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The unpredicted rise of motorcycles: A cost benefit analysis

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A R T I C L E I N F O

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A B S T R A C T

This article examines the consequences, for Paris, of the increase in two-wheel motor vehicle (2WMV) traffic (measured in vehicle/km). Our study reveals that, between 2000 and 2007, the subway's (Métro) share in total inner-Paris travel increased by 13.6%, the RER's share by 10.3% and the SNCF's share by 20.5%. These three means of transport account for 58% of daily travel. On the other hand, the bus share has decreased by 16% and that of cars by 23.7%. Private motor vehicles represent 37.3% of total travel. Looking at road traffic, where public transport (buses) and private motor transport compete for the use of limited road space, private motor vehicles account for 91.5% and public transport 8.5% of total travel.

The 2WMV share in Paris traffic increased by 36% between 2000 and 2007, with 2WMVs now accounting for a share twice as large as that of buses. A survey has shown that 100 million additional passenger kilometres were made by 2WMV in 2007 compared to 2000. 53% of this increase comes from people shifting to 2WMV from public transport and 26.5% from private cars. The remaining 20% is attributable to the increased use of 2WMVs by those already owning such vehicles in 2000.

Is the growth in the share of 2WMV traffic in Paris beneficial to the community? This shift in the means of transport generates time savings of €293 million and increases owners' vehicle usage costs by €49 million. The cost of accidents is increased by €49 million and the negative consequences in terms of pollution are estimated at €22.6 million. The welfare impact of the government revenue change is negative and equal to €4.7 million. In total, the gain for the community is therefore around €168 million. Accident costs are the key issue. The fact that there are on average 21 2WMV fatalities in Paris (average 2006–2007) for a means of transport accounting for 16% of passenger/km made every day in Paris offers a striking contrast to the 6 (average 2006–2007) fatalities concerning cyclists which account for a mere 0.1% of trips. The massive shift to 2WMV has taken place without any public policy support. Public policy could easily further improve the 2WMV cost-benefit balance by taking measures that would decrease the number of accidents.

1. Introduction

There is an extraordinary contrast between the lack of presence of 2WMV in the literature (and the public debate) and their rise in many cities. In large cities of developing countries, 2WMV are the first mean of transportation. Even in a city like Paris, where the public transportation system is very developed their share has being grooving by 36% between 2000 and 2007. This paper will show that this unpredicted rise is unavoidable because 2WMV presents very attractive characteristics. Moreover it is socially beneficial.

Transport in a big city can be analysed from two quite different perspectives: that of private choice, which seeks to optimise individual choice, and that of collective choice, pursuing a goal of sustainable means of transport. From the viewpoint of private choice, the choice of the means of transportation is determined by safety, reasonable cost and the least time. The comfort and flexibility offered by different forms of transport play a decisive role in individuals' choice. These variables can be summarised by stating that individuals seek to minimise their total cost of travel. Seen from a collective viewpoint, the choice of individual transport should be sustainable, i.e. compatible with existing infrastructures and causing minimal (environmental) impact. Public policy is designed to allow compatibility between these two choices. By increasing taxes, expanding infrastructures, developing public transport, etc., the government exerts its influence on individuals' choices, guiding them in the direction it has chosen.

2WMV transport has a number of specific features and should therefore be the object of specific public policies. It is surprising that there are only a very small number of studies focusing on 2WMV transport and public policies remain very unclear in this area.

In the case of Paris, using 2009 data from the Travel Observatory (*Observatoire des Déplacements*) and the comprehensive

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transport survey conducted in 2002 by the DREIF (*Direction régionale de l'Equipement d'Ile-de-France*) we can isolate the respective changes of intensity, measured in vehicle/km, in the use of different means of transport in the Paris metropolis. The purpose of this study is to begin to address the lack of debate on the role of 2WMV in major cities. We would like to engage in an initial cost-benefit study of the shift towards 2WMV. The terrain for this study is provided by the City of Paris[1] between 2000 and 2008.

This study opens up a debate on the relative effectiveness of different means of urban transport. Whether there is one means of transport "more efficient" than others is the subject of a broader debate, which we will come back to in the conclusion. This is an initial study aimed more at triggering a debate on the role of 2WMVs in large cities than claiming to arrive at any definitive conclusion. Our work is based on data, which we shall see to be, even though coming from official sources, questionable, incomplete and often inconsistent.

2. Methodology

We intend to calculate, for Paris, the costs and benefits of the increase in 2WMV traffic between 2000 and 2007. Using 2009 data from the Travel Observatory (*Observatoire des Déplacements*) and the 2002 and 2008 General Transport Surveys (*Enquête Générale Transport*) we can isolate the respective changes of intensity in the use of different means of transport within the Parisian metropolis, measured in vehicle/km.

On this basis, we are in a position to calculate the costs and benefits of the shifts in use. We will compare the benefits, particularly those associated with time savings and additional "new" travel, with costs, in particular those caused by accidents and pollution. To illustrate our approach, consider the case of a car driver, who decides from now on to use a 2WMV. The cost of depreciation of the vehicle decreases; fuel consumption, the speed of travel, insurance, taxes, potential accident costs, etc., all change. This requires identifying the vehicle/km now being made by 2WMV. Some of these vehicle/km are attributable to additional travel (2WMV users travelling more) while others will replace journeys previously made by car or public transport. It is worth noting that when users shift from using the car to using a 2WMV they no longer need so much road space, thereby contributing to easing traffic congestion. The community witnesses a change in costs and benefits. All variables are affected (speed, number of journeys, fuel consumption, CO_2, congestion, taxes, public transport usage rates, accident rates, noise levels, etc.).

Public policy can either facilitate or hamper the increased use of a means of transport. We will look into public policy in Paris.[2] The policy pursued by the city authorities may have encouraged widespread use of 2WMV unintentionally without actively targeting or encouraging it or even accompanying it by incentives or support.

All forms of urban transport have their advantages and disadvantages. It is interesting to know whether public policy is aiming to reduce the disadvantages associated with 2WMV usage or if it is neutral. In the case of 2WMV usage it can be assumed that the main drawback is its proneness to accidents. If, moreover, the benefits associated with this means of transport are high (time savings), we can expect public policy to try to reduce the disadvantages in order for citizens to take full advantage of the benefits.

Public policies are generally associated with public expenditure. The amount of expenditure attached to a policy is an indicator of the relative importance attached to different objectives by public decision-makers. Budgets of various ministries are often compared to discuss the relative importance attached to them. This approach, though somewhat frustrating when relating to completely different targets (Education versus Defence, for example), is well justified when comparing several programmes targeting the same objective. In the case of urban transport, the same goal is pursued, whatever the means of transport. Public policy must seek to facilitate mobility while keeping the sustainability of urban development in account. Accordingly, it is interesting to compare the interest, the directions taken, and, of course, the costs attached to each means of transport.

3. Distribution between modes of transport

The data for calculating the importance of 2WMV in Paris traffic is not very precise. There are two main sources: the General Transport Survey (*EGT: Enquête générale transport*) and the Paris "travel balance" (*Bilan des déplacements*). In addition there is a surveys carried out by us.

3.1. Sources and data

We use two sources. First, the national EGT survey on transport and travel carried out for the Ile de France by DREIF (Direction Régionale de l'Equipement Ile-de-France) in 1976 and 1983, which unfortunately has not been repeated. The EGT has the double disadvantage of only distinguishing between different types of public transport in the data collected but not in their analysis, and only involving journeys undertaken by Ile de France residents, excluding tourists' travel in Paris and all delivery vehicles. The second source is the "travel balance", a booklet published from 2002 onwards by the City of Paris, which lists all available information on travel in Paris. This booklet uses EGT data. Though the City of Paris has collated further data from a number of sources, the result is very disappointing. The Travel Observatory (*Observatoire des Déplacements*) only monitors 190 km (equipped with measuring devices) out of a total network of 1500 km, not more than the RER and commuter train share in Paris travel. Data on taxi use (we will refer to this later) is questionable. Data on bus use contradicts that produced by the RATP, a point to which we will also come back to later.

In the opinion of Orfeuil et al. (2006), experts in the field of transport and commissioned by the City of Paris to provide an assessment thereof, the Travel Observatory's booklet does not therefore provide a comprehensive view of travel in the Paris area. The booklet contains non-comparable indicators, usage levels of public transport, vehicle traffic statistics solely for a sub-network equipped with measuring instruments, usage levels at a few measuring points. In short, according to these researchers, "*there is no overall view with regard to the weighting of the different transport systems.*"

We are attempting to correct the Travel Observatory's data to get a clearer picture for the different means of transport. Table 4 addresses this deficit, providing a reasonable estimate of the modal distribution (the distribution between means of transport) in 2000 and 2007. The calculations upon which Table 4 is based firstly rearrange the official data in order to give a better picture

[1] Analysing urban travel in Paris focuses on travel within the city, i.e. with a journey's origin or destination in Paris (passing through Paris), regardless of a person's place of residence.

[2] Transport policy in Paris is affected by the decisions of the city authorities which have the authority to regulate traffic lanes and their usage, and by STIF, the company operating public transport on the Ile de France. The city authorities are therefore not the only political player in Paris transport policy. We can assume that the city policy is implemented under the constraints of the public transport offering managed by STIF.

of the modal split. Secondly include the 2WMV data provided by our own survey conducted in November 2008 (Kopp et al., 2008).

A first remark on the period preceding our study is needed here. Contrary to a widespread perception transport demand in Paris did not increase, but actually decreased in the 1990s. The number of vehicle trips with Paris as their origin or destination went down from 7.17 million in 1991 to 6.83 million per day in 2001, a decrease of about 5%, or 0.5% per year (see the different "travel balances"). This reduction encompasses all motorised trips. We need to wait for the new EGT, scheduled for 2009, to confirm or correct this trend.

Finally, several concepts need to be clarified. First, the statistics are calculated using the concept of a "principal means of transport". A journey on foot is recorded as a "walk". When two modes of transport are used (e.g. bus+walking), the mode used for the longer distance is the one used in classification. This method of classification underestimates the importance of journeys on foot. However, our table only covers trips using vehicles. The journeys listed in the table only "concern Paris", i.e. they relate solely to trips with Paris as their origin and/or destination.

The unit of measurement is "vehicle/km".[3] Using just the number of trips as the unit of measurement gives an incorrect picture, with 50-meter trips from home to the bakery having the same weight as 15 km trips from home to work. The "vehicle/km" unit of measurement includes the length of the trip in the weighting and is all the more justified as longer distance travel is the area, where the users come into collision with each other (public transport or road congestion).

The share of Parisians (in the sense of people actually living in Département 75) in these journeys is not known precisely, but is probably close to the half. They are undoubtedly in the majority when using buses and perhaps the underground, but in the minority when it comes to use of private cars, especially on the ring road, as well as in the use of the RER and SNCF. Orfeuil et al. (2006) provide the following data: 89% of trips on foot and 100% on rollerblades are attributable to Parisians. Furthermore, they account for 100% of cycle trips, 58% of 2WMV trips, 82% of bus trips, 69% of metro trips, 18% of RER trips, 46% of SNCF trips, 50% of car trips (with just the driver in the car), 58% of car trips with passengers, 70% of taxi trips, 30% of commercial vehicle trips, or 53% overall.

The data provided by the Travel Observatory on taxis is questionable, pointing to a 289% increase in taxi passenger/km in the period between 2000 and 2007. This seems hardly credible. The explanation is that the Travel Observatory considers that the taxi share in Paris traffic increased from 2% to 6% in the period between 2000 and 2006. We therefore consider these figures to be unreliable, necessitating a specific survey of taxi use. For the sake of realism, we have used, for 2007, the same figure as in 2000, pending more detailed information.

As regards buses, the Travel Observatory reports a slight increase in usage between 2000 and 2007. We contacted the primary source for statistical data, the RATP. According to this organisation, use of buses is declining. For some reason unknown to us, the Travel Observatory is reporting an increase in the use of buses during the decade while the RATP is stating a decline (Table 1).

The data on 2WMV usage compiled by the Travel Observatory (2000–2009) is unsatisfactory. The Observatory calculates an annual index of 2WMV usage based on sample measurements taken at six sites (Bd. Sébastopol, Boulevard Saint Germain, Rue de Rivoli, Boulevard Henri IV, Jemmapes Avenue) every other Tuesday, during the following hours: 8:30–9h30 and 17h30–18h30. This procedure is quite amazing. Besides the fact that data collection is concentrated around the Hôtel de Ville, it only covers major routes. Failure to include minor streets leads to an over-representation of 2WMV traffic on major arteries in total 2WMV traffic, without being able to predict the consequences of this over-representation. Similarly, the proximity of the sites to one another leads to vehicles being counted twice, probably without consequences. The sole focus on peak hours also leads to this part of the day being over-represented. The methodology used is relatively crude. It was without doubt warranted at a time when 2WMV traffic only represented a very small share of total Paris traffic. A more in-depth study was seen to be necessary in view of the gain in importance of this mode of travel. In this spirit, we conducted a survey ourselves. In November 2008, we counted vehicles in several locations in Paris (Kopp et al., 2009). In choosing November, we can in no way be accused of over-estimating 2WMV traffic. The choice of locations was made randomly.[4] Table 2 shows the aggregated measurements, by time-slots and types of vehicle.

Our survey shows that on an average day, commercial vehicles account for 10.55% of road traffic (excluding buses and bicycles), taxis 8.80%, 2WMV 17.18%[5] and private cars 63.48%. However, we have no data for 2000. Knowing that the Travel Observatory under-estimated the share of 2WMV in 2007, we can assume that

Table 1
Bus traffic (Paris).
Sources: RATP, Annual statistics, 2003, 2005, and 2007.

Year	2000	2001	2002	2003	2004	2005	2006	2007
Vehicles/km	920	907	8433	8159	8272	7851	7966	7660

Table 2
Measurement of vehicles by time and type of vehicles.
Source: own survey.

Time slot	Commercial	Taxi	2RM	Private cars	Total vehicles
7:00–9:00	2056	1008	2351	8673	14,288
10:00–12:00	1792	1179	2362	8925	14,258
14:00–16:00	1364	1116	2356	8269	13,105
17:00–19:00	1308	954	2893	9836	14,991
21:00–23:00	629	1505	1660	7315	11,109
Total	*7149*	*5962*	*11,642*	*43,018*	*67,771*

[3] Also referred to as passenger/km. It is generally assumed that the occupancy rate of a car is 1.3. In the absence of any specific 2WMV data, this figure has been arbitrarily set to 1 for 2WMV, although it is usually slightly higher than 1.

[4] The choice of locations was done randomly by drawing from among 50 selected locations in Paris. These 50 sites are representative of the total Paris road area and the differences in their use. Major boulevards, squares, the Portes opening onto the outskirts, streets going through several districts, minor streets were all part of the sample. The measurement took place at the following 6 sites: Montparnasse train station, Place de Clichy, Rue de Crimea, Rue de Vaugirard, Boulevard de la Villette, Rue Barrault. Measurements were taken during the period from 6 to 22 November 2008. Each site was surveyed for two days, a weekday and a Saturday. This procedure enables the differences in traffic flows between the weekend and the week to be taken into account, thus providing figures on the average traffic per mode of transport in Paris. Counting was done using five time-slots: 7:00–9:00, 10:00–12:00, 14:00–16:00, 17:00–19:00, and 21:00–23:00. A total of 67,771 vehicles were counted.

[5] In concrete terms, 2WMV traffic represents, according to our survey, 17% of private road traffic and other vehicles 83%. This means that 2WMV traffic accounted for 1.44 billion vehicle/km in 2007 and 1.06 billion vehicle/km in 2000, i.e. 11% of total private road traffic and not the 4% stated by the Travel Observatory.

Table 3
Vehicle proportions per time-slot.
Source: Own survey.

Type of vehicle	7:00–9:00 (%)	10:00–12:00 (%)	14:00–16:00 (%)	17:00–19:00 (%)	21:00–23:00 (%)
Commercial vehicles	14.39	12.55	10.41	8.73	5.66
Taxis	8.45	8.26	8.52	6.36	13.55
2WMV	16.45	16.68	17.98	19.3	14.94
Private cars	60.70	62.51	63.10	65.61	65.85
Total	*100*	*100*	*100*	*100*	*100*

a similar under-estimation was already made in 2000. The 2WMV growth rate put forward by the Observatory (36% between 2000 and 2007) is however credible, even though somewhat low, and we have applied it for 2005, based on our 2007 data (Table 3).

In our survey, 2WMV traffic is heaviest between 17:00 and 19:00. Demand for taxis is strongest between 21:00 and 23:00 and lowest between 17:00 and 19:00, probably because the offer is non-existent. Commercial vehicles are to be found on Paris roads the most in the morning from 7 to 9 am. The curve for private cars increases up to 9 am and then decreases up to 14:00. This reflects the fact that people use their cars to get to work, where they remain. Likewise, the curve increases up to 19:00, with people using their cars to get home from work. The curve again decreases throughout the evening, with only a few people using their cars late to get home. The 2WMV curve follows roughly the same pattern from 16:00 onwards. However, up till then, the 2WMV curve increases slightly. This may be explained by the fact that this means of transport is used for practical purposes within Paris, by mobile people going to appointments, by couriers, or by (secondary school) students with non-conventional schedules. The taxi curve is relatively flat up to 17:00, declines slightly up to 19:00 before increasing in the evening. Taxis are not used much between 17:00 and 19:00, the time-slot where people leave work. Taxi use is intensive in the evening, in line with other travel purposes than during the day (leisure, going out, returning home).

The weight of each mode of transportation greatly changed from 2000 to 2007 (see footnote 1). Table 4 gives a clear picture of these changes. We used the Travel Observatory's data, making the changes outlined above for bus and 2WMV usage. With regard to taxis we believe the data to be poor but we are not in a position to provide correct data.

3.2. *Changes in the modal distribution*

We see that over 57% of people transport, measured in passenger/km, takes place using the rail-based infrastructure, mainly underground (Métro, RER). The other 42% takes place in Paris streets, which are further burdened by lorry and commercial vehicle traffic (not included in Table 4 on people transport expressed in passenger/km). This basically means that public transport and private transport use different routes and therefore do not come into conflict with each other. The exception, and we will come back to this later, concerns travel by bus. In 2007, this accounted for nearly 4% of total travel, and about 9% of all journeys using the road network (less if we take into account delivery vehicles). Travel by bike does not appear in Table 4, which concerns only trips using motor vehicles. Bikes are of no great importance because they are slow, do not transport passengers or goods, and are not used for long distances. Bike use is estimated at 60,000 passenger/km per day, representing approximately 0.8% of total road travel, or 0.4% of all travel. Data on bike use is inaccurate. One component is, however, known fairly accurately—the Vélib.[6] 20,000 Vélibs, used 6 times per day for 2 km trips, amount to 240,000 passenger/km per day.

Table 4
Changes in traffic shares[a] between modes of transport (2000–2007).
Sources and notes: Figures in the first two columns are in billions of passenger/km p.a. The remaining figures are percentages. The growth data comes from the Travel Observatory (2007), unless stated otherwise.

	2000	2007	Rate of growth (%)	% of total
Subway	6.14[b]	6.98[b]	+13.68	32
RER (RATP lines A and B)	2[c]	2.21[c]	+10.5	10
SNCF (trains. other RER)	2.83[d]	3.2[d]	+13.07	15
Total rail-based traffic	*11*	*12.3*	*+11.82*	*57*
Bus	0.97[e]	0.77[e]	−20.62	4
Private cars	6.7[f]	5.11[f]	−23.73	24
Private cars (ring road)	1.85[g]	1.71[g]	−7.57	8
Taxi	0.19[h]	0.19[h]	+0[i]	1
2WMV	1.06[j]	1.44[j]	+35.85	7
Total road traffic	*10*	*9*	*−10*	*42*
Overall Total	*21.7*	*21.5*	*−0.77*	*100*

[a] We only have data for 321 working days. When calculating annual data, we consider traffic to be 20% less on Saturdays and Sundays than on the other 5 weekdays. This means that we add on 8%.
[b] 1283 (journeys p.a. in thousands) × 0.95 (percentage of journeys within Paris) × 4.8 (average distance in km)/321 (days per year).
[c] 404 (journeys p.a. in thousands) × 0.8 (percentage of journeys within Paris) × 6 (average distance in km)/321 (days per year).
[d] 547 (journeys p.a. in thousands) × 0.8 (percentage of journeys within Paris) × 6 (average distance in km)/321 (days per year).
[e] 357 (journeys in thousands) × 2.4 (average distance in km)/321 (days per year). The annual statistics of the STIF (*syndicat des transports d'IledeFrance* which is the regulatory body for public transport on the Ile de France) report 846 million passenger/km for Paris buses in 2000 and 827 million in 2004.
[f] 2143 (number of vehicles per km per hour on the roads monitored) × 190 (length of road network monitored in km) × 14 (hours between 7:00–21:00) × 1.25 (to take into account traffic between 21:00 and 7:00 × 2.5 (taking into account traffic on non-monitored stretches × 0.87 (taking into account the fact that, in 2000, 2% of vehicles were taxis, 7% commercial vehicles and 4% motorbikes. In 2007 the taxi share rose to 6%) × 1.25 (average occupancy).
[g] 6162 (number of vehicles per km per hour per direction) × 70 (length of ring road lanes in km) × 14 × 1,25 × 0,87 (see above) × 0.65 (share of traffic involving Paris) × 1.25 (average occupancy).
[h] Vehicle figure × 2/87 (2000) and 6/87 (2007) (taxi traffic as a share of total car traffic went up from 2% to 6%).
[i] In the absence of proper data for taxis we are using the 2000 figure for 2007.
[j] Vehicle figure × 4/87 (motorbikes/total cars).

The major trends reflected in Table 4 show that rail-based traffic has increased by 12% while road traffic has declined by 10%. The car share has declined by 24% (non-ring road traffic) while the bus share has gone down by 20%. The decade's big winner is 2WMV traffic, which has already risen by 36% (and this figure is probably under-estimated). There are, in 2007, twice as much Vehicle∗km done by 2WMV than by buses. The contribution of SNCF and RER trains (excluding lines A and B) is up by

[6] Vélib' is a public bicycle rental programme in Paris, France. The initiative was pushed by Paris mayor Bertrand Delanoë of the French Socialist Party. The system was launched on 15 July 2007. 17,000 bicycles were introduced to the city with 750 automated rental stations each with fifteen or more bikes/spaces. There is one station every 300 m throughout the city centre. Each Vélib' service point/station is equipped with an automatic rental terminal and stands for dozens of bicycles. If a user arrives with a rented bicycle at a station without open spots, the terminal grants another 15 min of free rental time. In order to use the system, users need to take out a subscription, which allows the subscriber an unlimited number of rentals. Subscriptions can be purchased at €1 per day, €5/week or €29/year. With a subscription, bike rental is free for the first half hour of every individual trip; an unlimited number of such free trips can be made per day. A trip that lasts longer than 30 min incurs a charge of €1–€4 for each subsequent 30-minute period. The increasing price scale is intended to keep the bikes in circulation. A private company, in exchange of advertising space on the public dominion, runs the system for the city.

Table 5
Distances travelled.
Source: Orfeuil et al. (2006).

Principal mode	Average distance travelled in Paris (km)	% of journeys	% distances travelled in Paris	Paris % the distance
On foot/rollerblades	1.8	35	7.1	95
By bike	0.2	1	0.8	66
By 2WMV	0.6	2	2.4	45
By bus	1.7	6	6.7	85
By Métro	7.7	20	30.4	73
By RER				
By car (as a driver)	5.0	16	19.8	33
By car (as a passenger)	1.2	4	4.7	36
By taxi	0.2	1	0.8	50
Commercial traffic	0.3	1	1.2	23
Total	*25.3*	*100%*	*100%*	*42*

10.5%, that of the RER (lines A and B) by 10% and that of the Metro by 13.6%. These results raise the question of congestion in public transport. Bus use is not as successful as expected, despite strong public policy in its favour. The metro, trains and the RER all benefit from the switch from cars but are at saturation point. The question is raised as to whether the car share can continue to decline without loss of mobility, knowing that the rail infrastructure cannot cope with unlimited demand. It needs to be stressed here that 2WMVs provide a service without public policy support or subsidies.

Orfeuil et al. (2006) provide interesting information on distances travelled. The calculation of the distances travelled strictly within Paris is no problem. The estimate of the "Parisian" share of travel between Paris and the suburbs is more complex. All major institutions (DREIF, IAURIF – an Urban Studies Institute under the aegis of the Conseil Régional d'Ile de France — the City of Paris, etc.) have geo-based traffic-allocation software, enabling the allocation of the load carried by Parisian arteries, i.e. letting them pinpoint the distance from the Porte de Vanves for a Metro journey from Chatillon to Saint Lazare or from the Porte de Bercy for a journey by car from Marne la Vallée to the Place d'Italie. As Orfeuil et al. (2006) did not have such a tool available, they used the following simple approximation: they considered that for a journey using a given mode, the distance travelled within Paris on a journey between Paris and the suburbs is equal to the distance travelled using that mode for any inner-Paris journey, which is listed in the EGT.

In conclusion, then, we know from Table 4 that the number of passenger/km made by 2WMV increased by 36% between 2000 and 2007, rising from 1.06 to 1.44 billion vehicle/km, an increase of 380 million passenger/km. We know from Table 5, which are the respective shares of trips made in Paris and in the suburbs. What remains is to investigate the source of the new 2WMV vehicle/kms. Are they made by former car-drivers or public transport users, or by individuals making greater use of their two-wheelers? To find this out, we dedicated some specific questions of our survey to 2WMV user (Kopp et al., 2008).

4. The growth in the 2WMV share of Parisian mobility

We have made an attempt to understand the source of the new 380 million passenger/km appearing in Paris between 2000 and 2007.

4.1. Survey method

We asked to 141 2WMV drivers to fill a questionnaire. The second part of our survey was carried out in two consecutive weeks between Thursday 6 November and Saturday 15 November 2008. Four investigators worked with a questionnaire in eight locations in Paris, with each investigator being responsible for two locations. The survey locations were selected randomly with a ballpoint pen thrown at the map of Paris. We initially selected fifty locations, with lots being drawn for the final eight locations. These were: Boulevard de la Villette, Rue Vaugirard, Porte de Clignancourt, Montparnasse station, Place de Clichy, Rue de Crimée, Place de la République and Rue Barrault. These places offer a range of different types of Paris traffic routes. At each selected location, the investigator stood near a place where 2WMV drivers routinely stopped (motorbike parking lot, filling station and motorbike shop) in order to question them. The questionnaire was used at each location on one weekday and one day of the weekend. This procedure enabled the different uses made of 2WMVs at different times of the week to be captured. This led to the questionnaire being used at each location on a Thursday and Saturday of the same week. The questionnaires were used during the 4 time-slots: 8:00–9:00, 11:30–12:30, 16:30–17:30, and 21:00–22:00. The questions were centred on the characteristics of the drivers (age, gender, income, location of work and housing, purpose of the trip, time spent per day on the trips, etc.)

Table 6
Vehicle characteristics.
Source: Kopp et al. survey (2008).

Under 50 cm^3	14.48%
Between 50 and 125 cm^3	56.55%
Over 125 cm^3	28.97%
Total	*100%*
Scooters	66.9%
Motorbikes	33.10%
Total	*100%*

4.2. Results

Vehicle characteristics show a strong predominance of low-powered motorbikes and scooters, due on the one hand to the urban character of this type of 2WMV and on the other hand to regulations governing 2WMV (Tables 6 and 7).

2WMV owners come from all classes. We perceived that age and gender,[7] rather than income, are more the inhibitors against a widespread use of 2WMV.

Other information concerning the characteristics of drivers are as follows. Daily trips made by 2WMV are 65% inner-city and 35% mixed. 70% of drivers reside in the Ile de France and 30% in Paris. Reasons for travel are: work (91.72%), school (3.45%), and recreation (2.76%). The distances travelled by 2WMV are very different from one use to another. On average 239 km are travelled per week. The median is 150 km per week. The average time spent on the 2WMV is 1.5 h and the median 60 min. It is interesting to note that 58% of 2WMV users do not routinely use any other means of transport. Those who do use such choose the car (28%) in preference to public transport (10%).

Of current 2WMV users, 60% were already using a 2WMV as a means of transport in 2000. 31% use it more intensively, on average 100 km a week more. This figure is important. With the average distance travelled by 2WMV at nearly 200 km and the extra distance travelled by those already using 2WMV at 100 km, it follows that once the 2WMV has been adopted as a means of

[7] Less than 10% of 2WMV users are women. We did not examine whether their use of 2WMV differed from that of men. Our survey needs to be extended in this direction.

Table 7
Drivers' socio-professional backgrounds.
Source: Kopp et al. survey (2008).

Managers	28%
Liberal professions	26%
Civil servants	6%
Employees	29%
Students	8%
Unemployed	2%
Retired	1%
Total	*100%*

Table 8
Sources of new 2WMV journeys.
Source: Kopp et al. survey (2008) and data from the Transport Observatory taken from Table 5.

Category	% per category	New passenger/ km (in millions)
Longstanding 2WMV users	20.16	76
Former public transport users	53	201
Former car users	26.5	100
Former cyclists	0.41	1.5
Total	*100*	*380*

transport, drivers greatly expand usage, gaining in mobility. We are witnessing a phenomenon that deserves to be looked into closer, but which reflects the increasing rate of adoption.

Table 8 lists the sources of the additional 380 million passenger/km (compared to 2000). It distinguishes between longstanding 2WMV users, former users of public transport, former car users and former cyclists.[8]

Table 8 shows us that, of the total additional distance travelled, between 2000 and 2008, across the whole range of sources, 26.5% is attributable to a switch from car use to 2WMV use, corresponding to 100 million passenger/km per year. The greatest switch is, however, represented by public transport users switching to 2WMV: 53% or 201 million passenger/km per year previously done using public transport and now done by 2WMV.

5. The welfare impact of the shift towards 2WMV

When needing to compare two situations, economic theory proposes the comparison of the level of welfare associated with each situation. The difference in levels is the expression, in monetary terms, of all the costs and all the benefits associated with each option. In our case, we are going to measure the variations in costs and benefits caused by the shift towards 2WMV. From a conceptual point of view, such an analysis can be seen as an extension of the concept of cost–benefit analysis. The latter consists of identifying all costs and benefits associated with a project or policy, giving them a value and comparing them. There are numerous difficulties attached to this. Economic theory has looked into these and the answers, or better some answers, are available in scientific literature. The World Bank, which has without doubt traditionally been the world's major compiler of cost–benefit analyses, has contributed greatly to refining cost-benefit analysis, publishing its own manual (World Bank, 1998).

Our study compares the situation in the Paris transport market in 2000 with that of 2007. We calculate the changes in costs and benefits associated with the new modal distribution. If the cost–benefit balance is found to be positive, this will mean that society as a whole benefits from the new distribution. In contrast to a traditional cost-benefit analysis, we are not calculating NPVs or RIRs,[9] as the change in the modal distribution is the result of a spontaneous adaptation of individuals to their environment, devoid of any public policy promoting a voluntary shift towards 2WMV usage. The shift is to be seen more as an unforeseen consequence of the overall transport policy of the City of Paris. The whole shift, whether positive or negative, can obviously not be attributed to the City of Paris authorities. The change in individuals' behaviour is explained by many factors affecting their choice of transport, including, but not solely, the City's transport policy. The price of fuel for example, completely unrelated to the City's policy choices, plays a significant role. The discussion on public transport policy in Paris, including the specific policy directed towards 2WMV, is quite complex, since the measured results cannot be directly attributed to policy.

5.1. The variables

The speed of travel is an important variable. Indeed, the main reason put forward by the 2WMV users we interviewed to justify their choice, is the time saving. Orfeuil et al. (2006) have calculated a speed index per mode of transport. The duration of the trip is measured "door to door", including the time necessary to gain access to a mode of transport and waiting time. The actual speeds achieved by each means of transport are therefore higher than the speed index. Furthermore, calculations of distance "as the crow flies" are done using the map squares in which the departure and arrival locations are located. These squares are sometimes the same, especially when journeys are done on foot. The distance is then zero, while the duration may be a few minutes. This leads, especially when walking, to a "distorted"-speed index compared to actual speed. Finally it is generally thought that the distance actually covered is around 1.3–1.4 times more than actual "door-to-door" distance for inner-city travel. This is the reason for Orfeuil et al. (2006) preferring to speak of "a speed index" rather than "spot speed".

It is appropriate to calculate the gain in time achieved by switching from one or other mode of transport to 2WMV. A 2WMV user does 45% of his daily mileage in Paris and 55% in the suburbs (see Table 5). The time savings achievable by switching to 2WMV are given (as a percentage) in the right column of the Table 9. One just needs to apply these time savings to the portion of travel made in Paris or the suburbs. For a mixed type journey (part of the journey in Paris, part in the suburbs) the following time savings are achievable: bus +221%; metro: +124%; RER: +34%; rail: +59%; car +47%.[10] Without any disaggregated data for public transport, we will make the conservative assumption that switching from public transport to 2WMV leads to a 60% time saving. Accordingly, on the assumption that public transport users spend 1 h a day in public transport, the switch to 2WMV will provide them with a daily gain of 36 min.

Time (saved) is assigned a value. In accordance with the recommendations of the Boiteux Report (2001) this is set at €15 per hour in 2007. Furthermore, a human life is valued at €1.5 million, a serious road injury at €150,000 (and at €225,000 when using public transport), a minor road injury to €22,000 (and at €33,000 when using public transport). These figures require two explanations. Firstly, all values assigned by the Boiteux Report to

[8] Without any good data on bicycle accident rates, we will not be taking this source into account. It is not very significant anyhow.

[9] The NPV is the Net Present Value derived from a project and represents the balance of current costs and benefits. The RIR is the rate of internal return discounting the NPV. In our study, we are not looking at a "project", but two situations distant in time.

[10] We use the date of Table 9, second row for a mix-trip (Paris and Banlieue).

Table 9
Range and speed of travel—within Paris and between Paris and the suburbs.
Source : Orfeuil et al. (2006) and own calculations.

Main means of transport	Range (km)	Speed index range/duration	Gain in time possible by switching to 2WMV (%)
Within Paris			
On foot	0.5	2.2	+386
By bike	2.2	6.5	+64
By 2WMV	3.3	10.7	–
By car	2.9	7.3	+46
By bus	2.4	4.7	+127
By Métro	3.7	7.1	+50
By RER	4.7	8.4	+27
By rail	3.8	7.2	+48
Paris-suburbs			
By 2WMV	11.6	23.7	–
By car	12.1	17.0	+39
By bus	4.8	6.7	+253
By Métro	7.1	9.2	+157
By RER	18.2	17.7	+34
By rail	14.0	15.0	+58

various costs represent opportunity costs.[11] To say that 1 h of time is worth €15.00 means that the value of the best alternative use of this time is €15.00. An individual spending 1 h travelling could use this time on a recreational activity with a value of €15.00 or on working to earn that amount. Putting the value of human life at €1.5 million means that, on average, an individual would, during his lifetime, have created net wealth equal to that amount. This amount is his contribution to general prosperity. The values estimated by the Boiteux report include all effects induced on all markets. By saving 1 h travelling, an individual avoids spending a scarce resource, time, for an amount of €15.00. Whether shopping or sleeping, the social effect is the same.[12] The theory implies that the individual makes little use of the marginal benefit of his activities. Secondly, the difference between the costs of accidents reflects their seriousness. It is legitimate to consider that the accidents while using public transport and accidents incurred while using private transport are not, on average, equally serious.

The probabilities of death or injury for the different means of transport are calculated by us using data from the Travel Observatory and the number of passenger/km. We use the average accident rate over two years to lessen the impact of any exceptional accidents on our results. Several remarks on accident rates are needed here. Recent articles highlight both the high 2WMV mortality rate and ways of bringing it down. Chapelon (2008) reports an increase in the number of motorcyclists killed which is "*mainly due to the increase in traffic: having separate lanes for cars (or public transport) has major consequences on road safety results*". The motorcyclist share of people killed in traffic accidents in France has risen from 10% to 18%. The same author underlines the specific risk for motorcyclists in France. The risk of being killed is about two times higher in France than in Germany and higher than in Belgium or Austria. According to the same author, 50% of fatalities could be saved with better compliance to road laws (in particular laws on alcohol and speeding). PREDIT (2008) states that, in France, the death risk for motorcyclists is 20 times higher than for car-drivers and puts forward a series of measures to reduce mortality. It is worth noting that the danger in the major cities, including Paris, is very different from that seen on average in France. We are not aware of any recent studies on this subject. It can be argued, however, that a significant element of the danger comes from other vehicles. Cycling is a case in point here. The fact that, since the launch of Vélib (the Paris public bicycle rental scheme) on 15 July 2007, 6 people using this service have been killed in the capital is worrying. The fact that on average 21 motorcyclists are killed each year on Paris streets (average 2006–2007), using a means of transport accounting for 16% of passenger/km made every day in Paris and 6 cyclists killed (average 2006–2007) using a means of transport accounting for a mere 0.1% of journeys, offers a striking contrast. Significant expenditure have been made for bicycles, in particular to make their use safer. Little or nothing has been done for the 2WMV sector even though its social benefit is incomparably higher and even though its accident rate is far too high compared to "protected" modes (cars and public transport), though low compared to cycling.

Greenhouse gas (GHG) emissions run linear to fuel consumption. The average emission of all cars (both new and used cars) registered in France is 176 gCO_2/km (Grenelles de l'environnement, 2009). ADEME's "eco-calculator", although only referring to "average motorcycles" without any distinction for 50 cc bikes, leads us to believe that 2WMV fuel consumption is about half that of cars. ACEM measurements (2008), using a representative sample of 2WMVs, shows average emissions of 71.4 g CO_2/km for 50cc bikes, 84 g CO_2/km for 125cc–250cc bikes and 125 g CO_2/km for bikes over 250cc. After taking into account the preponderance of low-powered bikes in urban areas, it is reasonable to assume that 2WMV emissions are half those of cars. Once emission levels in grams of CO_2/km are known, it is just a question of multiplying them by the cost per tonne of CO_2. The cost per tonne recommended by Boiteux and the "Grenelle de l'environnement" is €25/tonne or €0.04 per vehicle/km. This describes the cost to the community of having an additional tonne of CO_2 released into the atmosphere. This cost should equal the cost involved in preventing this tonne being released. In practise, this figure comes from observations of the CO_2 market. It can be criticised by saying that this figure is dependent on the number of emission allowances granted at the launch of the Kyoto Protocol. If this figure had been lower, the price of CO_2 would be higher.

Increases (or decreases) in government revenue are accounted for as profits (or losses). We follow here the cost-benefit analysis principle. We take account only the welfare loss (benefit) with a Marginal cost of Public fund[13] of 0.3 (Boardman et al., 2006). Other variables will be set in line with the continuing development of our project.

5.2. The results

Switches from cars to 2WMV. 26% of new passenger/km come from former car-drivers, making about 19,300 new motorcyclists. The overall balance of the switch to 2WMV is positive for the community. Time savings of 93 million exceed the increase in costs. The gain per person is high due to the fact that average 2WMV speed of travel is 46% higher than by car (see Table 9). The

[11] It would seem that the figures suggested in the Boiteux report are more the result of a benchmark than of any specific analysis.

[12] The surplus change in the primary market encompasses the entire change in prosperity except when the secondary market is affected by strong external factors. This is the only case where it is recommended to add a variation in the secondary market to the change in the primary market . There is no reason to believe that the time saved (or lost) in travelling is or would have been used for external activities. Shopping is obviously not an external activity with regard to walking. In the absence of external factors, the change in prosperity measured in the primary market and induced by a policy, is equal to the change in wealth (GDP). The effects of any resultant expenditure are therefore captured by our measurement method (Boardman et al., 2006).

[13] The marginal cost of public funds (MCF) measures the loss incurred by society in raising additional revenues to finance government spending.

Table 10
Consequences of switching from car to 2WMV usage.

Switch from car to 2WMV usage[a]	26%
Number of new 2WMV users	19.382
Time savings[b]	
Daily time saving, per driver (minutes)	85
Time saved while travelling (€Mio)	48
Time saved while parking (€Mio)	45
Total time saved (€Mio)	*93*
Changes in accident costs[c]	
Rise in the number of minor injuries	302
Rise in the number of serious injuries	+26
Rise in the number of fatalities	1.36
Rise in the costs of accidents (€Mio)	*−12.6*
Pollution[d]	
Drop in the cost of GHG emissions (€Mio)	2
Rise in the cost of local pollution (€Mio)	−5.1
Rise in the cost of pollution (€Mio)	*−3.1*
Diverse	
Change in the cost of vehicle usage (€Mio)[e]	27
Social cost of taxation (€Mio)[f]	−2.7
Total benefit change (€Mio)	*102*

[a] See Kopp et al. (2008).
[b] The time needed to travel one km by car is 3.77 min. Switching to 2WMV usage generates a time saving of 47% (Orfeuil et al., 2006). Time spent looking for a car parking space is 16 minutes, compared to 0 min for a 2WMV (ADEME, 2007). We are assuming that a motorist parks twice a day on the street. We do not count time spent parking in reserved underground parking lots in office and apartment buildings, considering that such time is already included in travel time. The time savings are multiplied by the number of new 2WMV users and the number of working days per week.
[c] The probability of having an accident is calculated based on data from the Travel Observatory (number of passenger/km and number of accidents averaged out over two years).
[d] Boiteux Report (2001). We take the cost of pollution per vehicle/km. We consider that 2WHV GHG emissions are half those of cars. In contrast, local pollution is three times higher with Euro 3 2WMVs than with Euro 4 cars.
[e] In 2006, motorists' expense budget for an average distance of 9777 km amounted to €5359. Of €100 spent, €35 went on the initial purchase, €11 on maintenance, €9 in insurance, €8 on garage hire, €5 on financing and €5 on fuel (all figures excluding tax) and €27 in the form of state taxes (ADEME, 2007). We assume that the cost of 2WMV use is, on average, half that of a car.
[f] The change in government revenue is −9 and the marginal cost of public fund 30% (Boardman et al., 2006).

cost of accidents goes up by €12.6 million, that of pollution by €3.1 million. Vehicle usage costs go down, as does the amount of tax revenue. Pollution has few negative side effects. However, the high accident rate partially wipes out the time savings. The following table suggests this will be one of our conclusions: the switch to 2WMV usage must be accompanied by a policy aimed at reducing the number of accidents. The cost of pollution seems a little high. We do not take into account the fact that the switch from car to 2WMV usage leads to lesser congestion for remaining motor traffic, thereby reducing CO_2 emissions by allowing traffic to go faster (compared to the attainable speed if individuals had kept with their cars) (Table 10).

Switches from public transport to 2WMV. 53% of 'new' 2WMV mileage is done by former public transport users. Time savings per person are extremely high as 2WMV usage is faster than cars and much faster than public transport. Travelling by 2WMV is 127% faster than the bus, 50% faster than the metro, 27% faster than the RER and 48% faster than travelling by rail. Remember that speeds are measured "door to door". We assume that public transport users spend 10 minutes a day reaching a station. The switch to 2WMV saves this time. As we have no data on this item, we are using this as a hypothesis. Accident costs rise appreciably. This result is logical since the accident rate per kilometre is almost non-existent in public transport. We are including on the cost side the entire new pollution caused by 2WMV. We should really be calculating the difference between pollution per passenger-km when using public transport and when using 2WMV.

Table 11
The consequences of switching from public transport to 2WMV.

Switch from public transport to 2WMV usage[a]	53%
Number of new 2WMV km (millions)	201
Number of new 2WMV users	38,714
Time savings[b]	
Time saved while travelling (€Mio)	127
Time saved while gaining access to public transport (€Mio)	31
Total time saved (€Mio)	162
Changes in accident costs[c]	
Rise in the number of minor injuries	652
Rise in the number of serious injuries	54
Rise in the number of fatalities	3
Rise in the costs of accidents (€Mio)[d]	−27
Pollution[d]	
Rise in the cost of GHG emissions (€Mio)	−4
Rise in the cost of local pollution (€Mio)	−10
Rise in the cost of pollution (€Mio)	−14
Rise in the cost of vehicle usage	−55
Social cost of taxation (€Mio)	−4
Total benefit change (€Mio)	62

[a] Kopp et al. (2008) based on Orfeuil et al. (2006).
[b] We consider that switching from public transport to 2WMV brings a 60% saving in "door to door" travel time. We need to use here a weighted average speeds of all means of public transport, especially bus and RER.
[c] The probability of having an accident is calculated using data from the Travel Observatory (number of passenger/km in relation to the number of accidents, averaged out over two years).
[d] Boiteux Report (2001) ; e: the change in government revenue is −14 and the marginal cost of public fund 30% (Boardman et al., 2006).

This simplification, due to lack of data, is unfavourable to 2WMV usage. It would be possible to add the consequences of crime in public transport, but this would have no influence on the result as the cost of crimes against persons is minute in relation to the number of passenger/km. The rise in the number of minor injuries needs to be highlighted, as their cost represents nearly 50% of the total cost of new accidents. Finally, a phenomenon rarely taken into account, public transport congestion reduces its social value. The switch to 2WMV helps reduce public transport congestion, thereby improving user-perceived quality. (Table 11)

Increased 2WMV *usage:* 20% of "new" 2WMV mileage is done by individuals who already owned a 2WMV in 2000 and now make greater use of such. The value of travel is calculated based on the value of time spent travelling, on the basis of €15 an hour (Boiteux Report, 2001). The benefit gained from the additional travel is almost entirely absorbed by the increased cost of accidents. Total benefits are low (+€8.6 Mio.). This is logical. In switching from one mode of transport 2WMV users benefit from moving from a less efficient to a more efficient mode of transport. When already using the most efficient mode of transport, their gains are smaller when they start using it more (Tables 12–14).

Accident rate. The accident rate is the main obstacle preventing people from fully exploiting the benefits of switching to 2WMV usage or increasing 2WMV usage.

It should be noted that it is the minor injuries that cause the largest share of accident costs. The number of minor injuries is probably fuelled by the daily friction between cars and 2WMV users, suggesting that gains could be achieved through better safety conditions for 2WMV traffic.

The analysis of the overall results of the consequences of the shift towards 2WMV shows that it is largely beneficial to the community. There is a considerable improvement in overall prosperity amounting to €168 million. Time savings (€293 million) are high enough to compensate the increased accident costs (−€49 million). The overall balance is favourable. A small reduction in accidents would have a significant effect on the results of shifting towards 2WMV usage.

Table 12
The consequences of increased 2WMV usage by longstanding 2WMV users.

Share of longstanding 2WMV users in the growth of WMV mileage[a]	*20%*
Number of new 2WMV kilometres (millions)	76
Time savings[b]	
Time saved while travelling (€Mio)	38
Changes in accident costs[c]	
Rise in the number of minor injuries	248
Rise in the number of serious injuries	20
Rise in the number of fatalities	1
Rise in the costs of accidents (€Mio)[d]	*−10*
Pollution[e]	
Rise in the cost of GHG emissions (€Mio)	−1.5
Rise in the cost of local pollution (€Mio)	−4
Rise in the cost of pollution (€Mio)	*−5.5*
Rise in the cost of vehicle usage	−21
Social cost of taxation (€Mio)	2
Total benefit change (€Mio)	*−3.7*

[a] Kopp et al. (2008).
[b] Time spent travelling one kilometre by motorbike is equal to two minutes (50% faster than by car).
[c] The probability of having an accident is calculated using data from the Travel Observatory (number of passenger/km in relation to the number of accidents, averaged out over two years).
[d] Boiteux Report (2001).
[e] The change in government revenue is 7 and the marginal cost of public fund 30% (Boardman et al., 2006).

Table 13
Problem of accidents.
Source: Compilation of own results.

Switch to 2WMV:	From car	From public transport	Increased 2WMV users	Total
Δ Number of minor injuries	302	652	249	1203
Δ Number of serious injuries	26	54	21	100
Δ Number of deaths	1	3	1	5
Δ Cost of minor injuries (€Mio)	−6.6	−14	−5,5	−26
Δ cost of serious injuries (€Mio)	−4	−8	−3	−15
Δ Cost of deaths (€Mio)	−2	−4	−1, 6	−8
Δ Total cost (€Mio)	−12.6	−26	−10	−49

Table 14
Balance of the shift towards 2WMV usage (2000–2007).
Source: Summary of the preceding results. Note: All results in €Mio.

Switch to 2WMV: from	Car	Public transport	Increased 2WMV usage	Total
Time savings	+93	+162	+38	+293
Usage costs	+27	−55	−21	−49
Accident rate	−12.6	−26	−10	−48.6
Social cost of taxation	−2.7	−4	+2	−4.7
Pollution	−3.1	−14	−5.5	−22
Total	+101.6	+63	+3.5	+168.1

6. Conclusion

There is a need for up-to-date and accurate data on the modal choice in Paris. Nonetheless several conclusions can be drawn from this analysis of the shift towards 2WMV usage in Paris. First, the report is important because, between 2000 and 2007, the number of vehicle/km involving 2WMV increased by 36%. The 2WMV share of road traffic is 17%, well above the usual estimates of between 4% and 6%. This share has increased and must have been around 10% in 2000. As we have been able to verify, the analysis of the overall results of the consequences of the shift towards 2 WMV usage shows that this is largely beneficial to the community, with a €168 million improvement in prosperity being registered.

Secondly, this massive switch to 2WMV has been achieved without any public policy support. On the contrary, 2WMVs have been penalised by City policy, probably due to under-estimations in the official figures on their actual share in road traffic. Streets have been narrowed, mainly to curb traffic, while pavements have increased in width. Due to a lack of political backing for specific 2WMV parking, the number of fines for illegal parking has approximately doubled in seven years. The ban on using bus lanes remains controversial. Many people believe that allowing their use would cut the number of accidents and improve the 2WMV mobility balance, at the cost of minimal inconvenience for buses—as shown by the City of London, which has recently successfully applied such a measure. By contrast, Paris city policy, in the period concerned, has neither anticipated nor accompanied new transport patterns favouring 2WMVs of Paris users.[14]

Thirdly, the switch to 2WMV by Paris users is dictated by their desire to reduce costs. With time savings more than offsetting the costs of vehicle use, individuals are increasingly opting for 2WMV. Even the accident rate, often under-estimated by 2WMV users, does not cause enough cost to negate the time savings. Public policy could easily improve the cost-benefit balance of 2WMV usage by taking measures that would reduce the number of accidents. The cost-benefit relationship of such measures would certainly be very positive because the cost of the necessary arrangements and regulations is very low and the benefit derived from avoiding accidents high. In this sense, it is encouraging to see that the City of Paris has recently engaged in an European project,[15] along with London, Rome and Barcelona and other partners, to identify, develop, exchange and implement measures improving 2WMV safety in cities.

Fourthly, 2WMVs are undoubtedly a future solution for transport in major cities. Compared to cycling, which has been intensively supported by public policy even though it merely represents 0.1% of daily travel in Paris, the 2WMV has two major advantages. Being motorised, it can carry a passenger and can travel long distances within cities. Compared to the bus and other public transport, it is a private vehicle that lends itself to the high flexibility requirements regarding individuals' mobility. The future technological developments will make it an essential asset for urban mobility. Three wheels, new protective measures against rain, are making 2WMVs compatible with users' mobility requirements. Regarding sustainable development, ultra-low-emission gas motorbikes, together with hybrids and electric bikes, are beginning to arrive on the market. It needs to be stated here that the City of Paris now seems to be putting a focus on 2WMVs, recently introducing a subsidy scheme for the purchase of electric 2WMVs and an infrastructure of free terminals for recharging these vehicles.

There is no doubt that in tomorrow's cities, motorisation, load capacity, full adaptation to owner needs, safety and cleanliness, will all help make 2WMVs an important means of transport.

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[14] We use this term to designate those travelling around Paris without necessarily living there.
[15] The eSUM (European Safer Urban Motorcycling) project (www.esum.eu).

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