Regulating the Last Mile: Paratransit in Delhi

by

Simon Harding

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Abstract

Paratransit plays a vital role in cities in the Global South, including India. Paratransit modes - those which lack a fixed route and timetable - perform trips impractical or impossible on mass transit and, in Delhi, increasingly provide feeder services to the city's metro rail and Bus Rapid Transit (BRT) systems.

Despite their critical role in the urban transit ecosystem in Indian cities, paratransit operators have a poor reputation amongst the middle-classes and the English-language media for overcharging passengers and flouting regulations. In response, the current policy approach to paratransit regulation is marked by judicial and technical interventions. These are seldom empirically driven, and often represent a relative neglect of the paratransit sector.

This study aims to correct this neglect by providing a detailed empirical account of paratransit operations and the regulatory environment in Delhi. It makes the case that paratransit is a vital last mile mode, and that evidence based regulation of paratransit modes is critical to improving public transport in Indian cities.

This study does this by analyzing existing paratransit regulation and demonstrating that the current approach involves a heavy burden of compliance that inflates costs for operators. It then presents an empirical analysis of the economics of operating an auto-rickshaw using a survey of drivers (n=301). It finds that overcharging may be explained by the structure of operators' costs and revenues. A survey of passengers (n=689) provides data for a series of statistical models, which suggests that the incidence and magnitude of overcharging are explained by the

economics of auto-rickshaw trip making and associated with such variables as trip distance and the location of the destination.

It then seeks to explain the rise of battery-rickshaws as a mode paratransit in the city and the lessons provided by their sudden proliferation. A fieldwork survey of drivers (n=302) provides data on their role and operating economics. A passenger survey (n=540) finds battery-rickshaws are largely replacing cycle-rickshaws. This case study sheds light on the environment in which urban transportation policy decisions are made. The study concludes by presenting some policy recommendations for paratransit in Delhi.

Lay summary

This thesis looks at the way paratransit is regulated in Delhi. Paratransit refers to public transport vehicles that operate without fixed routes and timetables, such as auto-rickshaws, battery-rickshaws and cycle-rickshaws.

Paratransit plays a crucial role in urban transportation in Delhi by providing a feeder service to the city's expanding metro system, and catering for trip impossible or impractical on other modes of public transport. Despite its importance, paratransit and its operators have a poor public reputation for overcharging passengers and flouting regulations.

This study uses empirical data on Delhi's paratransit sector to argue that the problems experienced by paratransit operators and passengers can be tackled by improving the way the sector is regulated. However, to achieve this urban planners must focus less on large-scale prestige projects, such as new metro lines and flyovers, and more on the thousands of individual operators that comprise the paratransit sector.

Preface

The design of the research project, data collection and analysis are all the work of the author unless indicated otherwise below.

Material from chapter 1 has been published: Harding, S. E., Badami, M. G., Reynolds, C. C., & Kandlikar, M. (2016). Auto-rickshaws in Indian cities: Public perceptions and operational realities. *Transport policy*, *52*, 143-152. The lead author was responsible for all material from that manuscript that appears in this thesis. Co-authors provided comments, edits and guidance for this material. This material appears in section 1.7.

Material from chapter 2 has been published: Harding, S., Kandlikar, M., & Gulati, S. (2016). Taxi apps, regulation, and the market for taxi journeys. *Transportation Research Part A: Policy and Practice*, *88*, 15-25. The lead author was responsible for the research and the writing of the entire manuscript. The co-authors provided comments, edits and guidance. This material appears in section 2.1, 2.2 and 2.3.

Chapter 3 has been submitted for publication: Harding, S. & Kandlikar, M. (forthcoming). The Auto-rickshaw "fleecing" problem – some empirical evidence. Section 4.5 of chapter 4 appears in this manuscript. The lead author was responsible for the research and the writing of the entire manuscript. The co-author provided edits, comments and guidance.

Chapter 4 has been submitted for publication: Harding, S., & Kandlikar, M. (forthcoming) Fare meter compliance by Delhi’s Auto-rickshaw drivers. Section 4.5 does not appear in this manuscript. The manuscript is the work of the lead author with comments, edits and guidance by the co-author. Appendix E is taken from this manuscript and is the work of the co-author.

An abridged version of chapter 5 has been submitted for publication: Harding, S. & Kandlikar, M. (forthcoming). Explaining the Rapid Emergence of Battery-rickshaws in Delhi: Supply-demand, Regulation and Political Mobilisation. The manuscript is the work of the lead author with comments, edits and guidance by the co-author.

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Given that material in this thesis has appeared in publications, there will be redundancies.

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List of abbreviations

AAP	Aam Aadmi Party
BJP	Bharatiya Janata Party
BRT	Bus Rapid Transit
BSUP	Basic Services to the Urban Poor
CAGR	Compound Annual Growth Rate
CBD	Central Business District
CNG	Compressed Natural Gas
CPCB	Central Pollution Control Board
DDA	Delhi Development Authority
EMI	Estimated Monthly Instalment
EPCA	Environment Pollution Control Authority
GDP	Gross Domestic Product
GPS	Global Positioning System
GOI	Government of India
IAS	Indian Administrative Service
IHSDP	Integrated Housing and Slum Development Programme
JNNURM	Jawaharlal Nehru National Urban Development Mission
MoRTH	Ministry of Road Transport and Highways
MHUPA	Ministry of Housing and Urban Poverty Alleviation
MOUD	Ministry of Urban Development
NGO	Non-Governmental Organisation
NPV	Net Present Value
NUPT	National Urban Transport Policy
OLS	Ordinary Least Squares
PAN	Permanent Account Number
PM	Particulate Matter
PMV	Private Motor Vehicle
PUCC	Pollution Under Control Certificate

QQE	Quality, Quantity, Economic
RA	Research Assistant
Rs.	Indian Rupees
SUD	Significant Unmet Demand
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
UIG	Urban Infrastructure Governance
WMD	Weights and Measures Department
WSA	Wilbur Smith Associates

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Chapter 1: Introduction

1.1 Rationale

The auto-rickshaw has been a familiar sight in Indian cities since its introduction from Italy in the early 1960s (Iyer, 2012). At this time, this small three-wheeled vehicle was ideally suited to the task of moving passengers around urban India: its small size meant it could navigate tight side streets and alleyways, and its simple design meant it was easy and cheap to repair. It was also affordable for both passengers and operators. When the bus and rail services proved impractical or unavailable, the auto-rickshaw offered a cheap and readily available mode of transport in an era when private-vehicle ownership was rare.

Urban transport in contemporary Indian cities is rather more complex. Private-motor-vehicle (henceforth, PMV) ownership has boomed, clogging roads and worsening air quality to the extent that it has prompted a wave of urban transport mega projects designed to tempt drivers away from their cars and motorcycles. The auto-rickshaw must now jostle for position in the urban transport sector with a plethora of metro rail systems and bus rapid transit corridors (BRTs) not to mention the rapidly growing fleets of cabs controlled by ride-aggregators, such as Uber and Ola. Compared to these new globally-oriented technologically-savvy competitors, the auto-rickshaw is often perceived by the middle-classes and media as out-dated and out of place in the “global” Indian city. Its transgression is not solely aesthetic, but also behavioural. Auto-rickshaw drivers have a poor reputation of overcharging their passengers, a behaviour ascribed to individual greed by both passengers and policy-makers. In 2011, the then Chief Minister of

Delhi, Sheila Dixit, reflected the heated, antagonistic public debate around the issue of “fleecing” by auto-rickshaw drivers by calling for the removal of the vehicles from the city’s streets (Indian Express, 2010).

This study argues that if auto-rickshaws are to play an effective role in the urban transport system – one expanding due to investments in metro and BRT systems - then the phenomenon of overcharging must be understood as the symptom of a wider set of problems with paratransit regulation in Delhi. Investigation of these problems must involve both auto-rickshaws and an alternative paratransit mode that has proliferated rapidly in the past five years seemingly outside the ambit of regulation – the battery-rickshaw.

This introductory chapter provides a detailed account for the context of this study, reiterating and developing the brief sketch above. It will discuss trends in urban growth, the expansion of the middle-class, burgeoning private-motor-vehicle ownership and recent investments in large-scale urban mass transit projects. It will then provide justification for the study by identifying the important role played by paratransit in the urban transport system and its relative neglect by policy-makers.

Whilst the phenomena described in this chapter are found across the major Indian cities, the focus of this study will be Delhi. As discussed below, the Indian capital provides an archetypal case due to its high levels private-vehicle ownership, much-publicised poor air quality, expanding metro system and antagonistic relationship with its large and varied paratransit fleets. Smaller Indian cities also face serious urban transport challenges, however, these are different in nature to those faced by the major cities, typically involving inadequate mass transit and a reliance on paratransit vehicles.

1.2 Population growth, urbanisation and urban planning

This section will argue that India has been experiencing swift urbanisation in recent decades and that the growth of its urban areas has been shaped by land use policies, which have pushed both low- and high-income developments to the peripheries. As a result, Indian cities have been decentralising and expanding outwards. Delhi provides an archetypal case.

India's urban areas are expanding and its population is urbanising. In 2014, 32% of Indians (410m) lived in urban areas, up from 26% (222m) in 1990. In the period to 2050, India is projected to add 404m urban residents, more than any other country, bringing its rural and urban populations into approximate numerical parity at around 800m each (UN, 2014). The country's 2011 census reports that urban population growth is accelerating, from 2.1% in 1991-2000 to 3.4% in 2000-2011. This growth was driven predominantly by rural-urban migration and the establishment of new urban areas (Pradhan, 2013; Bhagat, 2011). The 2011 census data signals that for the first time since independence, the absolute increase in the urban population was larger than the rural. Over the same period, the urban-rural population growth differential rose from 1% in 1991-2000 to 1.6% in 2000-2011 indicating an urbanising population and with it, growing cities (Pucher et. al, 2005).

India's major cities are among the fastest growing in the world: every "X-class[1]" city (with the exception of Kolkata) will climb the global population rankings from 1990 to 2030. Mumbai's population is projected to nearly double from 12.4m in 1990 to 23.4m in 2030, raising its global ranking from 6th to 4th. Delhi's is expected to grow faster still: from its 1990 population of 9.7m (9th largest globally) it has reached 24m in 2014 and is predicted to rise to around 36m in 2030, allowing it to retain its current position as the world's second largest urban agglomeration after Tokyo-Yokohama (UN, 2014). Smaller "Y-class" cities are also experiencing rapid growth. India's 39 urban agglomerations with populations of more than 1m people in 2000 experienced a mean population growth of 31.5% 2000-2011; an annual average increase of 2.6% (GOI, 2011), comparable to the country's larger "X-class" cities.

Increases in urban populations have had many consequences for cities. These include placing increasing pressure on already strained public infrastructure, the growth of informal employment markets, and bringing conflicts over urban space with regards to slum settlements (*jhuggis)* among others. Certain urban planning policies have been implemented to counter some of these trends, namely policies which aim to "decongest" the city centre by pushing development outward to the periphery. These policies include placing restrictions on the Floor Space Index (FSI) – the ratio of a building's floor area to the size of the plot of land on which it sits - in the centre of Indian cities where limits are around 1.6, in contrast to between five and fifteen in cities in other Asian countries (Pucher et al.2005). This keeps core densities low and encourages horizontal developments with high service costs, which restrict potential profits for developers.

[1] Since 2008, the Government of India has divided cities into larger "X-class" cities (New Delhi, Mumbai, Kolkata, Bengaluru, Chennai, Hyderabad, Pune and Ahmedabad) and over 50 smaller "Y-class" cities. All other cities are

In response, municipalities on the urban periphery offer lenient regulations to developers pushed away from the centre of the city, a move that has the effect of attracting new middle-class housing and commercial developments to the rural-urban fringe (Bertaud, 2002). However, new middle class developments in peripheral municipalities often outpace basic infrastructure: they are commonly without hospitals, schools or local shops. Accessing these services involves trips made by PMV as peripheral areas are poorly served by public transport (Pucher et al, 2005). However, policies to "de-congest" the urban centre do not affect the middle-classes alone; low-income groups living in centrally located *jhuggi*[2] colonies are the target of policies with a similar aim – de-congestion – but far harsher measures, namely forced eviction rather than merely providing disincentives for development. *Jhuggi* settlements are usually built on public land. Their establishment is technically illegal and occurs outside of the formal planning system. Following long periods of general de facto toleration in Delhi, premised on the acceptance of the low-income workforce's need for shelter - large scale demolitions and the relocation of residents to resettlement colonies on the peripheries began in earnest in the early 1990s (Dupont, 2000) and has accelerated since the millennium when demolition began to be framed within a new definition of "public interest" influenced according to neoliberal conceptions of inequality and citizenship (Bhan, 2009). Resettlement colonies are generally poorly served by essential services; they are also typically located long distances from residents' places of work (see Ghosh (2008) for an example from Delhi).

Whilst the growth of the urban periphery in North America and Europe was driven by the movement of wealthy households away from the urban centre in search of better living

[2] *Jhuggi* is the Hindi word for an informal urban settlement that closely maps onto the English word 'slum'.

conditions, Indian suburbanisation is characterised by the presence of both gated housing developments and high-end shopping malls and low-income areas without basic amenities, often the result of forced evictions (Jain et al, 2013). The Indian capital, Delhi is an archetype. Faced with significant numbers of post-Partition migrants from the Western Punjab, the National Capital Region[3] (NCR) Plan aimed to decentralise both population growth and economic development in the region by encouraging the growth of a series of satellite towns located 20-30km from central Delhi (DDA, 1962). These towns were intended to act as a check on the growth of Delhi (the National Capital Territory, or NCT). However, success was limited: some towns grew rapidly (i.e. Gurgaon and Ghaziabad) whilst others hardly expanded (i.e. Kundli). The plan did not reduce growth in the NCT as much as intended.

A combination of policies (discussed above) pushed development to Delhi's urban fringe. Jain et al (2015) show that an increasing percentage of the contiguous built-up area centred on the NCT is located outside of official municipal boundaries. They report figures of 20% in 1977, 35% in 1999 and 42% in 2010. The size of this total built-up area increased 17% from 1997 to 2008 (Jain et al, 2013). A significant part of this increase, they argue, is due to the growth of *jhuggi* settlements on the periphery. Furthermore, the city has also been reducing in density. From 1981 the density of built-up areas in central Delhi stagnated due to lack of available land. It then decreased in recent years due to slum clearance drives associated with the Commonwealth Games and the construction of the Delhi Metro: at present, Delhi has a core density of less than half that of London and Paris and a small fraction of New York and Tokyo (CSE, 2016). Overall,

[3] The National Capital Region contains the National Capital Territory (which comprises the city of New Delhi) and a number of satellite towns located in the neighbouring states of Uttar Pradesh, Haryana and Rajasthan).

the lack of available land in the urban core and policies to de-congest or “green” the centre push both new middle-class developments and *jhuggi* settlements beyond the municipal boundaries. For Jain et al (2013, 2015), this creates a growing peripheral population of both low and middle-to-high income groups.

In sum, Delhi’s population is growing, reflecting national demographic trends, despite earlier attempts to limit its growth. Urban planning policies designed to counter the growth of the city centre have resulted in a sprawling, multi-centred city (Tiwari, 2002) with fast rates of growth on the periphery. As the physical shape of Indian cities has been changing so have the ways in which they meet their mobility demands. The following section will describe the increasing number of private-motor-vehicles in Indian cities and will suggest some reasons for rising motorisation rates.

1.3 The middle classes, mobility and motorisation

This section will argue that both the number and modal share of PMVs in Delhi has been increasing as demand has increased along with the availability of increasingly affordable domestically manufactured vehicle. This increase in demand, it will contend, comes as the result of a growing middle class, the increasing affordability of domestically manufactured vehicles, the stagnation of urban public transport systems and, as argued above, the growth of urban peripheries.

India's national demand for mobility has outpaced GDP growth in recent decades, expanding by around 10% per annum in the 1990s with road transport, including freight, the fastest growing mode (World Bank, 2002). Delhi's growing population, its increasing geographical spread and large PMV fleet will continue to contribute to the growing national demand: the number of trips in the city is forecast to increase by around 70% from 2007 to 2021 (RITES, 2010). In the past few decades the city has also exhibited a shift away from public to private motorised modes of transport. The share of motorised PMVs as a percentage of all non-walking person-trips rose from 27% in 2000-1 to 36% in 2008-9 whilst bus trips dropped from 60% to 41% over the same period (Tiwari, 2011). This shift reflects a long term trend that has been accompanied by the fast growth of PMV ownership, in particular motorcycles, which represent three-quarters of PMVs (Badami et al, 2004). In the period 2000-2005 the city was registering over 900 new motor-vehicles per day (CSE, 2008). By 2009, Delhi contained 1.4% of the Indian population and 7% of the country's motor vehicles: the result of a decade which saw private car numbers rise at a CAGR of 9% and the city's motorisation rate (vehicles per 1000 people) to around 400 (Sanjay Singh, 2009) well above the national rate of 22 (Sharma et al., 2011).

The expansion of the Indian middle-class is a major contributing factor to the growth in PMV numbers. In the absence of an official definition, there has been much debate over both the determinants of the Indian middle class and its size. India's National Council for Applied Economic Research (NCAER) defines middle-class status as an annual household income of between Rs. 200,000 and Rs. 1,000,000 (Rs.258,600 to Rs.1,229,600 in 2014 rupees)[4]. Using this definition, Shukla (2010) presents an estimate of 28.4m households, or 153m people. He concludes that the number of middle-class households increased from 5.7% nationally in 2001-2002 to 12.8% in 2009-2010. However, Meyer and Birdsall (2012) produce a far lower estimate based on the same definition but correcting for what they argue are discrepancies in the data, namely relating to the accuracy of the survey instruments used and the gap between GDP growth rates, used by Shukla (2010) as a way of projecting 2004/5 data to 2009/10, and growth in household expenditure. They estimate a middle-class of around 70m people with wealth concentrated in the top decile amongst a small number of very wealthy households. However, regardless of its current size – it is, by all definitions still a minority – the importance of the rise of the Indian middle-class is that it proxies growing domestic private consumer spending and rising household incomes, which increased by around one-third between 1993-1994 and 2009-2010 (Meyer and Birdsall, 2012), and is a fast growing section of the population. It must be noted that Delhi had a per-capita income of Rs.219, 979 in 2013-14 (approximately US$3,400) (Government of the National Capital Territory, 2016a), roughly double the national GDP per-capita figure of US$1,647 in 2014, which goes some way to explaining the concentration of private-motor-vehicles in the city. This means that the city is likely to have a higher share of middle-class occupants able to afford private-motor-vehicles than the national average.

India’s private spending-GDP ratio is set to rise further as rising incomes allow more spending on consumer goods (Banerjee and Duflo, 2008). In particular, private consumer spending on

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[4] Throughout this study all rupee values that are not in 2014 rupees are followed by the 2014 rupee equivalents in parentheses where appropriate.

transportation rose from 11% of the average annual household budget in 1995 to an estimated 19% in 2015, largely due to purchases of increasingly affordable domestic automotive products produced by an expanding domestic industry (McKinsey, 2008). From Independence to the early 1990s the Indian automotive industry was subject to a policy approach centred on protection and indigenisation. The production of PMVs was strictly licenced by the government. However, the economic reforms enacted in the early 1990s lifted licencing policies and opened the domestic market to a raft of foreign companies, which entered joint-ventures with Indian partners. The automotive sector began to be seen as an important industry for GDP growth and foreign investment; as one deserving of supportive policies and complementary infrastructure investments (Goswami, 2011) The hitherto seller's market turned into a buyer's market as production increased and competition between the domestic manufacturers, namely Maruti Suzuki, Hero Honda, Bajaj and Tata, in addition to global manufacturers, brought about a drive for affordability in order to expand the domestic market to the burgeoning middle-classes who were previously unable to purchase PMVs (Ranawat and Tiwari, 2009), a process epitomised by the launch of the Tata Nano – the "one lakh car"[5] (Saxena, 2010). The Indian middle-class can now choose from a growing range of domestically manufactured PMVs starting from around Rs.60, 000-70,000 for a low-end motorbike, a figure within reach for a growing section of the population (KPMG, 2013). Effective marketing by manufacturers has helped the PMV become an aspirational product – a marker of middle-class status (Goswami, 2011).

[5] A lakh is one-hundred thousand.

If middle-class urbanites were pulled into the PMV market by choice and price; equally, they were also pushed into it by the long-term stagnation of India's urban public transport systems. Urban public transport in India is generally "old, poorly designed, inadequately maintained, dangerously overcrowded, undependable and slow" (Pucher et al, 2005). Inefficiency stems from a combination of poor management of resources, corruption and low worker productivity (Pucher et al, 2004). Most publicly owned undertakings rely on heavy subsidies in order to keep ticket prices affordable for the urban poor, leaving little funding for improvements, a situation which has led to the creation of undifferentiated, low-priced but universally poor quality transit systems (MOUD, 2006). The low quality of these systems has encouraged many middle class passengers to shift to PMVs as soon as financially possible (Pucher et al, 2007). By way of example, in Delhi, whilst the PMV fleet was expanding at near double-digit pace in 2000 to 2009, the number of buses increased by less than 1% (Sanjay Singh, 2009). Furthermore, during this period the bulk of the bus fleet, nearly 3,000 vehicles, were privately-owned "blue line" buses which were rented by drivers from non-driving contractors whose priority was the return on their investment as opposed to vehicle maintenance, passenger comfort and safety (Kidwai, 2010). Growing demand for mobility, stagnating capacity and poor service standards prompted anyone who could afford to do so to abandon these increasingly crowded vehicles, often unsafe vehicles (Bhatia and Jain, 2009).

India's fast-growing urban peripheries are generally poorly served by public transport networks, which often, as with the wider planning process, fail to keep pace with developments on the ground. Poor public transport provision and diffuse trip patterns on urban peripheries push both middle-class and lower-middle class households into private vehicle ownership – cars and motorcycles/scooters respectively. Private-vehicle ownership will continue to proliferate unless effective, competing public transit options are introduced (Shirgaokar, 2014; 2015).

In summary, India's demand for urban mobility is growing. The urban middle-classes have been increasingly able to meet their growing mobility needs by substituting poor, under-funded public transport for PMVs, which have become more affordable in the past two decades, a trend that is likely to continue as the Government of India perceives the domestic automotive industry is a key driver of economic growth and formal sector employment (Ranawat and Tiwari, 2009). Delhi epitomises this process with its expanding PMV fleet and failing bus network. However, motorisation brings with it a number of problems, which will be discussed below.

1.4 The problems of motorisation

This section will briefly outline some of the problems associated with increasing rates of motorisation in Indian cities with a specific focus on Delhi. These problems are worsening air pollution, congestion and concerns about equality.

Growing motor vehicle numbers have had a negative impact on local air quality in urban India (Kumar et al, 2013; Baidya and Borken-Kleefeld, 2009; Badami, 2004; Kandlikar and Ramachandran, 2000). The impact of increasing numbers is intensified by poor vehicle maintenance (Badami, 2002), a small number of highly-polluting older vehicles, the presence of two-stroke engines (Reynolds et al, 2011) and the recent surge in diesel-fuel vehicles, incentivised by domestic subsidies (Alam and Ahmed, 2013).

Transportation is a major contributor to air pollution. Using data collected by India's Central Pollution Control Board (CPCB) in six major Indian cities Guttikunda and Mohan (2014) concluded that between 30-50% of ambient particulate matter comes from transportation, either as tailpipe emissions or the re-suspension of dust particles on roads by passing traffic. Tailpipe emissions from motor vehicles in Mumbai and Delhi are responsible for 76-90% of carbon monoxide (CO), 66-74% of nitrogen oxide (NO2) around half of sulphur dioxide (SO2) and 3-12% of particulate matter (PM) (Gulia et al, 2015).

Delhi's annual mean PM10 (large particulate matter) count of approximately 200µg m-3[6] is well in excess of WHO guidelines (20µg m-3), more lenient CPCB limits (60µg m-3) and annual means recorded in any other global megacity (Kumar et al, 2013). The city's annual mean PM2.5 (fine particulate matter) count was 153µg m-3 in 2014, fifteen times the WHO guideline and amongst the worst for a global megacity (WHO, 2014). PM levels are closely linked to the incidence of respiratory disease. Studies by the CPCB indicate that hospital admissions increase when air quality deteriorates and that around one-third of adults and two-thirds of children exhibit one or more of the symptoms of respiratory disease due to poor air quality (CPCB, 2008a, 2008b). Estimates of the premature mortality rate due to PM pollutants have gradually risen from 5,070 in 1990 (Cropper, 1997) to 7,350-16,200 in 2010 (Guttikunda and Goel, 2013) and are projected to rise to around 30,000 by 2030 (Dholakia et al 2013). Exposure levels are highest on roads, especially for those working in open vehicles, such as auto-rickshaws or cycle-

[6] µg m-3 = micrograms per cubic metre.

rickshaws, and those work at the roadside (Apte et al, 2011), who are typically low-income groups.

However, vehicular emissions are one of many contributing factors to urban air pollution. Others include industry, agriculture practices in adjacent areas and informal sources, such as the burning of refuse within the city itself (see Guttikunda et al, 2014). Pollution levels are also closely linked to meteorological factors which mitigate or exacerbate the problem, typically on a seasonal basis. But whilst there are policy interventions which address these other sources, there has been a general reluctance to directly curb PMV use.

Furthermore, PMV contributions will continue to rise, potentially negating the impact of policies in other areas: the air quality gains from the conversion of Delhi’s public transport vehicles to compressed natural gas (CNG) in 2000-2002 were negated by PMV growth within a few years (Guttikunda, 2012), likewise, improvements in emissions standards cannot keep pace with the growth in overall vehicular emissions. Health impacts are also likely to worsen as high on-road and roadside exposure levels are intensified by the elongation of trip times by worsening congestion.

The substitution of public transport, namely buses, with PMVs has increased the amount of road space needed per passenger: four motorcycles in motion occupy the same road space as a single bus but with a fraction of the passenger capacity (Tiwari, 2002). Overall road space has not expanded in line with PMV growth: from 1996 to 2006, PMV ownership in Delhi rose 131% whilst road space grew by 20% (CSE, 2013), mirroring the national trend (Pranav Sood, 2014).

However, Delhi’s surface area is around 21% roads, the highest of any Indian city (DIMTS, 2011). This existing capacity, argues Tiwari (2002), is poorly managed with frequent bottlenecks, badly planned intersections and little attempt to separate vulnerable, slow moving non-motorised vehicles (NMVs) from faster moving traffic, all of which contributes to congestion. As a consequence of rising PMV numbers, low road space growth and poor utilisation of existing capacity, the average traffic speed in Delhi has fallen from around 20-30kmph in 1997 to roughly 15kmph in 2008 (WSA, 2008). Daily rush hour peaks last for up to five hours with significant impacts on commute times and productivity (Pucher et al, 2005).
A broader problem with increasing levels of motorisation in Delhi is the impact on equity. As mentioned above, PMVs occupy far more road space per passenger kilometre, or simply per passenger, than public transport, which tilts the distribution of public space in favour of the PMV owner. Furthermore, the number of trips taken and trip length increase dramatically with income: high-income families in the Global South, including Delhi, using PMVs use ten-times the road space as those on low-incomes whose mobility is solely provided by public transport (Vasconcellos, 2011). I.e. They take up more public space for more of the time.

Motorisation also alters the distribution of energy in society. A bus with two passengers uses less fuel per passenger kilometre than a car with a single occupant; if the bus has twelve passengers then it is more fuel efficient per passenger kilometre than a motorcycle (Vasconcellos, 2011). As energy becomes more available, argues Illich (1974), its distribution becomes more unequal and, on the policy front, ever more effort is expended increasing the speed with which the fastest, highest energy users in society move from place to place. In the urban Indian case, this means increasing PMV ownership and the subsequent shift in infrastructure spending and urban planning to become ever more accommodating of the needs of PMV users. Consequently, the maximum speed of the fastest travellers (in the Indian case, PMV owners) rises whilst the speed of the median traveller (walking, cycling or on public transit) falls as the city begins to incorporate its class inequalities into its physical structure, namely in the form of extensive road networks and PMV infrastructure. This pattern is already evident in urban India as distortions in current urban transport spending in favour of PMV-centric developments crowd out funding for modes utilised by low-income groups (Manchala and Vagvala, 2012), such as walking and cycling, which are themselves often negatively affected by flyovers, grade separators and other PMV-oriented projects (see Khatoon et al, 2010).

Overall, rising PMV numbers have had a number of negative impacts. They contribute to air pollution, which is closely linked to health problems; their space requirements combine with poor road management to create congestion – working hours lost in traffic jams reduce productivity whilst the sheer concentration of engines creates high exposure rates for road users and those who live and work at the roadside. More broadly, the proliferation of PMVs has shifted the distribution of public space, energy and public infrastructure funding further in favour of higher-income groups. However, these effects have not gone unchecked. The past decade has seen a concerted attempt to mitigate the current trend towards ever increasing motorisation both in rhetoric and infrastructure projects. The following section will discuss the nature of this resurgence of interest in public transport.

1.5 The public transport response

This section will briefly outline recent trends in urban transit developments. It argues that there has been a rapid increase in the number of metro projects in Indian cities, puts forward some potential motivations for these projects, and outlines several critiques of their applicability in this context. It then outlines some challenges to the effectiveness of metro systems, namely the importance of “last mile connectivity”.

Decades of decentralisation polices have placed the responsibility for mobilising resources for urban infrastructure projects in the hands of local governments of differing size with different economic bases and institutional capacities. Indian cities tend to receive their finances form federal government grants, and are largely bypassed by private financing (Ahluwalia, 2016). Additionally, complex institutional and funding frameworks mean that few have been able to make significant investments in infrastructure, including major urban transport projects.

The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) was established in 2005 with the aim of fostering urban development through better governance, improved public services and new infrastructure. The JNNURM comprises two components: the first focuses on basic service provision to the poor; the second deals with urban governance and infrastructure and is overseen by the Ministry for Urban Development (MOUD), which is in charge of urban transportation. This second mission has channelled funds into public transport over the past decade. Local governments can apply for grants or soft loans for urban transport infrastructure projects based on a comprehensive mobility plan (Kundu, 2014).

As of 2011, around one-quarter of the total funds allotted under the mission were for urban transportation projects. Out of this Rs. 14, 083 crore figure, 58% was designated for PMV infrastructure. The vast majority of this PMV infrastructure funding – around 80% - was earmarked for the construction of flyovers. Bus Rapid Transit (BRT) systems received 36% of the funding whilst cycling and pedestrian infrastructure – with a combined modal share of over 30% in all India's major cities (WSA, 2008) - received 0.2% (Manchala and Vagvala, 2012). In addition to the JNNURM funding, the MOUD has also sanctioned the construction of 380km of metro rail projects totalling Rs. 90,000 crore, a figure that eclipses investments in roads and BRT systems and points to something of a metro boom occurring in Indian cities.

The metro system appears to be an increasingly popular option in the effort to counter PMV use. In the 1990s, the small-scale network in Kolkata (with around 30km of track) was the only metro system in India. Since 2000, however, four metro rail systems have been built in Indian cities. As of 2016, five are under construction and 15 are planned. This explosion of metro projects has been the subject of considerable critique regarding its efficacy and motivations.

Mohan's (2008) extensive review of both international and domestic empirical data argues that metro systems are poor options for cities that do not have large dense central business districts. Metro systems only offer a time advantage over other modes on trips greater than 12km. Indian cities, as described above, are developing on the peripheries, typically contain multiple centres and have average trip lengths of less than 10km, which, Mohan (2008) argues, makes them unsuitable for high-cost fixed line systems. These systems will struggle to cater for diffuse trip patterns and will not represent a time-saving over other modes of transport at such short trip distances. This result in metro systems that run considerably below capacity, especially outside of the morning and evening rush hour peaks, and require continued subsidies or non-fare box revenue streams. Flexible lower-cost, medium-capacity systems, such as BRT systems, are better suited to the current requirements of Indian cities (Mohan, 2008; Tiwari, 2007). The situation may have changed in the decade since these papers were written as metro systems have expanded – the Delhi Metro has gained three lines and seen four line extensions in this period and a significant increase in passenger numbers (Delhi Metro Rail Corporation, 2016) – however, more recent studies are not available.

The MOUD does not specify a particular technology, but rather leaves the decision to local governments to make based on local land use and transport plans (MOUD, 2006). Local governments then apply for central funding through the MOUD (and often additional funding from the state level, private-sector or, occasionally, international sources). Developments in Delhi exemplify these trends in urban transport spending, and the challenges. The capital's investment in public transport is dominated by the construction of the Delhi Metro from 1998 onwards – an underground and arterial rail system with 213km of track in 2016 (roughly as long as the Paris Metro) and a further 109km planned by 2021. Despite good service standards, positive public attitudes and a perceived lack of corrupt practices (Siemiatycki, 2006), the Delhi Metro operates with considerable unutilised capacity: it carries around one-third of its projected ridership. Its share of non-walking trips was 4.1% in 2008 (RITES, 2008). Low fare box revenues mean it receives around one-third of its income from land and property revenue, in addition to receiving cost-price energy and an array of further subsidies (Tiwari, 2008). To reiterate the point made above, the situation may have changed since the publication of these studies nearly a decade ago.

Delhi's bus fleet has been upgraded considerably in the past decade-and-a-half at considerable cost (Krelling and Badami, 2016). Efforts have been made to improve rolling stock, including the phasing out the "blue line" buses in favour of higher-capacity, lower-emission alternatives with low-floor access (although procurement has been difficult (Bannerjee, 2015)). Service standards have been improved through the introduction of air conditioning on some buses and the overhaul of vehicle inspection and maintenance regimes designed to improve reliability. Passenger information systems have also been rolled out at some bus stops. Further investment is outlined in the Delhi Master Plan 2021 (DMP) (DDA, 2007). The plan approves the construction of a 294km BRT system with 26 corridors[7], supported by an expanded light rail system and a new monorail system with three lines (Jain, 2013) in addition to a significant Metro expansion. Figure 1 (below) shows this combined Metro, BRT and light rail network in Delhi in the year 2021.

[7] A poorly planned BRT corridor was installed in south Delhi in 2008, but was removed in 2016. Mahadevia et al (2011) identified several issues with the system, including bus pile up due to a signal cycle that favoured mixed traffic and the small scale of the system. Future BRT projects in the city are likely to build on these experiences.

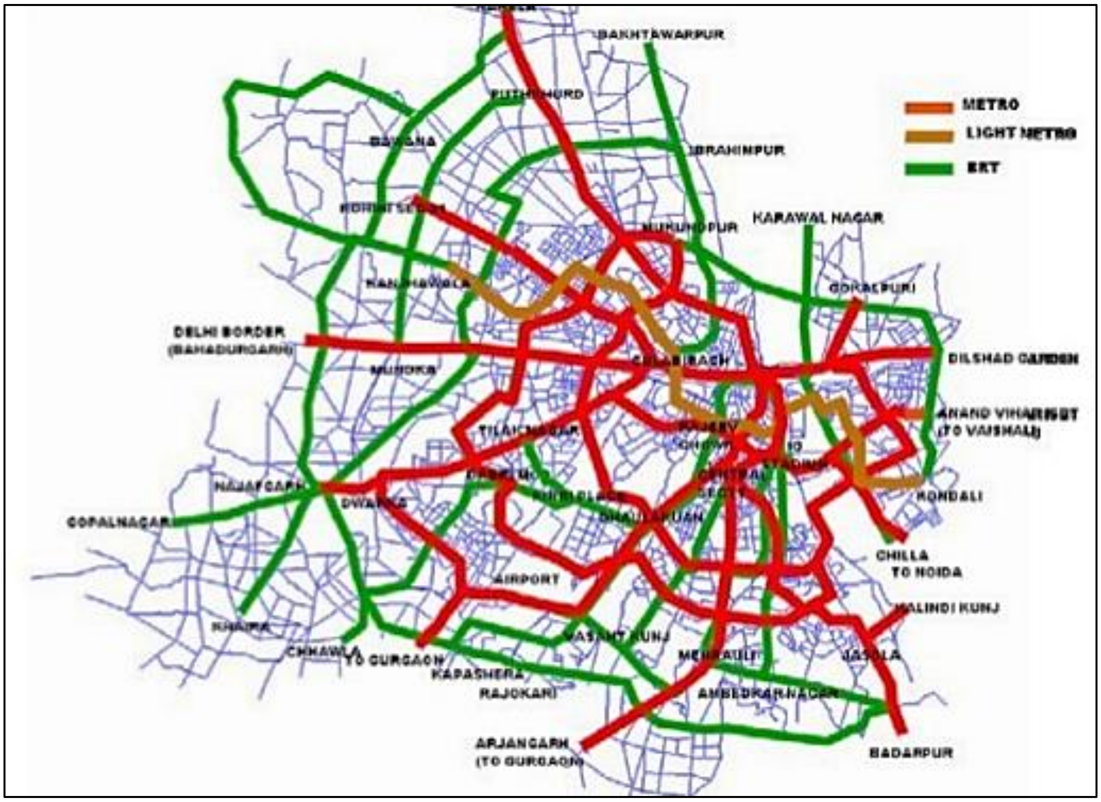

Figure 1: The metro, BRT and light rail network planned for Delhi in 2021. Source: CSE (2016).

Figure 1 is not intended as a detailed guide, rather its purpose is to illustrate both the spatial spread of the public transit network and give some indication of the scale of development involved: BRT (green) and light rail (gold) networks will be constructed from scratch, whilst around one-third of the Metro system (red) will be built 2016-2021. However, despite the extensiveness of this proposed public transit network, it faces several important challenges.

1.6 Paratransit and the Delhi Master Plan 2020

Although Delhi's proposed integrated urban transport system (see figure 1) appears geographically comprehensive, significant numbers of people still reside or find employment several kilometres from an access point to the mass transit system, namely metro stations and BRT stops. In the Global North these "last mile connectivity" trips are often made by bicycle (DeMaio, 2009) or walking (Daniels and Mulley, 2011), however, these modes are often not practical or safe in Indian cities due to poor pedestrian infrastructure (Badami, 2009), very high levels of air pollution, harsh weather and class related stigmas around the practice of walking (Rastogi, 2010). Safety is also a major issue: pedestrians and cyclist are the group most at risk of injury on Indian roads (Pendakur, 2011). Indian women are also effectively prevented from cycling by social stigma. They may feel unsafe due to the "male dominated culture of public space", which can be expressed as verbal harassment or physical assault (Bhattacharya, 2015; Jagori, 2010), a phenomenon not restricted to urban India.

Without effective "last mile" modes of transport, middle-income groups may simply rely on their PMVs for these "last mile" trips. This shift will require large parking areas near BRT and Metro stations. It will also add additional time and expense to the trip, perhaps to the extent that they may simply opt to save time and money by using PMVs for the entire door-to-door journey.
As mentioned above, Delhi is developing a densely populated periphery, one with its own distinct characteristics. Peripheries in North America and Europe are typically low-density suburbs with relatively concentrated trip patterns: most commonly from the periphery to the central business district (CBD). These trip demands can be met by a hub-and-spoke road network

with major arteries and high-capacity fixed-route mass transit systems running outwards, forming the spokes around the central business district hub. Residents on these suburban fringes are able to undertake lengthy trips of 20km or more on a daily basis to access employment or services, due largely to the ease and reliability of covering large distances at high speeds. In contrast, Delhi's expanding periphery contains areas of very high-density low-income housing and relatively dense middle-income developments. The ability to travel longer distances in short time periods is unreliable due to road congestion and public transport failures. Anecdotally, a 20km commute in Delhi could take anywhere between 30 minutes and three hours by car depending on traffic with both minimum and maximum travel times experienced on a fairly regular basis, too large a variation to be practical for a daily commute. Therefore, in contrast to North American and European peripheral trips, those undertaken in Delhi are comparatively short (Mohan, 2008). These short trips are also diffuse – they do not exhibit a concentrated spatial pattern to and from a single CBD, but rather link multiple origin points to the numerous urban centres created by decades of urban planning to decongest the geographical centre of the city. These short diffuse trip patterns are poorly catered for by public transit systems, such as the BRT or Metro, which can only link a relatively small number of locations in their networks.

These challenges point to the need for other modes of public transport to complement continuing investments in the Metro system and the planned BRT developments – to link residential areas, offices, schools and markets to public transit access points ("last mile connectivity") and to cater for the diffuse trips common in the city (point-to-point trips). The term for these modes of transport which are best suited to perform these roles is "paratransit", defined as: "an urban transportation service usually in highway vehicles operated on public streets and highways in mixed traffic; it is provided by private and public operators and is available to certain groups of users or to the general public, but adapting in its routing and scheduling to individual users desires to varying degrees" (Vuchic, 1981).

Delhi has a number of paratransit modes. Since the 1960s there has been a significant auto-rickshaw fleet in the city. Auto-rickshaws are three-wheeled vehicles powered by a small rear-mounted engine capable of up to around 50kmph. They have been fuelled by compressed natural gas (CNG) since the conversion of the city's entire public transport fleet from petrol and diesel in 2000-2002. They have space for three-passengers on bench seating located behind the driver's seat. Auto-rickshaws are typically flagged down at the roadside and taken to the passenger's desired destination within the city. By law, payment is made at the end of the journey according to the fare specified by the vehicle's fare meter, which charges according to a tariff structure set by the local Transport Department. Auto-rickshaw numbers, maintenance standards, emissions, fares and driver appearance are all regulated by the local Transport Department's auto-rickshaw unit in Burari (North Delhi). There are currently 89,000 auto-rickshaws in the city (Government of NCT, 2016b) operated by approximately 125,000 drivers[8] who own their vehicles (~40%) or rent them (~60%), usually from non-driving owners. Their modal share was 3.6% in 2007-8, up from 3.1% in 2000-1 (RITES, 2008). Auto-rickshaws perform a dual role. They are a provider of "last mile connectivity" (Mani et al. 2012) and also undertake door-to-door trips that are impractical or impossible on public transport and too long to be practically made by cycle-rickshaw.

[8] Estimation based on a total fleet of 89,000 auto-rickshaws, 40% of which are operated for two shifts per day (following Reynolds et al, 2011) and assuming that no driver works consecutive shifts (i.e. 18 to 20 hours straight).

Cycle-rickshaws are another common paratransit mode, however, unlike the auto-rickshaw which is ubiquitious with urban India, the cycle-rickshaw is predominantly found in Delhi and Kolkatta. These are essentially a tricycle with a seat for two passengers mounted over the rear axle behind driver (called the "puller" locally). These vehicles are pedal powered and typically cover short distances of 1-2km, usually between linking significant locations in a small area – markets, residential areas, schools and often metro stations. Fares follow no official tariff structure – they are agreed between passenger and puller before the trip commences. Whilst cycle-rickshaws are regulated, such is the gap between *de jure* regulation and *de facto* operations that official estimations of their numbers are very unreliable; unofficial figures point to somewhere between 400,000-600,000 cycle-rickshaws (Ashima Sood, 2009). Their modal share was 7.9% in 2007-8, up from 3.6% in 2000-1 (RITES, 2008). However, it is likely that this share in Delhi has decreased markedly in recent years as the number of battery-rickshaws in the city is thought to have risen from zero in 2010 to anything up to 100,000 in 2013 (Kant, 2014; Bhardwaj and Bhasin, 2014). Battery-rickshaws resemble elongated golf carts: they are three-wheeled vehicles with space for six to eight passengers in two or three rows of seats behind the driver. They are powered by rechargeable repurposed automotive batteries and reach speeds of around 20-25kmph. Their rapid proliferation in the city effectively outpaced the regulators who were left revising the rules to accommodate them (see chapters 5 and 6). Their modal share is unknown. See figures 2, 3 and 4 (below) for images of an auto-rickshaw, battery-rickshaw and cycle-rickshaw, as found operating on the roads in Delhi.

Figure 2: Auto-rickshaw[9].

Figure 3: Battery-rickshaw[10].

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[9] Image shot by Daniel Mennerich in New Delhi in October 2013. Labelled for non-commercial reuse. Available at: https://www.flickr.com/photos/danielmennerich/11024881786

[10] Image published by Biswarup Ganguly in June 2014. Labelled for non-commerical reuse. The battery-rickshaw in the image is operating in Kolkatta but is of identical appearance to those operating in New Delhi. There are currently few good non-commercial images of battery-rickshaws in New Delhi. Available at: https://commons.wikimedia.org/wiki/File:Toto_Rickshaw_-_Battery_Powered_Three-wheeler_-_Howrah_2014-06-15_5108.JPG

Figure 4: Cycle-rickshaw[11].

These paratransit modes cater for both "last mile" trips and the demand for short journeys with diffuse patterns that is largely unmet by BRT and metro systems. These are also called "point-to-point" trips. Both these challenges and the role of paratransit in solving them are recognised in the Delhi Master Plan 2021 (DMP) (Delhi Development Authority, 2007). The DMP's chapter on transportation promotes the concept of "transport on demand", which involves the synergy of transportation and land-use planning to enable easy access to mass transportation systems (the Metro and BRT corridors) through paratransit modes. "Easy, convenient and comfortable intermodal transfers" will, claims the DMP, help "reduce/discourage private vehicle dependency and induce public transport use". Practically, the DMP envisions the creation of "multi-modal interchange zones" around Metro and BRT stations which will prioritise facilities for auto-

[11] Taken from dailytravelphotos.com. Image shot in New Delhi by an unspecified photographer. Labelled for non-commerical reuse. Available at: http://www.dailytravelphotos.com/archive/2009/12/01/

rickshaws, cycle-rickshaws and battery-rickshaws over PMVs. There will be reserved parking for paratransit within 150m of mass transit system access points; 65% of parking within 300m will be for paratransit only. The DMP anticipates a system in which auto-rickshaws and cycle-rickshaws are available around the clock within 250m, or three minutes walking distance from every home and workplace, offering fast “last/first mile connectivity” to the mass transit networks and an alternative to PMVs on point-to-point trips that is available, convenient and cheap.

The DMP envisions a synergy of land-use planning, mass transit and paratransit. However, its provisions for the latter are confined to creating parking and waiting areas at strategic locations. Whilst this is a valid aim – there are few designated spaces for paratransit in the city in which operators can wait without the risk of being accused of illegal parking or encroachment – it simply assumes the existence of paratransit and its attractiveness to middle-class PMV owners. It does not specifically address paratransit in Delhi, a sector which appears to be beyond its purview. This oversight has resulted in poor policy making, and the emergence and rapid spread of a new and controversial paratransit vehicle, the battery-rickshaw.

This section has discussed the crucial role played by paratransit in Delhi and has touched upon the relative neglect of the sector with respect to urban transport planning. The following section discusses the negative perception of paratransit vehicles and their operators amongst the middle-classes and English-language media and how these perception are reflected in policy making.

1.7 Perceptions of paratransit - auto-rickshaws

Auto-rickshaws are the subject of a series of negative public perceptions. They are viewed as unsafe vehicles that contribute excessively to congestion and air pollution. Their operators are said to be greedy and to overcharge their passengers. These perceptions are reflected in the media and the websites of civil society organisations, which advocate on issues important to the urban "middle-class", such as "illegal" settlements (Bhan, 2009), street trading (Shapiro Anjaria, 2006) and pollution (Veron, 2006). The English-language newspapers, long a marker of middle-class status, have mirrored public hostility by portraying auto-rickshaws and their operators unfavourably. Negative perceptions have even been expressed by the highest level of municipal government in Delhi. In 2011, then Delhi Chief Minister, Sheila Dikshit claimed: "Auto-rickshaws are not a good option. They are uncomfortable and pollute [the] environment. Auto-rickshaw drivers are unruly and harass passengers" (Indian Express, 2010).

Auto-rickshaw fares in Delhi are set by the Transport Department. The official fare calculation in Delhi takes into account increases in fuel prices, capital costs, inflation and annual charges (for example, Bisht et al, 2010). All auto-rickshaws are fitted with a fare meter which is calibrated to charge the latest tariff. Overcharging is considered to occur when an operator refuses to switch on the meter, or claims it is broken, and/or bargains with the passenger to fix a price. This process is illegal but widespread, leading to accusations of greed and venality by passengers who attribute the problem to individual avarice on the drivers' part, a view reflected in policy interventions.

Perhaps the most drastic policy to tackle overcharging is the introduction of Global Positioning System devices (GPS devices) in Delhi. As of September 2012, all new auto-rickshaws in Delhi were required to have a GPS, receipt printer and panic button. The Transport Department intended to monitor all the journeys made by the city's auto-rickshaws from a central control room operated by Delhi Integrated Multimodal Transport Systems (DIMTS) (a public-private partnership). The passenger would receive a receipt for the journey, which, in the event of suspected overcharging, could be compared to the official GPS log of the trip. Neither the London nor New York taxi sectors have tried to implement such a high level of monitoring. The cost of the system was to be borne by drivers, who would pay Rs.7,500 (Rs.8,239) up-front, and a further Rs.1,200-7,500 (Rs.1,318-8,239) per year in maintenance fees[12] to DIMTS, the sole supplier (the driver's official "semi-skilled" wage was Rs.70,000 per year (Rs.76,895). GPS devices appear to have done little to curtail the practice.

However, the current policy approach is not based on empirical data, but rather on the assumption that this phenomenon is caused by the individual bad character of tens of thousands of drivers, an allegation which represents public attitudes but contains no explanatory value. There has been, at the time of writing, no systematic empirical investigation into overcharging, neither in the academic nor policy-making sphere and the accompanying grey literature. The perception of overcharging is the focus of this study. Unlike accusations about the auto-rickshaw's alleged poor safety record and contribution to air pollution and congestion, its existence as a phenomenon cannot be easily rebutted with available empirical data (see Harding

[12] A fee of Rs.12,000 (Rs.12,402) for fitment of GPS units on new auto-rickshaws and Rs.7,500 (Rs.7,751) on old auto-rickshaws was notified by DIMTS (Harding, 2013), though at the time of writing had been neither implemented nor withdrawn.

et al 2016). This is because overcharging is a common occurrence in Delhi – its existence is not in doubt, rather it is its causes that are in question. Investigation of these causes is important because the issue of overcharging is the focus of sustained public anger and poor policy interventions based on the assumption of individual greed on the part of the driver as opposed to any attempt to tackle underlying causes. Such interventions (such as the introduction of mandatory GPS devices and increasingly punitive penalties) may work to exaccurbate the problem.

As argued above, paratransit plays an important role in the urban transport ecosystem of Indian cities by providing "last mile connectivity" and door-to-door trips that are impractical or impossible on mass transit. In the past decade, paratransit has acted as an crucial "last mile" feeder service to the growing number of metro rail systems in Indian cities; linking trip origins and destinations, such as offices, homes, schools and markets, to metro stations. Yet the auto-rickshaw, a key paratransit mode in South Asia, is the subject of very little social science research, likewise there are few academic studies on the battery-rickshaw, a new and emerging paratransit mode. Given their crucial role, negative perceptions and poor policy making, research is needed into the ways in which paratransit can become an accepted part of an integrated urban transport system. In order to fill this gap, this study will focus on two broad areas: firstly, the phenomena which create poor passenger experiences and impacts the use of auto-rickshaws, namely the issues of overcharging and refusal; and, secondly, new and emerging modes of paratransit, focusing on the battery-rickshaw. Both areas will be studied in the context of Delhi.

1.7.1 Auto-rickshaws research questions

Any empirical investigation into the overcharging phenomenon must address two aspects:

The demand side: Overcharging does not occur at a uniform rate across time and space. Its incidence and magnitude will differ spatially, temporally and demographically.
Incidence refers simply to whether a trip is undertaken on- or off-meter - if the latter, then overcharging may have occurred if the fare agreed upon exceeds the on-meter equivalent. Magnitude refers to the additional surcharge (beyond the equivalent on-meter fare) a passenger pays for an off-meter trip. This amount could range from a significant surcharge on the on-meter equivalent to zero, or, rarely, even a negative figure if the driver makes an error in estimating the distance.

Both incidence and magnitude will be impacted by a number of factors. These may include the trip length, the time of day, the destination and the demographics of the passenger. Furthermore, the decision as to whether to accept an on-meter trip or haggle for a high fare (off-meter trip) will also depend on the incentives provided by the tariff structure, in particular the level at which the flag-fall fare, or minimum fare, is set. These issues will be investigated using a large scale survey of passengers disembarking from auto-rickshaws at a number of survey sites across the city.

The supply side: Whilst the incidence and extent of overcharging may be influenced by the circumstances of any given trip, these factors do not adequately explain why it occurs in the first place. An alternative explanation to individual greed must be sought. This explanation is likely to lie in the day-to-day economics of operating an auto-rickshaw in Delhi. This includes: capital costs (vehicle loans, repayments, renting arrangements etc.), maintenance costs (repairs), and operating costs (fuel). All these costs will be influenced by the prevailing regulatory conditions, which will imposed a certain regulatory burden on auto-rickshaw drivers. They will also be linked to whether the driver owns or rents the vehicle, and, in the case of the former, the political-economy of the sector and informal credit arrangements. These factors are likely to influence overcharging by exerting downward pressure on drivers' net incomes. The costs and revenues of operating an auto-rickshaw, both owning and renting, will be investigated using a large scale survey of auto-rickshaw drivers administered at a number of sampling locations across the city.

This work on auto-rickshaws is necessary as it investigates the notion that overcharging is caused by individual greed, an attitude that perceives the problem as one of compliance and monitoring. By presenting the underlying causes of overcharging – its incidence, extent and economic drivers – this work has the potential to lead to evidence-based policy recommendations.

1.7.2 Battery-rickshaw research questions

Delhi's battery-rickshaw fleet expanded rapidly from zero in 2010 to around 100,000 three years later (although this number is an estimate as reliable data does not exist). So sudden was their expansion that for a significant period they operated illegally, outside of the ambit of regulation. Unlike negative perceptions of auto-rickshaws which focus on their perceived transgression of existing fare regulations, public anger at battery-rickshaws centred on the total absence of regulation. They were regarded as a "menace", driving dangerously, causing congestion and encroaching on public space. The authorities allegedly refused to "tame" these errant vehicles due to their enmeshment in local networks of bribes to low level state representatives and their involvement in local politics, viewed as irredeemably corrupt by the middle-classes and the English-language media (see chapter 6).

Their proliferation represents the first significant new mode of paratransit in the city since the introduction of auto-rickshaws in the 1960s, yet, at the time of writing, they have not been the subject of empirical investigation. Research into battery-rickshaws is needed in order to clarify several areas.

Role: There is a need to ascertain their role in the urban transport system. This includes the types of trips they are undertaking (i.e. the balance between “last mile connectivity” trips or point-to-point trips) and whether they are substituting for existing modes in this role, which modes and to what extent. These questions will be answered using a large scale survey of battery-rickshaw drivers and a large scale survey of passengers disembarking from battery-rickshaws at several metro stations in the city.

Economics: The day-to-day economics of operating a battery-rickshaw and how they compare to those of other paratransit modes, namely auto-rickshaws, with which the battery-rickshaw competes for investment (see chapter 5). There is also need to clarify the relationship between operating economics, the regulatory burden placed on auto- and battery-rickshaws and how this might impact the investment decisions. This will be investigated using a large scale survey of battery-rickshaw drivers.

Political-economy: There is also a significant broader political-economic question: how did this mode of transport proliferate so rapidly in a highly regulated paratransit market without official sanction? What was the role of municipal and national politics in this process? What factors led to their eventual formalisation on concessionary terms? Why did this process elude their nearest competitor for passengers, the cycle-rickshaw? This area will be investigated using archival research, namely using grey literature and media sources as well as academic literature and NGO research reports on the city's cycle-rickshaw sector.

This research on battery-rickshaws is important for several reasons. It will produce insights into the role these vehicles are technologically suited to play in the urban transit system and the modes with which they are likely to compete for demand. It will provide a detailed analysis of their formalisation, a complex, protracted and dysfunctional process involving multiple actors. The comparative element will give insights into how the regulatory burden on existing paratransit modes affects decisions regarding market entry and investment, i.e. heavy regulatory burdens in the auto-rickshaw sector and the barriers to entry they erect effectively incentivise investment in unregulated modes. These are important insights if battery-rickshaws are to be rolled out in other Indian cities[13] as a "last mile" mode which delivers acceptable incomes and a decent level of labour dignity.

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[13] Battery-rickshaws are already operating in Tripura, which issued the country's first set of rules for the vehicles in 2014 (Government of Tripura, 2014), and in neighbouring Bangladesh (Rahim et al, 2013).

Additionally, in addition, since the fieldwork for this study was conducted this vision of a vibrant paratransit system acting in synergy with mass transit has been threatened by the entry of large international trip-aggregation companies, such as Ola and Uber, into the Indian market. These companies have large fleets in many Indian cities, including Delhi, and are expanding rapidly and aggressively. Uber reported a 60% year-on-year increase in drivers in January 2017 (PTI, 2017). Urban transportation experts estimate that around 550,000 cars in India were operating under the umbrella of ride-aggregators as April 2017 (Pai, 2017). They operate outside of the mandate of the Transport Department. Their presence effectively opens the taxi market to all entrants, beyond the control of the authorities. Drivers receive income top-ups which keep fares almost as low as auto-rickshaw rates whilst providing powerful incentives for market entry (Shah, 2017). Access to vehicle financing means many Uber drivers drive new vehicles (Pai, 2017), which are more comfortable than auto-rickshaws. The guarantee of a steady income, credit access and the relative lack of paperwork have made ride-aggregators a more attractive proposition for potential drivers than the auto-rickshaw market whilst comparable fares and far higher quality standards entice passengers. If established regulated paratransit is to compete then they must become more attractive for passengers and drivers alike; this will depend on the ability of regulators to make policy reforms that benefit both operators and passengers.

1.8 The structure of this thesis

The study begins by examining the regulatory environment in which paratransit operates. Chapter two uses concepts from the literature on taxi markets to provide a framework for the analysis of paratransit regulation, as well as the economic assumptions underpinning it, and the debates in this area. Grey literature on auto-rickshaw regulations in Delhi is used to provide context specific detail. Having established the regulatory environment, the study then presents empirical data on the economics of operating an auto-rickshaw. Chapter three finds evidence of low incomes, high cost-revenue ratios and considerable barriers to outright ownership of an auto-rickshaw, all of which exert pressure on the driver to overcharge, and have the potential to be mitigated through changes to the regulatory environment. Chapter four examines the phenomenon of overcharging from the passenger point of view by presenting empirical data on first the incidence and then magnitude of overcharging. The study then turns to the battery-rickshaw. Chapter five identifies the battery-rickshaw's niche role. It then argues that this new mode competes with cycle-rickshaws for passengers, yet with auto-rickshaws for investment. Finally, it discusses how battery-rickshaws have managed to displace cycle-rickshaws without significant resistance from the latter. Chapter six examines the wider political context in which battery-rickshaws became established. It contains a detailed analysis of the complex interaction of the multiple entities who shape urban policy making, including the judiciary, local and national governments, political parties and local bureaucrats, administrators and law enforcement. Chapter seven presents a series of policy recommendations derived from this study. It then draws together the threads developed in the previous chapters and concludes by arguing that urban transport policy making in India is dominated by a "techno-managerial" approach, which is unable to adequately engage with the paratransit sector. The creation of sound paratransit policies - those which benefit both passengers and operators - requires a more "democratic" approach, one to which this study aspires.

Chapter 2: Regulating paratransit

2.1 Introduction – the QQE framework

As outlined in the opening chapter, investigation into the phenomenon of overcharging must incorporate work on both the supply and demand sides. Before these aspects can be examined it is necessary to focus on the regulation of paratransit. Regulation mediates the relationship between operators and passengers. It plays a significant role in determining costs, and usually almost entirely determines revenues for operators, thus it is crucial that any study of paratransit contain an analysis of the regulatory environment in which it operates.

This chapter will a) provide a brief account of the history of paratransit regulation and its current forms, in particular the "Quality, Quantity, Economic"framework (QQE); b) discuss the economic rationales underpinning these forms of regulation; c) examine how the QQE framework applies to Indian auto-rickshaw markets and identify some of the problems for operators and regulators; d) provide a detailed account of the specific regulations to which auto-rickshaw drivers in Delhi are subject.

There is little academic literature on the regulation of auto-rickshaws in urban India, as such the literature on taxi markets in North America, Europe and Asia will be used as a proxy literature. This literature is suitable as taxis are a mode of paratransit. Their form and operations fit with Vuchic's (1981) definition of paratransit as:

> ...an urban transportation service usually in highway vehicles operated on public streets and highways in mixed traffic; it is provided by public and private operators and is available to certain groups of users or to the general public, but adapting in its routing and scheduling to individual users desires to varying degrees.

The literature on taxicab markets has several strands, which are described by Toner (2010) as follows:

1) A *conceptual* economic strand, which uses theoretical reasoning to propose and critique regulations and their underlying rationales (see Shreiber, 1975 and Coffman, 1977).
2) An *empirical* strand, which assesses the impact of regulation and deregulation on a variety of indicators (usually, supply, price, innovation and service quality). One sub-strand focuses on places specific case studies (see Gaunt, 1995; 1996, Marell and Westin, 2002); another compiles single case studies into overview analyses of national markets (see Teal and Berglund, 1987, Dempsey, 1996, Moore and Balaker, 2003, Schaller, 2007).
3) A *modelling* strand which uses *empirical data* to assesses the impact of regulation (see Ecetin and Eryigit, 2011, Cummings, 2009).
4) Models *without data* or with *exemplar data* (see Cairns and Liston-Heyes, 1996, Yang and Wong, 1998).

In addition to Toner's (2010) classification, I would add a fifth strand which focuses on the potential of technology to bring about efficiency gains in the taxicab industry (for example, see Lee and Chen, 1998 and Harding et al. 2016). However, the overriding focus of this chapter is on the first strand of literature, the conceptual-theoretical, with references to empirical studies where appropriate.

2.2 Paratransit regulation: history and contemporary forms

The earliest examples of paratransit mentioned in the literature are the horse-drawn carriages available for hire on the streets of London and Paris in the early 1630s (Dempsey, 1996). Dubbed "Hackneys" after the French for a plough horse, these carriages were operated by a single coachman and tailored their routes according to the needs of the passenger, similar to a modern taxi. Such was their popularity, proliferation and varying quality that in 1635 Charles I (of England) expressed a firm desire to regulate the number of Hackneys in order to "restrain the multitude and promiscuous use of coaches". However, it was not until 1654, under the Protectorate, that the London Ordinance for the Regulation of Hackney Coachmen was passed. The Ordinance created minimum service standards amongst coachmen in the capital, but did not set numerical or fare controls (Cooper et al, 2010).

The next major development occurred in 1834 when Leicestershire architect, Joseph Hansom, patented a new cab design. The Hansom Cab featured a passenger cab fitted over a single axle, which greatly improved manoeuvrability and allowed the cab to be drawn by a single horse. The ease of driving and the reduction in operating costs brought about a boom in carriage numbers. In 1859, the social reformer, Edwin Chadwick, bemoaned the "waste of capital committed by this competition within the field of supply is visible to the eye at all times and in all weathers - in full stands or long files, waiting hour after hour, and in the numbers crawling about the streets looking for fares". Chadwick worried about the coachmen's' welfare: excess supply would deprive them of a living wage. The capital, he argued, could be better used to generate employment elsewhere. The relationship between supply and demand in this market is particularly hard to calculate, he argued, identifying an issue which remains a key challenge for economists (Koehler, 2008).

The shift from horses to motors took place in the 1890s. Initially, electric battery powered cabs were popular: the London Electric Cab Company ran a fleet of battery powered taxis with a thirty mile range. However, by 1900 petrol and diesel engine vehicles began to dominate, the standards for which were set by the Metropolitan Conditions of Fitness of 1906, which is still in force in London today (albeit, highly amended) (Cooper et al, 2010).

In the US, New York City, the country's largest paratransit market, followed a similar course: Hansom cabs were introduced in 1869 and electric vehicles enjoyed a brief window of popularity in the 1890s before petrol and diesel cabs become popular. However, the New York market differed from the London taxi sector on two counts. New York drivers were typically recent migrants attracted to the job due to its modest barriers to entry and the relatively low level of English proficiency required. Furthermore, in contrast to the atomistic London market, New York has a history of large taxi firms, the first being Henry Allen's fleet of 67 yellow cabs operated by drivers in "West Point Cadet" style uniforms. Yellowcab was founded by John Herz in 1910, then sold to Checkercab in 1929 (Cooper et al, 2010).

From the first recorded appearance of paratransit in Europe in the 1630s to the late 1920s, the focus of paratransit regulation, be it related to horse-drawn or motorised vehicles, was on the enforcement of minimum standards of service. The driver was to be of good character (however defined), possess certain skills (such as the London “Knowledge” requirement which was introduced in 1865), and the vehicle was to adhere to certain technical standards. Permits were issued relatively freely to those who could meet the quality standards demanded by the regulators. Caps on permit numbers were rare. However, the Great Depression greatly expanded the scope of regulation, particularly in the US.

The Great Depression of 1929 created mass unemployment. Many newly unemployed workers entered the taxi industry illegally, flouting quality regulations by purchasing cheap vehicles often in a poor state of repair. This surge in supply coincided with a significant drop in demand as incomes fell. This mismatch of supply and demand led to disputes between drivers (both legal and illegal) over fares. Turf wars began between existing companies and unregulated, and technically illegal, “bandit firms”. Anger at the proliferation of “bandit cabs”, perceived as unfair competition, led to a major taxi driver strike in Times Square in 1934. The Washington Post (1933) sums up the public attitude towards the turmoil in the taxi industry:

> Cut-throat competition in a business of this kind always produces chaos. Drivers are working as long as sixteen hours per day, in their desperate efforts to eke out a living. Cabs are allowed to go unrepaired....Together with the rise in the accident rate there has been a sharp decline in the financial responsibility of taxicab operators. Too frequently the victims of taxicab accidents must bear the loss because the operator has no resources of his own and no liability insurance. There is no excuse for a city exposing its people to such dangers. (cited by Koehler, 2008)

Falling driver incomes and the perceived risk to the general public led, first, to the inclusion of taxis in the Interstate Commerce Act in 1935, giving the state power to regulate prices, and secondly, to the Hass Act of 1937 which introduced a strict permit regime in New York, removing the city's ability to issue new licenses, effectively freezing taxi numbers. As drivers retired or left the industry, taxi numbers dropped from 21,000 in 1931 to 11,000 in 1947 (Cummings, 2009) Almost all US cities followed New York's example and implemented permits freezes and fare controls (Frankena and Pautler, 1984), thus adding two extra dimensions to the earlier focus on service quality.

Cooper et al (2013) present a three-part framework for the analysis of taxi market regulation which contains the following elements:

1) *Quality Control*: i.e. controls on vehicle age, appearance and disability requirements enforced by annual testing and inspections, and driver licensing, including background checks and driving standards etc.
2) *Quantity Control*: i.e. controls on the number of taxis in a particular jurisdiction modified according to analyses of demand, Significant Unmet Demand (SUD), latent demand and projections of future demand.
3) *Economic Control*: i.e. fare setting based on regular analyses of operator costs and revenues with the aim of providing fair compensation for operators and stable prices for passengers through cross-subsidisation of fares (i.e. off-peak trips taken at a time at which demand is low are the charged according to the same tariff as trips taken at peak times when demand is high. This arangement effectively subsidises on-peak trips (Harris, 2003)).

The QQE framework is considered the standard for industry regulatory models (Cooper et al, 2013). The regulations it contains can be applied differently depending on the section of the taxi market: namely the “cruising” and “dispatch” markets. The “cruising” market refers to taxis which are allowed to pick up passengers direct from the street without prior booking; “dispatch” refers to taxis which are linked to a dispatch office which directs the driver to passengers who have booked by telephone. There is considerable overlap between both sections: if allowed by regulators, taxis may straddle both markets, taking dispatch calls but picking up street hail passengers when the dispatch business is light or street hail trips are plentiful (i.e. weekend evenings). In some jurisdictions all taxis must be linked to a dispatch (i.e. Canada), whilst others keep the two markets separate (i.e. London and New York City). The two segments are often subject to different regulations, for example entry into the New York dispatch market is far easier than into the cruising market and different service standards apply to each. However, regardless of regional variations, from the 1930s the majority of jurisdictions in the US enforced regulations from each part of the QQE framework on their local taxi markets (Frankena and Pautler, 1984). Many other countries followed suit, such as the UK (Toner, 2010), New Zealand (Gaunt, 1996, Morrison, 1997), Sweden (Garling et al, 1995, Marrel and Westin, 2002), Ireland (Barret, 2010) and Turkey (Ecetin and Eyigit, 2011).

Although the regulations in the QQE framework were first implemented largely due to the turmoil in the US taxi market, particularly in New York, following the Great Depression, they are also underpinned by a set of economic assumptions about the nature of the taxi industry, which are discussed in the following section.

2.3 The rationales behind QQE regulations

The justifications for quality, quantity and economic controls on taxi markets stem from a number of assumptions in the theoretical and conceptual economic literature about the fundamental imperfection of the market for passenger journeys. This section discusses these assumptions.

It is assumed that the taxi market suffers from an imperfect information problem (Shreiber, 1975, Douglas, 1972). A taxi journey is a “credence good” (Balafoutas et al, 2013). This means that passengers cannot ascertain the quality and appropriate quantity of the good on offer until after they have consumed it (even then it still may not be possible). Many medical or car mechanic services are credence goods. Alfred Kahn (1971) states that these goods leave consumers with a “limited ability to judge the quality of products and hence to keep it at acceptable levels even when they have a wide range of suppliers to choose from”. If passengers are unable to discern the relationship between the quality and quantity of the good (the comfort and length of a taxi journey) and its price (the fare) then the provider (the driver) has an incentive to cheat (to overcharge, take a circuitous route or operate a substandard vehicle). The driver’s hand is further strengthened by the high cost of finding a second taxi and the fact that elasticity of demand is low in the taxi market: if a single driver lowers his prices it will most likely not lead to an upsurge of custom.

However, Coffman (1977) critiques this assumption. He argues that the imperfect information problem relies on the assumption of a purely cruising market. In reality, cab stands, dispatches and cab fleets undermine this assumption. Passengers can compare prices at stands, dispatch companies can advertise competitive prices and branded cab fleets can act as markers of service quality. Furthermore, Harris (2003) argues that most passengers have some amount of prior information about the journey they are undertaking, such as personal experience. In recent years the development of smartphones with internet access and mapping applications means the majority of passengers, even non-locals, should have some idea as to the likely distance of their journey and the approximate fare that would be charged by a number of companies in the local taxi market. Against this critique, Shreiber (1977) argues that taxi firms would need to be major advertisers to bring about improvements in the elasticity of demand and that cab stands are generally first-in-first-out, which prohibits price comparison. In addition, due to large upfront capital costs, tight regulated profit margins and the large numbers of cabs required to deliver economies of scale, even larger cities can only support a small number of dispatch companies, which means cartelisation is relatively simple (Teal and Berglund, 1987). Free entry into dispatch markets will not break existing cartels (against D.J. Williams, 1980).

The imperfect information problem works to the advantage of the supply side. The rationale of economic and quality controls is to protect passengers from the handicaps suffered by consumers of credence goods. Passengers do not have the ability to judge quality in relation to price before agreeing to the ride: therefore they need to be protected by service standards and price controls which maintain a stable pricing structure and decent service quality. This notion is further criticised by Harris (2003) who states that bringing about price stability means it is necessary to cross-subsidise fares with off-peak fares subsidising on-peak ones, which he claims is socially regressive as off-peak fares are more likely to be people without PMVs on health, education and shopping related journeys. Furthermore, a lack of competition and capped incomes mean there is neither incentive nor means to improve service quality; rather the cost of maintaining service levels incentivises evasion.

Whilst imperfect information may enable price inflating by drivers, Dempsey (1996) argues that fundamental imperfections in the structure of the taxi market may, theoretically, lead to chronic instability in fare bargaining between drivers and passengers in a market without price controls. Drawing on core theory, an offshoot of game theory, he argues that the taxi market represents a game with an empty core. This means that players in the game can continually form new coalitions which beat existing coalitions. Dempsey gives an industry relevant example from the economist J. Wiley:

> For example, say that three strangers are willing to pay up to $7 each for a cab to the airport. Two cabs stop nearby. Each cab can carry one or two passengers, and each driver is willing to make the trip (with either one or two passengers) for a minimum of $6. Given these demands and costs, the worst-off or excluded player can block any arrangement by tempting some players to abandon others for a more attractive arrangement. Suppose, for instance passengers A and B force driver X down to her minimum $6 total fare, thus yielding for A and B a fare of $3 each. As a result, passenger C is stuck paying at least $6 to travel alone with driver Y. But driver X could gain an added $2 by dumping B and offering C a ride for $5-which C should accept because a $5 fare is cheaper than a $6 fare. This new coalition between X, A and C however, is vulnerable in turn to raiding by the excluded players, Y and B. Now passenger B faces a trip alone with driver Y at a fare of at least $6, and both will improve their lots if they attract passenger C with a $4 fare offer, which Y and B split between themselves and which C will prefer to the $5 that C pays as a member of the existing X-A-C coalition. This coalition instability occurs for every possible combination of players.

If the empty core argument is accepted then price controls are evidently needed to avoid this process of endlessly shifting coalitions (and the infinite deferral of the economic transaction). Another key justification for entry controls in taxi markets is the assumption that they are vulnerable to excessive competition: without strict entry controls to limit the growth of the industry, taxi fleets will expand rapidly. This growth is particularly problematic as taxi fleet growth tends to be economically countercyclical: new drivers enter the market at a faster rate when unemployment rises and economic indicators fall. Surging supply and falling demand reduces incomes for drivers and often leads to violence as drivers fight over fares. New York during the Great Depression is perhaps the quintessential case study, although by no means the only one. The removal of entry controls in the South African taxi and minibus market in 1989 led to a 2537% increase in operators within five years. Cut throat, often violent, competition led to the period being dubbed the "taxi wars" and transcending industry boundaries to become part of urban folklore (Dugard, 2001, Schalekamp and Behrens, 2010). The fear that open-entry will inevitably lead to the resurgence of low wages and desperate competition justifies the enforcement of strict limits on taxi numbers.

In addition, any expansion of the taxi fleet increases the negative externalities of the industry. Taxi numbers must be tightly controlled in order to check their impact on air pollution and congestion. Their effect on formal public transport systems must also be mitigated: taxis must not compete with bus or metro systems (Shreiber, 1975). Garrett Hardin's essay on the "Tragedy of the Commons" is widely cited in support of this assumption (Dempsey, 1996). However, Coffman (1977) critiques these notions, arguing that taxis are a small percentage of road vehicles and that other, often much larger and more polluting industries are not subjected to the same level of scrutiny regarding externalities.

To sum up, this section has argued that regulation of paratransit is perceived as necessary primarily due to imperfect information and excessive competition. It is needed to ensure quality standards amongst operators, safeguard their incomes and protect consumers at a disadvantage due to the lack of normal market conditions with regards to information.

2.4 Applying QQE to auto-rickshaws

Urban Indian auto-rickshaw markets display a number of similarities to Western taxi markets discussed in the theoretical and empirical literature. They are also subject to similar regulatory regimes. This section will briefly outline these similarities and differences between the two markets before assessing the regulation of Indian auto-rickshaw markets in terms of the QQE framework.

Without access to dispatch equipment, auto-rickshaws are, in effect, entirely confined to the cruising market[14]: their business comes from street hail passengers. Without a dispatch to connect drivers and passengers, auto-rickshaw drivers use a variety of tactics to ensure an adequate income. Waiting at stands, similar to taxis clustering at airports and cab ranks, is one such approach, however, in the auto-rickshaw market this is subtly different in that auto-

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[14] Dial-an-auto applications have recently come onto the market, but are used by a small minority of drivers.

rickshaws often wait for regular commuters at access points to the wider mass transit system, such as bus and metro stations, as well as to markets, cinemas etc. Whereas, the taxi takes passengers from origin to destination - point-to-point – and to access points for long distance transport (i.e. airports) the auto-rickshaw is also used as a feeder service to other modes of localized transport by many commuters on a daily basis in Delhi and Mumbai: Jain et al's (2014) study shows that around two-thirds of bus and metro passengers used an auto-rickshaw to cover the distance from their homes to bus stops and metro stations. Mani and Pant (2010) characterise the role of the auto-rickshaw as both providing "last mile connectivity" and undertaking point-to-point trips between areas not well connected by mass public transport or not well connected at certain times. This analysis attributes subtly different primary roles to the auto-rickshaw and the taxi, the latter being primarily responsible for non-feeder, point-to-point trips and occasional feeder services to long distance transport.

Unlike taxi ranks, auto-rickshaw stands are seldom located at airports as the vehicle is typically perceived as being out of place in such a prestigious location: they are usually banned, often justified under the auspices of traffic calming (Hindustan Times, 2010). This points to another key difference: that of ridership and class. Auto-rickshaws fares are considerably lower than rates charged by Indian taxis. Consequently, auto-rickshaws are used by a wider demographic than taxis in urban India; they are also regularly used by a wider section of society than taxis in cities in the Global North. Auto-rickshaw ridership is largely lower-middle classes to middle classes; out of reach of the poor and generally eschewed by the elite (Mani and Pant, 2010). The auto-rickshaw in Delhi plays a subtly different role to the taxi in the western city. The predominance of its feeder service role has several consequences. Firstly, the relative spatial predictability of feeder service trips may mean that the lack of dispatch equipment is less of a handicap because drivers will be able to locate both public transport access points and high demand residential areas which are poorly connected to them. Secondly, auto-rickshaws have a larger modal share than taxis, typically around 10-20% compared to ≤1% (TFL, 2011). Larger modal shares means auto-rickshaws are a larger employer. Indian cities also support considerable taxicab fleets (i.e. 58,000 in Mumbai). This suggests that large numbers of auto-rickshaws do not necessarily compete with taxis for passengers. It is likely that the growing demand for travel and relatively low levels of private vehicle ownership enable Indian cities to support both, although this point requires further research before it can be any more than tentative.

Despite these subtle differences, both Indian auto-rickshaw markets and western taxi markets are subject to very similar regulatory regimes. Auto-rickshaw regulation falls neatly into the QQE framework.

2.4.1 Quantity controls

Auto-rickshaws in all major Indian cities are subject to quantitative entry restrictions, normally in the form of a cap on the number of operating permits issued. Many of the negative effects of restrictive permit regimes experienced in western taxi markets are also present in urban Indian auto-rickshaw markets. The value of auto-rickshaw permits in several cities has increased markedly, becoming a lucrative investment and store of value.

In 2003, Mohan and Roy (2003) report Delhi auto-rickshaw permits selling for Rs.20-40,000 (Rs.38,640-77,280 in 2014 rupees). By mid-2011 permits were changing hands for Rs.350,000

(Rs.415,450 in 2014 rupees) (Agarwal, 2014). Garg et al (2010) put the price of a Chennai permit at Rs.70-100,000 (Rs.98,910-141,300 in 2014 rupees). High permit prices has led to large rental markets as incumbent permit holders, in this case also the vehicle owners, rent both permits and vehicles to renter-drivers on a daily basis, most of whom pay around half their total daily revenue in rent (Garg et al, 2010, supported by data collected by the author in Delhi, May 2014). This is similar to the percentage of revenues paid to permit holders by renter-drivers in the Dublin taxi industry prior to deregulation (Barrett, 2010) and in the contemporary Vancouver taxi market (Proctor, 2014).

Quantitative entry controls in most western taxi markets are determined by allegedly 'objective' criteria, such as measures of Significant Unmet Demand (SUD) (Toner, 2010) which can be calculated using systematically collected trip data. However, the objectivity of these criteria is severely compromised as their application is prone to “regulatory capture” by incumbents such as, larger cab companies, taxi unions and non-driving permit holders (Harris, 2003). For example, new entrants to the Vancouver taxi market must prove that their proposed entrance would tap unmet demand for taxi trips rather than take trips away from incumbents. Large amounts of trip data are required to make such as case. However, such large datasets are held by incumbent companies who do not release them to potential competitors (Proctor, 2014). Large taxi firms also under-report profits to block new entrants (Harris, 2033).

Quantitative entry controls in Indian auto-rickshaw markets are also not based on any genuinely objective criteria. The process of setting permit numbers appears to be largely arbitrary. They are often set by the judiciary, which does not have any specific experience in transport policy. In

2012, fifteen years after ordering a freeze on auto-rickshaw permits in Delhi, the Supreme Court ordered the release of 100,000 new permits, increasing the supply by around 150% (The Hindu, 2012).

Western taxi markets employ objective criteria which are distorted and market data is massaged and often withheld for the benefit of incumbents in debates with policy makers, often to the irritation of the media and consumer organisations (see Houmes, 2011 as an example). In Indian auto-rickshaw markets, no such objective criteria exist, data is simply absent and policy debates involve a wider range of actors: incumbents, new entrants, unions, the judiciary, political parties, the media and consumer organisations. This debate takes in quantity, quality and economic regulations.

2.4.2 Economic controls

Auto-rickshaws are, like most western taxis, typically required to have a fare meter which charges the passenger according to a predetermined tariff structure. All urban auto-rickshaw fares are set by local transport departments, which calculate meter rates using similar calculations to western taxi regulators, namely awarding the driver a living wage taking into account the capital and operating costs (see British Columbia Passenger Transportation Board (2013) and Hakim (2012) for examples of this similarity).

However, there are several important differences. Whilst fares in many western taxi markets are revised on a regular basis (usually annually), Indian cities do not update auto-rickshaw fare schedules on a constant schedule (with the exception of Mumbai). Furthermore, the calculation itself is neither standardised geographically (i.e. between cities) nor temporally (from one revision to the next in the same city). Without a timetable for regular revision, auto-rickshaw meter rates often lag operating costs to the point where strict compliance would mean that operators would struggle to make a living (Mohan and Roy, 2003). As many larger firms in western taxi markets increased their fares after the deregulation of price controls to compensate for the tendency of even regularly revised fares to lag costs (i.e. to "catch up"), auto-rickshaw drivers typically attempt to bridge this gap by abandoning the meter rate in favour of direct fare bargaining with passengers, which inevitably results in prices above the meter rate. The most prominent example of lagging meter rates is from Chennai, where, in August 2013, the auto-rickshaw fare was revised for the first time in six years (in which time the Wholesale Price Index, India's headline inflation index, had increased 54% and local petrol prices had risen 57%). The meter rate had been so outpaced by operating costs that the meter had become obsolete and fare bargaining prevailed, much to the annoyance of many passengers (The Hindu, 2013a). To restore the cost-revenue balance the minimum fare was hiked by 75% (The Hindu, 2013b).

A further discrepancy between economic controls in western taxi and auto-rickshaw markets lie in the inability of fare calculations to accurately capture all the costs incurred by operators. Reports on the auto-rickshaw sectors of Delhi (Harding and Hussain, 2010), Chennai (Garg et al, 2010) and Bangalore (CiSTUP, 2012) show that operators face a number of illegal and semi-legal costs, such as regular payments to the police and other state officials and the high cost of purchasing operating permits on the black market (as permit trading is either illegal or restricted). Costs of this kind cannot be taken into account by the regulators as, firstly, reliable data on them is lacking, and, secondly, any admission of these costs by regulators would implicitly sanction them. As such, official fare calculations tend to underestimate operator costs, which has the potential to create downwards pressure on net incomes, and provide incentive to abandon the fare meter.

2.4.3 Quality controls

Similar to western taxi drivers, auto-rickshaw drivers must obtain a series of official permissions. These involve passing a criminal record check, providing numerous proofs of address and educational certificates (outlined by for Delhi by Harding and Hussain (2010), Chennai by Garg et al (2010) and Bangalore by CiSTUP (2012)). In addition, they are also subject to a dress code (driver must usually wear grey or khaki uniforms and a name badge).

Auto-rickshaws are subject to technical checks, which are usually renewed on an annual basis, similar to the Ministry of Transport (MOT) tests for London black cabs and annual inspections in US markets. Such checks focus on the mechanical fitness of the vehicle. However, auto-rickshaws are subject to more stringent environmental policies and testing regimes than many western taxi fleets. Auto-rickshaws in a number of large cities have been converted to run on CNG and LPG, which are perceived as "clean" fuels[15]. Furthermore, in addition to annual testing, they undergo regular pollution checks, such as the quarterly emissions tests mandatory in Delhi for which certificates are issued.

[15] Conversion to perceived "clean fuels" like CNG and LNG is typically carried out regardless of whether the vehicle is powered by a two-stroke or four-stroke engine, the latter being associated with significantly lower levels of emissions. Reynolds et al. (2011) find that engine type is a more important factor in determining emissions from auto-rickshaws than fuel type.

The table 1 below sums up the similarities and differences between the two markets with regards to role, ridership and QQE:

	Similarity	**Difference**
Role	Paratransit modes: modify routes according to passenger requirements. Labour intensive; low driver: passenger ratio.	No dispatch services in Indian auto markets. Auto-rickshaws primarily feeder services; point-to-point secondary.
Ridership	Both serve primarily middle class ridership.	Auto-rickshaw ridership broader in terms of class.
Quantity	Quantitative entry controls. Supply lags demand. High permit prices. High levels of permit rental. New permits are the subject of debate amongst stakeholders.	No objective criteria to set numbers of auto-rickshaws in Indian cities (i.e. SUD). Auto-rickshaw numbers per thousand inhabitants higher.
Economic	Fare meters mandatory. Fares are set according to similar calculations (when price controls are in force).	Set timetables for fare revision rare in Indian auto-rickshaw markets. Fare calculations not consistent over time or space. Informal costs exist in Indian auto-rickshaw markets and are not accounted for.
Quality	Driver and vehicle standards enforced.	Auto-rickshaw subject to higher levels of environmental regulation than western taxis.

Table 1: Summary of the comparison between taxis and auto-rickshaws.

This section has outlined the way in which the QQE framework can be applied to Indian auto-rickshaw markets. The following section presents a detailed description of the specific regulatory burden borne by auto-rickshaw drivers in Delhi, including the interplay of official regulation and unofficial pay-offs to non-driving actors.

2.5 How auto-rickshaws are regulated in Delhi

This section contains a detailed descriptive account of the specific regulations which govern auto-rickshaws in Delhi. The information regarding documentation requirements in this section is taken from official policy documents issued by the Transport Department, the State Transport Authority and the Weights and Measures Department. Accounts of the complications associated with this lengthy administrative process, including offering bribes, is drawn from discussions with NGOs that campaign on behalf of auto-rickshaw drivers in Delhi, the accounts of drivers themselves and data collected as part of the fieldwork for the following chapter.

2.5.1 Quantity controls on auto-rickshaws

Quantity controls have had a profound impact on auto-rickshaw driving in Delhi over the past decade in the form of restrictions on operating permits.

In 1997, following a series of public interest suits that aimed to cut air pollution from public transport submitted by lawyer and environmentalist M.C Mehta, the Indian Supreme Court ruled that the Transport Department must stop issuing new auto-rickshaw permits until their contribution to air pollution could be practically reduced. This meant finding an alternative to the petrol-driven 2-stroke engines that powered the majority of the city's auto-rickshaws. This ruling was followed in 1998 by a fresh set of recommendations from the Environmental Pollution (Prevention and Control) Committee (EPCA) that called for the conversion of the entire public transport fleet to CNG by 2000-2002, which was quickly adopted. For auto-rickshaw drivers, this made the purchase of new CNG auto-rickshaws, or at least a CNG conversion kit, mandatory. The CNG conversion ruling came just two years after many auto-rickshaw drivers had replaced their vehicles in compliance with an earlier order banning all auto-rickshaws older than 15 years. Faced with the additional cost of a conversion kit – around Rs.30,000 (Rs.61,080 in 2014 rupees[16]) whilst still repaying loans on their new vehicles, large numbers of drivers sold their auto-rickshaws and operating permits to financiers who could meet the costs of CNG conversion, often taking back their old machines on rental arrangements or repurchasing them with fresh loans. Whilst owning multiple permits is technically illegal, it was, and remains, widely tolerated. Despite the conversion of the city's auto-rickshaws to CNG by the end of 2002, the permit cap was not lifted.

The permit cap created a zero-sum game: getting a new auto-rickshaw onto the road meant buying both the new vehicle and a second-hand permit on the new and burgeoning black market. By the early 2000s, the majority of permits had largely been bought up by a relatively small number of auto-rickshaw financiers.

In the subsequent years, as demand for public transportation and auto-rickshaws as a form of employment increased so did the price of a second-hand permit, rising from less than Rs.50,000

[16] Figures in brackets are 2014 rupee equivalents.

in 2001 (Rs.121,000 in 2014 rupees) to a peak of around Rs.300,000-350,000 in 2010 (Rs.415,000-Rs.485,000 in 2014 rupees), bringing the total cost of vehicle and permit to around Rs.450,000-500,000 (Rs.623,000-Rs.692,000 in 2014 rupees) – similar to the price of a new family car. Consequently, in this period few drivers purchased vehicles. Those who did often defaulted on their loans due to monthly repayments of over Rs.10,000 (Rs.12,925 in 2014 rupees) (Harding and Hussain, 2010). In addition, the asymmetry of expertise between financiers and drivers allowed for exploitation. Financiers generally required that drivers purchasing an auto-rickshaw and permit sign multiple contracts written in English (a language drivers do not understand) and often multiple blank contracts. Drivers complied as they had no alternative source of credit and often little understanding of the potential consequences of these actions, such as the creation of onerous conditions and punitive penalties for late repayments as well as for the invention of new clauses and changes in the interest rate, all of which were reported by owner-drivers. Furthermore, most financiers did not register the permit under their own name upon purchasing it from the former owner, turning the vehicle *benaami* ("by proxy", literally "no name"). Occasionally, if the transfer became necessary, the permit would be registered in the name of a third party, typically a low-income individual with an untraceable *jhuggi* address who would receive a nominal fee for their involvement. The motivation for turning the vehicle *benaami* is to disguise the ownership of multiple permits and to further delay the handing over of the permit to the driver once the full loan has been repaid (although it is not a formal requirement, Transport Department officials usually insist that both the old and new permit owners be present at their offices to complete the paperwork). Even without locating the previous owner, the transfer of the permit is a bureaucratic undertaking involving the submission of the original registration book, forms 29 and 30, attested copies of insurance documents and proof of address, current PUCC, PAN card, a permit surrender slip submitted to the State Transport Authority, challan[17] clearance from the Transport Department's Traffic Police and Enforcement Branch, tax clearance from the Transport Department's Accounts Branch and a valid Fitness Certificate.

In 2011, the Supreme Court intervened and ordered the Transport Department to issue 100,000 new auto-rickshaw permits, citing the growing demand for mobility and the rampant inflation of permit prices. The issuance of new permits drastically reduced the value of the existing permits held by financiers and effectively curtailed the black market. This made the process of getting a new auto-rickshaw onto the road easier, but did not completely preclude the inflation of costs. Purchasing an auto-rickshaw still required drivers to take a loan, typically from a financier – the sole source of credit available to them - and on similar terms as before. The driver would then have to purchase a new auto-rickshaw, usually sold by Bajaj-affiliated dealers, and obtain a letter of intent from the dealership. The driver would receive the operating permit upon presenting the letter of intent at the Transport Department. However, there are accounts of collusion between financiers, Bajaj dealers and Transport Department officials. Faced with a sudden spike in demand for auto-rickshaws, Bajaj dealers could take advantage of this sellers' market by favouring purchases made through financiers who would pay a premium for the vehicle (which would ultimately be repaid by the driver). The driver would only be issued with a permit at the Transport Department if the vehicle had been purchased at a premium (evident from the letter of intent), a portion of which would reach the administrators (Agarwal, 2012). The letter of intent

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[17] Challan is an Indian English word of Hindi origin for a receipt, invoice, summons or ticket. In this context is refers to tickets given by the Traffic Police for traffic offences.

must be submitted together with a Form 20, 21, 22 and 34, Fitness Certificate, address proof, insurance certificate, road tax and copy of Permanent Account Number card (i.e. tax number). Many drivers who did not purchase their auto-rickshaws through approved financiers were either refused permits or their applications were delayed. Whilst this arrangement did increase costs by between Rs. 50,000-100,000, (Rs.54,900-Rs.109,800) it did not inflate costs to the same extent as the black market for permits and did not prevent a rise in vehicle ownership. Mohan and Roy (2003) found that 65% of their sample were owner-drivers in 2002; Reynolds et al. (2011) report just 32% in 2009. Data collected in 2014 by the author found 53% owned their vehicles, amongst which 68% purchased their vehicles after 2012. However, whilst the release of 100,000 new permits undoubtedly lowered barriers to entry in the auto-rickshaw market, entry into competing paratransit sectors remained far easier. Getting a battery-rickshaw onto the road or driving for a ride-aggregator, such as Ola or Uber, still presented far fewer barriers since both are effectively unregulated.

2.5.2 Quality controls on auto-rickshaws

Auto-rickshaws in Delhi are subject to quality controls. There are several regulations regarding maintenance and emissions standards. Auto-rickshaws must obtain a Pollution under Control Certificate (PUCC) by passing an emissions test at any one of the 388 official test centres for petrol/CNG powered vehicles across the city. PUCCs for commercial vehicles are valid for three months and must be renewed on a quarterly basis (for private vehicles they last one year).

There are numerous problems with the emissions testing regimes in Indian cities. There are measurement issues (equipment is poorly calibrated), design flaws (only stationary emissions are measured) and a raft of institutional problems. In the event of a failed test, the PUC centre typically carries out the repair work needed for the vehicle to pass the test, similar to a "MOT" test in the UK. Where there are few testing centres, drivers are at the mercy of the PUC Centre staff who can make money by generating false negatives in order to carry out the repair work falsely deemed necessary; or, where there are a large number of centres, as is the case in Delhi, centres compete with each other for customers by returning false positives, which escape the limited oversight of the regulators (see Badami and Iyer, 2006). Whilst this is undoubtedly an issue when it comes to the ability of the regulator to enforce emissions standards in the city, it does not pose a major problem for auto-rickshaws operators who are effectively buyers in a buyers' market.

Auto-rickshaws must obtain a Fitness Certificate by passing an annual Fitness Test and submitting supporting documents. For renewals, the mandatory documents are the registration book, old Fitness Certificate, the last four PUCCs, road tax clearance from the Accounts Branch of the Transport Department and a fee of Rs. 50. New applicants require Forms 20, 21, the insurance certificate, a letter of intent from the State Transport Authority, a certificate of road worthiness from the manufacturer, temporary registration documents and a Rs. 50 fee. The auto-rickshaw is then subject to a test which includes 17 different criteria (listed in appendix B). Some of the criteria are highly subjective and depend upon the aesthetic judgement of the inspector. The test itself is malleable: if the vehicle is in good condition and the driver has provided all the supporting documents, then a bribe of Rs. 200 may be required to pass. However, if the auto-rickshaw has been poorly maintained and some documents are missing, the driver may pay up to Rs. 2,000 to ensure a pass. As with PUCCs, obtaining a Fitness Certificate is not particularly financially onerous in terms of direct costs, it does, however, involve a considerable administrative burden (i.e. the assembly of a large number of supporting documents) and the loss of working time. Again, the malleability of the test procedure has implications for the ability of the regulator to enforce quality standards.

The driver must obtain three types of driver accreditation: a driving licence, commercial licence and commercial badge, which are available in that order. The Delhi Transport Department often does not accept driving licences obtained outside of Delhi, an ad hoc rule that is technically illegal (all driving licences issued in India are valid throughout the entire country) and requires migrant drivers to apply for a local driving licence. This involves first obtaining a learners licence by submitting Forms 1, 2 and 3, proof of address, proof of age and proof of citizenship, then, after a 30 day waiting period, passing a practical test and receiving a permanent driving licence. Once a driver has held a permanent driving licence for a year then he can obtain a commercial licence by passing a medical test, providing school certificates proving an 8^{th} grade pass[18] and proof of address. Upon submission of these documents the driver is granted a provisional commercial licence; after 30 days he may take the commercial licence test. Upon passing the commercial licence test, the commercial badge is then available upon submission of a police-attested proof of address and criminal record check (the completion of which requires a Rs. 500 bribe). This three stage process is difficult for several reasons: Firstly, processing times are long – actual waiting times for licences are orders of magnitude longer than the official figures, which means long periods operating without mandatory documentation, leaving drivers vulnerable to fines or bribe seeking; secondly, many of the supporting documents are very

[18] This requirement was dropped in September 2015.

difficult to obtain (for example, it is difficult for a 30 year old driver to locate a two-decades old 8th grade pass certificate issued by a school in rural Bihar, if it was ever issued).

2.5.3 Economic controls on auto-rickshaws

The main form of economic control is the tariff structure determined by the Transport Department. Fare meters are mandatory on all auto-rickshaws in Delhi. They must be calibrated to charge the latest tariff rate. Tariff rates are set by a sub-committee of the transport department on a sporadic basis.

An internal Transport Department document[19] obtained by a local NGO through a Right To Information (RTI) claim outlines the procedure for the revision of the tariff rate in Delhi in 2010. The rate had remained unaltered since 2007. The document examines the cost increases in the period 2007-2010: It claims that the cost price of an auto-rickshaw rose 17%, CNG increased 65%, maintenance costs rose 65% and the minimum wage for workers in the semi-skilled category (into which auto-rickshaw drivers fall) increased 60.89% in this period. These significant hikes in costs demonstrate the extent to which the previous tariff structure had become out-dated.

The document identifies four different scenarios for auto-rickshaw drivers: three involve purchasing the vehicle on differing terms (interest rates and repayment periods), the other refers to renting. The authors then estimate the monthly income for each scenario at the current tariff rate for both 2007 and 2010 costs using a set of assumptions about daily operations (distance

[19] The document is entitled "Report of the Committee of Officers on Auto-Rickshaw Fare Revision". It is dated 15th June 2010 and is signed by six high ranking Transport Department officials, including Additional Commissioner (OPS) of the Transport Department, New Delhi, Ajay Kumar Bisht. It will be referenced as Bisht et al. (2010).

driven, empty kilometres, average trip length etc.) These estimations demonstrate two key points: Firstly, the tariff structure set in 2007 returns unreasonably low incomes for drivers in 2010: per shift income estimations range from Rs. -74 to Rs. 169, a range than involves some drivers making a loss at the end of their shift making overcharging a virtual necessity. Given the incomes that strict compliance with meter laws would return, there is little wonder that overcharging is commonplace. The second point refers to the wide variability between scenarios. In setting the new fare, the authors calculate a weighted average for the discrepancy between current incomes and the "ideal" income of an auto-rickshaw driver (the minimum wage for a semi-skilled worker plus a Rs. 1500 top up) across all four owning/renting scenarios for two different operating patterns (mean trip lengths of 5km and 5.5km[20]). The weighting is based on the percentage of auto-rickshaw drivers represented by each scenario – although these figures are rough estimates. The overall average monthly discrepancy is calculated at Rs. 5,822 (for all scenarios across both operating patterns), or an additional Rs. 233 per shift, which translates into a 37% increase in the meter fare. However, this average hides considerable variation. The discrepancy ranges from Rs. 2,833 for renters to Rs. 8,917 for drivers who purchased vehicles at high interest rates. According to the model specified in the document, the meter fare revision proposed in the conclusion (the 37% raise) would amply compensate renters who would earn Rs. 2,989 above the "ideal" wage level and undercompensate drivers repaying high interest loans who would still suffer a discrepancy of Rs. 3,095. The variation of scenarios for owning/renting makes fare revision something of a blunt instrument in Delhi, a point which will be developed in the following chapter, which will also suggest solutions.

[20] This chapter will use the 5.5km estimates as data collected by the author and others in the field (Reynolds et al, 2011) suggests an average trip length considerably longer than 5km.

Since September 2012, GPS devices have been mandatory for all new auto-rickshaws in Delhi. Regulation of the GPS device is done together with meter testing. Annual fare meter tests are carried out by the Weights and Measures Department (WMD) of the Delhi Government, which requires the driver to complete a 6km trip on a test track (WMD, 2003). If the meter reading is out by more than 100m, then recalibration is ordered. The WMD also tests the connection of the GPS device to the system operated by DIMPTS – a requirement for passing the Fitness Test. In addition, road tax certificates and insurance documents are also mandatory. Appendix A provides a summary of the documents the driver must carry on them at all times and the processes involved in their procurement; Appendix B lists the exhaustive criteria for the Fitness Test.

In short, auto-rickshaws and their operators must comply with a rigorous set of quantity, quality and economic controls. Compliance places a significant financial burden on the operator, if not directly, as official fees are nominal and most bribes are small compared to the cost of the vehicle and operating permit, then in terms of working time lost whilst assembling large numbers of supporting documents. Many supporting documents are extremely hard for auto-rickshaw drivers, as low-income, often migrant workers, to procure. Their absence makes them particularly vulnerable to bribe seeking by the Traffic Police and Transport Department officials who can easily find at least one mandatory document the driver lacks or a problem with a document being submitted.

2.6 Conclusion

This chapter has presented a review of paratransit regulations. It has identified their current form as the QQE framework: controls on quantity, quality, and economic factors, most notably, the tariff structure. It then identified some of the economic assumptions that act as their justification, which include arguments regarding "credence goods", asymmetrical information and Core Theory. It then argued that the QQE framework is applied by regulators in auto-rickshaw markets in urban India in the form of permit systems, maintenance and emissions standards and tariff controls, among other regulations. However, each of these areas is not without practical difficulties, such as setting permit numbers and revising tariff structures, the failure of which typically impact drivers and passengers. The chapter then presented a detailed account of the regulations with which auto-rickshaw drivers in Delhi must comply - a set of regulations that fits neatly within the QQE framework. These regulations, this chapter claims require the driver to provide large amounts of documentation and spend many working days at the Transport Department.

The lengthy review of paratransit regulations made in this chapter is necessary to provide background and to support arguments made in later sections of this thesis. Regulations governing permit numbers (quantity controls), it will be argued, play a role in inflating operating costs (with implications for driver incomes); the tariff structure (economic controls) fails to adequately compensate all drivers for the work due to the wide variation in costs structures between those renting their auto-rickshaws, those who own but are repaying loans and those who own outright (without debt) – it also incentivises and disincentivises trips of different lengths. Lastly, quality controls such as licencing requirements combine with quantity controls to create a frame of competition which places auto-rickshaws in a disadvantageous position in relation to an emerging alternative: the battery-rickshaw.

Chapter 3: The economics of operating an auto-rickshaw in Delhi

3.1 Introduction

The auto-rickshaw is a common sight in all major Indian cities. They take children to school, ferry commuters to work and, more recently, provide “last mile connectivity” (Mani et al, 2012) by connecting residential areas to metro and Bus Rapid Transit (BRT) stations. They are ubiquitous and synonymous with urban India. Their sheer numbers mean that they are also major employers. There are around 80,000 auto-rickshaws in Delhi, 80,000-150,000 in Bangalore (CiSTUP, 2012), 100,000 in Mumbai (Hakim, 2012) and roughly 85,000 in Chennai (Garg et al, 2010). Every auto-rickshaw provides support for at least one family (Iyer, 2012).

However, despite their important role in the urban transport system and central place in the urban milieu, auto-rickshaw drivers have a poor reputation for overcharging - or ‘fleecing’ - their customers. That is to say, refusing to switch on the fare-meter and, instead, haggling with the customer, the inevitable consequence of which is assumed to be a higher fare. The phenomenon is India-wide: reports of auto-drivers “fleecing” customers are so commonplace that the practice has even been the subject of satire (Faking News, 2014a, 2014b, 2015).

In Delhi, raucous public debate on the issue in the English-language media has been accompanied two broad types of policy interventions aimed at preventing the practice. The first are technical interventions, such as the mandatory fitting of GPS devices on all auto-rickshaws. A second set of policies are legal-judicial in nature and involve increasingly strict punishments for seemingly minor transgressions. The 66/192A legislation[21] is archetypal: a driver caught haggling faces vehicle confiscation and a court appearance. Less draconian but more frequent are "special drives" against overcharging during which hundreds of *challans* (tickets) are issued against auto-rickshaw drivers. However, despite their severity – confiscating vehicles and fines tests drivers' limited resources - both sets of policies are not based on any empirical data on the phenomenon they are supposed to counteract.

Despite widespread media coverage of overcharging and considerable attention from policy-makers, there have, to the best of my knowledge, been no attempts to understand the "fleecing" phenomenon through the collection of empirical data. This chapter takes on this task with a survey of auto-rickshaw drivers that focuses on the capital, maintenance, operating and administrative costs of operating an auto-rickshaw in Delhi as well as the revenues earned and driver demographics. It represents an attempt to understand the root causes of the phenomenon, namely the supply side economics of operation that exert pressure on the driver to overcharge (these could be termed 'necessary conditions'). In the following chapter (chapter 4) we address the specific trip conditions (these could be termed 'sufficient conditions') under which 'overcharging' takes place.

The following section outlines the methodology for the driver cost and revenue survey. The third section contains an analysis of the data collected. It finds that auto-rickshaw drivers who rent their vehicles and those who are repaying loans on their auto-rickshaws have low net incomes as

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[21] Repealed at the time of submission of this thesis.

the majority of their daily revenue is used to pay costs. As a result, taking into account dependents, many are likely to be close to the urban poverty line. It then argues that due to the diversity of costs between renters, indebted owners and outright owners, it is impossible to set a meter fare that compensates all adequately. Using a series of basic NPV calculations it shows that outright ownership is a more desirable scenario than renting the vehicle. It then argues that the involvement of formal financial institutions and the deflation of the permit price would go a long way to increasing the rate of ownership.

3.2 Methodology

The survey was administered to 301 auto-rickshaw drivers in 20 locations across the city of Delhi in May 2014. Survey locations were places at which a significant number of auto-rickshaws could be found (markets, metro stations etc.). These sample locations were geographically spread across the city in order to account for any unseen spatial variation in the auto-rickshaw sector. A systematic random sample was attempted – the research assistant approached every third auto-rickshaw driver waiting at each sample location, restarting the count if the driver declined to participate. However, occasional deviations were required when there were few drivers in an area. The survey contained sections on several different types of cost: capital (rents, purchasing and financing arrangements), maintenance (repairs), operating (CNG fuel) and administrative (costs associated with obtaining the necessary documentation, including the arrangements for the purchase of the operating permit). Fig 2 (below) contains an abridged version of the survey instrument. It also collected data on daily operations (kilometres driven and fuel expenditure), revenues and demographics (family and other employment). The survey was carried out by local research assistants who also noted any consistent unprompted comments made by drivers regarding the survey questions.

CAPITAL COSTS (OWNING AND RENTING)

Owning

How old is your auto?
When did you buy your auto?
What was the price of the auto?
What was the price of the permit?
From whom did you get the permit?
How many payments have you made?

Renting

How much rent do you pay per shift?
How long is your shift?
How many autos does the owner of your auto possess?
Where is he based?
Where is your shift change location?
Do you want to buy an auto yourself? If not then why not?

MAINTENANCE AND OPERATING

How much do you spend on maintenance per month?
Does your auto have GPS? Does it work?
How much do you spend on CNG per shift?
How far do you drive per shift?
How many trips with passengers do you make per shift?
How long do you spend waiting for passengers per shift?
How long do you spend queueing for CNG per shift?

REVENUES

How much do you earn in a normal shift?
How much do you take home after deducting expenses?
Do you rent your auto out to another driver when you're not using it?
If so, for how much?

DEMOGRAPHICS

How old are you?
Are you married?
Do you have children?
Does anyone else in your household have an income?
If so, who, how and how muc
Where does your family stay?
Does your family have any land?
How long have you been working in Delhi?
How did you get into auto driving?
What did you do before driving and auto?
What's te highest school year you have passed?
Do you have a bank account? PAN card?
Driving licence? Commerical licence? Commercial badge?

Figure 5: Survey instrument for the auto-rickshaw driver survey

Wherever possible, the survey questions asked for the most immediate short-term figure to reduce recall bias: i.e. a driver will be able to give a more accurate estimate of his daily revenue than the monthly total. Furthermore, parts of the data were triangulated with other surveys, most notably Reynolds et al (2011), and in discussions with NGOs[22] that work with auto-rickshaw drivers. However, given the nature of recall data, the figures reported below do not claim precision, but do provide an accurate enough quantification of the economics of auto-rickshaw driving in Delhi to be able to identify problems and make policy recommendations.

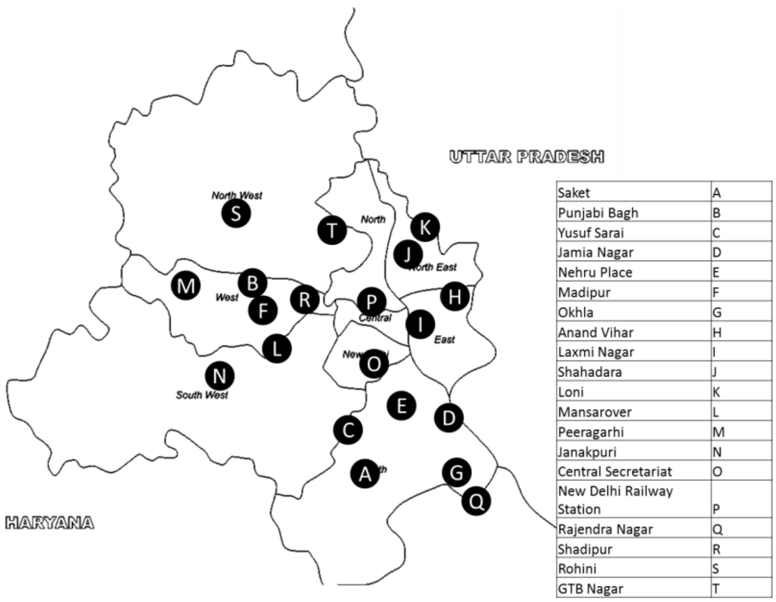

Figure 6: Locations of 20 fieldwork sites for the survey of auto-rickshaw drivers.

3.3 Analysis

Auto-rickshaw drivers fall into three categories: 1) Owners who have fully repaid the loans on their vehicles – they own the vehicle outright. They pay fuel and maintenance costs. 2) Indebted

[22] The NGO is Nyayabhoomi, a Delhi-based organisation that has worked on auto-rickshaw issues for over a decade, in particular on the issues of permit restrictions and the practices of informal financiers, as outlined in chapter 2.

owners who are still repaying the loans taken out to purchase their vehicle, in addition to fuel and maintenance costs. 3) Renters who pay a per-shift rate to a non-driving owner who pays the maintenance costs on the vehicle. Renters pay their own fuel costs. This section will present the data from the driver survey using these three archetypes. All figures in this chapter are given in 2014 rupees. Table 2 (below) presents data on mean monthly costs and revenues for indebted owner drivers who purchased their vehicles in the period 2012-2014 (n=108) and drivers renting their auto-rickshaws (n=141). Projected figures are included for the future income of indebted owner drivers once they fully repay their loans and become outright owners. Monthly maintenance costs were difficult to ascertain from the survey: driver had trouble acurately recalling the frequency and cost of repairs. Therefore, the maintenance figure is an estimate forwarded by a local NGO that works on auto-rickshaw issues.

Cost (2014 Rs.)	**Indebted owner**	**Renter**	**Owner**
Monthly instalment (flat interest at 15%/36 months)	-8660	0	0
Rent	0	-7500	0
Monthly maintenance	-2000	0	-2000
Monthly fuel	-3700	-3700	-3700
Total monthly costs	-14360	-11200	-5700
Total monthly revenue	20600	20600	20600
Net income	6240	9400	14900

Table 2: Monthly costs and revenues for operating an auto-rickshaw for renters, indebted owners and outright owners.

Renters: The capital cost faced by renters is the rent paid to the owner of the auto-rickshaw who typically does not drive an auto-rickshaw for a living. As the renter driver will never own his vehicle this cost will persist over time. Renter drivers do not incur maintenance costs (these are the responsibility of the owner), but they must pay for their own CNG. CNG costs averaged Rs.3,700 (Rs. 150 per shift based on a 25 day working month), which, given the mean daily driving distance of 119km, returns a fuel economy of 3.25kg/100km, slightly below the 3.51kg/100km found by Reynolds et al. (2011) but well within one standard deviation as reported in their work (SD=2.5). There were no significant differences in fuel costs or distances driven across the three groups. The absence of maintenance costs and similar fuel costs gives renters a higher income than indebted owners (approximately 50% higher). However, unlike the indebted owner, renters have little prospect of improving that income over time: renting provides a higher income with little risk, but offers scant opportunity for significant wage increases and with it social mobility. Increases in income are only likely to come about if the driver successfully purchases an auto-rickshaw, but in order to do this he must take on the considerable risk of defaulting and losing all capital invested, a prospect not faced by renters with their modest but stable income.

Indebted owners: The initial cost of an auto-rickshaw totals Rs. 252,000. The vehicle costs Rs.182, 000. The operating permit costs Rs.70, 000, although its official cost is negligible (see chapter 2). Figure 2 (below) gives a breakdown of these costs. This amount is too large for auto-rickshaw drivers to pay from savings and family loans. All owner drivers in our sample took loans from informal financiers who were typically also the retailer of the vehicle. No drivers in the sample received formal sector finance: unprompted, many cited the multiple supporting documents required by banks as a major barrier. Figure 2 shows that the largest portion of the capital cost is the vehicle itself (around half the total). Interest paid on the loan is the second largest contributor. The mean down payment was Rs. 32,000 with the remainder loaned to the driver by the financier at a flat interest rate of 15% over a period of 36 months, an arrangement which appeared to be fairly consistent across the sector, according to NGO workers. This results in a total loan of Rs. 319,000, resulting in a monthly repayment of Rs. 8, 660: i.e. Rs.252, 000/100*15*3=Rs.99, 000; then, (Rs.252, 000+Rs.99, 000)/36=Rs.8, 660.

When asked about the conditions of their loans, many drivers reported signing multiple contracts written in English, a language they do not understand. Many signed multiple blank contracts. This creates scope for the creation of new conditions and penalties as well as for changes in the interest rate.

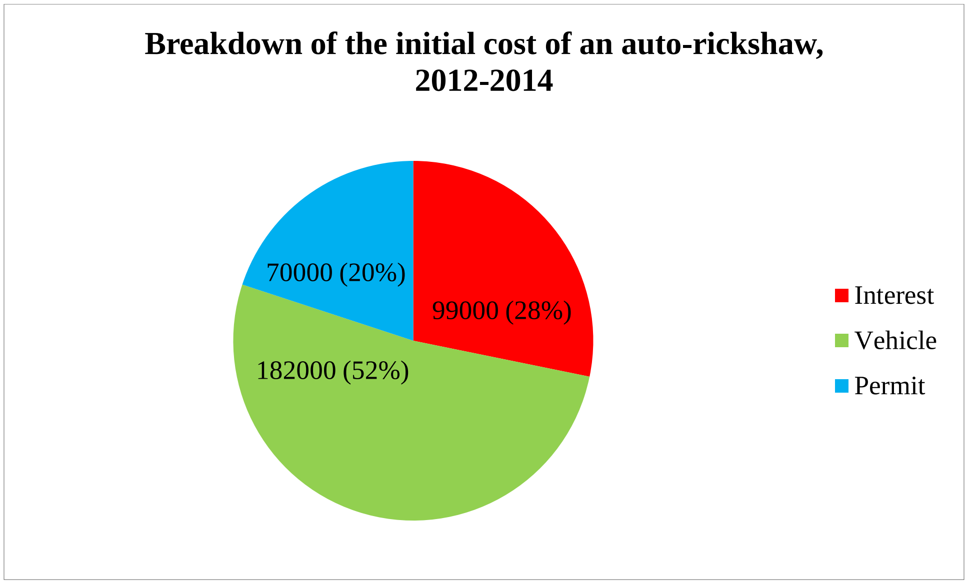

Figure 7: Breakdown of the purchase price of an auto-rickshaw 2012-2014.

Indebted owner drivers must also meet maintenance costs, which are around Rs. 2,000 per month for a newer vehicle which then increases approximately Rs.500 every five years, a figure ascertained from the empirical survey data and discussions with a local NGO that works in the sector. Mean total monthly revenue was Rs.20, 600 or Rs.824 per shift (SD=154) – a figure that did not vary significantly between groups. For indebted owners, this results in a net income of a little over Rs.6, 000 per month, or Rs.250 per shift.

Low net incomes earned by indebted owners are stretched thinly when the number of dependents is taken into account. 83% of all drivers had at least one child (M= 2.27); all drivers who had children also reported being married. Only 16 drivers (6.4% of the total sample) reported income generating activities carried out by members of their immediate family (spouse and older children). The driver typically supports at least three close dependents, which provides the family with a per capita income of Rs.1, 560 per month: relatively close to the official urban poverty line of Rs.1,000 per month, a figure that has been criticised as unrealistically low (Dreze and Sen, 2013). Given the low net income of indebted drivers and the number of dependents they must support, it is easy to see how even modest unforeseen expenses cause default.

Owners: If the driver manages to successfully repay the loan on his vehicle his monthly income increases 139% to Rs. 14, 900. Without significant capital costs, maintenance and fuel are his sole expenses.

The following section presents five NPV calculations for a series of scenarios relating to operating an auto-rickshaw over the vehicle's fifteen year lifetime. It includes analysis of the introduction of formal loans into the sector and the impact of deflating the permit price from its current level to a negligible administrative cost.

3.4 Net Present Value (NPV) – auto-rickshaws

This section contains a series of NPV calculations for the following scenarios: 1) renting an auto-rickshaw; 2) owning an auto-rickshaw with a permit and informal loan from a financier; 3) owning an auto-rickshaw with a permit with a formal loan; 4) owning an auto-rickshaw with an informal loan but without a permit; 5) owning an auto-rickshaw with a formal loan but without a permit. Scenarios 1 and 2 are the current choices available to auto-rickshaw drivers in Delhi; 3-5 are hypothetical. This section is based on data collected in the survey outlined in section 3.2. The NPVs for each scenario return a total annual cash flow figure for fifteen years of operation, the estimated life span of the vehicle.

The NPVs are based on a set of assumptions about capital expenditure expenditures, operating costs, revenues and cash flows and discounting.

Capital Expenditures

- Auto-rickshaw drivers taking loans from informal financiers pay a down payment of Rs.32, 000 in year 1, followed by 36 monthly instalments of Rs..8, 661 for a loan taken out with an informal financier at a flat interest rate of 15% (equivalent to around 24-25% AER).
- The total cost of the auto-rickshaw is Rs.182, 000. The permit cost is Rs.70, 000. There is Rs.99, 000 in interest: i.e. Rs.252, 000/100*15*3=Rs.99, 000; then, (Rs.252, 000+Rs.99, 000)/36=Rs.8, 661.
- The lifetime of an auto-rickshaw is fifteen years. Auto-rickshaws must then be scrapped at the Transport Department. The official compensation given for scrappage is ~Rs.1000 even though the vehicle's scrap value exceeds this figure. In scenarios 2 and 3, it is assumed that the permit is a perpetual asset and can be resold at its initial price. For scenarios 4 and 5, the negligible permit cost cannot be recovered.

- Loan terms for owning with formal finance are as follows: a downpayment of Rs.32, 000 is assumed meaning the total loan is Rs. 220,000, borrowed at a rate of 13.5% APR, the mean rate offered by the State Bank of India for personal loans[23]. Assuming a 36 month repayment schedule, this returns an Estimated Monthly Instalment (EMI) of Rs.7, 466.
- Without the permit, the loan amount is Rs.151, 000 (i.e. equal to the price of the auto-rickshaw (Rs.182, 000) and negligible permit price (Rs. 1, 000) minus the downpayment (Rs. 32, 000)).
- This returns EMIs of Rs.6, 082 on the informal loan and Rs.5, 124 on the formal loan.
- Rent is constant at Rs.7, 500 per month for the duration of the fifteen year period.

Operating Expenses

- CNG spending is assumed to be constant for the life of the vehicle, giving an annual expenditure of Rs..44, 400.
- Maintenance costs increase by Rs.500 every 5 years starting at Rs.2, 000. This accounts for the aging of the vehicle as derived from the survey and discussion with a local NGO. Renter drivers do not pay maintenance costs.

Revenues

- Revenues are assumed to stay constant at Rs.247, 200 per annum, equating to monthly revenue of Rs.20, 600.

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[23] The State Bank of India does not currently provide personal loans for small scale own account workers, such as auto-rickshaw driving, as it requires proof of income from a formal sector employer. However, renter drivers do meet the minimum income level and the total loan amount is within the maximum income-to-loan ratio stipulated by SBI. The figures here are indicative only

Cash flows and discounting

- Annual cash flows were calculated for each year by subtracting expenditures from revenues. A series of discount rates were applied to the annual cash flows to account for differing individual preferences rather than economic growth and inflation, which are not accounted for in the calculations. The sum of the discounted annual cash flows represents the final NPV calculation.
- All values are in 2014 rupees.

Results

Table 3 (below) gives the net present value for each scenario (1-5) at a range of discount rates (from 8%, the State Bank of India deposit rate, to 55%). The exact discount rates for auto-rickshaw drivers is unknown, therefore the range chosen is wide. Figure 3 (also below) shows the undiscounted annual cash flows for scenarios 1-5.

	NPV (Lakh Rs.) at Discount Rate						
Scenario	**0%**	**8%**	**15%**	**25%**	**35%**	**45%**	**55%**
Rent	16.9200	9.6551	6.5958	4.3532	3.1831	2.4971	2.0480
Own, informal loan, permit	23.1200	12.1066	7.6369	4.5062	2.9765	2.1296	1.6135
Own, formal loan, permit	23.6222	12.5380	8.0191	4.8330	3.2604	2.3793	1.8361
Own, informal loan, no permit	23.4805	12.7796	8.3357	5.1480	3.5456	2.6336	2.0633
Own, formal loan, no permit	23.8254	13.0759	8.5981	5.3724	3.7406	2.8052	2.2162

Table 3: NPVs for renting and owning an auto-rickshaws

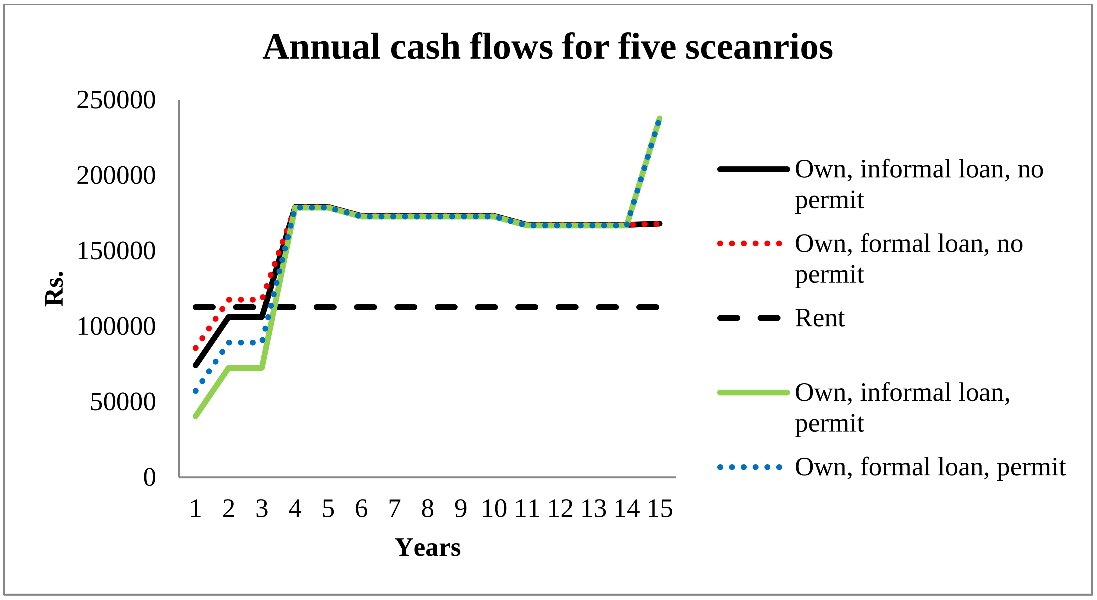


Figure 8: Annual value of cash flow for renting an auto-rickshaw and four ownership scenarios.

Table 3 shows that the net present value of owning an auto-rickshaw is higher than renting for all ownership scenarios. This holds up to a discount rate of 29%, at which point renting becomes the more profitable option (see Appendix C). Undiscounted, the various owning scenarios are between 36.6%-40.7% higher than renting the vehicle for the same period. Amongst the owning scenarios, owning with a formal loan and no permit (scenario 5) appears to return the highest net present value, however, the differences between all four owning scenarios are relatively small – they are all within Rs.0.7 lakhs of one another before discounting. As the discount rate rises, the scenarios without permits (4 and 5) begin to return higher NPVs as the income from re-selling the permit after fifteen years of operating (the spike at year 15 for both with-permit scenarios, 2 and 3) becomes less important and short-term income becomes more heavily weighted. These scenarios effectively exchange future income from the resale of the permit for smaller EMIs and consequently, higher shorter term incomes during the repayment period.

Figure 8 shows the undiscounted annual cash flows for all five scenarios (the revenue minus costs incurred). It illustrates the differences between the four ownership scenarios. Scenarios 3, 4, and 5 (the introduction of formal finance and negligible permit prices) offer significant improvements to annual cash flows in comparison with owning with a permit and informal loan (scenario 2) at a time at which the driver's finances are under considerable pressure. As explained above, low monthly incomes in this repayment period (the first 36 months) coupled with the number of dependents supported and a lack of other household income sources mean that the driver is vulnerable to default in the event an significant unforeseen expense, be it related to the vehicle (i.e. a major repair) or not (i.e. a medical bill). Default means losing the vehicle and all payments made to date. If a driver can successfully repay the loan, then net annual cash flows will increase rapidly. Thus, although the difference in NPV over fifteen years may appear slight, the distribution of the benefits of formal credit and deflated permit prices may prove crucial to mitigating the risk of default. The combination of both deflated permit prices and formal credit has the potential to increase owner incomes to above renter levels in the second year of ownership.

As is evident from the data presented in this section and the previous one, the meter fare may struggle to adequately reflect the costs of operating an auto-rickshaw for several reasons. Drivers have different sets of costs depending on whether they are a renter, an indebted owner or a debt-free owner, as is evident from both the data in table 1. The same tariff structure may reward a debt-free owner adequately, provide meagre reward for a renter and place an indebted owner with a high cost-revenue ratio under severe financial strain. It may be practically impossible to set a fare calculation that provides sufficient compensation for all three archetypes. Costs also change over time due to inflation and the impact of regulatory changes but meter fare revisions are done sporadically, which means that it may not keep pace with operating costs. Furthermore, meter fare revisions are made on the assumption that they come in response to increases in operating costs. However, although hiking meter rates may increase the total revenues of drivers, net incomes may not rise due to concurrent increases of rental payments and possibly even monthly instalments, as informal lenders commonly possess pre-signed blank contracts which enable them to increase monthly instalments if revenues rise significantly (due, perhaps, to meter fare hikes or lower fuel costs). Through this mechanism, meter fare rises may be *setting* some aspects of capital costs rather than responding to them. Consequently increasing fares may have little lasting impact on overcharging as a major portion of the rise in revenue is taken by increases in capital expenditure.

Such practices, often labeled “extortion” and defined as the lender extracting payment above that agreed with the borrower, are common in informal credit markets in the developing world. For example, Leong et al.’s (2016) study of the informal credit market in Singapore finds evidence of lenders making significant changes to the terms of the loan, which are typically verbal agreements, during the repayment period in order to extort additional payments from the borrower. Anecdotal evidence from the auto-rickshaw driver survey and NGO report (Harding and Hussain, 2010) supports the existence of this practice amongst auto-rickshaw financiers, however, at the time of writing the relationship between these practices and fare revisions is unknown, therefore this assertation is a tentative claim that may form the basis for future research, rather than an empirical finding.

In order to arrive at a situation in which a single meter fare calculation can adequately compensate a large majority of drivers it is necessary to facilitate the transfer of drivers to one of two of archetypes discussed above, i.e. to encourage a shift to renting or outright owning. This would standardise costs and revenues across the sector. Owning outright is the most beneficial in the long term (as the following section will demonstrate). It also makes it easier to translate hikes in the meter rate into increases in driver income because debt-free owner pay neither rent to a non-driving owner (who can raise rents as the meter rate increases) nor monthly instalments to financiers (who can increase these payments at will). However, purchasing an auto-rickshaw is a financially precarious proposition – one which involves three years of very low incomes and a considerable risk of default. In order to increase the level of ownership it is necessary to lower risk of default in these first three years – the period in which the driver is repaying the loan on the vehicle.

The introduction of formal sector creditors into the auto-rickshaw market is an important mechanism for facilitating this shift and would go some way towards improving the situation for both drivers and regulators. Formal creditors may be in a position to offer longer term loans to auto-rickshaw drivers with smaller monthly instalments, which would reduce the risk of default by increasing the driver's ability to withstand financial shocks (i.e. unforeseen maintenance costs etc.) Similarly, formal lenders would also perform several other important functions ignored or actively evaded by financiers, such as ensuring clients understand the terms of the loan and the contents of the documents being signed. Easy access to data from formal lenders would make the capital cost of operating an auto-rickshaw more transparent, which would allow for more accurate fare setting. One key difference between formal creditors and financiers is that the former do not benefit from default by the client as seizing the vehicle legally is tricky and time consuming and the asset cannot be easily liquidated; in contrast, the informal financier remains the owner of the vehicle and permit until the loan is fully repaid and is able to utilise whatever means necessary to repossess the asset, including violence and intimidation, if necessary. In this sense, informal financiers are faced with a moral hazard as they may stand to benefit from default.

However, there are significant challenges for any formal lender entering this market: as mentioned above, recovering and liquidating a mobile depreciable asset is tricky, which, combined with a lack of knowledge of their client's credit history and the necessity of less stringent documentation requirements means that formal lenders face increased risk and decreased ability to recover costs; both factors have the potential to push up interest rates. Whilst microfinance institutions have developed practices to deal with these problems, auto-rickshaw loans, at around two lakhs, would be too large to come under the single-cycle one-lakh limit for micro-finance institutions enforced by the Reserve Bank of India (Nair, 2015). Yet these loans are relatively small to be considered viable for commercial banking. The techniques commonly used by micro-finance organisations are also likely to be of limited use in this context: group lending is problematic due to the geographically fragmented nature of the occupation (drivers typically neither work nor live in the same place); there is also no existing organisation through which to route loans due to the modest scale of auto-rickshaw unions in the city (Harding and Hussain, 2010). The purchase of an auto-rickshaw requires the full amount to be paid to the retailer up front which means trust and credit history cannot be built up through a series of smaller loans, a common practice for micro-finance institutions. As a result, formal lenders entering the auto-rickshaw market may require state backing.

In addition to the introduction of formal sector credit, a second tactic to encourage the shift from renting to outright ownership would be to reduce the initial level capital expenditure. Little can be done to reduce the price of the vehicle; however, it may be possible to drastically reduce the permit price. The cost of obtaining a permit is officially a negligible amount – comprising only administrative expenses. However, collusion between various parties has inflated it to Rs.70, 000 (see chapter 2), which greatly increases the size of the loan required. Removing this collusion would encourage ownership by reducing the size of loans and, consequently EMIs.

3.4 Conclusion

This chapter has presented an investigation into the supply side constraints on auto-rickshaw drivers in Delhi based on empirical data collected in the city. It has argued that auto-rickshaw drivers face a series of challenges. Overall, net incomes for renting and indebted owner drivers are low, not far above the official urban poverty line when dependents are taken into account. This is largely due to the costs of operation that account for a significant portion of their revenue. The only prospect of improving this income comes from purchasing and successfully repaying the loan on the vehicle taken from an informal lender. However, this process is risky and often leaves the driver vulnerable to default and loss of the capital invested.

The analysis highlights two related issues: the high level of costs driving down net incomes and the inability of the meter fare to compensate all drivers adequately. It has argued that the involvement of formal sector finance has the potential to alleviate both problems by reducing monthly instalments and facilitating a rise in the level of outright ownership. The reduction of the permit price to a negligible administrative cost provides another significant reform. Together these reforms have the potential to ease the transition from renting to outright ownership. This also greatly simplifies the task of fare setting. Until that time, low incomes and the effect of diverse cost structures on the meter tariff will continue to drive the process of overcharging. The following chapter builds on the work presented in this chapter by investigating the incidence and magnitude of overcharging. Accepting that there are supply side drivers of overcharging, it seeks to clarify when this phenomenon occurs and, when it does occur, its magnitude.

Chapter 4: The incidence and magnitude of overcharging

4.1 Meters, tariffs and the determinants of meter use

This chapter focuses on the incidence and magnitude of overcharging by auto-rickshaw drivers in Delhi. It complements the previous chapter's investigation into the role of costs and revenues in providing the necessary conditions for overcharging by providing empirical data on when and where the driver may refuse to switch on the fare meter.

To understand why a driver might refuse to turn on the meter, it is important to look at what the meter does and how it compensates operators. Whilst there is little literature on auto-rickshaw fare setting, work on the taxi industry provides a useful proxy. The mandatory use of fare meters is intended to ensure consistent and predictable fares, usually through linear kilometric pricing: protecting passengers from spot price fixing, driven by statistical discrimination based on informational asymmetries (Koehler, 2008; Seibert, 2006). Fixed rates also remove the transaction costs for passengers (Gallick and Sisk, 1987; Toner, 1992). Fares are based on the capital, maintenance, operating and administrative costs of running the vehicle, with the addition of an income component. In Western taxi markets, such rates are usually revised on an annual or semi-annual basis based on changes in costs and inflation rates (TLF, 2014) However, tariff revision for auto-rickshaws in urban India is far less systematic. Rates can remain static for years, long after they have been far outstripped by costs. For example, the auto-rickshaw tariff in Chennai was not revised from 2007 until 2013, leading to the complete abandonment of the fare meter in the city.

Setting the fare typically involves deciding on a minimum 'flag-fall' fare, often with an associated kilometre distance, and a per kilometre rate thereafter. However, every meter rate incentivises or disincentivises either longer or shorter journeys[24] – in this sense, 'neutral fares do not exist', to quote Schroeter (1983). The flag-fall fare provides an incentive to accept shorter trips. It is meant to provide compensation for the implicit opportunity cost of taking any given fare: i.e. that the driver takes the shorter trip and misses out on a longer more lucrative journey (Cooper et al. 2010). It follows that raising the flag-fall fare strengthens the incentive for drivers to take shorter trips as it increases the compensation for the implicit opportunity cost of their time. Furthermore, if the trip is short, then the flag-fall fare may provide a higher per kilometre rate than the standard per kilometre rate[25]. Low flag-fall rates may have the opposite effect, providing little compensation for accepting shorter trips. In some markets, this latter situation may lead drivers to unwillingly embarking on these trips, in others, particularly Indian auto-rickshaw markets, drivers may attempt to increase their level of compensation by switching off the meter and haggling with the passenger, ostensibly for a higher price, or failing that, to simply refuse the journey. However, the driver of an auto-rickshaw cannot simply state that the trip will be off-meter. Going off-meter is not only illegal; it typically goes against the wishes of the

[24] An interesting example of the incentives created by the meter rate is provided by Yang et al. (2010) who argue that the meter rate in the Hong Kong taxi market (the near ubiquitous flag-fall fare with a linear per kilometre rate, as described above) incentivises longer trips over shorter ones. Competition for longer more profitable trips has led to the emergence of 'discount taxi gangs' which offer concessions for longer journeys, a process which is illegal as it deviates from the mandatory meter fare. As a result, legal drivers lose business and the meter has become largely obsolete as passengers become used to haggling for discounts. Legal 'non discount' drivers crowd at locations which are typically the origin points of lengthier trips (i.e. the airport), leading to local oversupply and long driver wait times, which the authors argue is an inefficient allocation of resources. They then outline how non-linear meter fares would go some way to increasing the attractiveness of shorter trips to drivers

[25] A simple example of this might be a 3.5km auto-rickshaw ride in New Delhi. The flag-fall fare is Rs.25, which covers the first 2km. Additional kilometers are Rs.8. A 3.5km ride pays the driver Rs.37, or Rs.10.57 per km, Rs.2.57 above the linear per kilometer rate of Rs.8.

passenger who may not agree to it. The driver's desire to go off-meter and his ability to do it will vary according to the particular circumstances of the journey.

Time pressure on the passenger may impact auto-rickshaw bargaining outcomes. A passenger forced to make a deal within strict time constraints may be willing to pay more. This may be exacerbated if the time constraint is known to the seller, which in the case of auto-rickshaw journeys, can be approximated through the passenger's destination. For example, journeys to inter-city train stations or airports typically involve stricter time constraints than those to a local market, as the consequences of missing a train or plane are greater than arriving after closing time. Any measure of time pressure by way of destination may also incorporate the regularity with which the passenger enters the market for that particular journey: workers taking auto-rickshaw trips as part of a daily commute will have a better idea of the local equilibrium cost of the journey than passengers taking annual or semi-annual trips to train stations. The informational asymmetry will be far greater for the latter than the former, meaning that the commuter may be less willing to allow the driver to switch off the meter.

In the wider economic literature on bargaining, gender is a key determinant of bargaining outcomes. Studies have found that women (and visible minorities) are quoted higher prices for goods, such as used cars (Ayres, 1991; Ayres and Siegelman, 1995). This would lead us to expect that women would be less likely to undertake on-meter trips, instead allowing the meter to be switched off, perhaps in order to avoid conflict. However, there is evidence to suggest that discrimination in some markets is statistical and is not motivated by animus (List, 2004). The relationship between supply and demand could also influence meter use. Intuitively, it seems that excess supply will lower prices and increase meter use; demand that outstrips supply will allow drivers to demand more money. Supply is often capped by permit/medallion systems, which tends to create pent up demand (Koehler, 2008). Supply in the auto-rickshaw market in Delhi has, historically, been strictly capped: auto-rickshaw numbers were frozen from 1997-2012, despite significant population growth. Permits are now being issued, however, there may not yet be enough supply to meet the latent demand created over fifteen years by this supply bottleneck. Drivers' ability to abandon the meter may be assisted by the (slowly easing) constraints on supply, which leaves passengers with little alternative other than to accept the demands of the driver who does not already have a passenger. This chapter will focus on several measurable variables which impact meter use in the market for auto-rickshaw trips. These are rush hour peaks, distance, destination, passenger gender and the regularity with which the passenger undertakes this particular trip. The remainder of the chapter attempts to answer the following questions:

1. What are the determinants of meter use? Here we focus on the conditions under which the driver turns the meter on/off. Examining the reasons for presence/absence of meter use helps understand the driver's decision-making related to the use of meters.

2. Where overcharging occurs, what determines its magnitude? Here we focus on the extent of overcharging when it occurs, and assess the specific trip variables that are associated with overcharging.

We use a passenger survey to address these questions. The following section outlines the operationalization of the variables above and the data collection methodology.

4.2 Methodology

4.2.1 Survey

Passengers disembarking from auto-rickshaws at six locations in Delhi were surveyed. A single occupant was approached from each auto-rickshaw sampled. A systematic sampling strategy was attempted. Research assistants (RAs) approached passengers disembarking from every third auto-rickshaw. However, in quiet periods, this was increased to every second arrival in order to attain the necessary sample size, and in peak hours it was decreased to every fifth as arrivals outpaced the RAs' capacity to administer the survey. Many passengers declined requests to participate, usually citing time pressures. When this occurred, the RA restarted the sampling count.

The survey collected the following information:

Variable	Explanation
Journey Origin	The origin of the journey in the auto-rickshaw from which the passenger is disembarking.
Meter	Whether the driver switched on the meter and charged for the journey according to its reading (yes or no).
Fare	The total fare paid to the driver for the journey (Rs.).
Regular Trip	Whether the journey is a regular trip for the passenger, for example, part of a commute (yes or no).
Gender Composition	Gender composition of all the passengers in the auto-rickshaw, excluding the driver (i.e. two men and a woman).
On-Off Peak	Whether the journey was undertaken during the daily rush hour peaks - morning or evening, see below. (Yes or no). Determined without asking passenger.

Table 4: Data collected by the passenger survey.

Three types of survey site were chosen: major train stations, metro stations and non-food market areas (i.e. clothing, general housewares etc.) The rationale behind this was to include locations which captured wide range of time pressures on the passenger, regular and non-regular trips and trips of varying lengths. Table 5 (below) lays out these variations:

Site Type	Time Pressure	Trip Frequency	Trip Length	Sites
Train Station	High – Passengers have trains to catch.	Low – Intercity train journeys occur, at most, every few months.	Long – There are only a few major train stations in the city.	Hazarat Nizamuddin Station, Delhi Railway Station.
Metro Station	Medium – Passengers must commute to work, however Metro services are frequent.	High – Daily commutes.	Short – These trips will be “last mile connectivity”, linking homes with Metro stations.	Hauz Khas Metro Station, Chhattapur Metro Station.
Market	Low – Passengers are in their leisure time.	Medium – Once or twice weekly trips, often with friends and family.	Medium – There are a number of major non-food markets in the city.	Sarojini Nagar Market, Connaught Place Market (Palika Bazar).

Table 5: Time pressure, trip frequency and trip length

Two locations were chosen at each site type in order to minimise sampling bias (see figure 9 below). The two locations under each sample type were observably similar. In order to capture any effect of congestion on non-compliance with meter laws, each survey site was sampled at on-peak and off-peak times at both morning (8:30am-10:00am) and evening peaks (4:30pm-7:30pm) (following Pucher et al, 2005). All data was gathered on non-consecutive weekdays in May 2014. No data was gathered on weekends, public holidays, days on which the flow of traffic was restricted or when auto-rickshaw numbers were artificially low (i.e. strike days).

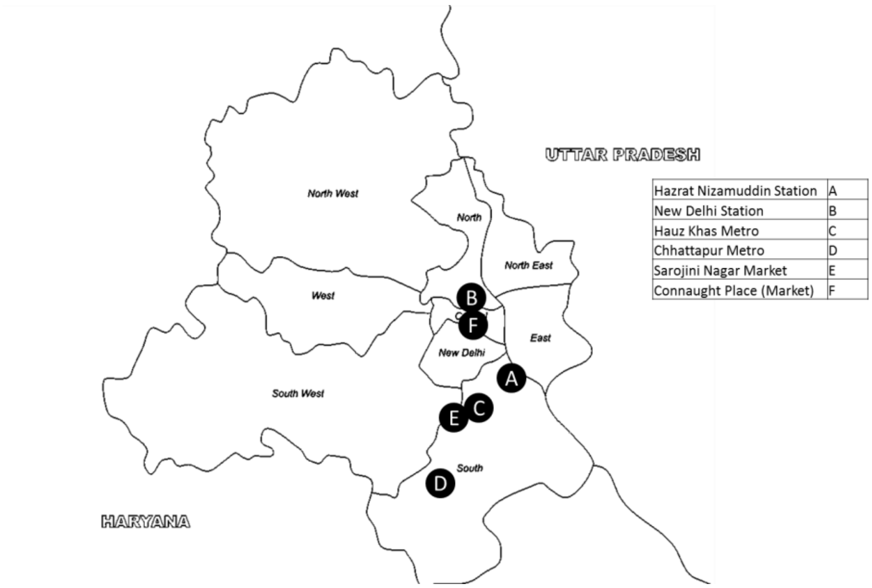


Figure 9: Locations of 6 fieldwork sites for the auto-rickshaw passenger survey.

4.2.2 Data

A total of 689 valid observations were collected across all six sites. Although the aim was to collect equal samples across all site types, this was not possible: train stations (n=125), metro stations (n=297) and markets (n=267). The sample for train stations is relatively small due to the harassment[26] of RAs at these locations, which cut short fieldwork.

439 trips were off-meter (64%); 250 were on-meter (36%). The data collected for fare for on-meter trips was used to calculate trip distance using the meter fare calculation: Rs.25 for the first 2km, then Rs.8 for every additional kilometer. However, the distance of trips made off-meter could not be accurately collected in the field. Calculating distance from the fare paid was also

[26] Several of the RAs were from states in the North East of India – a visible ethnic, religious and cultural minority in New Delhi. Much of the harassment was racially based and included threats of violence which meant curtailing fieldwork was the only viable option.

not possible as passengers were likely to have paid more than the meter fare, which would result in inflated distance estimates and an inability to detect overcharging.

Therefore, estimates of these distances were made by using online mapping software (Google Maps) to estimate the route and distance between the trip origin (often an area rather than specific point) and the data collection location (i.e. the survey location) for both on- and off-meter trips. Where the suggestions made by the mapping program appeared counter-intuitive, they were manually corrected. The accuracy of this method was tested by plotting the residuals of the mapped distances for on-meter trips minus the actual distances calculated from the meter fare. We would expect a large number of residuals to fall within the 0-0.5km range as on-meter fares are typically rounded up to the nearest Rs.5, equal to 0.5km distance. The mean residual was 0.67; standard deviation was 2.26. The mean residual is close to the 0.5km range expected due to the practice of rounding up. The variance of the residuals was peaked around a mean of 0. The plot of residual variance and trip distance showed uniform variance (homoscedasticity). Accepting the distance estimation method described above gives the following set of variables for analysis, set out in table 6 (below):

Variable	Code	Explanation	Type
Location	LOC	Sample site.	Text, nominal.
Location Type	LTP	Classification (i.e. train station, metro or market).	Text, nominal.
Trip Start Location	TSL	Origin of passenger's journey in the auto-rickshaw.	Text, nominal.
Peak	PEAK	Whether the data is collected on- or off-peak.	Binary. On-peak=1, off-peak=0.
Fare	FARE	Amount paid by the passenger to the driver.	Rs., continuous.
Meter	METER	Whether the driver was paid according to the meter.	Binary. On-meter=1, Off-meter=0.
Map Distance	MDIST	Distance of the passenger's journey according to estimations using an online mapping program.	KM, continuous.
Fare Distance	FDIST	Distance paid for by the passenger according to the meter fare calculation.	KM, continuous.
Distance km	DIST	Fare distance for on-meter trips and estimated distances for off-meter trips.	KM, continuous.
Distance km Log	DISTLOG	The log of DIST, used in place of DIST to correct positive skew.	KM, continuous
Overcharging	OVER	Fare Distance minus Map Distance (off-meter only).	KM, continuous.
Overcharging Percentage	OVER%	Overcharging as a percentage of the equivalent on-meter fare.	
Passengers	PASS	Number of passengers in the passenger's auto-rickshaw for the journey. Includes genders.	Continuous.
Male	MALE	Whether a male passenger was present on the auto trip.	Binary. Male =1, Female=0.
Regular	REG	Whether the journey was a regular trip (i.e. part of a commute).	Binary. Regular=1, not regular=0.
Fares Coded 16	FCOD	Fares coded into 16 categories.	Ordinal.

Table 6: Variables used in the analyses in chapter 4.

4.3 Incidence: the determinants of meter use

4.3.1 Logit models

Table 7 (below) shows a series of logistical regression models. The models have METER as the dependent variable. The full dataset is used (n=689), however, missing data means that *n* for all three models is slightly lower.

Model	**A**	**B**	**C**
n	667	667	685
DISTLOG	1.742**	1.744**	1.79**
MALE	-0.614**	-0.619**	-0.661**
LTP(Wald)	39.545**	40.019**	45.434**
LTP(1)	1.42**	1.425**	1.424**
LTP(2)	2.2**	2.206**	2.217**
REG	-0.231	-0.221	
PEAK	0.036		
df	6	5	4
-2LL	734.392a	734.428a	754.574a
Cox & Snell R-sq	18	0.18	0.19
Nagelkerke R-sq	0.249	0.247	0.258

Table 7: Logit models for the incidence of overcharging.
***Significant to 95%, **significant to 99%.**

The least significant variable was dropped from models A and B without notable impact on the coefficients of the remaining variables. Whether the trip happens at high congestion periods (PEAK) is not significant. This may be a true negative, or it may be that the survey has classified the peak period wrongly: it may be shorter and more intense or may have shifted earlier or later in the decade since Pucher et al (2005). The regularity with which the passenger enters the market (REG) does not appear to be significantly associated with changes in the likelihood of meter use. It could that local conventions have arisen to set fares between two known points which are accepted by both driver and passenger, meaning that regular passengers may readily agree to the reasonable off-meter fare. C is the final model.

The gender variable (MALE) is negatively associated: male passengers are less likely to travel on-meter than female passengers. A Mann-Whitney test (p=.135) shows that female passengers (M=4.95, SD=3.7, n=179) do not take significantly different trip lengths to male passengers (M=6.17km SD=5.08, n=510). Furthermore, Chi-Squared tests indicate that the relationship between METER and MALE remains significant in the location-based sub-datasets for markets ((1, n=267)=9.213, p=<.001) and metro stations ((1, n=297)=2.743, p=>.001), although Cramer's V (.105 and .107, respectively) points to its weakness. Whilst there are not enough non-male observations at train stations to run a Chi-Squared test, a Fisher Exact Test finds the relationship also hold in this location type (p=<.005, FET)..

The location variable (LTP) is categorical. The positive coefficients for both train stations (LTP(1)) and metro stations (LTP(2)), signify that trips to these locations are more likely to be made on-meter than those to the base category (markets). The distance variable (DISTLOG) also has a significant positive coefficient indicating that increases in distance raise the log odds of the trip being on-meter, which appears to be consistent with the idea that drivers abandon the meter on shorter trips, effectively creating a higher *de facto* flag-fall fare. However, the interaction of location and distance with regards to meter use must be accounted for given how constraints on passengers vary by location: i.e. does the distance effect hold across locations?

The table below (table 8) shows three separate logit models for subsets of the data based on location. Each has METER as the dependent variable and DISTLOG as predictor.

Location	Train station	Metro station	Market
n	125	297	267
DISTLOG	0.536	2.471**	1.775**
B	-1.918	-3.497	-3.437
S.E	0.416	0.36	0.245
df	1	1	1
Cox & Snell R-sq	0.014	0.202	0.232
Nagelkerke R-sq	0.019	0.273	0.324

Table 8: Logit models for distance and overcharging across the three location types.
****Significant to 99% *significant to 95%.**

Each additional kilometre significantly increases the log odds of the trip being on-meter at markets and metro stations. However, this relationship does not hold for train stations where longer trips are not significantly more likely to be on-meter. This is perhaps to be due to the nature of journeys to train stations: they have strict time constraints, especially for longer trips, which may make passengers less price sensitive and often involve three or more passengers. The mean length of trips to train stations is 12km (SD=5.3), far longer than markets (M=5.27km, SD=4.35) and metro stations (M=3.8km, SD=1.96): thus the association between distance and meter use may break down for these very long train station trips.

Overall, the model shows that location, distance and gender are significant predictors of meter use; peak periods and regularity are not. The interaction of distance and location is important as the role of the former breaks down at train stations. Whilst the gender component is engaging, further analysis into its causes is beyond the scope of this chapter. The locus of the remainder of the section will be the relationship between distance and meter use. Namely, if the likelihood of the trip being on-meter is increased by its distance, then the next step must be to investigate at what point off-meter trips are no longer more likely than off meter trips.

4.3.2 Cut-off analysis

Off- and on-meter fares were separated into sub-datasets. A Mann-Whitney U test[27] was run to assess whether the two datasets had significantly different distributions. The test assigned a higher median rank to on-meter trips (399) than off-meter trips (335), which reflects the high median cost of on-meter trips (Rs.55.5 to Rs.40). The difference in the mean ranks was significant ($p=<.000$), which confirms that off- and on-meter fares are from different distributions.

The fares were then recoded from a ratio to a categorical variable. Fig 10 (below) shows the count of on- and off-meter trips by fare band (given below). It provides a visual representation of these different distributions.

[27] This test was appropriate as neither dataset was normally distributed and both contained many incidences of tied data.

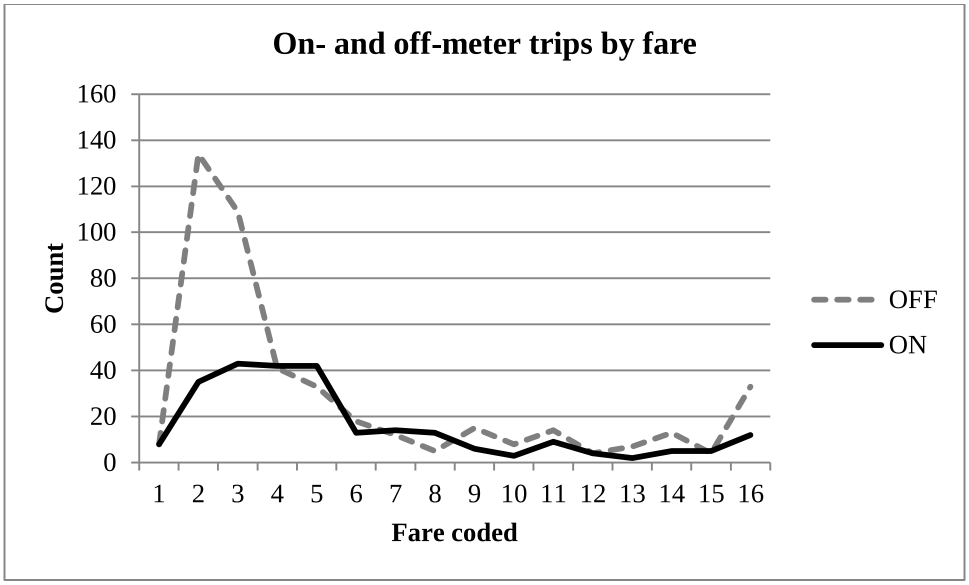


Figure 10: On- and off-meter trips by fare.

[Off- and on-meter fares, count by fare band. X Axis = Fare (0 thru 25=1) (26 thru 35=2) (36 thru 45=3) (46 thru 55=4) (56 thru 65=5) (66 thru 75=6) (76 thru 85=7) (86 thru 95=8) (96 thru 105=9) (106 thru 115=10) (116 thru 125=11) (126 thru 135=12) (136 thru 145=13) (146 thru 155=14) (156 thru 165=15) (166 thru Highest=16). Y Axis = count, n=689].

Off-meter trips are more prevalent at lower fares – perhaps as drivers bargain for a fare higher than the flag-fall fare, perhaps for a shorter distance trips than the standard flag-fall fare covers (i.e. 2km or less). This may be an attempt to increase the minimum fare (Rs.25) on shorter trips in order to compensate for the opportunity cost of losing a potentially more lucrative journey for a shorter fare. From Rs.46 (fare band 4) to Rs.155 (fare band 14), the ratio of off-meter to on-meter trips evens somewhat: these are, perhaps, trips which drivers perceive will easily exceed the minimum fare. Off-meter trips then dominate from around Rs.166.

Cross tabulation shows that, of the off-meter trips carried out in fare bands 1-4, 44% are to markets, 54% to metro stations and just 2% to train stations. In fare bands 15 and 16, 86% of trips were to train stations, of which a large majority (77%) were off-meter. In these fare bands, 14% of trips were to markets (only around one third of which (29%) were off-meter). None were to metro stations. This demonstrates that the abandonment of the meter for fares under Rs.45 is prevalent at markets and metro stations, whilst the lack of meter use at higher fare bands is likely to be due to the circumstances surrounding trips to train stations.

Overall, the field data suggests that the distance of the journey is an important determinant of meter use. Meters are used less on shorter trips as drivers attempt to gain higher levels of compensation for the opportunity cost of taking the journey than awarded to them by the official flag-fall fare. When the meter fare is likely to exceed the official flag-fall fare, then meter use increases only to fall away again for the longest trips, the majority of which are to train stations (with all the associated constraints on passengers) and may involve special circumstances (luggage, more than three passengers etc). See appendix E for a simple model which attempts to quantify the impact of the flagfall fare on the driver's decision whether to go by the meter or not.

This section has focused on the determinants of meter use. The following section investigates the magnitude of overcharging when it does occur.

4.4 Magnitude: the extent of overcharging

The previous section investigated the determinants of the prevalence of overcharging. This section uses a subset of the passenger survey data to investigate the factors that affect the magnitude of overcharging when it does occur.

Removing the on-meter trips (when overcharging does not occur) reduces the dataset from n=689 to n=427. However, there is a subset of off-meter trips (n=62) for which either overcharging does not occur (or at least, is not detectable) or, in a very small number of cases, is negative meaning trips are undercharged. For this subset, the value of the dependent variable (overcharging) is equal to zero or less than zero. The 'undercharging' subset was discarded as it was small (n=12) and was most likely due to driver error. The former – the off-meter trips in which no overcharging occurred – is harder to deal with as Ordinary Least Squares (OLS) regression does not handle over dispersed data well. Removing the zeros from the dataset risked introducing bias into the sample.

In order to address the issue of trips that were off-meter but without overcharging two models were run. The first, model 1, was an OLS regression using data from which all the observations in which 'overcharging' equalled zero were removed. The dependent variable was then log-transformed (n=352) to avoid heteroskedasticity in model residuals[28]. The log transformation was also necessary because the dependent variable was not normally distributed, which violates an assumption of regression analysis. In model 2, the dependent variable OVERCHARGING, was transformed by adding 1, prior to the log transform. Model 2 thus includes all the zero values of the dependent variable (n=427). Given the longer length of train station trips and the involvement of greater passenger numbers and luggage, a train station dummy (TRAINDUMMY) was created. Both models used the same set of independent variables:

[28] See Appendix G for an OLS model of this data using an untransformed overcharging variable as the dependent. The residual vs fitted value plot displays considerable heteroskedasticity. Appendix H contains three tobit models based on the same data. Having run these alternative models, it was decided that Model 2 in table 9 (below) would form the basis for this analysis as it involves keeping more observations in the model and displays fairly random residuals.

TRAINDUMMY, PEAK, MALE, REGULAR and DISTANCE. Results for both models are presented in table 9 (below).

Model	**1**	**2**
y	logovercharging	logovercharging1
n	352	415
TRAINDUMMY	0.92432**	0.707997**
PEAK	0.3314237**	0.23729**
MALE	0.0035906	0.128323
REGULAR	-0.3275322*	-0.4509**
DISTANCE	0.0535441**	0.021158*
cons_	0.2683844*	0.436711**
df	5	5
R-Sq	0.3267	0.3237
Adj R-Sq	0.3170	0.3156
F	33.58**	40.29**

Table 9: Models for the magnitude of overcharging.

Table 9 (above) shows the results of the two OLS models. Model 1 was run to predict values of LOGOVERCHARGING, the dependent variable. The overall model is significant; the variables TRAIN_DUMMY, PEAK and DISTANCE were significant to 99%; REGULAR was significant to 95%; MALE was not significant. Model 2 predicts values of LOGOVERCHARGING1. The model is also significant. The variables TRAIN_DUMMY, PEAK and DISTANCE are significant to 99%, DISTANCE (95%) and MALE which is not significant. There are no appreciable differences between the overall significance of Models 1 and 2 (see appendix F for residual plots). We proceed to use model 2 as the basis for analysis as the sample and the F-statistic are larger.

To account for the log-transformation of the dependent variable, coefficients for the independent variables must be 'exponentiated'. Trips to train stations (TRAIN_DUMMY) are associated with higher levels of overcharging (see Appendix D). The exponentiated coefficient for TRAIN_DUMMY is 2.03, i.e., overcharging on train station trips is 203% higher than non-train station trips. There appears to be a strong peak effect: trips at peak periods are associated with significantly higher levels of overcharging than those made off-peak. All things equal, peak travel results in a 27% increase in the amount of overcharging. Trips taken on a regular basis are associated with lower levels of overcharging. Off-meter trips by regular passengers on a certain route, the large majority of regular off-meter trips are to metro stations (84%) are overcharged 28% less. For every one kilometre increase in DISTANCE, OVERCHARGING will increase 5%.

4.5 Discussion

This section attempts to bring together the insights from the sections on the incidence and magnitude of overcharging.

4.5.1 Train stations

The work on the incidence of overcharging (section 4.3) shows that although trips to train stations are more likely to be on-meter than other locations, this relationship breaks down for very long trips – those costing >Rs.156. In terms of magnitude (section 6), off-meter trips to train stations are overcharged to a far greater extent (203% greater) than those to other locations.

Trips to train stations are special cases as there are strict time constraints on passengers, larger passenger loads (three or four) and longer distances. In addition local price-gouging and rules at train stations can increase the amount of time the driver must wait for his next passenger. These may be formal institutions, such as auto booths run by the Traffic Police which require drivers to ply on-meter and to wait their turn in an, often lengthy, queue. The existence (or perception of) long waits for passengers travelling outbound from train stations could lead the drivers attempting to get compensation for that wait on the inward journey, especially if the presence of the Traffic Police might prevent them from seeking direct compensation from the passenger travelling outbound in the form of an off-meter fare. Alternatively, a driver may decide that it makes more sense to drop the passenger at the train station and then drive on to another location in search of a passenger. The cost of the journey to this third location may be factored into the price demanded from the passenger going to the train station.

A potential policy option to tackle overcharging on train station trips would be to levy a surcharge on both trips to and from train stations (on top of the meter fare). Such a charge could be based on a measurement of the time drivers spend waiting in line for passengers at official Traffic Police station auto booths. The figure could be calculated from the cost of rent (around Rs.30 per/hour, returning a low end figure) or from the hourly income required to return a living wage from a 10 hour shift.

4.5.2 Peaks

Taking a trip at peak hours does not appear to have a role in determining whether the trip is on- or off-meter, however, it appears to be significantly associated with an increase in the magnitude of overcharging. I.e. peak hours play no role in determining whether a driver goes by meter, but, when the meter is abandoned at peak hours a higher level of overcharging is likely to occur than at non-peak hours.

This could be due to local surges in demand during peak hours, which allows drivers to demand a premium in a temporary sellers' market. This represents an ad hoc form of 'surge pricing'. It may also be related to the perception that roads will be congested at peak hours which causes average speeds to slow and journey times to lengthen. As the fare meter does not provide adequate compensation for time-consuming short-distance trips, demands for above meter fares at peak periods could also represent an attempt to incorporate the perception of longer trip times into fares. For example, the fare for a five kilometre trip that takes twenty minutes will be the same as a trip of the same length that takes an hour in heavy traffic.

Implementing surge pricing is unlikely to succeed in the auto-rickshaw market. Surge pricing, when used by taxi aggregators such as Uber, is an attempt to incentivise supply to enter the market. Bringing more drivers to the market lowers prices. However, supply is relatively fixed in the auto-rickshaw market. It is likely that most auto-rickshaws are already operating at peak hours, which means that surge pricing would have little impact other than to deal with overcharging at peak hours by officially sanctioning it. A better approach would be to incorporate time spent waiting in traffic jams into the meter fare (as distinct from waits requested by passengers, which are currently covered by the meter fare, although rather meagrely at Rs.30 per hour; the break-even point in terms of rental costs). This is a policy that is already under consideration[29]. Compensation could be calculated according to either: a combination of speed and time, i.e., a compensation mechanism kicks in if the vehicle does not exceed a certain speed during a set period of time; or an aggregation of distance and time, i.e., an amount is added to the fare for every kilometre that takes over a specified number of minutes to complete. The former system is simpler for both passengers and drivers to grasp, and possibly for meter engineers to calibrate. It may also suffice if the fare increases as soon as the vehicle stops moving as waiting in traffic jams typically involve short periods of waiting punctuated by short bursts of movement, often as traffic lights change at bottlenecks. The time component must be sensitive enough to pick up these multiple brief stationary periods. However, this recommendation is tentative: proper policy recommendations require further empirical study.

4.5.3 Regular trips

Taking a trip on a regular basis appears to have no impact on whether the meter is used, but significantly reduces the magnitude of overcharging. This appears to be quite logical as the purpose of the fare meter is to control for informational asymmetries between driver and passenger with the former assumed to know more about the true length of the trip than the latter and thus well placed to trick the passenger into overpaying. In the case of regular trips, this asymmetry is absent as the passenger is aware of the distance, the approximate meter rate and any local fare conventions. These regular trips, for which informational asymmetry between driver and passenger regarding the meter fare is low, tend to be short trips for which local 'fixed-fare' conventions appear to have arisen as evidenced by the presence of numerous off-meter trips

[29] In December 2015, the Delhi Government instructed Delhi Integrated Multimodal Transport Systems (DIMPTS) to submit a proposal on how a time component could be incorporated into the meter fare (Press Trust of India, 2015). As of mid-2016, the proposal has not been publicly announced.

which closely follow the meter rate: 120 off-meter trips were overcharged by less than 0.5km or Rs.4, the majority of which were to metro stations (62.5%). These fare conventions may have arisen due to a series of reasons: competition on these routes could limit the possibility of overcharging to simple rounding up, giving the driver few extra rupees removing the need to deal with change (i.e. needing to keep Rs.1 and Rs.2 coins on hand). Passengers may be willing to pay a few extra rupees in order to avoid haggling. The metro station may also be a desirable destination for drivers due to the availability of passengers who arrive at short intervals with every metro train. This may lead to shorter waiting times, and with it the possibility of picking and choosing the next trip (i.e. either another short "last mile" journey, or a waiting for a longer trip (see appendix)).

This lends weight to the idea that auto-rickshaws provide "last mile connectivity" by linking mass public transport access points and trip origins and destinations. This entails operating along more fixed, less diffuse routes between metro stations, bus stops and residential areas, offices and schools. If this is to be increasingly the role of auto-rickshaws in the urban transit system (see Mani et al., 2012), then the growing prevalence of shorter, relatively fixed routes, established local fare conventions and passenger familiarity will further decrease the prevalence and extent of overcharging without policy interventions.

4.5.4 Distance

Trip distance appears to impact both meter use and the magnitude of overcharging. Longer trips are more likely to be on-meter; however, longer off-meter trips are overcharged to a greater degree. It is likely that longer trips are more likely to be on-meter as the profits generated from such trips are higher than shorter on-meter trips and the opportunity cost of the trip is lower as the likelihood of missing an even longer trip is relatively slim. Thus the driver has ample incentive to accept the trip on-meter rather than risking losing the fare by haggling. This explains that propensity of longer trips to be on-meter. This relationship holds at metro stations and markets, but breaks down at train stations where many of the long trips exceptionally long and involve multiple passengers and luggage.

In terms of magnitude, amongst off-meter trips, the level of overcharging increases as distance increases. The willingness of passengers to tolerate overcharging, and hence agree to a greater fare while bargaining, may increase with longer trips (and thus meter fare) as the percentage of the fare that represents overcharging is likely to decrease with distance: i.e. a Rs.20 overpayment on a Rs. 150 fare is more likely to be tolerated than the same overpayment on a Rs.25 fare.

4.5.5 Gender

The gender variable (MALE) shows that being a female passenger with no male companions increases the likelihood that the trip will be taken on-meter; however, if the trip is not taken on-meter then gender does little to explain the magnitude of overcharging. The data on incidence provides tentative evidence for a moderate gender effect. Castillo et al (2013) provide a possible explanation for this finding. In their study of the taxi market in Lima, they found that taxi drivers accepted lower fares from women and refused them less. However, this effect disappeared when the researchers controlled for willingness to pay – making all passengers appear to have low-willingness to pay regardless of gender. The drivers' apparent preference for female passengers was underpinned by statistical discrimination – the perception that female passengers could not afford higher fares - rather than a general animus-based desire to take women passengers. The lack of impact of the gender variable on the magnitude of overcharging could also be related to this statistical determination and willingness to pay. Female passengers adjudged by drivers to have a higher willingness to pay may be overcharged like male passengers with similar perceived high-willingness to pay. As such, class, or the appearance of wealth may be an important missing variable here, although one that is very hard to operationalize.

4.6 Conclusions

The trip data shows a complex picture. Overall, it suggests that the fare meter is consistently abandoned on two types of trip. Firstly, short “last mile” trips to metro stations. These trips show suggest the existence of local fare conventions evidenced by large numbers of short off-meter trips with very low levels of overcharging, a surcharge seemingly accepted by regular commuters facing moderate time pressures. Secondly, overcharging is evident of very long trips, typically terminating at train stations.

The data suggests that trip distance, passenger gender and destination are significantly associated with the incidence of overcharging; peak hours, regularity, distance and trips to train stations are all significant determinants of its magnitude. Some of these variables correspond to workable policy interventions; others do not.

This study represents an attempt to provide empirical data on the incidence and magnitude of overcharging by auto-rickshaw drivers in Delhi, something which, to the best of the author's knowledge, has not been attempted, despite being the subject of considerable public anger and numerous policy interventions.

Chapter 5: Explaining the rapid emergence of battery-rickshaws in Delhi: supply-demand, regulation and political mobilisation

5.1 Introduction

India's population is urbanising. In 2014, 32% of Indians (410 million people) lived in urban areas, up from 26% (222 million) in 1990. In the period to 2050, India is projected to add 404 million urban residents, more than any other country, bringing its rural and urban populations into approximate numerical parity at around 800 million each (UN, 2014). Growth is happening fastest at the urban peripheries which are swiftly becoming home to a diverse and growing range of residents, from low-income settlements with few services to developments for the country's growing and increasingly affluent middle-class (Jain et al, 2015; 2012). Urban growth and rising incomes have been accompanied by significant growth in PMV numbers which have greatly outpaced growth in road capacity. The surge in PMV numbers has resulted in severe congestion (Sanjay Singh, 2009; Tiwari et al, 2004) and contributed to poor urban air quality, which has had a serious negative impact on public health (Mathew et al, 2015; Guttikunda and Goel, 2013; Rizwan eet al, 2013).

Many Indian cities have implemented mass transit projects, such as metro rail networks and BRT systems, in an attempt to mitigate PMV use. However, the development of an effective, extensive public transport network requires the integration of mass transit systems with many thousands of local paratransit operators who provide mobility in areas poorly served by the formal public transport system. Paratransit typically caters for trips that cannot be practically undertaken on mass transit, and enable mass transit use by transporting passengers to and from access points to the mass transit system, namely bus stops and metro stations. Most of these local operators fall under the term “paratransit”, meaning that they do not run on fixed routes with a predetermined timetable, but rather tailor their routes to suit demand on a weekly, daily or passenger-by-passenger basis (Vuchic, 1981). Disdain, ambivalence and pragmatic tolerance are common attitudes amongst regulators who must weigh concerns about externalities, such as safety, against the role of paratransit as providers of urban mobility and as a mode of employment for large numbers of often socio-economically disadvantaged people (Cervero and Golub, 2007).

Many paratransit services are described as “informal”. For the purposes of this chapter informality will be defined by the relationship of the paratransit mode in question to regulation (following Kanbur (2009; 2011)). This regulatory focus is useful because this chapter makes an argument about how formalisation, defined as the process of becoming compliant with regulations, came about on concessionary terms, that is, on terms chosen so that a large portion of operators would be able to comply quickly and without too much difficulty. This regulation-based approach breaks down enterprises into four categories. ‘Category A’ activities are both within the ambit of regulation and are deemed compliant - this is the formal sector; ‘category B’ activities are within the mandate of regulators but are not compliant - they are ‘evaders’; ‘category C’ activities change their operations to avoid the ambit of regulation - they are ‘avoiders’; finally, ‘category D’ represents those activities which are not within the mandate of regulation - they are truly ‘informal’ (Kanbur, 2011). The schema applies to operators rather than individual acts: i.e. a taxi driver may possess all the mandatory documentation and operate in the formal sector (category A) whilst occasionally overcharging his passengers. This is seen here as a momentary departure from formality (category A) rather than an indication of full ‘category B’ status – i.e. as an ‘evader’.

India’s major cities contain both diverse paratransit modes and massive numbers of individual operators: there may be as many as 600,000 cycle-rickshaws in Delhi (Ashima Sood, 2012), although the exact number in unknown, and roughly 80,000-100,000 auto-rickshaws (DIMPTS, 2011), which supplement the municipal bus and metro systems. Both types of rickshaw can be flagged down at the roadside and taken to the passenger’s desired destination. In recent years, the city has also gained a fleet of electric battery-powered rickshaws (henceforth, battery-rickshaws). These are three-wheeled vehicles, powered by electricity stored in lead-acid batteries (typically repurposed automotive batteries) with a top speed of about 25kmph, space for six passengers and a range of 60km before the batteries need to be recharged, usually for 8hrs at a standard 220V mains socket. Their construction is optimised for cost rather than durability: Delhi-based retailers pay approximately US$500-600 per vehicle in bulk orders from Chinese manufacturers and then sell the imported battery-rickshaws to individual operators.

In 2010, there were no commercially run battery-rickshaws in Delhi. By 2013, their numbers had grown to between 10,000 and 100,000. Despite the lack of an official estimate - media sources tend towards the upper end of the range (Kant, 2014; Bhardwaj and Bhasin, 2014) - it is evident that battery-rickshaw numbers have grown rapidly, seemingly operating outside the ambit of the authorities, and in defiance of a very highly regulated paratransit market in the city (see Ashima Sood, 2012; Mohan and Roy, 2003).

However, by 2015 they had been formalised as a regulated mode of transport by the Delhi government. More specifically, in this case, formalisation occurred on concessionary terms. It was "compliance through incentives to formalise" specifically through the simplification of regulatory requirements, as opposed to formalisation through deterrence or less direct "soft" measures such as social campaigns (C.C. Williams and Lansky, 2013). This chapter explains the emergence and proliferation of battery-rickshaws in Delhi. It aims to identify the causal factors that resulted in the sudden and sharp rise in the use of battery-rickshaws in Delhi and eventual passing of the E-Rickshaw Bill in 2015, which allowed for regulation and concessionary formalisation of this paratransit mode. To this end, it presents four arguments based on fieldwork carried out in the city in 2014-15.

First, it makes an argument about demand. It contends that battery-rickshaws fill a niche role in the city's urban transport system, one of "last mile connectivity" to the city's metro. Second, it uses primary survey data to show that by providing faster and cheaper transport battery rickshaws have out-competed an existing mode of paratransit in this role, namely the human-powered cycle-rickshaw.

From a supply perspective, the chapter provides evidence that battery-rickshaws are outcompeting the auto-rickshaw for investment due to favourable short-term operating economics, i.e. for potential owner-operators with capital to invest in the paratransit market in

Delhi the battery-rickshaw offers similar incomes in the short-term but poses far fewer barriers to entry (Section 4). However, it will present two net present value calculations which show that this advantage disappears once the value of the vehicles as an asset is taken into account.

Section 5.5 discusses the local political economy of battery-rickshaws and cycle-rickshaws. It argues that the former have been allowed to effectively replace the latter both in term of technology and labour due to municipal politics, in which battery-rickshaw drivers became a much courted voting bloc, and the relative lack of political power wielded by cycle-rickshaw pullers[30], which is closely linked to their status as rural-urban migrant workers. Section 5.6 offers some concluding thoughts.

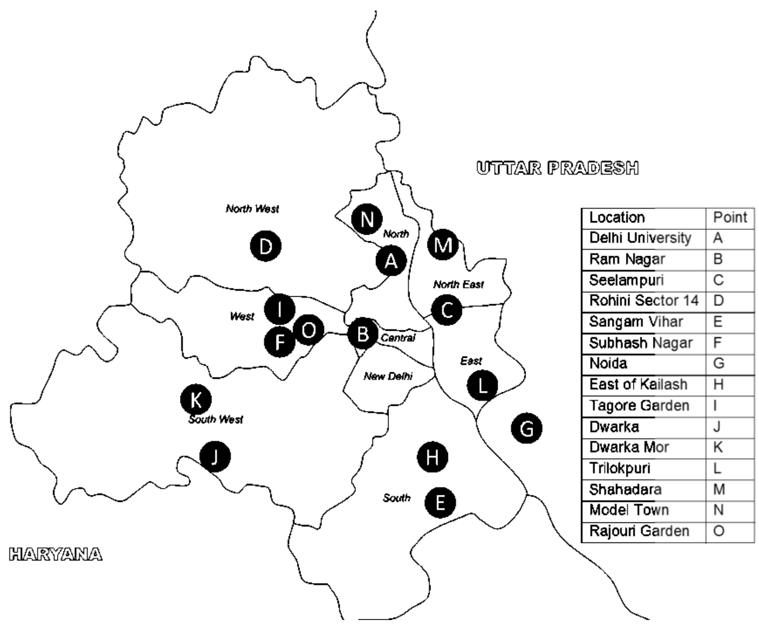
5.2 Methods

This chapter is based on five pieces of fieldwork carried out in Delhi between May 2014 and November 2015 as part of a research project on "last mile connectivity": modes of transit connecting trip origins and destinations with access points to the mass public transport system. There is little peer-reviewed work on battery-rickshaws in Delhi (or India) and no official data. To my knowledge, this is the first peer-reviewed study that gathers primary data on battery rickshaw usage and economics in Delhi, and within India more broadly. The four main pieces of fieldwork were preceded by a period of ethnographic and interview-based work which sought to establish basic information about battery-rickshaws, such as their geographical spread in the city

[30] The person pedalling the cycle-rickshaw is known as the "puller" in Indian English.

and the stakeholders involved in the sector and their interactions, as a basis for the fieldwork. This initial period included a set of semi-structured interviews with battery-rickshaws drivers (n=80), which provided the basis for the validity of later research instruments (namely, surveys) and insights into the working practices and perspectives of operators with regards to the local state. This latter point was supplemented by archival work on media sources.

Following the completion of preliminary work, a survey of battery-rickshaw drivers (n=302) was carried out in 15 locations across the city in 2015. These sites are shown on figure 7 (below).



Location	Point
Delhi University	A
Ram Nagar	B
Seelampuri	C
Rohini Sector 14	D
Sangam Vihar	E
Subhash Nagar	F
Noida	G
East of Kailash	H
Tagore Garden	I
Dwarka	J
Dwarka Mor	K
Trilokpuri	L
Shahadara	M
Model Town	N
Rajouri Garden	O

Figure 11: Locations of the 15 fieldwork sites for the battery-rickshaw driver survey.

Sites were chosen for the presence of battery-rickshaws and geographical spread in order to minimise the effect of any unobserved spatial variation in driver characteristics. One site, the satellite town of Noida (G), lies in Uttar Pradesh, outside the boundary of the city of Delhi.

However, Noida is both physically contiguous with Delhi and well integrated into the Delhi Metro system.

The survey contained questions on capital, maintenance and operating costs, daily operations, revenues, employment histories and demographics. Figure 8 (below) contains the survey instrument. It was administered by local research assistants who approached drivers waiting at the roadside for passengers. A systematic random sample was attempted by approaching every second driver. A similar survey of auto-rickshaw drivers (n=301) carried out by us in May 2014 provides a point of comparison for that mode.

CAPITAL COSTS (OWNING AND RENTING)

- Do you own or rent your e-auto?
- How much rent do you pay per shift?
- How long is your shift?
- Who pays for the maintenance of the e-auto?
- When did you buy your e-auto?
- What was the total cost of your e-auto?
- What was the upfront payment?
- How much are the monthly repayments?

MAINTENANCE AND OPERATING COSTS, AND DAILY OPERATIONS

- How much do you spend on maintenance per month, excluding batteries? (INR)
- How much does it cost to re-charge the batteries? (INR)
- Where do you re-charge the batteries?
- How many km of driving does one charge provide?
- How many passenger trips do you make per shift?
- How many trips do you make without a passenger per shift?
- What brand of batteries do you/owner buy?
- How much do these batteries cost for a full set? (INR)
- Why do you/owner buy this brand?
- How long before these batteries are dead?
- How much do you/owner sell the dead batteries for?

REVENUES AND FARES

- On a typical shift, how much do you earn? (Gross, before cost deductions)
- When did you start driving an e-auto?
- Where you earning more or less per shift back then?
- Do you run on fixed routes?
- What is your fare structure?

DEMOGRAPHICS AND FAMILY

- How old are you? (i.e. fixed, bargain with each passenger etc.)
- What was your previous occupation?
- Where did you do that job?
- How many children do you have?
- Where do your children stay?
- What is the highest year of education you have passed?
- How many of the following do you have?
- *Commerical licence*
- *Driving licence*
- *Bank account*

Figure 12: Questionnaire for the battery-rickshaw driver survey[31].

A passenger survey (n=540) was conducted to investigate the modes of transport for which battery-rickshaws are substituting at metro stations (16 locations). Metro stations were chosen as

[31] The term "e-auto" is a common local term for battery-rickshaw.

a significant number of battery-rickshaw trips originate and terminate at these locations (Shashank Singh, 2014), making the recruitment of participants straight-forward. Other location types were assessed but did not yield high enough battery-rickshaw trip densities to be viable. The survey asked passengers disembarking from battery-rickshaws about the entire trip being undertaken, from origin to destination and, if this was a regular trip they had undertaken for some time, how they had completed this trip before battery-rickshaws were available, i.e. whether they had used a different mode to reach the metro station or had not used the Metro, taking another mode of transport entirely. It also collected basic demographic information. The survey was administered by local research assistants using a systematic random sample with an over-sample to ensure relative parity of participants by gender and trips on- and off-peak hours.

Collectively, this set of fieldwork activities strives for the long exposure, micro-level approach which Harriss-White (2003) terms “field economics”: an attempt to collect primary data without the abstractions which risk loss of the context in which it is embedded.

No fieldwork was carried out in the cycle-rickshaw sector, since they are not a primary focus. For the purposes of this work several recent studies carried out in Delhi, Kurosaki et al’s (2012) extensive and detailed survey of livelihoods, Nandhi’s (2011) comprehensive report and Ashima Sood’s (2009) discussion of the regulatory aspects, suffice.

5.3 The niche role in meeting demand

This section will put forward two arguments. It will draw upon the driver survey and ethnographic work to show how battery-rickshaws play a niche role in the urban transport system in Delhi, namely the provision of "last mile connectivity" around Metro stations. Whilst "last mile connectivity" trips are an important niche in the urban transit system, the market for these trips is not a new one. The Delhi Metro system began operations with a single line in 2002 (and has since added five lines (Delhi Metro Rail Corporation, 2017)) pre-dating battery-rickshaws by almost a decade. This leads to the question of how these last mile trips were performed before battery-rickshaws: the mode for which they are substituting. Based on the passenger survey, this section will then argue that battery-rickshaws are largely substituting for cycle-rickshaws in this last mile role.

5.3.1 Niche role

Battery-rickshaws that ply the streets of Delhi suffer from a number of technological limitations: they leave their passengers relatively exposed to rain and dust; they are slow; their range is limited and their build is fragile. However, their design does confer some benefits, such as a larger passenger capacity (~6-7 people) than auto-rickshaws (~3 people) and cycle-rickshaws (~2-3 people); easy passenger embarkation and disembarkation; and, due to their electric motors, efficient stopping and starting. However, given their limited range and speed, they cannot compete with auto-rickshaws in their main market: long door-to-door trips on the fast arterial roads that link different parts of the city (the survey of auto-rickshaw drivers in Delhi suggests their mean trip is ~7km).

Their role in the urban transit system is to cluster around stations in the city's extensive metro rail system. Battery-rickshaws operate on linear fixed routes using a metro station as origin and then terminus, allowing passengers to embark and disembark at any point along the route for a flat fare, typically at a rate lower than equivalent auto-rickshaws and cycle-rickshaws trips (around Rs.10-Rs.15 per trip). Destinations are loudly and regularly announced by the drivers who typically operate along one of several routes, which connect the local metro station to nearby residential or commercial areas. In our sample, these fixed routes are an average of 4.4km for the round trip, or 2.2km from the metro station to the turnaround point. Around 13-14 such runs are made per shift on a single battery charge. These short fixed routes suggest that battery-rickshaws provide "last mile connectivity": they connect access points to the mass transit system, such as metro stations, with trip origins and destinations (homes, offices and schools etc.) Drivers tend to remain around a single metro station, changing their route relatively infrequently. Routes generally avoid large multi-lane roads with heavy fast-moving traffic, instead sticking to the smaller roads inside the city's residential areas, known locally as 'colonies'.

Provision of "last mile connectivity" is of particular importance in Delhi due to its urban footprint. The city spreads out in all four directions, unencumbered by the flat geography of the Gangetic Plain and encouraged by policies to "decongest" the centre (Pucher et al., 2005) and develop a multi-centred city (Tiwari, 2002). The result is a geographically sprawling, polycentric city with diffuse population centres that include rapidly growing suburbs in the nearby states of Haryana and Uttar Pradesh. Despite recent investments in bus system and the Delhi Metro, significant numbers of people still reside or find employment several kilometres from access points to the mass transit system. Tiwari and Goel (2014) estimate that only 12% of the population of Delhi lives within 0.5km of a metro station. In the Global North these “last mile connectivity” trips are often made by bicycle (DeMaio, 2009) or walking (Daniels and Mulley, 2011), however, these modes are often not practical or safe in Indian cities due to poor cycling and pedestrian infrastructure (Badami, 2009), very high levels of air pollution, harsh weather and class related stigmas around the practice of walking (Rastogi, 2010).

5.3.2 Substitution

The market for “last mile” trips from Metro stations precedes the introduction of battery-rickshaws by more than a decade. Battery-rickshaws must therefore be substituting for one or more previously established modes of transport. Figure 9 (below) shows the modes for which battery-rickshaws are substituting on trips to and from Metro stations based on the passenger survey.

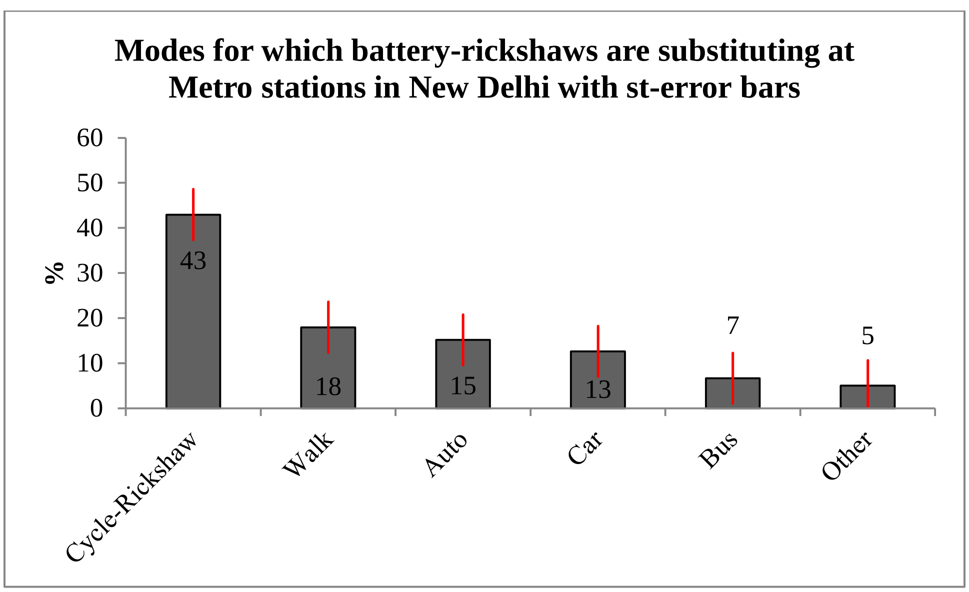


Figure 13: Modes for which battery-rickshaws are substituting.

The percentage of cycle-rickshaw trips replaced by battery-rickshaw trips is relatively consistent geographically: dividing the sample sites into five geographical categories based on their relation to the city's central Rajiv Chowk metro station, returns a mean of 42% for northern metro stations, 50% for western stations, 41% in the east and 69% at centrally located stations (within three stops of Rajiv Chowk), although the sample at central locations is very small (n=13) as there are few battery-rickshaws operating in central New Delhi. Only in south Delhi was the share lower at 26%; in this area battery-rickshaws appear to be substituting for auto-rickshaws (29%), perhaps due to the relative lack of cycle-rickshaws in this section of the city (Kurosaki, 2012).

Overall, the data shows that battery-rickshaws are substituting for cycle-rickshaws in markets for "last mile connectivity" trips at metro stations, a conclusion that supports anecdotal accounts from the ethnographic fieldwork which reported cycle-rickshaws disappearing from areas in which battery-rickshaws had become established. That the substitution involves additional modes is not surprising as battery-rickshaws have three-times the passenger capacity of cycle-rickshaws and thus must take shares from other modes. Also unsurprising is the suggestion that cycle-rickshaws are being replaced, or out-competed because their battery-powered equivalents are faster, more comfortable (they have suspension), more available, do not involve haggling and also alleviate any ethical qualms a passenger may have about using a mode of transport powered by manual labour. They are also significantly cheaper: a trip that costs Rs.20-40 in a cycle-rickshaw is typically Rs.10-15 by battery-rickshaw, which enables the battery-rickshaw to cater to those with lower price points who were previously excluded from the paratransit market.

Despite their limited capabilities, battery-rickshaws have been able to enter a market with trip characteristics that play to their technological advantages: the market for "last mile connectivity" with its short journeys and relatively consistent trip patterns. They have out-competed the former dominant mode in this market, the technologically simpler cycle-rickshaw, providing them with a niche and thus de facto foothold in the urban transit system. However, the ability to do so must entail the existence of favourable operating economics, to which this chapter now turns.

5.4 The economics of supply and operation

This section uses data from surveys of both battery-rickshaw and auto-rickshaw drivers to provide an analysis of the economics of purchasing and operating a battery-rickshaw as compared to those of an auto-rickshaw. The auto-rickshaw, rather than the cycle-rickshaw, provides the point of comparison because battery-rickshaw driving is a higher status profession than cycle-rickshaw pulling. It is associated with a higher level of "labour dignity" and social status (Shashank Singh, 2014; Rana et al, 2013). Cycle-rickshaw pulling is also much more physically demanding. Any individual with the financial means to enter the battery-rickshaw market would be unlikely to consider cycle-rickshaw pulling a viable option. It is also not an enticing economic prospect as cycle-rickshaw puller incomes are much lower than those of auto- and battery-rickshaw drivers and there is little chance of vehicle ownership (Kurosaki et al, 2012). Therefore, whilst battery-rickshaws compete with cycle-rickshaws for passengers, the competition for labour and investment is with the auto-rickshaw, which offers similar levels of status and, as will be shown below, comparable economic returns, albeit in the short term only.

Table 10 (below) contains average capital and operating expenditures for a battery-rickshaw and an auto-rickshaw for the first three years of operation, derived from our surveys of battery rickshaw and auto-rickshaw operators.

Cost (2014 Rs.)	**Battery-rickshaw**	**Auto-rickshaw**
Total cost	84,000	252,000
Vehicle	-84,000	-182,000
Administration (permit)	0	-70,000
Down payment	0	-32,000
Monthly instalment (flat interest, 15%/36 months)	0	8,660
Monthly maintenance	-2,000	-2,000
Monthly charging cost/CNG	-2,200	-3,700
Monthly battery cost	-2,450	0
Total monthly cost	-6,650	-14,560
Total monthly income (gross)	14,300	20,600
Total monthly income (net)	7,650	6,240

Table 10: Costs and revenues for battery-rickshaws and auto-rickshaws for the first three years of operation.

Table 10 shows that the total cost of purchasing a battery-rickshaw is Rs.84,000 (US$1,395)[32]; the same figure for an auto-rickshaw is Rs.252,000 (US$4,186). It must be noted that the down payment for an auto-rickshaw is well within the reach of battery-rickshaw drivers at Rs.32, 000. The majority of battery-rickshaw drivers in sample owned their vehicles (65%) - compared to around 40% of auto-rickshaw drivers. Of these battery-rickshaw owners, 84% were able to pay for their vehicles upfront without a loan from the retailer or a financier by drawing on personal

[32] Conversion at US$1 = Rs. 60.2, the exchange rate on 1st May 2014.

savings and loans from friends and family. No auto-rickshaw drivers in the sample were able to do this. As discussed in chapter 3, lacking access to formal credit, auto-rickshaw finance is handled by informal lenders many of whom are also vehicle retailers. Loans involve three years of debt and monthly repayments in excess of net earnings.

Unlike battery rickshaws, auto-rickshaws face additional capital expenditures of around Rs.70, 000 (US$1,163). This represents the cost of obtaining an official operating permit legally or on the grey market (see chapter 2). In addition to the costs shown here there is also the expense associated with assembling all sixteen documents required by the Delhi Transport Department to operate the auto-rickshaw commercially. Each document requires numerous supporting documents. Whilst the bribes required to secure the necessary permissions are relatively small (a few hundred rupees), drivers do suffer loss of income due to the significant time investment necessary – the process means many days spent at the Transport Department. Battery-rickshaws do not incur any administration costs; they can, at the time of writing, be purchased without loans and can be operated on the streets immediately afterwards. Initial total gross incomes for auto-rickshaws are higher, but after costs, the initial net income of battery-rickshaw drivers appears higher but may be over-estimated as the cost of pay-offs to the low-level state (*hafta*) are not included.

The data in table 10 shows that over the first three years of operation a battery-rickshaw driver can expect to earn a higher net monthly income than an auto-rickshaw driver: Rs.7, 650, as opposed to Rs.6, 240. However, comparison of the two modes over a longer time period is required to ascertain whether this advantage holds. I.e. Does the battery-rickshaw remain the better option over 15 years (the life of an auto-rickshaw) or 5 years (the life of a battery-rickshaw)? The following section presents four NPV calculations: 1) operating a battery-rickshaw as an owner for a fifteen year period; 2) Owning an auto-rickshaw with an informal loan and permit for fifteen years (a calculation introduced as scenario 2 in chapter 3); 3) and 4) represent identical calculations over a five year time frame. The NPV calculations that follow are based on the following series of assumptions derived from the empirical data presented in table 10.

5.4.1 NPV: Battery-rickshaws and auto-rickshaws.

Capital Expenditures

- Auto-rickshaw drivers pay a down payment of Rs.32, 000 in year 1, followed by 36 monthly instalments of Rs..8, 661 for a loan taken out with an informal financier at a flat interest rate of 15% (equivalent to around 24-25% AER).
- The total cost of the auto-rickshaw is Rs.182, 000. The permit cost is Rs.70, 000. There is Rs.99, 000 in interest: i.e. Rs.252, 000/100*15*3=Rs.99, 000; then, (Rs.252, 000+Rs.99, 000)/36=Rs.8, 661.
- The lifetime of an auto-rickshaw is fifteen years. Auto-rickshaws must then be scrapped at the Transport Department. The official compensation given for scrappage is ~Rs.1000 even though the vehicle's scrap value exceeds this figure. It is assumed that the permit is a perpetual asset and can be resold at its initial price upon sale or scrappage of the vehicle.
- The auto-rickshaw's initial asset value is Rs.182, 000. Its scrap value is Rs.1, 000. Its working lifetime is fifteen years. The sum of years depreciation method was used to

calculate the depreciation of this asset over its lifetime. This method estimates the value of the auto-rickshaw to be Rs. 83, 958 at the end of five years. This figure is used as the re-sale price after five years.

- Battery-rickshaw drivers pay for their vehicles in cash. The cost of their vehicles is Rs.84,000. This amount is counted as a capital expenditure.
- The life of a battery-rickshaw is 5 years after which it must be scrapped and replaced. The calculation includes three purchases at 5 year intervals. The scrap value of the vehicle is assumed to be Rs.1, 000

Operating Expenditures

- CNG expenditure is assumed to be constant for the life of the vehicle, giving an annual expenditure of Rs..44, 400.
- Maintenance costs increase by Rs.500 every 5 years starting at Rs.2, 000. This accounts for the aging of the vehicle as derived from the survey and discussion with a local NGO.
- Battery costs are assumed to remain constant at a biannual outlay of Rs.21,176 less Rs.6,442 for buy back of the spent batteries. Battery costs are Rs.29, 468 per year.
- Re-charge costs are a constant Rs.27, 000 per annum.
- Maintenance costs increase by Rs.300 each year from a base of Rs.2, 000 in year 1.
- The cost of informal payments, or graft, faced by both sets of drivers is not included in the calculation

Revenue

- Revenues for auto-rickshaw drivers are assumed to stay constant at Rs.247, 200 per annum, equating to monthly revenue of Rs.20, 600.
- Revenues for battery-rickshaw drivers are Rs.171, 600 annually, equating to monthly revenue of Rs.14,600.

Cash flows and discounting

- Annual cash flows were calculated for each year by subtracting expenditures from revenues. A series of discount rates were applied to the annual cash flows to account for differing individual preferences rather than economic growth and inflation, which are not accounted for in the calculations. The sum of the discounted annual cash flows represents the final NPV calculation.
- All values are in 2014 rupees.

Results

Table 11 (below) shows that owning an auto-rickshaw over both fifteen and five year periods returns a higher undiscounted NPV periods (121% and 100% greater, respectively) than owning a battery-rickshaw over the same period. This remains the case for all discount rates examined. Increasing the discount rate does see this gap close slightly as the difference in income between the two scenarios occurs in year four onwards when the auto-rickshaw driver's income rises significantly, an increase downplayed at higher discount rates.

Scenario	NPV (Lakh Rs.) at discount rate 0%	8%	15%	25%	35%	45%	55%
Battery-rickshaw (15 yrs)	10.4598	5.7832	3.8401	2.4320	1.7083	1.2846	1.0120
Auto-rickshaw (15 yrs)	23.1200	12.1066	7.6369	4.5062	2.9765	2.1296	1.6135
Battery-rickshaw (5yrs)	3.4866	2.6981	2.2020	1.6953	1.3427	1.0888	0.9006
Auto-rickshaw (5yrs)	6.9592	5.1431	4.0478	2.9779	2.2700	1.7835	1.4379

Table 11: Battery- and auto-rickshaw NPV comparison

5.4.2 Discussion

The results suggest that the auto-rickshaw is the better option over both five and fifteen year time periods. However, despite this, the battery-rickshaw sector has grown rapidly. There are several potential reasons for this growth. As discussed above, the short term operating economics favour the battery-rickshaw. Initial capital expenditures are kept low by the rudimentary nature of the vehicle and the absence of permits, which have long inflated expenditures in the auto-rickshaw sector. These initial expenditures are low enough to be met through savings and loans from family and friends without the need to deal with an informal financier - often perceived as a tricky and untrustworthy figure (see chapter 2). Furthermore, many entrants may simply be put off by the high barriers to entry in the auto-rickshaw market, despite its superior returns. Defeated and frustrated by the large number of mandatory documents required by the Transport Department, they make simply choose to avoid it by driving a battery-rickshaw.

The NPV calculations do contain some limitations, which may overestimate the incomes derived from auto-rickshaw driving. As mentioned above and explained in detail in chapter 2, the practices used by informal financiers often make outright ownership of the vehicle and permit very difficult due to moral hazard. As holders of the permit until full repayment of the loan, they stand to benefit from default. For this reason, entrants may perceive the already significant risk of default on EMIs to be deliberately exacerbated by the financier. This means that successfully repaying the loan may be viewed as a slim probability.

5.5 The political economy of battery-rickshaws

This section focuses on the political economy of battery-rickshaws and cycle-rickshaws. So far the chapter has shown how the former has outcompeted the latter for passengers, physically displacing cycle-rickshaws from the city's streets in many areas. This section attempts to understand how this process has been legitimised, i.e. why regulation has been shaped to enable battery-rickshaws to become compliant on concessionary terms, effectively granting them permission to take over these markets in perpetuity. First, it will brief outline the motivations for formalisation from the drivers' point of view. Second, it will contrast the demographics and status of battery-rickshaws with that of cycle-rickshaw pullers in terms of their potential for political mobilisation, which, we argue, is the key factor in the formalisation of the battery-rickshaw on concessional terms.

5.5.1 Motivations for formalisation

The interviews with battery-rickshaw drivers found that they faced a series of challenges related to their status as 'evaders' of regulation. Many drivers reported sleeping on their vehicles in order to deter gangs of thieves who target battery-rickshaws because they are relatively easy to steal and, once stolen, they are impossible to trace. Without documentation the police lack the records of ownership which link the vehicle to the owner. They also have no means of identifying the vehicle beyond the owner's visual identification. Similarly, the lack of official documentation makes insurance unobtainable, which provides further financial risk in the event of an accident or theft. Many drivers reported apprehension about the climate of regulatory uncertainty: the absence of continued permission to operate free from the threat of being banned. These risks were the source of significant anxiety due to the relatively large amount of capital invested in the vehicle – largely the savings of family and friends. Formalisation has the potential to alleviate some of these challenges: compliance with regulatory oversight would mean continued permission to operate. The associated documentation registering both driver and vehicle - linking the two - could facilitate access to formal credit and insurance markets (Costanzi et al, 2013; Amarante and Perazzo, 2013; C.C.Williams and Lansky, 2013; Iqbal, 2016). For these reasons, battery-rickshaw drivers spoke of their desire for a form of regulatory oversight with which they could easily comply, effectively bringing them from 'B' to 'A' on.

However, this eagerness for formality was tempered by the acknowledgement amongst drivers that formalisation does not necessarily improve the condition of the poor (Harding and Seram, 2014). The gap between the formal sphere in which policy-maker and planners operate and the on-the-ground realities of the Indian economy can result in dysfunctional regulations as the former often have little comprehension of the latter (Kanbur, 2013). This has the potential to result in regulatory burdens being placed on previously informal operators, often involving identification and address proofs, which simply push informal operators into further evasion measures and raise the levels of weekly pay-offs to local officials (Bhowmik, 2005; Anjaria, 2006). This concern was shared by battery-rickshaw drivers, who were also worried that formalisation could lead to the introduction of a permit system, similar to the one that has inflated capital costs in the auto-rickshaw sector. From the driver perspective, compliance would address their problems only if it occurred quickly and on concessionary terms, namely on terms with which the majority of existing operators could quickly and easily comply. These terms would need to waived more exacting requirements, such as commercial licences, which are difficult and time-consuming to obtain.

There is significant motivation for making battery-rickshaws compliant with regulation from the operators' point of view. Cycle-rickshaw drivers, the primary mode that battery rickshaws replace are also 'evaders' of archaic and impractical regulations which effectively prevent compliance (Ashima Sood, 2014) - an example of Kanbur's (2013) gap between the formal and informal. They would also benefit greatly from the opportunity to become compliant on concessionary terms. However, this opportunity was granted to battery-rickshaws and not the long-established cycle-rickshaw sector. Explanations of the rise of battery rickshaws need to provide reasons for why the existing mode, the cycle-rickshaw, could be so easily displaced.

5.5.2 Demographics and political mobilisation

Low economic barriers to entry mean that ownership rates amongst battery-rickshaw drivers are high (~65%) compared to auto-rickshaws (~40%) and cycle-rickshaws (>10% (from Kurosaki et al, 2012)). Regulatory uncertainty is likely acting to preclude the emergence of large fleet owners who rent out dozens of vehicles (as found in the auto-rickshaw and cycle-rickshaw sectors). The eight hour recharge time means that only a single shift is possible per day: the vehicle is either being driven, usually by the owner, or recharging. These factors mean that comparatively few battery-rickshaws are available to rent, practically preventing cycle-rickshaw pullers from switching to the new technology through renting. Switching through purchasing is also prohibitive as cycle-rickshaw pullers only spend part of the year in Delhi as they are mostly rural-urban seasonal migrants who divide their time between renting cycle-rickshaws in Delhi and tending to small-scale family farms or undertaking waged agricultural work, usually in the northern states of Uttar Pradesh and Bihar (Ashima Sood, 2014; Kurosaki et al, 2012; Nandhi, 2011; Dupont, 2000).

Furthermore, the initial investment required in the purchase of a battery-rickshaw is likely to be beyond the reach of cycle-rickshaw pullers who are in a more disadvantaged socio-economic position than battery-rickshaw drivers. Almost all the individuals sampled by Kurosaki et al's (2012) study of cycle-rickshaw pullers in Delhi owned either insufficient land in their home villages to support their families or no land at all. The inability to meet their family's food costs from their land and the local labour market was a significant motivation for migration for around three-quarters of cycle-rickshaw pullers. They typically remit all income that remains after meeting their own living costs in Delhi to their families, a figure of around Rs. 2,000 a month (US$33), for the vast majority of whom (85%) this money represents their only household income source. They have little money to invest in battery-rickshaws and most have little inclination to do so, given both their seasonal movements and the risks associated with ownership: they do not have the funds to absorb the cost of the loss of the vehicle through theft or accident. These factors help explain why only around 15% drivers in our sample of battery rickshaw drivers are former cycle-rickshaw pullers.

Cycle-rickshaw pullers are primarily engaged in a struggle to provide for their families in distant villages; as such, they are "not greatly involved in city life" (Kurosaki et al, 2012: 11). As seasonal migrants, they have little interest in improving local labour conditions, which are often seen as a temporary hardship. There is also mistrust amongst cycle-rickshaw pullers: a puller may only trust those from his home village or those for whom a close associate has vouched. This has created a fragmented workforce and a rapid turnover of short-lived unions. As a consequence of this, the cycle-rickshaw unions that operate in Delhi are weak (Ashima Sood, 2009). Cycle-rickshaw owners (known locally as *thekedars*) are not unionised (as their occupation is technically illegal). They are too few to constitute a significant voting bloc and, with incomes of around Rs. 22,000 per month (US$365), are not wealthy enough to acquire political traction through financial means (Kurosaki et al, 2012).

In contrast, battery-rickshaw drivers are not seasonal migrants who remit to support their families; rather their families (and friends) are often the source of capital that enables them to purchase the vehicle without a loan from the retailer. They are better educated (56% completed 8> years of schooling; whereas just 10.6% of cycle-rickshaw pullers have) and have some level of access to formal finance in the form of bank accounts (held by 55% of the sample, compared to less than 1% amongst cycle-rickshaw pullers (Nandhi, 2011)). Most (83%) are Delhi residents whose lives are based in the city in which they work and, most importantly, vote – only 9% of cycle-rickshaw pullers are registered to vote in Delhi. As Delhi residents, battery-rickshaw drivers have a stake in the future of urban transportation in the city and, as registered voters; they have the means through which to express these interests politically. The case of battery-rickshaws is further bolstered by the presence of a network of battery-rickshaw importers, assemblers and retailers whose revenues from the sale of these vehicles are significant enough for them to cultivate political connections in an attempt to guarantee their future revenue streams through the swift concessionary formalisation of the technology – even securing a meeting with the federal Minister of Roads and Highway Transport to push their case (Times of India, 2014a) (see Harding, 2016 for details).

The mobilisation of battery-rickshaw drivers as a voting bloc occurred in the run up to the Delhi Legislative Assembly election of February 2015 (a municipal election). During this period, battery-rickshaws were technically illegal as they did not comply with existing regulations. There had been several unsuccessful attempts by the judiciary to remove them from the roads. The Delhi Government could offer no definitive battery-rickshaw policy as it had been under a technical administration (President's Rule) following the resignation of the previous executive in February 2014 and thus lacked the mandate to do so.

Cognizant of the growing number of battery-rickshaw drivers and how their interests could be met, both front-runners, the Bharatiya Janata Party (BJP) and the Aam Aadmi Party (AAP) sought to capture their votes by promising changes to the existing regulations to make compliance easier, effectively ignoring earlier High Court rulings, a tactic used by the AAP to successfully mobilise auto-rickshaw drivers in earlier municipal elections. Both lobbied the Government of India (the central government) for concessions (Ashok, 2014).

In order to court the votes of battery-rickshaw drivers in Delhi, the federal BJP (in power at the Centre) drafted the E-Rickshaw Bill. It allowed battery-rickshaw drivers to operate with a standard driving licence rather than a commercial licence, carry up to 4 passengers and 40kg of luggage as long as their vehicles did not exceed 25kmph and 2000W (eight times the previous power limit). Each driver would be given a permit to operate; permit numbers would not be capped.

The E-Rickshaw Bill represents a compromise path which allows battery-rickshaws to transition from ‘category B’ (evading) to ‘A’ (formal) (Kanbur, 2009; 2011). It effectively legislates for the take-over of the market for “last mile” trips by battery-rickshaws at the expense of cycle-rickshaw pullers who have neither the voting power nor a group of well-connected backers to argue their case.

Since the passing of the E-Rickshaw Bill, thousands have made the transition. However, many have been unable to meet even these criteria, mostly due to the difficulty in obtaining the necessary documentation for whose absence they must continue to pay weekly bribes. As of mid-2016, the public debate around battery-rickshaws had shifted from their legality to apportioning responsibility for building re-charging stations (Kumar, 2016), which signals a change of debate to one of infrastructure provision that assumes the permanence of battery-rickshaws in the urban transit system.

This period constituted something of a crisis for urban transport planning in the city: large numbers of battery-rickshaws were operating without regulatory oversight whilst different parts of the state made competing and often contraditory rulings regarding their future, a situation which created uncertainty for both operators and passengers. This occurred against the backdrop of negative media coverage of both the operators, who were seen as illegal, and the authorities who were depicted variously as corrupt and incompetent. This “crisis” is discussed in detail in chapter 6 as it illustrates the environment in which urban transport policy decisions are made, particularly the invovlement of numerous entities with overlapping remits and different sources of authority, an understanding of which is crucial in any attempt to engaging with paratransit in urban India.

5.6 Conclusions

This chapter has argued that battery-rickshaws play a niche role in the urban transport system in Delhi by meeting demand for “last mile” trips, particularly around Metro stations. They have taken over this market predominantly from the cycle-rickshaw, which they out compete in terms of comfort, availability, speed and price. As potential investments, battery-rickshaws provide initial returns similar to auto-rickshaws. However, as the NPV calculations show, auto-rickshaws represent the better investment. Battery-rickshaw numbers have grown in spite of this, most likely due to the far smaller initial investment which removes the need for a financier, and the lack of prohibitive administrative hurdles, some of which, such as the permit, inflate the purchase price.

These advantages have allowed battery-rickshaws, primarily inexpensive Chinese imports, to proliferate rapidly in the city. However, purchasing also comes with considerable risk of losing the vehicle, which disincentivises any potential investment in more costly but more durable technology and causes considerable personal stress and anxiety for drivers, all of which provides ample motivation for regulation from the operators' viewpoint. Ultimately, their mobilisation of battery rickshaw drivers as a voting bloc led to formalisation on concessionary terms.

For informal urban enterprises, such as paratransit operators who 'evade' regulations, direct appeal to politicians provides a way of bridging the gap between regulators (grounded in the formal sector) and the realities of the informal economy. Battery rickshaw drivers have been able to do this bridging with great effect as evidenced in their path to formalization. This gap has produced unworkable regulation for cycle-rickshaws (Ashima Sood, 2009) and for informal enterprises more generally (Bhowmik et al, 2011; Anjaria, 2006; Bhowmik, 2003). Battery-rickshaws have been able to effectively oust cycle-rickshaws, which do not have political leverage and can mount no effective political defence of their traditional markets.

These markets are crucial to the efforts of rapidly growing Indian cities to reduce PMV use and with it air pollution and its health impacts. The past decade has seen significant investment in mass transit systems in Indian cities, mostly metro and BRT systems, the success of which partly depends on efficient, affordable paratransit. New paratransit modes will emerge as new technologies become available. Integrating them into the urban transit network is the task of regulators and transport planners who, as has been demonstrated here, may benefit from a swift and pragmatic approach to formalisation, especially to those that utilise technologies for which current regulation does not account. A focus on the new mode's role in increasing the supply of mobility and the ability of its operators to bear a regulatory burden, is likely to be more useful than one fixated on its legality. Approaches to emerging modes of paratransit must also balance the technical and legal aspects of transport planning with an appreciation of its role in providing employment for large numbers of low-income families (i.e. Iyer et al (2013) state that one auto-rickshaw supports two families), in this sense, regulators must temper the technical and legal aspects of transport planning with the democratic. This is necessary if they do not wish to be bypassed by the political process, which is responsive to the position of low-income operators due to their role as a valuable voting bloc.

This chapter has discussed the emergence of the battery-rickshaw in Delhi in terms of its role in the urban transport system, substitution and operating economics. It has provided a brief explanation for their swift formalisation, namely their mobilisation as a voting bloc. The following chapter develops this further by providing a detailed account of the formalisation process, which it uses as a lens through which to view the urban transport policy making environment, one which is ultimately contested and highly political.

Chapter 6: The battery-rickshaw “crisis” in Delhi

6.1 Introduction

This chapter sets out to use the policy reaction to the rise of the battery rickshaw in Delhi as a lens through which to view the policy making environment in urban India. This case study is of particular interest as it starts from a relatively blank slate: there is no existing regulation governing these vehicles in Delhi as the technology is new. The chapter will describe the negative perceptions of battery rickshaws in the English-language media. It then gives a brief history of battery rickshaws in Delhi, a story marked by indecision, delay, claim and counterclaim. It will then analyse the causes of this “crisis”, which it argues include the polycentric nature of urban governance and a lack of empirical data. It concludes by concurring with Roy’s (2007) assertion that policy making in urban India itself may be informal as the boundary between legality and illegality is not fixed in terms of objective criteria, rather it is constantly negotiated.

6.2 Negative perceptions

Despite their rapid growth and increasingly important role in the urban public transport system, battery rickshaws are the subject of a number of negative perceptions amongst the middle classes and the English-language media. The battery rickshaw is seen as operating without regulatory oversight. It is perceived as operating free from the burden of compliance, as such, the battery rickshaw and its driver seen as free to run amok on the streets of Delhi, driving dangerously and choking main roads, whilst the authorities, whose duty it is to govern such activities, stand idly by, either powerless - "stumped" by the sudden explosion of this new variety of rickshaw (Bansal, 2014) - or simply unwilling to protect the "common man" from the "menace" posed by this "unsafe vehicle" (Manzoor, 2014). One news agency story, reproduced by a variety of news sources, described the situation as Delhi's "e-rickshaw crisis" (see Business Standard, 2014). The Times of India (Bannerjee, 2013; Bhattacharya, 2013) succinctly and hyperbolically sums up this sentiment:

> *These slow-moving rickshaws add to congestion, flout traffic rules and freely move on main road, putting commuters at risk…The growing number of e-rickshaws is becoming a traffic menace in the city but all cops can do is watch helplessly (Bannerjee, 2013)*

> *Hundreds of battery-powered rickshaws can be seen ferrying people - speeding down narrow lanes, crowding Metro stations and creating a traffic jam on arterial roads….Neither the transport department, nor the civic bodies are willing to own up to [sic] these battery-powered rickshaws. ...Incredibly, the transport department is blind to the open sale of these e-rickshaws (Bhattacharya, 2013)*

The power and willingness of the authorities to "tame" battery rickshaws is widely perceived as having been curtailed by "sprouting" battery rickshaw operator unions, retailer organisations and the efforts of political parties to mobilise battery rickshaw drivers as a voting bloc. Courting battery rickshaw operators means stalling the introduction of regulations and promising that, when they do arrive, they will be as favourable to operators as possible. Such manoeuvring is seen as a common tactic used to get ahead of one's political opponents in urban "competitive politics" (Sumit Singh, 2014).

The reactions of the middle class and English-language media to the rise of the battery rickshaw in Delhi should be viewed with reference to a wider set of attitudes to what is often termed "informality" in urban India, which includes both occupations viewed as "informal" (such as food vending and street hawking) and "informal" modes of settlement (i.e. *jhuggi/basti* clusters). There is a well-developed literature on elite attitudes towards "informality". The term "informal" has many definitions and is particularly hard to pin down. In this chapter, it will be used to refer to groups of people whose professions are perceived as "informal" in a pejorative sense by the media and the middle classes rather than those who are given the term based on a set of analytical criteria.

Informality is perceived by the media, middle classes and many civil society groups as a disruption of an urban order that is based on a set of "orthodox modernist principles" originating in Europe and North America in the 1960s (Anjaria, 2006). These principles value the clearly delineated single-use spaces of mid-20th century urban planning over the comparatively chaotic, disruptive Indian street with its porous boundaries (which, it can be ventured, more closely resembles the post-modern conception of space). The archetypal disrupters are recent migrants from rural areas who make a living in low-wage occupations. Their employment takes them to the fringes of legality on a daily basis due to the inevitable lack of any number of official permissions and their unavoidable encroachment on public space. They keep this precarious balance between legality and illegality through negotiations with representatives of the local state, such as low ranking police officers. Weekly payments *(hafta)* buy police apathy, but this is not total - the need to appear vigilant means the police must occasionally make a big show of “cracking down” on informal professions. Many informal professions have unions which can cut deals with higher levels of the state (Anjaria, 2011), although they are criticised as “single interest” groups by the media and civil society organisations – groups which advocate solely for the benefit of a certain activity undertaken by their members without consideration for its potential impacts on wider urban society. They can also be courted by political parties. This complex toleration of informality, often involving selective application of the law, has led to the middle classes, media and middle class civil society organisations to claim that the local state and politicians reap benefits from what they see as informal law-breaking. The local state is corrupt and has no interest in doing its job which is seen as holding the latter to the letter of the law; the political realm is dismissed as a “dirty river” - a space of corruption and personal gain with little concern for the public interest or service (Harriss, 2006; 2007).

Seeing the informal disruption of ordered urban space as becoming more marked, better organised and increasingly indulged by the state and political parties, the middle class and middle class civil society organisations (such as those in South Chennai documented by Harriss, 2006, 2007) have come to regard themselves as the sole force for the maintenance of order: “Only five-percent of us keep this city from disaster”, a civil society activist in Mumbai told Anjaria (2009). Fernandes (2004) argues that the middle classes have recast themselves as the new “*aam aadmi*”, the archetypal common man of modest means, typically perceived as battling to make a living in the face of rent-seeking by a corrupt state. However, unlike the traditional common man for whom the ballot paper is the main outlet for expression, the 'new *aam aadmi*' and the civil society organisations which represent their views, seek to control urban space through media channels. With political influence curtailed by the rise of vote bank politics, they increasingly bypass the political process through legal campaigns: going straight to the judiciary, which has been increasingly supportive of what Bhan (2009) characterises as anti-poor actions. Measures to tackle informality are justified by recourse to ideas of the primacy of the law and legality but also increasingly through environmental narratives, which reconstruct informality into an environmental risk: i.e. the clearing of low-income housing is justified as an improvement to public health as it removes from proximity communities without access to sanitation (Ghertner, 2012).

The literature on the Indian middle classes and urban space provides a helpful characterisation of the ways in which those in informal occupations negotiate a place in the city, the prevalent perceptions of informality and the tactics employed to tackle it. It helps situate the following analysis in a wider context.

6.3 A short history of Delhi's battery rickshaw "crisis"

The Motor Vehicle Act (1988) stipulates that any electric vehicle with a power output of more than 250W or a top speed exceeding 25kmph is a motor vehicle and thus falls under the ambit of the local Transport Department. According to a study by TERI University for the Delhi Government, almost all the city's battery rickshaw fleet fall into this category, with power outputs of 650W-1000W (Indian Express, 2014). However, the local Transport Department was not able to register them as the battery rickshaw had not been assigned a classification – a prerequisite for regulation. In short, the authorities did not know what to register them as. The job of designating classifications falls to any one of four state-run technological research institutes under the Central Motor Vehicle Rules, 1989 (Rule 126): the Vehicle Research and Development Establishment of the Ministry of Defence of the Government of India; the Automotive Research Association of India, Pune; the Machinery Testing and Training Institute, Budni (MP); and the Indian Institute of Petroleum, Dehradun (Central Motor Vehicle Rules, 1989). In order to qualify for a classification, any given vehicle model must pass a series of performance tests. Failure means the vehicle is not fit for public roads. The battery rickshaws already on the roads in Delhi had not been subject to these tests, which they would be unlikely to pass due to their low build quality (Agarwal, 2014).

This situation created a paradox: in order to regulate battery rickshaws, they needed to be officially tested and assigned a classification. But the testing would most likely reveal that they were not in compliance with the Government of India’s (henceforth, the Centre) technological standards for road vehicles, which would result in their outright ban on public roads. Conversely, this situation would mean that attempts to bring battery rickshaws under the ambit of regulation using the traditional regulatory means would, paradoxically, push them further from it. This situation resulted in paralysis. Aware of the large numbers of battery rickshaws on the roads, their role in employment generation and the likelihood of failure in technical testing and the consequent ban, the Delhi Government, Transport Department and Traffic Police were loath to take action. However, the Centre stepped in. Citing non-compliance with the Motor Vehicles Act due to power outputs well beyond the 250kw threshold the Ministry for Road Transport and Highways (MoRTH) (at the Centre) issued a ban in April 2014 without demanding tests.

However, battery rickshaws continued to operate, largely due to the logistical difficulties of removing up to 100,000 vehicles from the roads and the unwillingness to do so by local state representatives who were reluctant both to deprive drivers of their livelihoods and to give up the regular informal payments they supplied (Harding and Seram, 2014). In response to their continuing presence, in May 2014, social activist S. Khan responded by filing a petition at the Delhi High Court in May 2014 asking that the ban be enforced if the vehicles could not be regulated as they posed a threat to the public (Iqbal, 2014).

Khan’s petition contains a telling axiom. A ban should be enforced if the vehicles cannot be regulated. It can be argued that whilst the public attitude towards the battery rickshaw was overwhelmingly negative, the focus of that ire was the prevailing use of the vehicle rather than the battery rickshaw as a technology. Controlled and regulated, the battery rickshaw fits neatly into the middle class urban environmental agenda: it is a technological innovation which can be claimed to contribute to lowering emissions from public transportation (whilst leaving emissions from private vehicles out of the analysis). The perception of prolonged failure to regulate their use by the authorities pushed the tide of middle class opinion towards support for the ban. On the supply side, battery rickshaw drivers themselves saw regulation as a double edged sword. It would bring much needed security of ownership and hinted at the possibility of access to credit and insurance markets whilst concomitantly threatening to unleash a Byzantine wave of mandatory documentation (Harding and Seram, 2014).

In June, following the Indian Election of 2014 and the formation of a new BJP-led government at the Centre, the new Minister for Road Transport and Highways, Nitin Gadkari, announced a formalisation scheme for battery rickshaws at a large rally in Delhi organised by a drivers union. The proposed "Deen Dayal" scheme would include a revision to the Motor Vehicles Act (1988) allowing battery rickshaws with power outputs of up to 650W to ply as non-motorised vehicles. This would allow them to operate without commercial licences, which are difficult and time consuming to obtain. Furthermore, battery rickshaws would not be subject to a permit regime, unlike Delhi's auto-rickshaw sector, which between 1997 and 2012 added only a few thousand operating permits despite huge growth in passenger demand. This created a large a lucrative black market for auto-rickshaw permits, which changed hands at massively inflated prices, often up to three times the cost of the vehicle itself. Under the banner of poverty alleviation and to phase out "inhuman" cycle rickshaws, new entrants to the sector would receive soft government loans to purchase Indian made electric rickshaws, which were seen as being of higher quality than Chinese imports (Bhasin, 2014). The proposed scheme was the result of a series of discussions between nascent battery rickshaw retailer associations, driver unions and local BJP officials. However, it later emerged that until 2011, the Minister had been the chairman of the Purti Group, which, among other concerns, included Purti Green Technologies Private Limited, one of the seven Indian companies certified to manufacture battery rickshaws by the Council of Scientific and Industrial Research in 2012. At the time of the announcement of the scheme, the Minister's brother-in-law was the chairman (Mazoomdaar, 2014).

The announcement from the Centre gave few details on how the proposals should be implemented at the local level. Furthermore, the processes of amending the Motor Vehicles Act (1988) would most likely be a lengthy one. The new government had bought itself time by remaining quiet on implementation and ensuring that no action on the scheme could be taken prior to the completion of the amendment process. The announcement of the scheme had boosted its popularity with a large and growing group of urban voters (operators and their dependents) without the need for measurable change in the short term. However, it further complicated the policy situation on the ground as enforcement of the earlier MoRTH ban slackened as the Delhi Government, Transport Department and Traffic Police believed that the Centre was looking favourably on battery rickshaws. This let up prompted renewed judicial attempts to tighten it.

The following month, the High Court heard an affidavit from the Delhi Chief Secretary (a high-ranking Indian Administrative Service officer), SK Srivastava, which called for swift regulation arguing that continued operation was "wholly unauthorised and illegal". The affidavit stated that since battery rickshaws were already covered by the Motor Vehicles Act, creating special amendments for them, as under the "Deen Dayal" scheme, was illegal. It also claimed that, following the intervention of the MoRTH Minister, the Delhi Transport Department had stopped taking action on the matter. Hearing the affidavit, the High Court criticised the Delhi Government for allowing "unregulated transport" to operate in Delhi and demanded that it clarify its stance on regulation by the end of the month. It also stated that battery rickshaws should not be allowed to ply without a licence, registration and insurance. As such, the court stated that the ban must remain in force (Josh, 2014).

August 2014 saw the Delhi Government take efforts to tighten the earlier MoRTH ban, partly in response to the demands of the High Court and partially due to the reaction of the media to a tragic accident in which a child died after falling from his mother's arms into a pan of hot oil on the roadside after she was struck by a battery rickshaw. The media lay almost all of the blame for the accident on battery rickshaw drivers (Times of India, 2014b). Efforts by driver organisations to get the ban lifted, such as the petition filed at the court by the Battery Rickshaw Welfare Association, failed (NDTV, 2014). A further legal attempt by the Centre and the E-Rickshaw Owners Association argued that the ban deprived drivers of income and that the Centre would soon put in place measures to regulate the sector making the current situation a short-term inconvenience. This was also dismissed by the court (Times of India, 2014c).

However, a month later, local BJP leaders were in talks with MoRTH in an attempt to come up with a clear regulatory framework, which would likely enforce new regulations on entrants to the sector, but exempt existing operators (DNA India, 2014). The discussions came after reports that large scale retailers and importers had privately met with the Minister, prompting fears that the final settlement would benefit them rather than drivers (Times of India, 2014d). In response, the leader of the Aam Aadmi Party (AAP), Arvind Kejriwal, accused the Minister of "misleading" battery rickshaw drivers by promising concessions (as part of the "Deen Dayal" scheme) but failing to deliver on his promises. The AAP leader met the Minister with a delegation of battery rickshaw drivers in order to push driver interests in the forthcoming settlement. The involvement of the AAP is significant as the party mobilised large numbers of auto-rickshaw drivers as part of its successful Delhi Legislative Assembly election campaign in December 2013. It won their backing on the promise of delivering favourable policies.

Enforcing the ban proved unpopular all-round. Many drivers had taken out loans to buy their vehicles and were compelled to flout the ban in order to make the repayments, risking fines and confiscation by the police. Furthermore, the absence of regulation put them in a precarious position with regards to vehicle ownership and removed any possibility of obtaining insurance (Harding and Seram, 2014). Retailers and importers lost business; commuters lost the feeder services they had come to rely on; stretched police resources were diverted from more serious issues; and the governing party lost the support of the group it had attempted to mobilise, only to see a political rival take up their cause. The "crisis" stemmed from the failure to come up with any workable policy for formalising battery rickshaws (not to mention one acceptable to all stakeholders).

6.4 Some causes of the "crisis"

6.4.1 Polycentrism

The battery rickshaw case study illustrates the polycentric nature of urban transport policy making (Vaidyanathan et al., 2013). It involves a number of actors none of which have the effective monopoly power over policy. Responsibilities are not clearly delineated and jurisdictions appear to overlap.

The Centre can amend the Motor Vehicles Act to allow battery rickshaws to ply as non-motorised vehicles and with it subject them to relatively light regulation. This policy is justified by the view that battery rickshaws provide affordable transport and create employment for the urban poor. Formalisation and expansion of the sector will reduce poverty, an outcome, which, for many voters, is the source of the government's legitimacy. Being perceived as the provider of livelihoods to a large and growing number of drivers (and their families) is also politically beneficial at both national and local levels. The Centre can attempt to influence the transport policies of the Delhi Government, but cannot make policies at the local level. With a BJP government at the Centre and in Delhi, party structures could be used to exert influence, but this was no longer possible following the landslide election of the Aam Aadmi Party (AAP) to power in Delhi in early 2015. However, whilst the AAP is not aligned with the BJP, both parties share a common policy on battery rickshaws. AAP leader, Arvind Kejriwal, had previously advocated for battery rickshaw drivers under President's Rule (Economic Times, 2014). Fortunately for the Centre, its views find little opposition in the Delhi Government itself (under the BJP or AAP) and its relevant administrative arms: the Transport Department and Traffic Police, both of which have some grasp of ground realities: the enormity of the task of removing battery rickshaws from the roads and the potential impacts on urban transport and livelihoods.

The main opposition to this enthusiastic embrace of the battery rickshaw comes from the judiciary, which has consistently questioned the legality of such a move and steadfastly upheld the ban with constant recourse to the law, the source of its legitimacy. It has even rapped the Delhi Government for its poor enforcement of the ban, which leaves the local state trapped between the Centre and the judiciary. The latter's position is powerful: it is able to enforce its view by supporting the ban, based on a petition by a single social activist, while dismissing a petition to the contrary by the Centre. However, its power is severely checked by the willingness and capacity of the Delhi Government to carry out its writs. Battery rickshaw unions and retailer-importer organisations represent further centres of influence, however, unlike intra-state relations, their membership, roles, responsibilities and connections are unknown. The influence of large scale manufacturers, importers and retailers on future policy in this area is hard to ascertain as any discussions with the state, as described by the Times of India (2014d), are private. The emergence of these organisations and their close ties to the Centre also allowed other political groups, notably the AAP, to attempt to hijack the Centre's claim that its legitimacy with regards to policy making in this field is based on poverty alleviation. Claiming that vested interests are preventing a pro-poor policy enabled the AAP to make political capital by claiming to represent driver welfare. Both could be accused of playing 'vote bank' politics: appealing to drivers as a community with common interests which can be played to in order to secure their support.

The above gives rise to a situation similar to the one characterised in the opening section. For the media, the judiciary is the only body willing to throw the full weight of the law at the burgeoning battery rickshaw fleet whilst political bodies court the law breakers and administrators wash their hands of the situation. Whilst there are multiple centres, Partha Chatterjee's (2004) concepts of the 'political society' and 'civil society' may provide some analytical clarity by categorising these multiple centres in terms of the way in which each connects to the state.

Battery rickshaw drivers and driver unions fall on the 'political' side of the dichotomy. Their demands are usually based on communal welfare and security. They make these claims "not within a framework of stable constitutionally defined rights and laws, but rather through temporary contextual and unstable arrangements arrived at through direct political negotiation" (Chatterjee, 2008). They articulate their demands using agitations and complex local and national urban politics. Components of the 'political society' are constituted as communities by the state through the recognition of their common interest (i.e. in better welfare), which provides a useful leveraging point for winning communal support.

'Civil society', by contrast, describes the middle class and elite groups which base their claims on the concept of equal rights for all citizens as individuals. They avoid politics, which is seen as abandoning the equal rights principle in order to privilege the claims of certain communities in order to win their support. Instead, their interests are articulated through legal activism, namely, through petitions to the law courts, which are perceived as the last remaining arena of objective, non-political governance. The intervention of S. Khan and SK Srivastava could be seen as examples of this latter strand. The entanglement of both strands around a single policy issue, such as battery rickshaws, gives rise to a situation in which different actors make contrasting claims in divergent ways. Without a monopoly power, the result is an antagonistic struggle of claim and counterclaim, ruling and counter ruling. However, whilst this multiplicity of actors gives rise to raucous debate and inertia, it should not be claimed that assigning power to legislate on the matter to a single authority constitutes a viable alternative. Vesting authority in the courts would mean legislating on the issue using laws which were written prior to the development of the technology involved which would ultimately result in prohibition: another 'anti-poor' ruling, to use Bhan's (2009) terminology that would have implications for urban livelihoods. Similarly, side-lining the courts would place the matter in the midst of a maelstrom of political interests which would not necessarily prioritise driver and public welfare.

In short, the battery rickshaw case study involves a number of actors, who justify their stances differently: the judiciary with reference to the law; the Centre and Delhi Government with poverty alleviation, challenged by political opponents; the Transport Department and Traffic Police with a combination of poverty alleviation and pragmatic concerns; and social activists with public safety and the law. The 'political-civil society' framework helps to clarify this confusion by focusing on actor-state connections. Overall, no single actor has monopoly power, despite the existence of established hierarchies (i.e. local and central government). This results in a situation in which no single ruling on the case is decisive - each is open to question, appeal and simple noncompliance by other actors. Furthermore, the rulings themselves frequently stem from claims which are not based on sufficient empirical data.

6.4.2 "Paucity of data"

At its simplest, there is no accurate data on the number of battery rickshaws in Delhi. A Transport Department official admitted (under the condition of anonymity) that "at present, we do not even know how many electric rickshaws exist in Delhi" (Chhabra, 2014). The figure of 100,000 is often quoted, but this is an estimate: it is not based on any official count. Nor can it be, as there is no systematic record of any data relating to battery rickshaws numbers, operator characteristics or vehicle performance in Delhi, aside from the small study by TERI University that sampled just 53 vehicles and was not made available for public scrutiny.

This lack of data means that claims relating to the vehicle are hard to substantiate. For example, the petition made by S. Khan argues that battery rickshaws are unsafe. It blamed the vehicles for two deaths and cited 137 cases of “rash driving” from police records (Garg, 2014). However, without total numbers and operating data (from which to estimate trip numbers) the number of fatalities per passenger kilometre is unknown, which makes any claim about it being an unsafe vehicle or predominantly dangerously driven highly speculative. To the contrary, the nearest equivalent to the battery rickshaw is the auto-rickshaw, which also acts predominantly as a relatively low-speed feeder service. The auto-rickshaw has a significantly lower pedestrian and cyclist death rates per kilometre than cars and motorcycles (Mani et al, 2012). Similar problems are associated with claims about the vehicle’s environmental benefits: little is known about the power sources used to recharge the batteries, the longevity of the vehicles, the durability of the batteries and the arrangements for disposal of the lead acid.

This “paucity of data” characterises the Indian state’s relationship with the “informal” or “unorganised” sector (Breman, 2010): typically small, often single person enterprises, which do not pay taxes or adhere to labour laws. Seen by the state as outside its ambit, little effort is made to collect data as a basis for guiding policy making or holding it accountable to its failures. As such, policies relating to “informal” or “unorganised” occupations tend to be archaic because, without regular data collection, there is little recognition of changing ground realities. As a consequence of the gap between *de jure* regulation and *de facto* everyday operations “one should not assume a direct relationship between the letter of the law and how the law works in practice” (Anjaria, 2006). This principle is illustrated in an article on Delhi’s cycle rickshaw sector. Ashima Sood (2012) argues that the 1960 Cycle Rickshaw Bylaws, which governed the sector largely unmodified until 2012, were a “marvel of over regulation”, which created a “series of nearly insurmountable hurdles” for operators and “choked the sector it purported to regulate”.

The Act capped the number of cycle rickshaws in Delhi at 750 in 1960; 20,000 in 1975; 50,000 in 1995 and 99,000 in 1997. However, despite strict limits imposed by the High Court, there were around 600,000 in 2006. The local state was simply unwilling to police the cap by removing 'illegal' rickshaws from the streets. The ban on battery rickshaws has been similarly patchily enforced.

6.5 Concluding thoughts

This chapter has argued that polycentrism and a lack of data are major causes of the battery rickshaw "crisis" in Delhi. The absence of a clear mechanism through which to make policy in this area combined with a dearth of accurate quantitative information on battery rickshaw operators, operations and technology gives rise to a chaotic situation in which multiple, often highly polemic, claims are made to numerous sources of authority based on different logics, but contain precious little analytical rigour.

Relating to the policy making process, the "crisis" relates to the formalisation of an informal sector, however, the nature of the state's response to the rise of the battery rickshaw could itself be called informal. Roy (2007) argues that when an object or profession cannot be tightly mapped onto existing regulations or the law, then "here the law itself is rendered open-ended and subject to multiple interpretations and interests". In this context, the boundary between 'legal' and 'illegal' is constantly changing, as Ghertner (2008) points out, most of Delhi is informally constructed - without all the necessary planning permissions, but only certain parts are deemed 'illegal' (i.e. *jhuggi* clusters). The setting of this boundary is negotiable at all levels. It is without solid base in codified laws and regulations. In this sense it is informal. In the battery rickshaw case, it is negotiated at the local level through police apathy or payment-seeking and at the national level through the willingness of the Centre to exempt battery rickshaws from the possibility of inclusion under the ambit of long-standing government acts, mobilising what Roy calls "unmapping" - going against its own rules to create a state of exception. As the complex urban environment means existing, often archaic, laws seldom mesh tightly to new phenomena or developments, the state is free to create a new boundary between legality and illegality based on its interests and those of a multiplicity of actors, unbound by legal prescriptions. As such, Roy contends that informality is the norm in Indian urban planning; formal processes are mere "fleeting fictions".

However, an informal policy making environment, as described by Roy, does not necessarily mean it is wracked with erratic decision making, just as adherence to formal laws does not necessarily deliver functional policies. Formal laws may be archaic and not accurately reflect ground realities, whilst the informal negotiating process, which forms the base of policy making, will most likely not make completely arbitrary decisions. Its task it to find a compromise between competing claims, an undertaking which still has use for accurate, systematically collected data. In cases like the battery rickshaw "crisis", there is little that can be done about the polycentric nature of the policy making environment short of attempting to understand its constituent parts and their motives and interactions. Despite this, there is still ample opportunity to improve the functionality of policy making in this case by collecting, analysing and disseminating data which may go some way towards improving on the current informational vacuum in which the veracity of claims from numerous competing actors cannot be weighed.

Chapter 7: Conclusion

7.1 Introduction

This conclusion begins by offering a series of eight policy recommendations for pratransit in Delhi. Whilst paratransit is a local phenomenon and policy recommendations for one urban area cannot be exported wholesale to another, the precise recommendations may be specific to Delhi, the use of fare meters, permit systems and the existence of auto-rickshaw unions across India suggest that these recommendations may act as starting points for research in other cities.

It then attempts to place the study into a wider context - that of the approach to urban planning in India - by using the literature on the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) to argue that a technical, purportedly objective approach to urban transportation is currently dominant in Indian cities, one which is incapable of dealing with the paratransit sector. In order to remedy this situation, urban transport planning must modify its approach in order to engage with the many thousands of paratransit operators. The chapter argues that this study has attempted to utilise this approach.

7.2 Policy recommendations

7.2.1 Formal sector financing

The need for formal sector financing for the purchase of auto-rickshaws is closely related to the meter tariff. The meter fare stipulates what a driver can charge for any given trip (justified by arguments discussed in chapter 2), which effectively caps his revenue. However, whilst revenues are capped and reasonably consistent across drivers, there is considerable variation in cost structures between drivers who rent their vehicles, those who have purchased an auto-rickshaw and are repaying a loan, and those who own their vehicles outright (see chapter 3). This variation in costs means that it is practically impossible to set a meter rate that adequately compensates all drivers and maintains the auto-rickshaw's price point in the paratransit market, a problem encountered but not directly acknowledged by the Delhi Transport Department (see chapter 1). If revenues are to be determined by a single tariff structure which is to compensate all drivers sufficiently then the variation in costs must be reduced. Owning outright appears to be most desirable: costs are lowest (maintenance and fuel only) and net income is highest (see chapter 3). It also allows for increases in the meter rate to be passed on directly to the driver as opposed to the non-driving owner in the form of rent.

Currently, the process of purchasing an auto-rickshaw involves considerable risk. Informal financiers often indulge in illegal practices contrary to the interest of the driver (see chapter 2). Large monthly repayments cut net incomes to very low levels, which leaves the driver vulnerable to default in the event of unforeseen circumstances, such as family expenses (i.e. medical) or major repairs to the vehicle (i.e. replacing key parts).

Formal sector financing is crucial to facilitating this shift towards outright ownership. Formal financial institutions are likely to charge lower interest rates, leading to smaller instalments, which reduce the default risk and improve the driver's ability to withstand financial shocks. Furthermore, formal lenders would perform functions actively avoided by informal financiers, such as ensuring clients understand the terms of the loan and the contents of the documents being signed. In contrast to informal financiers – who are usually also the vehicle retailer – formal financiers do not stand to gain from default on the loan. Data on loans and repayments collected by these financial institutions could be shared with the regulators, making costs more transparent.

However, any formal lending entering the auto-rickshaw market faces a series of challenges: recovering and liquidating a mobile and depreciable asset may prove difficult; the creditworthiness of auto-rickshaw drivers may be hard to assess; and documentation requirements may have to be loosened. All these factors have the potential to raise interest rates. Similarly tricky is the size of the loan: at around two lakhs it is too large to qualify as micro-finance according to rules set by the Reserve Bank of India, which limits a single loan to Rs.1 lakh (Nair, 2015), yet is relatively small for most commercial banks. Furthermore, group-lending models may fail to work amongst auto-rickshaw drivers – who are geographically fragmented;

there are also few existing organisations through which to route loans (Harding and Hussain, 2010); and the purchase of an auto-rickshaw requires the full amount to be paid to the retailer up front which means trust and credit history cannot be built up through a series of smaller loans. As a result, formal lenders entering the auto-rickshaw market may require state backing.

7.2.2 Open permit systems

Determining the number of vehicles in any paratransit sector is a difficult, often politically motivated process. Large amounts of reliable data are required and incumbent interests may seek to influence the process, as seen in many taxi markets (see Proctor, 2014 for detailed example). The Significant Unmet Demand calculations used to determine the number of new permits needed are difficult to perform and are frequently inaccurate indicators of latent demand (Kohler, 2008) (see chapter 2). However, for the past two decades, the Supreme Court has determined auto-rickshaw numbers in Delhi without recourse to such calculations. It froze permit numbers in 1997, stating that no new auto-rickshaws would be allowed onto the roads until an alternative to 2-stroke petrol engines could be found. The cap was finally lifted in 2012 when the Supreme Court ordered 100,000 new permits to be issued.

The court's first intervention gave rise to a black market for auto-rickshaw permits, which saw permits become more valuable than the vehicles themselves, greatly inflating operating costs for drivers, which effectively concentrated capital in the hands of non-driving owners and financiers at the expense of drivers and passengers. The court's 2012 ruling appeared to be based on ad hoc figures rather than any empirical data on supply and demand, and whilst it did go some way to reducing permit prices, in refusing to lift the cap in perpetuity, it simply inspired new forms of graft which have ensured that permits remain a significant capital expenditure. In short, the Supreme Court has no way of assessing the number of auto-rickshaws the city needs: it has neither the data nor the expertise. The relationship between supply and demand is hard to capture. It is especially difficult in the auto-rickshaw sector as reliable data on operating economics and the daily activities of massive numbers of individual operators is largely unavailable. With this in mind, the priority for regulators should be to avoid creating such black markets for permits, which inflate costs and effectively reduce market entry to the ability to pay – an ability intrinsically linked to exploitation by informal lenders. As a precautionary principle against the establishment of a black market, permits should be uncapped.

The risk of creating a black market outweighs the standard arguments against open permit systems, which cite externalities as the basis for their opposition, particularly regarding pollution and congestion. These can be dismissed as follows: auto-rickshaws in Delhi are powered by 4-stroke CNG engines, which have lower emissions than many private vehicles. Furthermore, a large and readily available auto-rickshaw fleet has the potential to lower air pollution and congestion by reducing private vehicle use and facilitating mass public transport. Moreover, even under an open permit system, auto-rickshaw numbers are likely to remain dwarfed by PMVs: currently, the city's 89,000 auto-rickshaws share the roads with around 6 million private cars, motorcycles and scooters (Government of NCT, 2016). On the road, the physical footprint of an auto-rickshaw is a third to a half that of a private car.

Further justification for open permit systems comes from the entry of ride-aggregators, such as Uber and Ola, into the Indian market. The inability of the Transport Department to regulate these new entrants, including controlling their numbers, effectively creates an unregulated open entry taxi market, which essentially offers passengers taxi trips for not much more than auto-rickshaw rates. If auto-rickshaws (over which the transport Department has jurisdiction) are to compete with ride-aggregators (on which its grasp is uncertain) then issuing permits openly is necessary step to balancing the frame of competition.

7.2.3 Regular fare revision

At present, with the exception of Mumbai, no Indian city has a standardised formula or timetable for fare revision. Most cities revise their fares on an ad hoc basis using a new calculation each time. Long periods can pass between revisions during which inflation can significantly increase the costs of operating the vehicle. This puts downward pressure on the already modest incomes of drivers. Often the meter rate fails to provide decent compensation to the point that it is replaced by haggling, a process that is perceived as "overcharging" by passengers. Revision then occurs, typically on an antagonistic, often political footing with auto-rickshaw driver unions agitating for a large fare hike while the media and middle-classes rally against them, angered by what they see as a reward for months or years of "overcharging" by drivers (Bhat, 2012).

This situation can be avoided through the implementation of a standardised fare revision system comprising a time table for revision (i.e. annual, biannual etc.) and a tariff formula based on capital, maintenance and operating costs, a living wage and daily operations. Provisions should also be made for spikes in costs that occur between fare revisions: I.e. sudden dramatic increases in fuel prices or costs relating to regulatory interventions that require the purchase of specific goods and services, such as new meter technologies etc. It should also include a time component (see below).

However, the impact of this recommendation relies on the implementation of recommendation 7.2.1 regarding formal financing. Regular fare revisions will not tackle overcharging or improve driver incomes if the fare calculation must still incorporate the diverse sets of costs faced by renters, indebted owners and outright owners. Likewise, an auto-rickshaw sector with a large majority of outright owners is still vulnerable to overcharging without regular fare revision. In this sense, 7.2.1 and 7.2.3 are interlinked.

7.2.4 Time-based component to the fare meter

In addition to regular fare revision, the fare meter must be revised to include a time component. Presently, time-based compensation is only awarded for stops requested by the passenger and even then the charge is Rs. 30 per hour, which merely covers capital costs (see appendix E). There is no compensation mechanism for short trips with long durations, such as trips taken during periods of congestion - typically at peak times. This provides incentives for overcharging and refusal as drivers attempt to factor congestion effects into their fare demands (see chapter 4). However, pricing occurs *ex ante*, meaning that drivers cannot accurately price for congestion that they have not yet encountered (they cannot forecast the delay prior to departure). At peak times when demand for mobility surges and waits between passengers shorten, there is an incentive for drivers to overestimate these congestion related delays.

Likewise, if a congestion-related delay occurs unexpectedly, then the driver has incentive to drive recklessly in an attempt to maintain his cost-revenue ratio. This may involve driving on non-motorised vehicle lanes and footpaths. There may also be an incentive to attempt to recoup lost earnings from subsequent passengers.

As discussed in chapter 4, there are several options for incorporating journey time into the meter fare calculation. This study leans towards a simple surcharge that kicks in as soon as the vehicle is stationary. However, this remains tentative until further empirical investigation is carried out.

Recommendations applicable to both auto-rickshaws and battery-rickshaws:

7.2.5 Simplify documentation requirements

As outlined in chapter 2, operating an auto-rickshaw carries a heavy administrative burden. Drivers must carry ten documents with them at all times. The application process for each of these documents involves multiple supporting documents, many of which are difficult to obtain (i.e. address proof for a room rented in a *jhuggi*) or hard to locate (i.e. school certificates issued decades previously in a different state). Applicants are usually able to compensate for less crucial missing supporting documentation (i.e. address proofs) with small bribes to low-level Transport Department officials. These bribes are relatively small (Rs. 100-300).

When responding to questions about the Transport Department, drivers described an atmosphere of opaque obstructionism, in which documentation requirements would change without notice and additional rules would suddenly come into force. Completing administrative tasks took several visits, drivers reported, costing several days income. This suggests an administrative system attempting to extract rents by making compliance overly difficult by quickly and secretively changing the requirements.

Reforming the administration of auto-rickshaws in Delhi involves two aspects. Firstly, the documentation requirements need to be standardised: they must be consistent and readily available, preferably in Hindi. Secondly, the newly standardised requirements must be simplified to make compliance easier. They must take into account the ability of applicants to bear a regulatory burden. As such, elements such as the proof of address, medical exam and 8^{th} grade school certificate are all easily identifiable candidates for removal.

However, the issues outlined above are not exclusively associated with the Transport Department. The Transport Department works closely with a number of other agencies to govern the paratransit sector. It is not immediately apparent where its authority lies vis-à-vis the minutiae of auto-rickshaw administration: i.e. which regulations are required by other entities, the judiciary or other arms of the state, and which are solely its prerogative. Therefore, the simplification of documentation may necessitate a wider approach, involving numerous entities.

Similarly, low-level graft seeking behaviour is not unique to the Transport Department, but is widespread across the Indian state whose decentralised structure results in fragmented, unstable, constantly changing graft seeking behaviour (Bardhan, 1997). Policy responses include reducing incentives, increasing wages for public servants and, as argued here, removing superfluous regulations as a practical first step (Bardhan, 2006).

The task for paratransit regulation in urban India is two-fold. It must set levels of documentation that are realistic for groups operating then paratransit mode in question, else bribe seeking is likely to ensue. It must also ensure that the regulatory burden falls at the appropriate level across all modes of paratransit; otherwise there will be considerable incentive to invest in less regulated modes if that lack of regulation leads to profit. Channelling investment into less regulated modes will ultimately increase the portion of paratransit operation outside the ambit of regulatory oversight.

7.2.6 Labour mobilisation

Chapters 5 and 6 exemplify the need for labour mobilisation in the paratransit sector. They show that policy changes beneficial to paratransit operators can be brought about through political channels via mechanisms associated with "political society" (Chatterjee, 2008) described in chapter 6 in which low-income groups articulate their demands by way of direct appeals to local politicians, whose recognition of those demands constitutes the group as a voting bloc. The success of this mechanism, as described in chapters 5 and 6, goes against the idea of urban planning as an objective, technical sphere; the sole preserve of experts, technocrats and the judiciary. Instead, it shows it to be “polycentric” - contested by multiple actors each with their own mandates, constituencies, jurisdictions and sources of authority. As such, this is less a recommendation for policy makers and more a reiteration of point of action long known to NGOs and labour activists.

More specifically, going beyond mobilisation as a voting bloc, paratransit operators would benefit from the formation of their own unions for two broad reasons. Firstly, without their own representative entities, paratransit operators may be mobilised by political parties, but may subsequently struggle to hold their political patrons to account regarding their pledges: i.e. despite successfully mobilising auto-rickshaw drivers as a voting bloc, the AAP municipal government is widely considered by drivers to have delivered on few of its pre-election promises. This reliance on electoral politics also limits the potential for reform to the political cycle. Thirdly, lacking representative bodies, the task of representing the interests of paratransit operators is left to a variety of groups which have significant investments in the sector, such as retailers, financiers and fleet operators. Their interests may align well with those of drivers, such as in the case of battery-rickshaws, in which quick formalisation on concessionary terms without a permit system was mutually desirable, allowing drivers to continue to operate whilst placing no limits on sales. However, interests can also run counter to one another, as in the auto-rickshaw sector where financiers, as holder of multiple permits, long had a vested interest in maintaining the permit cap and inflated black market prices that had made outright ownership difficult for drivers.

The process of unionisation has proved difficult in Delhi's paratransit sector. Unionisation efforts may be met with apathy by migrant drivers who feel they have little stake in the city and by those who have witnessed the failure of previous attempts (as in the cycle-rickshaw sector). This has occurred in the auto-rickshaw sector, in which multiple unions offer members little more than access to reasonably effective touts/fixers at the Transport Department. Anecdotal evidence recounted by some older drivers and local NGOs suggests that auto-rickshaw unions were significantly stronger in the 1970s and 80s when Punjabi Sikhs were the dominant driver group. Many were from families that had lost their land in the Western Punjab following the Partition. With nowhere to return to they became entirely invested in their new home city and were active and bullish in their attempts to improve their position within it. As this group became more established, it improved its socio-economic position and moved away from auto-rickshaw driving. Its place was filled by Bihari workers who, as migrants with land and families back in Bihar, felt little tie to the city and, like migrant cycle-rickshaw pullers, had little time for unions, preferring instead to accept temporary hardships and focus on remittances and their eventual departure. However, as Bihari auto-rickshaw drivers follow their Punjabi predecessors and put down roots in the city, their potential for mobilisation increases, as seen in the temporary mobilisations performed by the AAP prior to the Delhi Legislative Elections. Only 4.3% of the auto-rickshaw drivers sampled in chapter 3 had children residing outside of Delhi.

As argued above, the "techno-managerial" approach cannot engage with the paratransit sector. The sector's best chance to influence policy comes through the "democratic" approach – by becoming a force in the "dense substrate of social and political networks" (Gopakumar, 2015) with which municipal and national politicians must deal. Their ability to make their demands both heard and implemented in this sphere is to form lasting representative bodies which persist beyond the cycles of electoral politics.

7.2.7 Limit judicial involvement in paratransit regulation

As outlined in detail in chapter 6, the formalisation process through which battery-rickshaws passed was protracted and highly uncertain. This resulted in considerable anxiety for drivers who could not be sure of continued permission to operate, which jeopardised their ability to recoup their investments. During this period of uncertainty battery-rickshaws operated outside of the ambit of regulation. This status effectively prevented them from obtaining insurance, which further increased the risk to their investments. It also prevented drivers from proving ownership of their vehicles, a prerequisite for lodging a case with the police. This provided ample incentive for theft. For passengers, the process created confusion: bans, albeit poorly enforced, continually threatened the cheap, readily available vehicles on which they had come to rely.

The long and often chaotic nature of the formalisation process was closely related to the polycentric structure of urban transport governance in Delhi (as described in chapter 6). No single organisation had monopoly decision-making power over the process, which resulted in multiple actions and counter-actions from a number of sides with overlapping jurisdictions, each with a different claim to legitimacy, such as the law, poverty alleviation or administrative pragmatism. The majority of actors looked favourably on the battery-rickshaw and pushed for formalisation on concessionary terms: i.e. the GOI, Delhi Government, local political parties, the Transport Department and Traffic Police. However, the process was repeatedly hindered by judicial attempts to ban the vehicles. This represents the continuation of a longer term trend of increasing judicial involvement in urban planning decisions as a mechanism through which middle-class interests can circumvent the political realm. These judicial rulings relating to urban issues have become increasingly “anti-poor” as the ideas of the “public interest” reworked along aesthetic lines (Bhan, 2009; Ghertner, 2011) – a conception of the city into which the mass of battery-rickshaw operators does not fit. A similar middle-class green agenda lay behind the Court’s imposition of the cap on auto-rickshaw permits in 1997 (see above) (Baviskar, 2003; Veron, 2006).

The battery-rickshaw case study suggests that influence of the judiciary in paratransit policy should be curtailed. Existing laws and regulations fail to keep pace with technological changes in paratransit, such as the use of battery powered vehicles. The judiciary rules on emerging technologies based on existing frameworks, which may predate the technology in question by several decades, or simply envision a very different role for it, perhaps based on the technology’s earlier capabilities and limitations. Consequently, new technologies risk being quickly ruled illegal by the judiciary. The changes in the law required to reverse such a ruling are long-winded. In the meantime, the operators of that technology, in this case paratransit operators, are locked in an untenable position, having made capital investments with an uncertain future. This position is all the more difficult as many paratransit operators are individual owner-operators, often the sole wage-earner in the household, who may rely on family savings to finance their vehicles.

The process of incorporating new paratransit technologies within the regulatory framework should be forward looking – as opposed to relying on recourse to existing regulations. It should be based on an understanding of the role the new entrant plays in the urban transport system in terms of both supply and demand. The focus should be on the swift formalisation of the new technology, especially if low-income groups rely on it for their livelihoods. Operator unions, their political backers and administrators, such as the Transport Department and Traffic Police are in a better position to complete this task due to their understanding of the everyday realities of paratransit operation.

7.2.8 Data collection

At present there is little available data on auto-rickshaws and battery-rickshaws. Recent fare revisions have relied upon the regulator's own best estimates and figures put forward by auto-rickshaw unions, the accuracy of which is unknown. Data should be collected on capital and operating expenditures, revenues and daily operations for both modes. It would provide accurate information on the costs, revenues and incomes of operators, which would feed directly into fare revisions. It would also show the ability of operators to bear the burden of any new regulatory intervention, such as mandatory technological improvements. Such data could be collected direct from any formal sector lenders working in the sector (see 5.1) or in periodic driver surveys which could be carried out at the Transport Department, whose role as regulator provides it with a captive sample.

This section has given a series of detailed recommendations for the auto-rickshaw and battery-rickshaw sectors in Delhi. The remainder of the chapter will attempt to place these sectors within the wider context of urban transport planning in India, beginning with India's flagship urban renewal project, the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). It will argue that paratrasit modes (along with walking and cycling) are neglected by the current approach to urban transport planning, which is unable and unwilling to engage with them, a predicament which requires a significant shift in approach.

7.3 The JNNURM and two approaches to urban planning

The Indian economy grew at an annual average of 8% during the Eleventh Five Year Plan period (2007-2012). The majority of this growth (over 60%) came from the urban sector. However, investment in urban infrastructure lagged significantly behind the national economic growth rate (Kundu, 2014). Consequently, the poor quality of urban infrastructure came to be seen as a restriction on urban, and ultimately, national economic growth.

The JNNURM was launched in 2005 by the GOI as the large scale mechanism through which to tackle this urban infrastructure problem. It would rejuvenate India's urban areas by improving infrastructure and raising the living standards of the urban poor. Both interventions aimed to accelerate economic growth. The JNNURM contained four main project areas. Two areas, the programmes on Urban Infrastructure Governance (UIG) and Basic Services for the Urban Poor (BSUP), targeted India's 65 largest cities (titled "mission cities" in the JNNURM's terminology). A further two projects focused on small and medium sized towns and cities, which typically suffered the most severe infrastructure issues and the highest levels of poverty. These are the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) and the Integrated Housing and Slum Development Programme (IHSDP).

However, JNNURM contains a key tension between the dual imperatives of infrastructure development and poverty alleviation. It is most marked in the two programmes aimed at "mission cities" – the UIG and BSUP. It has been argued that the existence of different programmes for infrastructure projects (UIG) and services for the poor (BSUP) suggests a "segregationist logic" that separates out reforms for the poor as its own category (Coelho and Maringanti, 2012). This separation demonstrates the two competing agendas and the type of developments they prioritise for urban India (Mahadevia, 2011; Gopakumar, 2015).

On the one hand, there is the elite vision of the city as an ordered, rational space, planned by seemingly objective experts according to technical principles. This vision perceives the JNNURM as an opportunity to implement high-profile projects which increase the city's prestige, typically by utilising a technology or form of infrastructure that has been rolled out in major cities in Europe or North America. The ultimate goal of these projects is to transform the hitherto out-dated Indian city into a “global city”, comparable to its overseas equivalents, and capable of attracting both domestic and international investment (Mahadevia, 2006). The type of projects this entails, states Mahadevia (2011), “are a kind of fashion statement for cities, sold to the upwardly mobile who aspire to bring the Seine promenade to Ahmedabad or the Shanghai skyline to Mumbai”. This narrative perceives urban governance as a technical exercise that must be streamlined in the interests of efficiency and productivity (Gopakumar, 2015). It has little patience for the political aspect of the planning process, which involves “messy” negotiations between local political actors and their constituents. Political involvement is perceived as encroaching on the objective, scientific, domain of urban planning. With regards to the JNNURM specifically, this “techno-managerial” narrative (following Gopakumar (2015)) typically champions high profile projects under the UIG programme, most notably urban transport projects centred on private motor-vehicle use, such as flyovers, ring roads and grade separation. This agenda is associated with the Ministry of Urban Development (MOUD) (Mahadevia, 2011), which is responsible for projects under the UIG programme.

In contrast, on the other hand, a second agenda sees the city in terms of substantive democracy. Whilst Indian cities contain vast inequalities of wealth, the electoral calculus (the large number of low-income voters and their tendency to use their votes) tips the political balance in favour of the urban poor. As a consequence, political parties must court the votes of low-income groups in order to win power, a process that involves recognising and responding to their demands for better housing, sanitation, electricity, secure land tenure and access to state resources. This leads to a conception of urban governance as the outcome of informal negotiations with a “dense substrate of social and political networks” (Gopakumar, 2015), one that explicitly represents the interests of certain groups without recourse to the rhetoric of objectivity and technicality, or claims regarding the impact of a project on the city’s international image. The BSUP programme reflects this second “democratic” agenda (again, following Gopakumar (2015)), mostly in the form of housing, water and sanitation, which are the responsibility of the Ministry for Housing and Urban Poverty Alleviation (MHUPA).

There are significant differences in the funding allotted to the UIG and BSUP programmes. A total of Rs. 123,711 crore had been invested in the JNNURM as of January 2014. The BSUP programme received Rs. 22,659 as of April 2012 (the most recent data released by the MHUPA) (MHUPA, 2016). A total of Rs. 63,126 crore had been allotted to the UIG programme, as of January 2014. It appears that the former, “techno-managerial”, agenda dominates the “democratic” agenda.

To recap, the literature on urban development in India argues that the JNNURM contains a tension between two competing agendas, and the elite “techno-managerial” agenda appears to prevail. The remainder of this chapter will extend this idea by arguing that this tension is not limited to the JNNURM, but is also evident in the narrower confines of urban transport planning in India. It will argue that urban transport planning has reflected an elite vision of the city – one similar to the “techno-managerial” agenda outlined by Gopakumar (2015) - that has privileged private-motor-vehicle related infrastructure and prestige mass transit projects, such as metro rail systems over a more "democratic" approach. This latter approach recognises both the transportation needs of the urban poor and the role of urban paratransit as a provider of employment. The following section will first provide an account of two aspects of the elite vision of urban transportation: private-motor-vehicle centric planning and the proliferation of metro rail projects in Indian cities, both of which, it will argue, are approaches imported from Europe and North America with significant negative consequences. It will be broad, brief and illustrative rather than comprehensive. It will then argue that if metro systems are to succeed, then paratransit is needed to provide "last mile connectivity" (Mani et al., 2012). But paratransit services have long been neglected by policy-makers. If they are to deliver both an acceptable service to passengers and provide decent livelihoods then reforms are necessary.

7.4 "Techno-managerial" planning

The Indian economy was "liberalised" in the early 1990s. Liberalisation, a process brought about with IMF involvement following a balance of payments crisis, began with the financial sector but eventually broadened to include the scrapping of state controls on production - the infamous licences of the "licence Raj" era. The automotive industry was a major beneficiary of liberalisation. Free from production controls, it could now create a diverse range of vehicles for the expanding and increasingly affluent middle-class market (see chapter 1). As the automotive sector began to grow it came to be seen by the government as a key driver of economic growth, one that should receive favourable policies on the supply side (i.e. easing local ownership requirements) and, more importantly for this chapter, on the demand side in the form of an approach to urban transport planning that favoured the private motor-vehicle. Consequently, the current approach to urban transport planning has largely focused on building infrastructure for the private motor-vehicle with the aim of tackling worsening congestion through both increasing the supply of road space, and providing faster routes to different parts of the city for those with cars or two-wheelers, often at great public expense (Badami, 2009).

A brief examination of JNNURM spending under the UIG programme illustrates this focus. Manchala and Vagvala (2012) estimate that by 2011, a total of Rs. 14,083 crore had been allocated to urban transportation projects under the JNNURM. Projects to build flyovers, parking infrastructure and improve roadways accounted for 57.7% of this total. Kundu's (2014) analysis of spending patterns under the JNNURM's UIG programme shows that the 65 "mission cities" spent 22.3% of their funds on roads and flyovers, a figure beaten only by water projects (37.2%) and sewage (23.3%). Funding under the UIG also shows a "big city bias" with the seven "mega cities" receiving more funding per-capita than smaller cities. The city-wise breakdown also reveals considerable variation in spending on private motor-vehicle infrastructure between the "mega cities". Delhi spent 78.3% of its funding on roads and flyovers, Bangalore spent 57.5% and Ahmedabad 45.2%; Kolkata, Mumbai and Chennai spent considerably less, although this does not preclude large road building projects in the latter three cities as funding for road infrastructure can come from multiple sources (i.e. central and state governments, public-private partnerships etc.) This trend looks set to continue. The MOUD (2011) estimates that urban growth will require a total investment of Rs. 31 lakh crore, if urban infrastructure is to keep pace, of which, 56% is earmarked for urban road construction. Urban areas will be the site of "massive on-going and future road construction activities". Urban transport will receive an estimated 14.5%; sewerage 8%.

Private-motor-vehicle related developments are also highly visible in the urban landscape. Road infrastructure developments typically take the form of flyovers, road tunnels and high-capacity roads, often called expressways, which often feature both flyovers and tunnels, and usually deny access to buses, paratransit, non-motorised vehicles and pedestrians, such as Mumbai's Rs. 1, 436 crore Eastern Freeway (funded by the JNNURM's UIG programme). A large number of flyovers have been constructed over the past two decades, 82 of them with JNNURM funding (Manchala and Vagvala, 2012), and the rate of construction appears to be accelerating. Delhi has 90 flyovers, 25 of which were built in 2009-2014; 23 more are planned by 2020. Hyderabad has 16 flyovers under construction to add to the 40 currently in operation. Even smaller cities are building flyovers in an attempt to deal with congestion: Surat (far smaller than India's mega cities, with a population of 3.1m) currently has 6 operational flyovers, but has 37 planned, over three-quarters of all new bridge constructions in the city (Thomas, 2015). Surat is, according to one article, destined to become a "city of flyovers", a term which is not meant in the pejorative sense it would be in Europe or North America (Jha, 2003).

These forms of road infrastructure are more than practical constructions that aid private motor-vehicle ownership; they also arouse significant civic pride. At the inauguration of Kolkata's

4.3km Park Circus-Parama flyover in 2015, the Chief Minister of West Bengal, Mamata Bannerjee, signalled her party's intention to build the country's longest flyover (~30km) in the city and in doing so maintain the state's "rapid strides" being made in urban road infrastructure development. The media coverage of her speech referred Kolkata's plan to "go one better" than its rivals. Hyderabad, Bangalore and Mumbai currently outdo Kolkata in terms of high profile flyover developments, however, the article makes clear; the planned development would put the West Bengal city on top on the length ranking (Hindustan Times, 2015). This suggests that flyovers – pieces of urban infrastructure that are perceived as, at best practical, at worst, eyesores, in the West – are viewed as a mechanism for civic boosterism. The new Park Circus-Parama flyover was named "Ma" by the Chief Minister. This choice has two interpretations. Some local residents claim the flyover was named for the Hindu goddess, Durga; others say that the name is a clear reference to the slogan of the ruling party ("Ma, Mati, Manush" – "Mother, Earth, People"). Both interpretations point to the prestige with which this piece of road infrastructure is associated: on the one hand it's associated with a much-revered deity; on the other it is intended to drum up support for the ruling party (Gulf News, 2015). The glowing terms used by the media to report the opening of "Ma" suggest the working of the availability heuristic. Most journalists, as members of the middle-class, experience congestion as private-motor-vehicle owners and report on it in terms of a hindrance or "hardship" that can only be "relieved" by more road infrastructure (Times of India 2016). Consumers of newspapers and digital media read this framing of congestion (something they themselves experience) as an infrastructure problem; this framework is then widely adopted by the middle-classes and becomes the basis for public policy discussions on the subject, constantly reinforced by further reporting of the issue using the same framing.

This short discussion has pointed to the dominance of private-motor-vehicle infrastructure in transport planning in urban India, evident in funding allocations under the country's flagship urban renewal mechanism, the rapid proliferation of high-profile road developments and the way in which these developments are perceived by politicians, media and middle-classes. These developments were designed to assist the domestic automotive industry (see chapter 1 for an account of private-motor-vehicle growth in India). However, they also fostered in the middle-classes and the media ,the idea of a motorised city in which individual mobility, expressed through the purchase of one of an ever widening range of automotive choices, and speed were paramount (Dasgupta, 2009). This idea is, despite the boom in road infrastructure, a long way from the reality of lengthy traffic jams - new roads rapidly choked by induced demand (Badami, 2009); worsening air quality and ever more public space repurposed for automotive use as parked cars constrict roadways, mount pavements, and displace cyclists and pedestrians.

7.5 Metro rail systems

Faced with increasingly clogged roads and air quality at dangerous levels, around the turn of the millennium urban transport planners began to tempt drivers in urban India away from their vehicles with renewed efforts to provide fast, effective mass public transit systems. The preferred mode was the metro system: prior to 2000, only Kolkata had a relatively modest metro network. Four new metro systems have been completed since then, five are under construction and 15 are in the planning stage. They will cost an estimated US$26.1bn by completion (Tiwari and Goel, 2014), over ten times the cost of the equivalent surface rail systems in terms of passengers per hour/per direction/per kilometre and roughly five times that of BRT (Manchala and Vagvala, 2012).

Consequently, spending on metro projects outweighs investments for BRT systems and dwarfs money spent on alternatives, such as surface rail. As Mohan (2008) argues, the metro has become the dominant policy response to urban transport problems in India regardless of its suitability to local urban form and trip patterns. The MOUD stipulates in its National Urban Transport Policy (NUTP) (2006) that technological choices should be made at the local level to suit specific urban conditions; they should not be imposed by the centre (with the exception of surface rail, which the MOUD deems unfit for urban use). However, it has been stated that, despite the NUTP, the ministry is pushing for all cities with populations of 3 million or more to immediately construct metro systems. It has been argued that this figure is an "arbitrary" one (Srinivas, 2011) that appears to originate in comments made by Delhi Metro Chief, E. Sreedharan in 2004 (Mohan, 2008). More recently, this figure has been made official by the Planning Commission in the 12th Five Year Plan, which states that a population of 3 million requires a city to immediately begin construction, whilst passing the threshold of 2 million people necessitates metro planning, namely the identification of corridors and peak demand without consideration of whether a metro system is needed (Tiwari and Goel, 2014; Sreenivas, 2011).

The enthusiasm for metro systems is driven by a number of factors. They benefit tangible vested interests: broad coalitions, including property owners and developers, politicians and construction and engineering firms often unite to tip mass transit decision making in their favour (Townsend, 2003). Such groups typically stand to benefit in the form of land deals, construction contracts (see Ramachandriah (2009) for an example) and political standing. Secondly, the dominance of "big ticket" items is, like flyovers, closely linked to municipal prestige; they signify the city's supposed place amongst a domestic order and, increasingly, amongst an international club of metropolises with similar infrastructure. Siemiatycki (2006) notes how the Delhi Metro has used favourable coverage in international media outlets, such as the BBC and New York Times, to make claims about the city's "world class" status: its place as an equal amongst London, New York and other ubiquitous cities in the competition for international attention and investment. Metros are successfully marketed as outwardly signifying that a city is "world class" - that it adheres to international standards of speed, comfort and safety, and has access to high-quality logistical and engineering expertise - whilst replacing the "congested, unpredictable, chaotic" Indian city, long atrophied by political fragmentation, with a new culture of "discipline, order, routine and cleanliness" and action enabled by political consensus (Siemiatycki, 2006).

The involvement of international expertise is closely associated with the dominance of roads and metro systems. International consultancies are routinely contracted to produce reports on urban transportation planning, including policy recommendations that are usually perceived to be something of a gold standard – an aspirational target – by the high-level IAS officers in charge of urban transport planning decisions. These officers are trained to be generalists: they have little specialised training in their area of responsibility and are thus heavily guided by the recommendations of consultancies which are often firms from North America, such as Wilbur Smith Associates, whose reports typically reflect norms in Europe and North American urban transport planning that are based on the specific urban histories of those areas. A report by Wilbur Smith Associates (WSA) for the MOUD illustrates this: Of the total to be invested in urban infrastructure across 87 cities for the period 2008-2020, 33% is for road infrastructure, 54% for metros, monorails and BRTs and just 4% for walking and cycling (WSA, 2008).

In addition, a large number of Indian urban transport planners have trained in Europe and North America and have taken on urban planning approaches from those locations, which, again, are tailored to reflect the nature of urban areas in those locations rather than the Indian context. Moreover, Manchala and Vagvala (2012) argue that many Indian academics in the planning field are educated overseas and that is reflected in higher education. They review urban planning curriculums for Masters Degrees at a number of elite Indian institutions (IIT Mumbai, IIT Madras, SPA and CEPT). They argue that all show a strong focus on road transportation with only one institution, CEPT, offering a course on surface rail networks.

This focus on private-motor-vehicles and metro systems represents the “techno-managerial” approach to urban transport planning outlined in the introduction. It favours prestigious, large-scale infrastructure projects that are perceived as enhancing both local civic pride and the image projected by the city on national and international levels by demonstrating its ability to implement complex, high-profile projects, and in doing so signalling its suitability as a location for investment. These projects typically employ technologies that have been rolled out in cities in Europe and North America, representing the graduation of urban India into the order of "world class" cities with access to international standards of expertise, technological sophistication and rapid mobility for passengers and the growing numbers of private-motor-vehicle owners. Metro and major highway developments are seen as the result of urban planning that is objective, efficient and apolitical, making decisions based on technical criteria derived from international best-practices, quite apart from the close-knit and often opaque foundation of social and political relationships that govern urban India (see Chatterjee (2004) and Benjamin (2008) for examples).

7.6 The limits of the "techno-managerial"

The "techno-managerial" approach to urban transport planning has a number of limitations. The most prominent practical constraint is its relative neglect of the modes of transport associated with low-income groups – the majority of urban residents who cannot afford a private-motor-vehicle. These groups rely on walking and cycling, two modes of transport which are badly neglected by the current approach, despite comprising around 40% of trips in cities with populations of more than 5 million (Padam and Singh, 2006). They receive paltry funding – just 4% of the WSA (2008) plan, appearing as an afterthought – and are also badly affected by the development of infrastructure designed solely with the private-motor-vehicle in mind. Cycling or walking on flyovers or crossing the increasing number of multi-lane roads, which usually lack designated cycle lanes and pedestrian footpaths and crossings, increases the exposure of these already vulnerable road-users to road traffic accidents (Tiwari, 2002).

The “techno-managerial” also neglects an array of modes of transport that act as major employers for the urban poor. Namely, paratransit modes, which tailor their routes to suit the requirements of their passengers and do not operate on a pre-determined timetable (Vuchic, 1981), this includes auto-rickshaws, cycle-rickshaws and, more recently, battery-rickshaws which are found India’s major cities in large numbers: Delhi has as many as 600,000 cycle-rickshaws, although the exact number is unknown (Ashima Sood, 2012), around 80,000 auto-rickshaws (DIMPTS, 2014) and up to 100,000 battery-rickshaws, which provide employment for at least one driver and for a range of support services, such as mechanics and maintenance shops. Iyer et al (2013) state that one auto-rickshaw provides employment for two families. If four-in-ten are also driven on the night shift (following Reynolds et al (2011)) then the city’s auto-rickshaws alone provide jobs for around 112,000 drivers, dwarfing the 8,500 people employed by the Delhi Metro (Metro Rail News, 2015).

Paratransit is a major provider of last mile connectivity, defined as covering the distance between trip origins or destinations, such as homes, offices and schools, and access/exit points in the mass transit system, namely metro stations and BRT stops (Mani et al., 2012). In cities in Europe and North America, these short trip are increasingly made by non-motorised modes, such as walking and cycling and encouraged by policies to improve pedestrian infrastructure and separate cyclists from motorised traffic. Cycling and walking in Indian cities are difficult due to harsh weather conditions – often involving searing heat and, in the monsoon, large amounts of standing water, and poor pedestrian and cycling infrastructure, which often leads to motorised and non-motorised modes sharing a common roadway with consequences for the safety and respiratory health of vulnerable road users. Furthermore, both activities carry a heavy class related stigma – they are perceived as the activities of the urban poor, all of which, together with India's vast labour surplus and rural-urban migration, go some way to explaining the sheer size of Indian paratransit fleets.

Tiwari and Goel (2014) argue that only 12% of the population of Delhi resides within half a kilometre of a metro station; they find 27% of metro passengers used paratransit to get to the metro station; 36% used some form of paratransit to reach their destination from their destination metro station. Their data was collected in 2011, before the rapid proliferation of battery-rickshaws which now perform this role more cheaply than auto- and cycle-rickshaws, providing last mile connectivity at a new lower price point (see chapter 5). Integrating paratransit with the mass transit system is therefore an important task for urban transport planning; one made more urgent given the need to fill excess metro capacity and the planned expansion of both the city's metro and BRT system (Tiwari and Goel, 2014: World Bank, 2012). In addition to this complimentary "last mile" role, paratransit also caters for door-to-door trips that are impractical on mass public transport. Delhi contains many such trips due to its sprawling multi-centred urban form (Pucher et al, 2005).

However, when the "techno-managerial" approach deals with paratransit it usually takes one of two forms: either it is mentioned in passing, its presence taken as given, such as in the Delhi Development Authority's Master Plan for 2010 (2007) which recommends the creation of “interchange zones” including paratransit ranks, but does not address the current state of paratransit and the issues for passengers and operators; or, occasionally, when paratransit is the subject of policy change, the interventions are typically of a judicial, legal and technical nature. They focus on cracking down on the behaviour of what are seen as errant operators (i.e. introducing increasingly draconian penalties transgression) or banning a mode from certain areas of the city (see Ashima Sood (2012)) or on specific roads (such as Mumbai’s eastern expressway (see Harding (2014)).

The failure of the “techno-managerial” approach to adequately incorporate paratransit into integrated transport plans has several consequences. It has repercussions for the livelihoods of low-income groups who rely on paratransit as a form of employment. As argued above, a lack of concern for paratransit often results in dysfunctional policies which exacerbate the problems they are designed to tackle (i.e. the mandatory installation of GPS devices on auto-rickshaws in Delhi is an example, see chapter 2) and the consistent failure of policies to reflect changing economic conditions (i.e. haphazard fare revisions). These factors contribute to poor working conditions and low incomes in the paratransit sector (see chapter 3). As argued earlier in this study, the combination of poor monetary compensation and cumbersome bureaucracy in the regulated paratransit sector stands in stark contrast to the ease and speed with which drivers can begin working for ride-aggregators who may even offer income top-ups and access to quick and easy car loans. This contrast provides ample incentive to reject the auto-rickshaw sector in favour of Uber, Ola and other ride-aggregating companies, which operates without, or with minimal, regulatory oversight, a situation which has seen rapid entry into this market: over half a million cars have signed up for ride-aggregators in India in recent years.

The neglect of paratransit also leads to negative public perceptions amongst the middle-classes, media, policy-makers and even high-level politicians (see chapter 1). The potential consequences of negative public attitudes towards paratransit includes the abandonment of paratransit in favour of private-motor-vehicles, which, given the lack of parking at mass transit access points and the lengthy mode transfer time that would entail, would have repercussions for the metro network and for PMV use in general. Likewise, abandonment of auto-rickshaws for ride-aggregators would have severe implications for the ability of urban planners to regulate and plan urban transportation as well as for congestion and emissions as private cars have a larger road footprint than auto-rickshaws and are not bound by CNG regulations. In short, the provision of an integrated mass transit system, as envisaged by the Master Plan for 2020 (MOUD, 2007), requires engagement with paratransit services.

If metro systems represent the utilisation of global expertise to elevate the Indian city to “world class” status, then paratransit represents specifically local content: local to both South Asia (the region with a large and varied paratransit sector) and to individual cities, as each has its own unique paratransit sector (i.e. the auto-rickshaw sector in Delhi is very different from that of Kolkata). Improving paratransit in a manner that strikes a balance between the needs of operators and passengers requires engagements with the local context of operation. It requires an understanding of the role played by each paratransit mode in the wider urban transport system, trip patterns, the economics of operation, the current regulatory approach, the ease of compliance and the local political economy of operation. It also means recognising the various actors involved in the provision of each mode and the interactions between them. These actors include drivers, non-driving owners, financiers, retailers, the traffic police, the local transport department and the dense sub-structure of social and political relationships that characterise the "democratic" approach to urban planning (Gopakumar, 2015).

For the "techno-managerial" approach, engaging with this "democratic" approach to planning is both undesirable and impossible. It is undesirable because this approach prioritises high-profile prestige projects using technologies that have been rolled out in the Global North. Its aim is to signal the city's suitability for investment, and also to bring about local transformation through inculcating the values of efficiency, productivity, transparency, and political consensus (Siemiatycki, 2006). Paratransit, in its current form, is antithetical to this perspective. Aside from taxi fleets, the paratransit modes common in Indian cities (various types of rickshaw) are found primarily in the Global South: they mirror transit in Lahore, Dhaka and Colombo more closely than London, New York and Paris, the "world class" cities with which places like Delhi aspire to compete. In contrast to the modern technologies used in contemporary metro systems, paratransit technologies are comparatively basic. Many designs have not changed significantly in decades: the design of the auto-rickshaw has changed little since it was introduced to India from Italy by Piaggio in the late 1960s and the cycle-rickshaw has also remained relatively unchanged. Furthermore, whilst many of these well-worn technologies remain serviceable, some have become out-dated, such as two-stroke engines, which are significant contributors to air pollution in several Indian cities (Reynolds et al, 2011).

The “techno-managerial” favours transparency and political consensus. Metro developments appear to exemplify these values. They are relatively open (data on everything from financing and revenue streams to ridership projections is publically available); their operations involve clear hierarchies and delineated responsibilities (metro rail corporations provide leadership, often under charismatic individuals, and work with visible subcontractors and partners); and they generally represent political consensus (metro rail corporations are not viewed as political actors; they appear to operate independent from politics, frequently perceived as irredeemably corrupt by the middle classes and media (see chapter 1)). Paratransit services, in contrast, are provided by large numbers of small operators whose costs, revenues and daily operations are relatively opaque. Other than a few NGO reports, there is little data available and none of it official – even official policy reports work on the basis of estimates and poorly substantiated assumptions (see chapter 1). Paratransit modes do not have stable leadership structures: unions tend to rise and fall rapidly – many exist on paper only. This makes articulation of issues and direct negotiation with regulators difficult. Furthermore, paratransit operators can also be mobilised as a voting bloc (see chapters 5 and 6), which, from the “techno-managerial” standpoint, mires them in the messy, often graft-ridden business of urban politics, the converse of the ideals of objectivity, efficiency and rationality. For these reasons, paratransit is not only antithetical and undesirable to the “techno-managerial” approach; it is also beyond its reach. The technical analyses prioritised under the “techno-managerial” do not adequately capture the daily operations, cost structures and revenues of hundreds of thousands of small operators, nor do they even scratch the surface of the dense network of actors in the paratransit sector and their interactions. In this sense, the "techno-managerial" approach to paratransit reflects the manner in which the Indian state approaches the "informal" or "unorganised"[33] sector as a whole.

The Indian state takes a "dualist" approach to the "unorganised" sector that assumes a sharp divide between informal and formal sectors (Ashima Sood, 2012). The informal sector is seen as "parasitic" on the allegedly more productive formal economy into which it will eventually and inevitably be absorbed (La Porta and Shleifer, 2008). Given the subordination of the informal to the formal sector, the state's policy approach has been described as one of disregard. This can be interpreted as the view that the informal economy is "beyond the purview" of the state, or even if it is not, then the "paucity of data", coupled with the scale of informal activities involved, simply makes intervention too difficult (Breman, 2010). This attitude is impractical given that the unorganised sector employs around 93% of the Indian workforce (NCEUS, 2009).

Yet urban transport planning must engage with paratransit operators. This engagement requires two developments: firstly, the willingness to do so, perhaps fuelled by the consideration of equity (to improve their livelihoods) and pragmatism (to ensure "last mile" services); secondly, the ability to do so: this requires the extension of this "purview" to include this hitherto neglected area.

[33] The "unorganized sector" refers to "unincorporated private enterprises" with fewer than ten employees (NCEUS, 2005).

This extension requires urban planning to transcend the "techno-managerial". It must generate systematic data on various aspects of paratransit operations, their changes over time, and following policy interventions. It also involves an attempt to balance passenger and operator perspectives, which centre on the need for affordable, convenient and decent quality paratransit and the livelihoods of thousands of operators and their families. This has typically been thought of as a zero-sum game in which making conditions worse for operators, usually through increasingly draconian penalties for transgression, inevitably makes things better for passengers. As this study has sought to demonstrate, this perspective can be transcended given better understanding of the paratransit sector. This understanding must be based on systematically collected empirical data. It must be based on the recognition that driver actions are the result of underlying causes, and that these causes, and not the driver's behaviour, are the true subject of policy interventions. This study has attempted the sort of systematic data collection on paratransit for which it advocates. The chapters 2, 3, 4, 5 and 6 have presented and analysed this data.

7.7 Concluding remarks

This study has argued that urban transport planning must transcend its current focus on the type of large scale prestige projects associated with the "techno-managerial" approach. It must broaden its ambit to include the thousands of individual owner-operators that comprise the paratransit sector. These paratransit operators play a vital role in the urban transport system yet face certain challenges to operation, which are poorly addressed by regulators. Tackling these challenges for the benefit of operators and passengers alike requires making the paratransit sector transparent to regulators. This will involve the systematic collection of data and engagement with the "dense substrata" of actors in these sectors. Such engagement hinges on the abandonment of the idea that planning is an objective, politically neutral activity: on the contrary, if the decisions in question effect the distribution of resources then they are political in nature and demand the input of those they affect. This study has attempted to do just this: it has put forward a set of policy recommendations for two parts of the paratransit sector in Delhi based on systematically collected data. Continued neglect of paratransit modes, such as auto-rickshaws, risks channelling investment into unregulated or less regulated modes, such as the services run by ride aggregators, leading to the loss of the ability to regulate the sector. More importantly, it represents the neglect of the livelihoods of millions of low-income households across urban India.

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Appendices

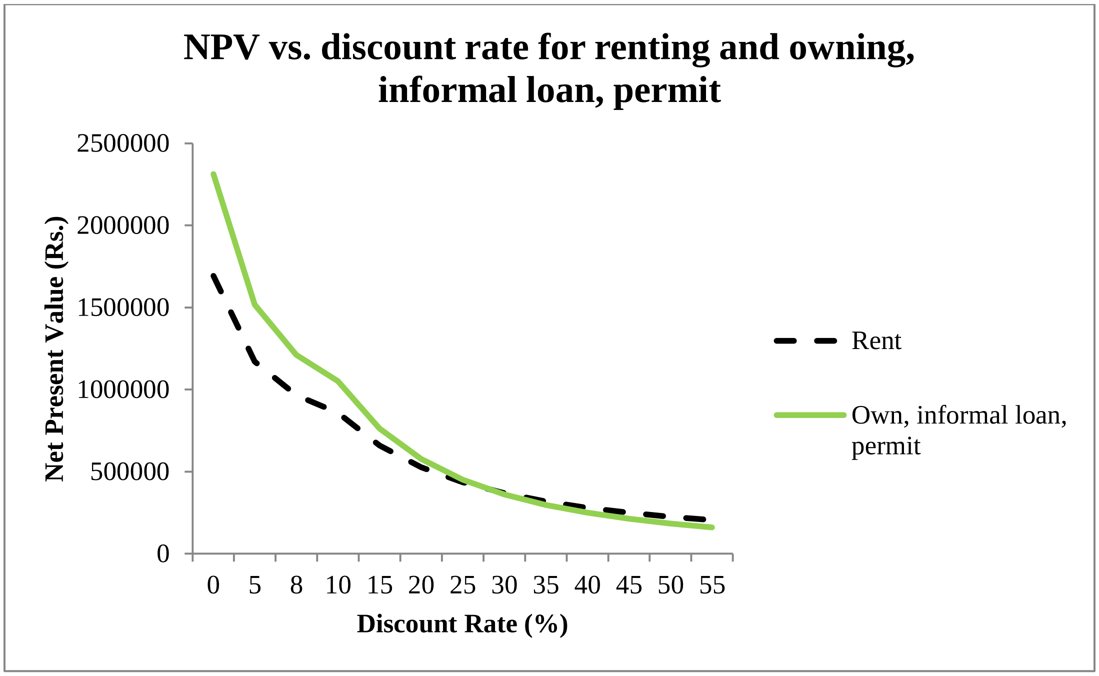
Appendix A The QQE framework applied to auto-rickshaw in Delhi.

REGULATION TYPE	DOCUMENT	REQUIREMENTS	PENALTIES & COMPLICATIONS
Quality	Driving Licence	Fee, Forms 1, 2 and 3, proof of address, proof of age and proof of citizenship and practical test.	Driving Licences from other states are frequently not accepted by the Delhi Transport Department despite a legal obligation to do so. The penalty for non-compliance is vehicle confiscation.
	Commercial Licence	Clean Driving Licence for 1 year, proof of address, medical examination, 8th grade pass certificate and practical test.	Bribe required for proof of address as many drivers live in jhuggis.
	Commercial Badge	Clean Driving Licence and Commercial Licence, police background check.	Bribe required for clean police check.
	Pollution under Control Certificate (PUCC)	Test at an official PUCC testing centre, renewed every 3 months. Fee of Rs. 60.	Bribe often required. Competition between test centres for custom lowers stringency of checks. Fine of Rs. 1000 for plying without an up-to-date PUCC as a first offence; Rs. 2000 for every additional offence.
	Fitness Certificate	New application: Form 20, Form 22, Sales Certificate 21, Insurance Certificate, Letter of Intent from State Transport Authority, fee and test. Annual Renewal: Road Tax Clearance, last 4 PUCCs, fee and test.	Fitness Test has 17 parts, many of which are highly subjective (i.e. paint condition). Subjective elements are used to elicit bribes. Fine of Rs.5000 for plying without a Fitness Certificate.
	Road Tax	Rs. 305 per annum.	
	Insurance	Insurance Certificate from private sector provider.	The penalty for non-compliance is vehicle confiscation.
Quantity	Permit	New application: Letter of Intent from dealer, Form 20, 21, 22 and 34, Fitness Certificate, address proof, insurance certificate, road tax and copy of PAN card. 5 Year Renewal: photocopy of PAN card, Bank Account number.	The penalty for non-compliance is vehicle confiscation.
	Registration Book		
Economic	Meter Certificate	Test, including GPS test.	

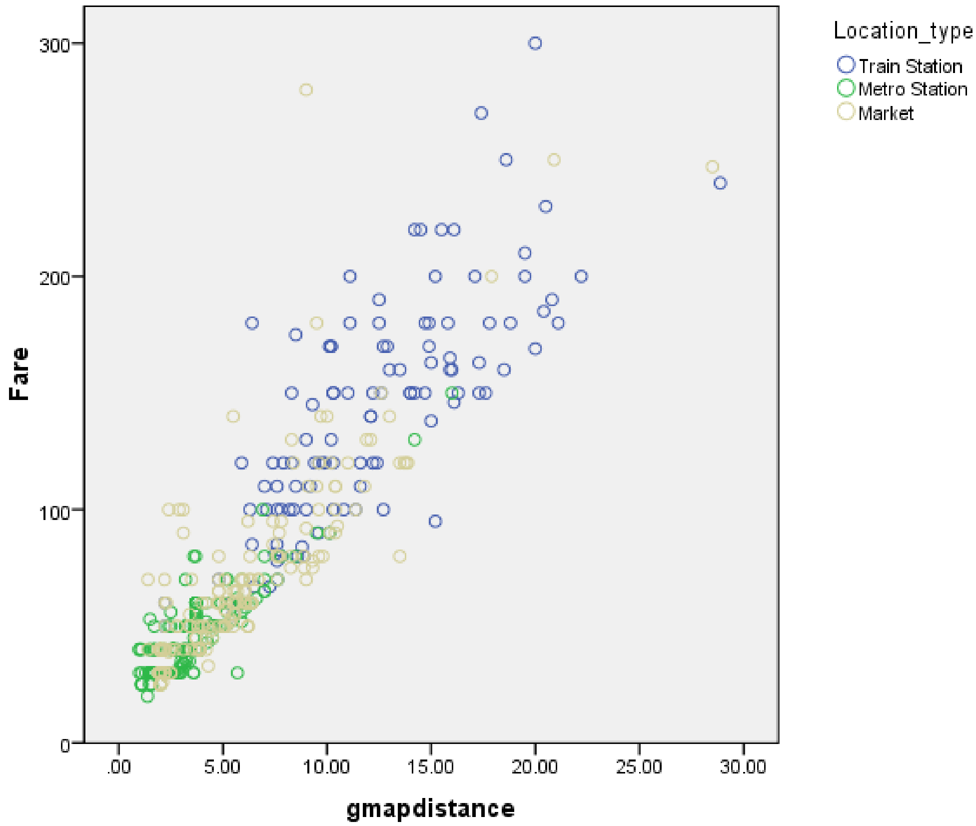
Appendix B - Fitness testing criteria at the Delhi Transport Department.

S.No	Item	CMVR	Check	Type of test
1.	Tyres	94,95	Cut, deformation, thread case wear	Visual, wheel tester
2.	Steering	98	Gear backlash, kingpin, stub axle, steering free play	Manual (check free)
3.	Engine	120	Noise level 85 dB, vibration, leakage, missing, Performance.	Engine analyser/ engine dynamo meter
4.	Suspension		Leaf spring, position, clamping, shock absorber , centre bolt, bushes, shackle	
5.	Horn		Electrical, bulb horn, pressure horn	Noise meter for decibel
6.	Brake	96, 97	Stopping distance at 30 kmph<13 meters, parking brake, brake oil leakage	Brake tester
7.	Lamp/Signal		Headlamp, parking, turn signals, top lights, reflectors, stop lights	Visual / Lumino scope
8.	Embossing of chassis E/G	122	Chassis no, engine no, identity plate, manufacturing month and year	Visual
9.	Speedometer	117, 118	Speedometer functioning (speed governor in the stage carriage)	Visual
10.	Painting	1	As per act and rule, N.P., N.P.local, stage carriage, school, AITP,	
11.	Wiper	119	Wiper fitment/functioning	Visual
12.	Body	93	Seating, mudguard, emergency gate, window size,	Visual
13.	Electricals	101 to110	Insulations, switches, starter, accessories, doom light, spark arrester	
14.	Finishing		Riveting, welding bonnet, crank case cover etc.	
15.	Road test	99	Clutch, transmission, differential axles and performance	
16.	Others		As per notification and permit condition	
17.	Pollution	115	Pollution level of vehicle	Smoke meter, gas analyser

Appendix C - NPV vs. discount rate for renting and owning, informal loan, permit.



Appendix D – Fare vs. trip distance, by location type



Appendix E - A simple decision making model

This appendix presents a simple decision-making model to gain insights into an auto-rickshaw driver's decision to take an on-meter trip, and the role that flag-fall fares play in that decision. It is informed by the survey of auto-rickshaw passengers introduced in chapter 4 and fifteen auto-rickshaw drivers, recruited though a local NGO. These drivers were issued with log books and asked to keep a record of their passenger trips for nine consecutive working days in May 2014. Eight auto-rickshaw drivers completed the task. The log books recorded the origin and destination of each journey, its duration and the fare charged. All drivers reported full respect for meter laws; however, it is likely that the stigma of non-compliance (and its penalties) led to rampant exaggeration of meter use. Nevertheless, the sample of 809 journeys provides a distribution of fares on which to base an analysis of the economic rationality of the arguments put forward in the following simple decision making model. It also provides data on which to base assumptions.

Consider an auto-rickshaw driver waiting for his next fare. A fare may be someone who wishes to take a short trip with probability $(1 - p)$ earning the driver revenue equal to the flag-fall fare R_f at a trip cost of C_f resulting in a profit $P_f = R_f - C_f$. Conversely the fare may be someone who wants to take a longer trip with probability p that provides the driver with a profit $P_m = R_m - C_m$. Here the trip revenue R_m and the trip cost C_m are both greater than their flag-fall equivalents. The driver may accept all fares and comply with the meter at all times (Scenario 1) or refuse short trips that would result in his earning the flag-fall fare and wait for a longer fare (Scenario 2). The expected profit for scenario 1 is:

$$P_1 = (R_m - C_m)p + \left(R_f - C_f\right)(1-p) - C_w \tag{1}$$

The cost of waiting C_w accounts for the time spent by the driver as he waits for a fare. In scenario 2, each refusal of a short trip adds an additional waiting cost C_w to the trip. Thus the expected profit from such an arrangement would be:

$$P_2 = \sum_{n=1}^{\infty}(R_m - C_m)\, p(1-p)^{n-1} - C_w - \sum_{n=1}^{\infty}(n)C_w p(1-p)^n \tag{2}$$

Where n is the number of passenger contacts made with driver consisting of n-1 trip refusals and 1 trip acceptance. Equation 2 can be reduced to:

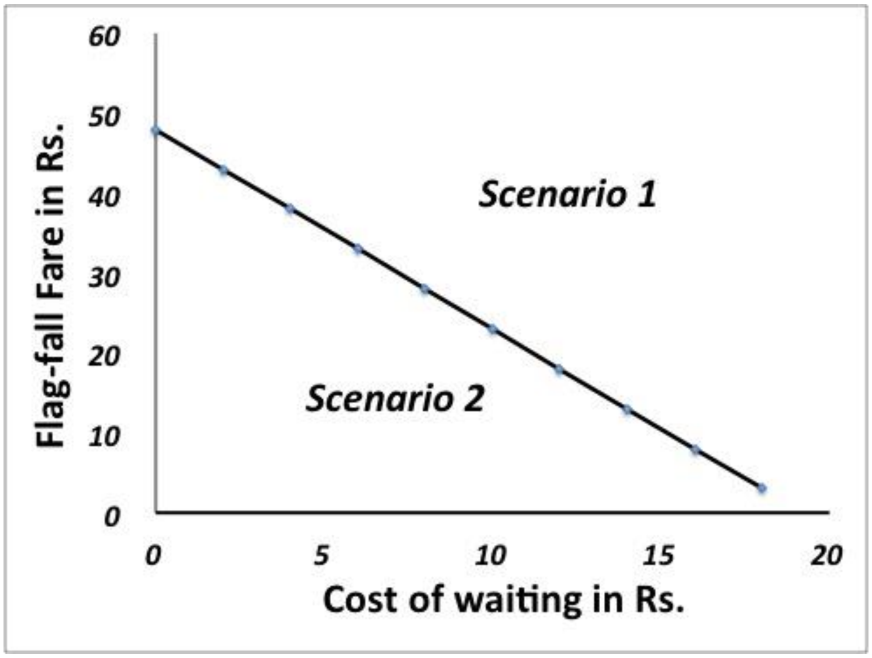
$$P_2 = (R_m - C_m) - \left[\frac{1-p}{p}\right] Cw - Cw \tag{3}$$

A driver chooses scenario 1 if $P_1 > P_2$ and the driver accepts all trips including those that would result in the flag-fall fare as revenue. From equations 1 and 3, if $P_m > P_f + \left[\frac{C_w}{p}\right]$ then the driver chooses scenario 2 and waits for the longer fare. Conversely if $P_m < P_f + \left[\frac{C_w}{p}\right]$ the driver chooses scenario 1, and accepts all trips. All else equal lower values of the flag-fall fare cause the driver to choose scenario 2 and vice-versa. When the flag-fall fare is set at a threshold level $P_{fT} = P_m - \left[\frac{C_w}{p}\right]$ the profit asymmetry between short and long trips no longer exists.

We estimate daily average values of P_m and P_f to be Rs. 48 and Rs. 19 respectively. Values for P_m and P_f were estimated by subtracting average fuel and rental costs associated with journeys from the trip revenue. Average fuel cost was calculated using (i) a fuel economy of 3.5kg/100km for a four-stroke CNG auto-rickshaw (Reynolds et al. 2011) (ii) mean lengths of trips of 2.6km and 8.8km for shorter than flag-fall (*f*) and longer than flag-fall trips (*m*) respectively. The rental cost of each trip was estimated using the average speed of trips undertaken by drivers in the driver logs (15kmph), while the cost of rent per hour (Rs.30.67) was taken from a survey of auto drivers in Delhi carried out by the authors in May 2014. This allowed for the estimation of the average profit of a trip in scenarios 1 and 2. The probability of the driver getting a longer trip *p* was estimated from the passenger survey to be 0.4. We do not have data relating to the cost of waiting Cw as we do not know the time between each passenger contact. However, we can parametrically vary Cw to ask how flag-fall fares might be related to refusals.

Figure 2 shows the relationship between cost of waiting and flag-fall fares in Delhi. The line represents the flag-fall fare level at which the driver switches from choosing scenario 2 to scenario 1 for a given cost of waiting. A driver can choose to wait for a longer period in order to get a long-distance fare; however, at a given cost of waiting he benefits from refusing short fares (scenario 2) only if the flag-fall fare is less than the amount specified in figure 2. Once the flag-fall fare exceeds the threshold value the driver switches to scenario 2.

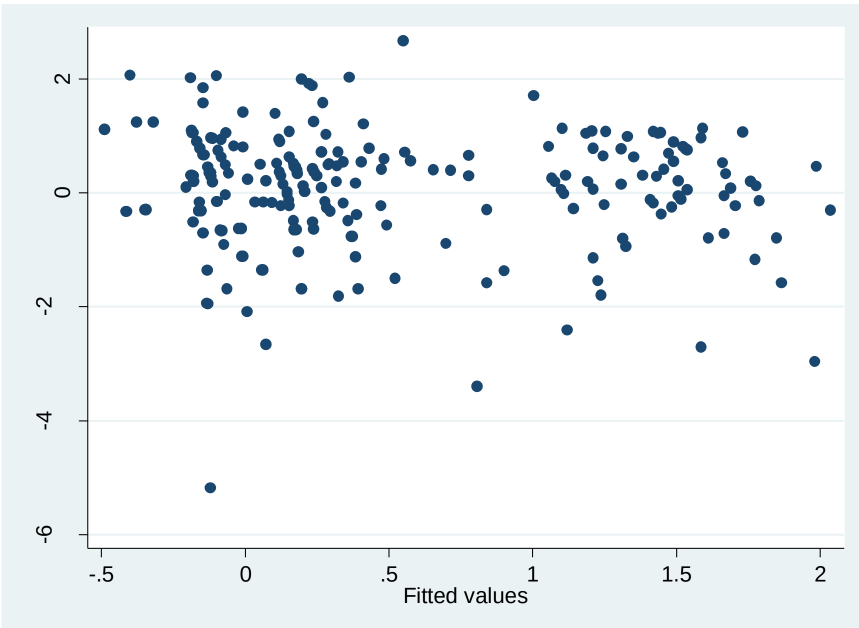
In this simple model non-compliance emerges from a trade-off between the cost of waiting for a longer fare and the level of the flag-fall fare. A lower cost of waiting provides the incentive for the driver to either wait for an additional fare or to bargain with a customer for an ‘off-meter’ amount that is greater than the flag-fall fare to compensate for revenue lost from taking the shorter trip. However, this incentive to 'overcharge' disappears when the flag-fall fare is set at an appropriate threshold level to compensate for the difference in revenues between a short trip and a longer trip that was foregone in its stead. For a flag-fall fare of Rs. 25, the current level in Delhi, the driver takes all trips irrespective of their length only if the average cost of waiting is Rs. 9 (equivalent to a 17 minute wait) or higher. Since a large proportion of short trips in Delhi are refused or result in bargaining/'overcharging', the simple model predicts that *Cw*, the average wait time is less than 17 minutes, and current flag-fall fare levels are set lower than required to meet the scenario 1 condition, i.e., the flag-fall fare is set too low for the drivers to voluntarily comply with using the meter. Increasing the flag-fall fare to Rs. 35 would result in bargaining/'overcharging' only for situations with wait times greater than 5 minutes. A flag-fall fare set at Rs. 48 would result in drivers complying with the meter at all times regardless of the wait time.



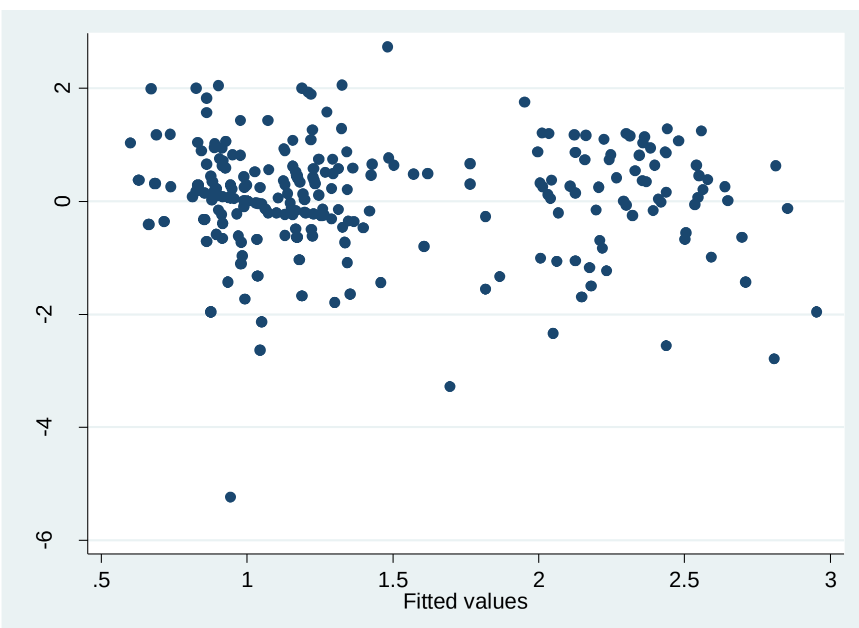
The figure above shows that the relationship between threshold levels of flag-fall fare and cost of waiting. The area above the threshold line represents scenario 1 where a driver agrees to take all fares. While the area below the threshold line represents scenario 2 where the driver chooses to refuse short trips or can engage in ‘over-charging’ for the short trip by seeking to increase revenues to the flag-fall threshold levels.

Appendix F - Residual vs. fitted value plots for models 1 & 2 (section 4.4)

Residual v.s fitted value plot for model 1:



Residual v.s fitted value plot for model 2:

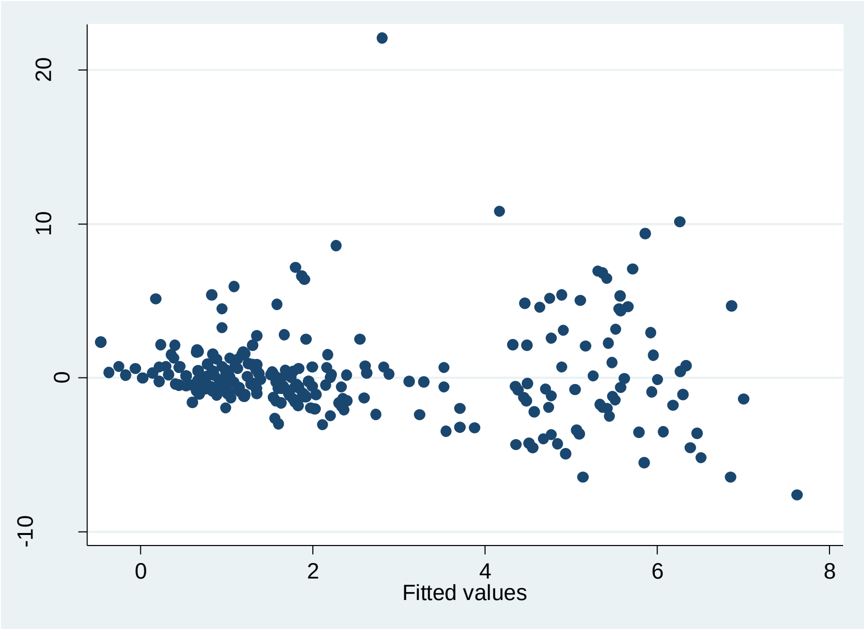


Appendix G - OLS models and residuals vs. fitted values plot.

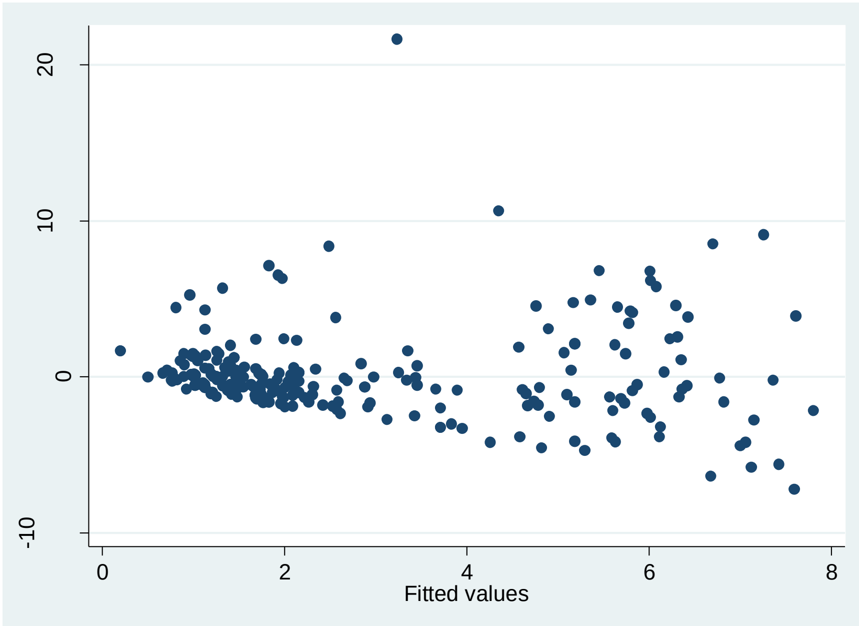
Model A includes all observations in the dataset, including those at which overcharging equals 0 or below. Model B removes all values of overcharging <=0.

Model	**A**	**B**
y	overcharging	overcharging
n	415	352
TRAINDUMMY	2.578528**	3.227744**
PEAK	0.8190604**	0.653202**
MALE	0.3892585	0.2656593
REGULAR	-0.988228	-0.6173492*
DISTANCE	0.1537065	0.213579**
cons_	0.2206344	0.393552
df	5	5
R-Sq	0.3401	0.365
Adj R-Sq	0.3323	0.3558
F	43.81**	39.78**

Model A: Residuals vs. Fitted Values plot



Model B: Residuals vs. Fitted Values plot



In the absence of a log transformation the plots of residuals to fitted values shows considerable heteroskedasticity with variance increasing as the value of fitted values increases.

Appendix H - Tobit models

Tobit 1 has an untransformed dependent variable and the same independent variables as the analyses in section 4.4. It includes the zero values. Tobit 2 has a logged dependent variable and keeps the zero values. Tobit 3 has the same dependent variable at Tobit 2, but omits the zero values.

Model	Tobit 1	Tobit 2	Tobit 3
y	overcharging	logovercharging	logovercharging
n	415	415	352
TRAINDUMMY	2.78249**	1.049287 **	0.8974881**
PEAK	0.9792003**	0.5434887**	0.4118423**
MALE	0.6707589	0.1995682	0.787787
REGULAR	-1.808227**	-0.5908314**	-0.2505296
DISTANCE	0.1381405**	.0493376**	0.671871**
cons_	-0.1893986	-0.7061391	-0.4604488
df	5	5	5
Pseudo-R-sq	0.0855	0.1691	0.1815