



World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016

## Income vs. travel time: Why do the poorest and the richest travel fastest in northeastern Brazil?

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### Abstract

The latest Census survey driven by the Brazilian Institute of Geography and Statistics (IBGE) shows that the income groups having the smallest commuting time in the city of Recife are those with the lowest and the highest incomes. This paper tries to find reasons behind that behavior for the groups with lowest income by using data from focus groups interviews in low-income areas of the city. Census data is from 2010, the interviews were held in the end of 2011. Results show that the poorest people in Recife cannot afford to use public transportation, restricting their activities to places that can be reached by foot or, in some cases, riding bicycles. Even though those people are not isolated in far suburbs, as it happens in many cities from many countries, the lack of access to public transport can also drive to isolation by creating restraints for participation in social-economic activities and, in this paper specifically, to work opportunities. Public transportation is usually seen as accessible to all: in economic theory it is even considered an example of inferior good; however, in this city, it may be a luxury item to a considerable part of the population.

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Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.

*Keywords:* social exclusion; income; commuting time; work; accessibility

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## 1. Introduction

This paper aims to prospect the elaborate relationship between mobility and accessibility of citizens from different income ranges and land use. The research uses *Micro-interlocutor Analysis* technique to cross-analyze data prospected in two previous researches developed in a large state capital in the poorer Northeastern region of Brazil. The main point this paper examines is how important are land use and income characteristics to determine accessibility.

Accessibility is influenced by income inequality; living in certain areas and being able to use certain types of transportation may assure the ability to undertake the important activities of life, i.e., education, jobs, health services and leisure. Because transport is primarily a derived demand, restrictions to mobility may contribute to social exclusion and may negatively impact psychological and social well-being.

However, the way income influences commuting time varies from place to place. Part of the literature affirms that people with higher incomes will have shorter commuting times, since, for valuing more their time, they prefer to live closer to their jobs and pay for faster modes of travel. On the other hand, it is also argued that wealthier people would have longer commuting times, since their demand for better life quality and more spacious houses can more easily be reached far away from downtown and from their workplaces (Dargay and Omereen, 2005). It is, however, usually assumed to be a linear effect: either it increases travel time or it decreases travel time.

It is also a question of land use and job location. In some countries, most of the cities have their CBDs in the kernel of the municipal area, where the wealthiest households are also located, whereas the suburbs have the social function of low-income dormitories. Such organization is common in European cities (Bruecker et al, 1999) and Australia (Dodson & Sipe, 2006; Burke & Hayward, 2001). In other geographical locations, mainly in the US, cities are generally quite dispersed and most jobs and richest housing areas are located in the rich suburbs while the old downtown is home for the poor (Alonso, 1964; Muth, 1969; Mills, 1967). However, many emerging countries, including Brazil, are known for their illegal land occupation at the so-called slums, or *favelas* – which, in Brazil's specific case, are located very close to the richest areas of the city. Because of this complex reality that is not only geographical, but also social and cultural, present in most developing countries, theories on social behavior that work well in developed countries, when applied to emerging countries do not always show the same expected result (Andrade and Maia, 2009; Rujopakarn, 2003).

The issue here concerned is that Lima and Mota (2012) found that commuting time in the Metropolitan Region of Recife does not vary monotonically with income. In fact, the pattern shows that the lowest and the highest income strata spend less time commuting. Acknowledging this peculiar behavior, this paper uses *Micro-interlocutor Analysis* to investigate qualitative data from two low-income communities in the city of Recife regarding their commuting travel patterns, in order to prospect the reasons of the non-monotonic behavior.

Understanding why such scenario prevails is important: in most cities, inequality in transportation may mean that the poor will have longer commuting times. If this is not happening in Recife, it is important to investigate the possible reasons. Does the good location of the *favelas* enable the low-income stratum to have equal access? Do they have better access to services and increased mobility?

This work is divided into eight sections. Section 2 introduces social exclusion and accessibility issues in a broader view and the specificities of Brazilian cities. Section 3 addresses income and commuting time, explaining the peculiarities found in the city of Recife. Section 4 depicts Recife and the city's metropolitan area in its socioeconomic characteristics. Section 5 explains the methodology adopted by the authors. Section 7 displays the findings achieved analyzing the focus groups answers. Finally, Section 8 conducts the conclusions.

## 2. Land use and commuting

Robust evidence confirms that land use and travel demand are strongly related (Kitamura et al. 1997). Residential density has been established to be associated with public transport service levels, household size and household income (Alonso 1964; Muth 1969). It has also been conjectured that, besides the intensity, the mixture of land uses is also associated with travel demand, as sized regarding trip frequency by mode and travel distance (Levinson & Wynn 1963; Pushkarev & Zupan 1977; Goodwin 1975; Cervero 1989).

There are several studies linking land use to accessibility. Howard/Stein-Hudson Associates (1993) state that higher-density developments decrease vehicle use and increase transit use. Handy (1993) found that elevated local and regional accessibility levels were associated with shorter trips but not with fewer trips. Ewing et al. (1994) verified

that density, mixed use and centrality appear to depress vehicular travel. Finally, Wachs (1993) cites that higher-density developments are correlated with lower energy consumption and an increased use of public transportation, carpooling and non-vehicular modes.

On the other hand, very little has been written about the impact of low-income communities “islands” close to wealthy areas (like the Brazilian *favelas*) in accessibility or commuting time. The main studies considering the *favelas* focus in slum upgrading programs (Rolnik, 1999; Marinho, 2007; Maia, 1995), the introduction of transport infrastructure and the benefits they represent to the community (Rivera, 2011; Fiori and Brandão, 2010; Duarte and Magalhães, 2009). Koch (2013) describes people's travel and activity patterns in three slums, specifically analyzing how investments on transport facilities can help improve quality of life in these communities. Maia et al. (2016) analyze two low-income communities in order to understand the intricate relation between mobility and accessibility needs of such areas.

This paper wants to address the importance of land use patterns, specifically the presence of slums close to high-income areas, in mobility. First it is important to stress the differences between the American, European and Brazilian land use models. Although not all cities in these regions follow these models, they are considered to be prevalent in most cities. In the American model, also known as monocentric, suburbs are highly valued by the middle class and the downtown areas are occupied by the deprived population. Of course there are exceptions to that model, such as the most famous cases of New York and Chicago (Cervero, 2004). There is no consensus behind this behavior: some researchers affirm that the poor concentrate in downtown arguing that richer consumers tend to buy more land and therefore they choose to live where the land is cheaper (Alonso, 1964, Muth, 1969, Mills, 1967). Nonetheless, this model has received some critics; Gleaser et al (2008) support it is outdated. For them, better access to transportation would be the main reason why the poor choose living in downtown areas.

The complementary model would be the European, where the central areas are desired by the wealthier population and the “blue collars”, not being able to afford life in the city center, are forced to set their homes in the far and usually dangerous peripheral areas (Bruecker et al, 1999).

In Brazil there is no clear pattern. As in many other issues, this one cannot be classified as either European or American. There are cities, like São Paulo, where the pattern is closer to the European model. But in most cities, as it happens in Recife and Rio de Janeiro, areas of great land value are neighbors to areas occupied by deprived communities, usually known as *favelas*. Even though people living in those communities do not suffer from physical exclusion in a geographical meaning, lack of access to private automobiles and dependency on a precarious transportation system can be a barrier to participating in economic activities such as access to work opportunities, education, health and leisure within a city (Cervero et al., 2002; Kawabata, 2003a).

No study has yet addressed the fact that the poor commute the fastest in some cities of Brazil, as for instance Recife. Thus the importance of observing the data available in order to try to imply if the closeness to regions with high level jobs and services increases their accessibility and lowers that barrier, or if in fact, even though they are close to those areas, their financial limitations imply they only commute by non-vehicular modes, lowering their access.

### 3. Income and commuting time

A high relative transport cost leads to physically isolating the poor from job opportunities, further diminishing their chances of social mobility. This represents a complex form of social injustice in Brazil, where transportation costs have dramatically increased over the last 40 years. In 1970, 5.8% of the income of a family earning from 1 to 3 minimum salaries was spent on transportation; that number increased to 12.5% in the 1980s and to 15% in the 1990s (Lucas et al, 2016). Nowadays, transportation costs characterizes 21.83% of the poorest population's income, remaining constant at 17% in the central strata and in the end lowering to 13.83% for the highest income levels (Carvalho and Pereira, 2012). Fig.1 and 2 show this inverse relation between income and percentage spent in transportation.

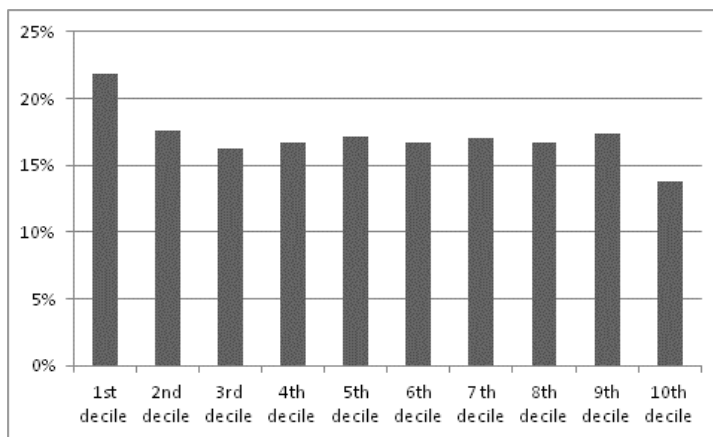


Fig. 1: expenditure with transport per income level in Brazil (2009), authors. Source: Carvalho and Pereira, 2012.

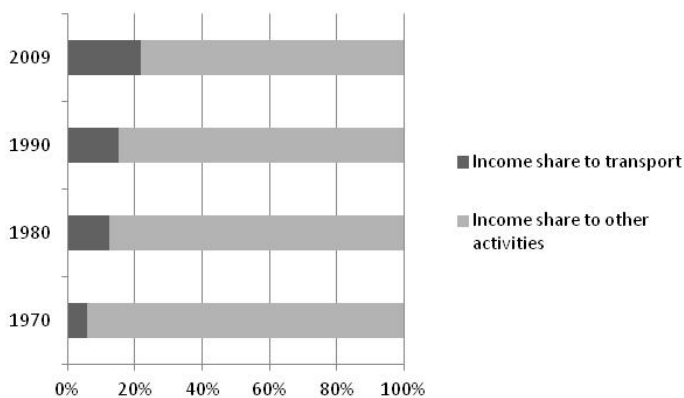


Fig. 2: Transport expenditure variation by year, 1970 -2009, in Brazil, authors. Source: IBGE, 2010, Lucas et al , 2016.

Travel time should also be expected to be proportional to income, being higher-income individuals more likely to travel and have access to transportation, and knowing the direct relationship between family income and percentage of income spent on transport. However, according to a study conducted by Lima and Mota (2012) using data from the Brazilian National Household Sample Survey (PNAD) regarding commuting time, the local population travel times do not vary monotonically according to income. The commuting pattern is distributed as follows: among the poorest 10% of the population, 68% took less than 30 minutes to get to their workplace; for the middle-income groups, this percentage varied around 50%; and regarding the 10% with the highest income, the percentage increased again, reaching 60%. This implies that those with less commuting time among the employed people of Recife are the richest and the poorest. Such behavior can be better understood in Fig. 3.

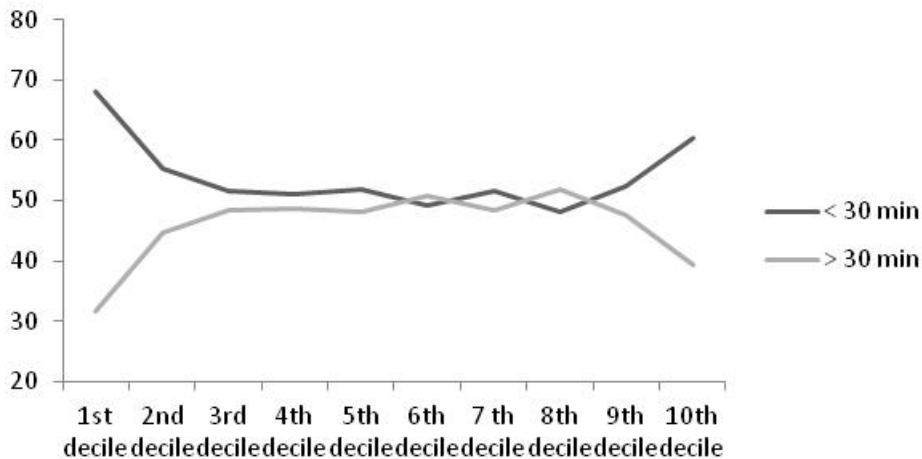


Fig. 3: Distribution of individuals according to travel time to work by deciles of *per capita* household income (%) - Recife, Lima and Mota (2012)

Previous studies state such behavior could be due to low-skilled individuals productively seek to reduce their mobility costs, eventually pursue occupations in the precarious and informal job market, generally in the vicinity of their homes, reflecting a reduced commuting time (Gleaser et al, 2008). On the other hand, higher income individuals have a higher spatial arbitrage capacity as the place of residence, without restrictions as to the quality of occupation, therefore they are also likely to introduce shorter trips to work. This conclusion was taken from a study held in North America, whose cultural and occupational characteristics differ a lot from emerging countries, especially Brazil. Then, what could be the causes of non-monotonic behavior in commuting/income relation low-income population of Recife? Which actions highlighted in the literature could minimize this group's accessibility issues in that region?

#### 4. Region characteristics

Recife is the capital of the State of Pernambuco, located in the poor Northeastern region of Brazil. The city's Metropolitan Area includes fourteen municipalities with a population of 4,046,845 inhabitants – the third most densely populated metropolitan area in the country, with 1,403.11 inhabitants/m<sup>2</sup>, overcome only by São Paulo (2,552.57/m<sup>2</sup>) and Rio de Janeiro (1,487.12/m<sup>2</sup>) (IBGE, 2013). Recife's population has a *per capita* monthly income of US\$ 442, considered low when compared to São Paulo's (US\$ 606), Brasília's (US\$ 686) or Rio de Janeiro's (US\$ 597) averages (IBGE, 2013).

Land use in Recife's Metropolitan Area does not obey the center-periphery occupation pattern (European), where the higher incomes tend to locate closer to the city center, or the periphery-center occupation pattern (US), where the rich tend to prefer the idealized quality of life of the suburbs (Lima et al, 2014). Deprived communities and slums are spread throughout the municipalities, in conurbation with the richest neighborhoods. In the capital Recife, any area is located within 1 km distance of a slum area (Maia et al, 2015).

In colonial times, Recife obeyed the European logic, where the bourgeoisie and the gently born would occupy the city center. However, the area has declined; nowadays, the few people living in Recife downtown are poor, but the area still holds an important role in commerce and service provision and it is considered to be the most accessible area in the city, either by public or private transportation (Cunha and Maia, 2004). Nowadays bourgeoisie has moved to Boa Viagem neighborhood, by the beach, with tall buildings and modern architecture, or to several neighborhoods in the city's northern zone, where the sugar mills from colonial times used to be located. Dark areas in Fig. 4 represent low-income areas present in Recife; as it shows, they are spread throughout the capital.



Fig. 4 - *Per capita* income distribution by neighborhoods in Recife, 2005

The Metropolitan Region of Recife is the third metropolitan area in Brazil with the highest percentage of households located in land not owned (10.86%), behind Porto Alegre (12.38%) and Fortaleza (12.12%) (Souza, 2007). This phenomenon can be explained by the State's historical omission in regulating urban properties through housing and urban development policies. Public investments have been selective, encouraging land speculation and restricting access to urban grounds and to housing for the poor. The alternative seen by those people was to informally and irregularly occupy land in areas with poor infrastructure and environmentally fragile, such as riverside lands or areas under geotechnical risk.

## 5. Methodology

This paper crosses data from a qualitative focus group study and Brazilian National Household Sample Survey (PNAD).

The focus group study was conducted in two low-income areas of Recife by a research team aiming to identify an interface between lack of access to transportation and social disadvantages, which can lead to scarcity of goods, services and employment opportunities and, finally, to social exclusion. A detailed review on how the research was conducted can be found in Maia, et al. (2016). Data on accessibility was collected in the focus groups regarding education, work, health and leisure. The authors were authorized to access the database containing data from these two focus groups in order to develop this paper, aiming to identify the reasons why the low-income population travels

faster than the medium income groups. It is important to stress that the focus group not necessarily represents the entire community, but the former methodology was developed trying to represent its inhabitants as much as possible. PNAD is a national survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) which collects data regarding commuting time to work.

Therefore, this paper examines the answers about travel time and work opportunities to individuals from both communities, aiming to understand the reasons why the lowest and the highest-income strata have the shorter commuting times and thus justify the non-monotone curve found when analyzing PNAD's commuting data for the city of Recife.

### 6.1 Data Analysis method

In order to analyze data collected in focus groups, several approaches can be used. Glaser and Strauss developed a method called *constant comparison analysis* (Glaser, 1978, 1992; Glaser & Strauss, 1967, Strauss, 1987), which is divided in three stages: in stage one, the data are fragmented into small units and a code is attached to each of the units; in stage two, these codes are grouped into categories; finally, in stage three, one or more themes that express the content of each group is developed (Strauss & Corbin, 1998). A similar approach is called *classical content analysis*, which is similar to *constant comparison analysis*; however, instead of creating a theme from the codes, those are placed into similar groupings and counted (Morgan, 1997).

Aiming to analyze how words are used in context with other words, Fielding & Lee (1998) created a method known as *Keywords-in-context*. It contextualizes words that are selected as central to the development of themes and theory by analyzing their previous and subsequent words, leading to an analysis of the cultural use of each keyword.

Another method widespread in Psychology is named *discourse analysis*. It was developed by a group of social psychologists who stated that, in order to understand social interaction and cognition, it is essential to study how people communicate on a daily basis (Potter & Wetherell, 1987).

Finally, the data analysis method chosen to be used in this paper was *Micro-interlocutor Analysis*, proposed by Onwuegbuzie et al (2009). It allows the researchers to include the silent inputs of agreement or disagreement coming from those participants who were not particularly keen in engaging the group's discussion, possibly due to shyness. According to Sim (1998), conformity of opinions within a focus group's data can be more relevant for the understanding of an issue than the aggregation of views from individual participants. In this method, researchers are supposed to document the number of focus group members having provided any signs of agreement ("Um-hum", "I agree", "Yes", head nods, etc.) that supports the consensus view. Equally, we recommend that the amount of statements suggesting dissenting views must also be documented. The framework used is shown in Fig. 6.

Focus Group Question	Member 1	Member 2	Member 3	Member 4	Member 5	Member 6
1						
2						
3						
.....						

Fig. 6. Matrix for assessing level of consensus in focus group (Onwuegbuzie et al, 2009)

The following notations can be input in the cells:

A = Indicated agreement (i.e., verbal or nonverbal)

D = Indicated dissent (i.e., verbal or nonverbal)

SE = Provided significant statement or example suggesting agreement

SD = Provided significant statement or example suggesting dissent

NR = Did not indicate agreement or dissent (i.e., nonresponse)

Some researchers use counts to provide information about the level of consensus/dissent. However, Onwuegbuzie et al (2009) argue that counts shouldn't be used to replace any qualitative data arising; more specifically, they state that "the fact that the majority or even all of the focus group members express a particular viewpoint does not necessarily imply that this viewpoint is important or compelling".

## 6. Findings

First, the data regarding Coque community was analyzed. Focus Group 1 was the one with fourteen housewives. Probably because they do not have formal jobs, they all agreed that they would save any money they could in bus or metro fares, meaning they would walk as much as possible. Some of the participants stated that sometimes the time spent walking to the bus stop, waiting for the transportation to come and actually traveling would be longer than walking directly to the final destination, thus they would prefer to walk. 35% of the housewives reported owning a bicycle. When asked if they would take the bus to attend to a job interview, some said they would but reported difficulties in paying the fare. One of the participants said she would walk, and reported having walked 14 km with a food cart to another city. They reported felling limited due to the lack of transportation at late hours and the refusal of taxis and ambulances to enter the community at night. Most thought the police would help in emergencies, but only if they were already nearby, not if called. They also agreed it was better when the informal and unregulated transportation system in private vans was still operating, and reported there was no motorcycle taxi service inside the community. They also said it was easy to locomote within it. Despite those problems, no one stated that the community had not improved over the last five years.

The second Focus Group was composed of school girls. Their data regarding commuting was only related to their study and, due to government policy, they all studied close to their homes and thus walked to school. Despite being aware they had the right to a student bus card which would enable them to pay only half fare, none of them possessed such card. All of the girls agreed that the community had improved over the last five years. An interesting observation risen during the interview was the fact that most of them reported using bicycles or horses while commuting to more distant locations. Three reported having access to private motorized transport means (car or motorcycle) belonging to relatives.

Focus Group 3 was constituted of eleven employed women. All participants who replied declared it was easy to move within the community. Regarding transport modes; 36% reported using the bus system; 18% have access to bicycles; 18% frequently used the metro system; and 36% said they would walk to reach every destination. Regarding displacements exclusively for work purposes, four said they would walk and three would take the bus; the others did not answer. When asked about the fare prices, the opinions split: some said it was expensive, but others reminded being able to reach far destinations using the integration system, paying only one ticket. Once more, the group was unanimous regarding the lack of motorcycle taxis, refusal of taxis and ambulances to enter the community and the stigmatization of the community as a violent area in work interviews.

Finally, Focus Group 4 was formed by ten men. 33% said it was easy to move in and out of Coque; 11% objected that it was rather difficult to reach some destinations, suggesting some changes should be promoted in the bus routes; 44% used bicycles to commute daily; 22% took the bus; 11% walked; the remaining 12% did not answer the question. 54% reported using buses. The issue of ambulances not wanting to enter the community was risen again. They also agreed that quality of life and transport availability in the community have improved in the late years. However, there was a level of disagreement on whether the fare was expensive or cheap. Some said it was expensive but another participant promptly remembered that all metropolitan area could be reached paying one single fare.

The second analyzed community was Alto Santa Teresinha, located in a hill area far from the CDB but close to a transport axis. As in Coque, the first group interviewed were the housewives, composed of nine participants. They all considered easy to move from the community to elsewhere, but 22% thought it was difficult to move within the



community. All participants reported making most displacements by foot, even though they all considered the area to be unsafe. 44% receive financial support from the “*Bolsa familia*” social program. None of the participants in this group reported owning bicycles or motorcycles; 44% use public transportation regularly, but 78% mainly walk to reach any destination; only one participant has access to car and only one reported using “*mototaxi*” (taxi on motorcycles) services. All considered the fare expensive, but only 33% had abdicated a trip for that reason.

The following group was composed of working men, with ten people. They all considered there is good access to the community, but reported that taxis denied ascending the hill due to security reasons. None of them reported using bicycles or motorcycles; 80% reported using public transport; however, 60% said their main transportation mode was by feet; only one uses *mototaxi* services and none reported using private automobiles. All reported using the free shuttle service that runs inside the community, connecting the top and bottom areas. Regarding fare price, 60% considered it too expensive, whereas 40% reported having missed some sort of appointment due to lack of ability to use public transportation.

On the other side, the working women of Focus Group 3, with eleven individuals, thought it was rather difficult to move within the community (54%). Nearly all of them used public transport services (90%), but 36% would walk to reach most destinations; only one participant had access to car. 27% thought the fare was too expensive, but only 18% had to back down an activity for that reason. They reported difficulties with the poor sidewalk infrastructure and vendors occupying the space supposed to be available for pedestrians. The shuttle service is seen as a big advantage; however, the buses’ waiting time is too long.

Finally, all eight male students first reported it to be easy to move within the community, but then they recalled problems regarding relatives with disabilities and quickly changed their minds. The main reason for commuting was attending school (this group had average age of 15 years old) and they all attended by foot. 75% of them owned bicycles and reported using the bus services, 25% had access to motorcycles and 50% had access to automobiles belonging to relatives. One reported using taxis and 50% used the free shuttle service. Only 25% said the fare was expensive.

## 7. Conclusions

In both areas, the relation between low commuting time and low income can be linked with little usage of public transportation. Individuals in general, but more importantly the unemployed, reported not being able to pay the public transportation fare, choosing to walk to their jobs or informal work related activities. Some of those distances were considerably long, the longest observation being a man that reported walking 14 kilometers for a job interview. For those individuals, transport cost is identified as the strongest barrier to reaching their informal jobs and work opportunities, although the possibility to walk to the main commercial areas and the CDB, in Coque region, decreases the social cost associated.

In Coque, although access to areas with a high concentration of jobs was not a problem, being close to downtown and to an integrated metropolitan terminal, many of its residents reported that by simply living in that region it was considerably more difficult for them to be accepted in a formal job. Many of them would provide CVs with some relatives’ address in another neighborhood in order to avoid the stigma of violence of the area. Many of the ones who surpassed this barrier and have found formal jobs reported doing their work-related trips mainly on foot or by bike – a feature that could explain this group’s short commuting time, since it limits job searching to areas nearby. Also, night shifts are nearly impossible to be taken by people living in Coque area, for the bus that enters the community stops circulating at 11 PM. If they accept a job offer on that period of the day, they ought to walk at night to the bus integration terminal, in an area that provides very little security to its inhabitants.

At Alto Santa Teresinha, transport costs did not represent such a big barrier regarding access to work opportunities. The community, being a hill area, is supplied with a free public transport system provided by the municipality. The vans that compose this system take people from the high hill areas down to public transport axis. None of the participants from this community has reported walking towards a work related activity for not being able to pay the transport fare. Many of the men and women interviewed said they commuted by foot every day, but the reason was they worked close to their jobs, frequently inside the community. The groups that complained the most about the transport fare were the housewives and the employed women.

The data collected provides evidence that, for those living in these two neighborhoods, and possibly for other low-income groups in the metropolitan region, the public transport fares act as a restraint for social mobility, being an obstacle to engaging in the formal labor market.

However, such scenario can be changed. In the last decade, Pernambuco state experienced strong economic development due to massive federal investments to lever the region's economy. In order to bring benefits to all citizens, that growth needs to be shared to the overall population, avoiding to replicate the historical pattern where only the privileged get to profit from economic development.

More specifically, from the transportation point of view, public policies to raise the quality of public transportation services, in order to increase the demand and decrease individual costs, would be needed. Policies enduring good sidewalks and bike lanes would also be of great value to increase poor people's access to work opportunities and other human activities. The Brazilian National Policy for Sustainable Urban Mobility (2004) points towards those initiatives, addressing that all investments in transport infrastructure should prioritize non-motorized mobility and public transport means. However, even though public policies in Brazil are seen as federal laws and therefore ought to be respected, what can be seen in practical terms is that this law is not enforced by the local government and the investments continue to benefit mainly those who own private automobiles.

Recife's metropolitan area transport planning document (PDTU), in its guidelines, states that non-motorized and collective means of transport should come first. It also states that good public transportation should be implemented and measures for safe and comfortable use of bicycles should be encouraged, in order to attract new users to those means and decrease the incentive for using private automobiles in daily displacements. However, as highlighted before, even though those documents and laws provide correct guidelines, the investment decisions from the government leaders are far away from those guidelines.

If those directives were enforced, the possibility of a larger insertion of the low-income population – a considerable percentage of the total population – as public transport system users would contribute to a more equal society, since they would have access to more diverse job opportunities and education, as well as to other services, not hereby addressed, that influence equity and quality of life. Such situation could work as a lever towards social inclusion, converging to increasing work and income levels, not only for this group, but to the overall region.

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