

## **A RESEARCH AGENDA FOR PUBLIC POLICY TOWARDS MOTORIZED TWO-WHEELERS IN URBAN TRANSPORT**

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## **A RESEARCH AGENDA FOR PUBLIC POLICY TOWARDS MOTORIZED TWO-WHEELERS IN URBAN TRANSPORT**

### **Abstract**

As a mode of urban transportation, motorized two-wheeler vehicles (motorcycles, mopeds, scooters) encompass a great variety of vehicles and they are used for a wide range of purposes. This mode plays different roles: from marginal for a few travelers in most industrialized countries, to the dominant role in many developing countries. However, it is shown that motorcycles/mopeds are also extensively used in some industrialized countries, particularly in moderate climates. However, despite its considerable use, this mode tends to be ignored in transportation organization and planning.

Case studies of several cities with very different conditions and incomes, which have extensive use of motorcycle/mopeds, are presented, including low- as well as high-income cities: Hanoi, Bangalore, Beirut, Bogotá, Taipei and Rome. It is observed that generally, these vehicles can provide an economical and convenient mode for a large portion of population in cities with inadequate public transit services and traffic congestion in streets. Counterbalancing this convenience and mobility, motorcycle/moped mode presents serious system problems, such as aggravated congestion, undisciplined behavior of its users, much lower safety than other modes, strong negative environmental impacts, unfavorable consequences on city's livability, and others.

The paper presents typical characteristics of this mode and points out the need for formulation of policies which should balance the benefits to users with social and environmental costs, as well as impacts of motorcycles/mopeds on uses of other, more efficient and environmentally-friendly modes, particularly transit, bicycling and walking.

## **A RESEARCH AGENDA FOR PUBLIC POLICY TOWARDS MOTORIZED TWO-WHEELERS IN URBAN TRANSPORT**

### **INTRODUCTION**

Despite their widespread usage in many cities, and in some cases being even the primary mode of motorized transportation, motorized two-wheelers (motorcycles, mopeds, scooters) are most often addressed as a safety issue. Use of this mode of urban transportation has been steadily increasing in many East Asian and South Asian cities for several decades and they have long been a significant component of the modal split in some Southern Europe, Middle Eastern, Asian and South American cities. Their use has been much lower in cities with colder climates, but rapid expansion of use can be expected everywhere with the rapid increase in fuel prices and worsening congestion for private automobiles.

Motorcycles are rarely analyzed with respect to their traffic impacts, capacity implications or special traffic engineering needs, such as separate lanes (*1*). But they are even more rarely analyzed for their optimal role as an urban transportation mode. Policies with respect to encouragement/discouragement of their use and whether special facilities should be provided are typically non-existent at municipal, provincial or government level. At the same time, there are lots of strong sentiments and unstated assumptions about what their proper role (or lack thereof) should be.

This paper uses some limited case study information from a few cities in widely different situations to help identify where the commonalities for usable data and research results might exist. Central to this is identification of what really constitutes a peer with respect to a particular policy question.

### **A COMPLEX ISSUE**

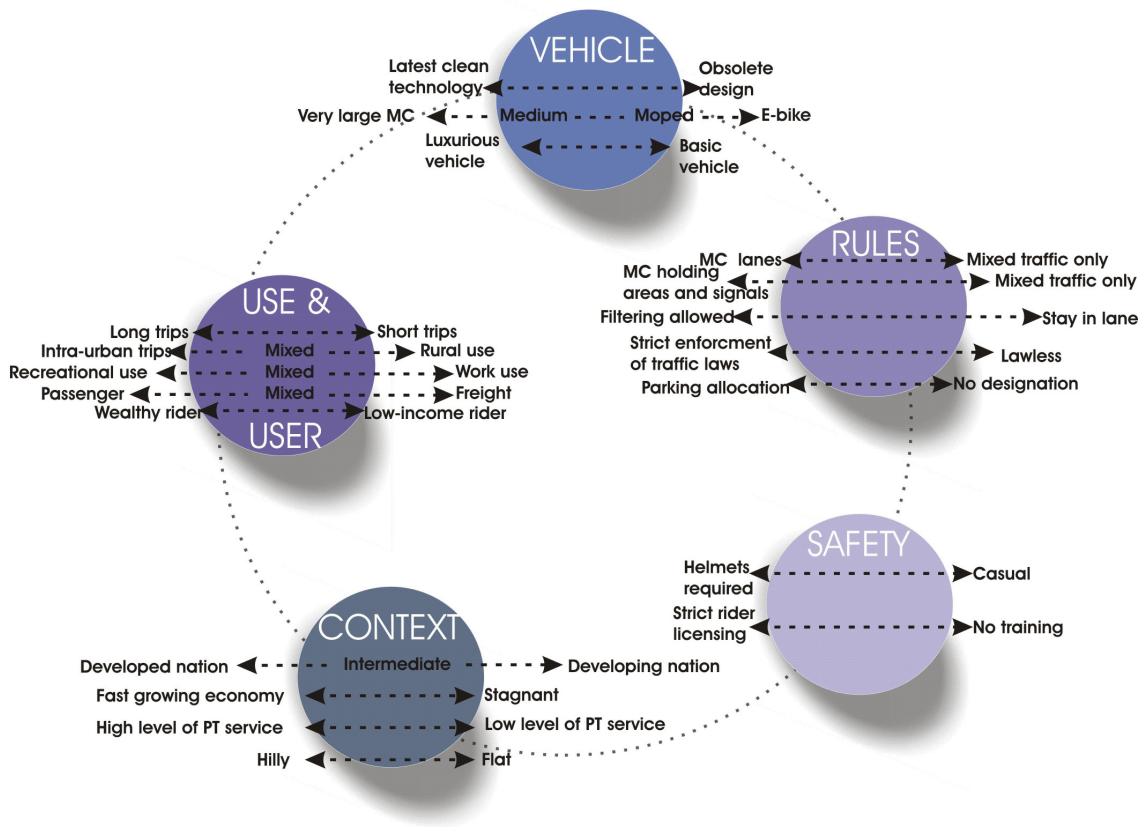
The number and types of motorcycles used, their frequency and purpose of use impact more than just their role as transportation modes or public safety. Energy consumption, air and noise pollution levels, and indeed the overall livability of the city are also involved.

It is not even clear where to draw the lines of what constitutes a “motorcycle”. They can range from a very small moped at 50cc to a huge touring machine in the 1500cc range. There are also three wheeler vehicles that are barely larger than a moped, motorized rickshaws that are almost the same size as a small automobile but use motorcycle technology, and so on.

Further complicating analysis is the wide range of unstated assumptions made by analysts. Feelings can be held strongly in a fashion analogous to religious beliefs. For example, one person might believe that there are absolute personal freedoms at stake while another might feel that the externalities from motorcycle use are so severe as to justify their immediate total ban.

Although there may not be many similarities among cities with intensive use of motorcycles, they can evolve rather quickly with their rapid economic and the impending gridlock which rapid auto ownership increase will intensify. Perhaps particular metropolitan areas can identify trends and thus anticipate what is likely to happen under the current policies and current infrastructure. This may be the critical moment for many cities to start deciding whether to develop new policies that either accommodate or avoid the expected flood of motorcycles.

The diversity of vehicle and user characteristics, types of ways they use, purposes of use, etc. is extremely great and, in some cases, contrasting (Figure 1). As the following case studies show, some features of this mode range as follows: types of motors: latest clean motors to obsolete polluting ones; light electric bicycles to powerful motorcycles; luxurious to most economical, etc.



**FIGURE 1** Categorization of motorcycles aspects and the wide range they span

**CASE STUDIES: CITIES WHERE MOTORCYCLES/MOPEDS MODE SPLIT IS HIGH**

**Hanoi, Vietnam: a low-income city**

Despite rapid economic growth in recent years, Hanoi has had little public investment in either road infrastructure or public transportation. As a result, it is an example of a city that has very high motorcycle/moped ownership and use (Figure 2) but without the supporting traffic regulation capacity. There are very few traffic signals and no dedicated motorcycle lanes.

Throughout the 1990s and early 2000s, motorcycle ownership was increasing faster than the population with many households owning more than one. Furthermore, average displacement was also increasing (2). The current population of Hanoi is about 3.2 million but increasing at about 3 percent per year. There are currently about 1.5 million motorcycles and only 150,000 autos, although the latter are growing quickly as well.

Not just ownership, use has also been growing very quickly. Non-walking trips have doubled between 1995 and 2005. The current mode split is 60 percent motorcycle/moped, 24 percent bicycle (formerly the dominant mode), 8 percent bus, and 5 percent car or truck (3). The

high number of motorcycles/mopeds combined with lack of traffic signals and no helmet laws has led to a rapid increase in accidents. Throughout the 1990s, there was often double-digit growth in annual fatalities. During the year 2000-2001, there was a startling 37 percent jump in fatalities to 10,477 in Vietnam as a whole, with 68 percent being motorcycle/moped users, plus 29,188 injuries. In Hanoi, motorcycles/mopeds were implicated in 73 percent of all accidents, suggesting that they are also injuring or killing many bicyclists and pedestrians (4). There has been some success in getting motorcycle/moped users to use helmets since then, but the accident numbers remain very high.

Even though over 90 percent of this enormous fleet of 1.5 million has 4-stroke motors, maintenance is generally poor. With average purchase cost over 3 times the average annual per capita income, ability to purchase replacement parts and engine tune-ups is limited (2). Thus, air and noise pollution are also very serious problems.

In 2003 an analysis to determine what might reduce air pollution concluded that a one-time registration tax of 100 percent of purchase price only decreases growth rate from 15 percent to about 8 percent per year (2). An annual tax of one-third to one-fourth the purchase price again only decreases rate down to about 8 percent per year. To determine whether improved public transport could reduce motorcycle/moped use, a logit model was developed based on Stated Preference using travel time reduction and travel cost reduction related questions. The researchers concluded that, based on an average trip time difference of 26 minutes between the two choices and current fares and motorcycle operating costs, the probability of shifting to the bus was only 3 percent. Furthermore, even substantial improvements in service would only increase public transport mode split a few percent. Thus, they focused on reducing the pollution impacts by reducing the accelerating and braking cycles through signalization and other intersection changes. Since they did their research, events have given reason to believe they were too pessimistic in assessment in that public transport improvements would be ineffective. The addition of 700 buses, new routes and schedules, and a new fare system together increased ridership from near zero to 700,000 per day in the last 5 years. Furthermore, the World Bank has agreed to finance two new Bus Rapid Transit lines that promise much larger service improvements in the corridors in which they operate with the specific goal to reduce the number of motorcycles/mopeds (3). Like Taipei (further described), Hanoi offers a controlled experiment to monitor what might reduce motorcycles/mopeds to a more manageable and less harmful level without depriving those who really want or need to use them from doing so.



**FIGURE 2 Multipurpose two-wheelers in Hanoi (5)**

**Bangalore, India: a low-income city**

As one of the main centers of the IT and biotechnology industries, this is one of the most prosperous and fast developing cities in India. The mode split on a per-vehicle trip basis has gone from 70 percent bicycle in 1965 to 56 percent motorcycle/moped in 2002. On a per-person trip basis, motorcycles have increased from 22 percent to 32 percent in the 12 years from 1994 to 2006. But simple percentages underestimate the change, as the absolute number of person trips per day is estimated to have increased to somewhere between 6.3 Million and 8.2 Million per day depending upon the estimating source (6). Thus, the increase in traffic volume, energy consumption and emissions generated by motorcycles has been enormous.

By comparison, public transport on a per-vehicle basis dropped from 10 percent of all vehicles to only 4 percent over the same period, 1965 to 2002. On a per-person trip basis, public transport ridership decreased from 61 percent to 46 percent of all trips between 1994 and 2006, but in absolute terms was actually carrying more persons. This case suggests that the belief that motorcycles/mopeds are space efficient really is not true if it comes at the expense of mode split for public transport. It is only true if the mode split increase comes at the expense of automobiles. But there is no reason to expect this to happen in Bangalore, as increasing prosperity will tend to increase the number of upgrades to motorcycles from autos, not vice versa. Indeed, the corresponding figures again for vehicle trips from 1965 to 2002 show that auto trips have also increased from 5 percent to 19 percent over the same period. Despite the large increase in autos, the mode split increased on a per-person trip basis from 1 percent to a still fairly small 7 percent of all trips between 1994 and 2006.

The dramatic negative impact on the city at only 7 percent auto mode split points to yet another problematic policy issue. It seems to be politically unjustifiable to take measures to inhibit motorcycle use and pressure travelers into public transportation if no corresponding measures are taken to inhibit automobile use. It is a mode that consumes not only far more space per person trip while underway, but also far more space for parking and consumes more non-renewable fuel.

**Beirut, Lebanon: a low-to-medium income city**

The city has been through difficult circumstances with a long civil war that destroyed infrastructure and weakened institutions. There were no working traffic signals in Beirut for many years. (As of this writing about 40 new signals have recently been put in service and more will be operational over the next year.) Furthermore, there has been very limited operational subsidy to the public transport system, the little available being used to pay public employees despite the virtual lack of a fleet in driving condition. Capital subsidy is non-existent. The lack of traffic signals and lack of financial support has left the Greater Beirut Area, a region of about 1.5 million people, with a mere 210 (170 privately operated and 40 publicly operated) fixed route bus services during the peak hours with an average speed of only 12 kmph on some routes (7). There are also thousands of poorly maintained minivans and taxis, but these too run very slowly within the mixed traffic stream. Many of the two-wheelers are noisy and poorly tuned with two-stroke engines are also polluting disproportionately to their size. Moreover, the stress level for drivers and pedestrians alike can be very high due to aggressive maneuvering needed in unsignalized intersections and multiple lane roadways without lane markings.

Two-wheelers abound under these circumstances. They can filter through the standing traffic and, due to lack of enforcement, even operate in the wrong direction on many one-way roads. They are not only used for personal travel, but play important roles as couriers and as

home delivery vehicles for the restaurant and other retail sectors. Their use is further enabled by the lack of enforcement against parking on sidewalks. Figure 3 shows a moped designed to deliver meals parked on the sidewalk and a 3-wheeled variant designed for carrying drinking water parked legally in the street. Compare the space required to the delivery vehicle parked ahead of it.

This case study shows the mixed positive and negative impacts from motorcycle use when the available alternatives like public transport are slow and almost non-existent in some parts of the region, or very slow and stressful in the case of private cars.



**FIGURE 3 Two-wheelers for deliveries in Beirut**

### **Bogotá, Colombia: a medium income city**

At the end of the 1990's for the city started a kind of Renaissance period due to a new transportation policy undertaken by the local administrators, whose aim was to provide Bogotá with a user-oriented transportation system. The challenge seemed hard to face for the city, one of the most densely populated in the world, because of the long-time lack of effective policies to manage the local mobility problems. The new policy was based on several measures acting on different fields, from road maintenance to rehabilitation of urban areas, from strengthening the roles of transit and non-motorized modes (namely due to the construction of new busways for the Transmilenio program, and bike routes) to restrain private cars use (8); in particular, the latter, called "pico y placa", is a system in which the digits of license plates are chosen such that a car with that license plate cannot circulate certain days of the week. Such a restriction is expected, during the 2009, virtually to halve the amount of vehicles circulating daily in Bogotá (9).

Consequently, the city can be regarded as a positive model, having the 2005 modal shares as follows: 57,2% transit, 17,3% non-motorized modes, 14,7% private cars, 0,7% motorized two-wheelers and 10,1% others (10); even the motorized vehicle ownership rate is rather low, about 73 cars every 1,000 inhabitants (11), but regardless of such official data, the number of motorized two-wheelers skyrocketed in the last three years, currently amounting to about 400,000 units. Low taxation, affordable prices and, above all, the enforced access restriction to central areas for private cars, are the main factors which made the usage of two-wheelers escalate, with no regard to safety problems. The number of fatalities involving riders is ranked second (after car drivers and passengers) in the overall fatal accidents statistics. On the contrary, the awareness about the environmental problems forced the local authorities to issue some new regulations: from the prohibition for two-stroke engine mopeds to circulate, to the requirement

for the newly-registered vehicles to be compliant with the Euro I (from 2010) and the Euro II (from 2011) standards.

Nevertheless, the attractiveness of motorized two-wheelers has become so strong and made them competitive with transit, that it gives rise to the so-called “mototaxismo”: the use of motorcycles as informal taxis, with fares that are negotiated before starting the ride. Surveys show that low operating speed and high fares, combined with the faster ride in the congested traffic seem to be the two key aspects which cause some travelers perceive the “mototaxi” as a substitute of the bus.

To fight illegal operations and improve safety for passengers and drivers (the latter are easily recognizable because they have a second helmet secured to the arm), recently a regulation has been introduced, specifically aimed at formalizing the business, which in the meantime has become more and more popular in other Colombian cities, too. Accordingly, private companies can now operate “mototaxi” services in any city with less than 50,000 inhabitants. The legalization of the “mototaxismo” in low demand areas is a clear attempt to provide citizens with an alternative transit system in contexts where transit would tend to be neglected; but it is also evident that it cannot be exportable to larger areas, because it can become a kind of “unfair” (and “unsafe”) competitor to the traditional transit modes: flexibility of rates and routes, solo-transportation has successful features which make it difficult to convert the “mototaxismo” into a proper transit system in spite of its initial success.

### **Taipei, Taiwan: a medium-to-high income city**

Taipei is a logical city to study as it had and still has very high motorcycle ownership and usage. In the late 1990s and early 2000s with increasing prosperity, several of the main corridors in the city had risen to as high as 80 percent motorcycles/moped mode split during peak hours. Even some rural highways have over 20 percent mode split (4). As a result of these high numbers, it also has developed special two-phase turn lanes, exclusive lanes in some places and other measures. Even with these measures, such a sea of motorcycles simply must detract from the experience of non-motorized travelers, and from the street life of the city, in general.

What makes Taipei a very interesting research target is that it has also undergone fast change in the available transportation options. The Mass Rapid Transit System (MRTS) went from non-existent in 1996 to over 74 km and 69 stations by 2008. It also underwent a re-organization of the bus system to a “checkerboard” grid in order to provide a better-organized ubiquitous coverage. One of the explicit goals was to decrease motorcycle use. This provided an opportunity to estimate the impact of dramatic improvements in public transportation without the complications of controlling for many variables over long time frames in order to obtain statistically significant results.

Taipei has a population of 2.6 million people. In 2005, there were about 720,000 autos but 1.2 million motorcycles. As of 2002, the nation as a whole has 12 million motorcycles versus only 5 million autos (4). These are mostly small displacement vehicles of 150cc or less, and as a result are not allowed on motorways. Furthermore, 60 to 70 percent of the 900,000 households have both a motorcycle and an auto (12) and in the nation as a whole, there is more than one per household on average (4). Thus, motorcycles were not being selected only because people couldn't afford an auto. The motorcycles were retained even after an auto purchase.

However, it is also clear that high ownership does not automatically translate into stubborn usage in the face of improving options. By 2008, MRTS usage had grown to 1.2 million trips per day, much of it apparently at the expense of motorcycles (and autos); the current Mayor



also states: “Thanks to the overwhelming support for the MRT, the number of cars and motorcycles on the street has dropped” (13).

The City of Taipei is not satisfied with visibly better conditions. In particular, the Transportation Commissioner has gone on record as saying that the pollution from and safety of motorcycles is unacceptable: “Pollution and accidents cost society dearly” They account for 60 percent of all traffic deaths (12).

Further reductions in motorcycle use can be expected. Parking has been largely free and unrestricted but “Parking fees will gradually become the standard.” Incentives for transit use and disincentives aimed at further reduction of motorcycle use are planned, as three additional metro lines are under construction.

### **Rome, Italy: a high-income city**

The Rome case study reflects contradictions and efforts to manage a popular mode of transportation whose attractiveness could contrast with environmental and social concerns.

The city’s motorization rate is one of the highest in Europe: 950 vehicles (two-wheelers included) per 1000 inhabitants (including the infant and senior populations), as recorded in 2005 (14). The number of two-wheelers in 2004 amounted to 457,270 units.

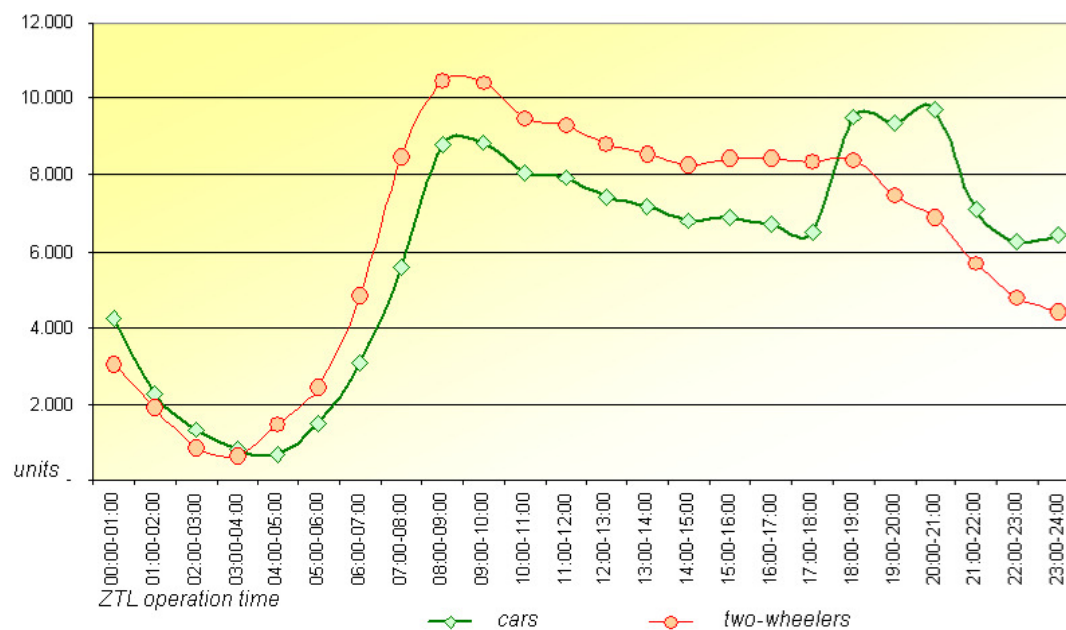
One explanation for such a high motorization rate is due to the city form: the ancient, historical city center has narrow streets and its semi-central areas and suburbs are connected by only two underground lines and a large bus network. This transit system is not able to meet Roman citizens’ demand in a satisfactory way and therefore in the last decades citizens have become addicted to private vehicles, leading to a consequent increase in the number of cars and two-wheelers. The former represents 77.4%, the latter 13.1% of the total motorized vehicles registered in Rome (14).

The role of two wheelers in the local modal split seems not to have markedly changed in the last few years. Indeed, the urban modal split in 2002 was: 30% transit, 27% private cars, 23% motorbikes/mopeds and 20% pedestrians. According to the 2005 estimations, these proportions have changed to 31%, 22%, 24% and 23%, respectively. The five point decrease (percentage) for private cars in favor of three point increase (percentage) for walking can be considered a noteworthy result and it suggests that citizens reduced their use of the car for trips of short distances, even though scooters and motorcycles still represent a good option for motorized trips (15).

If data are analyzed at the provincial level and all the systematic trips are considered (either to reach work or school places) during the 1991 – 2001 decade (i.e. when the two national census surveys occurred), transit decreased by 29.9%, car passengers increased by 43.3% and car drivers by 6.7%, but above all two-wheelers increased by 107.2%. Moreover, more than half of the overall amount of trips by two-wheelers occurs in a distance range between 2 and 11 km (as for cars) and even for walking distances (0 to 1 km), the use of mopeds and motorcycles is still an option (14).

The local, cultural and political approach can help explain such figures. On the one hand, local administrators avoid dealing with two-wheelers in a proper way, as demonstrated by two pieces of evidence: the unrestricted access to the city’s Limited Traffic Zones (LTZs) and the free on-street parking, whereas in both cases car drivers are charged; on the other hand, two-wheelers are a kind of status symbol citizens are not willing to give up, as described in the next section. As a consequence of such political choices, mopeds and motorcycles accessing the city centre LTZ are more than cars (Figure 4) (16), the number of free parking places for two-wheelers across the whole urban area is not even comparable to what the real demand requests,

since there is about 1 parking place available for every 14 two-wheelers (turning sidewalks into the most convenient parking facilities for mopeds); motorcycles play a major role in the production of pollutant emissions, being as “dangerous” as cars in terms of CO emissions, and far from negligible for what concerns particulates and NMVOC. In particular, simulations estimated that PM emissions due to two-wheelers are about 26.2% (morning peak hour) and 26.6% (average working day) of the total amount of PM emitted in central areas (17).



**FIGURE 4** Passenger cars and two-wheelers accessing the Rome city centre LTZ, average day

Poor air quality remains, but the fact that two-wheelers are regularly left out from any initiative concerning traffic restriction is a sign of the permanent underestimation of the problem at the political level.

The lesson learned from the electric scooters (or e-scooters) experience is another example. In 2000 the Municipality decided to support the usage of e-scooters and to set up suitable recharging points in the city central areas. Moreover, the Municipality advertised the benefits of electric vehicles in general using dedicated campaigns and allocated funds to prompt people to purchase electric bicycles, cars and e-scooters.

Mainly, the aim of the measure was to promote the use of e-scooters, due to the environmental concerns regarding PM<sub>10</sub> emissions.

Accordingly, Rome Municipality acquired a small fleet of 398 e-scooters in the same year. In 2001, a special dissemination activity was undertaken with tourist services, non-profit organisations and the general public and the results, in terms of possible acceptance, were encouraging. The 398 e-scooters were initially available for rental, but soon the public participation in the initiative was very low. Subsequently, some e-scooters were transferred to administrative units of the Municipality to be used for specific, regular urban trips, while 200 were donated to non-profit organisations. The recharging points became useless and soon turned into spontaneous, free parking places.

The reasons of the failure are manifold, and the simplest is that, after the initial dissemination, no further advertisement or education activities occurred. People simply forgot,

remained sceptical about e-scooters or did not find them convenient, because they are not comparable in terms of performance with traditional scooters. Such limited performance revealed the principal barrier to the implementation of e-scooters: i.e. the limited batteries life, which casts doubt on the possibility of implementing these vehicles on a larger scale. Recharge operations proved to be a limit themselves: the time required to recharge batteries (roughly 6 – 8 hours) also prevented the measure from becoming accepted.

### **THE LESSON FROM ROME: PERSONAL CONVENIENCE,**

In general, a trivial but realistic reason to explain the widespread population of two-wheelers is their low-cost, and this becomes truer in low-income economies and where transit supply is poor.

In developed cities, such as Rome, however, economic constraints are not an issue and reasons must be searched elsewhere. In such situations, the frequent keyword to analyze the success of motorcycles is “freedom”, but, leaving aside movie clichés such as “Easy Rider”, which do not represent the everyday life, more appropriate terms to define the phenomenon would be “attractiveness” and “convenience”.

The reasons why users are attracted to two-wheelers were synthesized into three assumptions: no separation between rider and its driving environment, the vehicles’ smaller size and easier manoeuvrability (18). Good weather conditions contribute to enhance the first hypothesis, and this could explain the popularity of the mode in milder climates; the size factor can be crucial in urban areas with scarcity of road space and high population density, but easier manoeuvrability is a tricky factor, which often conceals the underestimation of the skill required to drive a motorcycle, in spite of some recent important but contrasting experimental results (19). The always-too-high number of motorcycle fatalities and injuries, recorded worldwide, proves that.

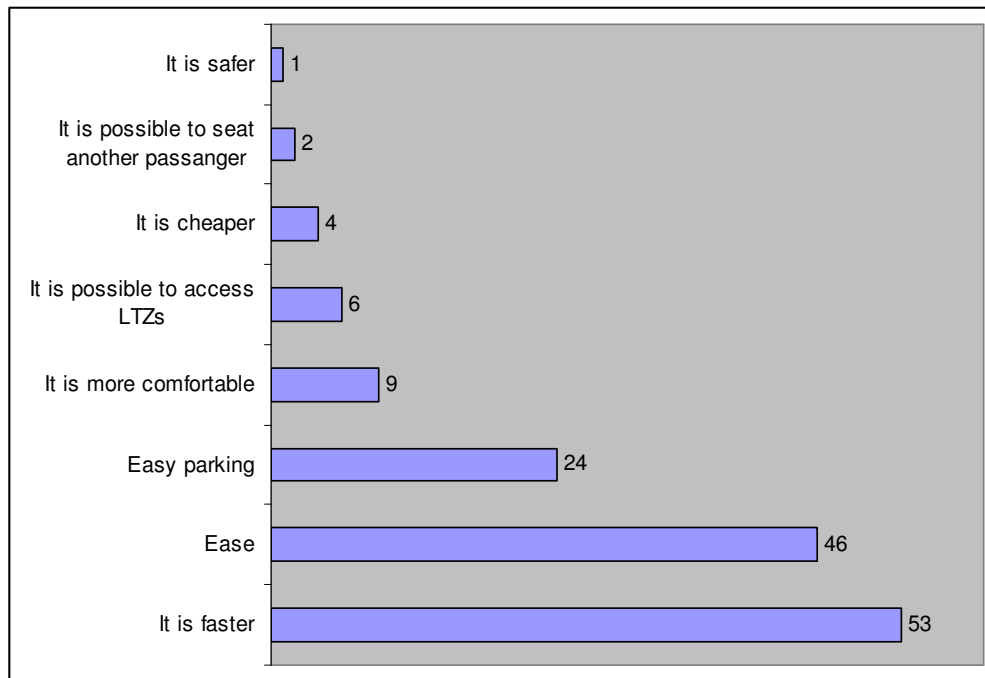
Consequently, “convenience” seems to be an even stronger reason to explain the preference for the mode than the usually cited: weather, population density or cultural habits. Since “convenience” can be defined as the “quality of being suitable to one’s comfort, purposes, or needs”, an explanation of the phenomenon based on personal motivations rather than exogenous factors seems reasonable. Such personal motivations are strong enough even to cast shadows on important issues such as safety and environmental concerns.

Thus, two-wheeler drivers are actually aware that motorcycles are more dangerous than cars, so that they perform a potentially hazardous activity. Their safety largely depends on their own behaviour (20), but they tend to marginalize the risk significance because they have a strong belief in their riding ability (21).

There are similarities observed in existing mixed-traffic situations, recurring patterns in Taiwan, Malaysia and Vietnam (4) which are typical of Mediterranean areas as well. They include risky or offensive behaviors, freedom to park everywhere and the ability to weave through queues in congested situations. Such driving and/or manoeuvring flexibility simply responds to the need to move fast, in spite of safety. It is not a product of cultural processes, because they are found in such different areas, and it is not affected by peculiar weather conditions.

To support the idea that the two-wheels option is a result of individuals’ will rather than external factors, it is worth analyzing some outcomes from a survey run in Rome (17) aimed at profiling typical two-wheeler users. According to the interviewees, main purposes to travel by motorcycles/mopeds are: work (53%), leisure (34%) school and errands/shopping (14% each). Moped riders assess favourably transit and especially the underground, but if the overall population of two-wheeler users is considered, 44% state that before riding they used to travel by

bus and 35% by car and the reasons to switch to two-wheelers is due to the mode's highest speed which allows surfing in the city traffic (53%), ease (46%), easy parking (24%). The other answers (Figure 5) still imply the personal convenience as the main motivation to switch to motorcycles and mopeds. It is worth noticing that low cost is not a top priority, as also confirmed by a 2008 survey run by IAC, the Italian Automobil Club, in which according to drivers' and riders' statements, the annual maintenance costs for two-wheelers are higher than those for cars (respectively 0,45 and 0,31 US\$\*km) (22).



**FIGURE 5 Reasons to switch to two-wheelers in Rome – preferences in percentage**

Pros and cons of riding, as revealed by the interviewees are consistent with the reasons which induced them to leave cars and transit; among the pros, again, speed, possibility to surf in traffic, easy parking are still the most favourably assessed issues. Moreover, moped drivers state that they like the fact that there is poor enforcement towards offending behavior. On the other hand, motorcyclists feel persecuted by control and enforcement officers and misjudged by other drivers. Other negative aspects shared both by motorcycles/mopeds riders are smog and poor road safety.

When asked about what they feel when riding, interviewees provided a number of motivations, virtually all not dependent on any economic concern. In particular they state that, as riders, they “pollute less and risk more”. Such an answer reveals, on the one hand, a total unawareness of the role played by two-wheelers as polluters (confirmed by the amount of riders whose vehicles are not compliant with the “clean vehicles” standards, about 41%). On the other hand, it is a kind of “egocentrism” which goes in hand with the feeling of almightiness and privilege revealed by the previous answers.

Roman citizens, in their turn, largely agree with the negative assessment perceived by moped drivers: according to a 2005 survey, Romans judge them as the greatest offenders of traffic rules.

Psychologists provided an interesting interpretation of the collected statements: riding in Rome is perceived as a “challenging, transgressive activity”, which allows individuals to express themselves freely, dominate the urban environment and feel as one with their vehicles. But transgression, challenge and misbehaviours are consistent with a shared feeling among the Romans who perceive the mobility situation in the city as in a state of “anarchy”, with no possibility to improve or trust administrators (15).

Hence, the Rome case study demonstrates that, in absence of economic reasons, the motivation of two-wheeler riders is influenced by the individuals’ convenience, regardless of any safety and environmental issues, and it is not strongly affected by the quality level of local transit.

## CONCLUSIONS

How many motorcycles/mopeds is “too many” for a given city or metropolitan region is a difficult question to answer. When there is general consensus that motorcycles are having an adverse impact due to large numbers, the policy can be one of reduction without setting a fixed limit. It is logical to begin with those who express the most willingness to switch to other modes if these modes can meet their needs. For example, commuting back and forth to an office job is a relatively easy travel profile for public transport projects to address. At the opposite end, it makes the least sense to target those who have a compelling need to use them for commerce or who express an emotional attachment to riding. This could lead to a backlash against all policies related to regulation of motorcycles. However, this motivation does not justify use of motorcycles without required discipline and charges for parking and, possibly, congestion.

Vehicle types that cause disproportionate numbers of accidents or pollution should also be targeted. Even if efforts to reduce usage have limited success, different vehicles could mitigate a lot of the externalities. It must always be borne in mind that impact can only be measured relative to what came before. If a person upscaled from walking or bicycling, the net impact to the community at large is negative. On the other hand, if downscaled from an automobile or truck, the net impact might be positive. Thus, the proliferation of exotic three wheelers and other larger displacement vehicles designed to carry heavier loads must be weighed against the reduction in use of trucks.

Policies are also ineffective where governments fail to advertise them or fail to appeal to riders’ sense of civic responsibility. The Rome case showed a good intention of encouraging a switch to less polluting and quieter electric scooters, but there was no follow through to let riders know that recharging stations were available. Nor was there a campaign to make riders aware how their behavior might endanger pedestrians or detract from the urban experience from others, something long overdue given that aggressive driving by large numbers of riders is not a recent phenomenon.

Similarly, classes of riders who cause disproportionate numbers of accidents or nuisances to the community at large should be targeted. Driving too fast, driving through red lights, parking on sidewalks, etc. should be addressed by effective deterrents in the same way that automobile violations are. But it should also be recognized that certain classes of riders need more training than others.

There is also the equity and fairness issue. Can motorcycles or mopeds be banned for the lower income classes when the higher income classes drive cars? If dramatic restraints are required, autos will probably have to be restrained in equal measure. This is especially true in the developing world where the poor might still be carrying heavy loads on their back. Moreover,

dramatic restraints may actually prove counterproductive, if the result is a significant increase in cars and trucks use.

As with any other transportation mode, the policy should not be the same in every city. There are questions that need to be answered before policies are formed. Research can only inform the decision-makers, who must ultimately reflect the political and economic realities of the metropolitan region and of the nation. Policies that cannot be enforced or cause excessive hardship to large portions of the population are doomed to failure.

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