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New Approaches for Integrated Multimodal Transport Systems

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NEW APPROACHES FOR INTEGRATED MULTIMODAL URBAN TRANSPORT SYSTEMS

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Integrating Fares, Information, and Informal Transit

Partha Mukhopadhyay and Gurkirat Singh Juneja

Amid looming climate concerns, engineering a shift to public transport is now imperative. India, where car ownership is yet to increase substantially beyond the large metros, can achieve a modal shift from private to public transport. Prioritising information and fare integration across transport modes can help achieve this shift without compromising user needs.

The essay enumerates the types of fare integration and evaluates transport use in India, which is biased towards 'informal' or 'popular' modes, while the global focus is on formal modes. It concludes by charting a policy roadmap for a fast-urbanising India to optimise public transport use.

Fare Integration

Multiple rides are necessary when travel patterns are too dynamic for transport networks. With fare integration, multiple rides will not add to the cost and deter usage. It also avoids the inconvenience of multiple ticket purchases, which is, admittedly, becoming less relevant with the increasing use of digital and biometric payments.

Fare integration can be intra-modal (changing from one bus to another) or inter-modal (from bus to metro rail and vice versa). The intra-modally integrated metro and bus rapid transit (BRT) systems and all-day tickets are also a form of fare integration.

Integration can be unrestricted via a single flat fare, as it is in New York City (1). It can also be mode-independent (i.e., invariant for travel from A to B), irrespective of the mode. Fare integration can also be ride-independent (i.e., the number of transfers in a journey does not matter). Though the fare for transfers in distance-based modes may seem costly, they are more cost-effective because of their telescopic nature. For example, in the metro system, the fare from A to C is usually less than the sum of fares from A to B and B to C (2). Fare integration can also be mixed, as is in London, where initial transfers are costly but subsequent transfers are free due to a daily fare cap (the maximum daily amount transit systems can charge each user) (3).

All such existing fare integration practices require formal but not necessarily public provision. While fare integration with private provision is possible with specific types of contracts, it poses a challenge in countries like India, where commuters often prefer 'informal' or 'popular' transport modes, such as autorickshaws, and other modes of intermediate public transport that fulfil the formal public transport system's sizeable unmet demand. Therefore, practical fare unification that benefits commuters is possible only if all informal transport modes are brought into an integrated fare system.

Information Requirements

However, fare integration alone will not be beneficial if the connecting schedules are mismatched, with long and unpredictable transfer waiting times. While geo-tracking vehicles and using predictive traffic models can reduce the unpredictability related to the arrival of connecting transport with some degree of error, they need accurate information on travel patterns and interchange points, particularly during peak-hour commutes. Unlike user surveys, digital tickets that record origin, transfers, and destination generate reliable data to improve the network.

Transport Behaviour in Urban India

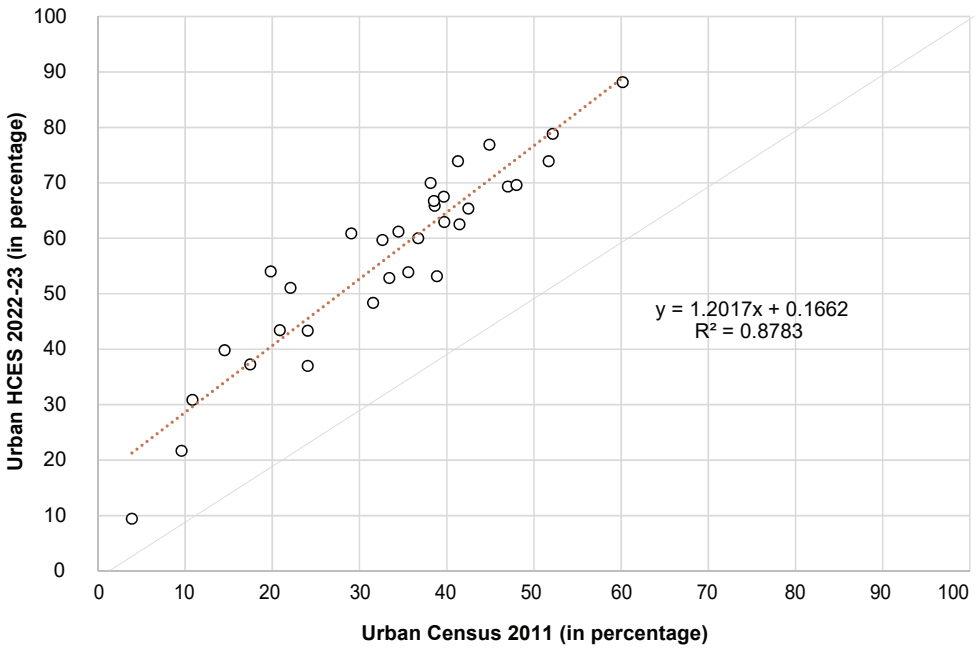
Based on data from the 2011 Census and the National Sample Survey Office's Household Consumption Expenditure Survey 2022-23 (HCES), Figure 1 (A and B) shows that car and two-Wheeler ownership has risen since 2011 levels, with several states ranking higher than the national urban average of 63.3 percent. Two-thirds of households in urban India now have access to private transport. Car ownership is growing evenly, while two-wheeler ownership is growing faster in states where it is already high.

Figure 1 (C and D) showcases the use and expenditure, respectively, on different modes for households with a private vehicle (measured as those who spend on fuel) and those without. The measure is given for those who use a given mode and those who only use the given mode to generate a multimodal index (4). Most households use multiple modes (see Figure 1 C). Further, even those with private vehicles use buses and trains for daily commutes (5), but do so less frequently than those without private cars. A high proportion of both groups use autorickshaws.

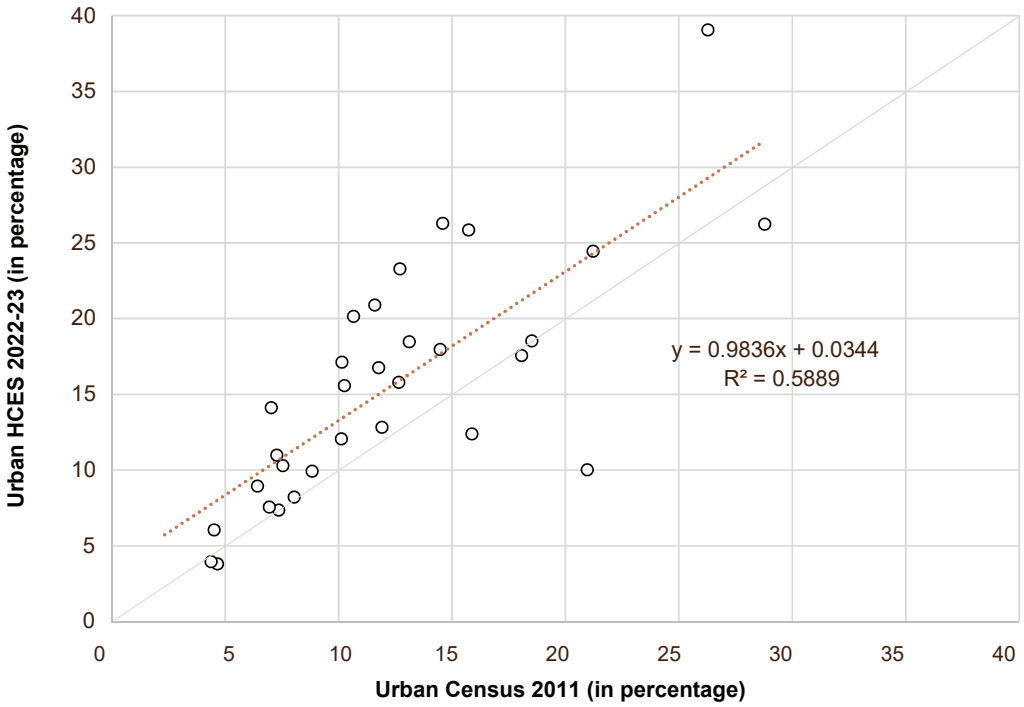
Vehicle-owning households spend almost three-fourths (73 percent) of their total transport expenditure on fuel. The largest share of non-fuel expenditure in these households is on school transport (see Figure 1 D). However, a high portion of expenditure is again on autorickshaws, even more for non-vehicle-owning households.

Figure 1: Two-Wheeler and Car Ownership (Based on Census 2011 and Household Consumption Expenditure Survey 2022-2023)

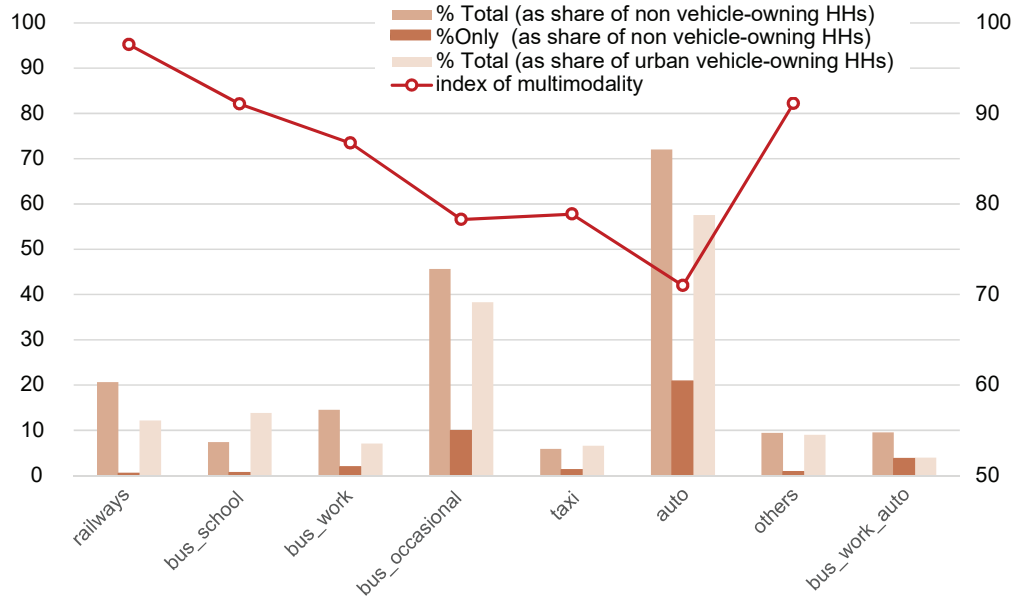
A: Two-Wheeler Ownership in Census 2011 and HCES 2022-23



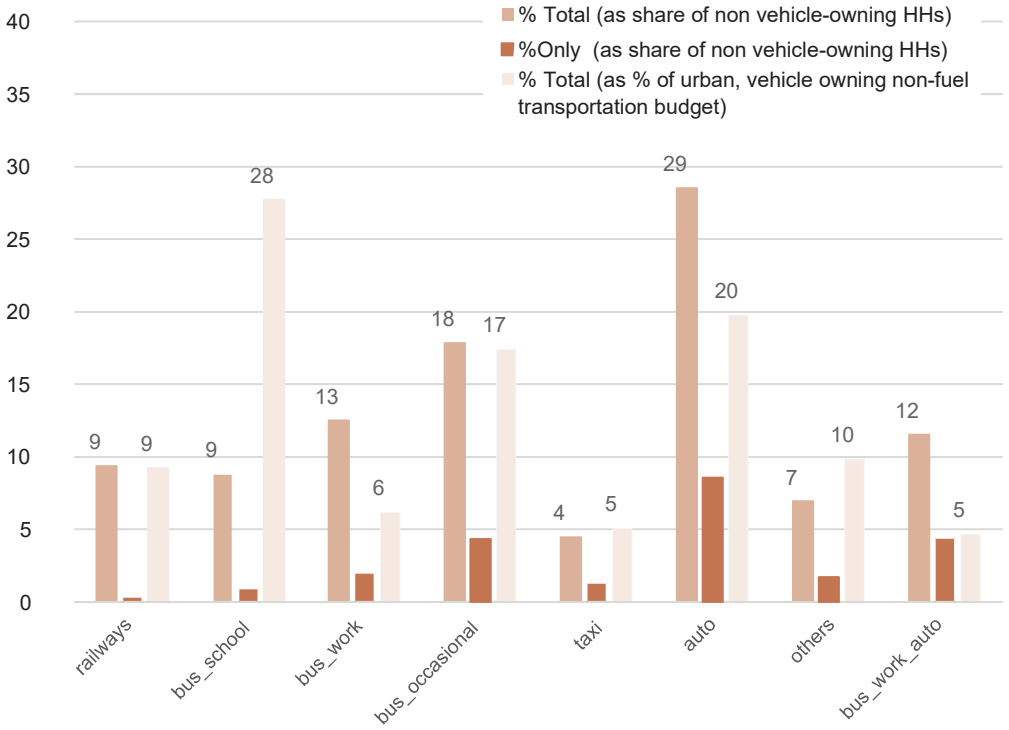
B: Car Ownership in Census 2011 and HCES 2022-23



C: Share of Urban Households Using Different Transport Modes



D: Urban Household Expenditure on Transport Node as a % of Non-fuel Transport Expenditure

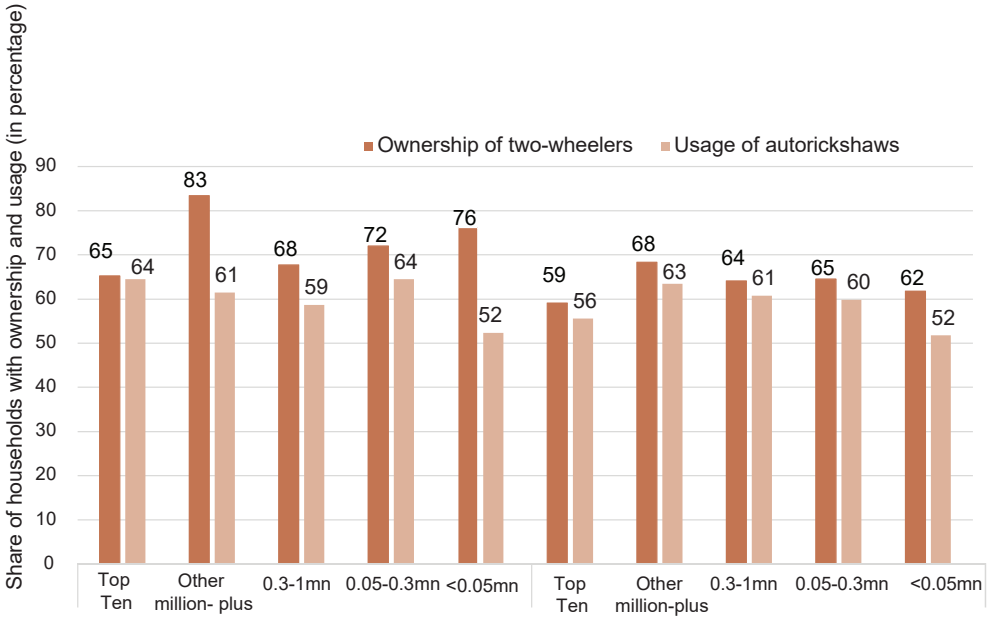


Sources (A, B, C, D): Census 2011 (6) and HCES 2022-23 (7). The HCES sample consisted only of car owners.

The authors thank Dr. Shamindra Roy for his help with this analysis.

Figure 2 showcases the two-wheelers ownership and autorickshaws usage across different city-size classes. Almost a third (31 percent) of India's urban population is in million-plus cities, and over half (54 percent) are in towns of less than 300,000. The mid-size cities between these two datasets account for the rest, about one-seventh (14 percent) of the total urban population. The National Sample Survey Office classifies households into affluent (about 1 percent) and non-affluent categories in all city-size classes. The ownership of two-wheelers is higher in affluent categories across city-size classes and is also high in the non-affluent categories. The high usage of autorickshaws across city-size categories also reflects a striking uniformity. Autorickshaws are likely to be a shared transport mode in all except the largest million-plus cities. Thus, any plan for a genuinely 'integrated multimodal transit system' in India must consider the enormous contributions of such 'informal' or 'popular' modes.

Figure 2: Two-Wheeler Ownership and Usage of Autorickshaws Across City-Size Classes



Source: Census 2011 (8) and HCES 2022-23 (9).

Global Experience

Technology has transformed transport over the past decade. Taxi aggregator apps such as Uber provide modal choice, fare certainty, and relative certainty on wait times, but are almost always for private travel (although two-wheeler taxis can be comparatively inexpensive, providing some benefit) (10).

Another significant technological change is digital ticketing, which generates critical data on travel patterns in addition to being more convenient for users and enabling them to prepay transport service providers, allowing for the better planning of routes and service frequency, as highlighted by Hong Kong's Octopus Card (11) and the use of digital ticketing data by Kerala State Road Transport Cooperation to improve public transport planning (12). Gender- and age-disaggregated data can also foster inclusive and equitable public transport services (13). The General Transit Feed Specification (GTFS) (14), a common standard, helps integrate multiple service providers and helps to evaluate the performance of public transport services in terms of service quality in peak and off-peak hours, travel time reliability, and more (15).

Technology Leapfrog

Low-income countries can leapfrog in matters of transport-related technology (16). Kenya's Digital Matatus (17) project (18) has generated a public map of routes, stops, and schedules similar to formal bus systems via community action. Cashless payment modes that are convenient for users and safer for operators are widely accepted (19), even in the 'popular'/ 'informal' transit modes. Kenya is also introducing digital ticketing to enhance the commuter experience further. Open data standards, like GTFS and low-cost GPS, make it possible to improve the predictability of wait times and push that information to the users. However, some privacy concerns (20) persist since few countries have data protection laws (21). Furthermore, digitalisation can also exclude certain sections (22), especially the poor and elderly (23).

Some countries have even tried to integrate the 'popular'/ 'informal' transit with interventions like BRT systems (24), but such integration can be "drastic" (25) (26). However, such efforts have mainly incorporated current transit operators into the 'formal' systems to preserve livelihoods. Consequently, they have replaced one system with another, losing vital features of the 'popular'/ 'informal' transit (27).

Frequency and Vehicle Size

Information about service frequency is critical, especially when service is intermittent. Larger the 'popular'/'informal' vehicles need a minimum passenger count per trip for viability. During off-peak hours, this reduces the frequency, which, in turn, reduces the number of users, enabling a vicious cycle. However, smaller vehicles could provide high-frequency service in big cities, reducing the need for frequency information.

Experience with Fare Integration

Digital payments have supported several variations, including time-varying fares. London (28) and Paris (with the new Navigo Liberté+) (29) use a daily cap, and New York City uses a weekly cap (30). Prices vary from a cap of £8 (about US$10) a day for London (in zones 1 and 2 only) to £49 (about US$62) a month for all public and regional transport in Germany. Singapore has no cap but allows five free transfers in a single journey (31). Sao Paulo's Bilhete Único (one ticket) offers transfers between rail and bus, which is typically the case in most cities having such facilities (32). Limiting the use of the same card or device can foster integration among cards and other digital payment modes. Inter-modal fare integration is uncommon in developing countries, though some cities like Delhi allow stored-value cards (33) across modes (34).

The Challenge of Integrating 'Popular' Modes

The real challenge lies in integrating 'popular transport' modes. For example, bolekaja in Nigeria, tuk-tuk in Thailand, becab in Indonesia, peruas in Brazil, jeepneys in the Philippines, and microbus in Vietnam cater to the daily commute needs of a large population (35). Given their market-oriented approach and use of manoeuvrable vehicles, these modes serve locations that may be unserved or underserved by public transport, solving the first- and last-mile connectivity problems for most commuters.

Many popular transport modes in India run on cleaner fuels, such as LNG/CNG (autorickshaws) or electricity (e-rickshaws) (36). Shared services using such vehicles provide a higher average passenger-km per litre than buses due to the high average occupancy. Autorickshaws and e-rickshaws are also easier to electrify because of their relatively quick charging time. Due to their high frequency and the ability to pick up and drop off passengers closer to their origins and destinations, they can wean people away from private transport. A 2019 study found that 37 percent of arrivals and 32 percent of departures from stations in Delhi were by informal transit, such as autorickshaws (37).

While 'popular'/ 'informal' transit is rarely integrated with formal modes or organised, some cities have been able to do so. In Kolkata, autorickshaws are 'self-organised' in a route network (with the vehicles displaying route numbers). Users can travel across the city, paying separate fares, offering users a high-frequency commute alternative with assured seating. Major bus and metro stations in Kolkata also have autorickshaws, and over 70 percent of the city's households are less than 500 meters from an autorickshaw route (38). However, though the 2019 amendments to the Motor Vehicles Act enabled the formalisation of such systems as licensed networks, the network's regulation and fares continue to exist in a liminal space as a modus vivendi between police and associations of autorickshaw drivers.

Fare integration can also be achieved by making one or all modes free. Over 100 cities globally run free bus services (39). Women can now travel free on buses in many Indian cities. Further, in India, two-wheeler users will likely be more attracted to use free buses. To further incentivise such a shift, a public transport cess, equivalent to a monthly loan repayment fee, can be levied on each private vehicle. Bus services can be procured using a gross cost contract model such as that used in Delhi or the PM e-bus SEWA scheme for electric buses. The operator will meet capital and operating costs not from passenger fares but through a payment (broadly, a per km amount set by bidding) from the government, fully financed by revenues from the public transport cess.

The Way Forward

Given this scenario, what kind of fare and information integration will engineer a shift to public transport? Larger cities can consider the following interventions:

- Integrating metro rail (where present) fares with daily caps (INR 50, or about US$0.50) with free travel on holidays,
- Providing a free bus system funded by a public transport cess, and
- Allowing shared autorickshaw routes with regulated fares, like in Kolkata, to lure private transport users, especially two-wheeler users, to public transport.

All uses need a digitally verifiable method, like a QR code or card. Information from this digital card/code could help optimise existing bus routes and metro extensions. Free bus travel and a daily cap on metro rail, coupled with low, shared autorickshaw fares, will keep total costs low. Smaller towns can experiment by providing high-frequency connections to and from key destinations, using gross cost contracts for autorickshaws or small vehicle routes.

These components exist—in part or wholly—in many cities. They must be brought together everywhere, or as a start, in the million-plus cities. Over time, as feasible and sensible, the vehicles (buses, autorickshaws, and e-rickshaws) could become electric, as a bid condition of the gross cost contracts. This will create an integrated, sustainable, and functioning public transport system across metros and smaller cities.

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