An Analysis of Car Ownership in Latin American Cities: a Perspective for Future Research

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Abstract

Car dependence must be avoided to achieve sustainable transportation; the diversity of studies available give a better perspective of the situation and how to tackle it. The reasons behind the increasing car use are still unknown in some regions such as Latin America. The gaps in the current literature are not just for location; some topics and methods are also unnecessarily predominant in the related studies. This research does a review of current literature for mobility in Latin America region with a special focus on car dependence. The aim is to detect gaps on the knowledge to further give recommendations on what should be studied. The results show the lack of numerical approaches to solidly taken case studies, especially in some countries of the region such as Central America and some of the states of South America. Disaggregate car ownership models are highly necessary for clarification of the region's behavioral aspects of car ownership such as personal and household preferences and lifestyles.

Keywords

car ownership, sustainable mobility, urban transportation planning, Latin America

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1 Introduction

One of the topics that are commonly addressed for achieving a sustainable city is mobility. How people commute has become a topic to study due to all the consequences that the modal split implies. Car dependence is becoming a common problem due to the different economic and social causes (Szendro and Torok, 2014). Contamination, bad use of resources, economic losses, social exclusion, among others are the consequences that a – non-energy efficient and pollutant commute brings (Szendro et al., 2014). The constant growth of the cities depending on different circumstances brings a change in the citizens, especially on the modal split.

The inclusion of car, or how some authors call it the born of the car city (Newman and Kenworthy, 2011) has been caused through industrialization; but how people have embraced the car is another history. Whyhave certain cities completely changed to car-oriented commuting? The reasons are extremely for urban planners who aim at changing the modal split of a city.

Latin America is following a motorization trend comparable with developed countries, but the conditions are different to this kind of countries. As shown in Table 1, some Latin American countries increase their motorization faster than developed countries. Figure 1 illustrates how fast the current gap between the Latin American countries and the developed states is filled until 2030. In fact, the average annual growth rate of car ownership in Latin America is much relatively higher than most of the countries in Table 1. Figure 2 depicts how this figure Latin America has overtaken all the major Western countries. The current status of other Latin American states that are not found in Table 1 is depicted in Table 2.

Why car is becoming a priority for commuting in this region is important to find the exact reasons without assuming that the trends are the same as the developed countries. There are similarities indeed, but a generalization of the studies by region can be problematic if the aim is to create guidelines.

The work of different researchers has been based on describing a sustainable city and how to achieve it, but not all have investigated the reasons behind people's choices regarding mode choice. Latin American studies have followed a trend on

Table 1 Car ownership rate increase in Latin America and selected developed countries.

No	Country	Cars per 1,000 inhabitants			Annual growth rate***
		2002***	2010 (Unless Indicated Differently)	2030***	
1	Mexico	165	275	491	**5.0%**
2	Argentina	186	314[1]	489	**4.4%**
3	Brazil	121	249[3]	377	**5.1%**
4	Chile	144	230*	574	**6.1%**
5	Dominican Rep.	118	128	448	**5.9%**
6	Ecuador	50	71	182	**5.6%**
7	Austria	629	585[3]	803	**0.9%**
8	Belgium	520	559	636	**0.7%**
9	Switzerland	559	573[3]	741	**1.0%**
10	Czech Republic	390	485	740	**2.3%**
11	Germany	586	588[3]	705	**0.7%**
12	Denmark	430	480	715	**1.8%**
13	Spain	564	593[3]	795	**1.2%**
14	Finland	488	551[3]	791	**1.7%**
15	France	576	578**	779	**1.1%**
16	Great Britain	515	519	685	**1.0%**
17	Greece	422	537	725	**2.0%**
18	Hungary	306	345	745	**3.2%**
19	Ireland	472	513[2]	812	**2.0%**
20	Iceland	672	747[3]	768	**0.5%**
21	Italy	656	682	781	**0.6%**
22	Luxembourg	716	741[3]	706	**-0.1%**
23	Netherlands	477	528	593	**0.8%**
24	Norway	521	591[3]	805	**1.6%**
25	Poland	370	580	746	**2.5%**
26	Sweden	500	520	777	**1.6%**
27	USA	812	809[3]	849	**1.1%**
28	Canada	581	607[2]	812	**1.8%**
29	Australia	632	723[6]	772	**0.7%**
30	Japan	599	588	716	**0.6%**
31	New Zealand	612	708[3]	786	**0.9%**

[1] Data available for 2007 derived from World Bank.

[2] Data available for 2009 derived from World Bank.

[3] Data available for 2011 derived from World Bank.

[4] Data available for 2012 derived from World Bank.

[5] Data available for 2013 derived from World Bank.

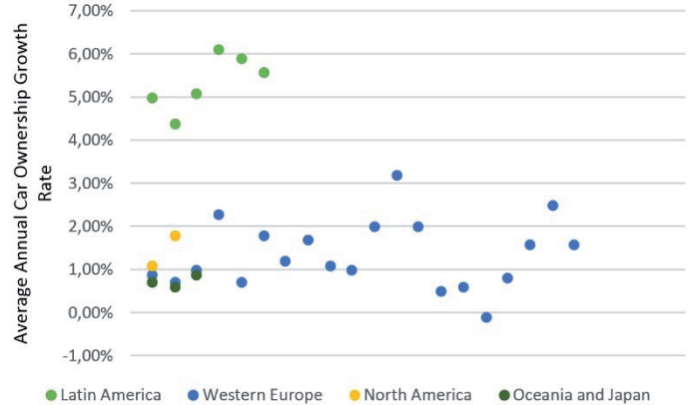[6] Data available for 2014 Australian Bureau of Statistics, 2013.

* Source: Instituto Nacional de Estadisticas, Chile.

** Source: CCFA Information Presse.

*** Source: Dargay, Gately and Sommer (2007).
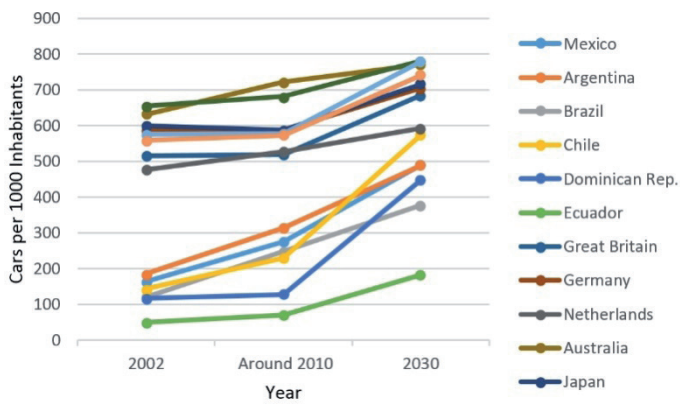
Fig. 1 Comparison of car ownership in Latin America and selected developed countries. Illustration by authors, based on the content of Table 1.

Fig. 2 Average annual car ownership growth in Latin America and industrial states. Illustration by authors, based on the content of Table 1.

Table 2 The current status of car ownership in smaller Latin American states.

Country	2010
Cuba	38[2]
Paraguay	54[3]
Nicaragua	57
Bolivia	68[1]
Guatemala	68
Colombia	71[3]
Peru	73
El Salvador	94[1]
Honduras	95[2]
Panama	132
Venezuela	147[1]
Costa Rica	177
Uruguay	200[3]

[1] Data available for 2007
[2] Data available for 2008
[3] Data available for 2009
Source: World Bank, 2011

their approaches and locations to investigate. Investigating a diversity of researches is critical to have different comparisons and not to assume just a tendency in a certain area.

The aim of this paper is to provide a description of the available literature on the topic of mobility for the region of Latin America with a special focus on car ownership and dependence. The analysis consists of a review of the used methods for analyzing such as the diversity of case studies, the approaches and the topics tackled.

This part is followed by an analysis of how well some topics are covered and the flaws in certain areas to end with recommendations for further studies. The general objective of this paper is to present the main gaps in the topic of car ownership in Latin America and identify the future research topics and methodologies.

2 The Current Status of Car Ownership Research in Latin America

The different literature in Latin America in the subject of sustainable mobility is not comparable with the state of the art in the developed world. International literature covers mostly Europe, Australia, and the USA and is diverse in their different topics. Recommendations and guidelines come from such studies and several policies and programs have been applied in different cities to achieve a change in the modal split. In the case of Latin America there are manuals describing the problems of dependence on cars or guidelines to change modal split but in comparison with the international findings these guidelines do not have the same scientific support due to the lack of research.

Changing the modal split in Latin American cities should be different from a developed city point of view, even when there are similarities on the behavior, the same policies could have different results. The quantity of manuals or guidelines for Latin America or at the national level is enough and covers different aspects such as the economy and the built environment. These researches are more about describing data, census or status of the cities, sometimes comparing cities to achieve a conclusion.

The different guidelines are not based on a result from numerical analyzes; it gives recommendations probably based on international studies. Most of the guidelines are with the aim of achieving sustainable mobility and only a few are with the specific subject of minimizing car dependence. It is a review of the different possibilities that cities can use to, in theory, accomplish a change on a better modal split, increase densities, avoid urban sprawl, as well as improving walking-friendly streets, and strengthening public transportation (PT) (Baranda Sepulveda et al., 2013; Medina Ramirez and Veloz Rosas, 2012; Pardo, 2013). Others have suggested push measures and analyzed the public acceptance via surveys to find out

if it works, and evaluated previous push measures used in the region (Calderón, 2009; Rivasplata, 2013). Suggestion on congestion pricing is more recommendable for cities where socio-economic and personal preferences are significant. The manuals are good as a starting point but do not justify the reasons behind a specific travel behavior, e.g. they do not explain why city dwellers have been increasingly using personal cars, even if PT systems have been improved in some cases.

Choosing case studies for a research depends on different aspects, such as data availability and the problem aiming to investigate. Latin American studies are focused mostly on capital cities due to their economic and political importance and the tendency to be the bigger cities in the country (Cervero et al., 2009; Crotte et al., 2011; Guerra, 2014; Hanson, 1989; Jakovcevic and Steg, 2013; Ureta Icaza, 2009; Zegras, 2004; Zegras and Hannan, 2012). Other studies have chosen cities normally with the population over a million.

The investigations are concentrated in cities such as: Bogota (Cervero et al., 2009), Medellin (Calderón, 2009), Buenos Aires (Jakovcevic and Steg, 2013) , Sao Paulo, Mexico City (Crotte et al., 2011; Crotte et al., 2008; Guerra, 2014, 2015; Hanson, 1989), Santiago de Chile (Ureta Icaza, 2009; Zegras, 2004, 2010; Zegras and Hannan, 2012). The selected cases probably are done by the available data; bigger cities currently have more information. This economic centers and demographic concentrations normally have more sources of data. Other papers concentrate in the whole region of Latin America (Clear Air Institute, 2012; Corporación Andina de Fomento, 2011; Gartner, 2014), the work of (Corporación Andina de Fomento, 2011) is a big descriptive work of fourteen Latin American cities, the cities have certain characteristics in common, such as the size and all of them are considered large cities or megacities. There are some works on Central America such as San Jose, the capital of Costa Rica (Alpizar and Carlsson, 2003), but these countries have not been studied for car dependence.

When a specific city is not chosen, some authors have decided to study at national or regional level (Baranda Sepulveda et al., 2013; Button et al., 1993; Gartner, 2014; Hidalgo and Huizenga, 2013; Islas Rivera et al., 2011; Medina Ramirez, 2012; Medina Ramirez and Veloz Rosas, 2012; Moctezuma Navarro, 2012; Pardo, 2013; Rivasplata, 2013; Sivak and Tsimhoni, 2008; Thomson and Bull, 2002). National studies are useful to detect similarities between countries, but they should be used with precaution due to the generalization of the cities within the country. For example comparing GDP becomes problematic due to inequalities between the countries, an example is illustrated in Fig. 3.

Different topics have been brought to study to understand the mobility-related behaviors. Finding relationships is interesting for urban planners due to the results and policies that they can develop. There are different areas related to mobility that have been, since many years, studied. As the international studies
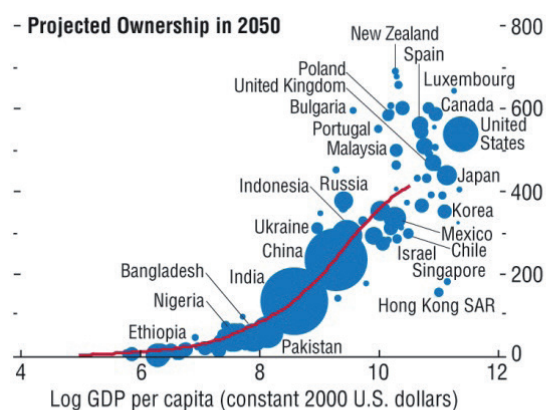
Fig. 3 Car ownership for 2050. Source: Chamon et al., 2008

present socioeconomic factors have been proved to be powerful triggers, therefore scholars have focused their studies on this area. The built environment such as densities and sprawl play a role in some cities but does not mean that it is a general driver of car dependence. The importance of having studies with a diversity of topics related to mobility brings more insights.

In Latin America there is an inclination in the socioeconomic area in researching income or Gross Domestic Production (GDP), especially comparing developing countries (Gartner, 2014; Islas Rivera et al., 2011; Moctezuma Navarro, 2012; Thomson and Bull, 2002).

The type of studies where income has intervened uses broad data such as the minimum wage or the national average, which can provide less detailed and specialized results. This variable is commonly used to investigate the causes of car ownership increase (Alpizar and Carlsson, 2003; Baranda Sepulveda et al., 2013; Button et al., 1993; Guerra, 2015; Henry and Hubert, 2000; Moctezuma Navarro, 2012; Sivak and Tsimhoni, 2008; Zegras, 2004, 2010; Zegras and Hannan, 2012). Other economic factors such as accessibility of cars in terms of price are also involved (Alpizar and Carlsson, 2003; Clear Air Institute, 2012; Islas Rivera et al., 2011; Medina Ramirez, 2012; Thomson and Bull, 2002).

The citizen profile is another area to take in consideration, as some international researches have concluded even when controlling some factors such as the built environment and adapting the different aspects for creating a perfect atmosphere to commute via PT or bike, some users will prefer the private commuting mode. These different personal preferences come from various aspects such as gender (Brennan, 2000; Ureta Icaza, 2009) and also the average age of the citizens by the different necessities and lifestyles that change over their life (Alpizar and Carlsson, 2003). The analysis include some surveys or interviews in which feedback is presented about the reasons people prefer to use their personal cars, but it is

difficult to understand which values are more present or powerful affecting acquiring a car such as comfort, flexibility or security (Bezerra and Taipa, 2004; Calderón, 2009; Jakovcevic and Steg, 2013; Thomson and Bull, 2002; Ureta Icaza, 2009).

Travel behavior has a relationship with built environment according to different international studies bringing variables such as diversity, land use mix, and densities. This area has brought more numerical studies in comparison with other areas, e.g. linking land use variables with car ownership levels (Newman and Kenworthy, 1989). Researchers have brought their studies on cities in Latin America with variables such as population density (Cervero et al., 2009; Islas Rivera et al., 2011; Medina Ramirez, 2012; Moctezuma Navarro, 2012; Zegras, 2004, 2010), while job density or employment availability has also been an involved factor (Guerra, 2014; Moctezuma Navarro, 2012). On the same area, the diversity of services is suggested to affect travel behavior; when services are not reachable in short distances. The car dependence may appear in the case of the concentration of only one or two services. For Latin American region some studies are available for Bogota and Santiago de Chile linking the diversity of land uses with the use of cars or travel behavior (Cervero et al., 2009; Guerra, 2014; Zegras, 2004; Zegras and Hannan, 2012).

The connectivity of the city is involved to what implies: commuting times and comfort, aspects such as quantity and quality of streets can influence the citizens. In Latin America variables such as bike infrastructure (Hidalgo and Huizenga, 2013) and the design of the streets (Cervero et al., 2009; Guerra, 2014; Zegras, 2010) are investigated to see its influence on travel behavior. The availability of parking creates comfort as the road priority over PT (Alpizar and Carlsson, 2003; Clear Air Institute, 2012; Medina Ramirez, 2012; Moctezuma Navarro, 2012). Priority on roads over PT is merely a statement based on observation, which has been more extensively developed or have been more invested. For the user, there is a decision to make concerning mobility mode; therefore some authors have investigated the road infrastructure, as previously stated, as well as the PT characteristics. Analyzing the PT qualities can give insights such as why in some cities it is losing the fight against the car. Therefore authors have included PT's aspects in their investigations such as price, commuting times, quality, punctuality, coverage, etc. (Alpizar and Carlsson, 2003; Cervero et al., 2009; Hidalgo and Huizenga, 2013; Thomson and Bull, 2002; Zegras, 2004; Zegras and Hannan, 2012).

Travel behavior is a wide topic, as some author pursue investigation of mobility in general aspects or the current problems emerging (Blanco, 2005; Calderón, 2009; Corporación Andina de Fomento, 2011; Henry and Hubert, 2000; Hidalgo and Huizenga, 2013; Pardo, 2013; Thomson and Bull, 2002). Other has been more specific and narrow to analyze and understand why people commute in a certain way, for example walk or bike (Bezerra and Taipa, 2004; Cervero et al., 2009; Zegras, 2004) or

motives to use PT (Crotte et al., 2011). However, some of the studies have a broad topic, general basis on sustainable mobility or trend studies about motorization and only some studies have narrowed the topic to find factors for the car ownership increase.

The real problem is the increasing motorization of Latin American cities, the involvement of different factors has been studied using various approaches (Alpizar and Carlsson, 2003; Clear Air Institute, 2012; Crotte et al., 2008; Gartner, 2014; Guerra, 2014, 2015; Hanson, 1989; Islas Rivera et al., 2011; Moctezuma Navarro, 2012; Ureta Icaza, 2009; Zegras, 2010; Zegras and Hannan, 2012), which are modest in comparison with broader topics.

The methodologies used for these specific studies are in its majority descriptive using case studies on specific areas as previously explained. Only a few numerical works are available for the region, using statistical analytical methods such as chi-square, multinominal logit modeling, generalized method of moments, intraclass correlation, etc. (Alpizar and Carlsson, 2003; Button et al., 1993; Crotte et al., 2008; Guerra, 2014, 2015; Hanson, 1989; Sivak and Tsimhoni, 2008; Zegras, 2010; Zegras and Hannan, 2012).

3 Discussion

Sustainable mobility as a topic has been studied by different authors and Latin America is no exception. The current problems that the region face come from different backgrounds; and the changes in the modal split to car orientated are present in most of the countries in Latin America. The negative consequences of the car are clearly established and further investigation for the region is pointless unless a deep investigation on the reasons behind is needed.

The motorization rates in Latin America have been studied with different approaches and case studies, the topic is not new or unknown but in general, the approaches have a lack on empirical work and diversity of case studies. The different guidelines or manual for Latin America are present with the trend of describing the cities, comparing data and giving an analysis of the status quo. Still there is not enough solid work for answering why motorization trends are increasing.

Most of the existing literature has taken the descriptive approach. Most all of the literature has been focused on describing the problem, but its roots are unclear. These methods have indeed brought answers to open a deeper investigation on some subjects, recommendations can be made to establish connections, but these studies and the lack of empirical results have a weakness due to the unfounded statement.

The reasons behind the increase in car ownership rates are still unknown for most of the cities in Latin America; still there are guidelines for achieving sustainable mobility or avoiding car dependence. Proposing a solution before knowing the cause is not optimal; international studies can give a starting point, but more in deep studies are necessary.

Every city is different; since a there might be a wide range of differences between the cities from culture to economic activities and geographic characteristics. Most of the work done has been focused on capital cities or metropolitan areas due to their importance and the quantity of inhabitants that they hold. Other reason behind is the availability of data, smaller cities can be problematic to study due to the lack of previous census and statistics. Then smaller cities have been neglected from being studied, and with a little research about them. Decision makers of these cities have to work with guidelines that are mainly for bigger cities with completely different scenarios of what a smaller city present. If medium and smaller cities are behaving in the same matter should be justified.

Assuming that similarly behave of cities is valid in certain ranges, but comparing a capital city with the population over 5 million with a medium-sized city with economic actives and a different urban form is not suitable. Intermediate cities and less populated ones have a lack of research probably due to the lack of available data and that all the efforts are on bigger cities.

The preference on the studied cities is not also for the size of cities, it is also for some countries such as Central and South American states such as Ecuador, Peru, Paraguay and Bolivia. The lack of research on car dependence can be justified due to the low cars per 1,000 inhabitants as shown in Table 1 and 2. Still travel behavior should be studied to avoid a further problem in those countries.

The other approach that these studies have taken is to analyze national data. National data are good for an overview, but the fact is that there are countries with a diversity of cities and inequalities such as income or size of the city.

As mentioned above, lack of suitable data has been a major obstacle against conduction of in-depth studies. The aggregation level of the available census data is not suitable for the development of comprehensive disaggregate models in many cases. Complication of providing disaggregate data to show individual behaviors and choices has led to a willingness towards aggregate and descriptive studies (Clear Air Institute, 2012; Corporación Andina de Fomento, 2011; Gartner, 2014; Hidalgo and Huizenga, 2013; Islas Rivera et al., 2011; Ureta Icaza, 2009) and guidelines lacking foundation for specific cases (Baranda Sepulveda et al., 2013; Bezerra and Taipa, 2004; Calderón, 2009; Medina Ramirez, 2012; Medina Ramirez and Veloz Rosas, 2012; Pardo, 2013; Rivasplata, 2013), while disaggregate modeling has been neglected.

From international studies, some areas of study are taken for granted that affect travel behavior such as socioeconomic factors, built environment and personal preferences. On socioeconomic area there is a common analyzed factor: average income per capita (Alpizar and Carlsson, 2003; Button et al., 1993; Guerra, 2015; Henry and Hubert, 2000; Moctezuma Navarro, 2012; Sivak and Tsimhoni, 2008; Zegras, 2010; Zegras and Hannan, 2012) . This variable along with GDP (Button et al.,

1993; Gartner, 2014; Moctezuma Navarro, 2012; Sivak and Tsimhoni, 2008) has been presented as a reason for increasing the motorization rates, but the last variable as previously mentioned is at national level which is not adequate for establishing a valid reason for all the cities of the country due to its broad implication.

Some which has not been so in deep studied are personal preferences. Only some surveys and interviews have been presented in order to have some feedbacks about why it is important to people to have a car. In the case scientific research indicates that personal preferences are stronger than the built environment, urban planners have to make a completely different approach on their strategy.

The built environment has been studied but not so deep as socioeconomic factors. There is a lack of studies related to car ownership and urban transformation i.e. urban sprawl. As many studies recommend avoiding urban sprawl due to its consequences such as car dependence, this argument has not been so much studied in Latin America to be as concrete like in international studies. The little research about this topic employs descriptive analysis approach with a lack of empirical support. Diversity is mentioned in the guidelines as a positive aspect to have; high diversity of services per area encourages walking or biking. However, the relation between land use mix and the car dependence is still not proven in the region, a few studies are based on land use but as already stated for big cities (Cervero et al., 2009; Zegras and Hannan, 2012). The same goes for variables such as densities (population, employment, etc.) (Guerra, 2014; Moctezuma Navarro, 2012; Zegras, 2004) This is constantly presented in the recommendations or in the descriptive analysis of the cities, but it rarely results from a numerical approach. The built environment has been indeed discussed, but there is a lack of studies related to car dependence and numerical approaches.

Accessibility and efficiency of transport infrastructure and PT quality (including vehicle quality, convenience, and comfort) seem to be varying. Some findings indicate that while people have a better income, they change quickly to private transport. Indeed, the different aspects do not work alone, and assuming that only a factor is the reason behind car dependence is illogical. The relationship between different variables has not been fully developed and is still difficult to define which factors have more influence than others. Therefore, an analysis to identify the determinants and statistically analyze their importance and their relationships between them is needed.

4 Conclusions

Mobility in Latin America has become a topic that has been studied in the last decades, since guidelines to empirical studies. But the lack of diversity in the studies can lead to misinterpretations such as assumptions to generalize the results to a wide range of cities and the causes behind their mobility

problems. Urban mobility has been studied as a broad topic and only a few take the specific topic of car dependence.

The studies show a clear tendency for large or capital cities, neglecting Central America and a few countries in South America. The countries that are studied show a clear preference to the capitals or metropolitan areas, with the little research for medium and small cities. From the topics also some variables have been more studied such as economic factors. Built environment variables are not so in-depth studied and mostly approached with a descriptive work. The same is for areas such as road infrastructure and PT qualities. Personal preferences is an area not so studied and only a few studies about perceptions about the car have been done before. The analysis maintains a descriptive method. Further research is necessary.

The present paper suggests new studies take statistical analysis approaches based on disaggregate data, focusing on the individual and household preferences and lifestyles towards car ownership. Geographically, small and mid-sized cities especially those located in Central America and some of the less-studied contexts can be targeted as a research priority.

Acknowledgement

References

Alpizar, F., Carlsson, F. (2003) Policy implications and analysis of the determinants of travel mode choice: an application of choice experiments to metropolitan Costa Rica. *Environment and Development Economics*. 8 (4). pp. 603-619. DOI: 10.1017/S1355770X0300329

Australian Bureau of Statistics (2013) [Online] Available from: http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/268932501A477446CA257BB00011A2FF/$File/93090_31%20jan%202013.pdf [Accessed: 31th May 2015]

Baranda Sepulveda, B., Cañez Fernández, J., Garduño Arredondo, J., Media Ramírez, S., Orozco Camacho, M., Padilla Rodriguez, X., … Veloz Rosas, J. (2013) *Hacia una estrategia Nacional Integral de Movilidad Urbana. ITDP*. (Towards a National Integral strategy of Urban Mobility.) (in Spanish)

Bezerra, B., Taipa, S. (2004) La "caminabilidad" de las ciudades como un reflejo del desarrollo Sustentable. (The "walkability" of the cities as a reflect of sustainable development. Advances in Renewable Energies And Environment.) *Avances En Energías Renovables Y Medio Ambiente*. 8 (1). [Online] Available from: http://www.cricyt.edu.ar/asades/modulos/averma/trabajos/2004/2004-t001-a017.pdf [Accessed: 31th May 2015] (in Spanish)

Blanco, J. (2005) Urbanizaciòn y movilidad: contradicciones bajo el modelo automovil–intensivo. (Urbanization and mobility: contradictions by the intensive car model.). *Anais Do X Encontro de Geografos de América Latina. Sao Paulo: X EGAL, CD-Rom*. [Online] Available from: http://www.observatoriogeograficoamericalatina.org.mx/egal10/Geografiasocioeconomica/Geografiadeltransporte/04.pdf [Accessed: 31th May 2015] (in Spanish)

Brennan, T. L. (2000) An Analysis of Trip Behaviour Patterns of Women in Developing Countries: A Case Study of Puebla, Mexico. *Women's Travel Issues Second National Conference*. [Online] Available from: http://trid.trb.org/view.aspx?id=721412 [Accessed: 31th May 2015]

Button, K., Ngoe, N., Hine, J. (1993) Modelling vehicle ownership and use in low income countries. *Journal of Transport Economics and Policy*. 27 (1). pp. 51-67.

Calderón, C. A. G. (2009) Estrategias tarifarias y desestimulación del uso del vehículo particular por medio del pico y placa en Medellín. (Tariff strategies and discourage of the private car use by the pike and plate in Medellin.). *Revista Ingenierías Universidad de Medellín*. 8 (14). pp. 95-110. (in Spanish)

CCFA Information Presse (2012) [Online] Available from: http://www.ccfa.fr/IMG/pdf/parcautofra1112.pdf [Accessed: 31th May 2015]

Cervero, R., Sarmiento, O. L., Jacoby, E., Gomez, L. F., Neiman, A. (2009) Influences of Built Environments on Walking and Cycling: Lessons from Bogotá. *International Journal of Sustainable Transportation*. 3 (4). pp. 203-226. DOI: 10.1080/15568310802178314

Chamon, M., Paolo M., Yoki O. (2008) Cars—Mass Car Ownership in the Emerging Market Giants. *Economic Policy*. 23 (54). pp. 202-242.

Clear Air Institute (2012) Gestión de la demanda de transporte: Oportunidades para mitigar sus externalidades y las de los vehiculos automotores en América Latina. (Management of the transport demand: Opportunities to mitigate the externalities and motor vehicles in Latin America.). [Online] Available from: http://www.cleanairinstitute.org/cop_gd/wp-content/uploads/2012/08/doc_completo_gdt_politica.pdf [Accessed: 31th May 2015] (in Spanish)

Corporación Andina de Fomento (2011) *Desarrollo urbano y movilidad en America Latina*. (Urban development and mobility in Latin America. Motorization rate study.), Bogota: CAF. (in Spanish)

Crotte, A., Graham, D. J., Noland, R. B. (2011) The Role of Metro Fares, Income, Metro Quality of Service and Fuel Prices for Sustainable Transportation in Mexico City. *International Journal of Sustainable Transportation*. 5 (1). pp. 1-24. DOI: 10.1080/15568310903050073

Crotte, A., Noland, R. B., Graham, D. J., Board, T. R. (2008) Estimation of Road Traffic Demand Elasticities for Mexico City. *Transportation Research Record: Journal of the Transportation Research Board*. 2134.

Gartner, A. (2014) *Estudio sobre tasa de motorizacion. Relaciones y determinantes*. (Investigating motorization rates. Relationships and determinants.). Centro Tecnologico de Transporte, Transito y Seguridad Vial. (in Spanish)

Dargay, J., Gately, D., Sommer, M. (2007) Vehicle Ownership and Income Growth, Worldwide: 1960-2030. *Energy Journal*. 28. pp. 143-170.

Guerra, E. (2014) The Built Environment and Car Use in Mexico City Is the Relationship Changing over Time?. *Journal of Planning Education and Research*. 34 (4). pp. 394-408. DOI: 10.1177/0739456X14545170

Guerra, E. (2015) The geography of car ownership in Mexico City: a joint model of households' residential location and car ownership decisions. *Journal of Transport Geography*. 43. pp. 171-180. DOI:10.1016/j.jtrangeo.2015.01.014

Hanson, M. E. (1989) The motor vehicle dominated city as a non-sustainable urban form: Mexico City and Jakarta. *Computers, Environment and Urban Systems*. 13 (2). pp. 95-108. DOI: 10.1016/0198-9715(89)90037-9

Henry, E., Hubert, J. (2000) Contrastes de la motorización y de la movilidad en las megápolis. (Motorization and mobility contrasts in the megapolis) In: *Documento presentado en la Conferencia CODATU IX (Coopération pour le Développement et l'Amélioraion des Transports Urbains et périurbains)* (Cooperation for Development and Improvement of Urban and suburban transport), *México, DF, abril*. [Online] Available from: http://horizon.documentation.ird.fr/exl-doc/pleins_textes/pleins_textes_7/b_fdi_55-56/010023428.pdf [Accessed: 31th May 2015] (in Spanish)

Hidalgo, D., Huizenga, C. (2013) Implementation of sustainable urban transport in Latin America. *Research in Transportation Economics*. 40 (1). pp. 66-77. DOI:10.1016/j.retrec.2012.06.034

Instituto Nacional de Estadisticas Chile (2014) [Online] Available from: http://www.ine.cl/canales/chile_estadistico/estadisticas_economicas/transporte_y_comunicaciones/parquevehiculos.php [Accessed: 31th May 2015]

Islas Rivera, V., Moctezuma Navarro, E., Hernandez Garcia, S., Lelis Zaragoza, M., Ruvalcaba Martinez, J. (2011) Urbanizacion y motorizacion en Mexico. (Urbanization and motorizacion in Mexico.). *Publicacion Tecnica*. (362). [Online] Available from: http://trid.trb.org/view.aspx?id=1285996 [Accessed: 31th May 2015] (in Spanish)

Jakovcevic, A., Steg, L. (2013) Sustainable transportation in Argentina: Values, beliefs, norms and car use reduction. *Transportation Research Part F: Traffic Psychology and Behaviour*. 20. pp. 70-79. DOI: 10.1016/j.trf.2013.05.005

Medina Ramirez, S. (2012) *La importancia de reduccion del uso del automovil en Mexico*. (The car reduction importance in Mexico.) [Online] Available from: http://mexico.itdp.org/wp-content/uploads/Importancia-de-reduccion-de-uso-del-auto.pdf [Accessed: 31th May 2015] (in Spanish)

Medina Ramirez, S., Veloz Rosas, J. (2012) Guía de estrategias para la reducción del uso del auto en ciudades mexicanas. (Guidelines to reduce the car-use in Mexican cities.) ITDP. (in Spanish)

Moctezuma Navarro, E. M. (2012) Estudio de la Motorizacion en Mexico mediante la dinamica de posesion vehicular: Determinantes Macro y Microeconomicos. (Motorization study in Mexico by the car ownership level: Macro and micro-economic determinants). *Publicacion Tecnica*. (374). [Online] Available from: http://trid.trb.org/view.aspx?id=1286001 [Accessed: 31th May 2015] (in Spanish)

Newman, P., Kenworthy, J. (1989) *Cities and Automobile Dependence: An International Sourcebook*.

Pardo, C. (2013) Elementos y Acciones para promover un transporte sustentable para America Latina. (Elements and actions to promote a sustainable transport in Latin America.). Clear Air Institute. [Online] Available from: http://www.cleanairinstitute.org/caifiles/file/Promo-Nov8-CFP.pdf [Accessed: 31th May 2015] ITDP.

Rivasplata, C. R. (2013) Congestion pricing for Latin America: Prospects and constraints. *Research in Transportation Economics*. 40 (1). pp. 56-65. DOI: 10.1016/j.retrec.2012.06.037

Sivak, M., Tsimhoni, O. (2008) *Future demand for new cars in developing countries: going beyond GDP and population size* (No. UMTRI-2008-47). The University of Michigan, Transportation Research Institute. [Online] Available from: http://deepblue.lib.umich.edu/handle/2027.42/60955 [Accessed: 31th May 2015]

Szendrő, G., Török, Á. (2014) Theoretical investigation of environmental development pathways in the road transport sector in the European Region. *Transport*. 29 (1). pp. 12-17. DOI: 10.3846/16484142.2014.893538

Szendrő, G., Csete, M., Török, Á. (2014) The Sectoral Adaptive Capacity Index of Hungarian Road Transport. *Periodica Polytechnica Social and Management Sciences*. 22 (2). pp. 99-106. DOI: 10.3311/PPso.7377

Thomson, I., Bull, A. (2002) La congestión del tránsito urbano: causas y consecuencias económicas y sociales. (Urban transit congestion: economic and social causes and consequences.). *Revista de La CEPAL*, (76). p. 109. (in Spanish)

Ureta Icaza, S. (2009) Manejando por Santiago: Explorando el uso de automóviles por parte de habitantes de bajos ingresos desde una óptica de movilidad sustentable. (Driving thru Santiago: Exploring the use of car in low income inhabitants from a sustainable mobility view.). *EURE (Santiago)*. 35 (105). pp. 71-93. (in Spanish)

World Bank (2007-2014) [Online] Available from: http://data.worldbank.org/indicator [Accessed: 31th May 2015]

Zegras, C. (2004) The Influence of Land Use on Travel Behavior: Empirical Evidence from Santiago de Chile. *Transportation Research Board (TRB) 83rd Annual Meeting, Washington, DC*.

Zegras, C. (2010) The Built Environment and Motor Vehicle Ownership and Use: Evidence from Santiago de Chile. *Urban Studies*. 47 (8). pp. 1793-1817. DOI: 10.1177/0042098009356125

Zegras, C., Hannan, V. A. (2012) The Dynamics of Automobile Ownership Under Rapid Growth: The Santiago de Chile Case. *Transportation Research Record: Journal of the Transportation Research Board, Forthcoming*. [Online] Available from: http://ebooks.narotama.ac.id/files/MIT%202012-2013/The%20Dynamics%20of%20Automobile%20Ownership%20Under%20Rapid%20Growth%20The%20Santiago%20de%20Chile%20Case.pdf [Accessed: 31th May 2015]