

Effects of Aging on Taxi Service Performance

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The taxi industry is recognized as a sector with substantial potential for sustainable development, involving key stakeholders such as policymakers, regulatory agencies, companies, drivers, and customers. Population aging presents a significant challenge with the aging workforce, potentially impacting the development of various industries.

Keywords: aging ; taxi driver ; taxi service performance ; multiple regression analysis

1. Introduction

The taxi industry is recognized as a sector with substantial potential for sustainable development, involving key stakeholders such as policymakers, regulatory agencies, companies, drivers, and customers ^[1]. Among these roles, drivers are pivotal as direct service providers and major contributors to the overall performance of taxi services. Nevertheless, the taxi industry has, over time, confronted an undeniable challenge: an aging workforce among its drivers ^{[2][3][4][5][6][7][8][9]}.

In recent years, the aging trend within the taxi industry has garnered widespread attention. It is widely acknowledged that as the driver workforce ages gradually, a range of new issues and opportunities arise. On the one hand, some argue that an aging driver workforce may face challenges related to declining physical and cognitive abilities ^[10], which could adversely affect their driving safety ^{[4][11][12][13][14]} and job motivation ^{[11][15]}. On the other hand, there is the viewpoint that aging could bring about some positive aspects. Older drivers may possess richer driving experience, potentially leading to higher driving skills ^[16], greater earnings, and a reduced likelihood of engaging in risky driving compared to younger drivers ^{[17][18][19][20][21]}. These controversial viewpoints may be attributed to a reliance on certain data sources. Given that studying how aging affects taxi service performance requires data derived from driver privacy, previous research has often relied on self-reported information provided by drivers, which poses challenges for conducting comprehensive and nuanced research in this area. This type of data source not only tends to have a limited sample size but also is susceptible to social desirability bias, as noted in previous studies ^[22]. Although researchers can mitigate this bias, it cannot be entirely eliminated. To attain a more comprehensive understanding of how aging impacts taxi service performance, it is imperative to surmount the constraints associated with prior data sources and leverage more expansive and objective datasets that are inclusive of driver privacy. The advent of the big data era has rendered this endeavor feasible. This metamorphosis has facilitated the conversion of taxi operational data into driver-centric operational data, culminating in a comprehensive and unbiased dataset of taxi driver operations.

Besides the research data, careful attention to the research methodology is crucial. To thoroughly understand how driver aging affects taxi service performance, it is imperative to utilize precise and practical research methodologies. At present, in the specific operation of causal analysis using objective big data on taxis, it is possible to combine the treatment of various variable biases by using methods such as simple linear regression ^[23], propensity score matching ^[24], instrumental variables ^[25], etc. It is also possible to combine the control of experimental scenarios and use methods such as regression discontinuity design ^[26], difference in differences ^[27], etc. But inevitably, the core of these methods is still multivariate regression, in order to quantify the impact of independent variables on the dependent variable. In summary, the core of these methods is still multivariate regression analysis, aimed at quantifying the effect of independent variables on the dependent variable.

In conclusion, driver aging is a significant issue within the taxi industry, but a comprehensive and profound discussion of the impact of aging on taxi service performance has been limited by constraints in available research data.

2. Effects of Aging on Taxi Service Performance

Population aging presents a significant challenge, particularly with the aging workforce, potentially impacting the development of various industries. Researchers across diverse fields have been dedicated to comprehending the

implications of aging on industry sustainability and growth, as well as devising potential solutions [28][29][30][31][32]. In transportation, researchers have also dedicated considerable efforts to address safety concerns related to driver aging. Using non-professional driver data, Reason et al. [33] found a decline in violations with age based on multiple regressions. Blockley et al. and Rimmö [34][35] reached consistent conclusions. On the contrary, Khan M T. [36] conducted an evaluation of the impact of aging on driving abilities. They categorized drivers into two groups, the young group (under 40) and the elderly group (over 60), and performed various tests that correlated neuropsychological outcomes with driving performance. Their findings indicated a decline in driving performance within the elderly group. However, Hakamies-Blomqvist et al. [37] present a differing perspective. Utilizing survey data from Finland, they compared accident rates between older drivers (aged 65 and above) and younger drivers (aged 26–40). Innovatively, they introduced an additional control to account for low mileage bias across all age groups. Their research, for the first time, revealed that age does not lead to an increase in accidents per kilometer driven. For professional drivers, Dorn and Af Wählberg [38] employed two different methodologies, direct calculations and the indirect method of quasi-induced exposure, to investigate the influence of age and experience on bus driver accident involvement. Their research revealed that both young and old drivers had a higher frequency of accidents, which became more evident when their experience was held constant. In a separate study, Hamido et al. [39] conducted a statistical analysis of experiential data from Japanese truck transportation companies. Their findings indicated that, in comparison to younger drivers, age had a significantly reduced impact on older drivers.

There is also significant research on how aging affects taxi driver safety, often making comparisons between older and younger drivers. In earlier years, some viewpoints asserted that younger drivers lacked experience and were more prone to being unsafe [40][41]. Conversely, in recent years, numerous studies have taken a contrasting stance, suggesting that older drivers should be more focused on safety concerns. Vahedi et al. [42] used linear regression models and data from the Driver Behavior Questionnaire (DBQ) to suggest that older drivers may be more susceptible to traffic accidents due to their declining physical abilities. Peng et al. [12] collected self-report questionnaires from 2391 drivers in China and employed a set of comparative analyses and three structural equation models to analyze samples from specific age groups. The results indicated that elderly taxi drivers engage in risky behaviors and traffic accidents more frequently. Sun et al. [8] utilized independent sample *t*-tests to analyze data from 550 taxi drivers aged between 25 and 59. Their findings revealed that older drivers with greater driving experience tended to exhibit slower responses to hazards in video clips and were more inclined to adopt maladaptive driving styles.

However, although there is a significant amount of research on taxi services [43][44][45][46], the relationship between driver age and various aspects of the taxi service has been surprisingly understudied. While Koh et al. [47] compared physical health, working hours, driving distances, and accident rates between older and younger drivers, research into other performance factors is limited. More recently, Meng et al. [15] identified age as the only demographic predictor of self-reported fatigue among taxi drivers. Their findings revealed a complex dynamic in which younger drivers earn higher incomes but report greater work intensity and fatigue. Further investigation into the nuanced impacts of aging on additional dimensions of taxi service performance, such as customer satisfaction, driving skills, and earnings, is needed.

In summary, population aging has evidently exerted pressure on workforce sustainability across various industries. Scholars in many fields have comprehensively and profoundly discussed aging's impacts within their respective disciplines. However, there has been limited research thoroughly examining how aging influences taxi service performance. The existing literature on aging's effects in the taxi industry primarily focuses on safety aspects. There remains an inadequate understanding of how aging affects other dimensions of taxi performance such as economic, environmental, and overall metrics. While some initial insights have been gained, it is important to recognize that the relationship between aging and taxi service performance is both nuanced and complex. More empirical research is needed to investigate the multifaceted effects of aging on the economic, safety, environmental, and holistic performance of taxi services.

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