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The transportation systems of Buenos Aires, Chicago and São Paulo: City centers, infrastructure and policy analysis

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Abstract

We compare the passenger transportation systems of Buenos Aires, Chicago and São Paulo. The selected cities represent distinctive combinations of land-use, infrastructure, and evolution of transport policy. Analysis is centered on accessibility to downtown areas, where transportation processes converge in an environment where space is scarce. In two of the three cities institutional arrays that legally establish unified decision making have shown little capacity to launch fare or physical coordination between modes. In two of the three cities the concentration of public transportation supply to historical downtowns has not been an attraction factor, and downtown uses have expanded to less accessible areas. Gen- trification in Chicago is also another process showing that land use changes are related to many factors, transportation being only one of them, and not always a necessary one. In all three cases the use of railways, as a set of inherited infrastructures, has seen an increase whose magnitude suggests a link to modal reassignment due to increasing congestion. Scarcity of space in old downtown areas is being counteracted through more intense use, or through the expansion of vertical space for transportation operations.

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1. Introduction

The cities of Buenos Aires, Chicago and São Paulo have reached a similar spatial scale, although their populations and functional roles in their respective countries/regions are different. Being all three multi-million metropolis, with similar size in terms of built area, comparable metropolitan transport demands exist, that in each case are dealt with differently. This paper provides a state-of-the-art review and analysis of passenger transportation systems in the three cities, i.e., automobile, bus, and rail. This overview includes discussion of the institutional framework for planning, the incidence of large-scale land-use patterns, infrastructure availability/investment, and recent trends in public transportation demand. Our approach differs from other studies in the literature in that we provide a strategic and integrated analysis of the factors contributing to the supply and demand of passenger transportation. In contrast, other studies are generally focused on issues such as infrastructure investments, socio-economic or demographic trends, transportation operations and technology. As such, they tend to be more detailed in specific areas, but often fail to identify the linkages.

The present study follows the framework proposed by Thomson (1977) in his book about transportation in great cities. Namely, the analysis is based on the following premises:

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Additionally, Thomson’s comprehensive case review is primarily based on the spatial structure of metropolitan areas, and even more specifically, on how the prominence of the city center influences the system as a whole. The present study also concentrates on this aspect, by focusing on accessibility to city centers in large metropolitan areas, as opposed to overall treatment of flows within a city or spatial area, which is a usual starting point for planning agencies and analysts. In addition, the approach used by Simpson (1988) is incorporated, emphasizing the impacts of large-scale changes at the downtown level, and the distribution of the planning process along government levels and its importance. This will also be addressed for the cities under consideration in this article.

The concentration of trip destinations in a small area poses the challenge of providing large transportation capacity in limited physical space, while preserving the historical, political, cultural, economic and environmental heritage/values of city centers. In smaller urban concentrations, i.e., cities of less than 2 million people, the number of commuters is smaller and distances tend to be shorter, which, in turn, reduces the need for public transportation alternatives. But in large metropolitan areas, i.e., cities with a defined and preeminent central area, and more than 5 million people, longer distances imply a larger share of trips to city centers, making the total number of trips grow exponentially with city size.

Transportation processes consume space in different measures according to the technology considered or, in the case of a given city, according to the existing combination of technologies available. At the same time, city centers are characteristically areas of high concentration of activities, and space is, therefore, scarce. In the present analysis the emphasis is placed on this apparently contradictory combination: the existence of a high demand for transportation capacity in a geographic environment where space is limited.

Thomson addressed the case of Chicago in the chapter he devoted to weakly centered cities or, using the term to be used here, city centers with a lower preeminence. But renewal of the city center in Chicago (Lin, 2002; Testa, 2004; Greene, 2006) justifies a reexamination of its transportation system. On the other hand neither Buenos Aires nor São Paulo were included in Thomson’s study. In particular, we feel that the analysis of São Paulo’s multiple downtown structure adds new elements to Thomson’s synthesis.

Before proceeding, we note that the selection of the cities analyzed herein was, to some extent, driven by our ability to conduct field observations, including use of bus and rail systems during peak hours, as well as interviews with leading transportation experts, government officials and users of public transportation. We recognize that this approach has many limitations. At the same time, we believe that the compilation of data from the three cities will be of interest to researchers studying passenger transportation in any one of them. Moreover, comparison of the three cities provides a frame of reference that allows us to contextualize our observations. Perhaps more importantly, though, our analysis of similarities and differences between the cities has allowed us to learn and document far-reaching lessons for transportation policy and practice.

The remainder of the paper is organized as follows: In Section 2, we present the data used in our analysis. We also provide an extensive survey of complementary literature. The land-use of the three cities is described in Section 3. In Section 4, we provide an overview of the jurisdictional structure, and how it applies to transportation policy and decision-making. Sections 5–7, respectively, provide an extensive review of the following modes of passenger transportation: automobile, buses, and rail (both metro/subway and commuter rail services). Our discussion and analysis are presented in Section 8. Finally, conclusions appear in Section 9.

2. Data and references

In this section, we discuss the data used in our analysis, as well as the sources where they were obtained. We also provide the reader with an extensive set of complementary references.

Demographic and geographic data for Buenos Aires were obtained from Argentina’s Instituto Nacional de Estadísticas y Censos, INDEC (National Census and Statistics Institute). Transportation statistics were obtained on-line as well from the country’s Comisión Nacional de Regulación del Transporte, CNRT (National Commission for Transport Regulation). For São Paulo demographic and geographical data were obtained from the State of São Paulo’s Fundação Sistema Estadual de Análise de Dados, SEADE (State Data Analysis System), and from the City of São Paulo’s website. Maps available at Deák (n.y.) were consulted. To ensure the comparability Transport data were obtained, from the Annual Balances of São Paulo’s transportation operators (CPTM, Metro, Sptrans), and from SEADE. Demographic data for Chicago were obtained from the US Census Bureau, built into shapefile GIS data provided by the Northern Illinois Planning Commission (NIPC), now the Chicago Metropolitan Agency for Planning (CMAP). Transportation data were obtained from the city’s Regional Transportation Authority (RTA) through the Regional Transportation Asset Management System (RTAMS) website. Ridership data from the Chicago Transit Authority (CTA), which operates extensive bus and urban rail services, were obtained from the agency’s Annual Balances.

geographical features and on-going urban processes associated were analyzed from Argentina (2000), Morano (2002), Randle (1981) and Torres (2001).


3. Land-use structure

In this section we describe the position, size, shape and internal structure of the urban areas in the three cities we considered in our analysis. In particular, we begin by providing an overview of the layout of the respective urban areas. We then provide a summary of geographic, demographic, and infrastructure related information that serve as a starting point for our analysis.

A schematic of the metropolitan area layout in the three cities considered in this paper is presented in Fig. 1. In particular, we have represented the shape of the urban areas, as well as the relative location of the city centers and freight transfer centers.

The physical-horizontal size of the cities under consideration is relatively similar: Chicago being largest and São Paulo smallest. It is interesting to note that the size-rank is opposite to that of population. Thus, in terms of population density, Chicago reflects the incidence of metropolitan sprawl, while São Paulo is the most compact of the three cities. Buenos Aires and Chicago are on-shore cities, extending over a flat plain as a half circle, whereas São Paulo is a mediterranean city with a circular footprint. As depicted in Fig. 1, we observe that São Paulo’s downtown presents a spatial concentration of functions, but instead of being laid out in a contiguous area, it consists of three (close to one-another but separate) sub-cores, which emerged sequentially. We also observe that in Buenos Aires and São Paulo, the concentration of freight traffic overlaps with intra-metropolitan flows. In particular, the location of a port facility next to Buenos Aires’s downtown is a distinguishing feature causing commuter and cargo flows overlap along highways all the way to the downtown.

The city centers of the three cities are preeminent in that they account for large concentration of employment, commerce, and entertainment. Chicago is different in that its downtown only concentrates about 15% of the region’s primary jobs (RTAMS, see work trip flows section), which, however, account for over 30% of white-collar jobs in the metropolitan area. In contrast, employment in Buenos Aires and São Paulo is highly concentrated. In discussing the preeminence of Chicago’s downtown it is important to point to existing and projected efforts to renew/develop areas for residential, retail, entertainment and educational purposes, e.g., Millenium Park. These features, in turn, make Chicago a city with a highly active downtown in comparison to other US cities (Greene, 2006).

Having presented an overview of the layout and structure of the metropolitan areas, we now consider Table 1, where we summarize geographic, demographic, and infrastructure related information that serve as a starting point for our analysis in the subsequent sections.

4. Jurisdictional systems: government and transportation policy

In this section we define the political geography of the three metropolitan areas considered in our comparison. We also describe the jurisdiction and structure of the government agencies and non-government organizations responsible for transportation planning, management and operations.
The Buenos Aires' metropolitan area is composed of 28 municipalities: 27 of the province of Buenos Aires, which surround the City of Buenos Aires, an autonomous municipality (onwards referred to as “the City”), roughly equivalent to a province in
terms of tax collections. The City is a federal district that serves as the location of the Federal Government (FG). The City began electing its mayor only in 1995. Until then, the Mayor was appointed by the president. In part, this explains why transportation policy, funding and management still remain very much, if not entirely, in the sphere of Argentina’s FG, including bus, subway, commuter rail and highways franchising and supervision. The City only has jurisdiction over bus stop locations, subway extensions planning and funding, and taxicab licenses. Additionally the City has an urban highway planning and operating agency, and a subway-planning agency. At this point it is relevant to mention the City represents just 4.4% of the total metropolitan area, but also 24.4% of the population and includes the main trip destination zone, Buenos Aires’ city center. Finally, the City has the largest per-capita tax revenue in the country, and funding from the FG is still negligible in the City’s budget.

In this study, we define São Paulo’s metropolitan area as the Municipality of São Paulo, and the surrounding municipalities that enclose the contiguous built area. The thorough data survey and mapping by Meyer et al. (2004) shows a delimitation of a contiguous built area, which is adopted here. The municipalities included according to this criterion are listed in Table 1, a total of 26, all belonging to the State of São Paulo, whose capital is the City-municipality of São Paulo (onwards identified as the City). In terms of population the City accounts for 62% of the population in the metropolitan area. This perceptual integration points out that policies carried out within city limits have a metropolitan impact, and as a consequence the need for explicit metropolitan governance is not urgent.

In the 1988 Brazilian constitution, many competences were explicitly transferred from the FG to the states and municipalities, notably many regarding transport (Firminio and Wright, 2001). Because São Paulo is Brazil’s strongest state economically and politically, in time the corresponding state-level agencies were built as part of a decentralization process, such as the Secretaria dos Transportes Metropolitanos (STM, Secretariat of Metropolitan Transports), created in 1991, which deals with transportation issues of all state metropolitan areas. São Paulo’s metropolitan transport operating agencies exist within this entity: commuter rail, metro are planned and operated, and intermunicipal buses (EMTU) are planned franchised and monitored. Highways remain at state-level, and defined as a state-level policy, having neither the STM nor the government of the City a binding legal role. Fifty seven percent of the state’s GDP comes from the metropolitan area, which explains the active presence of the state government as the metropolitan transportation agency.

Finally, the City handles bus services in its territory, designing routes, stops and establishing and monitoring franchises to private operators. This is managed through a separate public enterprise, owned by the City, named “SPTrans”. The scale of planning and supervision activities carried out by SPTrans (see Table 1) gives an idea of the large involvement of the City in transportation policy. Finally it should be added that road planning and maintenance within the City, including over 1000 bridges and tunnels, are also under municipal rule.

Chicago’s jurisdictional system is highly complex. The City of Chicago is a municipality entirely included, but not corresponding to the county of Cook. Chicago’s metropolitan area is composed by the City and 244 municipalities, 80% of which have less than 25,000 inhabitants. These suburban municipalities take part in decision-making through the counties they are part of. The six counties comprising the metropolitan area, plus the City of Chicago separately are represented at the board of the Regional Transportation Authority (RTA), which is greater Chicago’s legally-binding transportation body, as required by US federal legislation for all urban areas exceeding 50,000 people. The RTA has financial oversight powers for the City’s urban rail and bus agency, and for the commuter rail and suburban bus operating agencies. The RTA has taxing powers, currently exerted through the collection of an additional 1% or 0.25% sales tax, depending on the jurisdiction where a purchase is made. This funding covers operating subsidies exclusively, and it is distributed among the three mentioned agencies according to a pre-established formula. This formal structure exists in the context of a strong political divergence between the City
Fig. 3. Buenos Aires. Built area and metropolitan transport infrastructure. Built area corresponds to census fractions classified as urban by INDEC.

Fig. 4. Buenos Aires. Employment downtown. Data from Argentina (2000).
Fig. 5. Chicago. Built area (proxy) and metropolitan transport infrastructure. Built area corresponds to census tracts with a residential density of more than 10 hab/km², or with a median income above US$ 100,000.

Fig. 6. Chicago. Employment downtown. Data for 2004 from the US Census Bureau, LEHD.
and the rest of the metropolitan area. When the RTA was established through a referendum in the early 1970s the overwhelming majority of the positive votes were cast in the City (Young et al., 2007).

Fig. 7. São Paulo. Built area and metropolitan transport infrastructure.

Fig. 8. Expanded downtown area of São Paulo: employment distribution taken from Brasil (2004).
As a summary of the salient points of the discussion in this section, Fig. 2 lists the agencies responsible for transportation planning, management and operations. The list is organized by scope, i.e., city proper vs. metropolitan, and by transport mode, i.e., automobile, bus and rail.

In the next three sections we analyze the state and evolution of passenger transportation in the three cities by modes: automobiles, buses and rail. To put the discussion in context, Figs. 3, 5 and 7 provide detailed schematics of the metropolitan areas, which include urban and commuter (metropolitan) rail lines, selected bus routes and the main highways providing access to the city centers. Figs. 4, 6 and 8 present the density of jobs in the city centers, which highlight the importance of accessibility, and provide a proxy for land-use in the metropolitan areas.

5. The use of the automobile

In both São Paulo and Chicago the use of the automobile and the provision of road and parking infrastructure are prevalent. Chicago’s metropolitan structure has been the result of the very fast development of residential suburbs that took place during the 1950s and 1960s, and still continues today (Hudson, 2006), which conveyed a spectacular transfer of population from the City to the suburbs, through subsidies from the country’s FG regarding mortgages and construction of highways (Beuaregard, 2006; DiJohn, 2002). As most other US cities, Chicago is designed, at both macro and micro-scale, for driving. As evidence, we note that, even including compact neighborhoods in the City, the Chicago Metropolitan Area is less dense than Los Angeles (Hudson, 2006). The second element that indicates the prevalence of driving is the suburban scattering of employment. This feature generates multiple overlapped hinterlands (see analysis in Greene (2006)), centered at office parks that individually do not attract significant volume of trips that would enable the existence of reliable and visible public transportation lines. The result is a 90% or higher share of worktrips by car to such small but repeated concentrations of employment (RTAMS, work trip flows, 2000 census). As opposed to this, only 35.9% of work trips to the City’s core (defined as the Loop and Michigan Ave. areas) were reported to be made by car in the 2000 census. However low this percentage may be for a city in the US, land use consumption in the downtown area by parking needs is visibly present in the form of concrete structures occupying entire city blocks. As an indicator of travel conditions under an automobile-centered model, we point out that delays for drivers in the Chicago Metropolitan Area have increased by a factor of 5 between 1982 and 2003 (US, 2007a).

In São Paulo 50% of households do not own a car, and only 12% have two or more cars (Brasil, 2008b). Origin destination surveys conducted at the metropolitan level have shown that between 1967 and 2002 the share of trips by automobile grew steadily. Recently, the 2007 OD survey registered a reversal in the aforementioned trend, though the total number of trips by car grew (Brasil, 2008b). The use of the automobile in São Paulo is a consequence of long-term infrastructure policy. Between the late 1940s and the early 1990s, most investment was directed at providing infrastructure for cars and buses. In this period, highways were built around the City center (Mayor Maia’s plan and its inner city highways, see Pasternak and Machado Bogus (2004)), very much in the style of interventions in US urban cores as of the 1950s. The large number of tunnels, viaducts and bridges distributed around the city also belong to this period, which is a modality still guiding public investments made by the City government (Vasconcellos, 2005).

Land-use in São Paulo has evolved in a complementary manner to these infrastructure policies. As a result, the historical city center (Fig. 8), close to the convergence of all railway terminals, lost its preeminence, and as early as the 1950s architectural renovation, along with professional white-collar employment, moved to the axis of the Avenida Paulista (Meyer et al., 2004). Only in 1991 did a limited-connectivity subway line open to serve this newer district. A new cycle in the office estate market, which continues to the present, started in the 1970s along the east Pinheiros riverfront, not only for the amplitude of sights guaranteed by the river fringe, but also in connection to the S7-lane highway along. It is interesting to note that middle- and high-income residential areas lie immediately next to these newer employment centers (Meyer et al., 2004). As a consequence, driving distances are short: 45% of trips by car take 15 min or less (Brasil, 2008b). Although suburban, high-income, low-density areas do exist, such as those grouped under the name “Alphaville”, and others to the west, income differences between census fractions (see Deák; Meyer et al., 2004) suggest that commutes by car from outlying municipalities are not a predominant transportation segment. The studies by Aranha (2005) and Antico (2005) have shown the metropolitan prevalence of work and study trips within the municipality of São Paulo. Location of toll plazas beyond the border of the built up-area (beyond coverage of Fig. 7), and the absence of entries/exists in the stretches closer by, except for a tolled link to Alphaville, also suggest the primary intercity role of highways converging to São Paulo. However, the last OD survey and the expansion of real estate activity along highways suggest car-dependent land-use, and intercity trips, are increasing (O Estrado de São Paulo, 2009). To deal with the detrimental effects of increasing traffic, the State of São Paulo restricts vehicle circulation during peak hours in and around the city center. This policy, established in 1997, was implemented by the state, and after adopted by the City, during winter months to reduce the impact of pollution on health (Câmara and Valente de Macedo, 2004). Although initially successful at reducing congestion, the significant increase in the number of cars has overwhelmed this effect (see Deák and Schiffer, 2007). Between 1980 and 2004 the average speed to and from the expanded downtown dropped by 30% (Brasil, Município em Dados).

In Buenos Aires, increased reliance on automobiles for pendular trips is a five-decade long trend that is accelerated in the last 20 years (see evolution of traffic averages in Argentina, 2003). This is due to two processes: subsidies for car purchases, which resulted in acceleration of car ownership growth, and most importantly, the appearance of low-density, single-house
gated estates in the outer suburbs (Torres, 2001; Morano, 2002) where public transportation to the City center was not available. At the same time, country-club, weekend-only housing became options as permanent dwellings. Since Argentina has been energetically self-sufficient during the process, low and stable gas prices may also have provided a long-term security for those choosing to move to these new suburbs.

It is important to note that this far-off suburban expansion did not generate substantial outward transfer of employment, other than that associated to services consumed by the new residential areas. Thus, work trips from these new suburban residents still contain an end in the City, especially the city center. A second important element was the unchanged capacity of highways within the City. Capacity of outer branches beyond the City's beltway (Avenida General Paz, see Fig. 3) was indeed expanded, and much of the real estate activity was linked to the permanent press coverage of this process. These outer branches are under jurisdiction of the FG, and lanes were added with very few land expropriations. But the highway segments under jurisdiction of the City are constrained by adjacent land use. In addition, highway construction within the City during the 1970s created a negative connotation because of massive demolitions, and also because of the urbanistic divide caused by an east–west branch. This valuation of highways gained political entity after 1995. It is as of this moment that the most intense stage of the mentioned suburban expansion and the increase of capacity in highways began. At the time this report is being written some plans are being carried out to adjust, but not to increase, capacity in the City’s northern corridor highway. But other than that, highway capacity for commuting is not an established issue beyond trial implementations of pricing and HOV lanes. This overlap in the timing and in the jurisdictions for highway infrastructure (Fig. 3) and pendular trips has been largely overlooked, leading to an underestimation of the political importance of the City in metropolitan transportation planning.

6. Bus systems

Buses are run differently in each of the three cities considered herein. In Buenos Aires, lines are operated by the private sector. The FG auctions bus routes, a modality that has been in place for more than four decades (Brennan, 2003). Also as of the 1960s buses were allowed to serve the city center directly which, in a city where car use was not yet widespread, provided great connectivity for a public that had known a system strongly based on transfers to commuter rail and the subway (Argentina, 1973; Ruiz Díaz and Martínez, 2005). The FG also oversees safety and technical standards. Since 2002 operating subsidies, paid by the FG, have been introduced (Krantzer, 2008) to a system previously known for being reliant on fare collection. The City government subsidizes operations providing infrastructure at bus stops, and through the establishment of segregated lanes for short distances in the downtown area (not shown in Fig. 3). Fares are distance-based, but most ridership occurs within the first fare segment (Müller, 1999; Argentina, 2007). In the last two decades informal bus operators came into the scene, charging higher fares, and providing service only during peak hours. These operators use smaller buses and serve mostly point-to-point market segments, frequently middle and upper income, gated communities in the suburbs. The FG’s Transport Secretariat keeps track of these operators, but registration is voluntary (Kralich and Gutiérrez, 2007). The number of such services has increased steadily, and has become an issue of concern. An on-going study of this modality, will shed light on this new supply system. According to preliminary findings, an estimated 80,000 people commute daily from outside the city to the downtown area using such services.

In São Paulo bus routes are auctioned to the private sector by the City government. The City manages fare revenue. The fare is flat and transfers between City lines are free for a period of up to 3 h. The current fare is relatively high, given the income level of most users. System-wide free transfers were introduced in 2004, made possible by the use of magnetic cards, as routes were entering a new bidding process. Payment to operators is separate from ridership (Odila de Paiva Souza, 2007). At the same time informal bus operators partnered with official companies for the 2004 bids, and their fare revenue and ridership numbers were included in the accounting. This made up for lost revenues caused by free transfers (Odila de Paiva Souza, 2007), and introduced a transient statistical increase component in ridership data (Fig. 9).

One hundred and ten route-kilometers of avenues with segregated lanes have been established in São Paulo, somewhat complementing the coverage of rail infrastructure (see Figs. 7 and 8). According to a survey collected by the City in 2006 (Carvalho de Castro, 2008), average speed along segregated lanes is 16.2 km/h during the morning rush, and 13.6 km/h during the evening. Speeds on avenues without segregated lanes, remain below 10 km/h during rush hours (Brasil, 2008c). In contrast, commercial speed in metro lines, of around 37 km/h, and commuter rail, over 40 km/h. On-site observation suggests taxicabs, allowed to use the lanes when carrying a passenger, may be the main beneficiary from segregated lanes and the overtake docks present at some stops. Additionally it should be mentioned that official plans for the next decade do not include the implementation of new corridors serving employment concentrations (Brasil, 2006, 2009). A separate commentary should be made for the “Expresso Tiradentes” (see Fig. 8), a two-lane elevated viaduct exclusively for buses, where services are run with speeds over 37 km/h throughout the day.

Buses in Chicago have seen ridership decrease to almost 50% of what it was in the late 1970s, although recently it has remained stable, not showing an increase equivalent to that seen in the City's urban and commuter rail. Recent increases are strongly related to the introduction of free rides (US, 2009), and might not be comparable to previous years. Between 1990 and 2000 bus mode share for trips to downtown decreased as rail has gained the same ridership fraction. Transfers between bus and rail are made at a reduced cost. The network has been steadily expanded. Unlike São Paulo and Buenos Aires, services are run on a schedule basis, including weekday and peak hour-only routes.
7. Rail transportation: two spatial scales in use and infrastructure

All three cities under consideration have two sets of rail infrastructure: one aimed at a first core, high-density sector, with headway service and station spacing aimed at walking access. A second set is that integrates the entire metropolitan area, with scheduled service, greater station spacing, linked to vehicle-based access, public or private. The first type of infrastructure/service will be referred to as “metro” and the second as commuter rail.

7.1. Metro service

In Buenos Aires and São Paulo metro and subway systems are spatially associated to high residential densities, and walking is an important mode of access to stations. Buenos Aires has a 45.5 km long subway network, with stations just 0.4–0.6 km apart. Four lines reach out radially from the city center toward very high density, middle and high-income areas. Two other lines run transversally. The fact that all four radial lines encompass high-density residential areas and also high-density employment downtown result in a 260-million passenger annual ridership, with over 75% of intra-city trips (80% of total trips) walking to and from stations (Argentina, INTRUPUBA, 2007). Three of these lines have been in operation for over 70 years, and most growth in the stock of City residential units ever since has occurred within walking distance of these lines (Argentina, 2000). Subway service in Buenos Aires has a very positive image, and network extension policy has been re-established after 1995 exclusively with City funding. The network is currently operated through a franchise established in 1994 by the FG, who subsidizes operations and most capital investments, and has the legal responsibility to monitor performance. These two functions are channeled through the FG’s Secretariat of Transportation. In turn, this overlap of extension funding and planning by the City, and franchise management by the FG causes confusion among taxpayers, and also has weakened the political visibility of subway planning.

São Paulo’s metro is one of the most densely used subways in the world, carrying 543.1 million trips per year in a 60 km network, with headways of up to 101 s. This system enjoys the highest rate of approval among the City’s public modes (over 80%, Brasil, 2008a), well above commuter rail (50%). The system is run by a public agency (Companhia do Metropolitano de São Paulo, Mêtro) of the State of São Paulo, which has paid for the majority of capital investments. Recent deficits have been in direct relation to the introduction of free transfers from commuter rail (2001) and buses (2004–2006), but have been counteracted since 2007 (Pedreira Sobrinho, 2008). Fare exemptions or discounts to seniors, unemployed, students, and others are repaid by the State. As a new element, construction of line 4 is being developed by a partnership between private investors with the state and city governments under a 30-year Build-Operate-Transfer program. This is the first such program in Brazil, and interestingly, includes Buenos Aires’ subway operator. As for spatial coverage, only lines 1 and 2 complement commuter rail lines serving a large share of middle-class, middle to high-density neighborhoods (Daud Cardozo, 2006); a notable exception in a context where most public transportation users are of low income (Paiva, 2007). Stations at the far ends of lines 1 and 3 are large bus-metro transfer points (see Fig. 10).

One of Chicago’s landscape trademarks is its elevated urban rail system. Although its operating core (the so called “Loop”) was finished in 1897, the present network is the result of permanent change and expansion until 1993, when the last line was added (Loop-Midway airport). The numerous stages of this process are described in Young (1998) and Lascano and Durango-Cohen (submitted for publication). One consequence of this is the restricted articulation of land-use with this
infrastructure, limited to older stretches (north line along lakeshore, for example). Additionally, 30% of the current network is less than four decades old, that is, it entered service well after the transference of population to the suburbs had begun (Lascano and Durango-Cohen, submitted for publication). Here also the transference of some suburban features into the City have also changed land-use-rail association, notably commercial buildings whose size and parking lots decrease activity/residential density as well as pedestrian contiguity around stations. Additionally, a third of the service routes lie in highway/railway medians with difficult or restricted pedestrian access. Far out terminals are rather bus transfer points.

The system is operated by a public agency (the Chicago Transit Authority) of the US State of Illinois, whose board is composed of five members appointed by the City Mayor and two by the State’s governor. Thus, it is an agency primarily linked to the City. Following a classical pattern of the US, this agency also operates bus services. Since the early 1970s the agency’s operating finances have required constant reformulation (Young, 1998; Savage, 2004). Thus, capital renewal investments have found limited viability. Ridership has recovered in recent years, after dropping dramatically in the early 1990s. A preliminary analysis of entries per station suggests that recent Hispanic immigration to the City, gentrification and Airport ridership have been among the main contributors (Lascano and Durango-Cohen, submitted for publication). The recent evolution of ridership in the three above described systems is shown in Fig. 10.

7.2. Commuter rail

The analysis of commuter rail should consider São Paulo and Buenos Aires, on the one hand, and Chicago on the other. In the first two this technology plays a role that is close to that of a metro: demand is dense and sustained throughout the day, thus frequencies are sustained during the entire day. In North American cities, commuter services are, to a large extent, linked to post WWII suburbs, even though in some cases this kind of services existed as early as the late 19th century. A large share of demand accesses a station by car, in some cases by bus, and walking is exceptional. Since suburban densities are very low, station spacing is long, and lines reach farther out. Generally, demand is closely tied to white-collar jobs in the city center, and so trains run frequently only during peak hours, either inbound or outbound.

In Buenos Aires commuter rail precedes much of the initial metropolitan growth. Most segments currently with services to downtown were already laid by the 1870s as part of intercity links. Commuter services were subsequently introduced, as land plots were planned for division around future suburban stations. This provided space for housing during the first stage of Buenos Aires’ fast growth related to European immigration. Up to the 1960s, when buses were authorized to provide transport between City and suburbs, metropolitan growth had taken place exclusively around commuter rail stations (Randle, 1981). Simultaneously, highway construction was started but only gradually, and rail services kept good quality. Thus, Buenos Aires suburban growth remained primarily tied to commuter rail lines, although no longer exclusively: bus services and, to a larger extent, cars, also became players in shaping expansion.

These processes explain why in Buenos Aires there is a very good synergy between land use and metropolitan rail infrastructure. The early origin of urban growth has provided for pedestrian contiguity, and accumulated density. This is an inherited urbanistic composition. With bus services and car ownership also came a diversification of destinations, and rail transportation lost its absolute role. But for trips to downtown, rail transportation is still dominant if associated to safety and minimum quality, attributes of variable presence in the last two decades (Agosta and Martinez, 2007; Barbero, 2000, 2005; Kogan and Thompson, 1994; Martinez, 1999, 2007;). The urbanistic composition mentioned determines the existence of a first group of users, those living within walking distance of a station. A second group is that arriving by bus and bicycle. Arrivals by car are rare; given the lack of parking infrastructure: not a single parking lot is officially tied to a station.

Buenos Aires’ commuter rail services are the result of fragmented management: seven operational units of the former federal railway company (Ferrocarriles Argentinos) included each a metropolitan subdivision dealing with services in the
Buenos Aires greater area. Thus, stations and rolling stock can be very diverse. In 1994/1995 each of these metropolitan services were franchised individually, but linked to an investment plan, developed by the government, that set priorities considering metropolitan services as a whole (Kogan and Thompson, 1994). Given the limited international experience in such franchises (Raspall Galli, 2004) contracts were awarded for only 10 years, as a first phase to test the viability of the scheme. This was also due to the lack of data on ridership, and on operational deficit (Kogan and Thompson, 1994). The introduction of private operators under such conditions proved useful first at re-introducing ticket controls, which resulted in a first ticket sales increase after 1994 (40% conservative estimate), unrelated to an increase in ridership. Secondly, the franchise scheme proved useful at re-establishing safety, reliability, and cleanliness on trains and stations, which brought about new, non-captive ridership, resulting in an additional 40% increase. During this entire period, supply increased 20%.

The public’s overwhelming response to such non-structural improvements made evident the need to develop a second improvement plan (Gutiérrez, 1997; Martínez, 2007), including electrification of the many diesel lines (Fig. 3) and rolling stock replacement and expansion. With the merger of the privatization and control agency, UCPRF, into a larger, non-rail specific transportation agency, CNRT (Barbero, 2005; Agosta and Martínez, 2007; Martínez, 2007), conditions to address long-term planning ceased to exist. Operators sought to act as surrogate planners in the late 1990s, at their own expense, in the absence government planning. However, proposals were not able to avoid becoming conservative, exclusively intra-modal and technologically dispersed. These projected improvements depended solely on sharp fare increases, which were politically unviable once Argentina entered a 5-year recession in 1998. During this period, rail fares were kept below bus fares. After 2001, fares have been frozen, and recently they have started to significantly lag behind inflation. Stagnation in ticket sales over the last decade is due to lower ridership but also to evasion, either positive or due to ticket windows remaining closed at several stations during the evening and night. Ticket sales have ceased to directly represent ridership.

Before the 1980s São Paulo’s metropolitan railways would carry less than 150 million passengers per year. With extremely low fares, demand exploded in the following years, reaching 342 million passengers in 1991, and decreasing dramatically over the 1990s (Fig. 11) when fares were significantly increased (BID, 1994; Vasconcellos, 2005). A new cycle of growth begins in 2000, based on a gradual increase of operational rolling stock. By 2005, 23% more trains were in service, as a result of both train rebuilding, and acquisition of new sets (Lavorente and Yanéz Mondragón, 2006). Supply increase was the basis for implementation of management changes. In 2000 free transfers to Metro were introduced, and demand increased 27% in just 1 year. This was only possible though the physical integration with Metro, which did not exist until then, at Luz and Brás Stations. It is also at this time that refurbished rolling stock was introduced to line E, as an express service. This also included new stations. In line C (now rebranded 9), the few existing stations were refurbished, and seven new stops were opened, several close to employment along Pinheiros river. Additionally, signaling and electrical systems in this line were renovated. In 2002 a rail link (metro’s line 5) with lower fares and integration to buses was introduced as a feeder service to line C. In 2003, all rail stations were equipped with surveillance cameras, resulting in a decrease in crime (Brasil, 2008d). In early 2006 a new farecard system with minor discounts (Bilhete Único), initially implemented by the City for bus-to-bus transfers, began gradual integration with rail service. Between 2005 and 2007 a 23% increase in entries was registered. As can be seen in Fig. 11, fare integration and increases in downtown connectivity have had a larger impact than frequency in triggering ridership growth. As demand has grown faster than supply (80% against 38% between 1999 and 2007), trains have become crowded, multiplying public request for further improvement. Finally it should be pointed out that the last OD survey estimated that population growth between 1997 and 2007 was 15% (Brasil, 2008b).

For reference, the population for the three cities between 1870 and 2000 are presented in Fig. 12.

Overcrowding of trains in part was reflected in a stabilization in bus ridership (see data in Brasil, 2009), which can be interpreted as a proxy of commuter’s value of time: as soon as the fare integration was implemented, many trip segments

![Fig. 11. Commuter rail ridership. For Buenos Aires and Chicago ticket sales are plotted. For São Paulo entries to the system.](image-url)
Commuter rail ridership in Chicago is indicative of the role its downtown area has preserved after decades of suburbanization. Only recently, and with a strong transient component derived from high oil prices, ridership recovered to late 1960s levels, when population in the suburbs was 65% of what it is today. It is interesting to note that this growth has been concentrated in those lines serving the wealthiest suburbs to the north and northwest of Greater Chicago. Pre-existing rail stations played no role in structuring the conversion of rural to residential use, save during the initial stages prior to WWII. Access to stations is thus dependent on an additional mode, mainly the automobile: 85,000 parking positions are linked to the network, either as plain street parking adjacent to platforms, or in facilities owned by the agency (Metra). This number is equivalent to 65–70% of average weekday peak hour ridership (RTAMS). A survey conducted in 2000 estimated 7% of passengers arrive to stations by bus (US, 2001). Another element that differentiates the infrastructure assets in this case is track ownership: trains are run on tracks owned by the agency but also on rights of way owned by freight carriers. A large share of the rolling stock was incorporated in 2004. Downtown terminals are located at the Loop’s edge, making a large number of activities to be within walking distance: less than 17% of travelers complement with a bus ride once downtown. No connection to urban rail exists.

Demand is almost exclusively related to office workers commuting to downtown, although two suburban sub-centers, attract a visible number of trips from suburbs (Evanston and Des Plaines). Reverse commuting is growing, but it still is negligible and less significant than off-peak, inbound demand (See 2006 ridership counts at RTAMS). Unlike regular commuters, reverse commuters cannot reach final destinations on foot because the locations of suburban employment follows highways, and so it is likely to be beyond walking distance (US, 2007a). Direct observation suggests that also the absence of proper sidewalk infrastructure and pedestrian crossings and traffic light timings play a significant role.

8. Discussion

The transportation systems and the corresponding urban development of the three cities analyzed herein complement each other in terms of land-use, population density, infrastructure availability, and jurisdictional array. Buenos Aires is the oldest of the three cities, a national capital, with a strong and highly preeminent city center, with good infrastructure, though fairly managed. Chicago’s main characteristic is internal displacement of employment and residential uses, a process not necessarily linked to population growth (see Fig. 12). This functional fluidity coexists with a scenario of fragmented transportation policy-making, united only by the location of an inherited, though active city center. São Paulo is marked by enormous growth, as well as its particular decentralization of employment on the basis of two new and large concentrations that have become preeminent at the metropolitan level. Simultaneously, the involvement of the state government has resulted in dramatic increases in quality and quantity in public transportation.

8.1. Modeshare: tendency and recent changes

Fig. 13 presents the share of motorized trips made by automobile and through public transportation in the three cities. Data were taken from Gonzalez and Villadeamigo (1999) and Müller and Kralich (2009) for Buenos Aires, from RTAMS for Chicago, and from Brasil (2008b) for São Paulo.
The percentages reflect transportation mode share over the entire metropolitan areas. In the cases of Buenos Aires and São Paulo, they reflect the orientation of transportation toward the city centers, given the spatial concentration of employment and metropolitan functions. In the case of Chicago, percentages are rather indicative of the preeminent suburban land-use arrangement supported by automobile, and strongly differ from figures for trips to downtown, quoted earlier. This divergence challenges the applicability of the concept of metropolitan region, and points to the existence of two overlapped urban environments: transit corridors functionally-integrated to the city center, and another, which starts and ends in the suburbs, even though, symbolically, it includes the downtown as a “sub regional reference”.

Understanding recent changes in São Paulo’s modeshare requires additional analysis. Recent transportation policies have had a significant impact, as can be inferred from the ridership data and 2007 OD survey results. At the same time, large number of migrants from other parts of Brazil, almost exclusively of very low income (Pasternak and Machado Bogus, 2004; World Bank, 2007), constitute an increase in the number of public transportation users, causing a statistical effect unrelated to mode choice changes. Indeed, the absolute number of trips by car has continued to increase, making it unlikely that drivers switching to public transportation were a significant component of the mode share change registered between 2002 and 2007. Furthermore, growth in trips by car despite continuous migration shows the relative forces of the two main socio-economic processes occurring in the city: the increase in service jobs, while manufacturing employment has been stagnant (World Bank, 2007) is strongly counteracting the national-scale concentration of poverty taking place in the city.

Figures for Buenos Aires are only approximate, except for 1973 and 1997 values that actually derive from OD surveys (Müller and Kralich, 2009). Changes between 1992 and 1997 reflect the incidence of suburban housing in areas where public transportation was absent, as well as the sharp increase in unemployment and a 7% decrease in bus-km offered reflected in bus ridership loss, not counteracted by increases in rail ridership. Recent employment recovery accounts for the partial recovery in ridership, particularly bus ridership.

8.2. The role of extrajurisdictional transportation agencies

It is still usual for many analysts to describe Buenos Aires transportation system as subject to a variety of jurisdictions. The fact is that, except for highways within the City, all elements fall under the jurisdiction of the same party, Argentina’s FG.
In fact, public transportation policy is the responsibility of the Transport Secretariat within the Public-Works Ministry. Consequently, lack of integration cannot be attributed to a lack of inter-jurisdictional coordination. The subutilization of two rail lines covering the city's Southwest suburbs (see Fig. 3) exemplifies this very clearly: these suburbs are the result of migration to the city over the last 40 years. Only the tendency of political decision-makers and rail managers to repeat patterns and preserve what they have inherited can explain the fact that frequencies have not been increased, nor service upgraded. On the other hand, São Paulo's approach to the same phenomenon has been fast, harnessing the potential of the available rail infrastructure. Besides differences in the respective political contexts, one element that may have favored a more flexible approach in the Brazilian city is the role of a government entity closer to the scale of the problem: a state/provincial-level. In the context of a FG, metropolitan transport in one city does not have the relevance of national-scale issues. However, bringing Buenos Aires' transport to more suitable levels of government requires further analysis: São Paulo's state government has jurisdiction, in the frame of its own competences, over the City of São Paulo as well. Buenos Aires' City district, on the other hand, is jurisdictionally separate from the Province of Buenos Aires. This, in turn, raises the issue of the relevance of a metropolitan transportation entity and public transportation. In particular, here we have examples of two cities where a lack of dynamism in planning has been experienced over the last decades, one with a metropolitan agency (Chicago) and another without (Buenos Aires). On the other hand São Paulo's has shown larger flexibility in the absence of one. For Chicago the problem in coordination could be defined as the opposite to Buenos Aires: the lack of participation of state agencies has left a void in the current metropolitan agency, fragmented between City and suburbs. The bottom line is that, as long as policy objectives for a metropolitan area are clear, the issue of a legally-binding transportation agency may be secondary.

Chicago shares with São Paulo the trait of jurisdictional contiguity, but rather, its metropolitan transportation is not an issue within the state's transportation administration. For over 30 years a metropolitan agency has been the governmental party, and to this day for example no physical, let alone fare, integration exists between commuter and urban rail. Chicago, as well as Buenos Aires, proves that the efficiency of jurisdictional arrays may remain in theory as long as there is no political will to undergo planning and management. Not only has São Paulo made progress in upgrading quality, coverage and quantity in rail transportation in the absence of a metropolitan agency. Also, physical and fare integration with buses has been achieved, despite the complexity of municipal competence and exhaustive private operation. What differentiates São Paulo's case is the participation of the historical jurisdiction that politically encompasses both City and suburbs. Buenos Aires' system is largely in the hands of a far-off federal instance. Chicago's system is fragmented in the quest for agreement between two local political actors: city and suburbs with very different incentives and transportation requirements.

8.3. Land-use and transportation policy

As we have seen in the cases of Chicago and São Paulo, land-use changes create transportation planning challenges. But in neither case have development and accessibility been coordinated. The recent development of suburban communities in Buenos Aires' far northern suburbs, though smaller in scale, poses similar challenges. Chicago suburbanization can be pointed as the most dramatic case. In this process pre-existing infrastructures converging to the central area lost functionality. São Paulo's concentration of new, white-collar employment apart from the historic center is a similar process, and to a large extent the main purpose of the recent investments have aimed to deal with the fact that the available infrastructure does not reach two of the city's three employment centers (Paulista av. and Pinheiros riverfront). Interestingly, and in spite of the fact that the historical center is the most accessible part of the city, yet, fluent, uncongested accessibility, even as a scarce attribute in metropolitan areas, cannot be by itself a booster for real estate investors, or for companies choosing location (see analysis for this in São Paulo in Barbosa, 2001). Although partially, in Chicago the irrelevance of hyperaccessibility is also present. Newer estate investments as well as a diversification of uses have occurred along the City's "Magnificent Mile", north of Chicago river outside the very accessible Loop. As a result, a significant share of space in this newer area is occupied by verticalized parking lots, which fragment landscape. Buenos Aires, on the other hand, has a city center composed of a contiguous architectural landscape, and provides a high quality pedestrian environment and access. This may have played a role in preserving the preeminence of the city's center, in spite of the increasing congestion and decreasing quality of public transportation. In this same sense Portland, in the west coast of the US, may provide a clearer example: with much emphasis on urban architecture and sidewalk design (Abbott, 1997), but with limited public transportation, the city's downtown area has a clearly multi-role (rather than Central Business District only) functional preeminence at the metropolitan level. These examples strongly suggest the primacy of land-use, urban design and urban planning policy, of which transportation is an input. Additionally, these examples show that metropolitan changes are not only related to processes of horizontal expansion (Lloyd, 2000), but also to downtown and residential densification.

8.4. The quest for longitudinal space for transportation operations: the street grid and the new role for inherited infrastructure

Large metropolitan areas, except for early cases such as Paris and London (Focas and Navarre, 1992), are a recent phenomenon. But in most cases, including the three analyzed here, they have come to be on the basis of a preexistent city with a downtown for a former size. Today this same downtown is the functional core for many more people. Regardless of whether the most intense stage of expansion happened at an earlier or later stage, moving passengers on a daily basis to and from metropolitan city centers is a problem to be solved with the available space. In his book, Vasconcellos (1996) makes a profound analysis of transportation policy based on the principle that space is scarce in cities. It is following Vasconcellos' per-
spective that we assess the direction of the transportation policies analyzed in the present study. Additionally, we would like to stress the link between the utilization of space by transportation and urban landscape, defined as the overall experience of visual and auditive elements present in the streets.

The relationship between transportation technologies and space becomes relevant there where a large number of vehicles attempt to reach the same microgeographical space on a regular basis. The experience of US city centers in the 1950s (Mumford, 1963), in their adjustment to the overwhelming social preeminence of mode choice, has shown that transportation land-use can be well beyond a pattern linearity squeezing through urban fabric. Transportation processes can consume substantial amounts of space. This consumption could be analyzed in strict economical terms, considering the value of using space in city centers for vehicle movement and parking rather than for the creation of value. This would include automobile requirements, of course, but bus operations in São Paulo show that public transportation can also require large land plots (see the position of the terminals of bus corridors in Fig. 8). In this study we would like to point out not only the historical value of city centers, but mainly the more direct experience of landscape: how much amiable is it to spend time in an environment built with a particular amount of space occupied by the operations of motorized transportation. The difficulty to address this issue quantitatively, in particular in transportation disciplines used to statistical methodology, is not such in the context of the language of decision-makers or tax payers, where arguments frequently are limited in their complexity by the very simplicity of the issues of public concern. Landscape in city centers is one of those public issues in the most direct grasp of decision-makers and the public domain, and this is the reason why it may frequently have preeminence over reasoning based on economics and throughput considerations.

The relevance of the impact of a transportation project on landscape can be considered to have two parts: on the one hand, its evaluation by engineers at the moment of conceiving a project, which could be considered as a stage where their culture necessarily comes to play since the project’s consequences are not restricted to an isolated transportation process, but rather it will have broader consequences in landscape. On the other hand, the concern for the relation between an infrastructure project and landscape will be present in the decision-making process. Each of these two instances handles different languages. The closer these two languages are, the less time will be wasted in the scattered process of one project being adjusted by decision makers, the media and NGOs.

From the supply perspective, the matter is the scarce nature of space in city centers of metropolitan areas. The presence of more vehicles than the street grid can handle has annulated the linear space available for flows. Lane segregation is aimed at this, and throughput increases can be considered a functional expansion of this space. But this technology, as we have seen, has boundaries, especially when being applied in avenues and streets of old City areas. The purity of Transmilenio’s segregated lanes is not the most frequent possibility. Consolidated, historical urban settings also bring the issue of segregated lane use by taxi cabs, in the area of their natural market, city centers. But the quest for transportation space goes beyond horizontal strategies, and has its longest history in its vertical multiplication. This puts into question the perception that congestion is a consequence of the scarcity of space, a space exclusively defined in horizontal terms. In the urban histories of the three cities analyzed here (Ruiz Díaz and Martinez, 2005; Argentina, 1973; Dijohn, 2002; Lascano and Durango-Cohen, submitted for publication; Pasternak and Machado Bogus, 2004; Deák and Schiffer, 2007) it may be recognized that congestion is rather a consequence of the failure to keep up with the investments, and with management, of public transportation.

In a context where automobile use has reduced the transportation capacity of the street grid, the segregation of lanes for bus traffic can be interpreted as an attempt to go back to bus operations in the past. However, the scale of demand in the cities under study here raises a number of issues. Where attraction of daily trips is spatially concentrated, ridership aggregates along the structuring lines of transportation. In the case of a large concentration of population, the effect is enhanced, as mentioned in the introduction. Considering the geometric definitions of the three cities, pictured in Fig. 1, the low preeminence of Chicago’s downtown is reflected in the proportionally low ridership of its two rail systems, and consequently, lower linear inbound ridership aggregation. For the other two geometric metropolitan structures, the passenger volumes demanding access to downtown areas are higher. In both São Paulo and Buenos Aires a large number of bus lines converge into city centers. The reconstruction of past traffic conditions for buses, via segregated lanes, cannot be applied to all streets, and this way it becomes necessarily partial. This, in turn, implies that only a number of bus routes may benefit which, given the interest of private operators, has huge political consequences. São Paulo’s segregated lanes reflect this political issue: a greater number of bus lines, and thus of frequencies, are assigned to a segregated lane, than the segregated lane can handle. The attempt to manage high ridership volumes with bus handlers generates the need for a large number of frequencies paradoxically causing congestion, this time caused by buses (Brasil, 2009). The initial purpose is, thus, only achieved partially, as long as lane segregation is not accompanied by corresponding changes in bus routes. These changes, however, could face opposition when they involve a reductions in the number of operators. Bus operators, as well established technical and political actors, are for the reconstruction of the past as long as their share of the present remains unchanged. In Buenos Aires, after 15 years of lane segregation experience, no lanes have been segregated in the 16-lane central avenue (Avenida 9 de Julio) cutting trough the downtown area. Rather, they have only been applied on the right hand side of one-way, four-lane avenues.

Unlike the cases of Bogotá and Santiago (Ardila Gómez, 2005; Figueroa and Orellana, 2007), the establishment of segregated lanes in Buenos Aires and São Paulo did not imply the replacement of an atomized fleet of small buses. It is interesting to note that this replacement meant in both Andean cities an aggregation of supply, and of operations ownership. Thus, the effectiveness of segregated lanes does not only have to do with the geometry of the avenues in a city, but also with the political arrangement of the pre-existing situation.
In all three cities rail transportation is growing, remarkably as a result of different circumstances. Yet all three have in common the incidence of street congestion at city centers. In São Paulo people are willing to choose rail over bus despite higher fares, even when free bus-to-bus transfers are offered. Buenos Aires' public, including high income groups, flocked to trains during the 1994–2000 period, when safe and reliable service was provided with clean trains and stations. Even when trains crowded-up given the lack of rolling stock (Martinez, 1999). Chicago's urban and commuter rail systems have seen sustained growth over the last 5–10 years, despite the aging infrastructure. What all processes have in common is the reliability and time savings, whose value increase in a context of intensifying congestion. In all cases, the attractiveness of downtowns remains despite congestion.

8.5. Inherited infrastructure and inherited neighborhoods: the increasing valuation for landscape with a balanced transportation presence

In Chicago, demand spill toward rail is also linked to the process of gentrification (Lin, 2002; Lascano and Durango-Cohen, submitted for publication) and also, but to a limited initial extent in commuter rail. Gentrification is a result that harnesses a pre-existing stock of dwellings, and the pre-existing structure of residential density, that is the older urban fabric. This is, initially no adaptations in zoning are necessary, at least none requiring an increase in allowed densities. This is the single most important added value inner cities have to offer in the US, as opposed to the frequently established resistance in suburban municipalities to allowing for higher densities. This resistance partially explains why there hasn't been a widespread appearance of an equivalent real estate product around commuter rail stations. Washington DC is one of the rare cases where the conception of a rail network was carried out along land use planning (Schrag, 2005). This case, as well as the need for accessibility emphasized herein, suggests that land-use changes should precede transportation policy changes. The study by Lund (2006) showed that in thirty high-density real-estate developments housing quality and cost, and neighborhood features were the reasons most frequently reported by owners for buying. At the same time, in two cities access to fast and reliable transportation was pointed a reason by less than 25% of respondents. Notably, in these two cases, Los Angeles and San Diego, the city centers are ambiguously defined, and furthermore, have a low functional preeminence in their respective metropolitan areas. The associated residential developments could hardly be classified as “transit” oriented. The choice for a real estate product is a choice for landscape rather than for position. Moreover, the same study mentions that a number of residential developments, identified as “compact”, far off rail stations were excluded from the survey. There is then, a choice for landscape. It may or may not be located close to rail. Neither in Chicago is compact housing exclusively tied to rail. But rail does seem to attract developers of such a product if service possesses attributes of quality, being San Francisco and Washington DC the notable examples. With much of their energies put into labor conflict and financial deficits, transit agencies do not have quality among their top priorities. The quest for longitudinal space should be followed by a quest for quality.

9. Conclusions

The transportation systems of three cities were compared. Remarkably, the limits of comparability are the first thing to appear: statistics are collected differently, relate to different land-use patterns and to different infrastructure provision and coverage. Moreover, the same policy decision may be the result of heterogeneous governmental decision-making arrays.

On the side of commonalities, the large metropolitan areas are still growing and city centers are a part of the expanding process. Travel times by automobile are increasing, and bus ridership is dropping. Demand for non-automobile transportation options is on the raise.

The approaches to launch policies were the most efficient in São Paulo, where transportation is managed from an appropriate government level. This differs from Buenos Aires where the Federal Government is responsible, and from Chicago, where policy unnecessarily falls pray to the fragmentation of local politics in the region. In all three cases though, transportation policy has lagged well behind recent demand and changes caused by demographic, employment and land-use. We argue that present levels of congestion are, in large part, the result of this lag.

The quest for providing reliable capacity, that is, the quest for transportation space goes beyond horizontal strategies, and has its longest history in the creation of segregated rights of way. Segregated lanes present restrictions, especially when being applied in avenues and streets of old City areas, and when the owner of the lanes, City governments, do not own bus operations, or have the ability to adjust bus operations as quickly as it takes to segregate longitudinal space in the street grid. Even when transient losses of ridership are set aside, the stagnation or slow growth in bus ridership is an indirect but comprehensive indicator of these difficulties in modernizing existing bus networks. On the other hand, demand response to improvements in rail transportation has been disproportional, especially in São Paulo and Buenos Aires, the two metropolitan areas with highly preeminent city centers. Fig. 14 summarizes the recent divergent evolution in bus and rail ridership in three different cities.

Congestion, defined as a push between transport demand and transportation space available, has become a constitutive element (“congestion is here to stay”) but not of cities, but rather of critical stretches of highways and avenues leading to areas of concentrated and diversified functionality. The decrease in accessibility derived from congestion is being rapidly counteracted by new use of inherited infrastructure. As opposed to São Paulo’s highly accessible but stagnant historical
center, only where land-use processes and rail improvements coincide is there a synergy between the historical product of a city center and the incidence of space consumed by transportation flows. If this general outline gains greater visibility, the understanding of cities as an intrinsically congested artifact will likely cede to a more positive perspective. With a city’s landscape as the goal, that might even become a topic for economic assessment, rather than a notion dissociated to that of throughput, the discussion for funding allocation regarding transportation could reach a more balanced political understanding. Multimodality will then take place with or without specific inter-jurisdictional agencies prone to overlap the pre-existing historical array of jurisdictions and political balance in each metropolitan area.

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References

Abbot, Carl., 1997. The Portland region, where city and suburbs talk to each other and often agree. Housing Policy Debate 8 (1), 11–51.
Argentina, 1973: Ministerio de Economía, Obras y Servicios Públicos, Estudio preliminar de transporte del Area Metropolitana de Buenos Aires. 2 volumes.


