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Authors' version (2023)

# Is work hours' flexibility really a solution to morning peak period congestion? Comparative analysis between Paris and San Francisco

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## **Abstract**

According to transport economics theory, the effect of flexible hours should be that workers spread out their starting times with the result that rush-hour travel conditions improve. But is this really what happens regardless of territorial contexts and transport systems? Paris and San Francisco region are facing serious congestion and are also the French and American cities with their countries' largest share of workers with flexible hours. In those contexts, do employees with the possibility of flexible working hours in fact avoid peak-time travel? Drawing on an international literature review and data from the national household travel surveys for the Paris region and the Metropolitan Area of San Francisco, we reveal new findings that may even appear paradoxical. Far from leading to staggered workplace arrival times, in Paris, flexible hours are associated with a significantly higher probability of arrival at work during the morning peak period. In San Francisco, flexibility has no significant impact on peak period. In an era of flexible schedules, our research tempers the idea of any systematic impact of flexibilisation oriented toward desynchronisation. It reveals that the impact of flexible hours depends on territorial dynamics, where the “social distribution of flexibility” plays an important role.

## **Keywords**

Congestion; Peak hour; Work schedules; Synchronisation; Flexibility; Transport demand management

## 1. Introduction

The standard and symbolic representation of peak period coincides with familiar features of the history of the wage economy and the development of cities during the Industrial Revolution. It was the factory siren, clocking-in on arrival, employer surveillance and more globally, the standardisation of work, that dictated the synchronicity of working hours (Godard, 2007). Necessary as it was to the smooth running of production systems (Lefebvre, 1984), the collective and uniform imposition of standardised working hours generated peak hour congestion (Thompson, 1967). Today, with the rise of the service economy and the “dematerialisation” of production activities in the big urban centres (Castells, 2000), an ever-growing proportion of the working population is able to choose their working hours (OECD, 2021; Golden and Jaeseung, 2017; Thoemmes, 2013). The term for this practice is flexible hours.

Self-employed person, such as liberal profession, craftspeople, etc. have always enjoyed the ability of choosing their working hours. What is relatively new, is that their proportion has raised in western countries and taken place of usual wage-earning under the influence of labour market liberalisation (Thoemmes, 2013) also called “uberisation” (Nurvala, 2015). But the movement comes from further. Fifty years ago, the individualisation of working hours already entered the industry sector through the introduction of flexitime. As a reminder, flexitime is a contractual timetable offering a certain leeway to the employee to choose their daily working hours. Employees can for instance arrive when they want between 7 a.m. and 10 a.m., take their lunch break at any time between 12 noon and 2 p.m., and leave work between 4 p.m. and 7 p.m.

It is interesting to note that when it was introduced in an aeronautics firm in Switzerland and Germany, flexitime was initially seen as a means of relieving transport and commuting time problems (Pierce and Newstrom, 1980). Indeed, as argued by the transport economics literature (Small, 1982; Vickrey, 1969), it is recognised that individuals try to avoid the delays and discomfort associated with peak hour travel by changing their working hours, provided that their contracts allow it. Under these circumstances, the increase in the proportion of employees able to choose their work schedules should consequently lead to a reduction in peak period commuting and help to improve travel conditions.

Be it for international bodies like the OECD (2016, 2010), or for local or transport authorities in France (Région Île-de-France, 2020), flexible working hours have come to be seen as a tool of Transport Demand Management (TDM) (Nakamura and Hayashi, 2013), with no reservations regarding their effectiveness. When it comes to evaluation, only very rarely are these recommendations challenged and their real impact assessed (Coulombel et al., 2023; Shen et al., 2013).

Yet, despite a recent increase in flexible working as a result of the Covid-19 pandemic (Chung, 2022), a study of Paris traffic data has shown, that the hourly distribution graph for footfall on public transport systems has virtually returned to the same normal pre-pandemic level as in 2020 (Nguyen-Luong, 2021). On a broader time and space scale, Belgian (Glorieux et al., 2008), Dutch (Breedveld, 1998), English (Burkinshaw, 2018) and French (Munch, 2017; Bouleau and

Leroi, 2016) studies also show that the profile of work arrival times has hardly changed since the 1970s and the introduction of flexible working hours. It would therefore be wise to qualify efforts to increase flexible working given the inertia in the distribution of working hours observed in recent decades. We also think that these effects deserve to be measured and qualified to reflect different territorial conditions.

Recent results in Europe (Wöhner, 2022; Meissonnier and Richer, 2021; Gendreau, 2020; Munch, 2017b) reveal that flexible working hours are not always associated with a greater avoidance of peak commuting times. In other words, flexibilisation probably does not have the expected impact on morning congestion in every case and paradoxically can even sometimes have a counterproductive impact on peak hour congestion (Munch and Proulhac, 2019). Still, those results remain at the margins, because they are not compiled and clearly discussed in the scientific community of transport and social sciences researchers.

Moreover, there is a lack of linkage between transport and social sciences on the issue of peak-times congestion, due to disciplinary barriers. That is why we propose here to draw on social geography of peak period. As social scientists, we assume to move a research object that is generally classified in the field of the engineering and “mechanical” thermodynamics (Banister, 2008), to the field of social sciences and “organic” people dynamics (Sheller and Urry, 2006). This exploratory approach has clear interdisciplinary, heuristics and societal aims, as we will emphasize during the development. From this ground there is firstly an initial interest in establishing a recent literature review on the subject.

Secondly, if the territorial analysis of the impact of flexible working hours reveals a certain diversity, this invites comparative studies between two territories. This should make it possible to open up gaps in order to understand why, in one place or another, the effects of flexible working hours are measured in a way that could potentially be opposed. These insights might give clues to warn policymakers and big employers who would settle flexible hours to smooth traffic jam in the morning peak-period. This is our main contribution, since to our knowledge, we are the first to compare distinctively, within the same study, the effects of flexible working hours on rush hour in two territories: Paris (Fr) and San Francisco (USA). Using data from national travel surveys (US National Household Travel Survey (NHTS) and French Enquête Nationale Transports et Déplacements (ENTD)), we seek to answer the following question for each of the territories studied:

What is the impact of flexible working hours on the probability of arriving at work during peak-period?

Thirdly, in a quest for greater sophistication in understanding the impact of flexible working hours, we need to better isolate the territorial characteristics that influence the impact of flexible hours. Specifically, it requires to consider different types of flexible working hours at work. Two alternative social perspectives on flexible working are identified and linked to their relative presence depending on the territory. They will allow to specify the potential impact of Transport Demand Management (TDM) based on hours' flexibilisation (Région Île-de-France, 2020; OECD, 2016; OECD, 2010).

Lastly, note that in methodological terms, we will focus on the morning peak period because commuter synchronisation is usually more intense in the morning than in the evening (Thorhauge, 2015; Fosgerau and Karlström, 2010) and the inconveniences (discomfort, delay...) associated with it are therefore intrinsically more intense.

## **2. Literature review: What is the impact of flexible working hours on commuting times?**

The question of flexible working hours and their impact on the distribution of commuting times is a subject that has so far been little explored. In the last decade, fewer than a dozen studies have concentrated on this subject or have at least tackled it in a more general exploration of the “flexibilisation of work” (Thorhauge et al., 2016). In any case, it is clear that the findings do not line up from one region to another. It is therefore impossible to state that flexible working hours lead to a staggering of morning commuting journeys. This raises scientific questions on why flexibility is sometimes associated with a greater probability to travel during or outside the peak period, depending on the field study.

### **2.1. Greater probability of flexible arrivals after the peak: American cities, low PT ridership and contractual relationships at work?**

In the U.S., in the last decade, three researches have precisely quantified the impact of flexible working hours on the probability of starting a commute before, during or after the morning peak period. For each of these investigations, the interest took place in a specific field study.

Based on the 2009 US National Household Travel Survey (NHTS) in the Miami region, Yang et al. (2016) noted that “flexible workers” had a propensity to travel after the morning peak period. A recent study based on the 2018 Austin Household Travel Survey also revealed that workers with the option of flexible hours choose to leave later, predominantly with the effect of deferring the morning peak period (Rahman et al., 2022). The predicted probabilities show that flexible hours lead to a fall in the share of peak hour departures from 72.5% to 64.3%. The difference is more evident in post-peak hours: the option of flexible working hours increases the probability of post-peak departure from 8% to 18.4%. On a more specific segment of workers who are able to choose their work hours, Shin studied the travel behaviours of self-employed commuters in Puget Sound, USA (Shin, 2019). First, descriptive statistics reveal that, on average, the self-employed tend to start their commute 1 h later than employees. Second, his binary logit model shows that there is a significant ( $p < 0.01$ ) negative association between self-employment status and the probability of commuting during peak hours.

These regions have in common a low share of public transport ridership. No real efficient alternative of modal transfer exists when facing strong road congestion delay on peak times. Here, shifting the departure time becomes consequently the only solution to avoid time lost in traffic jams. Miami, Austin and the Puget Sound area can also be gathered in regards of their cultural particularities. Precisely, as American cities and as emphasized by Schulz (2015)

and earlier by Lefebvre and Régulier (2020), it globally matches with cultural organizations at work that tolerate real variability of working hours. This has to be put in comparison to other cultural areas where ritual control and reprobation of late arrival at work remains still very present (Munch, 2020), even though contractual relations to employer stipulate flexibility.

## **2.2. Greater probability of flexible arrivals during the peak: French and Swiss regions, high PT ridership, and ritual relationships at work?**

In Europe, in the last two decades we can count 4 or 5 studies questioning the link between work hours' flexibility and arrival times at work – mainly in France. One such is the study by Lesnard (2006) based on the 1999 Time-Use Survey. It indicates that compared with employees with fixed working hours, employees who enjoy flexible hours markedly prefer standard working hours. Through his definition of standard working hours, he showed that workers who can choose their schedules maintain typical working hours such as 9 a.m. to 5 p.m. and therefore travel mostly during peak periods. However, this study is not territorialised, and no real link to congestion periods can be made.

A recent study conducted in “la Plaine Saint-Denis” (a business district in northern Paris, France) tends to confirm this national result and highlight public transport congestion issues (Munch, 2017b) since most employed people in the Paris region travel by public transport. Here the questionnaire revealed that workers employed in companies with flexible working schedules were much more likely to arrive at work during the peak period compared with those working in companies with fixed schedules. This result seems to be confirmed mainly for car drivers with flexible hours in Rennes (Gendreau, 2020) and Lille (Meissonnier and Richer, 2021), France. More recently, a Swiss study (Wöhner, 2022) based on data from the 2015 micro-census shows that globally, across the whole country, workers with flexible hours are more likely (odds ratio = 1,3) to travel during the morning peak period (journey starting or ending between 7.15 a.m. and 8.15 a.m.).

In comparison to regions where there is a higher probability of using flexibility to avoid peak period, here we find globally a more developed collective transport network in each region. For instance, beside Japan, Swiss is known for having one of the most efficient public transport network of the world. Rennes, in France, is known for being one of the smallest towns of the world having underground lines (Briand et al., 2017). The majority of Parisian region's habitants use public transport. So, here one might suppose that the efficiency of PT during peak-period allow commuters to travel more easily during peak period.

Then, in cities belonging to Latin or Mediterranean cultural area (Lefebvre and Régulier, 2020), the “social norm of disciplined workers” (Munch, 2020) probably also channel the possibility of arriving later than their colleagues. In comparison to the Anglo-Saxon culture of work, here rituals and conventions on work timing probably have a stronger place than pure contractual relationships on flexible hours. Workers often fear the stigma of “being late”, even if contractually they are supposed to be free to arrive whenever they want at work (Bouffartigue, 2012). On a more macro-social scale, other authors questioned the stronger synchronicity of social rhythm in Europe compared to the U.S. Some consider that the

importance of synchronisation around the evening meal with the family in France (Saint-Pol, 2006) can be a factor in explaining the greater simultaneity of work hours - particularly when compared to the American practices commonly considered as “gastro-anomic” (Fischler, 1980).

### **2.3. Cumulative analysis of the behaviour of workers with flexible hours in two regions**

An original study from Syvilia Y. He (2013) focuses on the travel patterns of commuters of two different cities: San Francisco and Los Angeles. The global findings confirmed conclusions presented in other American cities. Flexible workers are indeed more likely than the rest of the population to start their journey after the peak travel period. Compared with workers with fixed hours and “all other things being equal”, workers with flexible hours are 3.3% less likely to start their journeys before peak period, 4.1% less likely to start during peak period (6.00–9.30 a.m.), and 7.4% more likely to start after peak period. One should note that this very interesting initial comparison of results in two cities is not the central point of the paper, which studies the aggregate effect of flexible hours in the two regions. However, through the analysis of the variable relating to the interaction between the region studied and being a worker with flexible hours, we learn that people working flexible hours in Los Angeles are 13.9% more likely to avoid peak period compared with their counterparts in San Francisco. The author explains this result by the fact that congestion levels are very much higher in Los Angeles than in San Francisco where PT ridership is higher. At the end, through the aggregate model, it is only stipulated that Los Angeles workers with flexible hours have a greater probability of peak travel avoidance compared San Francisco's. But for the author, the peak period avoidance is obviously also present for flexible San Francisco workers.

### **2.4. Contributions to the literature**

In sum, the findings from these different empirical studies make it hard to argue that more flexible working hours result in systematic staggered travel times and a spread of traffic flows around peak periods. In consequence, the aim of the paper is to provide to main types of contributions.

First, due to supposed territorial diversity of the impact of flexible hours, we propose to develop a comparative methodology for two cities, rather than cumulate data related to various territories. From a methodological point of view, we consider that cumulative analyses can lead to ‘average’ interpretations that do not take into account the disparity of the territorial dynamics. It therefore prevents us from understanding how the particularities of a territory can influence the choice of arrival time at work. Yet these elements of territorial context are very important for deciphering the impact of flexible hours.

Second, this comparative methodology opens an avenue to create new knowledge on the characteristics of the territory, the transport network, the population and their cultural habits that favor flexible hours oriented toward more travel in peak period or, on the contrary, toward greater probability to travel outside the peak.



The choice of the fields surveyed is based on the literature review, data availability and social interests. For sure, there is an upper interest to pick areas where everyday congestion is an issue concerning millions of people. In consequence, it invites us to choose important metropolitan areas. To help policymakers having a better understanding on the impact of flexible hours, we wish to pick territories where flexible hours are on one side, likely to worsen traffic during peak period and on the other side, likely to ease traffic conditions in the morning critical period.

In Paris, results revealing a paradoxical effect of flexibility toward more synchronicity where only emphasized at a CBD scale (Munch, 2017b). It could be heuristic to verify if those results are validated at the scale of the whole metropolitan area. In San Francisco, results exhibited conjointly with Los Angeles data, showed that flexibility is associated with a stronger probability to avoid peak period. However, it remains unclear what would appear if San Francisco was studied as a unique field survey, without any aggregation with another territory (He, 2013). It surely pledges allegiance for further investigation in this region.

### **3. Framing elements and methodological explanations**

#### **3.1. Transport in San Francisco and Paris Metropolitan Area**

The metropolises of Paris (France) and San Francisco (USA) are two large and dynamic economic regions. In 2021, >12 million inhabitants lived in Paris region (so called Île-de-France in French) and a bit <8 million in San Francisco Bay Area. Since the 1970s, they have been characterised by an increasing urbanisation away from economic centres (Walker and Schafran, 2015; Massot et al., 2008). This can be explained in particular by the housing crisis linked to rising property prices, which contributes to accentuating socio-spatial segregation, and by the efficiency of transport systems (Préteceille and Cardoso, 2020; Lehman-Frisch, 2017). Urban sprawl leads to low residential densities in the suburbs, and to a strong dissociation between places of residence and places of activity.

These urban configurations contribute to an increase in the daily mileage travelled (Metropolitan Transportation Commission (MTC), Association of Bay Area Governments (ABAG), 2018; Courel, 2008). The growth in distances results in very high levels of traffic on multi-lane highways in each direction. San Francisco is congested at peak times, particularly in the Bay Bridge corridor, although the time lost to congestion is less than in other US metropolises such as New York, Los Angeles, Chicago, Washington or Boston (Metropolitan Transportation Commission (MTC), Association of Bay Area Governments (ABAG), 2018). Daily congested road delay per asset increased from 1.9 min in 2010 to 3.6 min in 2017 (Ibid). The situation is similar in the Paris metropolis where the road network of the main expressways in the dense zone is congested throughout the day. Sections of some of these roads are among the busiest in Europe (Coulombel et al., 2023).

Furthermore, both cities are characterised by a dense network of mass transit networks. They are structured by major metropolitan rail networks with the metro, the Réseau Express Régional and the Transilien in Paris, and BART, Caltrain, Amtrak Capitol Corridor in San

Francisco. The French metropolis has one of the longest and densest urban rail networks in the world (Haywood et al., 2018). In San Francisco, the rail network (Appendix 1) is one of the most developed among American metropolises but is without comparison with the density and the usage of the collective transport network in Paris (Appendix 2). For instance, on an average weekday of 2022, the whole BART network (6 routes of rapid rail transit) in San Francisco is used by 146,500 persons.<sup>1</sup> In Paris, the A line of the rapid rail transit (in red in Appendix 2) gathers each day >1,200,000 passengers.<sup>2</sup> It is the busiest line of rail transit in Europe.

In this context, the biggest difference arises concerning the modal share in Paris that is consequently higher in comparison to San Francisco. Almost 45% of home-to-work trips are made by public transport in the Paris metropolis. The modal share of the car is equivalent, while walking and cycling account for <10% of trips (Bayardin and Jabot, 2021). In San Francisco, the modal share of public transport and soft modes to work is surely high for an American metropolis but remains relatively low in comparison to Paris. In San Francisco Bay Area, 23% of commuting trips are done by public transport, 57% by car (Metropolitan Transportation Commission (MTC), Association of Bay Area Governments (ABAG), 2018). In the more residential counties of Contra Costa, San Mateo, Alameda and Marin, the modal share of cars is higher, between 70% and 80%, while the share of public transport varies between 8% and 15% (Ibid).

### **3.2. Characteristics of the global sample: similarity and differences between Paris and San Francisco**

Table 1 shows the characteristics of the sample of working people in the Paris and San Francisco metropolitan regions.

**Table 1 - Presentation of the independent variables and structure of the sample of workers**

Variables	Modalities	Paris (N= 1,971)		San Francisco (N= 2,533)	
		Sample size (N)	Weighted %	Sample size (N)	Weighted %
Flexitime	Yes	590	28.7	1,632	59.3
	No	1,381	71.3	901	40.7
Job category	Sales or service	547	29.0	451	21.4
	Clerical, administrative support	542	27.0	217	9.4
	Manufacturing, construction	181	9.6	151	7.9
	Professional, manag., tech.	701	34.4	1,714	61.3
Working time	Full-time	1,749	89.8	2,043	81.6
	Part-time	212	9.8	489	18.4
	Not applicable <sup>1</sup>	10	0.4	1	0.0
Sex	Male	923	47.1	1,327	55.2
	Female	1,048	52.9	1,204	44.8
	No answer	0	0.0	2	0.0
Age	Under 30	337	22.2	365	20.2
	30 to 39	569	31.8	619	28.8
	40 to 49	561	24.8	507	20.5
	50 to 59	430	18.9	579	20.4
	60 and above	74	2.4	463	10.1
Household income <sup>2</sup>	First quintile (low income)	374	19.6	325	19.4
	Second quintile	375	20.8	352	17.2
	Third quintile	433	21.9	551	22.3
	Fourth quintile	395	19.4	571	19.5
	Fifth quintile (high income)	394	18.3	692	20.1
	No answer	0	0.0	42	1.5
Household structure	1 adult, no child	603	36.9	394	12.1
	2+ adults, no child	424	21.1	1,331	45.1
	1 adult, child	188	9.2	61	3.2
	2+ adults, child	756	32.8	747	39.6
Workplace density	High density	410	25.0	558	22.3
	Medium density	1,304	64.6	210	8.1
	Low density	257	10.4	436	16.7
	No answer	0	0.0	1,329	52.9
Commuting time	Less than 20 minutes	644	33.4	556	23.3
	20 to 39 minutes	630	32.2	709	27.6
	40 to 59 minutes	378	19.1	428	18.1
	60 minutes and more	319	15.3	421	17.3
	No answer	0	0.0	419	13.7
Commuting mode	Walking, bike	194	11.4	153	6.2
	Car	928	41.5	1,418	56.8
	Motorised two-wheelers	112	6.7	17	0.7
	Public transport	737	40.4	529	22.8
	No answer	0	0.0	416	13.5

Source : 2008 ENTD, 2017 NHTS. Calculations by the authors.

Although Paris and San Francisco are the cities in their respective countries that contain the largest proportion of workers with flexible hours, the orders of magnitude is different between the two countries. Since flexible working is less common in France, less than a third of employees in Paris work flexible hours (28.1%), compared with almost two-thirds in San Francisco (59.3%).

<sup>1</sup> "Not applicable" concerns workers who have two or more part-time jobs that ultimately correspond to a full-time job.

<sup>2</sup> Per consumption unit. The quintile classes in San Francisco are set on the basis of those in Paris.

Flexibility in working hours is closely connected with working time (Munch, 2020). Executive level workers (managerial, professional and self-employed) are the population most likely to work flexible hours (Ruppanner and Huffman, 2014). In the light of the previous observations, it is understandable why the proportion of professional, managerial and technical workers is almost twice as high in San Francisco (61.3%) as in Paris (34.4%). Here again, though Paris is the region in France with the largest number of people working in executive or higher cognitive roles, the figures bear no comparison with San Francisco (Schulz, 2015).

Other statistically significant differences are observed regarding the greater share of part-time jobs (18.4%) and smaller share of households with one adult (12.1%) in San Francisco (Table 1). Moreover, some of the differences observed can be attributed to the fact that in the American survey respondents have the option not to answer certain questions (“no answer”), whereas this is not the case in the ENTID. This ultimately affects the impact of the different response options in San Francisco.

### **3.3. National travel surveys in France and in the United States**

To study the impact of flexible working hours in Paris and San Francisco, we use the National Household Travel Survey deployed in each country. It has the advantage to offer an identical and comparative methodology. We work with the National Transport and Travel Survey, which has been conducted by the Ministry of Transport, INSEE (National Institute of Statistics and Economic Studies) and IFSTTAR (French Institute of Science and Technology for Transport), and the National Household Travel Survey conducted approximately every eight years in the United States by the Federal Highway Administration.

In France, this travel survey is the only source of data that are reliable and representative of the population at national and regional scale, and able to provide both information on flexible working hours and on the precise travel practices (time, duration, mode). Unfortunately, in France, in the most recent survey in 2020, the question about flexible working hours was left out. That is why, for the French case, we have been obliged to use not the latest version of the survey, but the one before, dating from 2009. For the American case, we use the most recent available survey, dated 2017.

The advantage of these two data sources is that they employ a fairly similar survey methodology. In both cases, we were interested in the arrival times of working people travelling to their usual workplace on the day before the survey date. In the San Francisco – Oakland – Hayward metropolitan area we studied the working hours of 2533 individuals. In the Paris region, we looked at the answers of 1971 respondents.

### **3.4. Multinomial logistic regression of work arrival time choices**

Conceptually speaking, it remains clear that the simultaneity of home-to-work commuting is the root cause of congestion on many transport networks, especially in big cities (Orfeuil, 2005). There is a logical and deterministic link between synchronised work start times and the

synchronisation of prior travel earlier in the morning (Gutiérrez-Puigarnau and Van Ommeren, 2012). This is why, like many authors (Habib, 2012; Ettema et al., 2007; Small, 1982), we will use arrival times at work and their synchronisation to discuss the synchronicity of morning commuting, i.e. peak period congestion. In other words, it can be assumed that a person who arrives at work during peak arrival period is very likely to contribute to prior congestion phenomena.

To achieve greater certainty about the links between flexible working hours and peak period arrival at work, we propose to model the probability of arriving at work during the peak on the basis of sociodemographic, socio-economic and “travel” variables. Like most researchers (Wöhner, 2022; Yang et al., 2016; He, 2013; Arellana et al., 2012; Ettema et al., 2004; Chin, 1990; Hendrickson and Plank, 1984; Small, 1982; McCafferty and Hall, 1982; Abkowitz, 1981), we then use the multinomial logistic regression method to model time behaviours. In this way, we can accurately isolate the effect of flexible working hours on the probability of arriving at work during the morning peak period.

More generally, it is important to note that extensive empirical research (Li et al., 2021) has already been done on the other factors that affect the time at which employees begin their commute or arrive at work. From these studies we know that, alongside flexible working hours, other sociodemographic characteristics such as age, sex, job type, income level, number of dependent children, mode of transport used or length of commute can also influence whether people arrive at work during the peak period (Rahman et al., 2022; Wöhner, 2022; He, 2013; Ben-Elia and Ettema, 2011; Saleh and Farrell, 2005; Chin, 1990; Ott et al., 1980).

The option of flexible working hours is the main independent variable in our study. It is expected to affect whether workers choose to get to work during the peak period (Golden, 2001; McCafferty and Hall, 1982; Saleh and Farrell, 2005).

### **3.5. Determining the peak period of arrivals at work in Paris and San Francisco**

It is noticeable that in Paris arrivals are more concentrated during the peak-period, whereas they are more spread out in San Francisco. In Paris, for example, only 3,9% arrive at work between 10.00 a.m. and 10.29 a.m. (Fig. 1), slightly after the peak-time; whereas this is the case for 7,1% of workers in San Francisco (Fig. 2). Another particularity in San Francisco is that the distribution curve for times of arrivals at work does not form a perfect “bell”. There is a dip between 8.30 a.m. and 8.59 a.m. Despite these few differences between Paris and San Francisco, in both cities the 3 time periods (each 30 min long) during which there are most arrivals are those between 8.00 a.m. and 9.29 a.m., with respectively 54% and 43% of arrivals falling within this peak period. It can therefore be reasonably considered that the peak period for arrival at work in Paris and San Francisco occurs at the same time, between 8.30 a.m. and 9.29. a.m. (dotted in black in Fig. 1, Fig. 2).

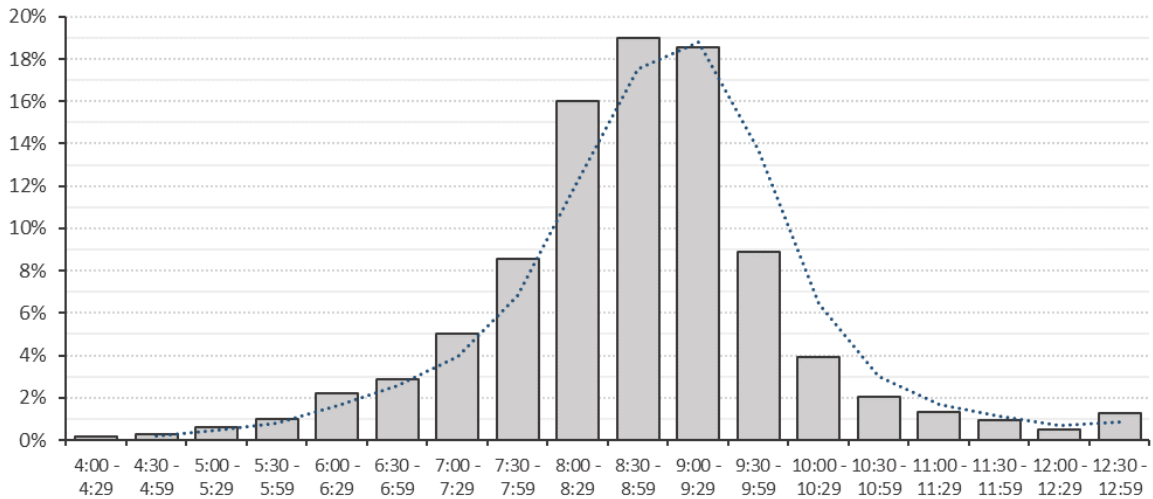


Fig. 1. Distribution of work arrival times on a weekday in the Paris metropolitan area.

In the Paris region, proportion of daily arrivals (1971 workers) at their normal workplace, during the time slot studied, on a weekday and for the first journey to work. Grouping by 30-min segment. Produced by the authors. Source: ENT D 2008.

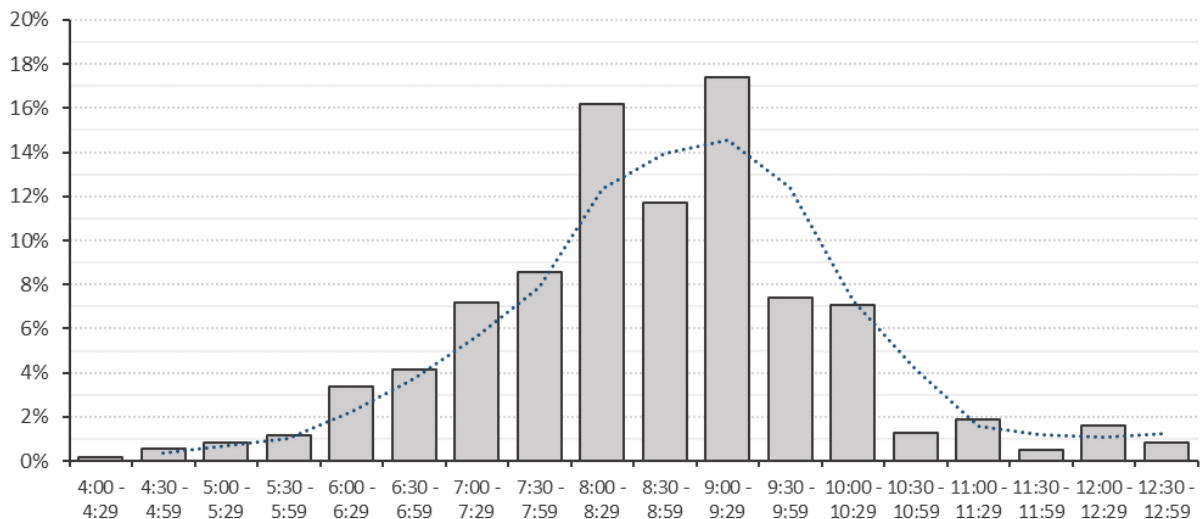


Fig. 2. Distribution of arrival times at work on a weekday in the San Francisco metropolitan area.

In the San Francisco region, proportion of daily arrivals (2533 workers) at the normal workplace, during the time slot studied, on a weekday and for the first journey to work. Grouping by 30-min segment. Produced by the authors. Source: NHTS 2017.

Following the method defined by McCafferty and Hall (1982), therefore, we constructed three periods of arrivals (Yang et al., 2016; He, 2013) for workers in Paris and San Francisco: (1) the peak period between 8.00 a.m. and 9.29 a.m. (aggregate of 50.7% of workers in Paris and San

Francisco), (2) the period before the peak period from 4.00 a.m. to 8.00 a.m. (24.0% of workers) and (3) the period after the peak period from 9.30 a.m. to 3.59 p.m. (25.3% of workers). We then investigate two specific hypotheses based on the literature review that,

- in the Paris metropolitan regions, working people with flexible work schedules are more likely to arrive at work during the peak arrival period, whereas;

- in the San Francisco metropolitan region, working people with flexible work schedules are less likely to arrive at work during the peak arrival period.

## **4. Flexible hours and peak period of arrivals at work in the Paris and San Francisco regions**

### **4.1. Bivariate statistics**

Appendix 3, Appendix 4 present statistics that describe the independent variables in terms of the time at which people arrive at work for San Francisco and Paris.

When having a closer look on the relationship between hours' flexibility and arrival timing at work, strong similarities between San Francisco and Paris arise. Both in San Francisco and Paris, workers with flexible working hours arrive more frequently during the peak period: 59.8% of Parisian flexible workers arrive between 8.00 and 9.29 a.m. compared to 53,6% for the whole Paris sample (i.e flexible and non flexible workers); 52,1% of San Franciscan flexibles compared to 45,2% for its whole sample. On the other hand, flexible workers less frequently arrive before the peak: only 15.0% in the Paris region and 20.4% in the San Francisco region. Lastly, arriving after the peak does not seem really linked with flexible working hours: respectively 25.2% and 27.5% compared to 25.7% and 28.5% for the whole sample. This is in contrast with past studies (Rahman et al., 2022; Shin, 2019; He, 2013) which frequently showed that flexible hours were associated with a greater probability of arrivals after the peak period.

While greater flexibility in working hours seems to result in more workers arriving at work during the peak, only a statistical model can clearly differentiate the effects of flexible hours from those of individual sociodemographic variables.

### **4.2. Base model: No impact of flexibility on peak period arrival times**

The choice of departure time is then estimated using a multinomial logit model (MNL) (McFadden, 1974). Because we wanted to model the impact of flexible working hours on the probability of arriving at work during the peak period, we decided to consider the post-peak period as the reference choice for the model. It allows us to show precise results for peak period (and pre-peak) choices. Convention would have suggested that we consider the peak period as the reference choice because this is the period in which the largest numbers of workers are concentrated, but it does not fit with the aim of our investigations.

A base model without interaction terms was first estimated with the variables of interest.

The base model applied separately in Paris and San Francisco (Table 2) shows that an individual with all the reference characteristics and flexible working hours has no significant different probability of arriving during the peak-period (8.00 a.m. – 9.30 a.m.), compared with the same “standard individual” with fixed working hours. Flexibility has no significant impact on peak-period arrivals, both in Paris (coefficient = 0.1089) and San Francisco (coefficient = 0.0129). In San Francisco, flexible working hours is associated with smaller probability of arriving at work before the peak period (coefficient = -0.7060). No effect on the pre-peak period is identified in Paris (coefficient = -0.2925).



**Table 2. Multinomial base model estimates of work arrival time choice in Paris and San Francisco**

	Base model Paris				Base model San Francisco			
	Pre-peak		Peak		Pre-peak		Peak	
	Coeff.	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.
Constant	-0.5565	0.3228	0.9780***	0.1885	0.8431*	0.3328	0.4070	0.2985
Flexitime								
No	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Yes	-0.2925	0.1885	0.1089	0.4352	-0.7060***	0.1295	0.0129	0.1146
Job category								
Professional, managerial	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Clerical, adm. support	0.6514**	0.2178	0.1954	0.1638	0.8268***	0.2188	0.4736*	0.2017
Manufacturing, construction	1.0414***	0.2779	-0.5150*	0.2575	0.7052**	0.2179	-0.1343	0.2238
Sales, service	0.2917	0.2381	-0.3774*	0.1783	0.023	0.1555	-0.3229*	0.1359
Sex								
Female	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Male	0.4571**	0.1595	-0.4501***	0.1216	0.0312	0.1260	-0.2577*	0.1074
Age								
30 to 39	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Under 30	-0.0774	0.2046	-0.2192	0.1516	-0.3683*	0.1777	-0.2307	0.1457
40 to 49	0.4542*	0.1917	0.0836	0.1516	0.2453	0.1773	0.3250*	0.1500
50 to 59	0.9907***	0.2160	0.3436	0.1764	0.8130***	0.1724	0.3424*	0.1585
60 and above	0.5804	0.4544	-0.2258	0.3653	0.5011*	0.2173	0.2008	0.1917
Household income								
Third quintile	Ref.	.	Ref.	.	Ref.	.	Ref.	.
First quintile	-0.0729	0.2294	-0.3500	0.1881	-0.4376*	0.1766	-0.4820**	0.1632
Second quintile	0.0430	0.2162	-0.1166	0.1751	-0.4849**	0.1883	0.1196	0.1588
Fourth quintile	0.3164	0.2336	0.2328	0.1841	0.3207	0.1883	0.5520***	0.1637
Fifth quintile	-0.2050	0.2639	-0.0863	0.1953	0.1916	0.1885	0.4700***	0.1604
No answer					0.7441	0.5839	1.1792*	0.5362
Working time								
Full-time	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Part-time	-1.0391***	0.2913	-0.2637	0.1838	-1.3226***	0.1681	-1.0012***	0.1386
No answer	-1.2761	1.0209	-1.5265	0.8370	-1.0169	1663.9	10.8947	1151.2
Household structure								
1 adult, no child	Ref.	.	Ref.	.	Ref.	.	Ref.	.
2+ adults, no child	0.0583	0.2036	0.1253	0.1594	-0.0245	0.1924	0.2237	0.1639
1 adult, child	0.2572	0.2997	0.7268**	0.2340	0.2948	0.3778	0.4532	0.3214
2+ adults, child	0.0662	0.1784	0.2590	0.1416	0.2391	0.2008	0.3954*	0.1736
Workplace density								
Medium density	Ref.	.	Ref.	.	Ref.	.	Ref.	.
High density	-0.7114***	0.2006	-0.3374*	0.1387	-0.8666***	0.2453	-0.4942*	0.2242
Low density	0.5701*	0.2384	0.2557	0.2190	-0.1774	0.2452	-0.1456	0.2354
No answer					-0.4957*	0.2227	-0.1494	0.2090
Commuting time								
Less than 20 minutes	Ref.	.	Ref.	.	Ref.	.	Ref.	.
20 to 39 minutes	-0.2743	0.1800	-0.2822	0.1481	-0.0787	0.1617	0.0123	0.1463
40 to 59 minutes	-0.0503	0.2303	0.0221	0.1828	0.1578	0.1904	0.0626	0.1744
60 minutes and more	-0.5732*	0.2569	-0.3223	0.1912	-0.3111	0.2031	-0.0913	0.1788
No answer					-1.2573	1.6116	-1.2214	1.2787
Commuting mode								
Car	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Public transport	-0.6602***	0.1921	0.2585	0.1460	-0.5122**	0.1756	0.2928*	0.1430
Walking, bike	-0.4130	0.2476	0.1179	0.1998	-1.1400***	0.3057	0.0265	0.2028
Motorised two-wheelers	0.0377	0.3025	0.5234*	0.2532	0.3694	0.6418	0.1490	0.6208
Summary statistics	N = 1,971 McFadden Pseudo-R <sup>2</sup> = 0.0939				N = 2,536 McFadden Pseudo-R <sup>2</sup> = 0.1033			

\* denotes significance at the 5% level;

\*\*denotes significance at the 1% level;

\*\*\*denotes significance at the 0.01% level.

Explanation: An individual possessing all the reference characteristics serves as the comparison point. He has all the characteristics associated with the abbreviation "Ref".

Source: ENT D 2008. 2017 NHTS. Calculations by the authors.

On one side, sociodemographic variables whose impact on the likelihood of travelling during the rush hour are observed similarly in Paris and San Francisco. Those variables, now well identified in the literature, are also found in Table 2. Age (Munch, 2019), being a female (Rahman et al., 2022; He, 2013), being a parent, and notably the need to take children to school, all seem to increase the probability of arriving at work during the peak period (Meissonnier and Richer, 2021; Schwanen, 2007; Saleh and Farrell, 2005). Higher socio-economic categories (Hendrickson and Plank, 1984; Small, 1982; Abkowitz, 1981) and incomes (Wilson, 1998) are also associated on average with a greater likelihood of rush-hour travel.

On the other side, there are other variables that have different impacts, whether studied in Paris or in San Francisco. One will be of great importance to allow a better understanding on how various forms of work flexibility might induce various schedules impacts on both side of the Atlantic sea: In San Francisco, being a part-time worker affects strongly and negatively the probability of arriving at work during the peak time (coefficient =  $-1.0012$ ), whereas it does not have any clear impact in Paris (coefficient =  $-0.2637$ .) One can observe very different practices of part-time jobs in Paris and San Francisco (Schulz, 2015). As mentioned by Schulz in its comparison between Paris, San Francisco and Oslo and further analysed in other comparative (Gu et al., 2022; Beham et al., 2019; Tremblay, 2012; Poster and Prasad, 2005) or recent national studies,<sup>3</sup> this difference comes from the higher scale of national differences between work organisation in France and U.S.

In France, the part-time is a form of more likely employment to be voluntarily and frequently associated with 4/5 time or half-time built to coordinate more easily professional and familial life (Briard, 2020). It is surely linked within the global working time reduction framework since the Aubry II law (2000), limiting the average weekly workload to 35 h (Méda, 2001). Even if wages are logically lower, part-time can here be seen as a "temporal privilege" for workers who can choose to leave work for one or more days during the week (Sautory and Zilloniz, 2015), without necessarily affecting the daily timing of work organisation and its peak period arrivals (Faivre, 2005).

In the U.S., part-time jobs are more frequently the results of job market flexibility that seek to recruit employees for precarious jobs and during temporary periods (Pech et al., 2021). Consequently, in the U.S., part-time workers more frequently divide their time at the daily scale, working at atypical hours in the personal service sector or healthcare for instance (Vanroelen et al., 2021; Perlow, 2001). In this context people may have multiples part-time jobs, which remains until now an extremely rare case in France and Paris (Proulhac, 2022). This comparative analysis can surely play a role when taking a proper look on the various form of work flexibility in San Francisco and Paris, and more generally in the U.S. and in France. In the U.S., regarding the duration of work (full time or part time), flexibility is more frequently associated with job market flexibility – a type of precarity. In France work flexibility is more oriented toward individual and work-life adjustments – a type of privilege.

Can this social difference between those two countries be duplicated on the impact of scheduling flexibility (flexible or non flexible hours)? Knowing the scheduling and the duration of work are closely linked (Munch, 2020), one would therefore know if flexible hours in Paris are mainly native to privileged jobs, in comparison with San Francisco where it could significantly be held by precarious jobs? And if so, how those social logics behind scheduling flexibility can influence the arrival time at work in Paris and San Francisco?

#### **4.3. Full model in Paris: the privilege of flexible working hours strongly generates peak period arrivals**

While considering the non-impact of flexibility in the upper subsection, the base model reveals an important problem. As shown in the correlation matrix in Appendix 4, Appendix 5, there is a strong (Corr. > 25%) and significant correlation between flexible hours and job type, household income. In consequence, the impact (or non-impact) of flexibility could simply be the result of flexibility being associated with certain types of jobs, such as professional and managerial positions, or else with high income levels. There is also an issue with verifying whether the impact of flexibility can be interpreted with a sufficient degree of certainty, regardless of the transport mode used.

Therefore, in addition to our basic logistical regression, we follow the model in He (2013) in proposing a second, more sophisticated model, where we include interaction terms between flexible working and the other variables that are highly correlated with it: flex\*job category; flex\*income. In order to verify whether people with flexible working hours are more likely to travel during rush hour when they use public transport rather than a private vehicle, we also include a flex\*mode of transport variable.

A comparison between the base model and the “full model” produces very interesting results, mostly for Paris. For Paris, the “full model” shows that once the correlations between flexibility and the other sociodemographic variables are isolated, flexibility has a strong and very significant influence (coefficient = 12,851) on the probability of arriving at work during the peak period (Table 3). To compare more accurately the impact of flexibility in the two different models, we furnish in Appendix the odds ratio's summary for both models in Paris. We move from an odds ratio (Appendix 7) that describes a near zero (1, 115) and non-significant effect of flexibility in the base model, to a strong (3615) and very significant ( $p < 0,01\%$ ) odds ratio. When we isolate the interaction effects between flexibility and the other variables with which it is correlated, we observe important changes that allow better explanations in Paris. In the full model, we see that working flexible hours in fact markedly increases the probability of travelling during rush hour compared with working hours set by the employer.

**Table 3. Multinomial full model estimates of work arrival time choice in Paris**

	Pre-peak		Peak	
	Coeff.	Std. err.	Coeff.	Std. err.
Constant	-0.7414*	0.3563	0.6420*	0.2769
Flexitime				
No	Ref.	.	Ref.	.
Yes	0.0378	0.5465	1.2851***	0.3810
Job category				
Professional, managerial	Ref.	.	Ref.	.
Clerical, administrative support	0.6983*	0.2762	0.2673	0.2091
Manufacturing, construction	1.0040**	0.3194	-0.5884*	0.2895
Sales, service	0.3562	0.2826	-0.3763	0.2139
Sex				
Female	Ref.	.	Ref.	.
Male	0.4629**	0.1602	-0.4732***	0.1228
Age				
30 to 39	Ref.	.	Ref.	.
Under 30	-0.0923	0.2059	-0.2058	0.1533
40 to 49	0.4561*	0.1932	0.1114	0.1532
50 to 59	1.0109***	0.2175	0.3869*	0.1781
60 and above	0.5339	0.4586	-0.2245	0.3698
Household income				
Third quintile	Ref.	.	Ref.	.
First quintile	-0.0314	0.2472	0.0230	0.2100
Second quintile	0.0011	0.2344	0.1342	0.1974
Fourth quintile	0.5246	0.2712	0.4879*	0.2280
Fifth quintile	-0.4963	0.3561	0.1918	0.2598
Working time				
Full-time	Ref.	.	Ref.	.
Part-time	-1.1035***	0.2920	-0.3196	0.1859
No answer	-1.3312	1.0552	-1.7740*	0.8648
Household structure				
1 adult, no child	Ref.	.	Ref.	.
2+ adults, no child	0.0657	0.2057	0.1317	0.1608
1 adult, child	0.2801	0.3004	0.7527**	0.2362
2+ adults, child	0.1057	0.1790	0.2598	0.1426
Workplace density				
Medium density	Ref.	.	Ref.	.
High density	-0.7612***	0.2028	-0.3290*	0.1402
Low density	0.6199**	0.2405	0.3529	0.2222
Commuting time				
Less than 20 minutes	Ref.	.	Ref.	.
20 to 39 minutes	-0.2815	0.1807	-0.2760	0.1493
40 to 59 minutes	-0.0419	0.2322	0.0417	0.1844
60 minutes and more	-0.6027*	0.2594	-0.3349	0.1932
Commuting mode				
Car	Ref.	.	Ref.	.
Public transport	-0.3872	0.2145	0.3816*	0.1714
Walking, bike	-0.2797	0.2735	0.2297	0.2286
Motorised two-wheelers	0.3946	0.3536	0.6904*	0.3206
Interaction terms				
Flexitime* sales, service	-0.3904	0.6050	-0.0502	0.4316
Flexitime * clerical	-0.1467	0.4673	-0.1823	0.3462
Flexitime * manufacturing	0.9451	0.9804	1.2260	0.9629
Flexitime * first quintile	-0.1231	0.6537	-1.9698***	0.4905
Flexitime * second quintile	0.5724	0.6262	-1.0308*	0.4483
Flexitime * fourth quintile	-0.4726	0.5968	-0.9426*	0.4051
Flexitime * fifth quintile	0.7227	0.6082	-0.9914*	0.4064
Flexitime * walking, bike	-0.2498	0.6021	-0.4616	0.4474
Flexitime * motorised two-wheelers	-1.6387*	0.8010	-0.4161	0.5161
Flexitime * public transport	1.1275**	0.4379	-0.4863	0.2766

Summary statistics	N = 1,971 McFadden Pseudo-R <sup>2</sup> = 0.1058
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\* denotes significance at the 5% level;  
 \*\*denotes significance at the 1% level;  
 \*\*\*denotes significance at the 0.01% level.

Explanation: An individual possessing all the reference characteristics serves as the comparison point. He has all the characteristics associated with the abbreviation “Ref”.

Source: ENTD 2008. Calculations by the authors.

The full model ensures that what is being studied is indeed the effect of flexibility on time of arrival and not the effect of flexibility combined with other variables. In order to understand the reason why flexibility, separated from certain characteristics of the survey subjects, leads to peak-time travel, it is necessary to read the last lines of the table.

Note the extremely significant and negative impact of the combination of flexible hours with very low income (Flex\*first quintile) on the probability of travelling during peak times (coefficient = -1.9698). Indeed, there is a whole category of workers in insecure jobs working flexible and non-standard hours who have very little chance of travelling during peak times (Proulhac, 2022). For these workers, flexible hours are not a privilege as they are for executives or for doctors and lawyers, who are free to determine what hours they work, but are often associated with badly paid jobs in sectors such as home-care services, which depend on demand. Low-paid people who are free to choose their own hours commonly work non-standard hours, often part-time or multiples small contracts (Jouffe, 2007). Typical occupations of this kind are cleaning jobs, self-employed delivery work, homecare provided by freelance nurses... This type of flexibility that emerges in the full model was masked in the base model by too broad an interpretation of the multiplicity and variety of “flexible hours”. Once the effect of this flexibility associated with insecure jobs and non-standard working hours is properly isolated, working hour flexibility on its own (separated from other variables) becomes very clearly associated with peak-time travels in Paris region.

#### **4.4. Full model in San Francisco: Flexible hours have no significant impact on peak period avoidance in San Francisco**

In San Francisco, these rationales seem also at stake. But they do not appear as strongly in Paris (Table 4). They do not have a sufficient impact to emphasize a clear role of hours' flexibility on peak-period arrivals.

**Table 4. Multinomial full model estimates of work arrival time choice in San Francisco**

	Pre-peak		Peak	
	Coeff.	Std. err.	Coeff.	Std. err.
Constant	0.9670**	0.3549	0.1832	0.3317
Flexitime				
No	Ref.	.	Ref.	.
Yes	-1.0302***	0.2737	0.2583	0.2541
Job category				
Professional, managerial	Ref.	.	Ref.	.
Clerical, administrative support	0.7684*	0.2989	0.6689*	0.2850
Manufacturing, construction	0.4101	0.2771	-0.7886*	0.3311
Sales, service	-0.0471	0.2126	-0.3070	0.2026
Sex				
Female	Ref.	.	Ref.	.
Male	0.0278	0.1275	-0.2575*	0.1086
Age				
30 to 39	Ref.	.	Ref.	.
Under 30	-0.3785*	0.1796	-0.2223	0.1478
40 to 49	0.2388	0.1783	0.3288*	0.1511
50 to 59	0.8225***	0.1737	0.3704*	0.1600
60 and above	0.5001*	0.2187	0.2344	0.1930
Household income				
Third quintile	Ref.	.	Ref.	.
First quintile	-0.4650*	0.2306	-0.1108	0.2404
Second quintile	-0.6103*	0.2577	0.2118	0.2496
Fourth quintile	0.3315	0.3032	0.7659**	0.2970
Fifth quintile	-0.1384	0.3485	0.8634**	0.3181
No answer	0.7911	0.5856	1.1657*	0.5392
Working time				
Full-time	Ref.	.	Ref.	.
Part-time	-1.3425***	0.1709	-1.0130***	0.1404
No answer	-0.9370	2743.4	11.8882	1898.0
Household structure				
1 adult, no child	Ref.	.	Ref.	.
2+ adults, no child	-0.0204	0.1940	0.2215	0.1653
1 adult, child	0.2953	0.3818	0.4515	0.3229
2+ adults, child	0.2627	0.2026	0.4096*	0.1752
Workplace density				
Medium density	Ref.	.	Ref.	.
High density	-0.8961***	0.2479	-0.4841*	0.2271
Low density	-0.1831	0.2466	-0.1352	0.2373
No answer	-0.5020*	0.2244	-0.1495	0.2112
Commuting time				
Less than 20 minutes	Ref.	.	Ref.	.
20 to 39 minutes	-0.0581	0.1625	0.0263	0.1474
40 to 59 minutes	0.2115	0.1920	0.1199	0.1758
60 minutes and more	-0.2874	0.2041	-0.0755	0.1796
No answer	-1.2346	1.6314	-1.3095	1.3014
Commuting mode				
Car	Ref.	.	Ref.	.
Public transport	-0.5724*	0.2450	0.3032	0.2114
Walking, bike	-1.3523*	0.5372	0.3696	0.3638
Motorised two-wheelers	-1.5158	0.9177	-13.0684	315.6
Interaction terms				
Flexitime* sales, service	0.0942	0.3123	-0.0654	0.2738
Flexitime * clerical	0.1346	0.4318	-0.4128	0.4012
Flexitime * manufacturing	0.7871	0.4511	1.3794**	0.4696
Flexitime * first quintile	0.1274	0.3624	-0.6519*	0.3314
Flexitime * second quintile	0.2841	0.3765	-0.0857	0.3232
Flexitime * fourth quintile	0.0384	0.3850	-0.3253	0.3530
Flexitime * fifth quintile	0.5312	0.4168	-0.5329	0.3674

Flexitime * walking, bike	0.4525	0.6485	-0.4010	0.4319
Flexitime * motorised two-wheelers	3.9543*	1.6067	15.2423	315.6
Flexitime * public transport	0.1438	0.3123	0.0386	0.2503
Summary statistics	N = 2,536 McFadden Pseudo-R <sup>2</sup> = 0.1109			

\* denotes significance at the 5% level;

\*\*denotes significance at the 1% level;

\*\*\*denotes significance at the 0.01% level.

Explanation: An individual possessing all the reference characteristics serves as the comparison point. He has all the characteristics associated with the abbreviation “Ref”.

Source: NHTS 2017. Calculations by the authors.

First, when we study the interaction effects, we see the appearance of an effect that is specific to manual workers with flexible hours. Compared with the reference category present here, i.e. professional and managerial occupations with flexible hours, flexible manual workers are significantly more likely to arrive at work during the peak period, broadly almost three times as likely (coefficient = 1.3794). This could be explained in different ways, but here is the explanation that seems to us most convincing. Compared with the professional and managerial occupations, manual workers with fixed working hours often work unsocial hours outside peak periods (for example early in the morning or in a 3 team fixed 8 h factory shift schedule). So when they have flexible hours, they are more likely to use this autonomy to choose standard working times, compared with people in managerial occupations who often work standard schedules even when their hours are set by their employer.

Following the same interpretations, like in Paris, the combination of flexible hours with very low income (Flex\*first quintile) also have a negative impact on the probability of travelling during peak times. Nevertheless, the effect is much lower and less significant (coefficient = -0.6519). Analysis of the San Francisco's table reveals that this effect of “precarious flexibility” could rather be better captured by the relationship between flexibility and part-time jobs as depicted in the upper Subsection 4.2. Indeed, in the full model, part-time jobs still have a very significant and negative impact of peak period arrivals (coefficient = -1.0130). And as described by the Appendix 6, working time is significantly linked with hours' flexibility. We thus estimated an another model for San Francisco where a new interaction term between working time and flexibility has been added. It shows effectively that, once part-time workers with flexible hours are considered apart in the model, pure flexibility becomes more strongly and positively associated with peak period arrivals. Still, the effect of flexible hours on peak-period arrivals remains unsure at >5% of uncertainty. Consequently, at this stage, our analysis can only reveal that hour's flexibility has no significant impact on travel at peak times in San Francisco.

Though possibly considered as a bit deceptive, this result offers important conclusions when confronted to past contributions on San Francisco's trip timing. Specifically, an article published ten years ago (He, 2013) showed opposite results in San Francisco. The city was described as a city where working hours' flexibility was more probably used to avoid morning peak-period. Mobility dynamics could certainly have changed between the two periods surveyed (NHTS 2009–2017). But while congestion has been raising in San Francisco Bay area (Metropolitan Transportation Commission (MTC), Association of Bay Area Governments

(ABAG), 2018), we think it is hard to argue that flexible workers would have moved their behaviours to peak period avoidance to indifferent practices regarding morning rush hour. Alternatively, we rather think that considering San Francisco as a peak period avoidance's city is due to a misuse of the methodological tools.

In fact, in He's paper (He, 2013), the multinomial model of trip time choices is estimated with an aggregate model where Los Angeles and San Francisco commuters are conjointly studied. With this cumulative study, it is concluded that flexible hours have a significant negative impact on the probability of travelling during peak period in both cities. Although there are clues indicating that the impact is largely more questionable in San Francisco. This cumulative methodology on the impact of flexibility in various cities invites to possibly make too much generalization and eventual deviation of specific results.

To illustrate this view, we furnish in Appendix 8 the cumulative base and full model for Paris in San Francisco. Here we can see, that when looking simultaneously at Parisians and San Franciscans mobility practices, we could have concluded without any difficulties that in both cities flexibility has a positive impact on the probability of peak period travelling. This would have been the exact opposite result for San Francisco compared to He's work (He, 2013).

When studied precisely and comparatively, we indicate that the proper result is located midway between those cumulative methodologies that biases results. Working hours' flexibility has no impact on the probability of travelling during the morning peak period in San Francisco.

## **5. Conclusion**

This article discusses the assumption or "belief-picture" (Laplantine, 1989) that flexible working hours will lead to alternative work schedules and a dilution of traffic flows during the morning peak period. Through a review of the international empirical literature, but above all by modelling workplace arrival times in the Paris and San Francisco urban regions, we identified a set of factors that show that this picture needs sometimes to be turned on its head.

- In Paris region, being a worker with flexible hours is associated with a very significant stronger probability of arrival during the morning peak period. It confirms results produced at a smaller scale and with a less robust methodological toolbox on the possible paradoxical effect of flexible hours (Munch and Proulhac, 2019).

- In San Francisco region, flexibility of working hours has no significant impact on the probability of travelling during the peak period. It contradicts precedent results (He, 2013), where San Francisco was studied cumulatively with Los Angeles and seemed to describe peak period avoidance.

The research provides a nuanced and more accurate reading of the impact of flexible working hours on peak period congestion through an original comparative territorial analysis. In the past researches, rationales behind arrival time choices had never been territorially compared



in a same reflexion. First, as mostly shown in the U.S. through the literature review, flexible hours surely can trigger peak period avoidance (Rahman et al., 2022; Shin, 2019; Yang et al., 2016; He, 2013). The aim of the paper is not to frontally refute this perspective. Rather to show that other possibilities exist. Second, as statistically confirmed here in Paris region and in Switzerland (Wöhner, 2022), we show that flexible hours can also have a counterproductive and opposite effect, increasing the probability of arriving at work during peak period. Here, from an operational perspective, it provides a caveat against the current direction of many transport policies relating to flexible working. In some cases, flexible working can exacerbate travel conditions at peak times on urban transport systems. Third, and as rarely discussed, because supposedly considered as uninterpretable, flexibility can also have an insignificant impact on the probability of travelling during the morning peak period. After various statistical comparison, this “intermediate” situation has been observed in San Francisco area.

Globally our research informs the debate, while leaving room for different findings. It contributes to a theoretical and still open debate in the social sciences. In fact, by contrast with most social science theories, in an era of flexible schedules, our research tempers the notion of an increasing and general desynchronisation in day-to-day activities (Wacjman and Dodd, 2017; Rosa, 2013). All in all, our work provides a more nuanced picture of the effects of time flexibility than previous descriptions, which have solely emphasized findings that pointed in the “right direction”. Flexible working hours can equally be a means to desynchronise and avoid congestion, to synchronise more closely with one's professional and social environment and even a means that has no evident impact. The effects of flexibility in reducing congestion on transport systems are more complex than intuitive.

The complexity is mainly deciphered by our comparative approach. It reveals that the impact of flexible working hours depends on territorial dynamics, where the structure of employment and the “social distribution of flexibility” plays a big role. Through the full specification of the model, the results show that a clear distinction needs to be made between workers who have the privilege of choosing their timetable to suit themselves (doctors, lawyers, executives on flexitime...) and those who, while they may be free to organise their working hours, have low income and are obliged to follow non-standard timetables in order to meet demand for service that is greater at certain times of the day. Among such workers are, for example, cleaners, self-employed delivery agents, and freelance nurses providing homecare.

In terms of transport policies, therefore, workers in insecure occupations who work non-standard hours because of the nature of the demand rather than benefiting from autonomy in their day-to-day arrangements, need to be excluded or at least isolated from the analysis. Once we exclude the effects of this precarious flexibility, the “privilege of flexible working” immediately becomes very clearly associated with peak-time travel in Paris region. While this was not significantly verified in San Francisco, it opens new avenues of research to look if this logic can be seen in other cultural and territorial contexts.

More generally, our exploratory results call for a deeper analysis on the role played by territorial characteristics on the impact of flexible hours. All the results we are presenting, as a first step, are to be considered as exploratory results which necessarily face certain limits and which also deserve to be tested again in other territories and with methodologies allowing

a deeper understanding. As Marc Bloch, a great historian reminds us, “comparative analysis methods allow for suggestion but no explanation”<sup>4</sup> (Bloch cited by Bloch and Baschet, 2018). A social geography of peak period, to be continued.

### **5.1. Outlook**

As solely discussed in the literature review, one would take further interest in the role played by the mobility structure of the territory. Due to the unavailability of homogeneous transnational dataset gathering both information on working organisation and level of congestion faced, we missed here information about the level of congestion faced by each respondents. A further analysis taking into account various degrees of congestion could be very heuristic to better understand its various sensitivity on peak-period avoidance.

Indeed, a rapid comparison of pro peak-time locations (Wöhner, 2022; Meissonnier and Richer, 2021; Gendreau, 2020; Munch, 2017b) with anti-peak-time locations (Rahman et al., 2022; Shin, 2019; Yang et al., 2016; He, 2013) also suggests that the structure of mobilities plays an important role in how people use flexible working hours. Indeed, pro peak-time regions (Switzerland, Paris, Rennes, Lille (Fr)) all have public transports with a high modal share compared with anti-peak-time regions (Los Angeles, Miami, Central Puget Sound and Austin) and San Francisco which can be classified in a median position. An additional conclusion to our own on employment structure could seek to verify and measure the following dual hypothesis: In cities with a high public transport modal share, do flexible working hours exacerbate peak-time travel conditions? Conversely, in cities with low level of PT use, flexible working could have a positive effect, in the short term, on reducing road congestion?

One could also try to take the investigations further in order to understand how the structure of mobilities (modal share, congestion level) and the structure of employment (share of privileged/insecure flexible workers) affects together the impact of flexibility on peak-time load on the transport system? After all, it is very probable that the dynamic of morning flows is affected by a range of interactions between the structure of employment and the structure of mobilities.

Second, a diversification of the methodological toolbox would undoubtedly help to give our conclusions better grounding by targeting the phenomenon under study more precisely. If we want to assess the impact of more flexible working hours, it would be advisable to study how employees alter their work schedules following the introduction of flexible working hours in their companies (Moore et al., 1984). Using longitudinal studies, this would then require more local observation, in one or more big companies, to assess the direct consequences of a relaxation in the imposition of working hours.

Third, one of the research questions that could be addressed would be why more people with flexible hours arrive at work at peak-time. This would shift the investigation to a more microsocial level compared to our territorial approach. This is very fertile ground for analysis around this topic and has been explored in an another paper (Munch, 2019). Recent studies

in the U.S. (Hall, 2021) and India (Kreindler, 2020) have shown that approximately half of commuters still have totally inflexible schedules, even when they enjoy apparent contractual flexibility, for example because they have to drop their children at school at a fixed time. If flexible hours do not reduce traffic congestion, they can still theoretically benefit individual workers by facilitating scheduling arrangements with family members. This social component of flexible working undoubtedly needs to be taken into consideration in transport policy.

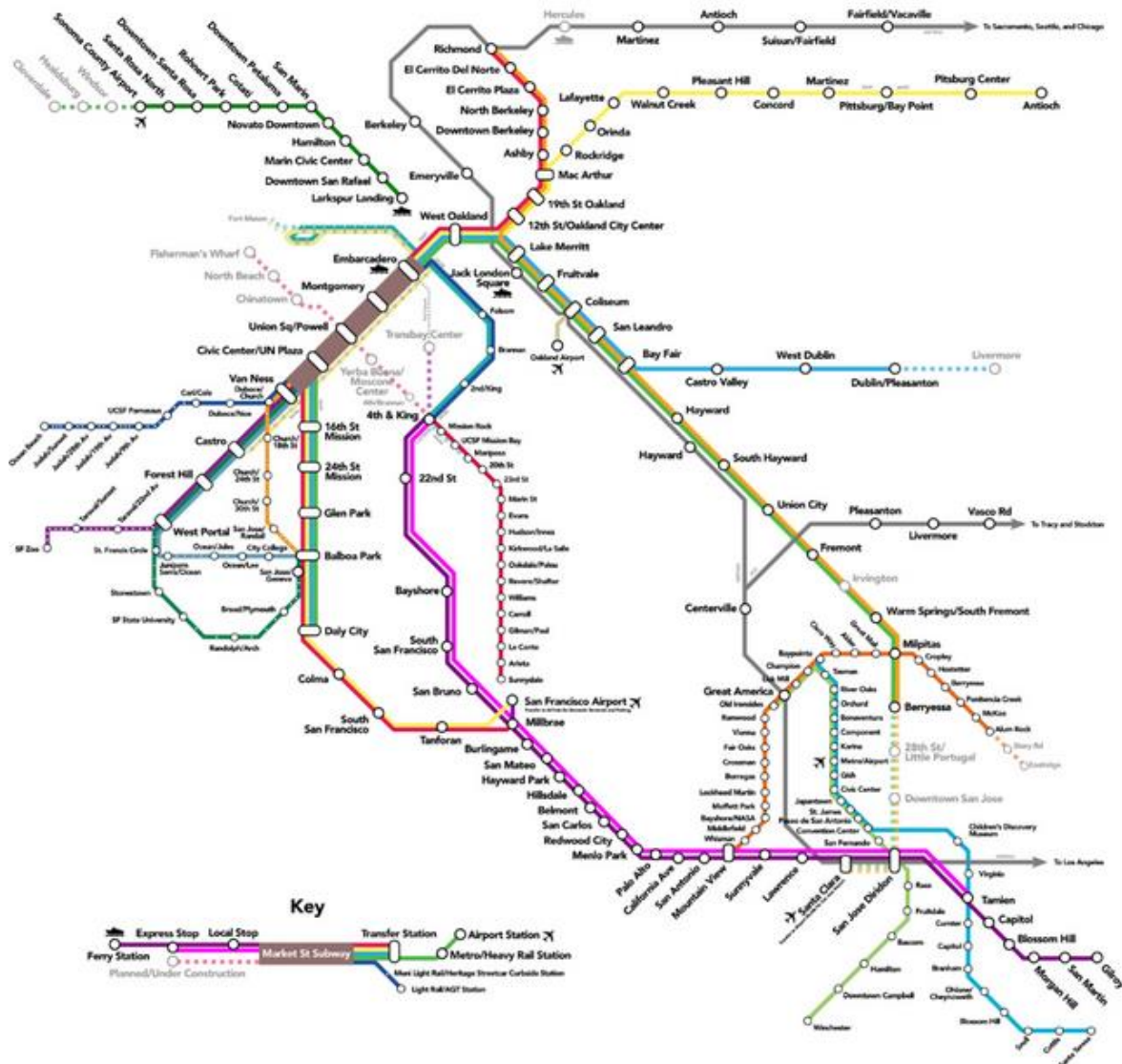
Flexible hours may also allow people to choose their commuting times and reduce the stress associated with strict timekeeping requirements. However, recent psychological literature has shown that flexible hours can have a negative effect on stress at work because flexible workers often work longer hours and are more psychologically invested in their jobs (Allen et al., 2013). For instance, in the French and Danish cases, studies have clearly shown that flexible working hours for executives may induce a severe “fear of being late” (Gilson, 2013), because people in these positions worry about the stigma of arriving after their colleagues or their boss (Munch, 2020; Haustein et al., 2018).

While these microsocial scale observations have been tested in the sociology of work and of time, they have so far had little impact in the field of “transport sciences”. More generally, drawing attention to the various impact of flexible working hours on transport peak period may therefore open up a dialogue between theoretical approaches that have hitherto remained in their separate silos. Midway between the sociology of time and “transport sciences”, this may perhaps offer a new entry into a social geography of the peak period.

### **Declaration of Competing Interest**

The authors declare no conflicts of interest. No funding was mobilised to produce this research. The data used is freely available.

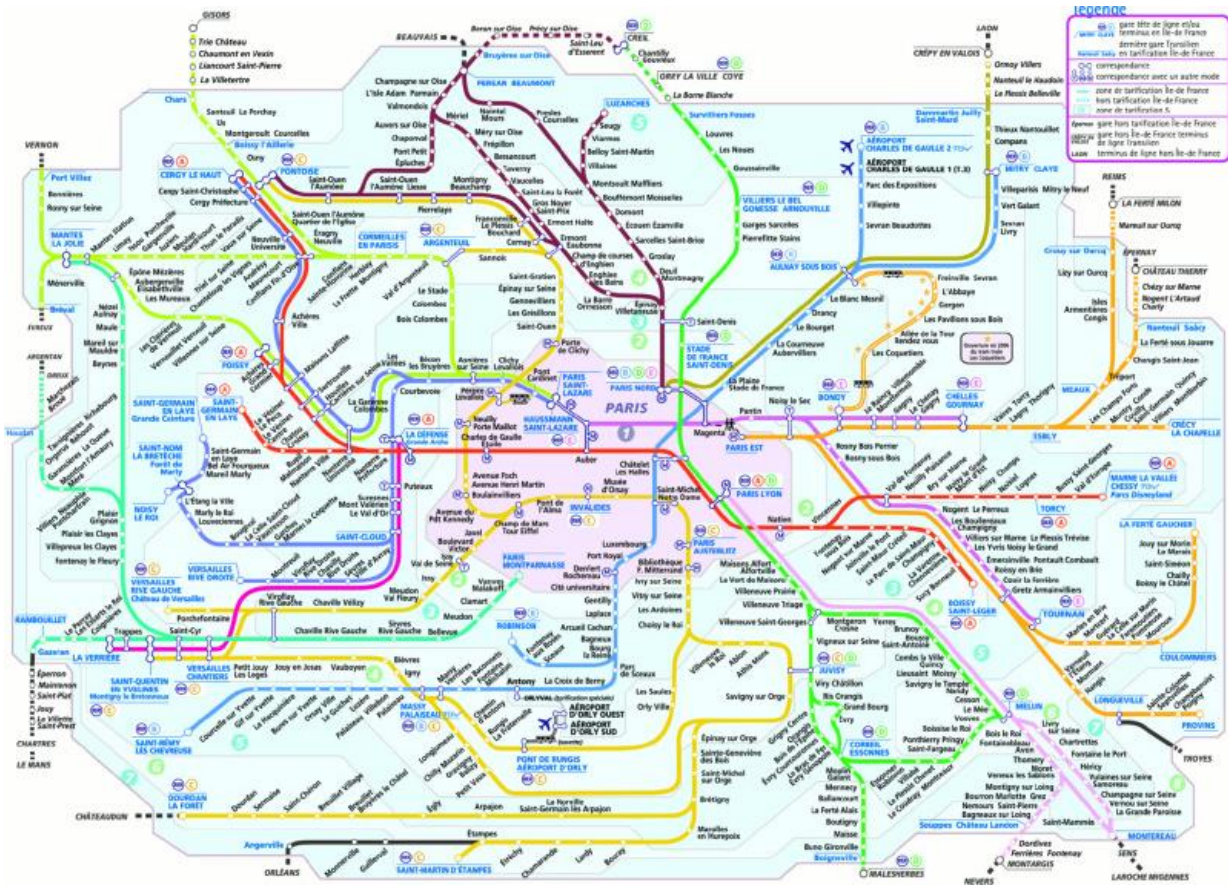
# Appendix A. Appendix



Appendix 1. San Francisco Bay Area Rapid Rail Transit Map.

Source: Wikimedia commons (2013). File available at:

[https://commons.wikimedia.org/wiki/File:SF\\_Bay\\_Rail\\_Transit.svg](https://commons.wikimedia.org/wiki/File:SF_Bay_Rail_Transit.svg)



Appendix 2. Paris region Rapid Rail Transit Map.

Source: [Transilien.com](https://www.transilien.com) (2023). File available at: <https://www.transilien.com/fr/page-deplacements/plan-reseau-ile-de-france>

### Appendix 3. Characteristics of the Paris workers in relation to their arrival time at work

	Pre-Peak (4.00 a.m.-7.59 a.m.) (N=417) (20.7%)		Peak (8.00 a.m.-9.29 a.m.) (N=1,081) (53.6%)		Post-peak (9.30 a.m.-3.59 p.m.) (N=473) (25.7%)	
	Sample size (N)	Weighted Row %	Sample size (N)	Sample size (N)	Sample size (N)	Sample size (N)
<b>Flexitime</b>						
Yes	99	15.0	356	59.8	135	25.2
No	318	23.1	725	51.1	338	25.8
<b>Job category</b>						
Sales, service	115	20.1	281	49.7	151	30.2
Clerical, administrative support	116	21.1	313	57.9	113	21.0
Manufacturing, construction	88	50.0	51	26.2	42	23.8
Professional, managerial	98	12.8	436	61.2	167	26.0
<b>Sex</b>						
Female	154	14.1	662	61.3	232	24.6
Male	263	28.2	419	44.9	241	26.9
<b>Age</b>						
Under 30	58	17.1	171	50.4	108	32.5
30 to 39	101	17.0	323	56.2	145	26.8
40 to 49	131	23.7	311	53.4	119	22.9
50 to 59	112	27.2	240	54.0	78	18.8
60 and above	15	23.1	36	47.5	23	29.4
<b>Household income</b>						
First quintile	95	24.3	174	45.3	105	30.4
Second quintile	94	24.2	191	49.0	90	26.8
Third quintile	95	21.4	237	54.5	101	24.1
Fourth quintile	75	19.1	241	60.0	79	20.9
Fifth quintile	58	13.9	238	59.9	98	26.2
<b>Working time</b>						
Full-time	397	22.0	946	53.4	406	24.6
Part-time	17	9.7	132	55.9	63	34.5
No answer	3	17.7	3	28.8	4	53.5
<b>Household structure</b>						
1 adult, no child	122	18.8	306	50.9	175	30.3
2+ adults, no child	89	22.2	237	52.9	98	24.9
1 adult, child	37	17.6	120	64.8	31	17.6
2+ adults, child	169	22.9	418	54.0	169	23.1
<b>Workplace density</b>						
High density	45	10.9	236	56.4	129	32.7
Medium density	291	22.2	712	53.5	301	24.3
Low density	81	35.4	133	47.6	43	17.0
<b>Commuting time</b>						
Less than 20 minutes	161	25.6	340	51.1	143	23.3
20 to 39 minutes	135	20.7	331	51.3	164	28.0
40 to 59 minutes	72	17.7	230	59.3	76	23.0
60 minutes and more	49	14.1	180	56.6	90	29.3
<b>Commuting mode</b>						
Car	259	29.6	469	47.7	200	22.7
Public transport	92	11.5	446	59.8	199	28.7
Walking, bike	41	19.7	102	52.1	51	28.2
Motorised two-wheelers	25	23.3	64	55.6	23	21.1

Source: 2008 ENT.D. Calculations by the authors.

#### Appendix 4. Characteristics of the San Francisco workers in relation to their arrival time at work

	Pre-Peak (4.00 a.m.-7.59 a.m.) (N=666) (26.3%)		Peak (8.00 a.m.-9.29 a.m.) (N=1,202) (45.2%)		Post-peak (9.30 a.m.-3.59 p.m.) (N=665) (28.5%)	
	Sample size (N)	Weighted Row %	Sample size (N)	Sample size (N)	Sample size (N)	Sample size (N)
<b>Flexitime</b>						
Yes	348	20.4	860	52.1	424	27.5
No	318	34.9	342	35.2	241	29.9
<b>Job category</b>						
Sales, service	109	25.3	177	34.3	165	40.4
Clerical, administrative support	73	35.0	97	44.5	47	20.5
Manufacturing, construction	71	47.8	40	27.9	40	24.3
Professional, managerial	413	22.5	887	51.4	412	26.1
No answer	0	n.s.	1	n.s.	1	n.s.
<b>Sex</b>						
Female	280	23.6	611	48.0	313	28.4
Male	385	28.3	590	43.0	352	28.7
No answer	1	n.s.	1	n.s.	0	n.s.
<b>Age</b>						
Under 30	67	19.6	159	39.4	139	41.0
30 to 39	129	22.0	304	47.5	186	30.5
40 to 49	124	25.0	276	52.5	107	22.5
50 to 59	223	39.3	258	41.8	98	18.9
60 and above	123	28.2	205	42.3	135	29.5
<b>Household income</b>						
First quintile	77	31.1	117	28.5	131	40.3
Second quintile	78	21.4	161	46.3	113	32.3
Third quintile	159	29.2	242	41.7	150	29.1
Fourth quintile	168	26.3	290	52.6	113	21.1
Fifth quintile	168	22.2	373	56.2	151	21.6
No answer	16	30.0	19	58.8	7	11.2
<b>Working time</b>						
Full-time	588	28.6	1,020	47.9	435	23.5
Part-time	78	15.9	181	33.6	230	50.5
No answer	0	n.s.	1	n.s.	0	n.s.
<b>Household structure</b>						
1 adult, no child	106	25.0	172	43.6	116	31.4
2+ adults, no child	344	24.5	631	45.9	356	29.6
1 adult, child	11	23.9	31	40.7	19	35.4
2+ adults, child	205	28.9	368	45.4	174	25.7
<b>Workplace density</b>						
High density	118	20.2	276	45.2	164	34.6
Medium density	71	34.8	93	42.9	46	22.3
Low density	149	37.6	187	38.8	100	23.6
No answer	328	24.0	646	47.6	355	28.4
<b>Commuting time</b>						
Less than 20 minutes	144	19.6	245	39.4	167	41.0
20 to 39 minutes	205	22.0	316	47.5	188	30.5
40 to 59 minutes	129	25.0	197	52.5	102	22.5
60 minutes and more	105	39.3	208	41.8	108	18.9
No answer	83	28.2	236	42.3	100	29.5
<b>Commuting mode</b>						
Car	471	34.0	574	38.4	373	27.6
Public transport	87	15.2	297	54.3	145	30.5
Walking, bike	19	10.3	89	51.2	45	38.5
Motorised two-wheelers	7	n.s.	7	n.s.	3	n.s.
No answer	82	19.2	235	56.6	99	24.2

Source: 2017 NHTS. Calculations by the authors. n.s. : not significant.

### Appendix 5. Paris' correlation matrix of the independent variables of the model (Pearson correlation coefficients and significance test)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	1										
(2)	-0.0502*	1									
(3)	-0.1104***	-0.1098***	1								
(4)	-0.0527*	0.0863***	0.0051	1							
(5)	-0.0477*	0.3923***	-0.2389***	0.0809***	1						
(6)	0.0393	-0.0388	0.1534***	0.01957	-0.1072***	1					
(7)	-0.0908***	0.3226***	-0.0419	0.1478***	0.4859***	-0.1435***	1				
(8)	-0.0590**	0.0079	0.0052	0.1089***	-0.0140	0.0544*	-0.0609**	1			
(9)	-0.0275	-0.0991***	0.0140	0.0557*	-0.1676***	0.0094	-0.1157***	0.2532***	1		
(10)	-0.0158	0.0123	0.0389	0.0018	0.0768***	-0.0263	-0.0263	0.1041***	0.0246	1	
(11)	-0.0368	-0.0259	0.0431	-0.0956***	0.0658**	0.0658**	-0.0133	0.0399	-0.2258***	0.4496***	1

(1) arrival time at work, (2) flexitime, (3) sex, (4) age, (5) job category, (6) working time (7) household income, (8) household structure, (9) workplace density (10) commuting time, (11) commuting mode.

\* denotes significance at the 5% level;

\*\*denotes significance at the 1% level;

\*\*\*denotes significance at the 0,01% level;

Source: 2008 ENTD. Calculations by the authors.

### Appendix 6. San Francisco correlation matrix of the independent variables of the model (Pearson correlation coefficients and significance test)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	1										
(2)	-0.1098***	1									
(3)	-0.0308	-0.0445*	1								
(4)	-0.0711***	0.0860***	-0.0211	1							
(5)	-0.1373***	0.2645***	-0.1008***	0.0405*	1						
(6)	0.1900***	-0.0830***	0.1467***	-0.0268	-0.2374***	1					
(7)	-0.1663***	0.2760***	-0.0276	0.0036	0.3343***	-0.2084***	1				
(8)	-0.0271	-0.0579**	-0.0739***	-0.0655***	-0.0088	-0.0089	-0.0938***	1			
(9)	-0.0365	0.0436*	0.0110	0.0376	-0.0569**	0.1047***	-0.0275	0.0433*	1		
(10)	-0.0939***	0.1878***	-0.0299	0.0770***	0.0742***	0.0121	0.0815***	0.03729	0.0988***	1	
(11)	-0.0932***	0.1955***	0.0397*	-0.0055	0.0437*	0.0736***	0.0626**	-0.03866	0.0674***	0.6949***	1



(1) arrival time at work, (2) flexitime, (3) sex, (4) age, (5) job category, (6) working time (7) household income, (8) household structure, (9) workplace density (10) commuting time, (11) commuting mode.

\* denotes significance at the 5% level;

\*\*denotes significance at the 1% level;

\*\*\*denotes significance at the 0,01% level;

Source: 2017 NHTS. Calculations by the authors.

## Appendix 7. Paris' odds-ratio of the multinomial models estimates of work arrival time choice in Paris

	Base model				Full model			
	Pre-peak		Peak		Pre-peak		Peak	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<b>Flexitime</b>								
No	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Yes	0.746	0.516-1.080	1.115	0.848-1.466	1.039	0.356-3.031	3.615	1.713-7.628
<b>Job category</b>								
Professional, managerial	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Clerical, admi. support	1.918	1.252-2.939	1.216	0.882-1.676	2.010	1.170-3.454	1.306	0.867-1.968
Manufacturing, construction	2.833	1.643-4.884	0.598	0.361-0.990	2.729	1.459-5.104	0.555	0.315-0.979
Sales, service	1.339	0.839-2.135	0.686	0.483-0.972	1.428	0.821-2.484	0.686	0.451-1.044
<b>Sex</b>								
Female	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Male	1.580	1.156-2.159	0.638	0.502-0.809	1.589	1.161-2.175	0.623	0.490-0.793
<b>Age</b>								
30 to 39	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Under 30	0.926	0.620-1.382	0.803	0.597-1.081	0.912	0.609-1.365	0.814	0.603-1.099
40 to 49	1.575	1.082-2.293	1.087	0.808-1.463	1.578	1.080-2.305	1.118	0.828-1.509
50 to 59	2.693	1.764-4.112	1.410	0.998-1.993	2.748	1.794-4.209	1.472	1.038-2.088
60 and above	1.787	0.733-4.354	0.798	0.390-1.632	1.706	0.694-4.190	0.799	0.397-1.649
<b>Household income</b>								
Third quintile	Ref.	.	Ref.	.	Ref.	.	Ref.	.
First quintile	0.930	0.593-1.458	0.705	0.487-1.019	0.969	0.597-1.573	1.023	0.678-1.544
Second quintile	1.044	0.683-1.595	0.890	0.631-1.254	1.001	0.632-1.585	1.144	0.777-1.684
Fourth quintile	1.372	0.868-2.169	1.262	0.880-1.810	1.690	0.993-2.876	1.629	1.042-2.547
Fifth quintile	0.815	0.486-1.367	0.917	0.625-1.345	0.609	0.303-1.223	1.211	0.728-2.016
<b>Working time</b>								
Full-time	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Part-time	0.354	0.200-0.626	0.768	0.536-1.101	0.332	0.187-0.588	0.726	0.505-1.046
No answer	0.279	0.038-2.064	0.217	0.042-1.121	0.264	0.033-2.090	0.170	0.031-0.924
<b>Household structure</b>								
1 adult, no child	Ref.	.	Ref.	.	Ref.	.	Ref.	.
2+ adults, no child	1.060	0.711-1.580	1.133	0.829-1.549	1.068	0.714-1.598	1.141	0.832-1.563
1 adult, child	1.293	0.719-2.327	2.068	1.308-3.272	1.323	0.734-2.384	2.123	1.336-3.373
2+ adults, child	1.068	0.753-1.516	1.296	0.982-1.710	1.112	0.783-1.579	1.297	0.981-1.715
<b>Workplace density</b>								
Medium density	Ref.	.	Ref.	.	Ref.	.	Ref.	.
High density	0.491	0.331-0.727	0.714	0.544-0.937	0.467	0.314-0.695	0.720	0.547-0.947
Low density	1.769	1.108-2.822	1.291	0.841-1.984	1.859	1.160-2.978	1.423	0.921-2.200
<b>Commuting time</b>								
Less than 20 minutes	Ref.	.	Ref.	.	Ref.	.	Ref.	.
20 to 39 minutes	0.760	0.534-1.082	0.754	0.564-1.008	0.755	0.530-1.075	0.759	0.566-1.017
40 to 59 minutes	0.951	0.606-1.493	1.022	0.715-1.463	0.959	0.608-1.512	1.043	0.726-1.497
60 minutes and more	0.564	0.341-0.933	0.724	0.498-1.054	0.547	0.329-0.910	0.715	0.490-1.045
<b>Commuting mode</b>								
Car	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Public transport	0.517	0.355-0.753	1.295	0.973-1.724	0.679	0.446-1.034	1.465	1.047-2.049
Walking, bike	0.662	0.407-1.075	1.125	0.761-1.664	0.756	0.442-1.292	1.258	0.804-1.970
Motorised two-wheelers	1.038	0.574-1.879	1.688	1.027-2.772	1.484	0.742-2.967	1.995	1.064-3.739

Interaction terms								
Flexitime* sales, service	.	.	.	.	0.677	0.207-2.215	0.951	0.408-2.216
Flexitime * clerical	.	.	.	.	0.864	0.346-2.158	0.833	0.423-1.642
Flexitime * manufacturing	.	.	.	.	2.753	0.377-17.57	3.408	0.516-22.49
Flexitime * first quintile	.	.	.	.	0.884	0.246-3.184	0.139	0.053-0.365
Flexitime * second quintile	.	.	.	.	1.773	0.519-6.048	0.357	0.148-0.859
Flexitime * fourth quintile	.	.	.	.	0.623	0.194-2.008	0.390	0.176-0.862
Flexitime * fifth quintile	.	.	.	.	2.060	0.625-6.785	0.371	0.167-0.823
Flexitime * walking, bike	.	.	.	.	0.779	0.239-2.535	0.630	0.262-1.515
Flexitime * mot. two-wheel.	.	.	.	.	0.194	0.040-0.934	0.660	0.240-1.814
Flexitime * public transport	.	.	.	.	0.324	0.137-0.764	0.615	0.358-1.057

Source: 2008 ENTD. Calculations by the authors.

### Appendix 8. Paris + San Francisco multinomial base and full model estimates of work arrival time choice

	Base model Paris				Base model San Francisco			
	Pre-peak		Peak		Pre-peak		Peak	
	Coeff.	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.	Coeff.	Std. err.
Constant	0.4790*	0.2347	0.4979*	0.1982	0.5119*	0.2505	0.2703	0.2179
Flexitime								
No	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Yes	-0.5889***	0.1047	0.0567	0.0869	-0.6906**	0.2333	0.5005**	0.1977
Job category								
Professional, managerial	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Clerical, admi. support	0.6592***	0.1424	0.0567	0.0869	-0.6906**	0.2333	0.5005**	0.1977
Manufacturing, construction	0.8599***	0.1647	-0.2755	0.1662	0.7421**	0.2012	-0.6382**	0.2112
Sales, service	0.0797	0.1256	-0.3002**	0.1046	0.0835	0.1629	-0.2976*	0.1425
Sex								
Female	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Male	0.1465	0.0961	-0.3606***	0.0789	0.1396	0.0967	-0.3688***	0.0794
Age								
30 to 39	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Under 30	-0.2555	0.1320	-0.2437*	0.1034	-0.2581	0.1326	-0.2351**	0.1041
40 to 49	0.3284**	0.1282	0.2239*	0.1056	0.3282*	0.1285	0.2196*	0.1060
50 to 59	0.8631***	0.1319	0.3439**	0.1159	0.8709***	0.1325	0.3631**	0.1168
60 and above	0.5036**	0.1894	0.0744	0.1638	0.5075**	0.1906	0.1126	0.1652
Household income								
Third quintile	Ref.	.	Ref.	.	Ref.	.	Ref.	.
First quintile	-0.2736*	0.1377	-0.4218**	0.1207	-0.2406	0.1649	-0.0429	0.1528
Second quintile	-0.2323*	0.1396	-0.0029	0.1162	-0.2709	0.1705	0.1284	0.1528
Fourth quintile	0.3034*	0.1442	0.4081**	0.1206	0.3805	0.1976	0.5735**	0.1784
Fifth quintile	0.0463	0.1495	0.2399*	0.1212	-0.6874	0.2375	0.4314*	0.1953
No answer	0.8232	0.5813	1.1542*	0.5305	0.8678	0.5852	1.0666*	0.5349
Working time								
Full-time	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Part-time	-1.2606***	0.1415	-0.7585***	0.1066	-1.2808***	0.1428	-0.7584***	0.1074
No answer	-1.0610	1.0071	-1.4660	0.8082	-1.0889	1.0187	-1.4882	0.8091
Household structure								
1 adult, no child	Ref.	.	Ref.	.	Ref.	.	Ref.	.
2+ adults, no child	-0.0146	0.1305	0.1830	0.1068	-0.0158	0.1311	0.1787	0.1075
1 adult, child	0.1916	0.2287	0.6417**	0.1819	0.1869	0.2294	0.6219**	0.1829
2+ adults, child	0.1552	0.1283	0.3410**	0.1060	0.1594	0.1288	0.3339**	0.1066
Workplace density								
Medium density	Ref.	.	Ref.	.	Ref.	.	Ref.	.
High density	-0.6898***	0.1427	-0.3888**	0.1115	-0.7028***	0.1437	-0.3792**	0.1125
Low density	0.1539	0.1543	0.0469	0.1404	0.1571	0.1543	0.0647	0.1410
No answer	-0.3032	0.1567	-0.0631	0.1343	-0.3082	0.1575	-0.0713	0.1353
Commuting time								
Less than 20 minutes	Ref.	.	Ref.	.	Ref.	.	Ref.	.

20 to 39 minutes	-0.2164	0.1185	-0.1223	0.1027	-0.2055*	0.1190	-0.1178	0.1035
40 to 59 minutes	0.0663	0.1442	0.0596	0.1245	0.0721	0.1445	0.0832	0.1250
60 minutes and more	-0.4241***	0.1565	-0.1546	0.1290	-0.4184***	0.1570	-0.1586	0.1294
No answer	-1.3765	1.6531	-1.3055	1.2572	-1.3875	1.6515	-1.4327	1.2836
Commuting mode								
Car	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Public transport	-0.6153***	0.1271	0.2950**	0.1001	-0.5539**	0.1563	0.3397**	0.1300
Walking, bike	-0.6265**	0.1816	0.1295	0.1389	-0.4655*	0.2284	0.2948	0.1876
Motorised two-wheelers	0.0962	0.2664	0.4328	0.2286	0.1570	0.3167	0.4177	0.2925
Urban fixed effect								
San Francisco	Ref.	.	Ref.	.	Ref.	.	Ref.	.
Paris	-0.4937**	0.1408	0.2257	0.1171	-0.5483**	0.1645	0.2537	0.1447
Interaction terms								
Flexitime* sales, service	.	.	.	.	-0.1087	0.2644	-0.1013	0.2163
Flexitime * clerical	.	.	.	.	0.1818	0.2952	-0.2545	0.2502
Flexitime * manufacturing	.	.	.	.	0.4808	0.3840	1.2217**	0.3736
Flexitime * first quintile	.	.	.	.	-0.0200	0.2969	-1.0131***	0.2500
Flexitime * second quintile	.	.	.	.	0.1436	0.2954	-0.2499	0.2363
Flexitime * fourth quintile	.	.	.	.	-0.0826	0.7769	-0.3408	0.2420
Flexitime * fifth quintile	.	.	.	.	0.7231**	0.3120	-0.3730	0.2488
Flexitime * walking, bike	.	.	.	.	-0.3727	0.3736	-0.3399	0.2703
Flexitime * mot. two-wheel.	.	.	.	.	-0.1962	0.5877	0.1678	0.4653
Flexitime * public transport	.	.	.	.	-0.1309	0.2328	-0.0961	-0.1735
Flexitime * Paris	.	.	.	.	0.0749	0.2189	-0.0668	0.1753
Summary statistics	N = 4,507 McFadden Pseudo-R <sup>2</sup> = 0.0939				N = 4,507 McFadden Pseudo-R <sup>2</sup> = 0.0986			

\* denotes significance at the 5% level;

\*\*denotes significance at the 1% level;

\*\*\*denotes significance at the 0.01% level.

Explanation: An individual possessing all the reference characteristics serves as the comparison point. He has all the characteristics associated with the abbreviation "Ref".

Source: ENT D 2008. 2017 NHTS. Calculations by the authors.

## Data availability

Data will be made available on request.

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