

**The Limits to Competition in Urban Bus Services  
in Developing Countries<sup>1</sup>**

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World Bank Policy Research Working Paper 3207, February 2004

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<sup>1</sup> We are particularly grateful to José Gómez-Ibañez, for very extensive comments on an earlier version. We would also like to thank Jose-Luis Irigoyen, Peter Roberts, Emile Quinet, Tomas Serebrisky and Andrés Velasco, for several very productive discussions.

# The limits to competition in urban bus services in developing countries

## Abstract

During the past three decades urban public transport policy has gone through several phases. From public ownership and monopoly provision, the eighties and nineties were characterized by a strong liberalization of the sector. This experience showed the limits of liberalization of the sector in terms of safety, prices and accountability. This paper discusses the market failures that justify this claim and the regulatory options available in this emerging new role of government, illustrating how they are being used in practice in some countries.

Keywords: transport, efficiency, safety, regulation, developing economy, reform  
JEL Classification: D43, L51, L92

## 1. Introduction

Any review of the perception of best practice in terms of the market structure and organization of urban public transport over the last 30 years or so would reveal the popularity of a hybrid model, that is a model in which the public and the private sector share responsibilities for the delivery of the service.<sup>1</sup> A more careful review would reveal an evolving consensus with respect to the optimal degree and form of government intervention in this hybrid model.<sup>2</sup> This evolving consensus is particularly obvious in bus transport which represents the largest mode of urban transport in the developing world since, according the latest data published by the UN (2001), over 40% of all trips to work are done by buses in low and middle income countries.

The new consensus on the organization of the bus services market has roughly emerged as follows.<sup>3</sup> During most of the 1970s, public provision and self-regulation were the norm but ended with major fiscal difficulties and the consequences of the two major oil price shocks. Starting in the 1980s, liberalization and privatization of services became the new norm but ended with major safety and environmental problems in addition to some social issues resulting from tariff rebalancing in the sector. The result, toward the end of the

1980s, was a wave of policies introduced to mitigate some of the excesses of competition by restricting entry in the sector. Since the end of the 1990s, the state seems to be returning firmly, at least as a regulator and as a facilitator of modal integration.<sup>4</sup>

The main purpose of this paper is to discuss why this last stage may be the most rational from an economic point of view, thus confirming the current intuition of many policymakers in the sector. The general perception is that the liberalization experience has demonstrated that there are indeed limits to competition and that the industry is characterized by many market failures which require regulatory intervention.

The paper emphasizes two sets of regulatory issues. The first is related to the industrial organizational of a competitive bus market since it drives the efficiency potential of the public transport services. They address the potential market failures that may plague this industry, including pollution and congestion externalities, network effects, the need to coordinate the large number of agents involved and the interactions with other urban planning issues.<sup>5</sup> The second set of regulatory issues flow from the first one. Indeed, if regulatory intervention is warranted, the challenge is to intervene without compromising the efficiency benefits of competition among private providers.

The paper addresses these issues as follows. Section 2 relies on a presentation of the experience of Santiago, the capital of Chile, as an illustration of the typical ways in which the regulatory issues tend to emerge in practice. Section 3 provides a detailed review of the main sources of market failures in the bus industry that would justify a regulatory role for government in developing countries, including excessive entry, social inefficient frequency decisions and agency issues resulting from various types of ownership structures in the sector. Section 4 presents the various possible regulatory responses to these problems. Section 5 shows how these solutions are converging into a new hybrid model and how they

are being implemented in practice in the context of the recent reforms of urban transport in Bogotá, Colombia. The last section summarizes the risks associated with the new model.

## **2. An illustration: evolution of the role of government in the bus sector in Santiago**

The recent history of urban public transport in Santiago, Chile, provides a good illustration of the typical evolution of urban transport policies and of the reasons behind the changes that have occurred regarding best practice in this field. This history can be divided into three distinct periods. The first period, ending in 1979, was characterized by heavy state intervention, both as a service provider (with the company Empresa de Transportes Colectivos) and as regulator of prices, routes, and permits for private operators. During this period there was a chronic shortage and low quality of services. The social costs of this insufficiency were in the form of long waiting times for bus arrival and congested buses.

The second period began in 1979 when the sector was liberalized with the introduction of free entry, freedom to establish routes and, beginning in 1983, freedom for each operator to set tariffs. The rationality for these reforms laid in the conviction that a free market would generate an optimal level and quality of services. Competition, it was thought, would guarantee an efficient level of prices. Unfortunately, in practice things did not turn out as expected.

During this second period, there was a significant increase in the number of buses and the geographical coverage of the system. Between 1979 and 1983, the number of buses increased by 40%, from 5,185 to 7,278. This increase and the problems it generated spurred a U-turn in the liberalization reforms. Between 1984 and 1988 entry was restricted, although illegal entry persisted and the number of buses reached close to 11,000 by 1988.

In 1988, just before the transition to democracy, the sector was again completely liberalized and the number of buses reached its peak of 13.698 in 1990.

The effects of liberalization clearly generated benefits to users as waiting times were reduced and the distance to the nearest bus route was shortened. As the process continued average capacity utilization dropped by 55% and 32% respectively in buses and taxi buses during this period.<sup>6</sup> In spite of this drop and of the associated large number of operators in the system, the users saw the benefits of improved service offset by a real tariffs increase of almost 100% between 1979 and 1990.<sup>7</sup> This increase was not related to increases in fuel prices. In fact, with the exception of 1986, fuel prices throughout the period were lower than their original level in 1979. This behavior of tariffs during the liberalization period implies that competition was not successful in curbing market power.

In addition to these price increases, the reforms were beginning to be associated with major quality problems. Indeed, the increase in the number of buses, their reliance on diesel fuel and the increase in the average age of buses—with lower technological standards—transformed the bus sector in one of the main generators of congestion and air pollution externalities in Santiago. By the late eighties, Santiago's atmosphere was one of the most polluted in the world.<sup>8</sup> The bus industry was not the only source of air pollution but it was one of the leading contributors. Congestion was related to the fact that 80% of bus routes passed through the 7 main arteries of the city and clogged the main roads of the central urban area (Malbran, 2001).

Towards the end of the eighties, the high tariffs, the high average age of buses, the low average capacity utilization of an oversized bus stock, together with the environmental and congestion externalities served to finally put an end to the free market experience. In

1991, new regulations were introduced that ushered in a new hybrid model for the organization of the industry in Santiago. Under a new tendering system, the authorities established the route coverage of services, while tariffs were determined through the competitive bidding process (subject to periodic adjustments for changes in input costs). The competitive tendering process—although not perfect—served to stop and revert the real tariff escalation of the eighties, lower the number of buses and increase the average capacity utilization rate.<sup>9</sup>

By 2001 there were only 8,179 buses in operation, in spite of the fact that the average number of passengers during a working day increased from 3,575,942 million to 4,275,913 million between 1991 and 2001.<sup>10</sup> Occupancy of buses doubled during this period. The average age of buses dropped to 6 years and over half of the current stock meets EPA-91 or EPA-94 emission standards. Service quality—measured by network coverage and waiting times—was not affected by the reforms since the authorities did not modify the existing route design when tendering was introduced. Waiting times at bus stops averaged only 4 minutes (Ministerio de Obras Públicas, Transporte y Telecomunicaciones, 1997).

The new role of government was further fine-tuned during the nineties when several other norms and regulations were introduced, including a limit of the maximum age of buses (10 years), emission standards, bus types (automatic transmission), among others, which helped to increase the quality of service and a reduction in the environmental externalities caused by the sector.

Although Chile's bus services are now firmly grounded in a hybrid regime with a strong regulatory commitment to address market failures, there are still several aspects of

the system inherited from the free market experience that have not been corrected but are being worked on. Among the remaining problems are the following. First, when concessions were introduced no effort was made to optimize the network configuration nor introduce some sort of tariff integration. Therefore, currently too many routes overlap, individual services are usually very long—the average length of a route is 63 kilometers (EMG (2002))—and tariff integration is nonexistent except for some minor integration between some bus services and the underground metro system. These features generate aggregate economic inefficiencies in the transport sector as discussed further below. Another consequence is that there are still an excessive number of buses in the system compared to an optimized network (SECTRA, 2002; Vivanco, 2002).

Second, since operators still earn their revenue from ticket collection, buses still have strong incentives to compete head to head on the road. Besides the difficulty this creates for an orderly bus-stop design—buses stop anywhere generating more frequent stop-and-goes, increasing travel times and thus further undermining the economic efficiency of the transport system as a whole—safety is the greatest emerging problem. In 2001, there were 7,392 accidents in the Santiago urban area where a bus was involved; of the 5,699 injured people in those accidents 112 were fatalities. On average then there is one death every three days in an accident involving a bus from the transport system. To put these number in perspective, this is larger than the total number of fatalities from bus accidents observed in Australia between 1990 and 1998.<sup>11</sup>

These pending issues illustrate some of the problems inherited from the liberalization experience. The weakness of regulation was a large one but certainly not the only one. A related factor, possibly one of the main obstacles to further reform of the organization and

regulation of the bus system, has been the pressure from the bus owner's lobby.<sup>12</sup> As in many countries, once the bus system had been liberalized, new strong interest groups were created by the new operators and they made future reforms more difficult.<sup>13</sup>

### **3. Market failures in the urban transport industry**

More generally, what Santiago's story reveals is that market failures in the bus industry are not only the result of environmental and congestion externalities but also the consequences of the economic characteristics of the business. The network characteristics of the industry, the peculiarities of demand for journeys, the specific organizational structure chosen for the delivery of the service and major governance issues can indeed result in many other forms of market failures.<sup>14</sup> Policymakers and the general public are typically concerned with the need to regulate to minimize congestion and environmental externalities related to public transport.<sup>15</sup> Safety concerns are also very present in the policy agenda.<sup>16</sup> However, the failures related to the economic characteristics of the industry may also justify a regulatory intervention even in the absence of the more traditional congestion and environmental problems as reviewed next.

#### **3.1 The lack of curb rights**

The street curbs and bus stops where vehicles pick up their passengers are public property and thus a 'common property' resource for all transport companies, even informal ones. According to Klein, Moore y Reja (1997), this is the main market failure in urban bus transport and explains many of the failures of this industry. Their argument is interesting but its relevance depends on the characteristics of the demand for public transport. There are transport markets where the demand for public transport depends on the prior existence of a regular service, with predetermined schedules and a high quality of service. In these



markets a company must invest in these characteristics, possibly by operating at a loss for a period of time, in order to induce demand for public transport. However, if a company undertakes this investment and generates the demand for the service, a competitor (formal or informal, or even private vehicles looking for passengers in order to use high occupancy lanes in certain cities) can take away the original company's clientele at the points where passengers congregate. Since curb sides are public property, and thus there is no way to avoid this 'business stealing', the company cannot recoup its original investment. Knowing this, the company does not invest in the first place, demand is not induced and the public transport service may disappear.

There are two solutions to the above problem. Klein, Moore y Reja (1997) propose a system of transferable curb rights. Under this scheme only companies that own rights over some curb space can pick up passengers at those points. These rights can be sold or rented, thus assuring that the most efficient companies own these rights. Klein, Moore y Reja (1997) suggest the use of video cameras to enforce these curb rights. The second solution is to give one operator exclusive rights over a route and then to enforce this exclusivity by keeping out potential informal operators. In order to avoid the abuse of market power by the exclusive operator, competitive tendering should be used to determine the franchise operator and fare levels.

Considering the country specific conditions, the lack of curb rights may help to explain the decline of public transport in some cities in developed countries. When high quality and scheduled transport services are preyed upon by interlopers, the formal high quality service declines, thus potential passengers, unsure of the time the next bus will pass by their stop, may prefer to use another mode of transport. As demand decreases, service supply decreases further and a downward spiral of decline of the bus market may ensue. If

the market does not disappear it will be dominated by the generally lower quality interlopers.

However, as a general explanation of the woes confronting bus markets in developing countries, the lack of curb rights argument is less convincing as a generalized explanation for the urban transport problem. In most developing countries, many individuals do not have an alternative mode of transport except by buses.<sup>17</sup> In these markets demand may be ‘thick’ in the sense that no prior investment in a regular scheduled service is required in order to induce demand. Moreover, the assignment of curb rights may be more complex in congested urban centers, a common feature of developing countries, because time schedules may be close to impossible to meet.<sup>18</sup> In many large cities, such as Santiago, Manila, Dakar or Bangkok, the problem is not one of disappearing public transport services, but of excessive entry and frequency, especially during off-peak hours.<sup>19</sup>

Note that even in the case of markets with ‘thick’ demands, the lack of curb rights may not be discarded completely as an explanation in developing countries. First, the curb rights argument may be relevant for the inexistence of private services in lightly traveled routes or during night or early morning hours. Second, it may explain certain distortions in the investment decision of operators that may degrade the quality of service. Since operators must compete for passengers at the curb, investments that allow operators to compete more effectively will be undertaken. One example may be the strong preference operators in Santiago have for vehicles with manual gear systems rather than automatic gears.<sup>20</sup> The control and faster acceleration provided by manual gears may be an advantage for racing and positioning vehicles in the competition for passengers at curbs.<sup>21</sup> Another distortion may be the incentive for introducing faster and smaller buses which are more maneuverable compared to their larger and slower counterparts. Although from a private

point of view the smaller buses may be preferable, the additional congestion, pollution and higher investment costs per seat capacity may not justify this decision from a social viewpoint.

### **3.2 Efficient entry and fares**

Besides the lack of curb rights, there are some other reasons why a free market in urban transport may not provide the efficient number of services in developing countries. One of the main one may be the underestimation of the importance of fare regulation to achieve a socially efficient level of service in the sector. Fares tend to be controlled politically to ensure their affordability but they also may need to be regulated or subsidized in order to induce the right entry/exit decisions and frequency decisions by private operators. Congestion, pollution and other externalities are clearly emerging as a growing problem as well for the design of the optimal organization of the bus industry and are increasingly generally recognized as such. Less appreciated maybe is the importance of “agency” problems in the design of the industry structure. In order to formalize the ideas of this section and show the interactions between the various forms of market failure presented, we first develop a very simple transport model that gives basic insights into the forces behind excessive or insufficient entry and then discuss each market failure in some detail.

#### **3.2.1 A simple transport model**

Consider a transport system that operates exclusively on buses during a certain cyclical period of time (say one day, one week, or one month). During this period,  $N(p)$  passengers arrive uniformly to take a bus, where  $p$  is the price of one trip.  $B$  is the number of buses in circulation. Assume also that each firm owns only one bus that is operated only once per period. There are no operation costs—again an assumption that does not change

the results—but there is a fixed cost of  $F$  per period. This fixed cost can be the capital value of the bus or terminal cost. If the arrival of these buses is equally spaced, the demand for a particular bus will be  $N/B$ , since it receives all passengers that arrive (uniformly) at the bus stop since the last bus passed. Under these assumptions, profits to a bus owner are:

$$\pi_i = \frac{p \cdot N(p)}{B} - F$$

When there is free entry, the private equilibrium condition (zero profit condition) is:

$$B^p = \frac{pN(p)}{F}$$

This implies that if there are  $B^p$  buses, there are no private financial incentives for additional entry and each firm is obtaining a normal rate of return on its investment.

However, this number of buses may not be socially optimal if there are market failures of the type discussed here. For instance, a good planner would also take into account the effect of the number of buses on the average waiting time of passengers with a cost for a passenger of  $c$  per unit of time. On average, a passenger will have to wait  $T/2B$  time units before he can board a bus, where  $T$  is the time it takes a bus to complete the circuit. Therefore, the social welfare function is given by the sum of the user and operator welfare associated with this service:

$$W = \frac{-cN(p)}{2B} + B \cdot \left( \frac{p \cdot N(p)}{B} - F \right)$$

Maximizing this function with respect to the number of buses one gives:

$$\frac{\partial W}{\partial B} = \frac{cN(p)}{2B^2} - F = 0 \Rightarrow B^s = \sqrt{\frac{cN(p)}{2F}}$$

The main point of this derivation is that depending on the specific parameter values that characterize the market, the socially optimal number of buses could be smaller or larger than the private equilibrium computed earlier.

The ratio of the social optimal number of buses to the private equilibrium can be expressed as:

$$\frac{B^s}{B^p} = \frac{1}{\sqrt{2}} \cdot \sqrt{\frac{F}{p \cdot N(p)}} \cdot \sqrt{\frac{c}{p}}$$

This result will depend on two effects. The ratio of fixed costs to revenues (the second term) represents the excess entry effect typical of differentiated goods models. The higher the fare is (assuming demand is inelastic) the higher revenues are and thus the higher the excess entry and the duplication of fixed costs. Thus, for high fares, the social optimal level of buses will be lower than the private equilibrium, independently of congestion or environmental externalities.

The last term represents the ‘waiting time externality’ well known to transport specialists. Mohring (1972) argued that private operators would supply too little service (in terms of frequency) since they do not take into account the social benefits of the reduction in waiting times of all passengers as additional buses are run on a network. If an extra bus is put into service, there will be an added private cost that the firm must recoup. However, the extra bus will decrease the interval between buses for the whole route. For example, if 5 buses pass uniformly each hour through a given point in the network, there will be a 12-minute interval between buses. Passengers—if they arrive uniformly to take a bus at that spot—will wait on average 6 minutes before they can board. If an extra bus is put into service, the time interval between buses will fall to 10 minutes, and the average waiting time to 5 minutes. Therefore, all passengers—independently of whether they actually use

the new bus—will gain an extra minute in the form of less waiting time. This is the positive externality created by the additional bus. For a high waiting time cost parameter to fare levels there will be an under-provision of services in the private equilibrium compared to the social optimal level.

### **3.2.2 Too much or too little entry?**

Both effects point to an over provision of services in a private “commercial” equilibrium when fares are high. Why could it be likely that in a competitive equilibrium fares will be above efficient levels? The argument is the familiar in the study of horizontal differentiated product markets and applies to buses. Indeed, while buses going to different destinations are not perfect substitutes and even buses passing the same final destination of a passenger may not be perfect substitute, in some ways, the bus industry can be seen as one in which horizontally differentiated products are being sold. The main source of this differentiation stems from the existence of a time lapse between the arrival of buses, or headway between buses. An individual may prefer taking the first bus that arrives at a stop rather than wait for the next one, even if there is a positive probability that this next bus is cheaper. Thus, the bus that just arrives at the stop has some ‘captive’ clients, which implies that it has some market power to raise tariffs.<sup>22</sup> Raising tariffs, however, creates excessive returns to investment and spurs the entry of new firms or buses beyond the socially efficient level. Evans (1987) uses a theoretical horizontal differentiation model, along the lines of Salop (1979), to show that a competitive equilibrium will imply high tariffs and excessive entry. Furthermore, some authors, such as Gómez-Ibañez (1999), have argued that in practice the ‘waiting time externality’ is likely to be small in quantitative terms. When buses pass at a high frequency, the gains from a reduction in the headway between buses is

likely to be small. When frequencies are low, it is likely that passengers will learn to schedule their trips better in order to avoid waiting long at a stop.

Thus, it may be likely that the excessive entry effect may dominate, especially in developed countries where the value of time costs may be low. One symptom that excessive entry has occurred is that a considerable number of buses will be running almost empty, something that is still observed in Santiago.<sup>23</sup> Also, the fact that price competition is not very strong in bus markets has been widely documented. For instance, Klein, Moore y Reja (1997), in their review of the British competitive experience concluded that ‘it has been rare in the British experience for companies to compete by offering lower fares. Rather, real bus fares increased 17 percent between 1986 and 1994. Instead of lower fares, companies chose to offer more frequent service than their competitors’.<sup>24</sup>

There may also be another phenomenon generating an excessive number of buses in a competitive transport system when there are fixed schedules. If there is an incumbent provider or a cartel (in the case of Santiago it could have been the operators association) then they may have an incentive to preempt entry by competitors. This preemption strategy implies ‘filling’ all the possible routes of the network in order to make entry by a small rival unprofitable and may also result in too many buses in operation.<sup>25</sup>

### **3.2.3 Congestion and other externalities**

Ultimately, whether there is excess supply in the bus industry is an empirical matter that needs to be analyzed with reference to particular experiences and circumstances. In Bangkok, for instance, the traffic averages a mere 13kmph but the bus system averages only 9kmph.<sup>26</sup> The problem is related to the fact that buses get stuck in traffic because the city’s transport policy does not cater to the specific needs of the bus industry. From a conceptual point of view, this points to additional influences on the optimal number of

buses. In particular, if congestion and environmental costs are considered and these externalities are proportional to the number of buses on the network, then the socially optimal number of buses may have to be lower still. This implies that the possibility that a free market will result in excessive, rather than insufficient, entry is greater.

There is an interesting dichotomy here between developed and developing countries. Whereas in the former the modal split is usually heavily biased towards private cars, in the latter public transport accounts for the majority of trips. For example, a recent report by NERA and TIS.PT (2001) reviewed the public transport system in 9 cities of developed countries. They found that public transport usually accounts for less than 25% of trips (the highest share of public transport was found in Zurich, 37%) in these cities. Private car transport, on the other hand, accounts for well over 50% of trips<sup>27</sup>. This is in stark contrast to developing countries, where in a city such as Santiago, Chile, 61% of trips are undertaken on public transport according to the 2001 Origin and Destination Survey.

The modal split will have an influence on the causes of congestion and pollution. In a developing country where buses are the main source of urban transport, these will have a greater responsibility for congestion and pollution.<sup>28</sup> This argument is reinforced by considering that in developing countries bus technology is often older and more polluting than in developed countries. It is possible then that in developing countries a free market may provide an excessive supply of services (due to these externalities) while in a developed country they are a solution to these same externalities. The policy recommendations must then be very different in each case. While in the latter subsidies to public transport may be justified in order to increase services, in developing countries efforts may be needed to rationalize the public transport system.



### **3.3 Agency problems**

The last source of market failure commonly encountered in the sector and that may entail regulatory intervention is associated with incentives problems built in the design of contracts given to drivers in a competitive market. Indeed, in a competitive bus market, the number of passengers using a particular bus is partly a function of the effort the driver makes to seek potential passengers on the road, stop to pick them up (usually not at a formal bus stop) and in general try to ‘beat’ other buses for this client. The natural “commercial” solution for this incentive problem is for the owner (principal) to design a contract for the driver (agent) that aligns the latter’s incentives to his objectives. In this context, this means that drivers are paid on a variable salary that depends on the number of tickets sold.

Although paying drivers based on the number of passengers collected makes sense as a private solution to the incentive problem faced by bus owners, from a social perspective it has several negative effects. The ensuing competition on the road between buses vying for passengers can create enormous safety problems, as described earlier in the case of Santiago. It also makes it very difficult to design a rational system of bus stops, since drivers will have a strong incentive to pick up passengers anywhere between stops. Frequency problems are also created by this structure as drivers use a strategy of ‘head-running’ (running just ahead of competitors) or wait until a competitor appears before undertaking the route.

Paying drivers a fixed wage rather than a variable wage is one way to eliminate the above problems. However, this will not arise naturally in a competitive bus industry, since a unilateral change of driver’s contract by one company will usually entail an economic loss.<sup>29</sup> Even imposing this by decree to all bus companies would be difficult. As long as

owner's profits are related to the number of passengers carried, there will be a strong incentive to pay drivers, either formally or informally, based on the number of passengers picked up.

Save very strict traffic monitoring, the only way to avoid the safety, congestion and other problems related to competition on the road is to break the link between profits and passenger carried. This is why in many regulatory experiences around the world, including Bogotá (see below) and London, bus companies are paid according to quality variables or schedule completion rather than passengers carried. However, this in turn requires some system of revenue sharing between bus companies that may be difficult to achieve without heavy regulatory intervention. In addition, this policy option has the draw-back that operators may have the incentive to reduce costs by lowering the number of frequencies served or not stopping at all bus stops. However, inexpensive modern geographical positioning system technology is now available to monitor the compliance with route scheduling of operators. Therefore, technological change has made it possible to pay operators according to variables other than the number of passengers carried (for example the compliance with route schedules and other quality measures) without a significant change in the service provided to passengers.

Revenue collection by drivers or other personnel on buses can also generate inefficiencies through a more subtle channel. When drivers or another employee on the bus must collect fares, there is the possibility that these employees will not report all revenue earned to the owner. Although this can be monitored by inspectors who check that passenger have been given tickets, full effective policing is costly. In fact, in Santiago owners and analyst agree that drivers supplement their incomes by around 20% through this type of fraud.<sup>30</sup>

This possibility of fraud by drivers makes it harder for bus owners to delegate the operation of buses to hired employees. Thus, one tends to observe that bus owners tend to be drivers also, or drivers are close relatives of the bus owners. The monitoring problem described here is one reason why in many cities in the developing world, private bus companies tend to be small, informal, and family oriented businesses. In Santiago, the average number of buses per owner is 2.11. Over 70% of buses are owned by entrepreneurs who own five or less buses.<sup>31</sup>

Authors such as Nash (1988) have argued that in a competitive bus market economies of scope or scale will not be exploited because of the transaction costs involved in coordinating schedules, integrating services and fares, and agreeing on a revenue sharing scheme between numerous private operators. This argument, however, is not fully convincing because there are many examples where a competitive market results in an efficient exploitation of these economies, specifically through mergers and vertical or horizontal integration. A good example is the airline industry where private companies have adopted a scope and hub system in order to exploit economies of density.<sup>32</sup> However, the diseconomies of size that arise due to the monitoring costs of a large fleet of buses when drivers are responsible for revenue collection, and which generates an atomized ownership structure, may make it difficult to exploit potential economies of density or scale in an urban transport network. In fact, preliminary work undertaken in Santiago show that there are large economies of density still to be exploited.<sup>33</sup>

#### **4. New Regulatory instruments to cut the risks of market failure.**

The previous section implies that there are four main regulatory challenges in the regulation of the bus industry which form the backbone of the new emerging hybrid model.

The first is to design and integrate the transport network in order to exploit economies of density and scale without compromising the system's coverage.<sup>34</sup> The necessary transfer infrastructure must be built and some system of tariff integration must be introduced (unless there is one operator for all services and relevant transport modes). It will usually also be convenient from a social point of view to create exclusive bus lanes on roads. This will guarantee that the lower travel times of an optimized system are not eroded away by an increase in private automobile journeys.

Second, some regulatory control must be exercised on entry decisions and frequencies, and tariffs must be regulated.

Third, operators' revenue must be decoupled from the number of passengers carried in order to avoid the negative effects that result from competition for passengers on the streets. This requires some integrated revenue collection system, independent of operators, which can then distribute these resources among firms. This has an interesting implication for the ownership structure of the bus companies. They will have to become larger and more formal enterprises, capable of raising working capital in order to operate in the short run since they will not receive revenues from fares on a continual daily basis.<sup>35</sup> In addition, the authorities would have to setup some system to monitor service compliance.

Finally, bus quality and technological specifications will need to be imposed in order to reduce environmental externalities and raise service quality.

It would seem that all of the above recommendations point to a return to the old model of monopoly provision of bus services, possibly by a public operator. However, the emerging hybrid model takes into account one of the important lessons of past experience: the need to guarantee the productive efficiency of the provision of transport services. Public

provision as well as subsidies is not currently favored by policy makers due to their negative incentives for efficiency.<sup>36</sup>

Naturally, direct competition and free entry into the industry is one mechanism to foster productive efficiency. However, it raises the problems identified in Section 3. There are however alternatives to direct competition that would promote efficiency while at the same time preserving the benefits of a centrally integrated and coordinated bus industry. When entry is restricted, a regulator wanting to set fares faces an asymmetry of information problem. The companies that are to be regulated have better information concerning the characteristics of the routes, the actual and potential costs of serving them, the costs of providing different service qualities as well as many other economic and technological variables that determine the efficient cost structure. Therefore, in many ways there is a direct analogy in the promotion of efficiency in this setting and the regulation of natural monopolies in utility industries.

#### **4.1 Combining restrictions with competition for the market**

Restricting head to head competition does not mean that the market cannot be competitive. It has been long recognized that in some circumstances competition *for* the market is a good substitute for competition *in* the market. Tendering bus routes can be a powerful regulatory instrument to address the asymmetry of information problems that arise from the need to pick among potential providers of services.

In utility industries such as water and electricity, the use of auctions to set prices is limited by the fact that assets usually last many decades and are sunk which requires frequent tariff revision. However, in the urban transport sector, where assets are much shorter lived it is possible to set price conditions for a similar period as the life of assets. In addition, since there is usually a secondary market for used buses these investments are not

sunk, which means that incumbents must not be compensated for their undepreciated investment if they lose a contract. Therefore, tendering bus routes is much more common in this sector than in other regulated utility sectors<sup>37</sup>.

Besides Santiago, Bogotá and London, many other transit authorities use tendering as a way to assign operators to serve previously defined network routes.<sup>38</sup> There is enough experience in the tendering of bus routes to state that this regulatory scheme is indeed quite feasible. The potential gains from tendering can be substantial. In Santiago, the tendering system reverted the tariff escalation phenomenon that characterized the deregulation period. In London, it has been estimated that tendering reduced operating costs per bus kilometer significantly. Estimates range from 20% gross of administrative costs or 14% net of administrative costs (Glaister, 1998) to 35% (White, 1995).

There are several ways to tender a route contract. In the case of Santiago, contracts are tendered for a 5-year period based on a multi-variable selection criterion, which includes the fare offered by a bidder in addition to certain quality variables. In England, two basic systems were used to tender three-year contracts. One is to award the contract to the bidder that offers the minimum subsidy. In this case, the firm receives revenue directly from passengers and the subsidy covers the estimate revenue shortfall compared to costs. The second system is based on a gross cost basis in which bids are received for the gross amount of transfers that the firm wants to undertake the service. In this case, the company does not retain any revenues from fares (or may not even be responsible for collecting fares as in the case of Bogotá) and funds its operation entirely from the transfers.

There is some evidence that the last alternative lowers overall costs and transfers more (White and Tough, 1995). This is because with the minimum subsidy scheme, operators still face revenue risk from fluctuations in demand. This revenue risk decreases

the interest of small operators for contracts thus lowering competition at the tendering stage. Bidders will also include a risk premium in bids to compensate for the added risk, increasing transfers compared to the gross cost type contract.

The gross cost contract also has the advantage that a company's revenue is not directly related to the number of passengers transported, thus competition on the road is avoided. However, it lowers the incentives for companies to seek passengers or otherwise stimulate demand by providing a high quality service. Therefore, if different routes do not overlap too much, there is effective traffic control policing and individual drivers within a firm coordinate their scheduling and traffic safety and other risks of competition on the road may be low. In this case, a system that leaves some revenue risk to firms (minimum fare or subsidy contracts) may be preferable to give firms an incentive to meet its timetable and provide a high quality service to users. However, in developing countries where traffic safety is an issue a gross cost contract that rewards a firm according to their compliance with reestablished service provisions may be preferable. As noted above, there is now relatively inexpensive technology to centrally monitor bus traffic and position.

#### **4.2 Combining entry restriction with yardstick competition**

While tendering is clearly an attractive instrument it is not always feasible. For example, there may be political obstacles to introducing tendering, especially if other types of contracts have traditionally been used and these have performed relatively well. Another possible reason why tendering may not be effective is that there may not be enough firms to guarantee sufficient competition during the process, perhaps because firms have an ability to collude.<sup>39</sup> Therefore, it is relevant to examine the performance of alternative regulatory contracts on productive efficiency of transport firms.

The ability to use yardstick competition or benchmarking is clearly an attractive alternative to tendering. It is common—especially in the transport industry—that regulators simultaneously regulate several services in contiguous spatial markets. Regulators then have a powerful tool at their disposal if they can compare or benchmark firms operating in the different markets. The use of benchmarking or yardstick competition can, if well applied, overcome the informational disadvantage of the regulator and in the limit can be used to reach a first best outcome (symmetric information).

The principal difficulty in applying yardstick or benchmarking type regulations is that firms may not be directly comparable. The regulator must then strip-out the variation of costs across companies that are due to legitimate differences among companies (in the urban transport setting this could be different route types, congestion levels, peak demand characteristics and other exogenous influences on costs) before comparing or benchmarking them. Naturally, companies have incentives to convince regulators that they are very unique and thus ‘non-comparable’ to other companies.

In spite of the above difficulties, there is at least one experience of the use of yardstick type competition in the bus industry.<sup>40</sup> In the late eighties, some counties in Norway started adopting a standard-cost model to determine annual transfers. In such a system, the county and the companies agree upon a set of criteria for calculating costs of operating a bus-network. It is a linear model that links driver costs, fuel costs, and maintenance costs to the number of bus kilometers produced for different categories of routes (from inner-city, low speed to long distance, high speed routes). Given fares and route schedules, the standard-cost model determines the level of transfers that is granted by the regulator. This increase the incentive power of the regulatory scheme. Once the criteria



are set, realized costs by one company that happen to deviate from the standard-cost figures, will not affect the level of its next annual lump sum transfer. This gives the standard-cost model a flavor of yardstick competition (see Shleifer, 1985). The main characteristic of yardstick competition is that transfers be based on a benchmark estimated on the basis of cost performance of a larger set of companies. Dalen and Gómez-Lobo (2002a) apply an econometric stochastic cost frontier approach to an 11-year panel of Norwegian bus company data and show that the yardstick type contract (standard cost model) increases cost efficiency of firms. In addition, there are dynamic effects to the use of yardstick contracts. Costs are lower the longer the contract has been in effect. However, the measured impacts tend to be small.

#### **4.3 Offering menus of contracts to the operators.**

There may be occasions when neither tendering nor yardstick competition is feasible. In this case the problem faced by the regulator is identical to a natural monopoly situation where he must regulate a single natural monopoly under asymmetric information. The new theory of regulation offers a normative framework for regulatory policies in such contexts.<sup>41</sup> What are the implications of the theory for policymakers? The first is that offering just one type of contract is not optimal (such as a Price-Cap in some counties in Norway). Regulators should try to offer a menu of options and allow firms to self-select according to their private information. This has seldom been the case in practice. There are very few experiences where regulators formally offer a menu of options to firms.<sup>42</sup> However, it could be that informally, during a negotiation stage, the regulator offers a menu of such contracts.<sup>43</sup>

It is interesting to note that several authors have tried to apply the theoretical results of the optimal second best contract under asymmetric information to the urban transport

sector. From a theoretical point of view there is the work of Pedersen (1994). On the other hand, Wunsch (1994) actually attempts to derive the optimal contract for transit firms through a mix of econometrics and calibration. He uses data on 177 mass transit firms in Europe to estimate the distribution of the asymmetry of information cost parameters of firms. In his words “...the asymmetry of information between the regulator and the agent is assumed to be limited to the unexplained variance of a cost estimation based on a cross-section of 177 transit firms”. Therefore, he estimates a cross-section cost function conditioned on the characteristics of each transit system and obtains that the confidence interval around fitted values has a standard error of about 15% of costs. He then uses this information, plus some calibrated parameters for other functions to calculate the optimal menu of contracts to offer firms.

Gagnepain and Ivaldi (2002), in their study of the public transit system in France, use a structural approach—previously explored by Dalen and Gómez-Lobo (1995)—to recover firm’s underlying cost efficiency distribution. They then model the effects of the introduction of an optimal regulatory contract, including route tendering.

## **5. Towards a solution in the real world: the experience of Bogotá, Colombia<sup>44</sup>**

The case of Bogotá illustrates how with political will and a well-structured project it is possible to radically improve the transport system in a short period of time. The reforms in Bogotá took 36 months to implement.

During the nineties Bogotá, the capital of Colombia, struggled with many of the problems alluded to in the previous section. Buses competed vigorously for passengers in the streets (called the “the war of the cents” by Colombians) generating unnecessary traffic

risks and a chaotic system of stops and goes. High congestion generated velocities as low as 10 kmh during peak periods. Even short trips would sometimes take considerable time. In 1998, it was estimated that the average trip took 1 hour and 10 minutes. The average age of buses was 14 years in 1998 and the service quality they could offer low. The average occupancy rate was 45%. It has been estimated that 70% of particular matter emissions from mobile sources could be attributed to the bus system.

Towards the end of the last decade the mayor of Bogotá undertook a radical reform of the transport system in the center of the city. The reform was organized around what came to be called the TransMilenio Project that became operational in December 2000, only two years after it was first proposed. This project is based on a system of exclusive bus lanes—along the busiest corridors of the city—to be used by bus operators. Private concessionaires, chosen through a competitive tendering process, operate these central corridors. An extensive network of feeder routes, also operated by private concessionaires, complement these corridors.

To date, three exclusive corridors totaling 35 kilometers in length have been built. Also, 22 feeder routes are in operation with a total extension of 66,7 kilometers covering over 40 neighborhoods of Bogotá. Infrastructure investments during this first stage totaled US\$213 million. The plan is to build up the system—in a period of 15 years—to 22 central corridors (for a total extension of 388 kilometers) and with the capacity to transport 5 million people daily. The total cost of the reform is estimated to be US\$1,970 million.

Institutionally, the project is organized around a publicly owned company, Transmilenio S.A., that designs the network, writes the contracts later tendered to private operators and administers the system. It is responsible for tendering the operation of the

central corridors, the feeder routes and the ticketing and payments system. Tickets are based on a system of prepaid cards, also administered by a private concessionaire. The lanes, bus stops, terminals, pedestrian bridges and transfer stations were built and owned by the public sector.

Among the most salient features of the TransMilenio project are a network design with bus enclosed stops every 800 meters, with pedestrian bridges and other services. Modern vehicles especially designed for passenger service were introduced through the conditions stipulated in operators' contracts. There are now 411 large articulated buses with automatic transmission systems, wheel suspension and modern natural gas or diesel motors operating in the central corridors, in addition to 147 standard buses on the feeder routes. A dual system of regular services (buses that alight at every stop with a frequency of 3 minutes) and express services (stopping only at a subset of destinations and with a frequency of 4 minutes) was introduced. Schedules and routes are monitored by an electronic surveillance system based on a Satellite Positioning System and controlled by a specially created traffic control agency.

Perhaps one of the most important changes introduced through the reform was the compensation regime for operators. Operators are now paid according to the number of kilometers traveled and the quality of service. This facilitated a radical change in driver's incentives; they are now under contract, work regular shifts and are not paid a bonus for passenger transported. The separation of the operation of buses and the collection of revenues was made possible by the introduction of the pre-paid ticketing system operated by the special revenue collection company. This eliminated overnight the 'war of the cents' radically improving traffic safety and quality of service. The electronic prepaid card system allows for tariff integration throughout the network

In 2001, after one year of operation, the evaluation of the experience has been very positive. Average velocity in the main corridors rose from 12 Km/h and 18 Km/h (Calle 80 and Avenida Caracas, respectively) to 26,7 Km/h after the project was in operation. As a consequence, average travel times fell by 32%, equivalent to a one hour saving daily for the average passenger.

Safety and service quality have improved dramatically. Figure 1 shows the number of accidents, injuries and fatalities on the roads corresponding to the TransMilenio network in 1999—before the reform—and in 2001 after one year in operation. A significant reduction in the number of accidents, people injured or killed and assaults can be noted.

**Figure 1: Weekly traffic accidents, injuries, mortality and assaults in the central bus network in Bogotá, Colombia**

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Pollution levels have also dropped since the new system came into operation. Sulfur dioxide, SO<sub>2</sub>, average daily concentration levels dropped by 43% between January and March 2000 with the same months in 2001. Maximum daily concentration levels dropped by 54% (January) and 39% (March) comparing both years. Nitrogen Dioxide, NO<sub>2</sub>, average daily concentrations dropped by 13% (January) and 41% (March) , while maximum daily concentrations fell by 10% and 46%, respectively. For particular matter smaller than 10 microns, the corresponding fall in average daily concentration levels was 31% (January) and 17% (March) and 16% and 13% in peak daily concentrations. Although its possible that other phenomenon (particularly climate differences) may account for these measured

improvements, it is likely that the introduction of the TransMilenio plan was also responsible.

As for the funding side of the reform, tariffs increased only 6% and most of the infrastructure investment was funded through petrol taxes, multilateral loans and other domestic sources. It must also be pointed out that the TransMilenio system currently accounts for only around 15% of bus trips in Bogotá. The vast majority of bus trips are still undertaken in the chaotic bus system outside TransMilenio's network.

## **6. Conclusions**

The paper has shown the importance of correcting the “developed economy bias” typically found in the literature on urban transport.<sup>45</sup> The problems are indeed different in the two country groups. Direct competition in urban bus markets is rare in the developed world. The share of people using public transport, particularly buses, in urban areas, decreases with development—according to UN-habitat, 40.19% of the trips to work are done by bus in the lowest income countries vs. only 18.15% in OECD countries. Finally, the ranking of the main policy issues relating to investment, network coverage and affordability of tariffs and other social considerations tend to vary different between developing and developed economies.

Considering these differences, the paper shows that under an emerging new hybrid model, the public authorities should consider more systematically a clear role in the determination of the network structure, service quality and frequencies, and force a separation between revenue collection and operating activities. However, unlike the traditional regulatory model, it is important for this emerging new model to continue

recognizing the importance of efficiency concerns and of the role that private operators and modern regulatory instruments can have in meeting this objective.

Although this hybrid scheme is a way to combine the benefits of a public monopoly with the benefits of increased competition allowed by private provision, there are several risks and prerequisites in developing such a transport system. First, the scheme requires the planning authority to be capable of defining the network configuration and service levels adequately. Otherwise, shortages may appear and the supply of transport services will not be able to meet demand levels or expected quality characteristics. Therefore, some institutional capacity is required to define these variables. In addition, it is important to leave some flexibility mechanism in place in order to change route design, or other service quality levels, after a particular contract has been awarded to a private operator. The required institutional capacity should also include the ability to manage the tendering system and monitor the contracts afterwards.

Second, by restricting entry into the market, direct competition is loosened. Thus, companies—although private—may not have sufficient incentives to increase productivity and control costs. The tendering of contracts avoids the problem. Tendering is in general to be preferred to negotiated contracts in this case both in terms of efficiency and equity outcomes. Additional safeguards can be provided through several regulatory instruments, including yardstick competition and offering a menu of contracts to potential operators.

It is important to conclude by warning that reformers should never discount the risks of regulatory failure as a limitation to this hybrid model. If the middle road is not feasible, which of the two extreme cases (public monopoly or unregulated private provision) should be preferred? This will probably depend on a case-by-case basis, but the experience outside

London and in Santiago, would tend to indicate that a competitive market is probably better for users. Insufficient institutional capacity implies that the efficient operation of a public monopoly will probably not be feasible either. For small urban areas where there are not many economies of density and services are not complex, the competitive model may however, require the introduction of selective public subsidies for the operation of unprofitable routes to maintain tariffs at levels consistent with the ability to pay of its users.



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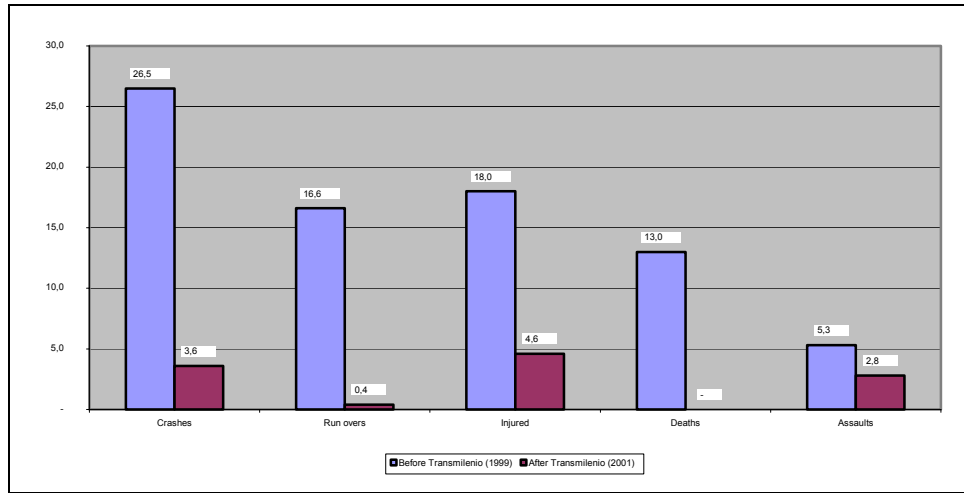
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**Figure 1: Weekly traffic accidents, injuries, mortality and assaults in the central bus network in Bogotá, Colombia**



*Source: Hidalgo (2001)*

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<sup>1</sup> See for instance, Gomez-Ibanez and Meyer (1997)NERA and TIS.PT (2001).

<sup>2</sup> Although public transport in an urban area is also serviced by metro and light rail, it seems to be fair to argue that the most pressing regulatory issues are related to bus services, at least in developing countries.

<sup>3</sup> See Gwilliam, Nash and Mackie (1985a; 1985b). Gómez-Ibañez and Meyer (1997), although not refuting the above consensus, argue that the empirical case against deregulation is not so strong.

<sup>4</sup> Although environmental regulations in this sector are important they will not be discussed here.

<sup>5</sup> Urban transport sector policymakers face many of the problems common to public utility regulation in general. Perhaps the only factor which makes urban transport regulation comparatively easier is the possibility of organizing competition for routes and the existence of competition from other modes of transport such as private cars and rail. However, even this adds an additional complication to the regulation of this sector: the need to oversee potential anti trust issues.

<sup>6</sup> Cruz (2002). Taxi buses were smaller buses of 20 to 30 seats compared to the larger 40 seat buses.

<sup>7</sup> The tariff increased from CH\$131 with a fleet of 5185 buses in 1979 to CH\$267 in 1990 with 12,698 buses in 1990. By 2001, after a few years of decline in tariff, it picked up to reach the tariff CH\$281 in 2001 with a fleet of 8,179. Note that until 1990, because tariffs were increasing, there were strong incentives to enter the sector in spite of the fact that low capacity utilization implied operating on a point high on the average cost curve. Therefore the true economic inference is that high prices induced excessive entry. However, once there was excess capacity in the sector it is curious that this did not induce price wars among operators. Possible reasons for this behavior will be discussed in the next section.

<sup>8</sup> Together with Mexico City, Santiago was the most polluted city in the region. In 1990, there were 95 days with particulate matter concentration levels above  $150 \mu\text{g}/\text{m}^3$ , 30 days above  $240 \mu\text{g}/\text{m}^3$ , and 6 days above  $330 \mu\text{g}/\text{m}^3$  (CONAMA, 1998). For reference, in the United States the norm for daily concentrations of PM10 is  $150 \mu\text{g}/\text{m}^3$ , the same as in Chile. Thus for more than one third of the year, Santiago's atmosphere did not meet national or international concentration norms in 1990.

<sup>9</sup> The authorities also directly retired close to 2,600 of the oldest buses in the system, paying close to US\$14 in compensation to bus owners (Cruz, 2002).

<sup>10</sup> The passenger data is from the origin destiny surveys undertaken by the government in 1991 and 2001.

<sup>11</sup> Between 1990 and 1998, there was a total of 103 fatalities due to bus accidents. The highest year was 23, the lowest 2. For more details see Australian Transport Safety Bureau (2001)

<sup>12</sup> This interest group has used the threat of strikes repeatedly. The last strike, which drove Santiago to a standstill, occurred in August 2002. However, the event helped to show the importance of this sector as a source of air pollution. Particulate Matter concentration levels dropped by half that day compared to a day with similar atmospheric conditions (Garreud and Aceituno, 2002).

<sup>13</sup> From a political economy perspective it may be easier to follow the example of London Transport, where routes previously operated by a public company were tendered without the intermediate liberalization experience. The main lobby in this case was the bus workers associations.

<sup>14</sup> While we picked Santiago de Chile to illustrate the point, we could have picked any medium to large city in the developing world since the evolution of the organization of the sector during the last third of the 20<sup>th</sup> century seems to have followed a very similar pattern across countries.

<sup>15</sup> Sometimes this sector is responsible for creating these externalities, at other times it is part of the solution to the externalities created by other modes of transport such as private cars (e.g. in developed countries).

<sup>16</sup> See the discussion by Gomez-Ibanez (2003) around a Sri Lanka case study.

<sup>17</sup> Bicycles may be an exception.

<sup>18</sup> In this case of a 'thick' demand for public transport, Klein, Moore y Reja (1997) recognize that the lack of curb rights may not be a problem.

<sup>19</sup> Although bus routes in Santiago are tendered and operators have exclusive rights over their routes, there is considerable overlapping of services in an extensive area of the city. Thus, buses do compete for passengers at the curb. However, the demand in these areas can be characterized as thick and thus the dwindling demand problem from lack of investment in scheduled services does not arise.

<sup>20</sup> In 2002 the industry successfully lobbied for a change in the regulations that forced new buses to have automatic gears.

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- <sup>21</sup> Another motivation for preferring manual gears may be that they consume less fuel. However, we do not have any evidence for either hypothesis.
- <sup>22</sup> See Fernandez and De Cea (1990) for a rigorous derivation of the demand curve faced by a bus.
- <sup>23</sup> Diaz, Gómez-Lobo and Velasco (2003) have estimated that, in spite of the competitive tendering process, in Santiago tariffs are still high and generate rents of the order of US\$ 16 million annually.
- <sup>24</sup> Klein, Moore and Reja (1997), page 68.
- <sup>25</sup> This argument is related to Schmalensee (1978). There has to be a cost to change schedules.
- <sup>26</sup> UN Centre for Human Development (2001), “Cities in a Globalizing World”
- <sup>27</sup> The rest include walking, bicycle and others.
- <sup>28</sup> This is not to deny that private cars are also important sources of congestion in cities of the developing world, just that their relative influence is probably smaller than in developed countries.
- <sup>29</sup> In fact, there is one experience in company in Santiago that started paying drivers a fixed wage. Revenue for this company dropped by 40%, thus ending the experience.
- <sup>30</sup> One popular way that this is done is that some passengers return the ticket to the driver before getting off the bus, giving the driver the opportunity to reutilize the ticket and thus keep the extra fare without the risk of being caught by an inspector. Straight fraud is also common. Some passengers ask the bus driver if they will take them for less than the fare. The driver keeps the money and does not give a ticket to the passenger. Clearly, this last strategy is only possible due to the scarcity of inspectors or the low level of penalties.
- <sup>31</sup> Data provided by the Ministry of Public Works, Transport and Telecommunications. Liability issues may also be responsible for this structure. In Chile bus owners are legally liable only up to the value of their property. This generates incentives to atomize the property of buses. It is common for an entrepreneur to formally spread ownership of his buses among family members.
- <sup>32</sup> See, for example, Brueckner and Spiller (1994)
- <sup>33</sup> Vivanco (2002), Sectra (2002).
- <sup>34</sup> Transport engineers have developed sophisticated models to find the optimal system configuration.
- <sup>35</sup> In many countries with informal or small family oriented bus firms, operators do not have access to credit and usually require daily revenues to pay drivers, fuel and other expenses. Decoupling revenue from passengers will by itself remove one of the obstacles to firm growth—the owners monitoring of drivers.
- <sup>36</sup> For a summary of the relevant literature on the drivers of performance see De Borger and Kerstens (1999).
- <sup>37</sup> Another sector where tendering is common is garbage collection.
- <sup>38</sup> For more cases see NERA and TIS.PT (2001).
- <sup>39</sup> This seems to have been the case in the tendering of contracts in Santiago in 1998, where there was only one bidder for 76% of route contracts and 97% of bids coincided with the maximum allowed tariff according to the bidding documents (Sanhueza and Castro, 1999).
- <sup>40</sup> Different researchers have tried to analyze the impact of the yardstick regulatory contract in Norway. See for example, Jorgensen, Pedersen and Volden (1997) and Dalen and Gómez-Lobo (2002a). They all find a positive impact of the yardstick contract on firm performance. However, the effect is surprisingly small (around 2-3% of operating costs) and may not even be significant (see Dalen and Gómez-Lobo (2002b).
- <sup>41</sup> For an overview of the theory, see Laffont and Tirole (1993).
- <sup>42</sup> The only documented experiences in this respect seem to be the in the US telecommunications market, where both state and federal regulators have offered choices of regulatory contracts to firms.
- <sup>43</sup> This was the idea used by Wolak (1994) in his study of the California water supply sector. He estimated two models econometrically, one assuming the regulator offered the companies an optimal menu of regulatory contracts and another where the regulator observes the efficiency parameter of firms. His statistical tests show that the first model is more consistent with the data, implying that the regulator is effectively screening companies according to the theory presented above.
- <sup>44</sup> The sources for this case study are [www.idu.gov.co](http://www.idu.gov.co), [www.transmilenio.gov.co](http://www.transmilenio.gov.co) and Hidalgo (2001).
- <sup>45</sup> For a good compilation of the literature see Oum et-al. (1997).