Attracting higher income class to public transport,
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*Atracción del mayor nivel de ingresos al transporte público
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Abstract
In Caracas, as in most socially clustered cities, modal split is highly related to income. High income population is mostly car dependant, while lower income people are captive of public transport. This typical situation is explained by world-wide social values and fashion but also by the fact that new, segregated residential areas for the upper social levels have been located in areas poorly served by public transport, creating a dependency on the private car. It is not surprising that, during the 1970's, a high proportion of Caracas's middle and high-income citizens were systematically using their car even in areas where there was a good offer of public transport. What is more unusual is to realise that, since 1983 when the metro system was inaugurated, there is a new pattern of travel behaviour. The metro has mainly attracted high-income people. Besides the few of them who have transferred from surface to underground public transport, many of the wealthier patrons seem to be regular car users that presently take the metro when it provides a good alternative. Currently, the transit system in Caracas is comprised of four main modes: the metro (since 1983); the "por puesto", which are minibus vehicles of 18 to 32 seats; the jeeps, which are dual traction vehicles of up to 12 seat (most of them serving hilly areas, basically slums); and the bus system, consisting of metro-bus and private operators. CA Metro operates the metro and, since 1987, metro-bus lines, which are bus feeder services to its heavy rail metro operation that extend the cover area of the system into the less central zones of the city. While the metro and metro-bus offer transit services to middle and high income users, the mini-buses and jeeps provide flexible transit service to low income groups. The metro and metro-bus services are more reliable and offer higher quality that mini-buses and jeeps. This higher quality service is one of the main attributes attracting the wealthier people to metro and metro-bus. Also, since the inauguration of the metro, a strong advertising of the service has been promoting its use and creating a different civic behaviour of the system's users. It is well known in Caracas that local people are much more civilised when underground". The aim of the paper is to provide a quantitative explanation of the phenomenon, identifying the sociological variables that have induced the observed changes in modal choice for the higher income class and establishing the influence of the promotion of the metro and metro-bus services in this behaviour. The analysis of the data collected by CA Metro on modal split by income show the existence of a strong correlation between the quality of public transport and the income distribution of users, which can not be explained by tariffs only. The series of data collected over the years allow an econometric analysis of the evolution of the trend. A series of interviews with metro and metro-bus managers, as well as sociologists and social psychologists have helped identify the sociological variables with the highest influence in the travel behaviour of high income population and those quality attributes of metro and metro-bus with most attractiveness. The results could be indicative on how successful policies to induce a change in modal choice from cars to public transport could be implemented even in cities where social segregation is extreme.

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Key words
Modal split, Caracas.

Resumen
En Caracas, como en la mayoría de las ciudades socialmente segregadas, la distribución modal del transporte está muy relacionada con los ingresos. El objetivo de este trabajo es proporcionar una explicación cuantitativa del fenómeno, identificar de las variables sociológicas que han provocado los cambios observados en la elección entre modos de transporte para la clase de ingresos más altos y establecer la influencia de la promoción del metro y de autobús de metro en este comportamiento. El análisis de los datos recogidos por CA Metro sobre la distribución modal de los ingresos muestra la existencia de una fuerte correlación entre la calidad del transporte público y la distribución del ingreso de los usuarios, que no puede explicarse sólo por las tarifas. La serie de datos recopilados en los últimos años permiten un análisis econométrico de la evolución de la tendencia. Una serie de entrevistas con el metro y los administradores de metro-bus, así como sociólogos y psicólogos sociales han ayudado a identificar las variables sociológicas de mayor influencia en el comportamiento de viaje de la población de altos ingresos y los atributos de calidad de metro y autobús de metro con más atractivo. Los resultados podrían ser indicativos de cómo las políticas de éxito para inducir un cambio en la elección modal de los vehículos al transporte público, podría ser aplicado incluso en ciudades donde la segregación social es extrema.

Palabras claves
Distribución modal del transporte, Caracas.

Summary

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Introduction

In Caracas, as in most socially clustered cities, modal split is highly related to income. High-income population is mostly car dependent, while lower income people are captive of public transport. This is a typical situation in many cities of less developed countries. In Caracas this link between modal split and income was reinforced by the construction of segregated residential areas for the upper social levels in areas poorly served by public transport. During the 1970's, a high proportion of Caracas's middle and high-income citizens were systematically using their car even in areas where there was a good offer of public transport. It is therefore interesting to realise that, since 1983, when the Metro system was inaugurated, there is a new pattern of travel behaviour. The Metro has attracted higher income users to public transport. An important proportion of them is a regular car user that presently takes the Metro when it provides a good alternative.

Currently, the transit system in Caracas is comprised of four main modes: the Metro (since 1983); the *por puesto*, which are minibus vehicles of 18 to 32 seats; the jeeps, which are dual traction vehicles of up to 12 seat (most of them serving hilly areas, basically slums); and the bus system, consisting of Metro-bus and private operators. CA Metro operates the Metro and, since 1987, Metro-bus lines, which extend the cover area of the system into the less central zones of the city. The Metro and Metro-bus services are more reliable and offer higher quality that mini-buses and jeeps. Also, since the inauguration of the Metro, a strong advertising of the service has been promoting its use and creating a different civic behaviour of the system's users. It is well known in Caracas that local people "are much more civilised when underground". This combination of improved supply and user-oriented policy has been successful in attracting a new class of users to the public transport system.

The aim of the paper is to provide a quantitative explanation of this social phenomenon, identifying the sociological variables that have induced the observed changes in modal choice for the higher income class and establishing the influence of the promotion of the Metro service on this behaviour. The series of data collected over the years allow an econometric analysis of the evolution of the trend. Interviews with Metro and Metro-bus managers, as well as sociologists and social psychologists have helped identify the sociological variables with the highest influence on travel behaviour and those quality attributes of Metro and Metro-bus with most attractiveness.

This paper is structured in seven sections including this introduction and the conclusions. The second section is an overview of the urban development of Caracas. The third section refers to its transport system. The fourth section explains the advertising and promotion campaigns that CA Metro has carried out to attract new users and to induce civic behaviour in the Metro system; it also presents the evolution of the characteristics of the Metro users. The spatial segregation of the population in Caracas and its relationship with modal split is analysed in section fifth. Finally, the

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sixth section studies the evolution of quality of the Metro service and their relationship with the socio-economic characteristic of the users.

	% trips	Trips
TABLA 1 **Trips in Caracas (MAC). 1995**		
Daily Trips (thousands)		6.100
Pick hour daily trips		
Work (%)	56%	
School (%)	33%	
Other (%)	11%	
Modal Split (percent)		
Auto (%)	41%	
Transit (%)	46%	
Walk/Cycle (%)	13%	
Transit trips (thousand)		2.800
Metro (%)	34%	
Por puesto- jeeps (%)	60%	
Bus and metrobus	6%	

1.- Caracas urban development

Caracas has around 3.1 million people and is located in an east-west valley at an altitude of 900 m. It is bordered to the north by a mountain range (2,700-m) and, to the south, by hills and small valleys connected to the main valley. The city began to grow slowly in the main valley, where most of the flat land is located. But between the 1940s and the 1980s, the city experienced an exponential growth and a strong process of suburbanisation (1920: 118 000 people; 1961: 1.4 million; 1971: 2.2 million; 1990: 2.9 million; 1999: 3.1 million (estimate)). The whole central valley is now occupied and the city has continued to expand into the smaller adjacent valleys and the surrounding hills. Marginal settlements have sprung up in open areas, often on hills (Flórez, 1998b). The city has an area of some 37.000 ha, with 26.000 of them either urbanised or proposed for development (Tobía, 1992). Present density, at around 120 inh/ha, is already quite high.

The Metropolitan Region of Caracas has a population of about 4.6 million, but the Metropolitan Area (MAC) has some 3.1 million inhabitants (FPECM, 1998). The MAC consists of five municipalities (Libertador, Chacao, Sucre, Baruta and Hatillo). Each

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municipality has its own City Council and mayor, making co-ordination of transit services rather complex.

The street network of Caracas was developed following the geographic characteristics of the area. As a result, most highways and principal avenues in the city centre are oriented along the main valley. They are connected with highways that follow the small valleys, linking the city to the surrounding region and to the rest of the country. The road area accounts for 14% of the developed land in Caracas (Tobía, 1992). As currently managed, this network has insufficient capacity, particularly on North-South streets, and does not provide a great deal of connectivity.

Caracas used to have one of the highest rates of automobile ownership in South America (in 1982, it was 167 car per 1000 inhabitants). Its road system developed quickly during the 1950s and 1970s but, since then, investment in highways has not kept pace with travel demand and present road infrastructure is, in general, rather deficient. Caracas has nevertheless one of the most modern heavy rail Metro systems in the world, providing transit services to a key sector of the population (Rivasplata and Flórez, 1998).

The city centre was initially characterised by mixed-use development, with different socio-economic groups sharing common areas. However, in the 1940s, this pattern began to change when a number of single-family residential neighbourhoods, exclusively oriented towards middle income residents, were developed in suburban areas. This urban expansion process has continued and resulted in the creation of exclusive residential areas and a predominance of the central axis, where most of the urban activities and a number of other small industrial and commercial sub-centres are located (Flórez, 1998b).

In Caracas, land use planning based in zoning has induced not only a segregated activity pattern but also a spatial "clustering" of the population according to income. In general, new urban developments are focused on specific socio-economic groups and bring with them an urban design that encourages social segregation. On the other hand, the irregular topography of Caracas has limited its urban development, because it is very difficult to connect some neighbourhoods. Public transport services have also been restricted by topography constraints. Many residential neighbourhoods of high and middle-high income people, with high levels of car ownership, are however located in some hills or in small valleys in high altitude areas. They often have poor connections to the main road network, but this lack of accessibility is considered to provide both security and urban quality (Flórez, 1998b).

2.- The urban transport system in Caracas

Three levels of government administer Caracas urban transport: local, state and national. The local government is responsible for planning, management and control of public transport. The states are responsible for highways and for intercity bus transport, which also provide some low cost services inside the metropolitan area.

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Urban transport policy is defined, at the national level, by the Ministry of Transport and Communication (MTC), which is also responsible for applying and controlling it through a special force, although some local governments have now their own traffic police (Nelson et al, 1999).

More than six million trips are made daily in Caracas: 46% of them by transit 41% by private vehicle and the remainder on foots (Table 1). The transit system consists of non-subsidised private operators and the Metro and Metrobus system that is owned by the public sector. Private operators provide informal services without proper schedules and adapting their itineraries to suit passenger's needs. They use *por puesto* (minibus vehicles of 18 to 32 seats) or *jeeps* (dual traction vehicles of up to 12 seats). The *jeeps* are used in hilly or badly paved areas not accessible to conventional buses. Most operators only own one vehicle. There are also some private bus companies providing formal services, mostly interurban. These companies own up to 40 buses each. Large bus companies are not known in Venezuela[1].

Metro and Metrobus are operated by *Compañía Anónima Metro de Caracas* (CA Metro), a company with private status but 99% owned by the MTC. The Metro was inaugurated in 1983 and, since October 1987, CA Metro also administers Metrobus, a set of feeder bus lines providing direct services to specific Metro stations. The integration between the bus services and the underground system is supported by a consolidated Metro/Metrobus fare. The Metrobus services have effectively extended the Metro's catchment area beyond the immediate surroundings of its stations into other areas of the city where topography allows it (Rivasplata and Flórez, 1998).

The Metro has three lines. Line 1 with 22 stations and 20.36 km long; Line 2 with 13 stations and 17.81 km long; and Line 3 that only has 4 stations and 4.35 km, but is due for extension in the next four years. Line 3 was opened in 1994 and is the last extension of the underground system.

The Metro follows the principal east-west axis along the main valley, with more recent extensions towards the south along the small valleys. It only provides acceptable direct access to some 40% of the population of the MAC. The Metrobus, which operates a total of 25 routes and carries 120,000 daily passengers, extends services to areas with good road access and even reaches some urban areas outside the MAC. Overall, the Metro/Metrobus service only takes some 38% of the total number of transit trips (Table 1, [and 7 and Figure 4, in original article]).

The surface transit system (predominantly minibuses and *jeeps*) does not offer a high degree of reliability (lack of schedules and designated stops) but takes 60% of all transit trips because of its much wider coverage. The *por puesto* and *jeeps* are run by

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[1]   The Metrobus operation is unique in having 300 buses (Nelson *et al*., 1999).

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private operators and provide transit services basically to low-income groups. They have minimum public support while the Metro/Metrobus service, which offers premium transit services mostly to middle and upper-middle income residents, is heavily subsidised. Public subsidies have actually been increasing. Its flat rate has been going down, in constant terms, since the inauguration of the Metro until 1996, when its real value was 60% lower than in 1983. In spite of later increases, the present tariff is still 38% lower than in 1983. It comes to no surprise that since 1988 the operation has been subsidised. In 1998 ticket sales only covered 53% of operational costs.

Private operators receive some minor assistance through student bonuses directly paid to the service provider and soft loans for fleet replacement. In spite of tariffs being fixed by the MTC they are able to provide a rather effective service. But this system has severe negative impacts on road safety and on pollution (as vehicles are often poorly maintained) and implies a loss of scale and scope economies because more than 80 percent of all multi-operator connections are made informally, without the benefits of fare and route integration (Cedano and de Freitas, 1994). Institutional integration between Metro and private operators has been indeed problematic owing to (Rivasplata and Flórez, 1998):

- The uncertainty of *por puesto* routes and schedules (severe traffic congestion hinders their reliability) and the difficulties to organise and manage so many private operators;

- The aggressive competition among *por puesto* operators and the lack of a legal framework within which to co-ordinate these services, as there is no single metropolitan transport authority and different levels of authorities assume the same responsibilities;

- Insufficient financial resources available compared with what is required.

In fact the two types of services are extremely different. The quality standard of Metro and Metrobus is impressive in comparison with the *por puesto* operation. The Metro system is extremely clean and tidy, it has automated entry and exit barriers controlled by magnetic tickets and has staff that is helpful and well dressed (Nelson et al., 1999).

3.-The effects of marketing and quality of service in the social mix of public transport users

3.1.- The design of a user-oriented policy

During 1979 and 1980, prior to the commissioning of the new underground system, CA Metro designed a set of policies to obtain a positive attitude from the potential users of the system. The main objective was to have Metro users behaving differently than those using the then available public transport modes. The policies and the corresponding actions to produce the attitudinal change took advantage of the

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experience of metro operators around the world and focused on management methods directly linked to the characteristics and desires of the users. The results were outstanding, so two years after the inauguration of the first line, the idea that there were two types of people in Caracas "those moving around in the surface and those travelling underground" was widespread (CA Metro, 1987).

To define policies and actions, the fundamental hypothesis adopted was that the behaviour of transit users in Caracas was a complex phenomenon and that the typical user was responsive to the conditions of the service he was offered. The hypothesis of inherently rebellious and vandalic users was thus rejected in favour of the theory that his behaviour was purely reflecting the environment he was submerged into. Surface public transport was aggressive to his qualities as a human being and he was reacting aggressively against it. The conditions (the environment) of the system had to be changed to bring about a positive attitude. The following policies were considered to be sufficient to create an adequate environment:

1.- The use of persuasive techniques to control the user.
2.- The provision of high quality service regarding, in particular, the reliability of the transport services and the correct operation of stations equipment (ticket machines, automatic gates, etc.) and cleanness in stations and vehicles.
3.- The selection and maintenance of capable staff, with strong motivation.
4.-The periodic launching of information and guidance campaigns directed to the users. (CA Metro, 1987).

These policies were implemented through some concrete actions:

3.1.1.- Persuasive control

At the time, end of the 1970's, persuasive control was considered quite innovative, particularly in the South American cultural context where control actions were basically repressive. It was based on the following measures:

a. Persuasive attitude and communication language. Operational staff would be given special training.

b. Positive written messages. This was reflected in the user's norms indicating what the correct behaviour of the Metro user should be. The norms provided a justification of its implementation and, in some cases, alternatives to interdictions were given. The same philosophy was applied to the messages conveyed through loudspeakers.

c. Creation of an unarmed Metro security force in charge of ensuring norms' compliance and protecting and assisting users.

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> d .Creation of a specially trained Metropolitan Police Unit devoted to the protection of Metro users and premises. (CA Metro, 1987).

3.1.2.- Service quality

CA Metro was committed to provide very high quality of service. The concept is that people soils areas that are already dirty and destroys equipment that does not work. So the education of the users must go hand in hand with clean facilities, equipment (vending machines, escalators, public telephones, etc.) that consistently works and is quickly repaired when fails. Users must also be given precise and rapid information on any problem occurring in the system. Of course, high frequency and reliability of train services and safe and comfortable travel were deemed critical factors in the perception of quality. Speed and physical elements (i.e. location of and access to stations) were assumed as given.

3.1.3.- Staff training

The company gave the greatest importance to the selection and training of the staff that had to be in contact with the public. The programme started in 1980, well before inauguration, to ensure its success. It introduced training approaches and incentives to performance that were unheard of in the public sector in Venezuela.

3.1.4.- User education and guidance

A full year before opening, separate education campaigns for prospective adult users and for children were launched both to attract users to the Metro and to improve their behaviour. These campaigns have continued ever since. Scholars' visits have proved to be effective both in training future users and in inducing parents to use the system. A separate action to inform station neighbours of the works taking place in the area and a massive advertisement campaign in the media three months before inauguration contributed to create positive expectations from the local population and practically eliminated any opposition to the new system. An advertisement campaign, with specific objectives, is launched every year to maintain this positive approach.

A service of personalised attention to users, with staff addressing users in trouble, and a "suggestions and claims" service individually responding to customers' comments complement the programme. This direct and continuous relationship with users has been positive for patronage but has also provided a good knowledge of user's perception of the service that has proved very useful to improve the performance of the operation.

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3.2.- Characteristics of Metro users and their trips

The effects of the various policies can be observed from the results of semi-annual and annual surveys carried out by the Planning Direction of CA Metro since the start of operations. They have been mostly used as a qualitative information source and for short-term management measures. Here they have been used for a more comprehensive time series analysis, following a complex selection and screening process that was necessary to determine consistent input data.

3.2.1.- Socio-economic data

The typical Metro user is a young employed person. Users between 18 and 40 years old represent 75% of total patronage ([Table 2, in original article]). This figure has remained constant since 1983. Depending on the specific year, white-collar employees represent from 23% to 30% and professionals between 20% and 29% of all users (table 3). Over the years the proportion of professionals has been going down in favour of the number of white-collar employees. The proportion of students (17% to 20%) and blue-collar employees (around 15%) has remained relatively stable over the period.

The distribution between males and females is balanced, but the percentage of women has been steadily increasing. A subjective indicator of socio-economic level used in the surveys has not been included in the input data as it has not been considered sufficiently reliable and because car ownership provides a more accurate estimator of income level in the context of Caracas. A reduction in the number of car owners using the Metro over the period of operation can be clearly observed. While in 1983 some 34% of the users were car owners, this figure has gone down to 20% in the early 1990's and to 16% in the latest survey ([Table 4, in original article]).

This reduction in car owners among Metro users could be argued to be due to changes in traffic management. Indeed, between the inauguration of the Metro and 1988 there were some restrictions to the use of cars within the city[2]. However, while data tend to indicate an important impact of car restriction measures on Metro use (some 15% of the reasons for car owners taking the Metro), it would appear that this disguises lack of car availability, which increases from 15% to 25% when restrictions are levied ([Table 5, in original article]). It seems that cost (including parking), security, speed and comfort (although this –worryingly- with less and less weight) are the main reasons to leave the car at home for centre-bound trips. Nevertheless it is interesting to observe that the Metro is considered the alternative mode, when car is not available, for some 30% of car owners using the system. Overall, however, Metro patronage mostly comes from transit users. Trips that would otherwise be made by car

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[2] Cars were forbidden inside the city for one working day a week ("stop day"), according to the plate number to reduce congestion and pollution. This action was rather unsuccessful and was declared illegal in 1989.

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were some 20% at inauguration but only 7.5% when a similar survey was carried out in 1991 ([Table 6, in original article]).

From the observation of the data: less professionals, more women, less car owners and less trips attracted from prospective car users, one can conclude that the socio-economic level of Metro users has been going down steadily. The indication that comfort is less relevant could show both a deterioration of the service or more importance being given to cost aspects. The evolution of service quality is discussed in point 5.

4.- Spatial segregation and modal split

4.1.- Caracas, a socially clustered city

Spatial segregation according to income levels is particularly marked in Caracas. Dividing the city in 10 main areas and the population in four different income categories (slum inhabitants, low income, medium income and high income) it can be observed that 92% of the people in the Northeast and 77% of the people in the East live in slums. On the contrary, 62% of the South-eastern residents have high and 18% medium income levels. In the central axis 69% of the population has low income and 20% medium income. All the other areas also have a clear predominance of a specific income level group. Only in the North axis there is a certain social heterogeneity, with 11% of the people living in slums, 19% having low, 26% medium and 44% high income levels. Within the areas segregation is still more relevant, so neighbourhoods are strictly segregated from the sociological point of view (Flórez, 1998b).

4.2.- Comparison of income levels between Metro users and the general population

According to a survey carried out by CA Metro in May 1998, the average income of Metro users was some Bs. 246.000 ($500 in 1998), 20% higher MAC's average. Figure 5 shows the statistical distribution for both populations, indicating that the phenomenon is based on a higher usage of the system by medium income people than by low-income people[3]. This figure shows that the proportion of middle income Metro users is higher than their proportion of the overall population of the city. Low income users are and, correspondingly, less represented in Metro patronage, as they mostly use the *por puesto* and *jeeps* services[4], which have much lower tariffs[5] (CA Metro, 1998b).

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[3]   As already indicated by the very low percentage of unemployed and modest percentage of workers in Table 3 [in original article].

[4]   Around 60% of all Metro users complete their trips with *por puesto* and jeeps services.

[5]   The very low petrol taxes in Venezuela explain, in part, how these services can operate practically without subsidies, but also the financial difficulties of many individual operators, the atomisation of the

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4.3.- Car ownership and correlation with public transport usage in Metro served areas

Contrary to the detailed information available for Metro users, there is little systematic information on surface public transport users[6]. CA Metro has gathered, however, some useful aggregated information in the Metro served corridor, where the highest population and employment densities can be found in the city and where there is the highest concentration of transit services. Nine macrozones, with a total population of 1.348.000 people in 1996, have been used for referencing. Figures 1, 2 and 3 [in original article] synthesise the analysis of 1996 data.

The percentage of households owning one or more cars in the whole of Caracas is 44.4 %. Along the Metro axis car ownership, at 41.5 %, is slightly lower. These averages hide, however, high differences between areas. Variations between the nine macrozones (from 26.5% to 67.3%) reflect the gaps in income levels and urban quality. It is interesting to observe (figure 8) that car ownership levels in the areas progressively served by the Metro following its extension do not show relevant differences with the average. The reduction in the percentage of car owners amongst users cannot be blamed on the different characteristics of the population with direct access to the service.

Figure 1 shows that the percentage of public transport trips goes down slightly, from 63% to 53% (53% is the city average), with increasing car ownership. The correlation is not very strong (R^2= 0.33). The linear fit is even milder (R^2= 0.22) for Metro trips, but in this case (figure 2) the link is positive meaning that the number of Metro users increases with car ownership for households located in the Metro axis. Figure 3 confirms this particularity, showing an important reduction of non-Metro transit trips with higher car ownership. The correlation is not strong (R^2= 0.38) as there are substantial differences between areas with similar income levels but with different accessibility to Metro stations[7]. Data show a clear preference for Metro as public transport mode for people with higher income living in the areas directly served by Metro. So, in spite of the observed reduction in the number of car owners using the Metro system, this analysis indicate that there is a good potential to reverse the trend if adequate measures are applied.

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industry and, consequently, its poor performance. Public transport tariffs (and petrol taxes) is a very sensitive political issue in Venezuela.

[6] Only information on Metrobus users is periodically collected.

[7] The Chacao-Dos Caminos macrozone is the one with the highest motorization, the highest employment concentration and has a good access to the Metro system. 53% of the trips are made by public modes, 79% of them by Metro.

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4.4.- Relationship between residential area and modal split

Residential areas can be classified according to the amount of controlled urban development. Type I areas are those where more than 80% of the development is controlled. In type II areas between 40% and 80% is controlled, while in type III more than 60% of the people lives in slums. Type I areas obviously have the residents with the highest income levels.

From the 45% of the population of MAC with direct access to Metro services approximately half a million live in type I areas and the same amount in type II areas, with some 300.000 living in type III areas. Metro usage decreases, however, with urban quality, with type I areas having 21% of Metro users and type III only 15% (figure 4 and table 7). The highest usage of Metro is outside the central axis, but it is relatively small (11%) for type II areas. This indicates again that higher income levels are ready to use the Metro, particularly if access is good.

5.- Quality of service and income level of public transport users

Every six months CA Metro carries out detailed quality evaluation surveys. Interviewees give values between 0 and 10 to several attributes and the results are added up by CA Metro to produce a single global quality indicator. The results have been extremely useful to the company to define specific actions to improve those aspects being perceived as more important by the users and those requiring enhancement. This policy proves correct in the short term, as low points in one specific survey tend to improve in the next one. But it is not clear that the long-term effects are as good, because the global evaluation indicates a continuous deterioration of the quality of service perceived by Metro users. In the 1980's values between 6 and 7.5 were common, while since 1990 the global index has reduced to values between 4.7 and 5.7.

A time series analysis (between 1983 and 1998) of quality indicators and Metro user characteristics provide a quantitative assessment of the impact of service on the socio-economic composition of patronage. Global indexes have been plotted against the percentages of car owners and professionals users. A strong direct correlation ($R^2=$ 0.84) with the amount of car owners and a significant one ($R^2=$ 0.49) with the percentage of users defining themselves as professionals (figures 6 and 7) show that higher income users, particularly those owning a car, are very sensitive to quality of service.

In 1998 a survey comparing the satisfaction levels of Metro and surface public transport modes showed that Metro users have a very positive perception of the system compared to the service received, which is sensibly more appreciated than the service provided by other modes. Almost 68% of them thought that Metro provided a good or very good service (29% that it was just satisfactory), while only 26% thought

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that surface public transport was good, 61% that it was satisfactory and 12% thought it was poor (CA Metro, 1998a).

It is interested to observe that both Metro and surface transport fares decrease over time in real terms. In 1998 both fares were about 40% below 1983 level. Lower Metro fares may attract more low-income people to the underground. But the real income of households in Caracas has substantial decreased during the periodic (1998 average income was half of what it used to be in 1985), so no direct link between the reduction in the percentage of higher income users and fares reduction can be established. On the contrary, the general impoverishment of the population has let to a reduction in the number of metro users. Probably this lost is due to poorer people is not travelling or using the *por puesto* service.

6.-Conclusions

With the inauguration of the Metro of Caracas a significant proportion of car users was diverted to the underground system. The modal transfer was related to the high quality of service offered by the new system compared to surface public transport. This quality was not only the result of technical performance and high quality standards but the response to a well organised image campaign, the special education of staff directed towards the persuasive control of users and the provision of adequate guidance and information systems. This user-oriented policy was able to generate a civic behaviour that was unheard of in the city and to convert the Metro into a symbol of public pride and an example of effective public service.

Quality of service has slowly deteriorated, however, due to some financial difficulties produced by tariffs strongly diminishing in real terms, growing demand (induced by the extension of the network) and other factors. User surveys indicate that this deterioration is clearly perceived, but the direct reflection is a rapid reduction in the percentage of car owners using the Metro and, in general, of users with higher income level. The analysis of the time series available clearly shows a correlation that seems independent of the effects of tariffs and extension of the network. So, there appears to be a much higher sensitivity than expected of higher income people to the quality of service (in particular security and comfort, as speed remained basically constant).

A high percentage of Caracas Metro users require a separate mode to complete their journey. However, except for the Metro-Metrobus there is no intermodal integration. In the short term, it looks difficult to reach an integrated transit system in Caracas, but a performing central operation such as the Metro-Metrobus seems the best catalyst for the modernisation of the whole system.

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