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Impact of public transport and ride-hailing services on female labour force

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Impact of Public Transport and Ride-hailing Services on Female Labour Force Participation in Lahore, Pakistan: A Mixed-Method Approach*

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Abstract

In many developing countries, restricted mobility is a significant barrier to women's economic empowerment. Mobility constraints can hinder women's ability to access job opportunities and attain financial independence, perpetuating gender disparities and limiting their involvement in economic activities. This study employs a mixed-method approach to investigate the impact of mass transit and ride-hailing services on female labour force participation in Lahore, Pakistan. Using a synthetic control method and labour force surveys spanning over two decades (1999-2020), we evaluate the impact of mass transit and ride-hailing services on female labour force participation by constructing a synthetic Lahore series to compare it to the actual Lahore series. The results show that the provision of mass transit has led to a small but positive increase in female labour force participation compared to the synthetic counterpart. However, ride-hailing services did not show any significant impact. Additionally, qualitative analysis revealed that spatial mismatch significantly affects women's mobility choices. Although most metro users have access to stations, inconvenient locations necessitate additional costs and time-consuming modes of transportation. Time-saving emerged as an important factor for women, with the metro bus system being a more efficient option due to its dedicated route and frequency. Finally, safety concerns remain a significant issue for women using different modes of transportation, highlighting the need for gender-sensitive transport planning to address the specific needs of women commuters.

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1. Introduction

Infrastructure development in cities is the foundation for achieving inclusive growth as it provides direct access to education, work, healthcare, and other services. However, inadequate mobility infrastructure is often considered a serious problem that exacerbates inequalities by reducing the opportunities for women to realize their full potential. The ability to move around freely is fundamental to the empowerment of women, as it enables them to seize opportunities and resist the limitations imposed by the pervasive patriarchy (Tiwari & Jian, 2013). It is well established that the transport sector has been gender-blind by ignoring the differences in the mobility patterns of men and women (Litman, 2007; Njoh, 1999; Thondoo et al., 2020; Turner, 2012; Priya Uteng & Turner, 2019). Research on travel behaviour has provided ample evidence that highlights the contrast between the transportation needs and experiences of women and men (Priya Uteng, 2012). Due to various factors such as distinct attitudes towards public and private transportation, differences in employment and commuting patterns, and differences in caregiving responsibilities for children and elders, it has become evident that women require different treatment (Loukaitou-Sideris, 2020; Mahambare & Dhanaraj, 2022; Mahadevia & Advani, 2016; Nobis & Lenz, 2005; Scheiner & Holz-Rau 2017; Singh, 2020).

Gender travel behaviour in developing countries, particularly in cities, is characterized by the existence of a huge disparity between the educated middle class and low-income uneducated women. Furthermore, the limited access to urban spaces and different modes of transportation, the existence of slums, and the pervasion of cultural or social norms in society places a burden on women's participation in the outside world (Priya Uteng, 2012). These factors can result in longer travel times, greater difficulty accessing transportation, and limited job opportunities, particularly in areas with inadequate transport infrastructure. A crucial factor that can ensure increased participation of women in the labour force is the access to opportunities that come with ease in mobility. Enhanced access to public transportation for jobs has been shown to increase the likelihood of employment for individuals, particularly in metropolitan areas, smaller cities, and towns (Bastiaanssen et al., 2022).

Notwithstanding the accumulation of factors typically linked to increased female labour force participation rates[4], such as an increase in female education, a decrease in fertility rates, and high levels of economic growth observed in most developing countries over the past 25 years, there exists a heterogeneous regional trend. While the Latin America and Caribbean regions have experienced an increase in female labour force participation, South Asia has exhibited a decrease from previously low levels (Klasen, 2019). Despite experiencing approximately 9% growth in female labour force participation, women in Pakistan continue to exhibit significantly lower rates of workforce engagement compared to regional averages (Amber & Chichaibelu, 2023a). Furthermore, women who live in urban areas are less likely to participate in the labour force than women who live in rural areas (Amber & Chichaibelu, 2023b). A significant barrier to women's participation in the labour force in the urban areas of Pakistan is the constraint on their physical mobility outside their homes (Field & Vyborny, 2016). The emerging low-income communities on the outskirts of urban areas often lack adequate transportation infrastructure, posing a significant accessibility challenge, particularly for women (Mahadevia, 2015). The societal restrictions against women interacting with men who are not relatives, coupled with fear of harassment, social stigma, and discomfort, further act as an obstacle to women's freedom of movement and their reliance on different modes of transportation (Sajjad et al., 2018). Therefore, the factors of accessibility, affordability, and safety are crucial to consider when addressing the constraints on women's mobility.

Public transportation provides an affordable option for women to commute. However, the research (Sajjad et al., 2017) shows that in Pakistan, women deal with various challenges concerning safety, harassment, and worries about their social reputation while traveling by public transport. Safety issues can indeed differ across various modes of public transportation. Additionally, the study finds that approximately 70% of the male family members discouraged their female relatives from utilizing public wagons, which are an informal or unregulated mode of transportation. However, the integration of infrastructure and technology in mass transit systems has introduced measures ensuring the safety of women, particularly when compared to other modes of public transportation (Martinez et al., 2018). These advancements may include the presence of well-designed and well-

[4] Labour force participation rates are used for the quantitative analysis, but we interviewed females who are currently employed for the qualitative analysis. It is worth noting that labour force participation encompasses women who are actively seeking employment but are not currently employed. In our study, we use both terms interchangeably.

lit stations, surveillance cameras, and security personnel. Such elements contribute to a safer environment for female passengers, reducing the risk associated with harassment and other safety concerns. Delhi metro, a large-scale mass transit transportation service offers women a travel experience that is more empowering and positive in comparison to other modes of public transportation (Gopal & Shin, 2019). That is, primarily due to the implementation of safety measures and the sense of security women feel while using the system.

In contrast, private transportation services offer better accessibility and safety, but they are not affordable compared to public transportation. Using a smartphone app, individuals can reserve a ride from any location through ride-hailing services (Rayle et al., 2016). However, the service remains more expensive than public transportation and does not attract transit users, particularly females (Singh, 2020). Furthermore, residents in more well-off neighbourhoods tend to rely more on private cars, taxis, and ride-hailing services for transportation, while those in low-cost and middle-class neighbourhoods prefer public transit for commuting and use ride-hailing for leisure trips (Qiao & Yeh, 2023). Using a commuter accessibility model, William et al. (2019) analyse commute costs for driving alone, private drivers, app-based taxi services, and the new metro system for Riyadh women. The results show that increased commute cost result in decreased employment among women. Addressing safety, a study in Bangladesh shows that in comparison to other modes of transportation, women who took Uber, a ride-hailing service, generally experienced a greater sense of security (Kumar et al., 2018). This feeling of safety was derived from the fact that the Uber app recorded the driver's name, number, and vehicle details. Despite the limited research on the impact of ride-hailing, there have been notable safety concerns, with reports of male drivers sexually assaulting female passengers from various locations worldwide. Consequently, there has been a growing demand for safe transportation services for women, resulting in the launch of several women-only ride-hailing services in different countries. These services exclusively feature female drivers and passengers, such as She'Kab (Pakistan), She Cabs (India), Riding Pink (Malaysia), HerRyde (Nigeria), LadyDriver and FemiTaxi (Brazil), See-Jane-Go (US), and many others. Moreover, the emergence of ride-hailing platforms, such as Uber and Careem, has provided women with a viable option for a flexible job opportunity. Female drivers working with these companies have reported the flexible nature of the job as a key motivation for entering the labour market, alongside financial obligation (Rizk et al., 2018).

Considering the importance of the provision of public and private transportation services in facilitating female labour force participation, this research aims to answer the following questions: (1) What would have been the female labour force participation in Lahore if there were no provision of 'Lahore metro' transportation services? (2) What would have been the female labour force participation in Lahore if there were no provision of 'ride-hailing' transportation services? (3) What are the factors associated with the use of public and private transportation services that facilitate or hinder women from participating in the labour force (commuters' perspective)? and (4) What are the perspectives of service providers on mobility constraints faced by women, and how are they addressing these constraints? To answer these questions, we use a mixed-method approach combining quantitative and qualitative research methods to gain a more holistic understanding of the impact of transportation services on female labour force participation in Pakistan.

By utilizing a mixed-method approach, this study significantly contributes to the existing literature by investigating factors that influence women's transportation choices and their subsequent impact on labour market inclusion. First, employing a synthetic control method with labour force surveys conducted between 1999 and 2020, the study investigates the causal impact of mass transit and ride-hailing services on female labour force participation. To our knowledge, Martinez et al., (2018) are the only ones to examine the causal impact of mass transit on women's employment in Lima, using the difference-in-difference approach. Additionally, Christensen & Osman (2021) examine the causal impact of price reductions provided to Uber riders and their subsequent effect on mobility demand through an experimental approach. In Pakistan, Field & Vyborny (2022) use an experimental approach to quantify the impact of transportation to work on both men and women in Lahore and find that safety and social acceptability are the primary constraints to women's mobility. Furthermore, Majid et al. (2018) demonstrate the causal impact of mass transit on commuting and report that access to mass transit reduces both time and cost of commuting. Second, using qualitative data collected from employed females that use the metro bus and ride-hailing services in Lahore and the service providers, we perform thematic analysis to gain insights into the role mobility constraints play in female labour force participation and the determining factors in women's selection of the modes of transportation. Therefore, by using a combination of quantitative and qualitative approaches, we gather a comprehensive range of data and perspectives, allowing for a deeper understanding of the causal impact of the provision of transportation services

on female labour force participation. Kabeer (2019) argues that incorporating mixed methods allows to overcome certain limitations related to causal analysis, leading to a stronger foundation for drawing robust conclusions.

The findings of the study indicate the positive impact of the introduction of metro services on the participation of women in the labour force in Lahore. However, the launch of ride-hailing services did not lead to a subsequent increase in female labour force participation. The outcomes of the qualitative investigation highlight accessibility and safety as the primary factors that women consider when selecting modes of transportation. Moreover, the analysis suggests that transportation planning in Lahore has failed to adequately consider gender-related factors. Nevertheless, the transport service providers (metro bus, and ride-hailing) offer additional safety features for women compared to other modes of transportation. Hence, to tackle the challenge of urban mobility for women commuters, it is crucial to establish cooperation between public and private service providers to expand the range and features of mobility alternatives available to women.

The remainder of the paper is divided into six sections. Section 2 provides the context of the study. Section 3 explains the conceptual framework of the study along with relevant literature. Section 4 describes the details of the research methods along with secondary and primary data used for the analysis. Section 5 communicates the results and discussions of the quantitative and qualitative analysis. Finally, section 6 provides conclusion and policy recommendations.

2. Context of the Project

2.1 Study Area

The section provides an overview of the study area, delineating the specific context in which the research was conducted. In Pakistan, the cities across the four provinces vary in terms of economic development and women's employment. In Punjab, the most populous province, cities like Lahore, Faisalabad, and Rawalpindi are more economically developed, offering diverse job opportunities across various sectors. In Sindh, Karachi stands as the economic hub of the country, offering a wide range of employment options for both men and women. However, despite its economic prominence, women's employment rates in Karachi still face challenges. In Khyber Pakhtunkhwa, cities such as Peshawar and Abbottabad exhibit potential for economic growth, yet gender

disparities persist, influencing women's access to employment opportunities. Baluchistan, the least developed province, faces considerable economic challenges, resulting in limited job prospects for both men and women. We selected Lahore as the research site for analysing the impact of transportation services provision for several reasons, which are described below.

Lahore is the 21st most populous city in the world and the second largest in Pakistan. It is one of the fastest-growing cities in the country with a population of 11.1 million[5] and a population density of 6275.39 inhabitants per square kilometre. The city is the capital of the Punjab province, which ranks highest in terms of the working-age population, that is, around 88.4 million[6]. The city is home to a huge population including indigenous and immigrants who come to the city in search of better living conditions, including health, education, employment, and commercial activities. However, rapid urbanization along with the inadequate provision of public services has given rise to congestion, pollution, inequality, and social exclusion.

Females make up almost 48 percent of Lahore's working-age population. However, their labour force participation rate is only 13.5 percent compared to 64.6 percent for men[7]. Even though the city has a better transport infrastructure (compared with other big cities), access to safe and affordable modes of transportation is still a dilemma for the females who are spatially isolated from the job market. According to the Women's Economic and Social Well-being Survey (2018), 34% of women, aged 15 to 64 (in Punjab) cite a lack of transport as a barrier to entering the labour market. The survey also reports that only 3.3 percent of females who are in paid employment have dedicated pick-and-drop facilities. Hence, restrictions on physical mobility outside the home act as a critical hindrance to the labour market inclusion of women in urban areas in Pakistan (Field and Vyborny 2016).

Through a series of public and private planning endeavours, the provision of transportation services in Lahore city has developed over the last decade. Lahore being the pioneering city in Pakistan where mass transit infrastructure was initially implemented, offers a valuable opportunity to examine the impact on women's employment over an extended period. The dominant modes of public transportation include the Lahore metro bus, the orange line, and speedo buses.

[5] https://www.pbs.gov.pk/content/final-results-census-2017
[6] https://www.pbs.gov.pk/publication/labour-force-survey-2020-21-annual-report
[7] Same as above

Furthermore, private transportation modes comprise (excluding personal vehicles) ride-hailing (Uber, Careem, and InDriver), taxis, auto rickshaws, and motorcycle rickshaws.

2.1.1 Lahore Metro Bus System

BRT technology is based on the idea of providing transportation service through buses similar to rail-transit modes that include dedicated routes, institutional branding, electronic ticketing, and proper stations (Flores 2013). The Lahore metro bus (MBS) is the first BRT in Pakistan. It is operated by the Punjab Mass Transit Authority (PMTA) along with a system of feeder routes (speedo buses) that connect different spatial locations to the metro stations (Figure A1). PMTA is one of the regulatory authorities and is directly responsible for the operation and maintenance of metro buses. The Lahore MBS was constructed and inaugurated in 2013 (in less than a year) at a cost of 11 million dollars per kilometre. However, it was the completion of an idea that took almost 20 years of consideration (Sajjad 2014) as it had first been proposed in 1991.

The Lahore metro bus is currently based on a fleet of 64 articulated air-conditioned buses with a capacity of 108 passengers per bus[8]. These buses operate on a single route of 27 kilometres with 27 stations. The buses operate on totally separate corridors with nine elevated stations (8.3 km) and are not stalled by city' traffic, which has markedly reduced travel time between Shahdara (start point) and Gajjumata (ending point). The fare per trip for one side is Rs. 30 (approximately 0.11 USD / 0.10 euros). The passenger is required to exit the system within an hour and 15 minutes after taping at the entry turnstile. Two modes of ticketing allow passengers to buy a token (for a single ride) or a metro bus card (a package for multiple rides). The buses operate from 06:15 am to 10:00 pm with a headway time of 2.25 to 3.0 minutes. However, during the last hour (09:00 pm – 10:00 pm), the headway time is 6 minutes from Gajjumata to Shahdara. The system has separate seating and standing area for women along with the female staff at the ticket counters and waiting area.

The route of the metro bus is not accessible to many areas in Lahore, therefore, PMTA has introduced a network of feeder routes (Figure A1) ensuring accessibility to different metro stations. According to PMTA, the metro bus system has achieved the highest passenger volume of 179,104 per day. Furthermore, up to May 2017, the system had transported 210 million passengers.

[8] The information about metro bus system has been reported from PMTA (https://pma.punjab.gov.pk/).

2.1.2 Ride-hailing

Ride-hailing (also known as ride-sharing) is a tech service that connects two sides of the market place i.e., riders and drivers. Ride-hailing services are well established in Lahore as well as in other metropolitan cities across Pakistan. There are multiple tech service providers in Lahore; nonetheless, considering the market share and period of the study, we focus primarily on Uber and Careem. Careem started its operations in Lahore in 2015 a year earlier than Uber. However, Careem became a wholly-owned subsidiary of Uber in January (2020), preserving its brand[9]. According to an independent research report by Oxford Economics[10] (2021), Careem has around 800,000 registered captains (drivers) in Pakistan. The female registered captains are nearly 1586, which have taken more than 570,000 rides. On the customer side, out of 9 million registered customers, 36% are females. Considering safety as an important determinant of female mobility choices, about 51% of females feel that Careem is a safe mode of transportation compared to only 3 percent who feel it is not safe.

For the sake of brevity, we only discuss important details regarding Careem App. The service is available 24 hours a day and 7 days a week. Careem has different categories of car types which vary in price, size, and comfort level. The passengers can simply select the one that suits their preferences. The options include (1) Go: the most affordable ride for everyday use (2) Go+: extra comfort at an affordable (3) Business: Perfect for corporate and business rides with top-rated captains (4) Dabba: perfect for group commute, airport rides or grocery shopping (5) Rickshaw auto rikshaw rides at an extremely affordable price (6) Bike: an affordable and good option for skipping traffic (7) Delivery: only available to deliver stuff on a bike. The customers can simply select the one that suits their preferences. Cancelation is possible for a new booking within two minutes after a driver has been assigned. After that, a cancellation fee will apply.

The rates for all available cars and booking types for each city are available on the Careem App. The fare per kilometre is different for each vehicle. There is an option of “Help” on the Careem App which people can contact to report various issues regarding rides, food delivery and, Careem pay. Considering the safety option, there is also an option for safety and security that addresses different issues regarding COVID-19, ride insurance, accidents, and support to make a claim.

[9] https://www.uber.com/en-JO/newsroom/uber-careem-close-jo/
[10] https://blog.careem.com/wp-content/uploads/2021/11/EIR_Infographic_consolidated_v2.pdf

There is also an option of "Share ride details" that allows riders to let their friends and family track the ride in real-time.

3. Conceptual Framework and Related Literature

The conceptual framework of our study relies on the neoclassical model of a labour-leisure choice framework, which attempts to investigate the labour supply behaviour of individuals. The model explains the labour supply choice of an individual striving to maximize her utility by allocating her time between the labour market (wage) and home (reservation wage). The reservation wage is the minimum wage an individual requires to enter the labour market, and if the market wage is lower than the reservation wage, the individual will not work. The decision to work is determined by comparing the market wage, which shows how much an employer is willing to pay, and the reservation wage, which shows how much the worker needs to start working (Borjas & Van Ours, 2010). The reservation wage, often viewed as the marginal utility of non-work, encompasses all determinants of labour supply decisions for women, except for the anticipated market wage (Klassen & Pieters, 2012). An interplay of social, economic, cultural, and regional factors influence women's labour supply decisions (Mehrotra & Parida, 2017), including childcare responsibilities (Cassirer & Addati, 2007; Clark et al., 2019; Dang et al., 2022; Narayanan, 2008), household income (Klassen & Pieters, 2015; Afridi et al., 2018), social norms (Cavapozzi et al., 2021; Jayachandran, 2021), and constraints in physical mobility (Field & Vyborny, 2016; Lei et al., 2019; Martinez et al., 2020; Williams et al., 2019).

Transportation infrastructure plays a crucial role in facilitating women's employment through its direct impact on transport affordability. The term "transport affordability" refers to the degree to which the cost of transportation creates a financial burden for an individual or household, requiring them to make sacrifices in order to travel or the extent to which they are able to afford travel without constraints (Carruthers et al., 2005). Affordable transportation services can have a significant impact on reducing reservation wages for women. The reservation wage hypothesis suggests that higher transportation costs are likely to result in a higher reservation wage, which in turn can limit the geographic range of job opportunities available to workers (Patacchini & Zenou, 2005). Therefore, reducing transportation costs can expand the search radius for job opportunities and increase the labour force participation of women (Martinez et al., 2018). The fare structure that is disadvantageous for multistep journeys can result in higher transportation costs, which may

make it more difficult for women to afford transportation (Dominguez Gonzalez et al., 2020). According to Williams et al. (2019), more affordable commute services are associated with higher job participation of Saudi women.

Improved access to employment opportunities through transport infrastructure could potentially decrease the time it takes to find work by broadening job search options and increasing the wages offered for a given job, hence reducing associated reservation wages (Bastiaanssen et al, 2020). As a result, the likelihood of applying for and accepting such work may increase. In transport literature, accessibility is defined as the level of ease with which someone can reach their desired destination using their preferred mode of transportation within a chosen period, or the ease with which they can reach transportation infrastructure to undertake further journeys (Joshi et al., 2021). Ong and Houston (2002) analyse the employment outcomes of unmarried women and find that proximity of transit service to the women's homes plays a significant role in increasing the likelihood of their employment. Two studies conducted at different times show that low-wage workers and low-educated women have reduced individual employment probabilities as their average commute time increases (Thakuriah, 2011; Thompson, 1997). The gender differences in access to and use of various travel modes in low-income households in Delhi have been shown to have a negative impact on the ability to improve job quality and income due to the lack of affordable transport access (Mahadevia, 2015). Furthermore, women's lower access to financial resources has shown to lead to lower access to private and more efficient modes of transportation, resulting in additional penalties due to the time lost in traveling by slower modes of transportation (Singh, 2019). A study in Lahore, Pakistan that examined the effects of access to transport services on men's and women's job search behaviour found that access to transportation significantly affected women's job search behaviour and that providing women-only transport can help reduce physical mobility constraints, making it easier for women to search for jobs (Field & Vyborny, 2022).

The provision of transportation services also influences women's participation in the labour market indirectly. First, safety issues in transportation disproportionately affect women. In many developing countries, the physical mobility of women and girls is restricted due to concerns about their safety and social reputation (Jayachandran, 2015). A review of international studies by Gekoski et al. (2015) reveals that rates of harassment against women in public transportation vary

from nearly 15 percent to 95 percent with higher rates for developing countries, which is potentially attributable to cultural and gender norms that favour men. Several studies suggest that women face greater challenges with public transportation, especially regarding personal safety and harassment concerns, in comparison to men (Allen et al., 2018; Malik et al., 2020; Orozco-Fontalvo et al., 2019; Gautam et al., 2019; Noor & Iamtrakul, 2023). A study by GIZ (2007) in developing countries finds that women prioritize safety and personal security when selecting modes of transportation, which can lead to choosing less efficient or more expensive alternatives when they perceive a threat. Research (Bhattacharya & Kopf, 2017) conducted in Delhi shows that female students are opting for lower-quality colleges due to safety concerns on their travel routes, affecting their labour market inclusion in the end.

Second, emerging transportation services such as ride-hailing can also increase women's employment opportunities as they provide flexible and safe job opportunities. Female drivers in Egypt who work for ride-hailing services have identified the flexible nature of the job as a key incentive for them to enter the labour market (Rizk et al., 2018). However, the proportion of women working as drivers on these platforms remains low due to concerns over personal safety and security, lack of financial means to own a car, low access to the internet and smartphones along with various cultural and societal norms that limit women's participation in the workforce[11].

In addition, the importance of considering a gender-sensitive perspective in the provision of transportation services can also increase women's inclusion in the labour market. Women can bring unique insights into the needs and concerns specific to their gender, which can be taken into account during the planning and design of transport systems (ITF Global, 2019). This approach aims to create safer and more accessible transportation options for women. However, it is noted that women's representation as transport operators and in managerial positions is limited, particularly in developing countries (Noor & Jamtrakul, 2023). This indicates a gender disparity in the transportation sector, which may hinder the full realization of gender-sensitive improvements in transportation services.

[11] https://www.thecairoreview.com/global-forum/empowering-women-to-ride/

4. Research Methods and Data

The literature on transportation and women's employment shows that transportation is not just a physical resource like vehicles, roads, and public transport. It is also about the social and cultural factors that affect women's access to transportation and their ability to use it to connect their home and work lives (Dobbs, 2007). Therefore, the study aims to employ a mixed-method approach to provide a more comprehensive understanding of the interplay of physical, social, and cultural factors and their impact on women's employment in the context of a developing country i.e., Pakistan. The following subsections delve into the quantitative and qualitative analysis, presenting detailed information regarding the methodologies employed and the data sets used.

4.1 Quantitative Analysis: Synthetic Control Methods

Using the synthetic control method developed by Abadie and Gerdeazabal (2003), the study estimates the causal effects of the provision of public and private transportation services on female labour force participation in Lahore, Pakistan, in a comparative case study setting. The method has been considered an eminent innovation in the policy evaluation literature in the last 15 years (Atheys & Imbens, 2017). The synthetic control method aims to estimate the impact of some intervention at the aggregate level that affect a small number of large units for some aggregate outcome of interest (Abadie, 2021). The method treats the region that receives an intervention as a treatment group and compares the outcome variable with a group of units not exposed to the intervention. The aggregate composition of unaffected units provides a good control group rather than a single unaffected unit. The method builds a counterfactual of units using a convex combination of similar units not exposed to the treatment. The convex combination requires nonnegative weights that are determined to ensure that the treatment unit and the synthetic control resemble each other as closely as possible before intervention.

In our study, we consider $j + 1$ cities (Table A2) and assume that Lahore is exposed to the intervention (either metro or ride-hailing). Thus, we have j remaining cities as potential controls or donor pools. This is a group of 27 cities in Pakistan for which data has been constructed from labour force surveys (1999-2020). The cities in the sample are examined for the time period $t = 1, 2, \dots, T$. It is important to note that sufficient data should be available before interventions $1, 2, \dots, T_0$ as well as post-intervention $T_0 + 1, T_0 + 2, \dots, T$ to be able to construct a synthetic

Lahore and estimate the effect of the intervention. Synthetic Lahore is constructed as a weighted average of potential controls and is represented by a vector of non-negative weights that sum to one such that $W = (w_2, \dots, w_{j+1})' with\ 0 \leq w_j \leq 1\ and\ w_2 + \cdots + w_{j+1} = 1$. Each value of W represents a weighted average of the potential control regions, hence a synthetic control (Abadie et al. 2010)[12]. The weights are chosen so that the difference between Lahore and the potential control cities on a number of important predictors of female labour force participation and FLFP itself is minimized in the pre-intervention period. As key predictors, we have constructed various variables at the city level including average age, the proportion of married women, the average number of years of education of the household head, the share of females without formal education, the share of females with a primary level of education, the share of females with a secondary level of education, the share of females with tertiary level of education, average household size, the average number of children between 0 and 4 years of age, employment rate of males and log of household income excluding the income of employed women (Table A1). The variables are averaged over pre-intervention period and augmented by adding two years of lagged female labour force participation rate (2001 and 2007).

Similarly, predictors are assigned weights (V) to allow more weight to be given based on the relative importance of their impact on the outcome variable. In the study, predictor weights (V) and city weights (W) are jointly chosen so that they minimize mean square prediction error (MSPE) of female labour force participation over the entire pre-intervention period. It is important to mention that we use household-level data for employing the synthetic control method. To the best of our knowledge, Peri & Yasenov (2019) are the only ones to apply a synthetic control method using household data.

In this study, we employ a synthetic control method to assess the influence of metro bus and ride-hailing services on female labour force participation in Lahore. By constructing a synthetic counterpart of Lahore using comparable cities as a reference, the synthetic control method aims to offer insights into the overall impact of the introduction of metro bus and ride-hailing services on female labour force participation. The utilization of the synthetic control method necessitates the availability or construction of data at an aggregate level. Therefore, in this study, the quantitative

[12] We suggest reading 'Abadie et al. 2010' for a more detailed technical description of the synthetic control method.

analysis is based on annual labour force surveys (1999-2020)[13] to measure female labour force participation and the predictors of labour force participation at the city level. LFSs provide information on the sociodemographic attribute of the households as well as individual-level information on age, gender, marital status, level of education, etc. The outcome variable of interest is the female labour force participation rate at the city level, which includes employed and unemployed women. Employed women are those who worked for pay, profit, or family gain during the last week, at least for one hour on any day. It also includes women who did not work last week but had a job or an enterprise such as a shop, business, farm, or service establishment. The unemployed females are the ones seeking work during the survey period. Since the project aims to address labour market outcomes of females, we restrict our sample to women of working age (15-64). The labour force participation rate is calculated by dividing the number of employed and unemployed females by the total population of working-age females. The study constructs several predictors of female labour force participation rates at the city level.

We construct data for 28 cities (Table A2) across four provinces of Pakistan. The selection of cities is based on the availability of labour force surveys and the coding schemes so that we could construct data on listed cities for all the available LFSs. To examine the impact of the metro bus on the participation of women in the labour force in Lahore, we used data until 2018 due to the launch of another 'orange line metro train system' of mass transit in 2020. The first stretch (27 km) of the Lahore metro was inaugurated in February 2013, giving us around 10 years of pre-intervention data. We excluded Islamabad, Rawalpindi, and, Multan from the control cities pool that had the same intervention in 2015 and 2017 respectively. In addition, three years of post-intervention data, spanning over six years (three data points) to make reasonable predictions of the effect of this infrastructure intervention seems acceptable. The synthetic group or synthetic Lahore was constructed as a weighted average of potential control cities. The ride-hailing (Uber and Careem) was launched in 2015/2016 in Lahore along with other cities. However, no labour force survey was conducted in 2015/2016. For the sake of analysis, we took 2014 as the intervention year which gave us eleven years of preintervention data. Furthermore, we eliminated Faisalabad, Rawalpindi, Multan, Sargodha, Gujranwala, Sialkot, Bahawalpur, Islamabad, Karachi,

[13] We have data sets from 1990 to 2020. However, the coding schemes were not available for all the data sets which reduces the pre-intervention years for the analysis. Additionally, the labour force surveys for the years 2000, 2002, 2004 are not available and the labour force surveys were not conducted for the years 2011, 2015, 2016 and 2019.

Hyderabad, Sukkur, Peshawar, Quetta, and Mardan from the control states pool because of the introduction of ride-hailing (Uber or Careem) in the post-intervention period (spanning over four years) i.e., 2017-2020.

4.2 Qualitative Analysis: Thematic Analysis

For the qualitative analysis, we used a semantic approach to thematic analysis, since we are primarily interested in women's perceptions and their experiences with using public and private transportation services when travelling to their workplaces. Thematic analysis is used when research aims to explore an issue or problem, and focus more on words, not numbers (Creswell 2012; Miles and Huberman 1994). The method allows one to analyse data in a flexible manner, helps organize data into themes, and interprets the research question (Braun and Clarke, 2006).

In thematic analysis, one can use either a deductive (top-down) or inductive (bottom-up) approach. Alternatively, both can be used together to enhance the analysis of the study (Braun and Clarke 2006). In the study, we followed both deductive and inductive approaches to the thematic analysis. Following the deductive approach, we constructed themes and subthemes (Table A3) based on the literature review (Ali et al., 2022; Bastiaanssen et al., 2020; Dobbs, 2007; Dong, 2020; Field & Vyborny, 2016; Field & Vyborny, 2022; Gautam et al., 2019; Hadi, 2017; Joshi et al.,2021; Joshi et al., 2022; Mahadevia, 2015; Majid et al., 2018; Malik et al., 2020; Martinez et al., 2018; McLafferty & Preston, 1992; Noor & Iamtrakul, 2023; Olivieri & Fageda, 2021; Quinones, 2020; Sajjad et al., 2018; Shah & Hisashi, 2017; Singh, 2020; Weersinghe, 2017; Williams et al., 2019; Zolnik et al., 2018) and the study context to formulate the questionnaire and analyse these themes. In an inductive approach, themes emerge from the data itself without paying attention to themes included in other studies (Braun and Clarke, 2006). We used thematic analysis to analyse semi-structured interviews conducted with metro and ride-hailing commuters as well as to analyse textual data from key informant interviews. Data analysis under thematic methodology primarily involves six steps. In the very first step, we familiarized ourselves with the data by iteratively reading and re-reading the transcripts. After familiarisation and developing an understanding of the data, we marked the initial codes that were relevant to the investigation. These initial codes were quite large at first. The next step was to make themes of those codes by adding similar/related codes to the same categories. Creating themes from the codes reduced the data to fewer themes. In the next step, we reviewed the themes on two levels. The first level dealt with checking if all the

codes included in certain themes are fitted appropriately. During this process, detailed notes, comments, and memos of any decision made were recorded. While, in the second level of the same step, the same process as level one was repeated and we checked whether the data supported each theme adequately and whether the themes are connected in some meaningful way. Another relevant question was whether or not some themes were intrusive and distinct enough that they can be made separately. All these considerations helped us to drive a meaningful relation among themes (constructed and derived) from the data. The next step in this process was to define and name the themes in a narrative way. It is to show why each theme is important to the broader research question. Finally, the last part was to report on the themes and provide the final findings and insights from the analysis. It is also important to mention that selected statements will be presented textually as citations with unique codes appended to each text representing the participant.

An important step in qualitative research is the selection of respondents which requires thorough consideration, as it is fundamental to the validity of the results (Curtis et al. 2000). Taking into account two distinct research questions that attempt to understand the factors associated with women's mobility related to public and private transportation services and the perception of higher authorities in providing these services to women, the study targeted working women using either metro or ride-hailing services to commute to and from their workplaces. The study area is the district of Lahore comprising of 9 town zones (and cantonment which is an independent municipality under the Lahore cantonment board) and 274 union councils.

We collected data in Lahore through a structured questionnaire, semi-structured interviews, and key-informant interviews in July-August 2022. We conducted structured interviews through a pre-tested structured questionnaire that included sections on demographic information, employment and income, education, information, and communication technology, and a transportation services section that contains separate sections for metro and ride-hailing users. To select a random sample of females using the metro, we conducted structured interviews with 46 females from every station covering from Shahdra to Gajjumata. There are 27 metro stations including Shahdra and Gajjumata and we selected at least one female from every station. Furthermore, we conducted 10 semi-

structured interviews[14] based on the themes (Table A3). With their semi-structured format, interviews provide greater flexibility, as well as adequate responses to the formulated research questions (Creswell 2013). To conduct semi-structured interviews, only three women from the 46 mentioned above agreed to give semi-structured interviews. The rest were selected by combining snowball sampling and respondent-driven sampling where initial respondents enlist additional respondents from their networks of friends to avoid the risk of limiting ourselves to collecting data from the same network of peers. The structured questionnaire was completed by a total of 53 female participants.

To select ride-hailing commuters, we conducted structured interviews with 38 females. Due to the fact that unlike metro stations there is no place where you can select a random sample of female ride-hailing users, therefore, we endeavoured to select our sample from all 9 towns of Lahore by approaching females visiting different offices and public places in Lahore (Figure A2). Furthermore, similar to metro users, we conducted 10 semi-structured interviews of the females by combining snowball sampling with respondent-driven sampling. The method of contact for all semi-structured interviews was face-to-face and telephone interviews. We have a total of 48 ride-hailing users who completed structured questionnaires.

To understand the perspective of service providers, we conduct four semi-structured interviews with the key informants of the following organizations: (1) Punjab Mass Transit Authority: General Manager Operations (2) The Urban Unit: Senior Research Analyst Transportation Planning and Management (3) Punjab Commission on the Status of Women (anonymous) and (4) Ride-hailing (anonymous). In semi-structured interviews, the respondents and key informants were given the opportunity to share their stories, provide detailed information, and share insights on the research questions posed in the study and related themes. We conduct face-to-face interviews with all key informants.

[14] It is important to mention that all the females (metro and ride-hailing users) who were part of the semi-structured interviews also took part in the structured questionnaire.

5. Results and Discussions

The section presents descriptive and empirical findings, which are further divided into two subsections. The quantitative subsection reports the results and discussion of the synthetic control method, while the qualitative subsection presents the findings and discussion of thematic analysis.

5.1 Quantitative Section

Figure A3 shows the trends in the female labour force participation in Lahore and all other cities under metro bus transit and ride-hailing intervention specifications. The plots suggest that the control group of all other cities may not provide a good comparison group for Lahore to analyse the impact of the provision of different transportation services on female labour force participation. The trend began to converge in 2007 and onwards under the metro bus control group. However, the trend is quite heterogeneous for the control cities chosen under ride-hailing which shows that these cities (excluding major metropolitan cities across four provinces) do not provide a good estimate for comparison. Hence, the construction of a synthetic control group becomes necessary for impact evaluation. Furthermore, we can observe that female labour force participation is higher in Lahore than the overall averages in the control groups under both specifications. Following the interventions, female labour force participation in Lahore continued to increase. In order to assess the impact of metro bus transit and ride-hailing in Lahore, the main question is how the participation of women in the labour force would have evolved in Lahore after 2013 and 2016, respectively, in the absence of the aforementioned interventions.

5.1.1 Metro bus system

Table 1 compares the pre-treatment characteristics of Lahore with that of synthetic Lahore as well as with the averages of the 24 cities in the control group for metro bus intervention[15]. We construct synthetic Lahore as a convex combination of cities in the donor pool that closely approximate Lahore in terms of pre-intervention (metro) values of female labour force participation predictors. We observe that averages of cities that did not have mass transit intervention after 2013 do not provide a suitable control group for Lahore. For example, the proportion of females with no formal education is higher in the average of 24 control cities than in Lahore. Furthermore, the male employment rate average of 24 cities is lower compared to the average of Lahore. Hence, we

[15] We also calculated pre-treatment characteristics with sampling weights and results are not much different.

observe that the control group average does not establish similarities to Lahore in terms of pre-metro bus intervention predictors. However, the synthetic Lahore reproduces estimates much closer to the real Lahore than the average of 24 control states. The method chooses predictor weights (V) to minimize the mean squared prediction error of female labour force participation in Lahore during the pre-intervention (metro) period.

Table 1 Female labour force participation predictor means before the metro intervention

	Lahore		Average of 24
Variables	**Real**	**Synthetic**	**control cities**
Proportion of married women	0.674	0.672	0.707
Average age	31.5	31.65	31.67
Education of the household head	6.588	6.719	6.151
No formal education	0.334	0.335	0.532
Primary education	0.273	0.276	0.223
Secondary education	0.288	0.288	0.189
Tertiary education	0.105	0.099	0.055
Male employment rate	0.774	0.749	0.733
Average household size	6.249	6.307	6.968
Average number of children under 4 years of age	0.728	0.746	0.914
Log of average household income	9.252	9.212	9.177
Female labour force participation rate (2001)	0.152	0.152	0.075
Female labour force participation rate (2007)	0.087	0.096	0.078

Note: All variables are averaged for the 1999-2012 period.

Table 2 shows the list of control cities and the share of each in the construction of synthetic Lahore. The weights indicate that female labour force participation in Lahore before the intervention of metro bus transit is best reproduced by the weighted averages of Bahawalpur, Karachi, Sialkot, Hyderabad, Faisalabad, and Gujranwala. The weights of other cities in the donor pool are zero.

Table 2 City weights in the synthetic Lahore (metro intervention)

City	**Weight**	**City**	**Weight**
Lahore	Treatment city	D.G khan	0
Faisalabad	0.042	Larkana	0
Rawalpindi	-	Mirpur Khas	0
Multan	-	Malakand	0
Gujranwala	0.012	Kohat	0

Sargodha	0	D.I Khan	0
Sialkot	0.214	Hazara	0
Bahawalpur	0.398	Bannu	0
Islamabad	-	Mardan	0
Karachi	0.258	Sibbi	0
Hyderabad	0.076	Kalat	0
Sukkur	0	Mekran	0
Peshawar	0	Zhob	0
Quetta	0	Nasirabad	0

Figure 1 presents the female labour force participation rate of Lahore and synthetic Lahore during the period 1999-2018. We can observe that compared to the average female labour force participation rate in other control cities, female labour force participation in synthetic Lahore very closely follows the path of this variable for the entire pre-intervention metro period. Our estimate of the impact of the large-scale public transport infrastructure provision (metro bus) is the difference between the female labour force participation rate between Lahore and synthetic Lahore from the 2013 to 2018 period. The gap between the two after 2013 shows a small positive effect of the Lahore metro bus system on female labour force participation in Lahore. To the best of our knowledge, Martinez et al. (2020) are the only ones to investigate the causal impact of bus rapid transit and elevated light rail investment on women's employment outcomes. The study reports large gains (around 7%) in employment for women through increased accessibility to jobs.

To comprehend these findings, we examined various pathways that demonstrate how the metro bus transit can facilitate women's labour market inclusion in Lahore. Firstly, the metro bus together with its feeder routes (speedo buses), offers accessibility that connects women to employment opportunities. Based on primary data collected from female metro commuters, the majority of them reported that the metro is an accessible mode of transportation for commuting to their workplaces. Improved access to public transportation can enhance women's mobility and facilitate their travel to work, especially for those residing in areas with limited job prospects. Bastiaanssen et al. (2020) report that improved access to employment opportunities could potentially decrease the time needed to find a job and increase the wage offered for a given job. Majid et al. (2018) find that the introduction of mass transit in Lahore has reduced both the time and cost of commuting for those who depend on public transportation for commuting. Nevertheless, the challenge faced by working women when using public transportation is that the

routes and station locations do not always suit the available infrastructure in their neighbourhood, resulting in lengthy or expensive commutes.

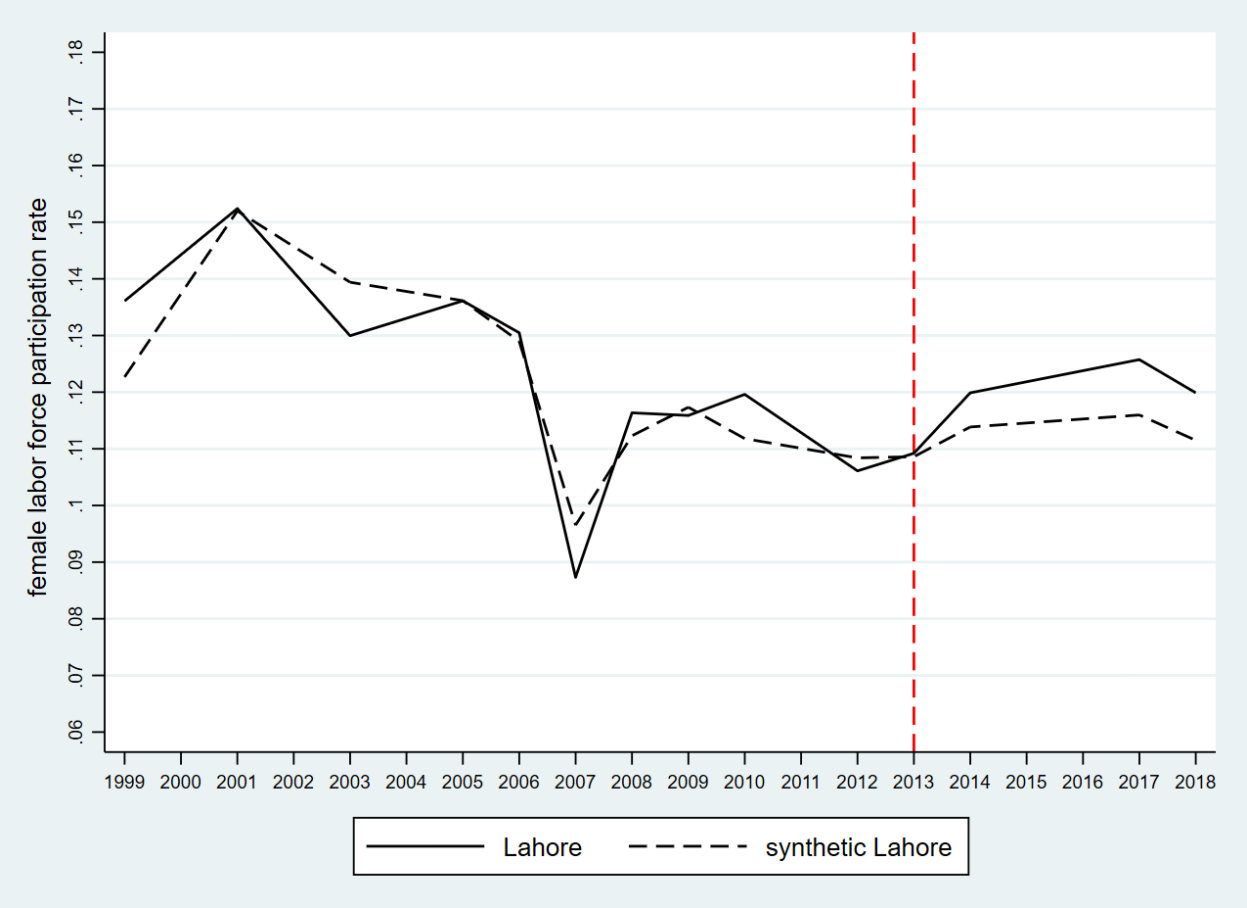

Figure 1 Female labour force participation in Lahore and synthetic Lahore

Secondly, affordability is the primary factor that attracts low-income women to use the metro bus for commuting to work. For all the female participants (structured and semi-structured interviews) who use the metro bus, the transportation cost is easily manageable within their budget. As described in the conceptual framework section, lower transportation costs enable women to accept jobs that pay less or are located farther away from their homes. It can also decrease the time and money spent by women on commuting, making it easier for them to accept job offers located further away from their homes. Although the current fare system is subsidized, a considerable number of commuters expressed their willingness to continue using the service even if the fare were increased. This is because the system offers faster and better-quality service and attracts commuters who have a higher earning power (Majid et al., 2018). A majority of the ride-hailing

female commuters in our sample have expressed their willingness to use affordable metro service provided that it is easily accessible to them.

Another important pathway that promotes employment opportunities for metro commuters is the safety features provided. The risk of harassment has made public transportation unsafe for women in Pakistan, restricting their mobility, and access to jobs, and contributing to cultural expectations that limit women's participation in the workforce (Field & Vyborny, 2022). However, public transport in the form of mass transit has certain safety features that represent a significant improvement in comparison to other forms of public transportation in the city (Martinez et al., 2020). The presence of guards or security personnel at metro stations, along with an operating helpline for complaints and suggestions, has substantially reduced concerns regarding the harassment of women. From the qualitative survey, we found that 91 % of the women in our sample reported that they have never faced harassment at the metro stations.

Figure A4 (left panel) displays the yearly gaps in female labour force participation in Lahore and synthetic Lahore. It suggests that metro intervention caused an average increase of around 1.0 percent in female labour force participation during the 2013-2018 period. The magnitude of this impact is not quite substantial; however, observing the low participation of females from urban areas in developing countries (Klasen, 2019; Klasen & Pietres, 2015), the ease of mobility brought about by the metro bus transit can serve as an important driver of female employment in Pakistan.

There are several reasons that lead to a smaller-than-expected positive impact of metro bus intervention. First, the use of household data to construct city-level aggregates does not provide us with all the predictors of female labour force participation at an aggregate level. Other important predictors of female labour force participation include fertility rate, regional or city-level GDP, regional human development index, urbanization, degree of industrialization, etc (Cipollone et al., 2014; Gaddis & Klasen, 2014; Kumari, 2018; Mammen & Paxson, 2000; Taşseven & Turgut, 2016). For instance, not including a relevant variable such as fertility rate can potentially lead to a smaller impact of the metro intervention on female labour force participation. Given that the fertility rate has a significant association with female labour force participation as it reflects the decision-making process regarding family planning and trade-off between work and child-rearing responsibilities (Klasen, 2019). Second, in terms of accessibility, a large population of potential female employees does not have access to metro stations. For example, mass transit does not

operate in areas like Gulberg, Faisal town, Johar town, etc. It is also important to mention that many ride-hailing users reported the unavailability of public transport infrastructure (metro bus and orange train) in their neighbourhood. Hence, limited or inadequate access to mass transit can act as a barrier for female employees, hindering their ability to commute efficiently and access employment opportunities. This transportation barrier can contribute to reduced labour force participation and restricted employment choices for women. Finally, due to the change in coding schemes after 2017, the construction of aggregate level variables also includes the urban areas outside the main Lahore city. For the labour force surveys from 1999 to 2017, we aggregate data on 28 cities by combining codes of large-sized cities and codes of other urban areas. The district-level urban areas were taken into account while constructing aggregate variables for the years 2018-2020. Therefore, the inclusion of other urban areas that lack direct or indirect access to metro stations accompanied by lower female labour force participation may have potentially contributed to a diminished impact of metro buses on female labour force participation in Lahore.

To evaluate the reliability of the estimates, we use placebo tests by iteratively applying the synthetic control method to every other city that did not have a mass transit intervention during the sample period. In each iteration, we reassign the metro intervention of 2013 to one of the cities in the donor pool and shift Lahore to the donor pool. For example, we assume as if one of the cities in the donor pool would have the same mass transit intervention in 2013, instead of Lahore. By following the iterative procedure, we obtain a distribution of estimated gaps for the cities where no mass transit infrastructure was implemented. If the gaps generated by placebo studies are of a similar magnitude to the one calculated for Lahore, it indicates that our results do not offer substantial proof of a positive impact of metro bus transit on the female labour force participation rate in Lahore. Conversely, if the gaps produced by the placebo studies demonstrate that the gap estimated for Lahore is considerably more significant than the gaps for cities that did not have mass transit intervention then we conclude that our analysis presents significant evidence of a positive impact of metro bus transit intervention in Lahore (Abadie et al., 2010). We expect the estimated effect for Lahore to be an outlier in the distribution of placebo tests (Gharehgozli, 2017) Figure A5 shows the results of the placebo tests. The grey lines represent the gap estimated from a placebo synthetic control analysis for each city in the donor pool. In addition, the black line represents the gap estimated for Lahore. The right panel shows the gap plots for all control cities in the donor pool. It does not seem like Lahore is an outlier in the distribution of the placebo

effects. In the left panel, we exclude those cities with an MSPE (the average of the squared differences between female labour force participation rate between Lahore and its synthetic counterpart for the pre-intervention period) of three times or higher than Lahore as suggested by Abadie et al., (2012). The remaining cities show a better fit of synthetic control and are better entrants to include in the placebo distribution. We can observe that Lahore is an outlier in terms of its positive effect post-intervention. Some of the control cities show a larger positive effect; however not for the entire pre-intervention period. Had the synthetic Lahore not been able to match the female labour force participation rate with the real Lahore before the metro intervention, we would have concluded that a substantial portion of the difference observed between the real and synthetic Lahore after the intervention was created artificially due to the lack of fit, rather than being a result of the intervention's impact.

5.1.2 Ride-hailing

Table 3 compares the pre-intervention fit of real and synthetic Lahore along with the average of 13 control cities. As mentioned in section 2.1.2, Uber and Careem started operating in Lahore in 2015/2016 and were soon introduced in other metropolitan cities that are closer to Lahore in terms of economic development. The table shows that the control cities' average does not demonstrate the pre-intervention approximation to Lahore in terms of predictor balance. However, synthetic Lahore provides a better approximation as compared to the averages of 13 control states.

Table 3 Female labour force participation rate predictor means before the intervention (ride-hailing)

	Lahore		**Average of 13 control cities**
Variables	**Real**	**Synthetic**	
Proportion of married women	0.675	0.675	0.733
Average age	31.54	32.03	31.78
Education of the household head	6.614	7.315	6.054
No formal education	0.328	0.363	0.614
Primary education	0.274	0.254	0.197
Secondary education	0.291	0.285	0.149
Tertiary education	0.106	0.098	0.039
Male employment rate	0.771	0.655	0.725
Average household size	6.213	6.504	7.102
Average number of children under 4 years of age	0.721	0.751	0.977

Log of average household income	9.322	9.335	9.235
Female labour force participation rate (2001)	0.152	0.133	0.059
Female labour force participation rate (2007)	0.087	0.098	0.077

Note: All variables are averaged for the 1999-2013 period.

Table 4 reports the weights assigned to the cities in the donor pool for ride-hailing intervention. The weights show that female labour force participation in Lahore before the intervention of ride-hailing is best reproduced by the weighted averages of Hazara, and Larkana.

Table 4 City weights in the synthetic Lahore (ride-hailing intervention)

City	**Weight**	**City**	**Weight**
Lahore	Treatment city	D.G khan	0
Faisalabad	-	Larkana	0.178
Rawalpindi	-	Mirpur Khas	0
Multan	-	Malakand	0
Gujranwala	-	Kohat	0
Sargodha	-	D.I Khan	0
Sialkot	-	Hazara	0.822
Bahawalpur	-	Bannu	0
Islamabad	-	Mardan	-
Karachi	-	Sibbi	0
Hyderabad	-	Kalat	0
Sukkur	-	Mekran	0
Peshawar	-	Zhob	0
Quetta	-	Nasirabad	0

We do not see an increase in female participation in the labour force in Lahore after the ride-hailing intervention. It is also important to mention that due to the unavailability of 2015/2016 data sets[16] we choose 2014 as the intervention year to match the pre-intervention predictor balance. Figure 2 shows a reasonable but noisy Lahore-control match for the pre-intervention period and almost no impact after the intervention.

[16] Pakistan Bureau of Statistics did not conduct labour force survey in 2015 and 2016.

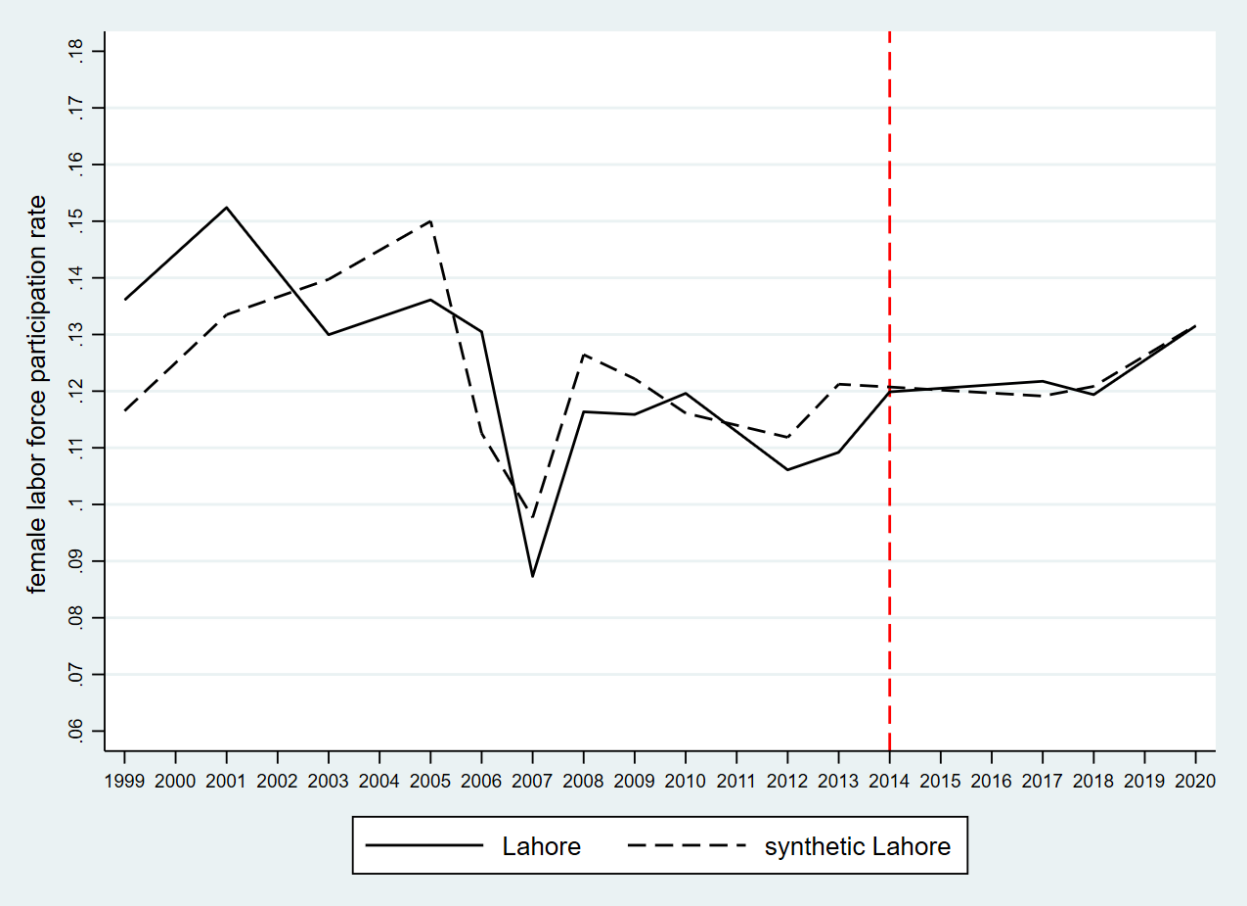

Figure 2 Female labour force participation in Lahore and synthetic Lahore (ride-hailing)

Figure A4 (right panel) shows the yearly gaps in the participation of women in the labour force between Lahore and synthetic Lahore before and after the ride-hailing intervention. We can observe no impact of the intervention in Lahore after 2015/2016 and can infer that the provision of ride-hailing has not contributed to the increase in female labour force participation.

There are several reasons for the no impact of ride-hailing on female labour force participation. First, it is worth noting that the launch of ride-hailing in many metropolitan cities in Pakistan, which are similar to Lahore regarding socio-economic conditions, has resulted in a poor match between synthetic Lahore and actual Lahore. This could be a potential reason for the lack of intervention impact.

Second, the labour market behaviour of women in Pakistan shows that it is driven by necessity rather than intent (Amber & Chichaibelu, 2023a). According to Saqib & Arif (2012), monetary poverty is an important determinant of female labour force participation in Pakistan. Furthermore,

household income is negatively associated with women's labour market inclusion (Klasen & Pieters, 2015). The descriptive statistics of the primary data collected show that the users of ride-hailing in Pakistan are earning more than metro users, and hence can afford to pay for the premium service (Shah & Hisachi, 2021). As ride-hailing customers come from higher-income households, females belonging to these households tend to participate less in the labour force. The price reduction experiment conducted with Uber riders in Cairo, Egypt shows a notable demand response for the services (Christensen & Osman, 2021). Furthermore, the researchers find the price reduction for ride-hailing services has an uneven impact on women. It leads to an increase in Uber usage, overall mobility, substitution away from buses (less safe transport), and a higher self-reported safety. Despite this, the study find no significant increase in employment or job search activity as a result of the price cuts.

Third, it is commonly understood that the emergence of ride-hailing brings employment opportunities for the rising population of Pakistan. It is also important to mention that globally Uber has been increasing gender diversity in the workforce with 59.7 percent of males and 40.3 percent of females (2020)[17]. However, in Pakistan, more than 90 percent of the Careem registered captains are men[18]. Furthermore, according to the information provided by the key informant of a ride-hailing service provider, women drivers constitute less than 2 percent of the registered drivers. Considering the conservative social norms and behaviour of men towards female drivers, it seems highly unlikely that women can take advantage of this great opportunity that provides them with flexible working hours to maintain their work-life balance[19]. An interesting insight shared by the key informant of ride-hailing reveals that (according to a survey conducted by the service provider) 80 percent of Pakistani men reported that they would not take the ride if the driver is a female.

As mentioned in section 5.1.1, we perform placebo tests under ride-hailing specifications. Figure A6 (left panel) displays the female labour force participation rate gaps in Lahore and placebo gaps in 13 control cities. We exclude those cities with MSPE three times higher than Lahore and results are presented in the right panel of Figure A6. The remaining cities show a better fit of the synthetic

[17] https://www.statista.com/statistics/693807/uber-employee-gender-global/
[18] https://blog.careem.com/wp-content/uploads/2021/11/EIR_Infographic_consolidated_v2.pdf
[19] https://www.thecairoreview.com/global-forum/empowering-women-to-ride/

control. We can see that Lahore is an outlier in the distribution of placebo tests in terms of having no impact of the intervention of ride-hailing on female labour force participation in Lahore.

5.2 Qualitative Section

Table 5 provides a summary of the demographic characteristics of the metro users in Lahore. It shows that the major share belongs to the age group 25-34 years, followed by 18-24 years old. Under the employment category, all women belong to paid employment (either full-time or part-time). An important insight is that around 79% of females earned less than or equal to 45,000 rupees (158 USD) per month. For the education category, most (41%) have a tertiary education level followed by women with no formal education (21 %). Most women travel around 5-10 kilometers every day to and from their workplace.

Table 5 Summary statistics of Lahore metro users

Variable	Classification	Frequency	Percentage
Age	Under 18 years old	1	1.89
	18-24 years old	14	26.42
	25-34 years old	16	30.19
	35-44 years old	10	18.87
	45-54 years old	9	16.98
	Above 55 years old	3	5.66
Marital status	Unmarried	28	52.83
	Currently married	24	45.28
	Divorced	1	1.89
	Widowed	0	0
Employment status	Employer, employing less than 10 people	0	0
	Employer, employing more than 10 people	0	0
	Paid employee (full-time)	33	62.26
	Paid employee (part-time)	20	37.74
	Self-employed	0	0
Monthly income	Less than Rs. 25,000	24	45.28
	Rs. 26,000-Rs. 45,000	18	33.96
	Rs.46000-Rs.65000	4	7.55
	Rs.66000-Rs.85000	4	7.55
	Rs.86000-Rs.1,05,000	1	1.89
	Rs.1,06,000-Rs.1,25,000	1	1.89
	More than 1,25,000	1	1.89
Education level	No formal education	11	20.75
	Primary education	5	9.43
	Secondary education	5	9.43
	Tertiary education	22	41.51

	MPhil	9	16.98
	PhD	1	1.89
Mobile/smartphone	Mobile phone	8	15.09
	Smartphone	38	71.70
	None	7	13.21
Daily travel (km)	Less than 5 km	7	13.21
	5-10 km	23	43.40
	10-15 km	15	28.30
	More than 15 km	8	15.09
Sample size		53	

Source: Author's own construction from structured questionnaire responses.

Table 6 provides demographic information on ride-hailing users. Most of the ride-hailing users belong to the 25-34 years old age category, followed by 35-44 years old. The employment status shows consistency with metro users as the majority of the female (around 88 %) are paid employees. Regarding monthly income, the data shows that ride-hailing users are earning more than metro users with 25% of females earning between 66,000-85,000 rupees (230-300 USD). Under the education category 50 % of ride-hailing users have a tertiary level of education followed by 39 % of females with 18 years of education. Considering the daily travel section, around 35% of the females are traveling 5-10 kilometres every day, followed by 31% percent of females traveling 10-15 kilometres.

Table 6 Summary statistics of ride-hailing users

Variable	**Classification**	**Frequency**	**Percentage**
Age	Under 18 years old	0	0
	18-24 years old	7	14.58
	25-34 years old	28	58.33
	35-44 years old	10	20.87
	45-54 years old	2	4.17
	Above 55 years old	1	2.08
Marital status	Unmarried	28	58.33
	Currently married	16	33.33
	Divorced	3	6.25
	Widow	1	2.08
Employment status	Employer, employing less than 10 people	3	6.25
	Employer, employing more than 10 people	0	0
	Paid employee (full-time)	34	70.83
	Paid employee (part-time)	9	18.75
	Self-employed	2	4.17
Monthly income	Less than Rs. 25,000	5	10.42
	Rs. 26,000-Rs. 45,000	11	22.92

	Rs.46000-Rs.65000	7	14.58
	Rs.66000-Rs.85000	12	25.00
	Rs.86000-Rs.1,05,000	8	16.67
	Rs.1,06,000-Rs.1,25,000	3	6.25
	More than 1,25,000	2	4.17
Education level	No formal education	0	0
	Primary education	0	0
	Secondary education	3	6.25
	Tertiary education	23	50
	MPhil	19	39.58
	PhD	2	4.16
Mobile/smartphone	Mobile phone	0	0
	Smartphone	48	100
	None	0	0
Daily travel (km)	Less than 5 km	4	8.33
	5-10 km	17	35.42
	10-15 km	15	31.25
	More than 15 km	12	25.00
Sample size		48	

Source: Author's own construction from structured questionnaire responses.

The demographic characteristics of metro and ride-hailing commuters show that ride-hailing commuters are not only more educated but also earning more compared to metro users. They are also the ones who travel long distances every day to commute to and from their workplaces compared to metro users. The findings corroborate those of Shah & Hisachi (2021) who report that the majority of ride-hailing users in Lahore are young, highly educated, and have above-average income levels.

Following subsections present the findings of the qualitative analysis of the interview data (structured and semi-structured interviews). The findings from interview data are organized around six main themes: (1) Accessibility (2) Affordability (3) Acceptability (4) Availability (5) Gender inclusion in transport, and (6) Offered suggestions. Overall, the study provides insights into the complex relationship between transport provision and female labour force participation in Pakistan. Using thematic analysis, the study identifies challenges faced by women in accessing and using public and private transportation services that directly affect their labour force participation. Furthermore, it also helps us to gain a deeper understanding, at the subject level, of how the provision of the metro bus system and ride-hailing in Lahore have helped females to overcome those challenges.

5.2.1 Accessibility

The accessibility to transportation services emerged as an important theme for labour market participation, according to both public transport and ride-hailing users. The focus is on how the participants perceive and experience their access to transport, which helps them reach their workplaces. The theme of accessibility to transportation is particularly important for women's livelihood opportunities. The three recurring and most important sub-themes that emerged were the infrastructure in their neighbourhood, the spatial position of their residence, and related services which affect their access to job opportunities and transportation services.

- **Mobility infrastructure**

All the female users spoke about how the mobility infrastructure in their neighbourhood both facilitates and impede their access to transport and economic opportunities, respectively. Most of the females have access to metro stations either it is on walking distance or they have to take other modes of transportation (such as rikshaw, speedo, and chingchi, among others.) to access the metro station (Figure A7.1). However, the females who use other modes of transportation to reach the metro station reported a lack of mobility infrastructure in their neighbourhood in terms of living far away from the metro or orange train stations. These are reflected in the statement by one participant:

"There is a lack of mobility infrastructure in my neighbourhood because the metro station is far from our area. It is affecting me because I have to spend a lot of my time and money to reach a nearby station."PM4

Moreover, most of the ride-hailing users responded that they use Uber/Careem/InDriver because they cannot access public transport (metro and orange train), as they have no nearby metro stations in their areas. A participant reiterated that:

"Public transport is not available in my area; I have to change 3 to 4 transports to reach the public transport". PU2

It was also observed from the responses that the choice of job and workplace is affected by their access to transport to commute to and from their workplace. The observation was captured through the following text from one of the participants from the interview:

"I have only selected that job where the metro station is near my home as well as my workplace." PM1

A similar response was recorded from a ride-hailing user:

"*My job location is near to my home, so I can easily access transport to my workplace, but if I will do the job in other areas that are far from my home then my mobility choice will definitely change with changing of the job location*." *PU1*

Transport infrastructure and access to transport are crucial for female participation in economic activities (Birch & Marshall, 2016; Lei & Vanneman, 2019). According to the interviews and structured questionnaires, transport options such as metro and ride-hailing services have positively affected female labour force participation by providing mobility options to thousands of commuters. However, the infrastructure still poses problems as the location of stations may not be easily accessible, requiring the use of other modes of transportation, which can be time-consuming and costly. Moreover, respondents reported that they are able to access their current job through the metro or ride-hailing, and may have changed jobs if they were unable to access it with available mobility options.

- **Spatial Position**

The spatial position of the residents emerged as an important sub-theme in the accessibility of transport and employment opportunities by females. The majority of females selected a given mobility option because they found it more feasible for their residential location. As one participant highlighted:

"Where I live, public and private transport options are readily available, but the Metro suits me the best. The metro station is available within walking distance from my place after walking 5 to 7 minutes." PM1.

Better spatial access to jobs can lead to lower unemployment among women (Parks, 2004) as it increases their ability to search for and access job opportunities. When women have better access to job opportunities through accessible transport infrastructure, they are more likely to find suitable

employment that matches their skills and qualification. As described in the following statement from a participant:

"The jobs available near me offer a low payment structure and do not provide substantial compensation. To access better job opportunities that align with my qualifications, I must be willing to travel farther distances" PU4.

The restricted spatial access to employment and transport for females indicates their dependence on mass transit and the presence of a spatial mismatch in the labour market (McLafferty & Preston, 1992). Beyazit & Sunger (2019) examine the gendered nature of mobility in Istanbul and find that women often face challenges in finding higher-paying jobs in central areas due to long commute times from suburban regions along with the cost of transportation and household responsibilities. The findings infer that the spatial position of women in urban areas can hinder their access to better employment opportunities.

- **Related Services**

Another important sub-theme under accessibility to different transport services is the related services, which include sidewalks, bus shelters, parking places, supporting services (toilets), fare method, etc.

In a study conducted by Dong (2020) in Philadelphia, researchers examine the willingness of individuals to use ride-hailing services vs public transportation. The study finds that ride-hailing is more popular among females, people over the age of 30, and those who do not frequently use public transportation. The study also found that people find walking to and from the transit system, in-vehicle travel time, and waiting time for transit more burdensome than ride-hailing. In the context of Pakistan, we find that working women, when other factors are the same, choose ride-hailing over public transport because of the additional services such as ease of carrying their children and elderly relatives, pick-up and drop-off at specific locations, location sharing, technological access to booking, and reduced burden of car parking.

"Uber and Careem is the best option because I want that car to pick me up from my location." PU4

Another female mentioned the ease of booking a ride for others as:

"I mostly use Uber and Careem for transport. Even I book a ride on Uber for others, like a guest or family members. I also pay through a credit card for others when this option is available, so another person does not get embarrassed and doesn't know how much I paid for them." PU3

The majority of the users of metro buses are satisfied with the associated services; however, there were some who complained about traveling with children and toilet facilities as one participant puts it:

"I am not satisfied with metro facilities. The washrooms are not good; sometimes there is no water, and if available, then it does not seem clean. The buses are extremely crowded and the air conditioners do not work properly." PM4

Keeping other things, the same, ride-hailing emerged as a preferred choice for females when it comes to related services.

The theme of accessibility to transportation is essential for women's livelihood opportunities, according to both metro and ride-hailing users. Better accessibility to transportation has positively impacted female employment; however, the infrastructure still poses problems as the location of stations may not be easily accessible, requiring the use of other modes of transportation, which can be time-consuming and costly. The restricted spatial access to employment and transport for females indicates their dependence on mass transit and the presence of a spatial mismatch in the labour market (McLafferty & Preston, 1992).

5.2.2 Affordability

The section explored the relationship between the affordability of transportation services and female labour market participation. We define affordability as the ability to travel without sacrificing essential activities. Participants shared their experiences managing transportation costs while commuting to work. The theme focuses on how female workers in Lahore afford transportation services and how their employment affects their transportation choices. The theme takes into account transport expenses, sacrificing other essential expenses to cover transport costs, individual income, and type of employment. We find the manageable transportation costs and choice of transport based on one's employment status as the most important sub-themes.

- **Cost of Transportation**

Considering the income level of females using either metro or ride-hailing (Table 5 & Table 6), the fares are manageable within their salaries, especially for the metro commuters as indicated in the following statement by one participant:

"*Even if PMTA increases the fare, it will be cheaper than other public transport services."PM4*

Furthermore, the majority of the metro commuters say that they do not need to cut other essential expenditures to pay for the transportation service, see below statement by a participant.

"There is no need to cut other expenditures to pay for the metro bus because the fare is not high and I can easily afford that."PM2

Women's transportation choices depend on their income levels. As women's income increases, they tend to opt for more convenient, time-saving, and comfortable transportation options. So low-paid employees are often unable to choose ride-hailing due to associated costs. This may limit their job options, as they may turn down jobs that are far from their homes due to the cost of transportation, resulting in a significant portion of their income being spent on fares as one of the participants puts it:

"It has happened to me many times. Many jobs are available to me, but I cannot accept them because there is no option of metro available. If I get a good job far away and most of my salary is consumed by transport expenditures, then I think that is not a good option". PM5

- **Choice of transportation**

The transportation choices of female workers are significantly influenced by their job status. For instance, most women opt for public transportation to travel to far-off work locations since the fares of the metro and orange train is comparatively affordable and easily manageable with their lower incomes. On the other hand, women who use ride-hailing services, such as Uber, choose to pay more for their transportation even though it is expensive compared to public transport. This is because they earn better salary packages.

All of the users of ride-hailing services responded that they are using Uber/Careem for work-related commuting because they can afford it with their current job status, for instance, as captured in the following statement from a participant in the interview:

"I have a very handsome salary, and the office gives me the amount to bear all the expenses to afford Uber. In my previous job, I was not earning enough and was using an auto rikshaw". PU4
Another respondent from ride-hailing mentioned: *"If I was not doing this job, I definitely would have made a different choice". PU3*

There are females who switched to the metro and orange train because of the availability of feeder routes, for instance, one revealed that:

"Previously I was using ride-hailing (Uber), but it was very expensive. Now, with the availability of the speedo bus I have switched to the metro, and I am able to afford my travel expenditures". PM6

The extracted information indicates a direct link between the affordability of transportation and women's involvement in economic activities. When women have access to affordable transportation services, they can benefit from better economic opportunities. A study conducted in Riyadh find that a rise in female commuting expenses leads to a reduction in female employment, highlighting the importance of affordable transportation for women's participation in the workforce (Williams et al., 2019). Our study reveals that transportation costs are manageable for the majority of the females using public transport (metro or orange train), while ride-hailing services are opted for by women with higher salaries. Moreover, low-paid employees are limited in their job options due to the cost of transportation, leading to a significant portion of their income being spent on fares.

5.2.3 Acceptability

The theme underlines personal perceptions towards transportation services that play a critical role in an individual's choice of transportation mode based on their socio-economic background. In Pakistan, social norms play an important role in determining women's transportation choices and employment options. The country's patriarchal society (Hadi, 2017) has long discouraged women from using public transport and pursuing specific types of work. This has inevitably hindered women's independence and access to different services (Khan, 1999) and potential opportunities, consequently limiting their contribution to the economy. The most noticeable sub-themes that emerged from the interviewee responses are elabourated below:

- **Safety concerns**

Most of the metro users (Figure A7.2) mentioned that they have never faced harassment[20] at the metro stations or stops; however, it is more evident on their way to the metro stations (Figure A7.3). Furthermore, some females witness incidents of harassment by other females as one of them recounted:

"I haven't faced harassment. However, recently, I witnessed an incident inside the metro bus in which a boy harassed a girl."PM9

We observe that most females do not perceive staring as harassment, but rather as a behaviour of men in the country, and everyone perceives it differently as indicated in the following statement from a participant:

"I haven't heard of any harassment cases until now, and nothing has happened to me; however, I want to slap the men who stare at me. There is not too much harassment happening on the metro because it is too crowded, and the main problem is stealing things. In addition, we know some males are mad and have some mental issues." PM3

Private transportation service users (semi-structured interviews) feel safe while traveling, especially during the daytime. This was better captured from the statement from one participant who mentioned:

"*Nothing happened to me because I travel almost in the daytime and I use Uber auto and we know that auto rickshaw is safe. I have never faced any kind of harassment and there is less chance of getting harassed during the daytime*." PU4

In Lahore, both public and private transportation sectors have made significant strides in enhancing the safety features of their services. Women in particular have shown a preference for location-sharing features in ride-hailing apps. By sharing their location with family members, women feel safer and their family members can track their whereabouts as indicated in the following statement in which staring also emerges as of less concern:

"It [harassment] never happened to me. Of course, we all face a starting issue. Since I am traveling in Uber, the moment I sit in Uber, I share my ride with my husband so he knows, where I am." PU5

[20] Sexual harassment in public places can manifest in various ways, and women are frequently the primary victims. Within the scope of our research, instances of sexual harassment that women encounter include being stared at, receiving verbal harassment such as catcalling, lewd remarks, and inappropriate sexual advances, being subjected to physical harassment such as unwanted touching, groping, or other forms of physical contact, as well as other forms of harassment like stalking, and non-consensual photography or videography.

Additionally, all ride-hailing services, as well as metro buses and orange train have complaint cells available to address any concerns or issues that may arise.

In Pakistan, public transportation has long been regarded as an unsafe option for women due to the high risk of harassment and assault. As a result, women have faced significant limitations in their ability to move around comfortably, leading to reduced mobility and restricted access to job opportunities. A survey conducted by the Center for Economic Research in Pakistan (CERP) in 2017, which involved interviewing 1,000 households across Lahore, revealed that 70 % of male family members discouraged their female relatives from using public wagons[21]. However, in this research public transport refers to the mass transit system, which comes with some additional features and services to ensure women's safety and security.

Manager Operations, PMTA gave a brief history of safety situations in the past and measures being put in place at the metro stations and inside the buses to enhance safety in the following text:

"In the beginning, we got complaints that at night boys sit near the areas where there are escalators and if a female goes through those areas, they used to tease her. Therefore, to address this issue we put lights near the escalators. At the same time, we did crackdowns and placed our guards there. Now you can call a number at any time or get off the bus and make a complaint at the station if someone is teasing you. You can also tell that to the driver and they do not drive buses unless they solve the issue. These are standing orders. That's the reason you couldn't find many incidents of harassment inside the buses or at the metro stations."

Similarly, ride-hailing services are safer, but the cost is higher and not everyone can afford safety at a higher cost. The informant from the ride-hailing service reported that, in addition to the safety features already present in the app, they have implemented several measures to enhance the safety and security of women commuters:

"We customize the safety policies according to specific markets, such as Lahore (Pakistan). We provide mandatory training to drivers on sexual harassment and partner with NGOs to create content. We also check the criminal background of drivers and perform in-person verifications. In addition, we have strict policies on safety incidents and permanently deactivate drivers with multiple complaints. Our safety portfolio covers road safety, interpersonal safety, health safety, and women's safety, with additional work done to ensure women's safety."

[21] Sajjad et al., (2017)

Ride-hailing has become a lucrative market in Pakistan due to the lack of safe and reliable transportation options in many cities, thereby filling the demand gap between public and private transportation. Recent studies (Ali et al., 2022; Shah & Hisashi, 2021) find that several latent variables, including comfort, convenience, privacy, security, fare system, and safety significantly contribute to customer satisfaction with ride-hailing services in Lahore.

- **Women-only transport**

Women-only transport in Pakistan has been a debatable topic over the last few years due to the impact it has on employment. This idea of having segregated transport is seen as a way of providing safe and secure transportation to women who may not be comfortable using traditional public transport.

The majority of the respondents appreciated the idea of women-only transport in a way that it would reduce their family concerns about transport-related safety issues as shown in the following text from a participant:

"I would prefer *to travel on a bus that is only for females. Because, on every bus, males take more seats than females." PM5*

However, a few females pointed out the need to allocate more space for women inside metro buses rather than introducing altogether a different service for women. As mentioned in the section (study context-metro), there is a dedicated section for women inside the metro buses so that they can feel comfortable. This is reiterated by the following statement from Manager Operations, PMTA.

"In 2011, we also introduced pink buses but we had to shut that down because of no demand. It is not like every time your buses reach the capacity of female commuters. You always take the collective, not the individual. In order to provide more opportunities to females, we need to work on both genders." Manager Operations, PMTA.

- **Clothing Choices**

There is a common perception that the way women dresses is linked to the likelihood of experiencing harassment. This belief places the burden of preventing harassment and assault solely on the victim rather than on the perpetrator. In societies like Pakistan, harassment is often associated with the dressing of women. We observed that 51% of the metro users agree with the statement that women face harassment on public transport/public places because they are not dressed appropriately, however, 37% of ride-hailing users agreed with the aforementioned

statement (Figure A7.4 & Figure A8.2). Therefore, the majority of the interviewees mentioned that they cover themselves properly while going out, see the following two statements from participants:

"I cover myself appropriately. I am conscious of my clothing choices whenever I step out of the house. It is not just about traveling on the metro."PM5

"Yes, I am much conscious about my clothing choices; I learned to dress appropriately, from my upbringing, and I feel comfortable that way. Whenever I go to a party and use Uber, I wear cheddar and cover myself." PU4

The reason that makes women conscious about their clothing choices is that after being harassed they may internalize the societal message that their clothing choices are responsible for the harassment they experienced. Ceccato & Sideris (2022) in their study of harassment and safety perceptions in transit environment reports that female students are conscious about their clothing choices and dress appropriately while commuting. A study conducted in Sri Lanka finds that 64 percent of the participants observed a connection between women's decision to wear revealing clothing and harassment in public transportation (Weerasinghe, 2017).

- **Masculine choices of mobility**

In Pakistani culture, men have greater freedom of movement and access to public spaces than women, which can create significant challenges and barriers for women when trying to access transportation and move around the city. Men are more likely to use cars, motorcycles, or bicycles as their primary mode of transportation, while women may rely on walking, public transit, or more passive modes of transportation, which limits their excess to job opportunities, education, healthcare, and social and cultural activities.

The majority of the metro bus and ride-hailing users showed interest and acceptance towards masculine choices of mobility. However, the only fear they face in using a Scotty or bicycle is the probability of having an accident as two participants narrate:

"I have seen lots of girls who use Scotty, and I also think that I should use Scotty, but my father thinks that I might face an accident because there is a lot of traffic in Lahore, so I can't easily handle Scotty. I am afraid of accidents too because people don't even know about the traffic rules and also if they know they don't follow." PM1

"I think girls will get the benefit of using such opportunities as Scotty and bikes. I have seen many girls using the Scotty and noted that many boys and men stare at them. If our society accepts them

and normalizes this mode of transportation, many issues will be resolved. However, I think it will take time because some families do not permit their girls to use the Scotty or bikes." PU6

Women have a lower likelihood of vehicle ownership and driving license possession. They also have a lower proportion of trips that involve personal vehicles like bicycles or other modes of transportation (Priya Uteng, 2012). Moreover, in some cultures, women's clothing is designed in such a way that it may not be suitable for riding bicycles (Mahadevia, 2015).

The issue of safety concerns for women in transportation options in Pakistan is of critical importance, as social norms play an important role in determining women's transportation choices and employment options. Women have faced significant limitations in their ability to move around comfortably, leading to reduced mobility and restricted access to job opportunities. Public transport has long been regarded as an unsafe option for women due to the high risk of harassment and assault. However, there have been some efforts made by public and private transportation service providers to enhance safety features.

5.2.4 Availability

Having the availability of different routes, schedules, and frequencies can increase women's labour market inclusion. When it comes to women's access to employment and transportation, it is crucial to take into account the different features of accessible transportation services. Public transport can offer a wide range of routes at a reasonable cost and frequency, but it may not be suitable for those living in peripheral urban areas (Mahadevia, 2015). Private transportation can be more expensive but may be the only viable option for some individuals. We discuss the availability theme with the interviewees and come up with the following important sub-themes:

- **Peak hours**

The discussion with the metro users brings out that crowding during rush hours is quite challenging for females. While sharing their experiences, one participant reported that:

"After 17:00 or 17:30, the buses are extremely crowded. I skip many buses to get on a bus that is less crowded". PM9

Traveling during peak hours has an impact on the comfort and safety of females as one highlighted:

"Metro buses are extremely crowded; they should limit the number of people entering the buses. And because of over-crowding air-conditioners do not work properly."PM8

Many females reported that during rush hours when buses are extremely crowded, stealing is very common. The majority reported that they take care of their belongings; however, some have lost their valuable belongings e.g., gold bangles and mobile phones in the hands of thieves.

The problem with ride-hailing is the availability of the ride during peak hours as the demand is quite high. Furthermore, the fares are nearly doubled during peak hours due to congestion on the roads which make ride-hailing an expensive option. A participant stated that:

"It takes time in peak hours to get a ride, and the fares are double. They charge more in rainy season or in events like matches because they know people demand more during that time." PU9

- **Travel time and frequency**

Regarding travel time and frequency, the metro commuters expressed their satisfaction in terms of the frequency of the buses. Furthermore, the metro operates on a dedicated route, which makes it a time-saving option as one participant remarked:

"I agree that employment status affects mobility choices. However, even if I get a job that pays me a good salary, I would still prefer to commute on metro buses because they are time-saving. You are not stuck in traffic. I always like to travel on the metro."PM5

Considering ride-hailing, the frequency is not an issue for females as they can book a ride readily except during peak hours. Furthermore, in terms of time-saving aspects, a user mentioned that:

"I have used auto, buses, and Uber previously. However, Uber is very convenient for me in terms of bargaining for the fare. So not much time is wasted on that. If I travel in an auto, I have to argue with the driver on fare rates like ***rate Zada hai Kam Karo****, etc. Therefore, a lot of time is wasted in this process." PU7*

- **Use of Technology**

The use of technology has changed the way we travel, making it easier and more convenient than ever before. The majority of the users of public and private transportation services mentioned the convenience and ease with which they can avail of transportation services, for example:

"The first thing is that we can easily book a ride from inside our house and we don't have to waste too much time on bargaining because the rates of Uber are feasible, and there is no need to bargain on that. Previously it was not the case. Females had to go out and be on the road and ask for autos or taxis and bargain with them. All this hassle has been resolved." PU3

To sum up, female commuters expressed their satisfaction with the availability of public transportation options like the metro bus and orange train, which operate frequently, with a metro

bus arriving every 3 minutes. However, the only issue is with the crowding during peak hours. We discuss the issue with PMTA key informant and he said:

"In one hour, 20 buses are traveling in one direction. One bus has 38 seats out of which 10 are for women. Therefore, in one hour, approximately we are accommodating 200 females who can sit, which may not be the right figure as I am talking in terms of seats. Otherwise, the capacity is 160."

Similarly, ride-hailing services are also easily accessible through technological applications, with the waiting time being just a few minutes. Overall, these options have positively impacted women's mobility and access to job opportunities. However, a substantial gender digital divide has been identified in Pakistan, which is primarily linked to societal and cultural norms that prevent women from benefiting from technological advancements (Amber & Chichaibelu, 2023b).

The availability of different transportation options, routes, schedules, and frequencies plays an important role in increasing women's labour market inclusion. While public transport is a cost-effective option with a wide range of routes and frequencies, it may not be suitable for those living in peripheral urban areas. Private transportation, on the other hand, can be more expensive but may be the only viable option for some individuals. During peak hours, crowding in public transport can impact the comfort and safety of females, and ride-hailing services may become more expensive due to high demand. However, the use of technology has made transportation services more convenient and accessible, with ride-hailing services being readily available through technological applications. Overall, the availability of transportation options has positively impacted women's mobility and access to job opportunities, although there is still potential for further improvement, particularly in addressing the issue of crowding during peak hours.

5.2.5 Gender inclusion in transport

This theme was generated through in-depth interviews with authorities responsible for public mass transit and private ride-hailing services. The goal was to shed light on two aspects of gender inclusion in the transport sector as explained below:

1. In the context of our research, gender inclusion in the transport sector means taking into account the unique needs, challenges, and perspectives of both men and women when planning, designing, and operating transportation systems. This includes considering gender-based differences in travel patterns, safety concerns, accessibility, and affordability (Das, 2020; Joshi et al., 2022).

The interviews clearly showed that gender, in particular females, is not central to decision-making in transport planning in Pakistan. According to interviewees from both public and private transport providers in Pakistan, they do not plan transport specifically for females but rather for people in general. They stated that their focus is on improving overall mobility, rather than gender-specific mobility. A key informant respondent (anonymous) from the Punjab Commission on the Status of Women mentioned that women's participation in transport planning is essential, but unfortunately, it is low in Pakistan. This has led to insufficient provision of transport facilities for women and inadequate consideration for their safety and security.

Furthermore, Manager Operations (PMTA) stated that the metro bus transit system was originally designed for everyone, not just women. However, on the first day the metro bus was launched, all the women chose to sit in the first section of the bus and it has remained that way since then. Despite this, he emphasized the need to do more to provide better transport services for women as captured in one of his statements:

"Our mission statement is to provide a safe, efficient, and affordable transport system for all. However, we need to do more for women."

The key informant from the Urban Unit shared his views about the gender inclusion of women in transport planning:

"Historically, we have not been planning with this consciousness that gender needs are different. Our primary objective is to connect point A with point B with the best possible fastest space H. Things, as gender has never been really given attention. It's not like a dominancy thing but people just ignore this factor and get too involved in the whole technical element of it that we forget that men and women have different transit needs."

According to the key informant from the ride-hailing company, their focus is on the younger generation who are more equipped to use digital technology. They do not do services targeting employed females, for example.

Transport planning and development in Pakistan often overlook gender differences in transportation usage, patterns, and modes. However, with the advent of rising safety concerns for women and their restricted mobility, the service providers have taken many steps in the existing infrastructure to take into account the specific needs of female commuters. The ride-hailing

company provides mandatory training to all the drivers where they are trained on the dos and don'ts on the platform, especially while dealing with female riders. For example, the content includes the method to give cash to riders by putting cash in trays in the car to avoid any physical contact, etc. Furthermore, the provision of a helpline and the presence of security personnel at the metro stations to deal with different sorts of incidents including harassment shows that authorities are now catering to the specific needs of the female commuters.

2. Gender inclusion in transport also means ensuring women have equal employment opportunities in the transport sector. However, the inadequate representation of women in the transportation industry is a matter of concern (Shah et al., 2017). The transport sector in Pakistan has low participation of female employees, which results in male dominance, particularly in the decision-making positions. This marginalizes women's interests and needs in the transport sector. Manager Operations (PMTA) talked about female representation at PMTA as:

"Females came to join our organization a little bit late because the UET (University of Engineering and Technology) adopted a transport degree program much later. Therefore, there was no opportunity for females to become transport engineers. As soon as that opportunity came, we had females. Now our manager in Rawalpindi is a female and we also have other females in various positions."

In response to the proportion of females at the policy level in the Urban Unit, the key informant mentioned that the proportion in the urban unit is 50-50 between males and females, and not just at the policy level but in the technical fields as well.

Women bring unique perspectives and experiences that are often overlooked in the transport planning process. In many cities, women are primary users of public transport, which exposes them to issues such as inadequate infrastructure, safety concerns, limited accessibility, and lack of related services. Through examining the user's perspective, it was discovered that all of the female users surveyed suggested that female inclusion in decision-making is crucial in transport planning to ensure their unique transport needs are met. The following statement captures that notion:

"I believe that it is important to include women in the decision-making process because they have a better understanding of the issues that affect other women, and this can help create more job and employment opportunities for them." PM8

The findings from interviews highlighted the need for considering the unique needs and perspectives of both men and women in planning, designing, and operating transportation systems. The shared information showed that gender, particularly females, is not central to decision-making in transport planning in Pakistan. It has resulted in insufficient provision of transport facilities for women, inadequate consideration for their safety and security, and low participation of female employees in the transport sector. However, some service providers have taken steps to cater to the specific needs of female commuters, and there are some examples of female representation in decision-making positions in the transport sector.

5.2.6 Offered Suggestions

Women commuters offered suggestions to improve the transport system for them by sharing their personal experiences and insights on the challenges they face while commuting. The majority of the metro and ride-hailing users expressed their demand to expand the mass transit system in other areas of Lahore as suggested in the following statement:

"The public transport sector is not readily available in many places. Metro routes should be expanded to the areas where there is a need for public transportation." PM5

The majority of the metro commuters complained about in-vehicle crowding and suggested that authorities should limit the number of people entering the buses. Furthermore, some females talked about stealing and mentioned that authorities should take proper action against the thieves, here follows one such statement:

"First equal seats should be allocated to males and females in both speedo and metro buses. They should separate the areas for males and females with some physical object. The ticketing booths should be separated for males and females." PM8

The ride-hailing users offered suggestions in terms of the cleanliness of the cars and they also mentioned the lack of proper safety and hygiene measures during the pandemic as drivers were not wearing masks nor they placed sanitizers in their cars as pointed out in the following statement from a participant:

"I believe that ride-hailing platforms should increase their recruitment of female drivers and prioritize the adherence to traffic rules. During the pandemic, they did not provide masks and

sanitizers to their riders, which I believe should have been made available. Additionally, it is important for the ride-hailing to inform riders and drivers about the necessity of using masks and sanitizer during the ride. Cars should also be properly cleaned and sanitized to ensure the safety of passengers." PU2

Some women have reported experiences with drivers who were unable to properly use Google Maps, and have suggested that training should be provided to drivers who are not literate and not comfortable using digital tools.

6. Conclusion and policy recommendations

The research offers both a qualitative and quantitative analysis of the impact of public and private transportation services on the inclusion of females in the labour force in Lahore, Pakistan. Employing the synthetic control approach, we detect a small but positive effect of metro bus transit provision on female labour force participation in Lahore. However, we do not observe an increase in female labour force participation following the launch of ride-hailing services. To interpret the findings, we conduct a thematic analysis and examine several channels through which the provision of public and private transport services can promote women's labour market inclusion. table

The results of the qualitative analysis show that a larger part of the women interviewed consider public transportation (metro bus, speedo bus, and orange train) affordable and easily manageable with the resources (monetary) they have. On the other hand, ride-hailing users reported that ride-hailing is comparatively an expensive option, however, due to relatively higher earnings they can manage to afford it. Regarding accessibility, most women said that their spatial position affects their mobility choices. Furthermore, the majority of the metro users have access to metro stations, either within walking distance or by taking other modes of transportation such as rickshaws, speedo buses, chingchi, etc. to reach the metro station. However, challenges persist in terms of infrastructure as the location of stations may not be conveniently situated, necessitating the use of other modes of transportation, which can be both expensive and time-consuming. Females who are using ride-hailing are more than willing to use public transportation if it is accessible to them. Travel time turns out to be an important factor when making choices among different mobility options. Metro bus emerges as time savers in terms of frequency i.e., headway time of three minutes and a dedicated route (no traffic jams). Despite the fact that Uber is readily available, it

suffers from traffic jams. Furthermore, there are many females who could afford ride-hailing but prefer to use the metro bus because of the time-saving aspect associated with the metro bus system. Safety concerns turned out to be a major sub-theme under acceptability. The most frequent response of the users of public and private transportation services was that they have never faced harassment in either of these mobility options. Regarding women in decision-making, a large number of respondents support the idea that women should be given opportunities to participate in the decision-making process, especially when it comes to designing transport infrastructure. However, the results also show that there is no gender-sensitive transport planning in Pakistan. The authorities at different institutions confirm the notion that the transportation infrastructure is primarily designed to facilitate the masses rather than catering to the needs of different demographic groups.

Based on the findings of our research, we recommend the following policies. First, improving the accessibility of public transportation, particularly by strategically locating metro stations and introducing feeder routes in areas with a high concentration of female worker force. This will reduce the need for additional modes of transportation, making the commute more affordable and time-efficient. Second, enhancing the safety and security of female passengers in public transportation through the implementation of policies that protect them from harassment and abuse. This can be achieved by increasing the number of female transport personnel, introducing gender-sensitive training, and strengthening the monitoring and reporting mechanism. Third, encouraging the participation of women in decision-making processes related to transport infrastructure planning and design. This will ensure that the unique needs and concerns of female commuters are taken into account and addressed in a gender-sensitive manner.

To increase the use of ride-hailing among female workers who do not have access to affordable public transportation and cannot afford premium service, we recommend following policies. First, by introducing affordable ride-hailing services that cater specifically to female commuters. This can be achieved by collabourating with ride-hailing companies to offer discounted fares or subsidized rides for female workers who meet certain criteria, such as low-income or working in certain industries. Second, by collabourating with employers and organizations to provide ride-hailing benefits to their female employees. The employers can offer ride-hailing vouchers or discounts as part of their employee benefits package, or partner with ride-hailing companies to

provide a dedicated shuttle service for female employees. Third, by developing ride-hailing apps that are user-friendly and accessible to female commuters who may not have access to smartphones or internet connectivity. This can be achieved by collabourating with telecommunication authorities to provide access to smartphones and internet connectivity, or by developing a simplified version of the app that can be used on basic mobile phones. Fourth, to increase the employment of females as ride-hailing drivers, the service providers can partner with women-focused organizations to reach out to potential female drivers and provide them with training and support. These organizations can also help address the socio-cultural barriers that prevent women from working as drivers. The use of ride-hailing services by predominantly higher-earning females and the lower likelihood of women from well-off households engaging in the labour market highlight the insufficiency of solely providing transportation services. It underscores the necessity of addressing social norms that impede the labour market participation of women from high-income households. An appropriate policy recommendation for women from higher-income households who do not work would be to address the socio-cultural barriers that hinder their labour force participation. This may involve implementing measures to challenge traditional gender roles, promoting equal employment opportunities and supportive workplace policies, and providing resources and support for women to balance work and family responsibilities.

Lastly, conducting regular assessments of the effectiveness of public and private transportation services, including the impact on female labour force participation, and adjusting policies and interventions as needed will go a long way. Overall, these policies can help, promote greater inclusivity and accessibility in transportation services and support the increased participation of women in the labour force in a developing country urban context.

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Appendix

Table A1 Construction of predictors used in the quantitative analysis

Variable	Description
Age	Average age of the females in completed years at the city level
Marital Status	Proportion of married females at the city level
Education of head	Average number of completed years of education of household head at the city level
No formal education	Share of females with no formal education at the city level
Primary education	Share of females with primary education at the city level
Secondary education	Share of females with secondary education at the city level
Tertiary education	Share of females with tertiary education at the city level
Household Size	Average number of individuals living in the household at the city level.
Children (0-4)	Average number of children between 0 and 4 years of age in the household at the city level
Male employment rates	Employment rates of males at the city level
Household income	Log of average household income (subtracting working female's income) at the city level in Pakistani Rupees.

Source: Author's own construction

Table A2 List of cities along with information on the launch date of different transportation services

S. no.	**City name**	**Public transportation (Metro Mass Transit)**	**Ride-hailing (Uber and Careem)**	
			Uber	**Careem**
1	Lahore	2013	2016	2015
2	Faisalabad		2017	2017
3	Rawalpindi	2015	2017	2016
4	Multan	2017	2018	2017
5	Gujranwala		2017	2017
6	Sargodha			2018
7	Sialkot			2017
8	Bahawalpur			2018
9	Islamabad	2015	2017	2016
10	Karachi		2016	2016
11	Hyderabad		2017	2017

12	Sukkur			2018
13	Peshawar	2020	2018	2017
14	Quetta			2018
15	D.G Khan			
16	Larkana			
17	Mirpur Khas			
18	Malakand			
19	Kohat			
20	D.I Khan			
21	Hazara			
22	Bannu			
23	Mardan			2018
24	Sibbi			
25	Kalat			
26	Mekran			
27	Zhob			
28	Nasirabad			

Source: Information about the launch date of metro has been gathered from the service provider's official website and confirmed with news sources. However, information about the launch of ride-hailing (Uber and Careem) has been gathered through different news sources and platforms (such as social media, among others).

Table A3 Themes and subthemes (pre-determined)

Themes	**Subthemes**
Accessibility	Spatial position in the city (residential location), access to work, education, health, and social life, provision of mobility infrastructure, trip chaining, sidewalks, bus shelters, parking places, supporting services (toilets), spatial expansion of labour market, distance covered, integration of different modes, use of technology.
Affordability	Formal or informal employment, individual's wages or income, household income, expenditures on transportation services, personal vehicle, social relations in the household, non-work vs work trips
Acceptability	Experience in using different modes of transportation, quality of service and vehicle, the idea of modernity, safety concerns, surveillance and protection, ability to travel on one's own, prestige and status in the society, presence or

	absence of security personnel, the attitude of the staff (drivers, conductors, among others), choice of clothing, confidence, and ability, gatekeeper's behaviour, response to user's needs, masculine choices of mobility,
Availability	Route possibilities, timings, headway time or frequency, peak hours availability, night commuters, use of technology (mobile or internet)

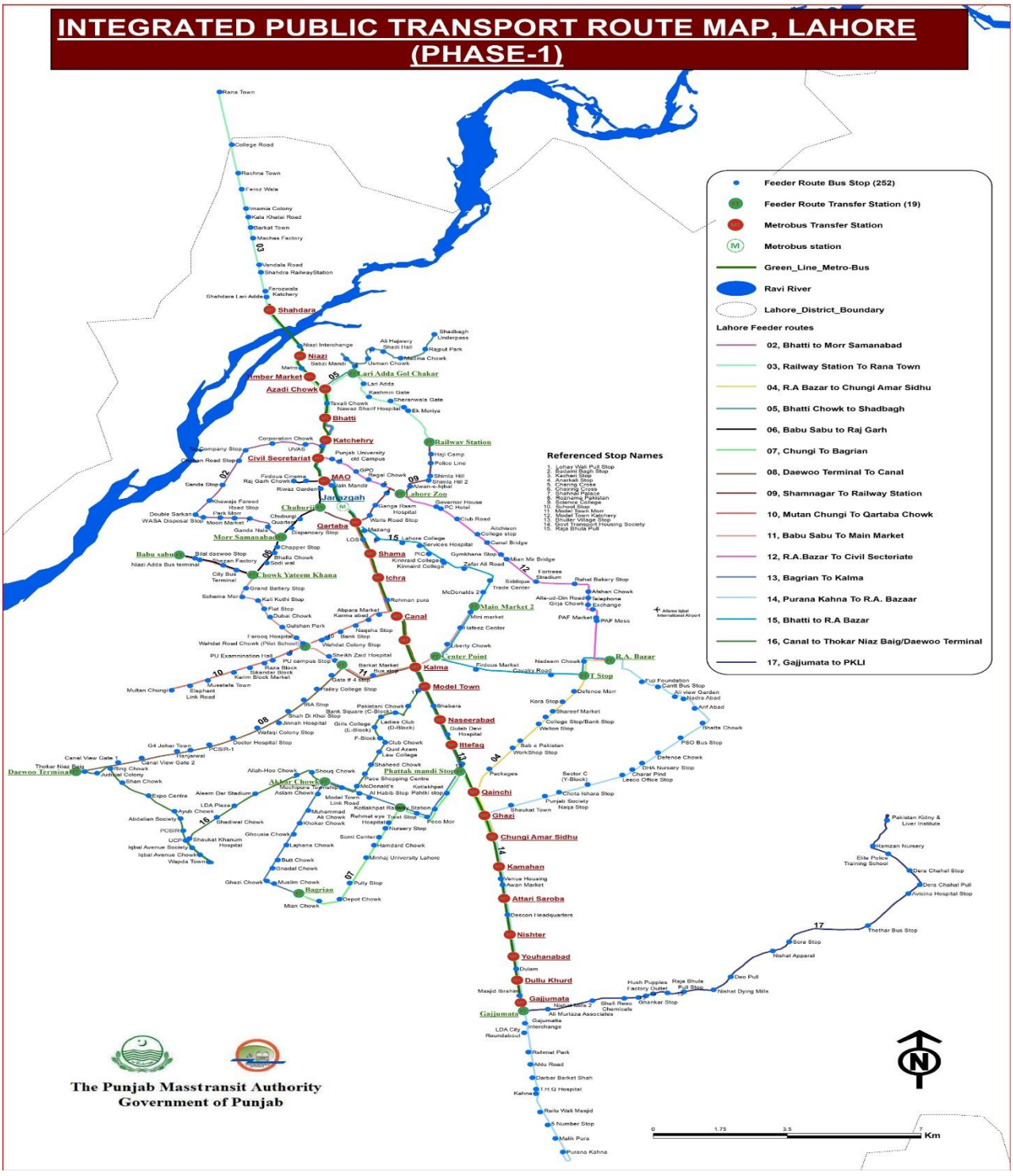

Figure A1 Route of metro bus and feeder routes connecting other areas to metro stations

Source: Punjab Mass Transit Authority (PMTA)

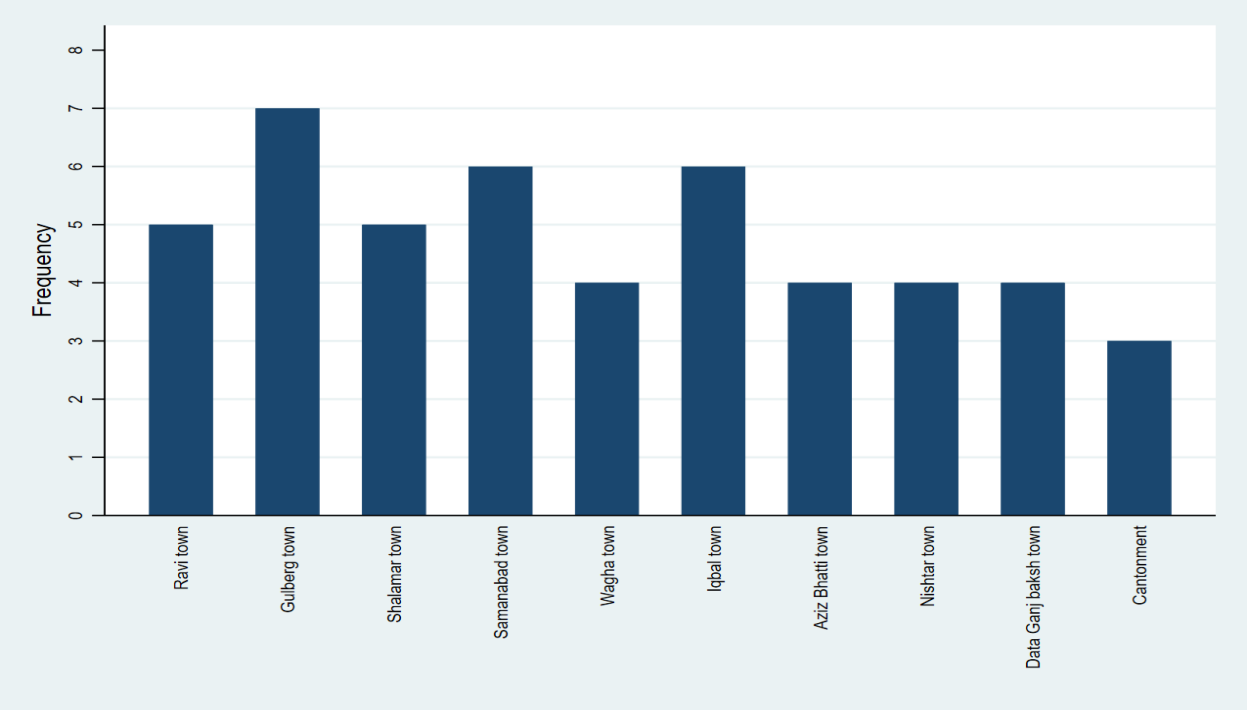

Figure A2 Geographic location of ride-hailing users

Source: Author's own construction from structured questionnaire responses.

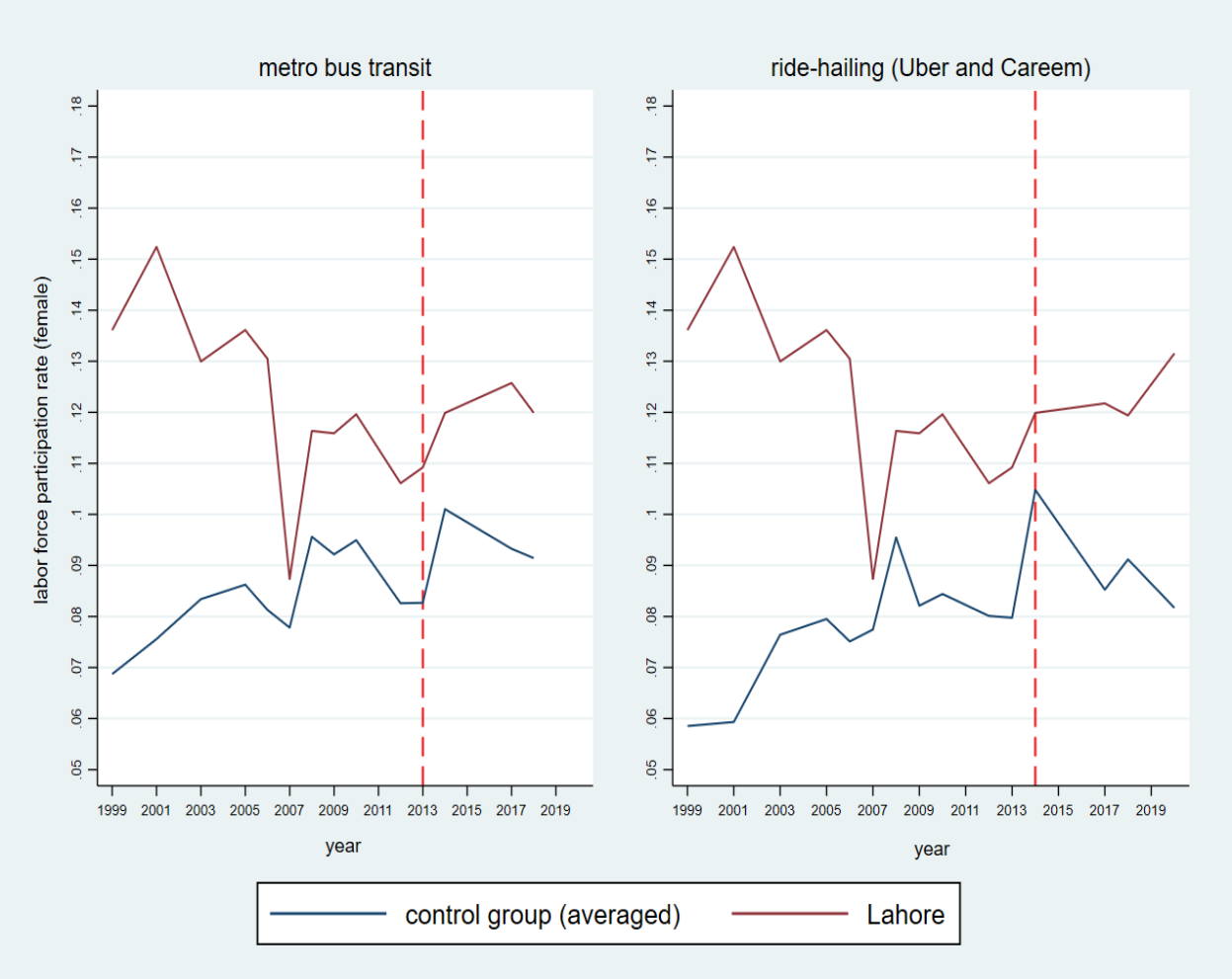

Figure A3 Trends in female labour force participation (Lahore vs the rest of cities in the control group under the metro bus and ride-hailing intervention specification)
*Source: Authors own construction from labour force surveys (1999-2020**).***

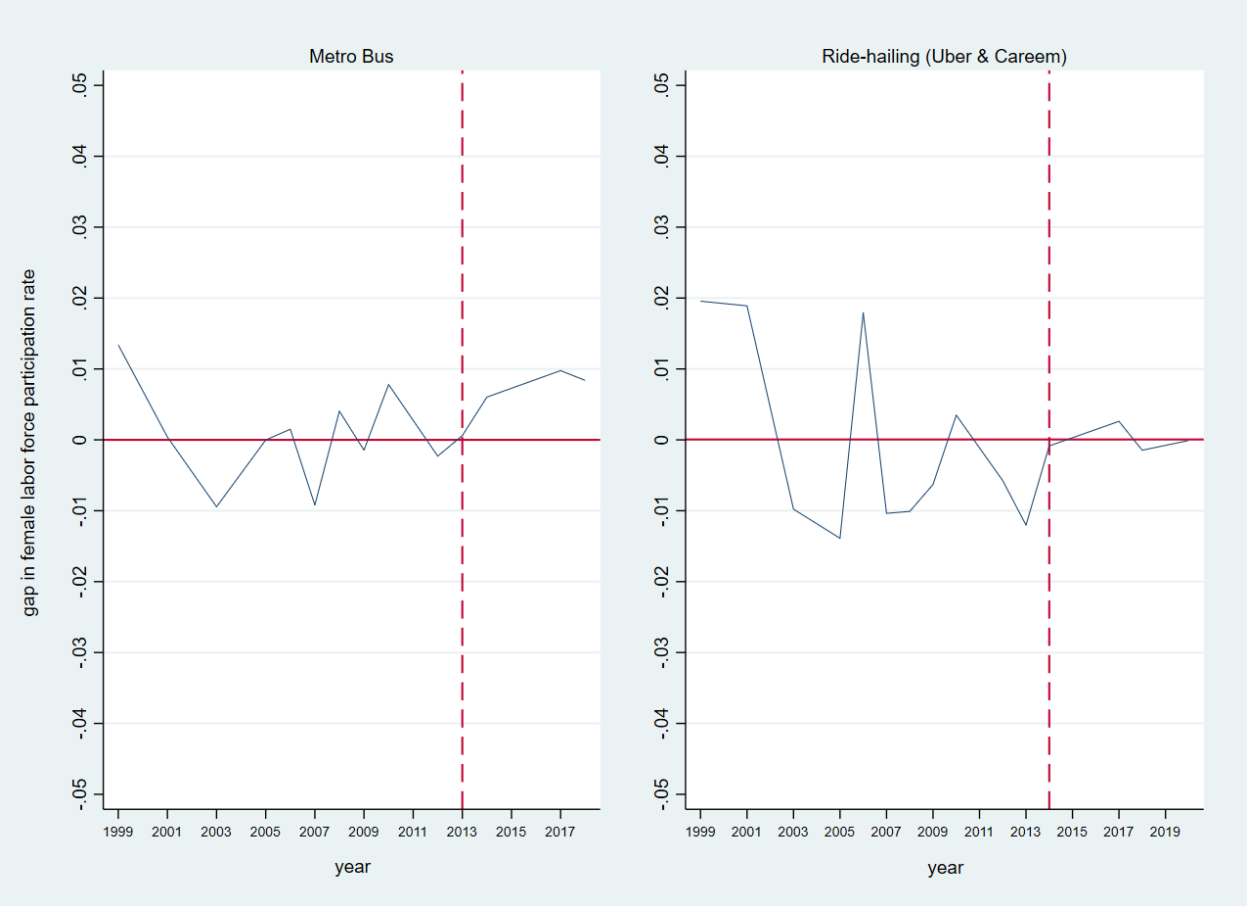

Figure A4 Female labour force participation rate gaps between Lahore and synthetic Lahore under metro and ride-hailing intervention specifications

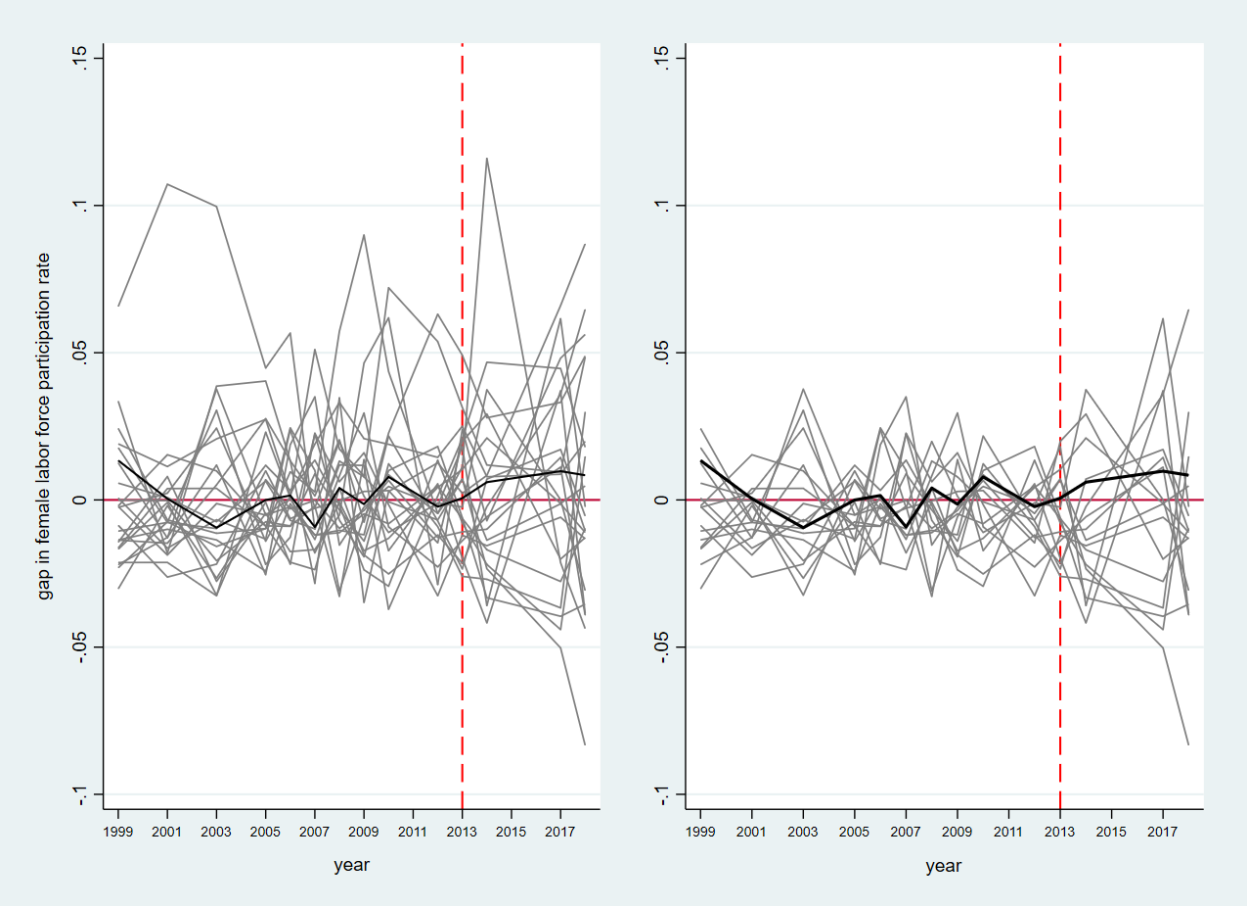

Figure A5 Female labour force participation rate gaps in Lahore and placebo gaps in control states (metro analysis)

Note: The left panel shows female labour force participation rates gaps in Lahore and placebo gaps in all 25 states. The right panel shows female labour force participation rates gaps in Lahore and placebo in 17 control states (eliminate states with MSPE three times higher than Lahore)

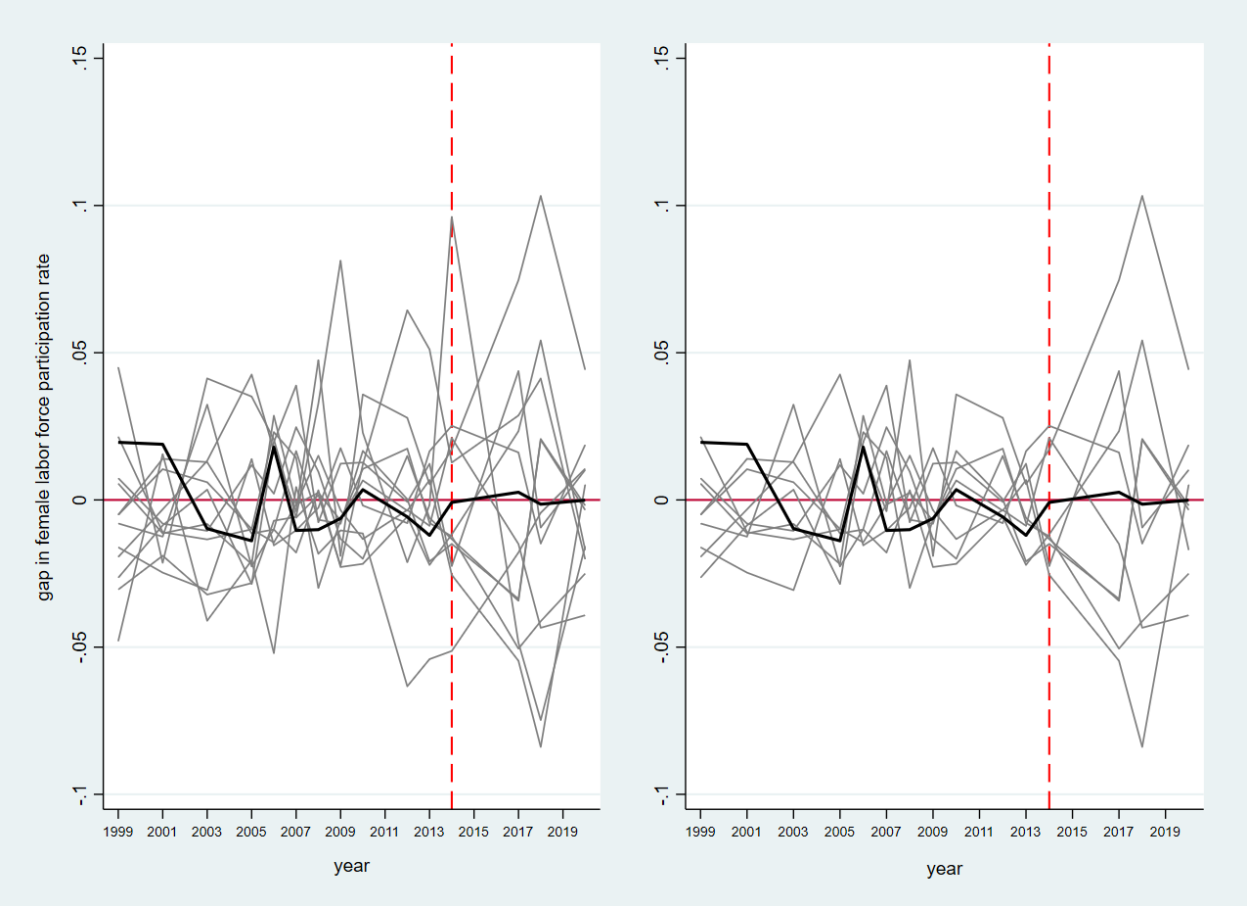

Figure A6 Female labour force participation rate gaps in Lahore and placebo gaps in control states (ride-hailing analysis)

Note: The left panel shows female labour force participation rate gaps in Lahore and placebo gaps in all 13 states. The right panel shows female labour force participation rate gaps in Lahore and placebo in 10 control states (eliminate states with MSPE three times higher than Lahore).

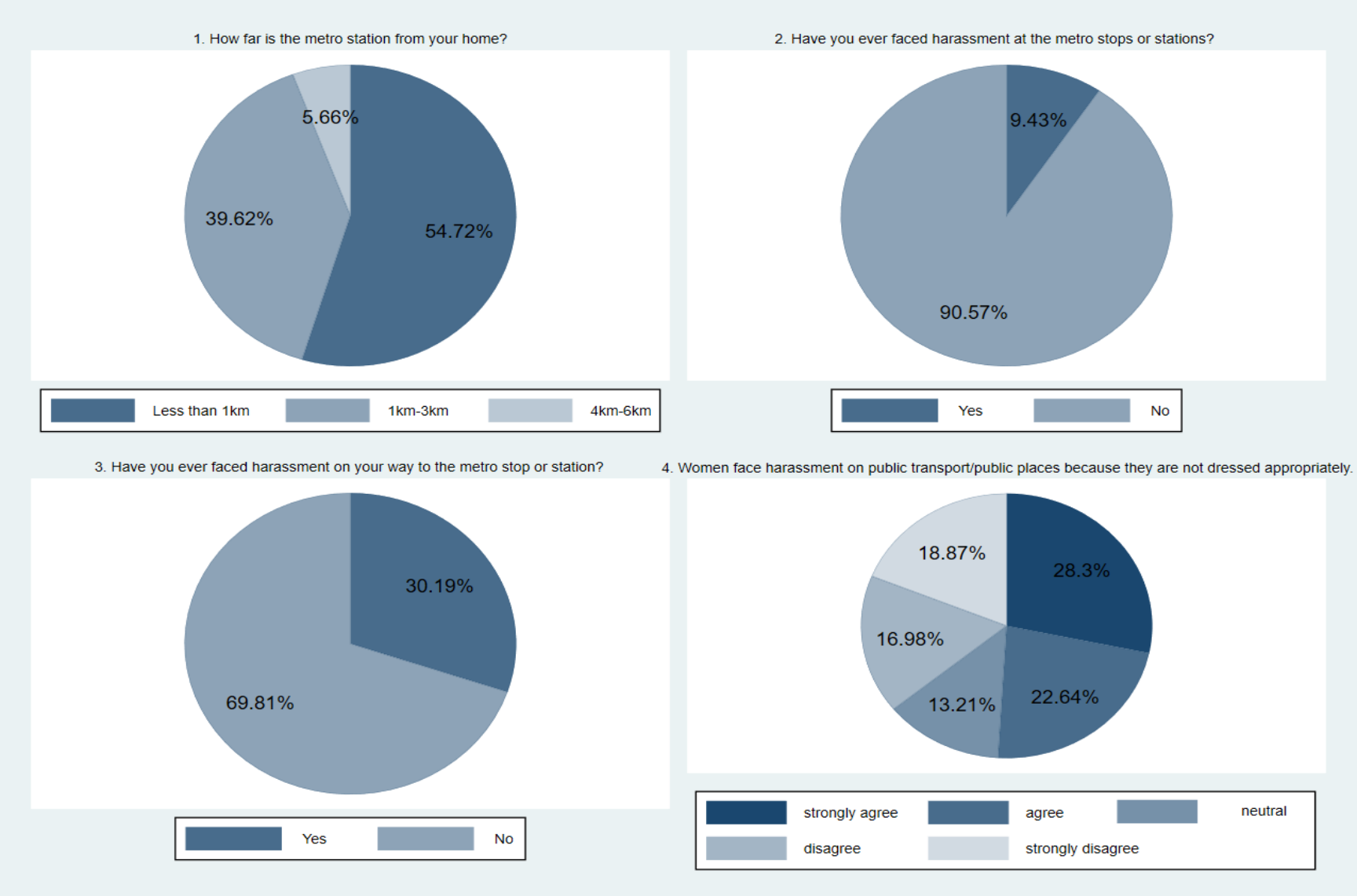

Figure A7 Responses to the structured questionnaire (selected responses from metro users)

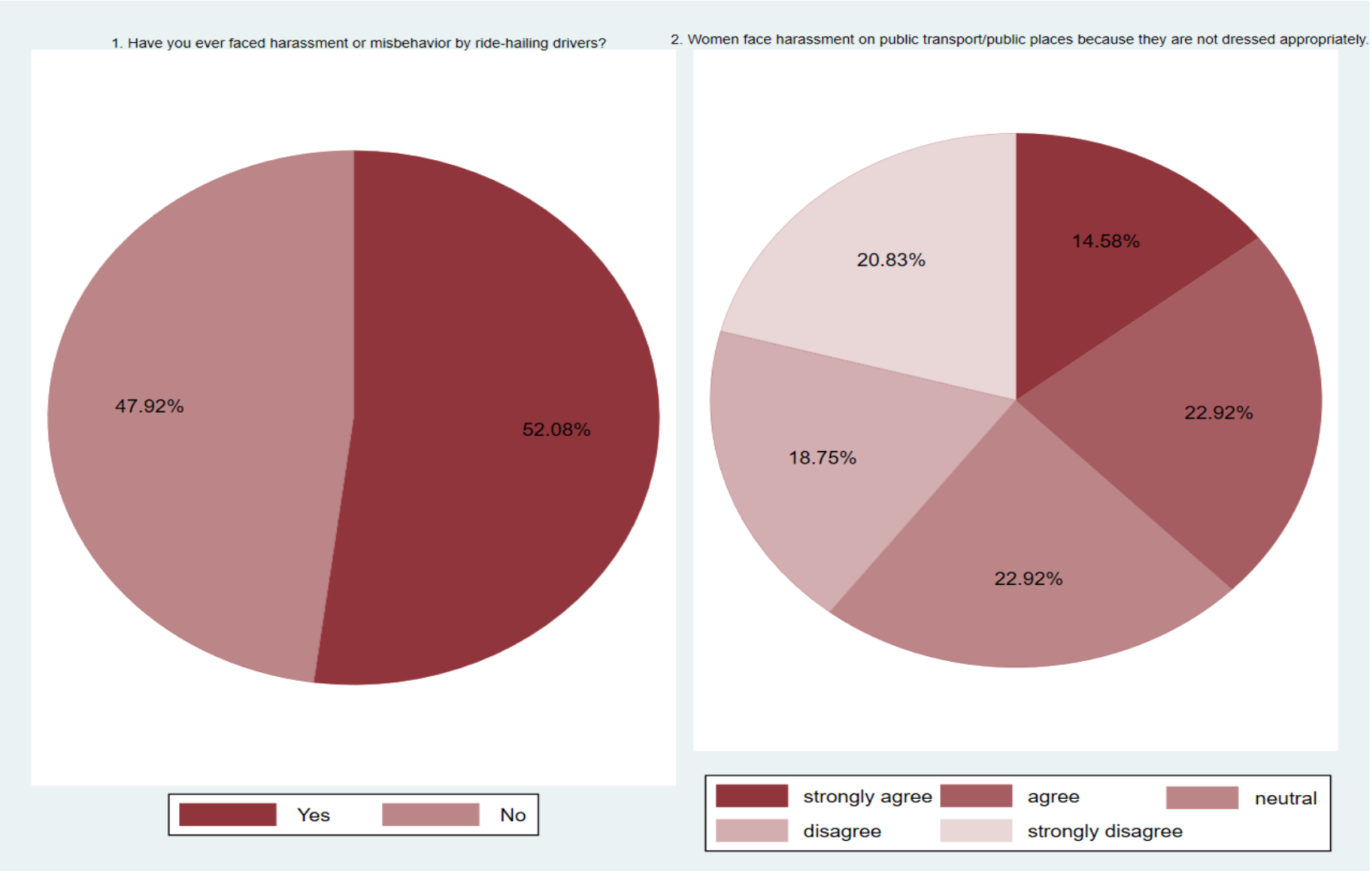

Figure A8 Responses to the structured questionnaire (selected responses from ride-hailing users)

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