational conditions, and makes its housing choices optimally. Furthermore, the interrelationship between household residential location decisions based on transportation mode choices, and housing and travel costs occur on multiple dimensions. Residential choices can be perceived as a trade-off between housing and transportation expenses (Scheiner, 2018). Duranton and Puga (2015) elucidated the heterogeneity of household income groups, delineating cities into affluent and impoverished districts, and analyzed how the trade-off between commuting costs and housing distance varies among the wealthy and the impoverished.

Conclusion

The influence of telecommuting (TLC) and staggered work hours (SWH) on urban transportation and housing markets has been extensively researched. TLC, involving remote work, can significantly reduce daily commuting demands, alleviate traffic congestion, conserve energy, and improve air quality. SWH aims to distribute traffic demand by encouraging travel during non-peak hours, thereby mitigating congestion during traditional rush hours. These strategies contribute to reducing peak-hour traffic stress and promoting smoother traffic flow in urban areas. Furthermore, TLC and SWH have dynamic effects on urban development, residential distribution, and transportation modes. The interplay and conflicts between housing and commuting issues are crucial considerations. The impact of housing costs on commuting as well as the influence of residential choices on travel patterns and housing needs are significant topics to address. Consequently, the impacts of telecommuting and staggered work hours on urban transportation and housing markets are complex and multifaceted, necessitating a comprehensive examination of various factors to achieve sustainable urban development while enhancing residents' quality of life.

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