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THE UPS AND DOWNS OF A PUBLIC TRANSPORT REFORM: THE CASE OF TRANSANTIAGO

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The ups and downs of a public transport reform: the case of Transantiago

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Abstract

In Santiago, the capitol of Chile, an ambitious reform of the public transport industry, aptly named Transantiago, was introduced in February 2007. Serious design and implementation problems were immediately evident, creating one of the most important social and political crises in Chile since the return to democracy more than 20 years ago. In this paper we review the Transantiago experience, identifying the main design, institutional, contractual and implementation mistakes associated with the reform and the painful consequences that these failures generated among the population. We also review the policies that were implemented to address these problems and that enabled the system to provide a reasonably satisfactory service by late 2009. We believe that documenting and reviewing the Transantiago experience is important for policymakers so that analogous mistakes are not made in other transport reforms in developing countries. This may be particularly relevant now that several countries are considering or implementing reforms similar to Transantiago, for example the SITP in Bogotá, Colombia.

Keywords: transit, transportation systems, transportation planning, Latin America,

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1. Introduction

The final stage of an ambitious reform of the public transport system, Transantiago (or TS from now on), was introduced in Santiago, Chile, in February 2007. This reform completely changed overnight the route structure, the fare payment method, the contractual relation with operators as well as many other dimensions of the city's public transport system. The results were immediate and catastrophic.

After the reform was implemented on February 10th, 2007, a date known as the 'Big Bang' —due to the complete overhaul of the old system from one day to the other—, it was clear that public transport supply was insufficient for a city where almost 56% of motorized trips used public transport.[1] Waiting times and total travel times increased substantially, congestion was notorious at bus stops, inside buses and in the metro system, and users were forced to make costly and unpopular transfers between transport modes and vehicles in order to complete their trips. Furthermore, the promised technological improvements (such as the fleet management system and electronic payment cards) were not fully operational when the new system was introduced in February 2007.

The consequence of the above problems was a social and political upheaval not seen in the country since the return of democracy almost 20 years earlier. This crisis was epitomized by spontaneous riots at bus stops, culminating in a major riot on May 14th, 2007, when in addition to the shortcomings of the bus system, the main metro line had to be shut down due to operational problems. As was to be expected the political support for the government plummeted. The national approval rating of the President (Michell Bachelet) fell from 54% in December 2006 to 35% in

[1] See Table 1 below. This figure includes all trips where at least one segment was undertaken in a bus or metro.

September 2007.[2] These figures probably mask an even sharper decrease in Santiago compared to the national average.

In this paper we review the TS experience, identifying the main mistakes that were made in the general design, contractual framework and implementation of this policy, and the painful consequences these mistakes generated among the population. It is argued that many of the design problems were caused by insufficient attention to the impacts of the reform on the generalized cost of travel in public transport. These design problems were compounded by operational problems due to faulty concession contracts and an inadequate regulatory and institutional framework for such a reform.

With the benefit of hindsight, our most general conclusion is that the original reform, as initially conceived, did not offer any benefits to users except perhaps in the reduction of negative externalities. Another important general lesson of the Transantiago experience is that a sweeping reform of such a critical public service at one stroke (the "big bang" approach) is too risky and a more piecemeal and gradual approach is recommended.

In this paper we also review the policies that were implemented to address the problems encountered so the system could provide a reasonably satisfactory service by late 2009. A brief comparison with other transport reforms in the region, particularly the successful reform called Transmilenio in Bogota, Colombia, is also presented in order to identify the main differences between these experiences that may explain their divergent results.

[2] Adimark-GfK, Evaluación del Gobierno, Diciembre 2009.

Finally we present an evaluation of the system as it stood in early 2010 describing its achievements, particularly in reducing the negative externalities attributable to the public transport system, and a brief epilogue of events since 2010 to date and a discussion of the remaining challenges faced by the system.

We believe that documenting and reviewing the TS experience is important for policymakers so that analogous mistakes are not made in other transport reforms in developing countries. This may be particularly relevant now that several countries are considering reforms similar to TS. For example, in Bogotá, Colombia, a full scale reform of the public transport system (outside of Transmilenio) was being planned. This reform, called Integrated Public Transport System (SITP), has many elements similar to TS, although there are notable differences.

This paper is organized as follows. First, we present a brief description of the public transport system prior to TS and the motivations for reform. We then describe the initial design and implementation of TS. This is followed by a description of the main mistakes or problems in the design, contractual framework and policy implementation of the reform. This discussion is organized around the generalized cost of travel (GCT) of using public transport and how the reform was expected to impact the different components of this cost. We conclude that the original design most probably increased this cost for most users. We then describe the measures that were taken to lower the GCT and make the public transport system provide a reasonable service. Subsequently we take stock of the system as it stood in early 2010. We provide evidence to conclude that the reform had a positive impact on externalities generated by the public transport system. The paper concludes with a brief summary of events to date, a discussion of the remaining challenges of the system and the major lessons learned from the painful TS experience.

2. The public transport system before Transantiago

Like most cities of the developing world, the bus system in Santiago before 2007 was characterizes by informal operators, the absence of fare integration, low quality buses and competition for passengers in the streets.[3] Since 1991, when a tendered franchise system was introduced in this industry, there had been some successes in reducing fares, the number of buses, and improving the quality of the fleet. However, by the late nineties there was a growing consensus that the system required major reform.

Among the most important problems was the low quality of buses despite the fleet modernization achieved since 1991. Old buses with diesel motors generated significant amounts of air and noise pollution. In a city heavily polluted by particulate matter, buses accounted for 22% of anthropogenic emissions.[4]

The fleet also seemed to be over dimensioned, with 8.000 buses plying the streets for passenger often with very few users during off-peak hours. Since there was no fare integration, routes were very long and services tended to offer passengers point to point services throughout the city. Thus there was a proliferation of services going from each part of the city

[3] A historical summary of the development of Santiago's public transport system, including the entry and fare liberalization experience of the 80's, can be found in Estache and Gómez-Lobo (2005).

[4] CONAMA (2006). Prior to 2001, average yearly concentration of PM10 (Particulate Matter equal to or smaller than 10 micrograms) in Santiago was over 100 mg per square meter, above the legal limit of 80 mg and much higher than standards in the developed world. Pollution levels were reduced during the last decade but average yearly concentrations have remained above or close to 80 mg. Further below we discuss the impact of Transantiago on PM10 pollution.

to each other part of the city, but overlapping in the high demand area of central Santiago and thus creating important congestion problems.[5]

Another major problem was the traffic chaos and accident risk generated by buses competing in the streets for passengers. As owners' income depended directly on fares collected, they gave drivers — through informal contracts— important incentives to cater for passengers.[6] As discussed in Gómez-Lobo (2007a), in a competitive environment buses in urban transport will often compete in frequency rather than through lower fares. This seemed to have happened in Santiago, with drivers competing aggressively to arrive first at a curb with passengers, block other buses and undertake other actions to physically compete in the streets. The result was a high accident rate, with over 6.000 accidents and 120 deaths a year involving buses.[7]

Further reform of the system was hampered by the atomization and informality of the industry. Although there were formal concessions for routes, these were owned usually by the largest operators or leaders of the bus operators association, who then affiliated small scale operators to provide the transport services. On average there were 2.1 buses per owner. Drivers were paid the minimum wage plus an informal payment related to the fare income of each bus and worked up to 15 or 16 hours per day. This industrial structure, with many informal or small scale firms without access to formal capital markets impeded more radical reform to modernize the fleet, introduce state of the art technology (GPS, fleet management systems) and more modern management techniques.[8]

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[5] According to Malbran (2001), 80% of the more than 300 services of Santiago's bus system passed through one of the six main arteries in the city.

[6] It was estimated that close to 2/3 of drivers' income depended on the number of passengers transported.

[7] These figures implied that on average each bus in Santiago had an accident every 16 months and one person died every three days in an accident involving a bus. The figures come from the National Commission for Traffic Safety (Conaset).

[8] Operators were taxed according to "presumed income" (a percentage of the fiscal value of buses) and so did not even keep accurate financial accounts.

In spite of these problems, the public bus system had many advantages. The city's coverage was excellent with a plethora of services offering point to point services for the majority of users. According to the 2006 Origin-Destiny Survey (see Table 1 below) less than 10% of users in the public transport system (excluding taxis) had to transfer to another bus or mode to complete their trip. Although the resulting overlap of services created congestion problems it also increased the services available to user's who made trips in the central part of the city (trips that did not originate or terminate in the outskirts). Thus, the effective frequency of buses in many parts of the network was quite high reducing waiting times for many passengers. A demand study undertaken in 1997 showed that waiting times were less than four minutes on average (MOPTT, 1997).

Besides buses, Santiago also had a modern and efficient metro system. In 2000 the metro had an extension of 40.4 kilometers and 52 stations but it was growing rapidly. By 2006 it had an extension of close to 85 kilometers and the construction of new lines and extensions would increase this to over 100 kilometers by the end of 2010. However, buses and metro were not integrated and thus most public transport users, particularly poorer ones, preferred to use a bus that offered point to point service for one fare, in spite of the longer travel times, rather than pay several fares in a trip that combined the use of metro with other modes. As shown below only about 22% of public transport trips used the metro. A study by Gómez-Lobo (2007b) indicates that the Santiago metro was underutilized, carrying less than half of the passengers per kilometer of similarly sized metros, such as the Sao Paulo or the Hong Kong systems.

Finally Table 1 presents the modal split of motorized trips in a normal working day in 2006, just prior to the introduction of TS. It can be seen that trips that used buses represented close to 46% of motorized trips, while those that used the metro in some segment of the trip was 10%.

Thus, the use of metro represented a small fraction, 22%, of all public transport demand. From Table 1 it can also be seen that the lack of fare integration generated a situation where users minimized mode transfers, with bus only or metro only trips representing the bulk of public transport use.

Table 1: Modal split of motorized trips, normal working day 2006

Mode o combination of modes	Number of trips	Percentage of total
Private (car or motorcycle)	3.664.221	36%
Bus only	3.962.023	38%
Bus – Bus combination	239.176	2%
Bus – Metro	203.119	2%
Bus – Other mode	613.065	6%
Metro only	625.811	6%
Metro – Other mode	201.017	2%
Taxi (shared and private)	645.100	6%
Other modes	164.495	2%
Total	**10.318.027**	**100%**

Source: Own calculations based on the 2006 Origin-Destiny Survey (Sectra, 2006).

3. The success of public transport reforms in other countries

Another element which must be taken into account is that when TS was being planned, the successful experience of Transmilenio (TM) in Bogotá, Colombia, was becoming known around the region. TM is a Bus Rapid Transit (BRT) system introduced in the year 2000 consisting of segregated bus lanes, with off-board payment, high quality boarding and alighting stations and high capacity buses; some have called it an "over ground metro". This reform — inspired on the pioneering experience of Curitiba, Brazil— was an operational success and immediately popular among citizens of Colombia's capital.[9] As a result, BRT projects have been

[9] For a description of the original TM project see Hidalgo (2001). A more recent critical review can be found in Gilbert (2008).

replicated all over the world, including reforms in Mexico City, Guayaquil (Ecuador), and several cities in China and Turkey, among others.[10]

Key to the success of TM was the investment on infrastructure such as high quality stations and segregated bus lanes, which reduced overall travel times and made this public transport mode attractive to users. Initially, only two trunk routes were opened but the network has been gradually extended to encompass 84 kilometers of trunk routes a decade later and is still growing. This gradual approach was another key aspect of the reform that, as will be discussed below, Chilean planners did not fully appreciate. Currently, close to 30% of public transport users in Bogota use TM.

The TM experience, and Curitiba before that, generated a sense of optimism among transport planners that public transport reform was feasible and would produce immediate benefits to users. However, TS was much more ambitious than TM. Having already a good Metro system, planners in Chile wanted to change the whole public transport system overnight, not just create a few "over-ground" metro lines in the form of BRT corridors as in Bogotá. As will be discussed below, with hindsight this decision was most probably unwise. However, it is interesting to note that in Bogota, close to 70% of users do not use TM. Rather they use the old chaotic bus system similar —or even worse— than the public transport in Santiago before TS. As such, the authorities in Bogota have recently embarked in a new public transport reform to change the rest of the system. As will be discussed in the conclusions, this new reform (Integrated Public Transport System, SITP) which was

[10] A brief recount and comparison of these experiences can be found in Hidalgo, Carrigan and Cooper (2010).

expected to be operational by the end of 2011, has many similarities but also notable differences with TS.[11]

4. TS: the original design

In this section we describe the design of Transantiago as originally conceived.

4.1 General description

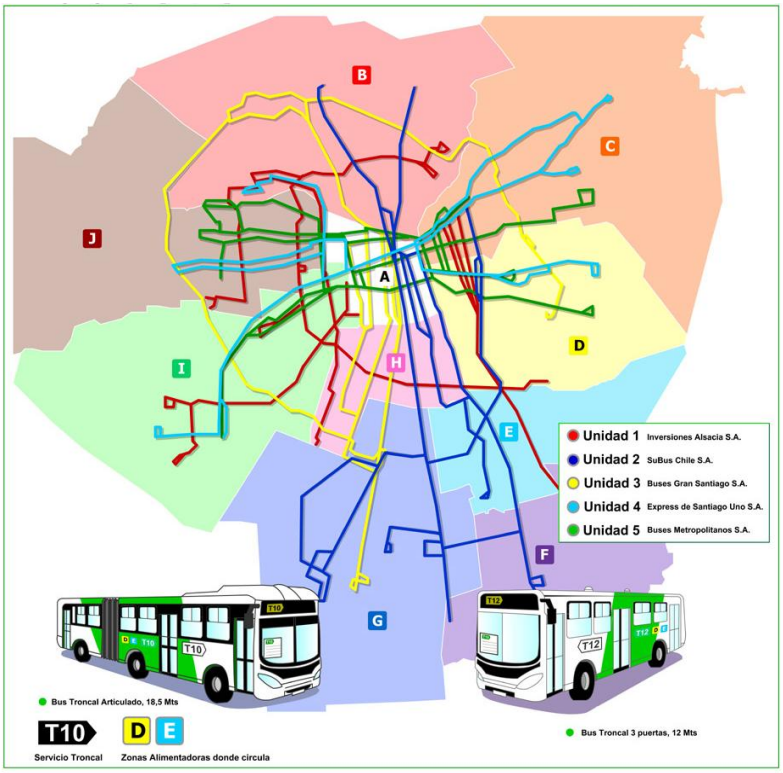
One of the most important characteristics of the new system was the transformation of the route network from the point to point, non-integrated and overlapping route scheme of the old system to an integrated trunk and feeder system. The city was divided into 10 zones, —where local and feeder services would operate under a franchise arrangement in each one— plus 5 trunk operators that would provide longer services that crossed the city. Figure 1 shows the general design adopted. The colored lines indicate trunk services while the colored areas are the ten local and feeder zones.[12] In addition, the metro was to be integrated into the system, providing one of the most important ("backbone") trunk services of the new system.

It is important to mention that contracts guaranteed exclusivity of service for each operator. That is, the local feeder services of one area could not cross into other zones, nor could they penetrate more than 800 meters (or up to two contiguous stops) into roads were trunk services operated.[13] In turn, trunk operators were only authorized to operate in

[11] This reform however has been stalled by the judicial problems faced by Bogota´s mayor promoting this initiative.
[12] After the tendering process of 2004 only 9 concession contracts were finally signed for the feeder zones since there were no operators interested in the central local area services (Zone A).
[13] Section 4.1.4.1 of the original tendering document for feeder services.

the network assigned to each concessionaire. Therefore, route overlap in the network was minimal and even when it occurred the overlapping services were usually operated by the same concessionaire to avoid competition in the streets.

Figure 1: Map of the original TS network



In order to integrate fares among different services and modes an electronic payment card was introduced.[14] Users would need to pre-charge the card before boarding a bus or metro. This system allowed different fares to be charged on different segments of a trip.

For fare integration to work, revenues must accrue to a centralized agency that then distributes this income among operators according to the terms of their respective contracts. To this end, the Transantiago Financial Administrator (AFT) was created. The concession to operate this

[14] In the old system, passengers paid the driver with cash. In the metro a paper ticket system was used with users usually buying a one ride ticket or 10 tickets at a discount.

institution was tendered to a consortium of Banks and a technological firm in 2005. The AFT is responsible for administrating the electronic payment system, collecting all revenue from users and paying operators according to the terms of their contract. The AFT was also responsible for providing and maintaining the technological elements of the fleet, such as the payment card readers, the fleet management system, including GPS, emergency equipment (video cameras and panic button) and passenger counting equipment.

Another institution, called SIAUT, was designed to provide customer information, including route maps and a web page application to help users plan their trips.[15]

To curb air pollution emissions and noise, as well as to offer users the benefits of modern low floor buses, the fleet would be renovated.[16] New buses had to meet Euro III or IV standards and some were to be equipped with ramps and equipment to cater to physically handicapped users in wheelchairs who could not use buses in the old system. However, to keep costs down and to allow existing operators to participate in the new system, only a fraction of buses had to meet the new TS standards. In fact, only 58% of the total fleet met these standards in February 2007. In addition, to reduce costs even further, a large fraction of the new fleet was designed to be high capacity (160 passengers) articulated buses.[17]

4.2 Fares and subsidies

[15] This contract was tendered in 2006.
[16] The existing fleet was composed of high floor buses that required climbing several steps when boarding. However, once inside, the floor was level and there was ample seating capacity (80 seats).
[17] Due to economies of scale and lower labor requirements per passenger, for a given capacity operating costs are lower the higher the fraction of articulated buses in the new fleet.

The original design did not consider the introduction of public subsidies. This meant that the fleet renovation, the new technology (fleet management and electronic payment system), and the formalization of labor relations of drivers —all of which implied higher costs compared to the old system— had to be funded through fares. Although there were inefficiencies in the old system that if eliminated could help to fund the reform (Díaz, Gómez-Lobo and Velasco, 2004), it was obvious that the average fare would have to increase if the new system was to be self funding.

The original tariff design considered an initial payment for the first leg of a trip and a marginal surcharge when the user changed to another service or mode. The fare for one adult trip in the old system was CLP 380 (about 80 cents per US dollar at the current exchange rate) in February 2007. However, since a fraction of users used a combination of modes to complete their trip and metro fares during peak hours was CLP 460, the average adult fare was about 12% higher than the one trip adult bus fare.[18] Thus in the new integrated system, even if fares were set equal to the average fare of the old system, most public transport users —who only used one bus to complete their trip— would face a tariff increase of 12% while a minority of passengers —those who used more than one mode or took several buses to complete their trip— would benefit from a fare decrease under the new system.

The absence of subsidies and the need for fares to be similar to the average fare of the old system forced planners to reduce the costs of the new system through other means. In particular, the required size of the fleet was reduced to 4.500 buses (from 8.000 before the reform) and, as mentioned above, a large fraction of new buses were required to be

[18] Students paid only 33% of the adult fare both in buses and the metro.

articulated high capacity buses.[19] As will be discussed below, this situation was the root cause of many of the problems of the reform.

4.3 Contracts, risk-sharing and incentives

Operators would be paid according to the conditions established in their contract. The key variable that determined the bi-monthly payment to operators was the PPT (Payment per Passenger Transported) and was the key bidding variable in the competitive tendering process held in 2004.

Although actual payment would be the result of multiplying the PPT by the number of passengers transported every two weeks, a complex mechanism was introduced to reduce the demand risk faced by operators. The result was that payment to operators would be based on a fixed pre-established demand estimation (called the "reference demand" and included as an Annex to each contract). Operators faced negligible demand risks amounting to 10% of the *deviation* between the reference demand and effective demand.[20] There were also other mechanisms in the contract to protect the cash flow of operators, particularly those that would be making investments in new buses. Although these mechanisms were meant to lower financial risks and thus enable operators to obtain funding for fleet renovation, they blunted incentives to cater to demand.

An operational plan would be established every three months determining the services and frequency that each operator had to meet each period of the day. Income did not depend directly on compliance

[19] As shown theoretically by Jara Díaz and Gschwender (2008) when planners face a binding financial constraint, they optimally reduce the fleet size and increase bus size of a public transport system. However, from a social welfare perspective these adjustments are inefficient.

[20] Thus, if demand fell 10% below the reference demand for a given month, the payment formula would compensate operators by 9% and they would only loose 1% of projected income.

with the operational plan but rather on penalties defined in the contract (a "sticks" rather than "carrots" approach to regulation). For example, a fine of 200 UF was established for each time the effective frequency of a service was below 60% of that required by the operational plan.[21] A long list of fines for different infringements was defined in the contracts. However, if an operator accumulated more than 6.000 UF of fines in a twelve month period, the authorities were *obligated* to terminate the concession contract.

Contracts also stipulated that drivers had to have formal labor contracts and could not be paid according to passengers transported. This was introduced to curb driver's incentives to compete for passengers in the streets, a situation that created traffic chaos and safety hazards in the old system. The downside is that it also eliminated all incentives for drivers to control non-payment and cater to demand.

4.4 Infrastructure

Another element of the reform was the design of a complete network (225 kilometers) of segregated bus corridors. By separating bus traffic from private automobile traffic the average speed of buses would increase, reducing travel times and making public transport more attractive to users. However, unlike the experiences of Bogota (Transmilenio) and Curitiba, the plan had a horizon of 20 years for its completion and when Transantiago was introduced there were only 13.4 kilometers of exclusive bus corridors operational. Another 11 kilometers were under construction but would not be operational for several months after February 2007. There were also 11 kilometers of bus lanes, inadequately separated from general traffic, and 8 kilometers of roads

[21] The UF is an indexed monetary unit commonly used in contracts in Chile in order to avoid the effects of inflation. It rises daily according to the variation of the consumer price index the month before. In February 2012 one UF was worth approximately US$ 46.

that could only be used by public transport during peak hours. For the most part then, trunk and feeder services would have share the road infrastructure with private traffic.

As part of the reform shelters were also built at bus stops. The old system did not have shelters as buses stopped anywhere a passenger flagged a service. Exchange stations between metro and buses were planned but a subsequent decision to extend certain metro lines meant that only one station was built (La Cisterna, in southern Santiago) and was not in operation on February 2007.

In general then, the reform did not contemplate an important infrastructure development plan, at least during the initial years of the reform. This was a mistake, as will be discussed below, and is one of the main differences between Transantiago and more successful experiences such as Transmilenio in Bogota.

4.5 Institutional and regulatory aspects

Finally, from a public policy perspective, it is important to note that the regulatory framework for the reform was all contract based. For political expediency —and in contrast to the successful private concession infrastructure program in Chile launched during the 90's— there was no law passed to give a stronger legal and regulatory basis to the TS reform. This implied that subsidies —which required congressional approval— could not be introduced. Another implication was that the State was not allowed to undertake transport activities directly.[22] Unlike most cities in developed countries, no Metropolitan Transit Authority was created to regulate and coordinate transport activities in Santiago.

[22] In Chile, the Constitution forbids the State to undertake productive or economic activities without a specific law authorizing such activities. Thus, the operation of public owned companies, for example, needs to be approved by a specific law.

5. The "Big Bang"

After several postponements, the reform in its full form was finally implemented on February 10th 2007.[23] The route network was changed overnight, fare integration was introduced and the new fleet requirements and payment mechanisms for each concessionaire came into operation. The new electronic card payment system was yet untested and delays in the deployment of all the technological elements required for its operation meant that the system could not be used on February 10th. For one week the system was free for users. In addition, the recognition that the reform was going to be problematic forced the authorities to change the fare structure. The adult fare for all trips was fixed at $380, the price at the time for a one trip adult bus ticket in the old system. Transfers were not charged, except for a $40 surcharge for transfer to the Metro during peak hours. Thus, the system began operation with a fare level 12% below the average fare of the old system.[24]

Problems arose immediately and there was considerable chaos in the city. Although the electronic pre-payment card was operational a week after the 'big bang' —and it became one of the only features of the new system that from its inception was highly valued by the public— there was a scarcity of charging points and 75% of users charged the card at metro stations. Once in the underground to charge the card it was convenient for users to use this transport mode instead of returning to the

[23] Prior to this date there was a one ramp-up stage which began in October 2005 whereby the new operators took over the operation of the old system. However, the old route network was not modified during this stage, payment was still made with cash on the bus and fares were not integrated. The only discernible change during this period was the introduction of new buses in three of the five trunk concessions.

[24] As discussed above, in the old system a fraction of travelers in the public transport system transferred to Metro or between buses paying the full fare so that the average income of the system was around 12% higher than the one-trip adult bus fare level.

street to catch a bus. In addition, the effective price of transferring to the metro was reduced drastically with the reform. The $40 surcharge during peak hours was much lower than the $460 a user had to pay previously when there was no fare integration.[25] Furthermore, the scarcity and unreliability of buses, for reasons that will be discussed below, further increased the attractiveness of the metro system. As a result, this mode passed from carrying on average 1.2 million passengers per working day to 2.2 million passengers. Although some of this increase was probably efficient —owing to the underutilization of the metro prior to the reform— congestion during peak hours increased significantly and created discontent among users as well as safety concerns.

The fleet management system in February 2007 was clearly deficient. A significant portion of the fleet was not equipped with GPS. Even among those that had this technology, the authorities were unable to ascertain quickly and on-line where those buses were operating. Thus, enforcement of operational plans was minimal and depended exclusively on reports by inspectors in the streets.

During the first few months after February 10th it was not possible to determine how many buses was operating nor their frequency or regularity. However, one thing was certain: supply was insufficient to cover demand. Bus stops were overcrowded, passengers fought their way into available buses, waiting and travel times increased and there was a generalized dissatisfaction —to put it mildly— with the new system. The lack of buses in the street can be attributed to several factors.

First, the theoretical fleet size was too small. As mentioned above, in order for the system to be self-funding, planners reduced the fleet from 8.000 buses before the reform to 4.500 (in equivalent units) in the new

[25] In off-peak hours the transfer price to the metro was zero while in the old system users would have to pay $360, the off-peak metro fare.

contracts. In addition, many of the new buses were high capacity articulated buses, which implied that the effective number of buses was lower than 4.500, increasing the headway between buses for the same transport capacity and thus increasing waiting times.[26]

Second, operators had scant incentives to meet the operational plan. They only risked 10% of income and in the beginning not even this; the payment system based on passengers transported did not become operational until mid-year and during the first period payments were made based only on reference demand thereby making income totally independent of passengers transported.

Third, although there were penalties for non-compliance these were ill defined, relatively low in monetary terms and difficult to enforce given the lack of a monitoring technology.[27] Furthermore, as discussed above, the contracts had a limit of 6.000 UF in penalties during a 12 month period before the authorities were forced to terminate the contract. This was useless in practice as an incentive mechanism. This limit was quite low (around US$ 276.000 at current UF values) for an industry that in the aggregate has annual income of close to US$1,000 million). Moreover, it was unclear who would operate the services before a new concessionaire could be found. This transition could last months and would imply leaving users without services during that period. Thus, terminating the concession contract was not a viable option for the authorities once the new system was in operation and thus paradoxically this total fine limit restrained the authorities' capacity to pass fines and enforce the operational plan. It was a non credible threat that eventually worked in to the operator's benefit.

[26] The fleet size of 4,500 is a calculation based on the number of standard 12 meter (80 passengers) buses that would be equivalent to the capacity of the new fleet. Since a fraction of the new fleet was 160 capacity articulated buses, the number of vehicles was lower than 4,500.

[27] Note, for example, that according to the contracts an operator could provide just 60% of the required frequency and not risk being fined.

Thus, the system lacked the "carrot" incentives of a competitive system (whereby operators' income depends on passengers transported) and the "stick" incentives of penalties. Unsurprisingly, operators found it profitable to reduce costs by lowering supply since income was unaffected. Non-compliance with the operation plan was the norm during the first period of the reform.

A related problem was the lack of proper incentives for service regularity, that is, the equal spacing of buses along a route.[28] Thus, besides frequency or dispatch levels below those stipulated in the operational plan, lack of service regularity also contributed to the increased waiting times at bus stops.

The new feeder-trunk design implied that many users that previously had a point to point service now had to transfer between buses and metro or between different bus services. Due to the local area concessions, users sometimes had to make awkward transfers to go from their residence to a nearby hospital, for example, if the trip implied crossing two concession zones. It is well known that the value of value of transfers is much higher than in-vehicle travel time valuation.[29] Therefore unless the new system provided speedier travel times during some segments of the trip —which was not the case initially— the additional transfers increased the generalized cost of using public transport for many users, as will be discussed further below.

The planned infrastructure was also lacking at the start of the reform. Although bus stops had been installed, only 13.4 kilometers of dedicated bus corridors out of 225 kilometers of the master plan were operative on

[28] In contrast, in London, for example, payment to bus operators depends in part on excess waiting times, a measure that depends both on frequency and regularity of service.

[29] See VTPI (2011) for a comprehensive review of travel time costs in different countries and for different uses.

February 10th. Another 11 kilometers were under construction and would become operational in the following months. The Cisterna modal exchange station (buses-metro) was also under construction at the time of the big bang.

The absence of pre-boarding payment stations, the lack of financial incentives to cater for passengers on the part of operators and the difficulties in enforcing payment, meant that non-payment became a significant phenomenon in the new system. Non-payment in buses reached 20% in June 2007.[30]

For reasons already detailed above, the system began operation at an average fare below that of the old system. Non-payment and reduced demand from planned levels, lowered income still further. The result was a financial deficit that grew each month. Initially, this deficit was funded from a special fund created with the surplus payments from the tendering of operator's contracts in 2004. However, this fund was quickly exhausted and new resources had to be found in order to avoid (politically catastrophic) fare increases. The authorities expended a large amount of energy and "creativity" in funding this deficit during the following two years.

Finally, the institutional structure required to regulate, monitor and enforce contracts in the system was quite weak in February 2007. There was a special unit within the Ministry of Transport and Telecommunications (the Coordinación General de Transantiago, or CGT from now on) charged with these tasks. However, it initially lacked the financial and human resources to properly undertake these activities.

[30] Non-payment in the metro was close to zero due to the higher monitoring possibility in metro stations and the existence of guards near the entrance machines.

6. Generalized cost of travel and the expected outcome of the reform

In this section we evaluate the expected welfare impact of the original design and the early implementation of the reform as described above. This analysis follows some of the arguments presented by Doña and Morande (2007). We argue that the design of TS, as originally conceived, did not have much to offer to users and therefore the subsequent discontent and social unrest was predictable. This was probably so even in a hypothetical scenario where the implementation problems and the contractual errors did not exist.

To arrange our discussion, we first specify the utility individuals receive when undertaking their trip in mode *m*.[31] Let's assume this utility as the typical linear structure used in most random utility models of modal choice:

$$U_m = V_m - p_m - v_a \cdot t_{am} - v_w \cdot t_{wm} \cdot (1 + Tr_m) - v_{iv} \cdot t_{ivm} - Ext$$

Where,

U_m = utility of using mode *m*.
V_m = value of making the trip in mode *m*.
p_m = financial cost of using mode *m*.
v_a = value of access time.
t_{am} = average access time for mode *m*.
v_w = value of waiting time.
t_{wn} = average waiting time per segment in mode *m*.
Tr_m = number of transfers required to complete the trip in mode *m*.
V_{iv} = value of in-vehicle time.

[31] In what follows trips undertaken using several modes or services (e.g. bus-bus, taxi-metro, etc.) will be considered as a separate mode.

Ext = the value of externalities generated by the transport system.

Except for the last term, the above expression is fairly standard. The purpose of the variable *Ext* is to capture the valuation individuals may have for the external impacts caused by the transport system, such as air and noise pollution, and accidents, among others. Although each of these externalities may have a separate impact, we include a catch-all term for all of them.[32]

With the above expression, we can evaluate the impacts of Transantiago on the welfare of the average individual by analyzing the expected impact of the reform on each of these terms.

First, as a consequence of tariff integration, there was a price reduction for those passengers that prior to the reform used more than one service or mode to complete their trip. However, from Table 1 it can be noted that only 7% of all public transport trips used bus-bus or bus-metro combinations before the reform. Thus, only a minority of users benefited financially from fare integration. Most users would have perceived an increase in fares, had the original plan of charging the average fare of the old system prospered. In practice, with fares fixed at $380 when the reform was introduced, the vast majority of users were financially unaffected by the reform.[33]

Second, the lower network coverage of the new system meant that access times, t_{am}, increased for a fraction of users. In addition, waiting

[32] However, note that this term is not mode specific. That is, does not depend on the actual mode used to travel since a change in the level of pollution or accidents can affect the individual independently of how he travels.

[33] Nor were they hurt financially from the reform. If a user changed from public transport to a taxi then his expenditure on transport would most probably have increased. However, we are here analyzing the impact on the welfare of using public transport. If negative, this value would be a ceiling on the welfare impact on users, since some of them might have changed modes in order to lower these negative effects.

times increased due to the lower bus frequency and regularity. As discussed above this was due to the small fleet size, the introduction of high capacity articulated buses — increasing headway between buses for the same supply capacity—, and the contract design problems that generated low incentives for operators to actually comply with the operational plan.

Waiting times, t_{wm}, also increased due to the fact that in the new feeder-trunk system, 70% of users had to make at least one transfer (either to the metro or to another bus) in order to complete their trip. Thus, for a majority of users increased Tr_m for public transport increased from 0 to 1, 2 or even 3, compounding the extra costs due to the increased waiting times at bus stops.[34]

As is well known, waiting time cost per unit of time is much higher than the cost of in-vehicle time ($v_w > w_{iv}$). Therefore, unless in-vehicle time is reduced significantly more than the increased waiting times, the users generalized cost of travel will go up when more transfers are required to complete a trip. This is unlikely to have happened in the initial stages of Transantiago. Although the electronic payment card meant that boarding was faster than in the old system and many transfers were to and from the metro —a relatively fast transport mode— the majority of transfers were bus to bus. Since the needed infrastructure to make buses run faster (exclusive lanes and corridors) was not in place, there was absolutely no gain in in-vehicle times compared to the old system.[35] Thus, the increased waiting times and transfers implied a strong welfare loss to users of public transport, at least to those using buses.

[34] By 2008 transfer had been reduced due to increased services and the lengthening of others. At the end of 2008, 41% of users had to make one transfer, 14% had to make two transfers and 2% had to make three transfers to complete their trip.

[35] In-vehicle travel times probably increased due to slower and more careful driving under the new system.

The lack of infrastructure was probably one of the main design failures of Transantiago. Unlike Transmilenio in Bogotá, where the boarding stations and exclusive bus corridors were constructed before the reform was launched, in Santiago planners believed that they could introduce a trunk-feeder system —that would necessarily increase transfers and thus waiting times— without the needed gains in in-vehicle travel times provided by specialized infrastructure. Clearly they did not interpret correctly the underlying reasons for the success of BRT schemes such as Transmilenio or, for that matter, the expansion of the metro system.

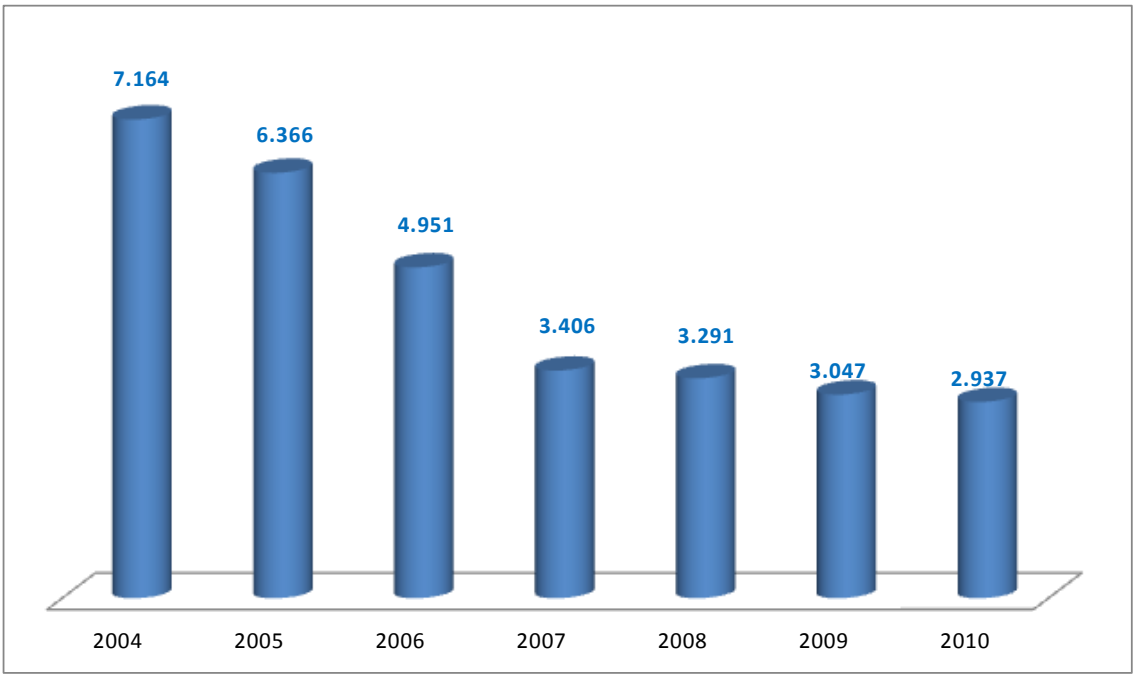
With the benefit of hindsight, it was probably to be expected that the modal constant, V_m, for buses and metro would decrease making these modes less attractive to users. In the case of buses, although 58% of the new fleet was to be renovated, the new buses had fewer seats compared to the old buses and a significant proportion of passengers had to stand. Furthermore, the low floor design implied that the available seats were difficult to access requiring passengers to climb several steps.[36] In turn, the expected increased in the use of the Metro was bound to create more congestion.

Probably the only immediate positive effect of the reform was a reduction in negative externalities. The new buses were considerably less noisy than the old buses. This plus the lower number of buses running in the main corridors of the city significantly reduced noise pollution. Unfortunately, objective measurements to prove this are not available. However, there is evidence that particulate matter pollution —a grave problem in Santiago during winter months— was significantly reduced with the reform. Figueroa, Gómez-Lobo, Jorquera and Labrín (2011),

[36] Many of the new buses allowed boarding by physical handicapped users in wheelchair, something unavailable in the old buses. However, the most prominent physical disability in Santiago is blindness. For this group, the required bus or mode transfers in the new system was costly. Plus in the old system drivers usually allowed blind people to travel free.

using daily data from 1997 to 2010 estimate a drop of close to 4 µg/m3 of particulate matter concentration levels after 2007. This represents a fall of nearly 6% in annual average concentration levels and represents a welfare gain of close to US$200 million per year in health benefits. This reduction in air pollution was to be expected given that a significant proportion of the new fleet had EURO III and IV technology and had lower emissions compared to the old buses.

Figure 2: Number of accidents involving a bus, Gran Santiago



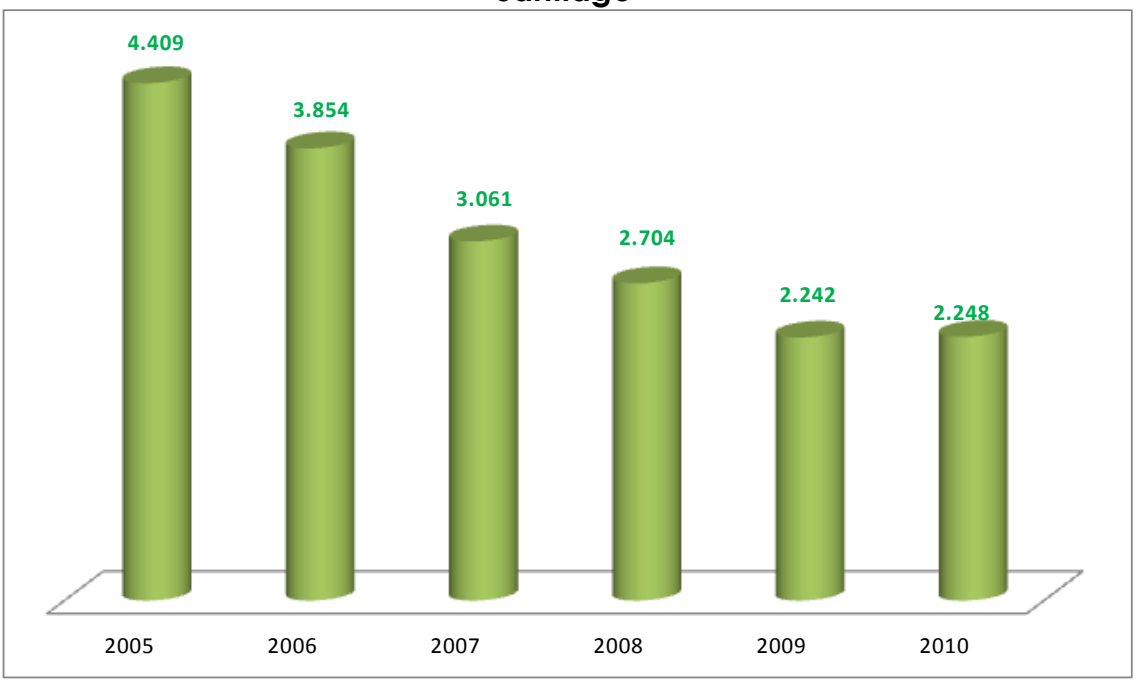
Source: CONASET and Carabineros de Chile.

Accidents were also immediately reduced as a consequence of the reform and the end of competition for passengers in the streets. In 2005 the total number of accidents in Santiago involving a bus was 6,366 (See Figure 2). This figure fell to 3,406 in 2007 and 3,291 in 2008.[37] Injuries due to

[37] Accidents in 2006 were 4,951. However, it must be borne in mind that there was a one year ramp up period prior to the 2007 big bang whereby the new concessionaires took over the old services. Even though the system operated under the logic of the old competitive system, drivers in some companies where not paid according to passengers transported during this period and thus competition in the street was reduced and accidents for this year partly reflect the effects of TS. Thus, comparing data from 2005 and 2007 (or 2008; the first full year of data under the new system) is a better reflection of the effects of the reform.

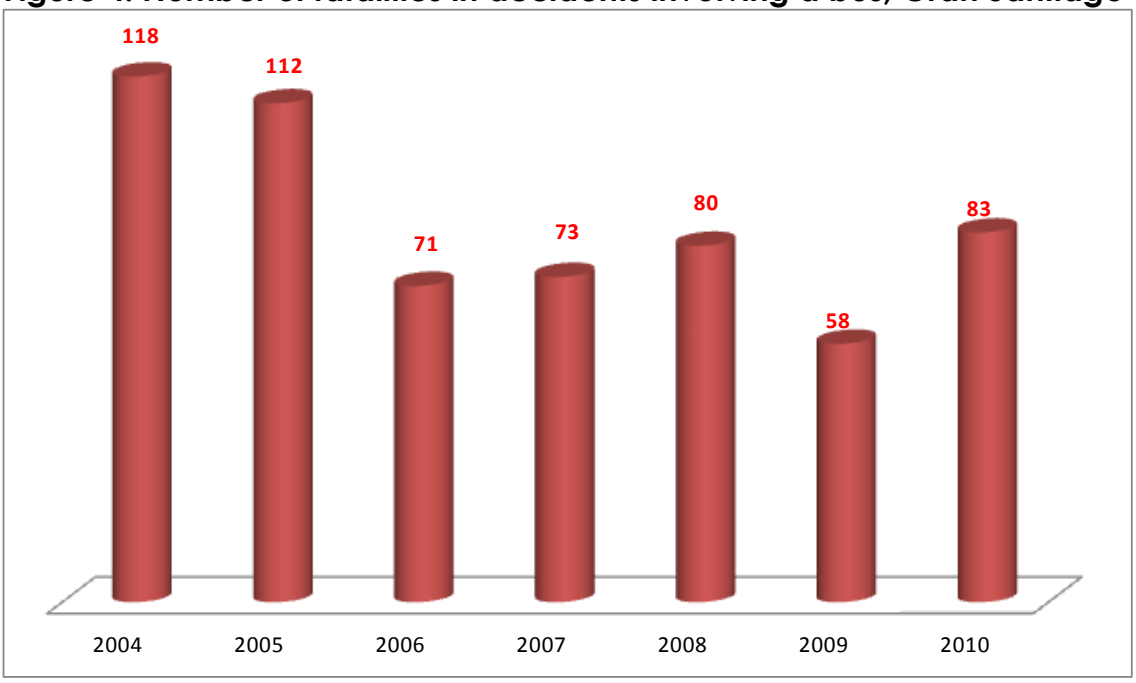
these accidents fell from 4,409 in 2005 to 3,061 in 2007 and 2,704 in 2008 (see Figure 3). Fatalities during the same period fell from 112 in 2005 to 73 and 80 in 2007 and 2008, respectively (see Figure 4).

Figure 3: Number of people injured in accidents involving a bus, Gran Santiago



Source: CONASET and Carabineros de Chile.

Figure 4: Number of fatalities in accidents involving a bus, Gran Santiago



Source: CONASET and Carabineros de Chile.

In summary, the reform was successful in reducing negative externalities attributable to the public transport system. However, the social and political outcry after the reform would indicate that in general people did not value these benefits very highly or at least not as much as the deterioration of other attributes of the generalized cost of travel in public transport mentioned above.

Thus, it is reasonable to venture that the generalized cost of travel in public transit increased with the reform, particularly for those trips involving the use of buses. This had two consequences. First, alternative modes of transport such as the private car, taxis and shared taxis, became more attractive to users. Although there is insufficient evidence, it is reasonable to postulate that there was a substitution from public transport to other transport modes.[38] Related to this the use of metro increased substantially —for reasons already mentioned above, particularly the reduction in the price of transferring to and from this mode.

Welfare for the majority of users was probably reduced. Those that could substitute to another mode suffered a welfare loss due to using a mode that ex-ante was revealed to be less preferred than public transit. Those that continued to use buses probably suffered a significant welfare reduction as generalized travel cost rose with the reform. Some users could have benefited if the cheaper access to metro meant that they could now use this fast transport mode.[39] However, the crowding conditions in the metro during peak hours and the difficulties faced

[38] In this respect see Gallego, Montero and Salas (2011).

[39] In fact, metro statistics indicate that the greatest proportional increase in users were poor. 79% of the increase in metro riders between December 2006 and May 2008 were people from socioeconomic groups C3 or lower. These passed from representing 55% of metro riders to 65% of riders between both dates.

when trips combined metro with buses probably conspired to make the gains quite small to this group.

What is more troublesome is that the negative impact of the reform on the generalized cost of using public transport was probably predictable ex-ante. The absence of dedicated infrastructure, the decrease in the bus fleet and the increase in transfers by going from a point to point to a feeder-trunk system, were all expected to increase this cost.

7. Coming out of the crisis

In this section we describe the policies and actions taken after February 2007 to reverse the crisis and assure that the system could provide a reasonable service. For the most part these measures aimed to reduce the generalized cost of travel to users of public transit.

7.1 Fleet size and incentives

One of the first priorities was to increase the number of buses in the fleet and to make sure operators complied with the operational plan. This would reduce waiting times and congestion at bus stops and inside buses. To this end, contracts were amended to increase the fleet size and allow operators to use old buses if required. However, as a short-run emergency measure, interurban 'Pullman' buses were hired until December 2007 to undertake "Super-Express" services. These new services would have a few stops at either end of the route, without intermediate stops, and would use the high speed urban toll highways to quickly cross the city from one end to the other. By lowering in-vehicle travel times, these super-express services significantly reduced travel times and were highly valued by users. In 2008 these services were transferred to the standard TS fleet and according to consumer surveys continue to be valued by users.

Besides increasing the nominal fleet size and introducing a transitory emergency fleet, it was crucial to give operators the incentives to comply with the operating plan. This required a change in the payment mechanism for operators and the deployment of the technological capacity to monitor and enforce the operating plans.

In order to give the correct incentives, operator's concession contracts were renegotiated in mid-2007. The essential modifications included an increase in the demand risk faced by operators. Operators would now face risks for roughly 35% of deviations of effective demand from the 'reference demand', compared to 10% before this change. Another important change was to make payment to operators conditional on an index of compliance with the operational plan. This index —denominated ICPH for its Spanish acronym[40]— was a the ratio of the capacity of buses effectively operating each half hour over the capacity that should have been operating during that period according to the operational plan. This index was aggregated over the two-week payment period for each concessionaire and actual payment was equal to the income of the original contract multiplied by this aggregated index.[41]

In order for a bus to be considered in operation, it had to be moving (according to the GPS information) at least 5 minutes in the half hour period. This was the only realistic possibility in mid-2007 given the absence of a more sophisticated monitoring technology and even in this simple case efforts had to be expanded so that all buses had a GPS installed.

[40] Índice de Cumplimiento de Plazas Hora.
[41] This index had a value between 0 (total non-compliance with the operation plan) and 1 (perfect compliance with the operational plan).

The changes introduced in 2007 had the desired effect of increasing the supply of buses in the streets. However, by 2008 it was clear that more monitoring and incentives would be required for a better compliance with the operational plan. There were several ways that operators could "game" the ICPH index. First, an operator could have buses moving out of route or service that would count towards the ICPH index but where not providing a transport service to users. Until mid-2008 the authorities did not have a system available to monitor the exact position of a bus within the city only whether the information sent by the GPS indicated that the bus was moving or not. Second, a bus could arrive at a depot 10 minutes after the hour, say, and the operator could then dispatch the same driver in a different bus 20 minutes after the hour. The system would register two buses in movement during the half hour period, although there was really the equivalent of only one bus providing the service on route during the period. Finally, there were some loopholes in the ICPH that companies learned to exploit.[42]

By mid-2008 the AFT had developed a technological system whereby the exact position of each bus could be monitored on-line. This allowed the authorities to tighten the compliance with the operational plan. Two new indices were introduced, the Frequency Compliance Index (ICF) and the Regularity Compliance Index (ICR). The first index measured the proportion of buses at the head of a route service compared to the buses required on that route by the operational plan. The ICR measured the regularity (variance in headway) between buses at the head of a route service. Both indices provide a much finer control over compliance with the operational plan.

[42] For example, there was a provision that during peak hours companies that provided between 94% and 100% of the capacity would not be penalized if they provided double the shortfall during off-peak hours. Since it was cheaper to provide service during off-peak hours, companies started optimizing this rule, offering just over 94% of capacity during peak periods.

Less than 100% compliance with the ICF and ICR gave rise to discounts in payments to operator. Although these indices were not formally included in the contract, these discounts were made possible since the deficit of the system was being funded by a special constitutional provision. The Constitution included the possibility of using up to 2% of the government budget for emergency uses without having to pass by Congress. Starting in October 2008, the government used this provision —that is reserved for very special purposes and had not been used since the 1985 earthquake— and there was wide political consensus that these funds could not be used to pay operators for services not rendered.[43]

The introduction of the ICF and ICR indices, together with the possibility of discounting payments to operators without the risk of triggering the termination of a concession contract (as occurred with fines) finally gave the authorities to teeth for the proper regulation of the system. Between Augusto 2008 and June 2009 there was a sustained increase in the compliance with the operational plan and an increase in the quality of service provided.[44]

Other measures were taken during the second half of 2008. The concession contract was terminated for a small operator in the south of the city (Zone G) that was unable, despite the new financial incentives, to improve its service. This operator was finally replaced by a new concessionaire although the transition period before a new operator was found proved to be difficult. The decision was also taken to re-assign the contract for the Trunk Services 3 that also showed consistently low compliance with the operational plan. At the end of 2009, half of the

[43] Naturally, operators challenged the ICF and ICR discounts in the courts but where unsuccessful.

[44] The ICF in the morning peak period (6:30 AM to 8:30 AM) increased from 76.2% at the end of Augusto 2008 to 94.5% at the end of June 2009. The increase in the ICR during the same period was from 74.6% to 89.1% during the morning peak hours.

routes of this trunk service were transferred to another operator. The other half was transferred in 2010 to Trunk Services 1 and 4 as compensation for the extension of Line 5 of the Metro.

The experience with Zone G and Trunk Line 3 illustrate how financial incentives may not be enough to guarantee a good quality service. In both of these cases, the concessionaire was an operator (and leader political leader) of the old pre-TS system, and operated under the logic of the old system, affiliating buses, without creating a real company and without any modern managerial capacity. As fines and discounts for non-compliance became stronger, they were unable to improve their operational capacity and their financial situation deteriorated reducing even more their quality of service. This experience points to the fact that financial incentives ("carrots" and "sticks") made not be sufficient to guarantee quality service and administrative and legal requirements, past experience in similar transport systems, and financial capacity are necessary screening devises that should be used at the tendering stage to filter out inexperienced or bad quality operators.

Besides the ICF and ICR indices other changes were made that were inconsistent with the original contracts. For example, the overlapping rules between zones and trunk services were in practice ignored as new services or extended services blurred the line between existing feeder areas or trunk services. Therefore, a new contract renegotiation process was undertaken in 2009 with the aim of introducing all these changes formally. The new contracts no longer obliged the authorities to terminate a contract when 6,000 UF of fines were passed and flexibility to the overlapping rules between services of different concessionaires was introduced. The ICPH index was changed to the ICPHK index, introducing the kilometers of service effectively operated in addition to

the capacity (seats) per hour as a compliance dimension.[45] Studies by the authorities showed that a high ICPHK was equivalent to a high ICF. In the new contracts the ICF and ICR were also included (with fines replacing discounts for not meeting these performance indicators). However, they were reserved as instruments to control specific problems in a route or service rather than as an aggregate performance indicator. For this last purpose the ICPHK was chosen. The new contracts also introduced a mechanism for operators to renovate the whole fleet, including feeder services. Thus, by the end 2010 almost the whole fleet was expected to be new modern buses of Euro III or IV technology.

7.2 Fares and financial deficit

Since one of the main impacts of TS on users was an increase in the generalized cost of travel in public transport, increasing this cost even further through fares adjustments would have been politically unfeasible. The authorities opted to maintain the fare at $380 until the system provided a reasonable quality of service, although in February 2009 a small adjustment was made increasing this fare to $400. Also, the transfer to metro at peak hours was increased from $40 to $60 on that same month.

Naturally, freezing tariffs while at the same time increasing the fleet size, the routes and kilometers of service required (as discussed further below) and other measures dictated by the authorities, generated a growing financial deficit. Table 2 shows the real annual deficit from 2007 to the present. It can be seen that the deficit peaked in 2008 when it represented 50% of operational costs and has been slowly decreasing

[4545] This change effectively introduced "seat-kilometers" as a relevant performance indicator for payment purposes. This is in line with the way payments are determined in many transport systems around the world.

since then.[46] In 2011 the deficit (and thus the subsidy) represented 40% of operational costs, which is below the average subsidy level in developing countries' transit systems.

Table 2: Operational incomes, costs and deficit (US$ million)

	Income	Costs	Deficit
2007 (Jun-Dec)	872.6	501.1	-371.5
2008	1,643.3	818.6	-824.6
2009	1,606.7	811.9	-794.8
2010	1,718.2	962.9	-755.3
2011	1,790.2	1,067.8	-722.4

Source: Financial Report, January 2012, CGTC, MTT.
Note: the figures were first expressed in UF of December 2011 and then converted to dollars using an exchange rate of $480/US$.

This deficit was funded by several means until September 2009, including a subsidy approved by congress and a credit given to the system by the Inter-American Development Bank. When this last credit was deemed unconstitutional by the Constitutional Court in September 2008 (because it deemed it was a public credit not approved by Congress), no option remained but to use the 2% Constitutional provision described above. Finally in August 2009 a Public Transport Subsidy Law was finally approved by Congress.[47] This law introduced a permanent and a transitory subsidy for public transport, both in Santiago as well as the rest of the country.

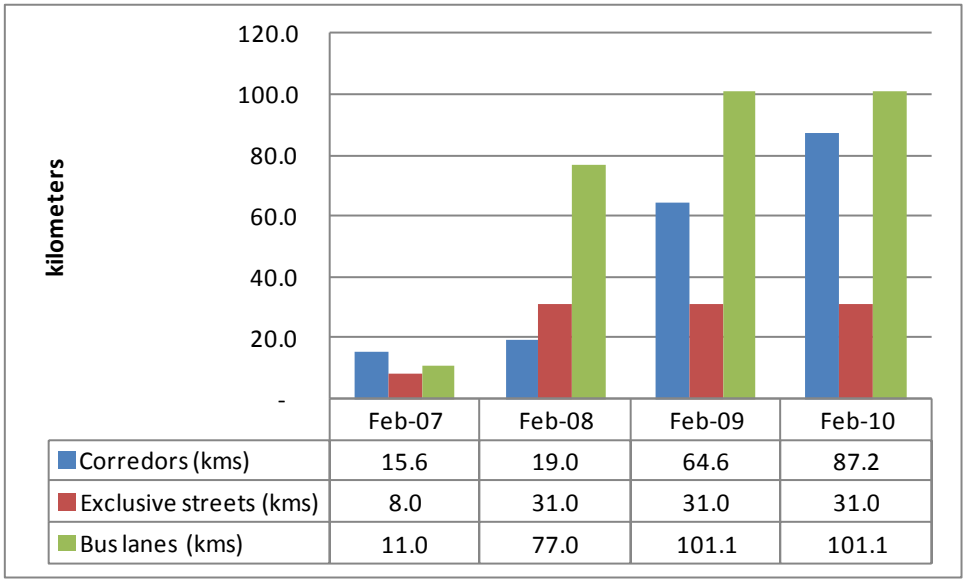
One interesting aspect of this law is that it created an independent expert panel in charge of determining monthly fare levels in order to guarantee that the annual deficit does not exceed the yearly amount of subsidy defined in the subsidy law. In the conclusions we will return to this topic.

[46] As will be discussed in the conclusions, the decrease has mostly to do with sharp fare increases applied since 2010.
[47] Law 20.378 published in the *Diario Oficial* on September 5th 2009.

7.3 Infrastructure

Another urgent measure after February 10th 2007 was to accelerate the construction of the required dedicated infrastructure for the system. Between 2007 and 2010, 75 kilometers of segregated bus corridors were constructed. By the end of this period the network of segregated bus corridors reached close to 90 kilometers (see Figure 5) and was comparable in size to the Metro (104 kilometers) and similar to the first two stages of Transmilenio in Bogotá.

Figure 5: Evolution of bus corridors, bus lanes and exclusive streets



	Feb-07	Feb-08	Feb-09	Feb-10
Corredors (kms)	15.6	19.0	64.6	87.2
Exclusive streets (kms)	8.0	31.0	31.0	31.0
Bus lanes (kms)	11.0	77.0	101.1	101.1

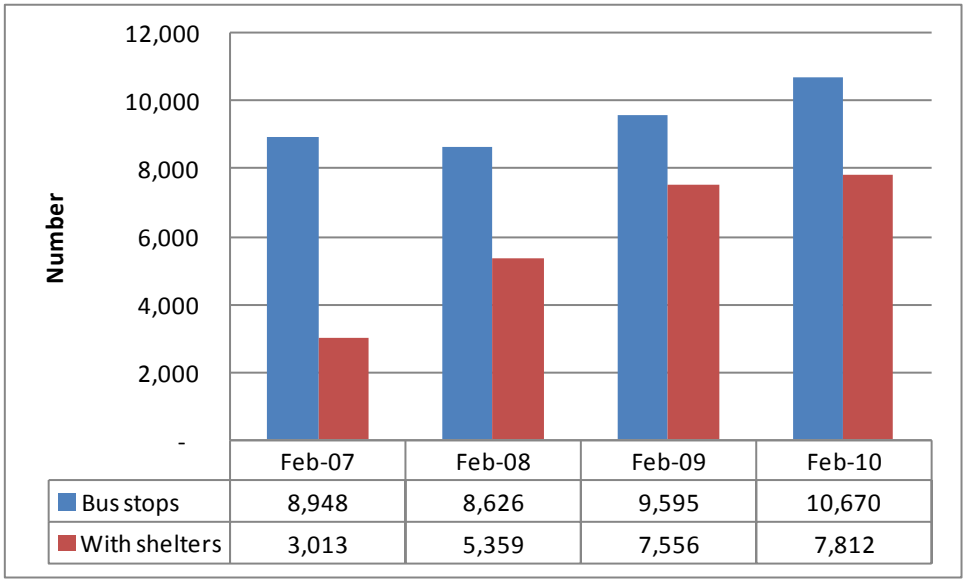
Source: Ministerio de Transportes y Telecomunicaciones

Besides segregated bus corridors other low cost transit management measures were introduced. One was the use of bus lanes, whereby on certain major roads one lane was reserved for buses (and taxis). These lanes were marked by paint on the pavement and were not completely segregated from private traffic but if properly enforced increased average bus speeds. Bus lanes increased from 11 kilometers in 2007 to just over 100 kilometers by February 2010. Another measure was the exclusive use by public transport of some major arteries during peak

hours. During these periods, private transport could not use these roads. These "exclusive streets" reached 31 kilometers by 2010.

The traffic management measures increased average bus speeds, lowering in-vehicle travel times. In order to increase the perceived quality of travel in public transport, bus stops (many of them sheltered) were also increased.[48] These increased from 8.948 in February 2007 to 10.679 in February 2010 (see Figure 6). The stops with shelters more than doubled, from 3.013 to 7.812 during the same period.

Figure 6: Number of bus stops, total and with shelters



	Feb-07	Feb-08	Feb-09	Feb-10
Bus stops	8,948	8,626	9,595	10,670
With shelters	3,013	5,359	7,556	7,812

Source: Ministerio de Transportes y Telecomunicaciones

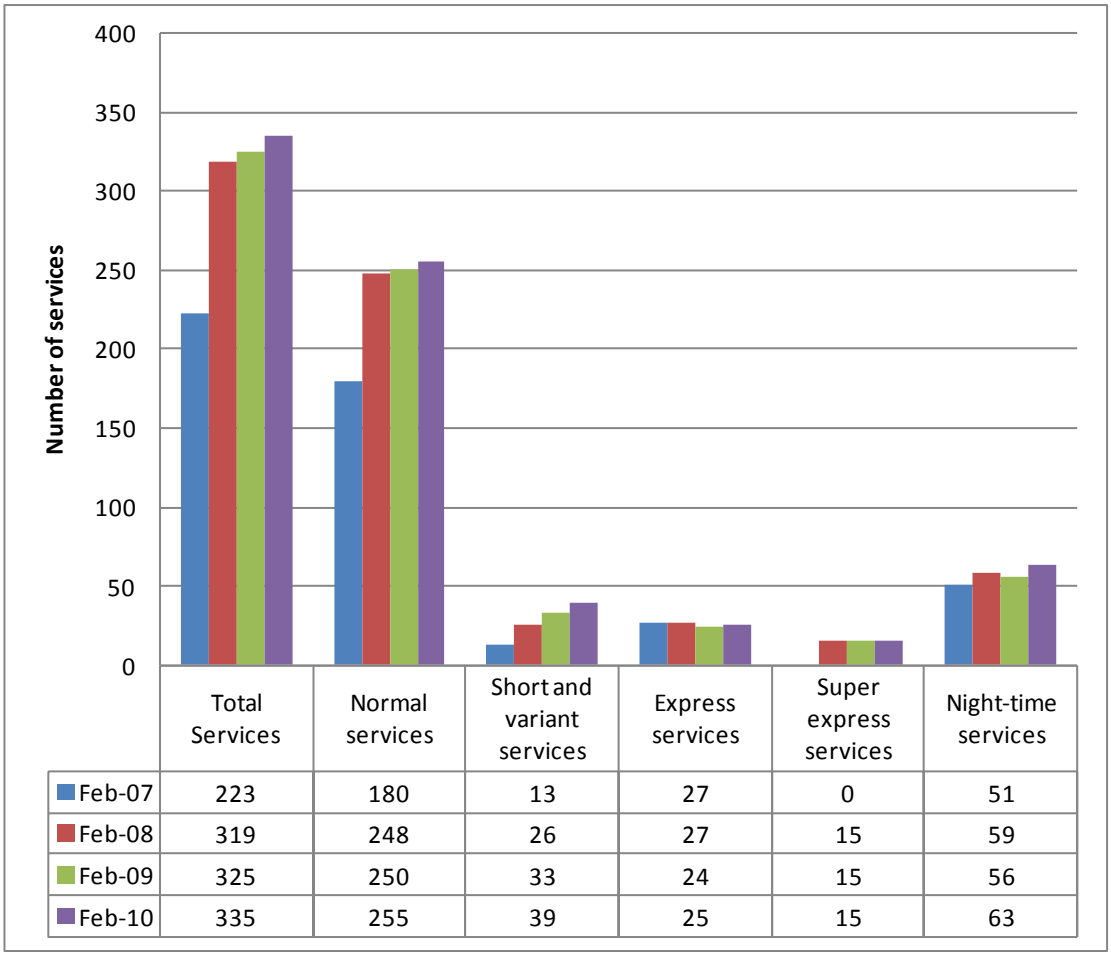
Finally, it is important to mention the construction of 155 pre-boarding stations whereby passengers pay on entering the pre-payment area and then board the bus by any of the available doors. These stations reduce non-payment by users (since there are monitors posted at the entrances) and decrease the boarding time required particularly for high-capacity articulated buses.

[48] Before TS there where hardly any bus stops since buses would stop anywhere a passenger flagged them. The TS standard for bus stops included the posting of user information, particularly in sheltered stops where network route and map information was posted.

7.4 Network restructuring

In order to reduce the generalized cost of travel, it was crucial to increase network coverage and reduce transfers. To this end new bus services were added —increasing from 223 in February 2007 to 335 in 2010 (see Figure 7)— some trunk and local services were extended to avoid costly transfers, and new short services and variant services were introduced.

Figure 7: Evolution of bus services



	Total Services	Normal services	Short and variant services	Express services	Super express services	Night-time services
Feb-07	223	180	13	27	0	51
Feb-08	319	248	26	27	15	59
Feb-09	325	250	33	24	15	56
Feb-10	335	255	39	25	15	63

Source: Ministerio de Transportes y Telecomunicaciones

7.5 Other measures

There were many other measures taken after the 2007 crisis but for reasons of space cannot be recounted with much detail. Among the most important was the increase in the supply of metro services. Investments were made in 85 new coaches that were operational by the end of 2007. Stations were remodeled, increasing the number of stairs and platform space, and introducing a passenger flow management plan with monitors and contention barriers, all with the purpose of reducing congestions in stations. In addition, a "skip and stop" system was introduced 3 of the 4 metro lines that increased available capacity by 10% to 20% depending on the line.[49] Finally, the opening and closing hours of Metro were changes to increase the availability of this transport mode.

All the above measures had an effect and by 2009 it was no longer necessary to close stations due to congestion. Passenger density had also decreased below 6 persons per square meter and even below 5.5 in a number of lines.[50]

Another important measure was the strengthening of the institutional capacities of the authorities to monitor and regulate the public transport system. To this end, human and material resources were increased in the Transantiago Coordination Office (Coordinación General de Transportes de Santiago, CGTS) and the Transport Inspectors Department, both dependent to the Ministry of Transport and Telecommunications. As a result, user surveys, external advisors and technical studies started to be contracted, and enforcement of operational plans were increased. A Bus Monitoring Center (CMB) was created within the CGTS whereby the exact position, frequency and other operational parameters could be

[49] A skip and stop system not all trains stop at each station at peak hours. Rather, trains are sorted according to color scheme (two colors in each line in the case of Santiago) and each type of train stops in a pre-determined subset of stations.
[50] During 2007 and 2008 some lines exhibited over 7 passengers per square meters during peak hours.

monitored on-line for each route and service. This allowed an early detection of operational problems on a route prompting the CMB to contact operators regarding these problems and demand an immediate solution if required. For example, if frequency problems were detected, the CMB would call the responsible operator for an explanation and demand an injection of more buses.

8. Epilogue and conclusions

By the end of 2009 the above measures —as well as others not mentioned here— had the desired effect. Operational indicators where much improved, at least compared to the early crisis months. Average waiting times at bus stops in morning peak hours had declined by half, from 12.8 minutes on average for all trip segments in late May 2007 to 6.5 minutes in late May 2009, and the daily average number of people that waited more than 10 minutes at a stop had declined from 21% in June 2007 to close to 6% in June 2009.[51]

Overall, average travel time for a representative sample of trips was less than 45 minutes in May 2009, down from a high of 57.4 in May 2007 and below the estimate of 52.6 minutes in 2006 prior to the reform (DICTUC, 2009). Although this does not guarantee that the generalized cost of travel was below pre-reform levels, it does imply that this cost decreased significantly in the two years after the initial crisis. As a result of the improvement in the operation of the system, congestion at bus stops and in the metro (as discussed above) were greatly reduced. In fact, as buses became more reliable, the use of the Metro decreased slightly in 2009.

[51] These figures come from Dictuc (2009). In order to avoid seasonal factors affecting the comparisons, we present figures for the same months in 2007 and 2009.

As already described externalities caused by the public transport system decreased significantly with the reform. Both noise and air pollution was decreased, as well as accidents involving buses.

Consistent with the above results, opinion surveys started to show an improvement in the system's reputation. In a scale of 1 to 7, average satisfaction levels was 3.0 in March 2007, with 78% of interviewees indicating a very low satisfaction level (1 to 4) and only 7% indicating a high satisfaction level (6 or 7).[52] By September-October 2009, the average satisfaction of the system had increased to 4.9 with 33% of interviewees reporting a satisfaction level of 6 and 7 and 29% indicating a 1 to 4.

However, by early 2010 there were still several important challenges remaining. The most important being the financial deficit. Although a law had been passed in 2009 to provide a permanent and a transitory subsidy to the system, the amount of resources approved for this purpose still required substantive fare hikes. Thus, when the expert panel created by the subsidy law began operating in 2010 it immediately started increasing fares. During that year it decreed five fare increases and several more in 2011. In spite of a special law passed in 2010 to increase the transitory subsidy amount, in March 2012 nominal fares during peak hours were CLP 580 for an adult trip (up from CLP 400 in March 2010) and CLP 660 if metro was used in some segment of the trip.[53] To put these figures into perspective, the exchange rate was around CLP 480 per US dollar at this time. Therefore, fares are well over one US dollar.

Naturally this sharp fare increase has taken a toll on consumer satisfaction. By March-April 2011 satisfaction with the system was down to

[52] Data as reported by Collect GfK (2011).
[53] Off peak fares were CLP 580 if only buses are used or CLP 600 if buses are used in combination with Metro or Metro alone. Early in the morning and late at night fares are slightly lower, CLP 550 for metro rides that do not combine with buses.

4.2, with 49% of people surveyed reporting a low satisfaction level (1 to 4) and only 17% indicating a high satisfaction level (6 or 7). Although this drop may partly be attributed to other factors (such as an increase in waiting and travel times during 2010 and a misguided communications strategy by the new Minister) it is highly likely that the fare increases were the main culprit in the deterioration in the users' perception of the system.

More worrying, fares are set to continue increasing as the transitory subsidy levels are phases out according to the law. The permanent subsidy will cover only around 15% of operational costs in the long-run from the current 40% total subsidy levels. Thus, unless the permanent subsidy level is increased as the transitory subsidy is phased out fares would continue increasing in 2012 and 2013. The current government has recently presented a bill in congress to do just that. According to this bill, the permanent subsidy level would increase in order to guarantee a total subsidy similar to 2011 levels, and thus avoid further real fare increases.[54]

The financial problem encountered with Transantiago points to a very important lesson from this experience. High quality modern public transport systems are expensive and may explain why in most developing countries transit systems usually of low quality and informal affairs. With the benefit of hindsight it was to be expected that renovating the bus fleet, formalizing labor relations for drivers (without a substantial wage reduction) and introducing technological elements, such as GDPs and an electronic payment system, was going to be expensive. Pretending to do all of this while maintain the average fare of the previous system and without introducing subsidies was clearly

[54] Although the motivation for increasing the subsidy is mainly distributive and political it must be borne in mind that high subsidy levels for public transport are warranted on efficiency grounds. On this see Small and Parry (2009).

unfeasible, as was dramatically shown in Santiago. Other countries or cities in the developing world intending on global reform and modernization of their public transport systems should learn from this experience and carefully consider the cost and the way these will be funded from fares vis a vis subsidies.

Another major lesson from Transantiago is that incentives and detailed contractual design are crucial if these reforms are to be successful. Several rounds of contract renegotiation were required between 2007 and 2009 before operational incentives were improved. But even the changes introduced through these processes were not enough to induce optimal behavior. Although operators began meeting their operational plan, new problems began to arise. Since payment was linked to seat-kilometers offered, companies had the incentive to put buses in the streets at the right frequency and regularity. However, they did not have strong incentives to stop for passengers at bus stops. Neither did they have incentives to control non-payment, which in some services and areas had reached 30%. In order to tackle these problems, the current authorities undertook another round of contract renegotiation, increasing demand risk from 35% to around 70% of income.[55] These new contract have just recently been introduced, so it is too early to evaluate their impact.

One important lesson for other countries regarding the experience of Transantiago with incentives and contractual design is that a trial and error process may be necessary in order to achieve good results. Therefore, a reform should be introduced piecemeal with pilot trials in some areas and services until the authorities are sure that the design is

[55] In order to induce trunk operators to change their contracts and accept more demand risk, the authorities offered to give them the local area service contracts that expired in October 2010. Thus, there was a sharp decrease in the number of distinct companies operating in the system with only the trunk companies now operating both local as well as trunk services.

producing the expected results. Therefore, the last major lesson from the TS experience is that a global reform of a crucial public service such public transit cannot be undertaken overnight and just based on theoretical and desktop designs. Irrespective of the quality and technical abilities of the professionals designing such a reform, a "Big Bang" approach to public transport reform is very risky and —as shown with the case of Santiago— can lead to disastrous results.

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