Study on the socio-economic rationale for subsidising urban transport

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FINAL REPORT

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CONTENTS

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TABLE OF CONTENTS

CONTENTS

TABLE OF ILLUSTRATIONS

Executive summary

The funding of urban transport represents about 7% of annual commitments by the French Development Agency (AFD). The agency commissioned a study from Nodalis Conseil, Emile Quinet and Setec International to analyse the relevance of the rationales offered by the various stakeholders when deciding to subsidise urban transport, whether individual or collective.

➢ Levels and forms of urban transport subsidies

The comparative analysis of urban transport subsidy levels in nine conurbations of various developed or developing countries highlights the variety of forms of subsidy according to their objectives, conditions, recipients and beneficiaries:

- Investment subsidies (CAPEX) for part or full funding of infrastructure, fixed equipment or rolling stock;
- Operating subsidies (OPEX) such as supply-side subsidies paid to the operator per unit of service produced; balancing subsidies to cover losses from below-cost fares; contributions to certain costs; compensations for concessionary fares; and tax exemptions, particularly on fuel for road-transport operators;
- User subsidies such as those paid per consumed unit of a good or service; fuel-related subsidies in the case of individual transport (whether tax exemptions or price subsidies); or employer-provided, full or partial coverage of employees' transport costs;

Intervention by the public authorities is not necessarily financial. They can also act by implementing regulations that lead to a public-transport monopoly, or price regulations (such as the price of fuel in some countries).

➢ Review and critical analysis of rationales given for urban transport subsidies

There are two main categories of rationale for subsidising urban transport: micro-economic rationales and social rationales.

Micro-economic rationales

Micro-economic rationales given for subsidies are based on the existence of economies of scale and of urban transport-induced positive externalities. These effects distort the micro-economic equilibrium, which does not occur at the optimal level of supply.

Increasing returns, "Mohring effect" and coverage effects

Increasing returns are one of the usual rationales for public financial intervention. Such increasing returns, particularly for urban public transport, are due partly to a transport cost function that includes a high fixed term (the cost of infrastructure) which increases with capacity, and partly to a club effect called the "Mohring effect".[1]

[1] The "Mohring effect" reflects the fact that to cope with increasing demand, a carrier that increases service frequency increases service quality for all users, as waiting time becomes shorter.

In the presence of private increasing returns, i.e. a cost function with a high share of fixed costs, marginal-cost pricing, which should be the rule, is not viable because it entails losses for the operator. However, this typical rationale for subsidies has several limits:

- It does not apply to bus transport, which cannot validly be considered to have a cost function that creates increasing returns;
- It is hard to defend in large developed cities, where the existing system is already extensive and often saturated, which technically and financially constrains its expansion and the possible decisions regarding "marginal equipment".

The hypothesis of increasing returns is therefore chiefly valid for cities where the transport system is growing but not saturated, and for infrastructure-intensive modes.

Likewise, the "Mohring effect" rationale for subsidies, induced by urban public transport, must be put in perspective and imperatively take account of the trade-off between the frequency of service and the unit capacity of vehicles. This trade-off is a major subject in a context of cohabitation between formal and small-business transport[2] in some developing cities (the partial or total elimination of subsidies to the formal carrier would increase the market share of small-business vehicles, which operate at higher frequency thanks to low salary costs).

Spatial coverage effects, when a line is not in itself profitable but feeds other, profitable parts of the system, justify subsidies in a competitive market. In an uncompetitive market they take the form of equalisation effects, in which case financial support provided amounts to cross subsidies.

The same applies to the effects of time coverage. These may also justify subsidies in a competitive market; to keep public transport attractive during off-peak periods, it is necessary to implement a minimum frequency level, which will probably be higher than that required only to cover demand during these less busy periods.

Likewise, in the case of a competitive market without equalisation, the introduction of fare integration across a whole public transport system, with multiple operators, can be considered as a rationale for public subsidies: the development of intermodality in particular requires fare harmonisation (a single ticket for all modes, ticket validity for one hour's travel, etc.), which induces price drops for each participating operator. As the traffic induced by this enhanced system coordination does not generally offset revenue losses, subsidies become necessary.

Internalisation of positive and negative externalities

Urban transport, whether individual or collective, generates positive externalities (agglomeration effects, cost savings for public services and utilities related to better land use) and negative ones (environmental impacts, impacts of accidents and congestion).

The search for the optimal supply-and-demand equilibrium requires these effects to be internalised through a price-correction process. In theory, therefore, negative effects should be taxed and positive ones should be subsidised: policies in developed countries are geared more towards limited taxation of individual transport[3] (road pricing, for example) and broad-based subsidization of collective

[2] We designate as "small-business transport" the shared taxis or mostly unregulated minibuses that are often, though incorrectly, characterised as "informal".

[3] External costs related to individual transport are generally not covered by collected taxes, due in particular to the cost of congestion. In France in 2011, according to the French General Commission for Sustainable Development (CGDD), taxes covered between 44% (diesel) and 72% (petrol) of the external costs of individual transport, excluding congestion. If congestion is included, coverage of external costs falls to 14% and 22%.

transport. But this model, rooted in the theory of welfare economics, is difficult to implement by the book.

The payment of public subsidies especially requires taking account of a specific externality, the opportunity cost of public funds (OCPF). Generally funded by taxes, public subsidies induce a loss of efficiency related to the cost of public resources: a certain amount levied as tax has a negative effect on collective welfare that is greater than the nominal amount. According to studies done in France, one euro of "average tax" costs about 1.3 euros,[4] i.e. a subsidy of X euros corresponds to a loss of collective surplus of 0.3 euros.

The absence of methods to evaluate (positive or negative) externalities, or the difficulty of implementing such methods, is a major constraint in the internalisation process. Although reference values are set and applied in developed countries (noise nuisances, local nuisances, greenhouse-gas emissions, etc.), these methodological approaches are less advanced in developing and emerging countries.

By way of example, the promotion of agglomeration economies could over time appear to be one of the main rationales for subsidising urban transport, as there is a growing body of work on the subject. However, these innovations, applied notably in the context of the Crossrail project in London, require databases and tools not necessarily available in the countries where AFD works. In addition, calculation methods adapted to the economic environment of developed countries are hard to transpose to the economic structure of developing countries, where a large part of the economy is informal. It is noteworthy that the economies-of-agglomeration rationale also concerns individual transport, as long as road congestion does not offset the beneficial effects of accessibility.

Public authorities' financial support for urban public transport as a "means" to ensure a city's sustainable urban development is not a given: what creates compact cities is not the promotion of urban public transport but essentially a pro-active land policy that encourages densification along a corridor. The subsidisation of public transport in the city of Atlanta is a notable example of the inefficiency of public transport in influencing the urban form, as past policies restrict the realm of current and future possibilities.

Lastly, individual urban transport generates a high level of negative externalities (especially congestion and the resulting greenhouse-gas emissions and pollution). The most economically viable solution to this issue would be to tax it to internalise these costs to collective welfare. However, applying this theory often encounters acceptability barriers in the population, which must be considered in the decision-making process.

Social rationales

Social equity as a major rationale for subsidising urban transport is based on the double idea of:

- making transport available to the poorest categories of people by limiting its cost (notion of affordable price);
- ensuring the same conditions of access to transport, as restricted access to urban resources may entail risks of social exclusion.

The degree of social efficiency of subsidies varies according to the type of funding considered and to the entities impacted. To best ensure that revenue is truly redistributed, the envisaged funding must be targeted and address the needs of categories of users that, without any public financial intervention, are truly excluded from access to transport. Subsidy benefits frequently reach the whole

[4] If the subsidy under consideration is funded by a tax which has lower-than-average distorting effects, the coefficient relative to this tax should be used.

community without distinction; in this case, subsidies becomes regressive and create a deadweight loss, which goes against the intended effects. This is the case, for example, of fuel subsidies, or of the systematic employer coverage of 50% of the cost of employees' public transport passes in the Paris region. Conversely, subsidies targeted on the basis of socio-economic criteria are generally progressive but tricky and costly to implement (as in the city of Medellin, where fares vary according to user income) and do not totally eliminate certain inclusion or exclusion effects. In Brazil, the *Vale Transporte* scheme for commuter travel targets the poorest registered employees but "forgets" informal-sector workers.

Financial consequences

When modal competition between individual transport and collective transport is distorted because external costs are not internalised, or when the public authorities, in order to meet access and social-equity objectives, impose excessively low fares, urban public transport operators often suffer a recurrent financial imbalance that generally leads to public financial intervention. But such a near-guaranteed support creates bias in decision-making and reduces the participants' pursuit or profitability improvements. This perverse effect then leads to economically suboptimal subsidy levels and subsidy terms, which sometimes the public finances cannot sustain. The recommendations made in the final part of this study propose avenues to reduce risk and optimally allocate subsidies on clear and credible terms, thus encouraging operators to be more efficient.

- **Recommendations**

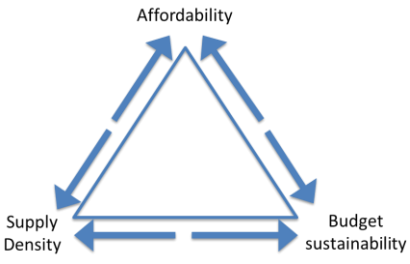
Of the various rationales for subsidies, the promotion of agglomeration effects and mobility of the poorest people is perhaps the most robust one for emerging and developing countries: urbanisation plays a paramount role in their economic and social development. Introducing or reforming these subsidies presents both risks and opportunities for these countries' decision-makers and for the funders supporting them. Poorly-designed subsidies frequently have adverse effects, especially in budgetary, social and urban-development terms. These tend to be long-term effects, difficult to reverse, and accentuated by deficient governance and urban-planning tools, as well as by the lower resilience of developing countries' public finances.

However, rapid urban growth in these countries opens up opportunities: there is still time to orient the development of cities so that it is compatible with high-performing and more environmentally friendly modes of urban transport, such as collective modes. Socially, subsidies can increase access for the most disadvantaged, and thus the fairness of the transport system, but only if they are well targeted.

We therefore propose several concrete recommendations for decision-makers, their technical teams, and the funders supporting them. They are grouped under five principles and summarised in the table below. These recommendations deal with methods for setting realistic objectives, for defining a reform of the subsidy system, and for implementing it. They also include budgetary and financial safeguards to secure the sustainability of the transport system and the efficiency of public spending over the long term.

In every case, political decisions must be analysed in the light of three main objectives, which may conflict with each other in pairs:

- Affordability (the price of service compared to users' incomes);
- Supply density (quality and quantity);
- Budgetary sustainability.



Any subsidy policy corresponds to a a compromise between these objectives. This compromise must be explicit and acknowledged.

Among the financial safeguards, a preference for investment subsidies supplemented by a rule of full cost recovery excluding infrastructure funding (the sum total of commercial revenues and dedicated tax resources must be greater than operating, rolling-stock and maintenance costs)[5] outlines a possible partnership between concessional funders and governments. For the reforms driven by such a partnership to be truly beneficial for citizens, they must address the more sensitive issues – notably the elimination of fuel subsidies and the integration of the small-business suppliers, which can be an asset for mobility in developing cities.

The following table lists the report's recommendations. It also gives a highly qualitative and general judgment on the degree of importance and difficulty of each of these 18 recommendations. Some are doubtless more widely acceptable, which certainly does not mean they are always implemented; but in developing countries, if a funder supports their implementation they will stand a good chance of success. The recommendations that are both highest priority and least acceptable are those where the political decision-maker will have to play the strongest role to ensure successful implementation.

[5] The costs of rolling stock correspond to the provisions that must be made for its economic depreciation. Dedicated resources are those that the law allocates directly to urban public transport.

Summary table of recommendations

Promote agglomeration effects but discourage nuisances		
1. If there is no true congestion charge, consider simpler systems such as road tax stickers, and create tolls on access infrastructure and parking where none exists, integrating to such tolls the cost of congestion created by their users.	Top priority	Difficult
2. Subsidise public transport to promote agglomeration effects, and as a second-best solution to the unfeasibility of taxing individual modes of transport at the level of their actual long-term social cost.	Top priority	More widely acceptable
Determine priorities on the basis of evaluated impacts		
3. Conduct benchmarking analysis of the three parameters (affordability, supply density and budget sustainability) in comparison with similarly-sized cities in other countries.	Top priority	More widely acceptable
4. Set a subsidy policy with clear objectives and explain the trade-offs they involve.	Top priority	Difficult
5. Use urban transport subsidies as a tool to complement land policies; they can influence the nature of an urban development project, but also be financed by it.	Important	Difficult
6. To determine the most effective subsidy mechanism in terms of a social objective, conduct a distributive analysis of the use of public funds. Base it on a detailed transport survey.	Top priority	Difficult
7. New dedicated resources must be created on a basis justified by a cost-benefit analysis and/or a distributive analysis.	Important	More widely acceptable
For better social impacts, have the courage to take counterintuitive measures		
8. Consider the option of improving physical access to public transport (bringing lines into poorly served neighbourhoods) rather than simply improving affordability.	Important	More widely acceptable
9. Examine targeting possibilities to reduce subsidy inclusion and exclusion errors.	Important	More widely acceptable
10. In a growing city, when budgetary resources and fares are insufficient, putting public transport operator(s) in financial jeopardy, it may be less detrimental for users, including the poorest ones, to raise fares rather than reduce supply.	Important	Difficult

11. Eliminate fuel subsidies and fuel tax exemptions, which are highly regressive; and at the same time implement suitable measures to at least offset the poorest people's loss of income.	Top priority	Difficult
Ensure the sustainability of public transport through fiscal discipline		
12. If there is no increase in budgetary effort (or no proven productivity gains), do not in any event lower real fares – which therefore means raising them at least by the rate of inflation of input costs – or face a reduction in supply either straight away, or in the medium term due to accumulated deficits.	Top priority	Difficult
13. Give priority to investment in the allocation of subsidies and concessional funds, verifying through due diligence that other resources are available to ensure adequate operation and maintenance of this investment (as per the rule set out below).	Top priority	More widely acceptable
14. Endeavour to follow a simple rule of "full cost recovery excluding the funding of initial infrastructure": Commercial revenues + dedicated resources > Operating, rolling-stock and maintenance costs	Top priority	Difficult
15. When public authorities provide funding to an operator, they must do so through multi-year contracts that set fixed funding amounts; and the renewal or negotiation of a new contract must be coupled with a re-evaluation of costs.	Top priority	More widely acceptable
Strengthen existing supply for efficient implementation		
16. Rather than destabilise the unregulated sector through unfair competition from subsidised modes, harness its strengths to develop services and improve overall transport quality.	Important	Difficult
17. Provide incentives (particularly financial ones) to leverage information and communication technology to improve service at a lower cost (and thus with a lower subsidy).	Important	More widely acceptable
18. Take advantage of a subsidy reform or an infrastructure project to set up or strengthen a transport authority endowed with contracting powers and monitoring capacity.	Top priority	Difficult

1 — Objectives of the study

1.1. Context

The French Development Agency (AFD) commissioned a study on the socio-economic rationales given for subsidising urban transport. This study has two objectives:

- to detail the theoretical foundations of these subsidies, show their actual implementation in sample cities, and analyse their consequences from the perspective of the various economic agents (project owners, operators, users, etc.).
- to formulate recommendations that will enable AFD to strengthen its dialogue with borrowers. To be truly usable, these recommendations must be pragmatic and take into account the diversity of institutional and organisational contexts. They form an operational framework of best practices to support dialogue and decision-making.

1.2. Theoretical framework and definition of subsidies considered in the study

1.2.1. Definition of a subsidy

At first glance, the definition of a subsidy may seem quite straightforward: financial assistance granted by the public authorities to external entities in order to promote an activity of general interest.

But questions arise about the limits of this definition, with regard to the nature of the aid, the granting conditions, and the possible links between the public authorities and subsidised entities.

The French law of 31 July 2014, relative to the social economy, uses the following definition: "*Subsidies, as understood in the present law, are optional contributions of any nature, defined in value upon allocation, decided by administrative authorities and entities in charge of an industrial and commercial public service, justified by general interest and intended for the execution of an investment project or investment deed, or to contribute to the development of activities or to the overall funding of the activity of the beneficiary private-law body. These actions, projects or activities are initiated, defined and implemented by the beneficiary private-law bodies."*

Several points in this definition, to which we will return, should be highlighted:

- "*Optional nature*"; "*Decision by administrative authorities and entities in charge of an industrial and commercial public service*": the public entity that grants the subsidy is not bound to do so, but chooses to do so. This raises the question of recurring subsidies and of those provided for by law, which we will discuss in the report.
- "*Assistance of any kind*": a subsidy does not have to be a direct financial payment.
- "*Justified by a general interest*"; "*Intended for the execution of an investment project or investment deed, or to contribute to the development of activities or to the overall funding of the activity of the beneficiary private entity*": what characterises the subsidy here is its ultimate purpose, i.e. the general interest. However, its direct objectives and recipients may vary.
- "*Beneficiary private-law bodies*": this refers not to "*private-sector companies"* but rather to any body not subject to administrative law. The definition appears restrictive: we will see, on the one hand, that activities funded by public authorities within the scope of what appear to be subsidies are sometimes performed by entities which are themselves public and subject to administrative law; and, on the other hand, that the beneficiaries are often, and sometimes in a fairly direct way, the users, i.e. natural persons, not legal entities.

As part of its objectives in the fight against unfair international competition, the World Trade Organization, in its 2006 World Trade Report,[6] has also emphasised accounting for subsidies that are not direct transfers. These also exist in the urban transport sector:

- The recipients of assistance are not necessarily the ultimate beneficiaries: there are intended indirect effects, and others that are unintended.

- The assistance is not necessarily financial:
  - The State can use its powers (for example: the State can act as a guarantor so that a beneficiary can gain access to private loans for which it would have otherwise been ineligible; moreover, in this example, the beneficiary will probably have access to a risk-free interest rate more attractive than it could have otherwise obtained).
  - The State can supply goods and services at a price below the market rate.
  - The State can define regulatory policies.[7]

Ultimately, we can keep as our unifying thread the idea that a subsidy is defined by its ultimate purpose: to contribute to a general-interest activity; and by the nature of the grantor, a public entity. We will describe its other characteristics further into the report, in the specific case of urban transport.

1.2.2. Types of urban transport subsidies

This study considers the following subsidies:

- Investment assistance (CAPEX):[8] transfer of capital, in cash or kind,[9] by the public authorities to partly or wholly fund the cost of acquiring fixed assets
  - Funding of infrastructure and fixed equipment;
  - Funding of rolling stock;
  - Tax exemptions (on investment);
- Operating assistance (OPEX):[10] transfer from the public authorities to the operator
  - Supply-side subsidies: assistance paid per service unit produced; these reduce certain charges or encourage certain activities.
  - Balancing subsidies: they cover operators' losses arising from the implementation of an economic policy that entails setting fares below the average cost of production.
  - Contributions to certain costs (infrastructure, operation, debt, etc.).
  - Fare compensations (difference between the normal fare and the concessionary fare, which may go as far as free travel);
  - Tax exemptions (on fuel, sales, etc.);
- User assistance: transfer from public administration to user
  - Demand-side subsidies: funds paid per consumed unit of a good or service;
  - Compulsory payment by employers of part of their employees' transport expenses;
  - Fuel tax exemptions, or even fuel price subsidies;
- Regulations implemented by the public authorities
  - Public transport monopoly or pseudo-monopoly;
  - Price regulation: for example, price of fuel in some countries.

[6] World Trade Organization (WTO) – 2006 World Trade Report – Chapter II-B: Definition of subsidies.

[7] The legal definition in the WTO Agreement on Subsidies and Countervailing Measures (SCM) is more restrictive, and does not include this aspect.

[8] CAPEX = Capital expenditure.

[9] In the former case, the State gives money to the beneficiary, who is bound to use it to acquire fixed assets; in the latter case, the State purchases the good then gives it to the beneficiary.

[10] OPEX = Operational expenditure.

1.2.3. Main objectives of subsidies

The study concerns the analysis of subsidies to urban transport, whether individual or collective. In the remainder of the report, we will see that urban transport subsidies do not only include public transport subsidies; however, the latter first come to mind when addressing the subject. In this sub-section, we thus endeavour to draw up a first list of the main economic reasons given to justify subsidies to urban public transport (UPT).

The appropriateness of these measures will be addressed further on, especially as generalised subsidisation of UPT is not inevitable: small-business public transport services, such as the minibuses which cover a large share of mobility needs in many developing-country cities, usually receive no subsidy; there are also BRT and metro projects where operating revenues cover costs, excluding depreciation.

Further, in this subsection, we consider a comprehensive framework in which the subsidy is the difference between the unit cost of producing the service and the price paid by the user, multiplied by the number of users.

This definition gives rise to a first determining factor: the number of users, i.e. the volume of UPT services. We assume that this volume is given (it depends on decisions by the transport authority)[11], and we analyse the other causes, related to the gap between the production cost and the user fare. To do this, we proceed with searching for the collective optimum, based on the principle of pricing at the social marginal cost, and progressively adding more and more diverse hypotheses to this general principle.

1. A first set of determinants comes from the technical characteristics of UPT production. Indeed, UPT, or at least infrastructure-intensive modes, is recognised as having the characteristics of a natural monopoly, whose marginal cost of production is generally lower[12] than the average cost; marginal-cost pricing thus creates a deficit that must be covered by a subsidy. This subsidy will be all the higher as the marginal cost differs greatly from the average cost. In this respect, for example, a subsidy for a metro, which is a capital resource, would be higher than that for buses, where economies of scale are generally thought to be lower.

2. This level of analysis must be supplemented by considering that the marginal cost in question must include not only the cost of production, mentioned above, but also the marginal costs of the externalities directly generated by UPT use. We know that these include environmental externalities (pollution, noise, greenhouse effect, water pollution, etc.), which are not entirely negligible in UPT, though lower than for individual transport.

3. Added to these external costs are congestion externalities. Again, they are not as high in UPT as in individual transport, and are less well known; they seem chiefly to concern comfort and punctuality rather than travel time as such.

4. UPT is characterised by the existence of the “Mohring effect”: when traffic increases, the operator increases service frequency to meet this demand; as a result, the marginal user, who prompts this rise in frequency, provides a benefit to the existing users, since the increase in frequency directly causes a reduction in waiting time. This effect is particularly strong for off-peak services. However, some economists question this rationale.

5. Agglomeration effects are another type of positive externality: the improvement in travel conditions induces, through a reduction in the effective density of the city (the ease and low cost with which economic agents can interact to trade goods and ideas), an improvement in business productivity. This improvement reduces the collective cost of UPT – as well as the collective cost of individual

[11] The equilibrium of supply and demand, and consequently UPT user volume, is of course impacted by the level of subsidy and its effect on fares (see paragraph no. 6 in the present subsection).
[12] This may be more complex if lines are saturated or when the cost function is a step function.

and road transport modes, provided that these help to increase access (i.e. as long as the congestion externalities do not exceed the agglomeration effects).

6. So far, we have assumed that we were in a first-best situation, and have not considered other means of transport, i.e. individual transport, mainly on the roads. If individual road transport is priced as per the principles described above, all is well. Otherwise, the discrepancies in individual transport pricing impact on UPT pricing, in ways that vary according to whether road and urban public transport are complementary (rarely the case) or in competition (the most common situation). In the latter case, UPT prices must be increased or, most often, reduced depending on whether road prices are above or below the level to which the aforementioned principles would lead.

7. The previous points derive from an analysis that is valid in situations where the public authorities can levy tax without it having a specific cost. But the authorities may face budgetary constraints of varying severity, depending for example on the size of the deficit they run: using public funds for transport is thus not economically neutral (it competes with alternative uses: other spending or tax cuts). Another reason stems from the idea that operators, especially public companies, in a monopoly situation have no strong incentive to improve their productivity; and that marginal-cost pricing is dangerous in this respect because it gives no incentive to reduce fixed costs (quite the contrary); which induces a harmful situation in which the public company expends its energy trying to justify the subsidies it receives. These reasons often encourage setting prices above marginal cost, which thus reduces the subsidy needed to cover the financial deficit. The corresponding pricing systems are of the Ramsey type; they lead to increases in price relative to marginal cost that are inversely proportional to the elasticity of demand. Within the scope of urban costs, these issues must be considered and weighted against each other at the level of the conurbation.

8. Added to these considerations, based essentially on efficiency, are concerns having to do with income distribution and access to transport. Transport authorities manage pricing according to their specific preferences on the efficiency-distribution scale, for example by reducing peak-time fares or by distinguishing fares for certain categories (unemployed, retirees, low- income, etc.). Adjusting fares in this way indirectly impacts on the subsidies associated to the fares. This is the social aspect of subsidies.

1.2.4. Subsidy impact channels

Subsidies, whatever their objectives and forms, have a double impact on the entities that benefit from them:

- They provide extra resources to the entity;
- They influence the decisions of the entity, which adapts its organisation and activities to optimise the amounts received. These adaptations may help or harm service quality and efficiency, depending on the subsidy award terms and conditions.

Financial statement items	Possible subsidy mechanisms	Potential impact on decision-making
Turnover	Supply-based subsidies and price compensations	Encourage the stakeholder to expand supply, if the subsidy is high enough for the marginal cost to be lower than the marginal revenue.
	Financial assistance to users	By reducing the private cost, increases demand and thus encourages the operator to expand supply, if the subsidy is high enough for the marginal cost to be lower than the marginal revenue after subsidy.

	Performance-related pay	Through a remuneration structure based not (or not only) on turnover but on performance indicators, the operator has a direct incentive to meet its contractual targets.
Operating costs	Fuel tax exemptions	- Leads the operator to underestimate this cost relative to its social cost. - By reducing the marginal cost, incentivises the operator to expand supply, if the subsidy is large enough for the marginal cost to be lower than the marginal revenue.
	Contribution to certain costs	
	Free or reduced-cost access to public infrastructure, reducing operators' marginal operating costs (dedicated bus lanes, etc.)	By reducing marginal cost, incentivises the operator to expand supply, if the cost reduction is large enough for the marginal cost to be lower than the marginal revenue.
Fixed-asset costs	Funding support for basic infrastructure for a specific mode	Allows the stakeholder to bear only part of the cost of new infrastructure, which would not otherwise be profitable.
	Funding support for rolling stock	Enables the stakeholder to bear only part of the cost of fleet expansion, which would not otherwise be profitable; and thus promotes increased supply.

Figure 1: Subsidy impact channels

1.2.5. Organisation of the report

After presenting city cases in chapter 2, the report organises the various points covered above into four parts:

- **Micro-economic rationales**: the existence of economies of scale and of negative or positive externalities distorts the micro-economic equilibrium, which thus does not occur at the optimal level of supply. These issues will be addressed in section 3.1. This section also deals with future externalities, such as sprawl.
- **Social rationales**: access to employment and services, irrespective of income level, through access to transport. These issues will be addressed in section 3.2.
- **Financial consequences**: owing to the two issues above, transport operators tend not to make enough profit to be sustainable, whereas their activities are useful for society; section 3.3 analyses this fact and its consequences.
- **Recommendations**: these are covered in chapter 4.

2 — Overview of subsidies in a worldwide selection of cities

This part of the study provides an overview of the terms and levels of individual and public transport subsidies, taken from a varied sample of cities, some of which are representative of conurbations where the AFD works.

The sample consists of the following nine conurbations:

- Paris and London, representative of large conurbations in developed countries, but where public transport is approached in fairly different ways;
- Cairo, Rabat and Lagos for Africa;
- São Paulo and Medellin for South America;
- Hong Kong and Mumbai for Asia.

The sections below summarise the salient points of the factsheets, which cover the following:

- Description of the city (income level, density, growth, challenges);
- Qualitative description of the transport supply (public and private) and its changes over time;
- Description of the various subsidies; their levels, terms and mechanisms; and their financial burden for the public authorities,
- Description of the beneficiaries of these subsidies (social and redistributive impacts).

2.1. Paris

In France, one in five people live in the Ile-de-France region, which, put simply, is constructed around a single centre: the capital, Paris. The city of Paris is very dense (21,650 inhab/sq.km), unlike the outer ring of towns, which are more rural. Current regional development policies aim to increase density in the inner ring of suburbs around Paris to stop urban sprawl in these outer areas.

The modal share of public transport within Paris is about 30%, and the modal share[13] of private cars is below 10%, whereas in the whole of Ile-de-France, and especially in the outer ring area, cars dominate, with a modal share of 38% versus 20% for public transport. The average number of trips across all modes and for all reasons is 3.87 per person per day.

The regional public transport network is mainly radial, with interconnections in Paris. It comprises suburban trains and a highly structuring regional express network (RER), supplemented by a network of feeder buses to the rail stations. Within Paris, public transport density is very high, with a fine-mesh system of metro and bus lines. The tramway projects in progress and the project for a circular automated metro line (Grand Paris Express) will improve suburb-to-suburb service without travelling via Paris.

The main road network comprises radial motorways which converge on expressways that bypass the city: the ring road (5km from the centre) and the A86 motorway (7-10km from the centre). Peak traffic conditions are difficult, especially when joining the motorways. The city of Paris has a network of wide avenues highly susceptible to traffic jams. In the city centre, parking is very restricted. Current projects tend to constrain car use in the capital, by pedestrianising certain streets and reducing speed limits.

Public transport is organised by the Ile-de-France Transport Authority (STIF). Operation is mainly funded by a transport tax, the “Versement Transport”, and public contributions from the regional council and county councils. The “Versement Transport” is a payroll-based contribution payable by

[13] The modal split of travel in Paris and Ile-de-France comes from the findings of the Transport Master Survey (EGT) conducted in 2010 among 43,000 Ile-de-France residents. The modal shares given above refer to the individual mobility of Paris and Ile-de-France residents, and are based on the number of trips per person per day in 2010, including modes other than public transport and private cars, such as walking, two-wheeled vehicles, etc.

employers with more than nine employees in a well-defined area (see subsection 3.2.1). Investment is funded by a portion of road fines and by public funds. The overall share paid by users is 30% if one considers operating and rolling stock costs only, or 25% if one includes all investment.

The “de-zoning” of transit passes (elimination of zone pricing for pass holders at certain times), decided in late 2014, will further reduce, by 400 million euros, the share of service funding derived from sales revenue (out of STIF’s annual budget of more than 8 billion euros). This loss of revenue is not fully offset by the 210 million euro increase in the transport tax accepted by the Chamber of Commerce, and 190 million euros will thus come from an increase in the funding awarded yearly by the regional council. The impact of this measure on the sustainability of the public transport budget, and primarily on investment, in Ile-de-France, will need to be evaluated in the medium term.

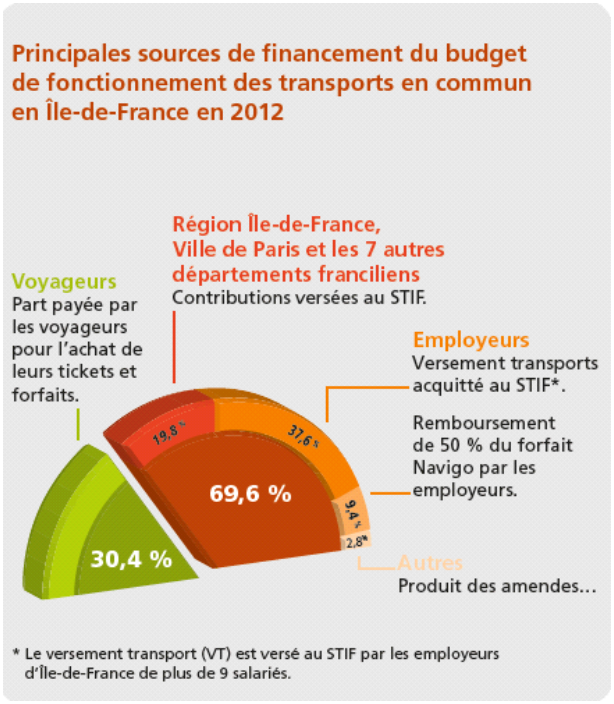


Figure 2: Funding of Ile-de-France public transport operating budget (2012) – Source: STIF

Funding channels for public transport investments are fairly complex but generally involve public money, whether for network extensions (State-Region project agreements), system upgrades, or service quality improvements. Rolling stock is funded by the operator (RATP), but depreciation costs are included in the operating costs covered by STIF.

The road network is managed by the Regional and Inter-County Directorate of Infrastructure and Development (DRIEA-IF), which is now funded by the State. An “eco-tax” project (taxing heavy goods vehicles on the main free arteries of the French road network) was intended to fund future investment, but this project met with social resistance. Private vehicles are taxed when registered; since 1956, there has been an annual vehicle tax in the form of a sticker, but this was abolished in 2000. The revenue from taxes on fuel, i.e. VAT and the TICPE[14] (Domestic Tax on Energy Product Consumption, formerly TIPP), which amount to 23.6 billion euros per year, is distributed to the State, the regions and the counties. Moreover, the special tax on certain road vehicles, known as the “axle tax”, is intended to offset extra road maintenance and reinforcement spending related to use by vehicles with a permissible maximum weight of over 12 metric tons and registered in France.

[14] Diesel fuel at the pump and for business are taxed differently: a fraction of the TICPE tax is reimbursed to road-transport operators, and since 2007 this amount has been determined region by region, by the difference between the TICPE rate in force in the region of purchase and the rate of €39.19/hl.

Other modes of transport are expanding fast, although their modal share is still low. These modes are the Vélib' self-service bike system, the operation of which is funded by the city's billboard revenues; and the Autolib' self-service electric cars, which are mostly self-funded.

The main challenges include securing the sustainability of the system, which is necessary to maintain and develop service quality. In the longer term, the funding of the Grand Paris Express automated metro network is also an important issue; economic and land value impacts should help fund the project.

2.2. London

London is well known for its urban toll system, introduced in 2007, which imposes a charge of about 15 euros on vehicles using the restricted access zone (about 21 sq. km in central London) between 7am and 6pm, Monday to Friday. Payment is per day, and entering the zone even once during the applicable period equates to a whole day. London also stands out for the degree to which private car use has receded: modal share fell from 42% to 33% between 2000 and 2012, and the car ownership rate fell from 178‰ to 146‰ in central London and from 247‰ to 211‰ in outskirts between 2001 and 2011. Rail, bus and walking each represent a good fifth of Londoners' 2.2 daily trips.

Could this be a case of successfully internalising externalities? That, at least, is how the council presents it, calling its urban toll "congestion pricing".

The second strand of London's policy is the intention to increase the quality and volume of public transport supply. This has led, on the one hand, to reinvestment of urban toll revenue in expanding bus supply; and, on the other hand, to increased investment in transport infrastructure.

Regulation of the sector and part of its management have been assigned to Transport for London (TfL), reporting to the Greater London Authority (GLA), an administrative superstructure that acts as a Greater London council. TfL has directly managed the underground metro network since its private partner was liquidated. TfL also manages the bus networks, where several private-sector companies have public-service delegations through contracts with London Buses, a TfL subsidiary. The overground metro lines (Overground and Dockland Light Railway) and the tramway are concessions awarded by TfL. TfL is also responsible for river buses (services provided both directly with its own fleet, and partly by private-sector operators under licence with set fares). TfL also conducts many transport-related oversight and investment activities, including for private transport (toll management, taxi licences, traffic lights, maintenance of the main road network, etc.).

Inter-city trains, which fall outside TfL's remit, operate under franchises on the network owned by Network Rail, which carries out investment through contracts on a cofunded basis with the Ministry of Transport (in 2012-13, 6.4 billion euros of investment subsidies nationally, including a significant share for projects around London).

The major London transport project is Crossrail, a new 118 km railway that will run east-west across Greater London. Construction began in May 2009. The cost, more than €19 billion, is funded by a state subsidy of about €6 billion, by the GLA and TfL, primarily through a loan (nearly €2 billion from the European Investment Bank), and also through the following three funding sources:

- A contribution from businesses based within the Greater London perimeter, through a surcharge called the Business Rate Supplement (BRS), based on the rental value of corporate property (up to 2% of the rental value of the premises);

- Section 106 of the 1990 Town and Country Planning Act. This section provides that authorities issuing the administrative authorisations required to construct a new building may request a

financial contribution from the developer to cover the costs borne by the authorities, due to the authorised new buildings;

- The Community Infrastructure Levy (CIL), a fiscal tool introduced to enable taxation on planning gain, which replaces section 106 in cases where it is necessary to levy expanded contributions on multiple developers. Section 106 and the CIL are mutually exclusive: a developer is subject either to section 106 or to the CIL for the same infrastructure.

The rest will come from various sources, particularly sponsoring by private-sector stakeholders, and revenue increases generated in the first years of operation.

The sector depends heavily on the public authorities' backing. Despite high fares (€2.70 for a single trip in zone 1 paid for with an Oyster card, versus €1.70 per ticket in Paris, with average fares of €0.22 per kilometre for buses, and €0.21 for trains), TfL does not cover its OPEX, making an operating loss of 29% in 2013-14 (forecast), due mainly to the 25% gap between bus fare revenue (transferred to TfL) and TfL's payments to operators. However, the various subsidies, which amount to nearly one-third of revenue, more than offset this deficit.

TfL thus generates some free cash flow and uses it to cofund part of its investments, complementing subsidies from the State and the GLA. In 2013-14, TfL spent the equivalent of 79% of its budget on investment (half on Crossrail), funded 86% by subsidies (mainly from the Ministry of Transport, but also from a general GLA subsidy and from a transport tax on business) and 14% from its own funds, i.e. indirectly through subsidy too, because TfL's free cash flow comes, as we have seen, from operating subsidies.

The funding of London's transport thus involves considerable national resources (subsidies) and local ones (budget support, allocated levies, sales revenues). Despite the maturity of the conurbation, public funding is primarily allocated to investment in new infrastructure. This is the price paid by the British capital (population: more than 8 million) to promote a modern, efficient public transport system.

2.3. Cairo

Cairo, the world's third-largest conurbation with 20 million inhabitants in 2008, according to the Japanese International Cooperation Agency, has seen profound urban change, with the sprawl of a historically extremely dense conurbation and the construction of new housing estates (named "New Urban Communities"), some of them a long way from the city centre. This rapid transformation of the city, from a highly concentrated centre to a more satellite-based organisation, has strengthened the need for coordinated planning to address all urban issues, particularly transport. The Greater Cairo Transport Regulatory Authority, set up for this purpose in late 2013, was still in its gestation phase as of mid-2014.

A low car ownership rate (52‰ to 94‰ depending on sources), due to income levels, restricts private vehicle travel to one quarter of motorised transport, despite a very high level of fuel subsidies until recently (at the pump, 42% for petrol and 62% for diesel). The public bus service (31% of motorised transport) is of low quality. The metro is very popular and fairly egalitarian (a household survey from 1998, cited by UN Habitat in 2011, showed that if the Cairo population is split into five household income bands, only the top category, representing 2% of the population, had fewer than 14% metro users), but the system has only a small modal share (currently 10%) because at present it has only 87 km of track: lines 1 and 2, linking the north and south of the city, are in service, while line 3 (east-west across the capital) is gradually entering service (full operation was initially scheduled for 2017, but will suffer a hard-to-quantify delay). Three other lines are planned. Likewise, tram and train do not have the geographical coverage required for a mass service, and also suffer from ageing rolling stock and poor management: each represents 1% or less of motorised transport. The key link in the transport

chain is therefore the conurbation's 80,000 private minibuses, which provide one-third of motorised trips.

Minibuses and cars, which together represent 60% of motorised transport, are criticised as being responsible for traffic jams and pollution. It is estimated that congestion in Cairo, in 2012, had a direct cost of 1.4% of Egyptian GDP (the value of time lost in jams accounts for 37% of this amount, and the extra fuel consumed for 38%). Indirect costs are far higher, when one includes all the business activities deterred by the prospect of congestion. If the main economic development trends remain the same, and nothing is done to change the modal split, congestion will worsen as many vehicles new are bought, and its annual cost will likely be multiplied by 4.6 by 2030. Even assuming strong Egyptian GDP growth of 5% per year, the cost of Cairo's congestion could thus rise to 2.7% of GDP in the same period.

The solution may have been partly provided in an incidental way. In July 2014, the Egyptian government announced the end of fuel subsidies, with prices rising overnight by as much as 70% for diesel; and the introduction of a new food-subsidy system, to reduce the colossal budgetary cost of subsidies (one-quarter of public spending, as Egypt spent seven times more public resources on fuel subsidies than on healthcare). The price of electricity, which is also heavily subsidised, is expected to be gradually adjusted in the coming five years to soften the impact on the poorest people. Egypt thus stands apart from typical North African and Middle Eastern countries, where, on average, fuel subsidies account for 20% of public spending. It hopes to rebalance its public finances, which have been hit hard by three years of political instability.

A more direct measure against pollution was the introduction in 2008-2010 (with a second phase from 2011) of a National Taxi Replacement Scheme to help taxi owners comply with the Traffic Law: since July 2011, public-transport vehicles (including taxis) more than 20 years old have been banned. This scheme is partly funded by the African Development Bank, the Nasser Social Bank and the Egyptian Government. More than 40,000 taxis have been replaced nationwide, mostly in Cairo.

At the same time, the Egyptian authorities are extending the metro network: the National Authority for Tunnels is building the extensions and owns the lines. Two lines are being built and cost respectively, €2 billion and €1.6 euros. The network is managed by a public company, Cairo Metro, which covers its operating costs but receives investment subsidies.

The Cairo authorities' efforts are also focused on the bus network, operated by two public companies: the Cairo Transport Authority (CTA, 2,500 buses) and its subsidiary the Greater Cairo Bus Company (900 buses), which are massively subsidised. Fare revenues only cover 31% of operating costs. Unfortunately, this assistance is largely squandered by the operator's inefficiency. In its bus business, the CTA employs more than nine people per vehicle.[15] Public buses have seen their modal share halved since 1998, from 40% to 20%. In addition, the rolling stock is fairly old and highly polluting, and the fare is estimated to be less than half of what it should be, give the negative externalities generated. This raises questions about the operator's efficiency and how subsidies are used.

2.3. Rabat

The 2000s in Rabat were a textbook example of the launch of pro-active transport infrastructure planning and construction. The Moroccan capital, now the heart of a conurbation of 2 million people, with a river cutting through it, had previously conducted no major public-transport investment, and only had a very incomplete public bus service. As the seven main municipalities in the conurbation had no joint administration, the transport service was run by each of them in a fragmented way.

Conurbation-level planning was launched in 1994 with the creation of the Rabat-Salé Urban Agency, although it has not played a key role in transport. In 2005, the Bouregreg Valley Development Agency (AAVB) was set up by royal decree; the River Bouregreg separates Rabat and Salé. From the start,

[15] Twice the necessary number, according to the World Bank (Proposed Urban Transport Strategy, 2006).

this agency has received heavy funding in subsidies, mainly provided directly by the Moroccan State. The Agency is tasked with developing the valley in all respects: construction of bridges and tunnels, housing, cultural amenities, heritage conservation, etc. It oversaw the preparation and execution of the project that gave the conurbation its transport spine: the Rabat-Salé tramway. It offers a new mean of crossing the river, which is difficult via the road bridge at peak times due to congestion.

The infrastructure was funded mainly (72%) by subsidies from Morocco's public authorities, including in particular the equity capital (€175m) with which the AAVB endowed its subsidiary in charge of the project: the Société du Tramway de Rabat Salé (STRS). The rest of the infrastructure, and the rolling stock, were funded by concessional loans directly to STRS. The remit of the Moroccan State's Transport Reform Support Fund (FART) was very recently amended to enable it to contribute to servicing STRS's debt. Despite optimistic forecasts in the feasibility study, STRS alone is apparently unable to cover repayments. Peak-time tramway traffic is a success, but low off-peak demand was not foreseen, and has forced STRS to cut single ticket fares from 7 to 6 dirhams (about €0.50 as per the exchange rate, but €1.4 euros at PPP) and also to cut pass prices. As a result, despite apparently sound management (through an operating contract with Transdev), operation just covers OPEX (99% coverage in 2013). However demand evolves, it is unlikely that the company will make enough revenue to service its investment debt. For this reason, a large proportion of the funding for line extensions is expected to come from the Moroccan authorities.

Buses are also an interesting case. Rabat's publicly-run buses were taken over in 2009 by a private-sector operator, which was given a two-fold mission: develop business by investing in new buses (without external funding), and (slightly) reduce fares. Unable to generate the same turnover than the previous operator and burdened by inherited costs and competition from taxis, the company never covered its operating costs. However, it still passed the order for the 350 buses it had committed to purchase over four years, but actually went bankrupt after 16 months. The company was taken over in 2011 by the Al Assima Group of Municipalities (a new local body initially including the municipalities of Rabat, Salé and Temara), which was created especially, received an injection of State funds to finance the fleet extension, and was allowed to increase fares. By mid-2013, the company was still making an operating loss of about 1.3 million euros per month, although the loss was narrowing. The public authorities conducted a recapitalisation of nearly 50 million euros in mid-2012 (thus multiplying the company's equity by 3.5). The current investment plan of more than 70 million euros (devoted mainly to buying new buses) is chiefly funded by subsidy, by the State's general budget, by the General Directorate of Local Authorities (VAT funds), and the Al Assima Group of Municipalities. The public authorities' stated objective is to shift the economic equilibrium of operations towards higher levels of both supply and profitability, thus expecting increasing returns. This shift should be helped by planned investment in dedicated bus lanes.

Despite the investment carried out, public transport supply remains limited and insufficient to meet needs. The conurbation's population walks a lot (two-thirds of trips),[16] and taxis account for more than 10% of motorised transport (of which 9% are white "large taxis", typically Mercedes over 30 years old, which carry about six passengers on average, mostly on set routes between the city centre and the outskirts, and charge fares similar to those of buses), despite the absence of fuel subsidies, which is rare in the region. The large number of taxis causes considerable externalities, primarily due to the poor condition of the fleet, which generates CO_2 emissions, and despite the government's financial contribution to scrappage schemes. The challenge is thus ongoing, and while it should be possible to correct some inefficiencies rather than offsetting them with subsidies, especially in the bus segment, it is hard to see how the public transport sector can develop without strong support from the public authorities in the medium term, especially for investment.

[16] Threshold distance not provided.

2.4. Lagos

Nigeria's economic capital has 18 million inhabitants. It is experiencing annual population growth of 3-5%, which in 2015 could make it the world's third-largest conurbation according to UN Habitat's definition. This tentacular expansion poses very substantial challenges regarding all types of infrastructure. Population growth, coupled with high economic growth that has enabled heavy buying of vehicles (currently 257 per 1,000 inhabitants), is causing Lagos to suffer increasingly from congestion due to cars (12% modal share of motorised transport, of which 5% for taxis) but due especially to the 75,000 minibuses in the conurbation (72% share of motorised transport). Yet in recent years Lagos has often conveyed the image of a conurbation that has managed to reduce its transport problems, whether thanks to successful communication or to actual improvements.

One interesting aspect of Lagos is that the public sector has a real intent to organise and to take over transport that used to be provided by the private sector, more by transferring control than by modal transfer. For buses in particular, Lagos's public agencies have invested in dedicated lanes and other infrastructure to control and organise (into franchises) a service that was once largely delivered by private-sector buses. The chief purpose of this approach is probably to exclude minibuses from certain key routes when control is transferred, in order to limit their congestion.

As part of the general push to improve and rationalise public management, in the 2000s Lagos State created agencies responsible for the transport sector. The Lagos Metropolitan Area Transportation Authority (LAMATA) is charged with coordinating the sector, in order to steer the required investment in a truly comprehensive approach. It is directly responsible for the Bus Rapid Transit (BRT) system, part of the bus operations, rail investment, and part of the ferry operations. It manages certain activities itself (road maintenance on main bus routes), coordinates, advises and regulates the other stakeholders' work (recommendations on public policy, trips, etc.), collects the revenue allocated to the Transport Fund, and coordinates vehicle inspection and licence granting activities.

To cover its operating budget (€1.9m in 2014), LAMATA receives funding from various sources, including substantial subsidy components. A transport fund partly covers its operating and investment costs. The fund receives contributions from the federal budget and various payments related to road use (50% of revenue from new vehicle registration, vehicle administration, road tax, parking and tolls). LAMATA also receives a modest direct operating subsidy from Lagos State, and franchise commissions paid by operators for road use, commissions for use of terminals and depots, and advertising revenue.

To cover its investment budget (€147m in 2014), LAMATA uses the transport fund mentioned above and a €115 million investment subsidy from the Federal State, which is chiefly allocated to rail and BRT infrastructure. This subsidy is financed in particular by concessional loans obtained from international financial institutions, on-granted to LAMATA.

The metro-type rail system is designed as a large-scale piece of infrastructure. The first of seven planned lines, which is 27 km in length and is to carry an estimated 700,000 passengers/day, has been under construction since 2010. The second is in the preliminary studies phase. The estimated total cost of both lines is €1.1 billion. The majority of funding is being spent on the blue line, with the concessionaire providing rolling stock and equipment. The red line also received subsidised funding for its initial design, but most funding, including for infrastructure, will be provided by the private sector under the concession contract.

The BRT network has a first section 22 km long, and is currently being extended by 13.5 km. The operators' fare revenues cover their operating costs, even allowing them to pay franchise commissions (though these do not cover the cost of infrastructure investment).

The PPP transport schemes in Lagos are relatively similar in terms of the assignment of roles, even though investment effort and technical and legal provisions differ according to the type of service. The authorities invest in infrastructure, except in theory for the red line of the metro, and the private-sector

companies provide rolling stock and have access to this infrastructure subject to certain financial conditions and service undertakings (fares, coverage). Contractual arrangements vary by mode, depending on the infrastructure: licences for ferries, concession for trains, and franchises for buses.

We can thus see that in Lagos, public funds have been injected in infrastructure to improve service quality (especially operating speed), at the same time as the public authorities have taken control of the routes in question.

2.5. São Paulo

São Paulo in Brazil is the world's seventh most populous conurbation. The city is a leading financial, trade and industrial centre. It is also segregated: the northern and eastern districts are home to low-income categories, whereas the most affluent people live in the central and western areas. Informal housing (*favelas*) is developing unhealthily on the edge of the city, eating up protected spaces and posing environmental and social problems.

One-third of trips are made on foot, one-third by public transport (mainly buses) and one-third by private car (the ownership rate is very high). The number of trips per person per day varies between 1.5 and 2.7 according to income band. Congestion is widespread, and investment is under way to try to improve the situation: doubling the length of the rail network, construction of a ring road and development of dedicated bus corridors, all subsidised by Federal State funds. Another funding mode is also used: the authorities auction extra construction rights for certain zones that they wish to develop. The collected funds are then invested in public infrastructure projects in the zone in question (social housing, transport infrastructure, etc.).

Public transport consists of a metro-train network, representing 8% of trips in the conurbation, and a vast bus network with more than 16,000 vehicles.

The metro network currently comprises five lines, with lines 4 and 5 being extended and a new line under construction. These lines are operated by the public company Companhia Do Metropolitano de São Paulo (CMSP), except for line 4, which is run by the rail company ViaQuatro in a public-private partnership with São Paulo State. The 30-year concession began in 2006.

The purpose of this contract is the operation of line 4 as well as the partial funding and the integration of the rolling stock and of the signalling and communication system. São Paulo State used its own funds, plus loans (from the World Bank and the Japanese Bank for International Cooperation) to pay for all of the infrastructure and 80% of the rolling stock. The concession contract is split into three phases and the concessionaire has three types of revenue:

- Payments to the concessionaire, in two stages, before operation starts;
- Fare revenue: the risk of a revenue shortfall due to incorrect traffic forecasts is shared by the concessionaire and Sao Paulo State for a certain period (up to six years after the start of commercial operation of phase 2). During this period, the concessionaire will be compensated if revenue is lower than forecast, but must also share the upside with the delegating authority if revenue is above forecast. Once this period has elapsed, ViaQuatro will assume traffic-related risks alone;
- Other revenue from advertising, retailers, etc.

As for the state-owned company Metrô (CMSP), which operates lines 1, 2, 3 and 5, its revenue covers 103% of operating costs (excluding depreciation), with São Paulo State only paying compensation for free admissions (for over-60s, children, etc.). The remainder of its non-fare revenue come from property rental, advertising, media, etc.

Coverage Rate 2012-2013

In R$ million

Description	2013	2012
Total Revenues	2.055,10	1,987.15
Fare + non-fare revenues	1.720,33	1,632.87
Gratuities - reimbursement by the São Paulo State Government	274,89	274,52
Other operational revenues	59,88	79,76
Total Expenses	2.001,50	1,944.05
Personnel	1.487,11	1,314.36
Materials	63,64	66,17
General expenses	450,75	563,52
Revenues/ expenses	102,68%	102.22%

Source: Financial Management Control

Figure 3: Coverage of Metrô costs in 2013 – Source: Annual Report 2013, Metrô

Public subsidies also contribute to investment in the metro network's extension, maintenance and upgrading. Out of an annual total in 2013 of 3.057 billion Reales, about 97% came from São Paulo State, 2.6% from São Paulo City Council, and 0.4% from other Metrô company resources.

The six suburban train lines are operated by CPTM (Companhia Paulista de Trens Metropolitanos), which is owned by the São Paulo State Secretariat for Transport.

The company's revenue comes from fares, other non-fare revenue (shops, advertising, etc.) and São Paulo State subsidies, which contributed 39% of total revenue in 2013 (31% in 2012). This year-on-year rise in the share of subsidies is a form of financial compensation for the fact that the fare adjustment that was to take place in 2013 was not implemented. CPTM calculated an average revenue per passenger (fares + economic subsidies) of R$2.43/passenger, 22% less than the estimated operating cost per passenger carried (R$3.11). CPTM's revenues therefore only cover 80% of operating costs, despite the subsidies already paid by the State.

in R$ millions	2011	2012	2013
Gross operating revenues	**1,468**	**1,704**	**1,994**
Fare revenues	1,017	1,114	1,160
Other revenues (retailing, advertising, etc.)	55	53	62
State subsidy	397	538	772
Costs and expenditure	**1,615**	**1,830**	**2,377**
Operating costs	718	782	845
Maintenance costs	639	676	779
Administrative expenditure	258	371	753
Revenues/Costs ratio	**0.9**	**0.9**	**0.8**

Figure 4: Coverage of CPTM costs in 2013 – Source: 2013 Annual Report, CPTM

SPTrans, the public company in charge of organising bus services, coordinates eight private operators. Fares are set by the State. Transport was the focus of many violent demonstrations in 2013 after bus fares rose. Overall, passenger revenue covers 80% of operating costs (29% of which comes directly from subsidies). SPTrans uses public funds to invest in terminals and dedicated corridors.

2013 (R$)	Operating income	
Revenue	640,568,743	
of which subsidies	187,389,274	29%

Figure 5: Share of subsidy in SPTrans revenues in 2013 – Source: SPTrans

The Vale Transporte scheme, introduced in urban centres, requires employers to partly cover their poorest employees' transport costs (to be precise, the share of these costs that exceeds 6% of gross salary). It was initially limited to commuting trips, but a monthly version was launched in 2014, giving users weekend access to transport as well. Financial data are provided in subsection 3.2.1.

The road network is extremely saturated at peak times, due to the high car ownership rate and the long distances travelled to work. A UN study estimated that private-car owners drove for more than 2hrs40 a day. In the city centre, the municipality has set up a system called Rodizio, requiring each motorist, once a week, not to use their car during rush hours (7-10am and 5-8pm). The day is determined by the last digit on the registration plate.

The number of road traffic deaths (1,550 per year), relative to the number of trips made in private cars, is eight times higher than in the Paris region: the motor vehicle ownership tax includes compulsory insurance to cover traffic-related personal injury. The use of bioethanol has reduced greenhouse-gas emissions.

2.6. Medellin

The conurbation of Medellin occupies the steep-sided Aburrá Valley. Medellin, located in the middle of the valley, is the second most populous city in Colombia (2.5 million inhabitants) after Bogota. The River Medellin runs through the region from north to south, linking the 10 municipalities. In the 1980s, Medellin was mainly known for its cocaine trafficking cartel. In parallel to the Colombian government's security and military policy, the municipality decided to invest heavily to reduce social inequality and develop the most deprived districts. In 2012, Medellin won the Sustainable Transport Award for its innovations.

The modal split is as follows: 30% of trips by foot, 34% by bus, 13% by car, 6% by metro, and 6% by taxi, with an average of 1.6 trips per day per person. Development projects in the various districts aim to enhance public space and improve access to education, healthcare and mobility. Escalator and cable car systems have been built to connect the hillside districts with the city centre. Special care has been paid to intermodal links between cable car, metro and bus services.

The operation of the public transport system breaks even. Ticket revenue is supplemented by advertising revenue and retail malls in stations. The metro is thought to achieve or exceed OPEX coverage. The public investment related to its construction was chiefly funded by cigarette and fuel taxes. Public-transport fares are set according to socio-economic criteria such as income, housing, access to urban services, etc. The population is split into six categories. The most affluent strata (3% of the population) fund the shortfall generated by the most deprived strata (90% of the population), who enjoy concessionary fares. This differential pricing applies to a cable car line (line L) and to

certain social fares (students and the elderly). The method for determining a person's socio-economic category is described in subsection 3.2.1.

The set fares of the integrated transport system vary according to the number of modes used in a trip, to the user's category, and to whether they have the Civica transport card, a re-loadable contactless payment card.

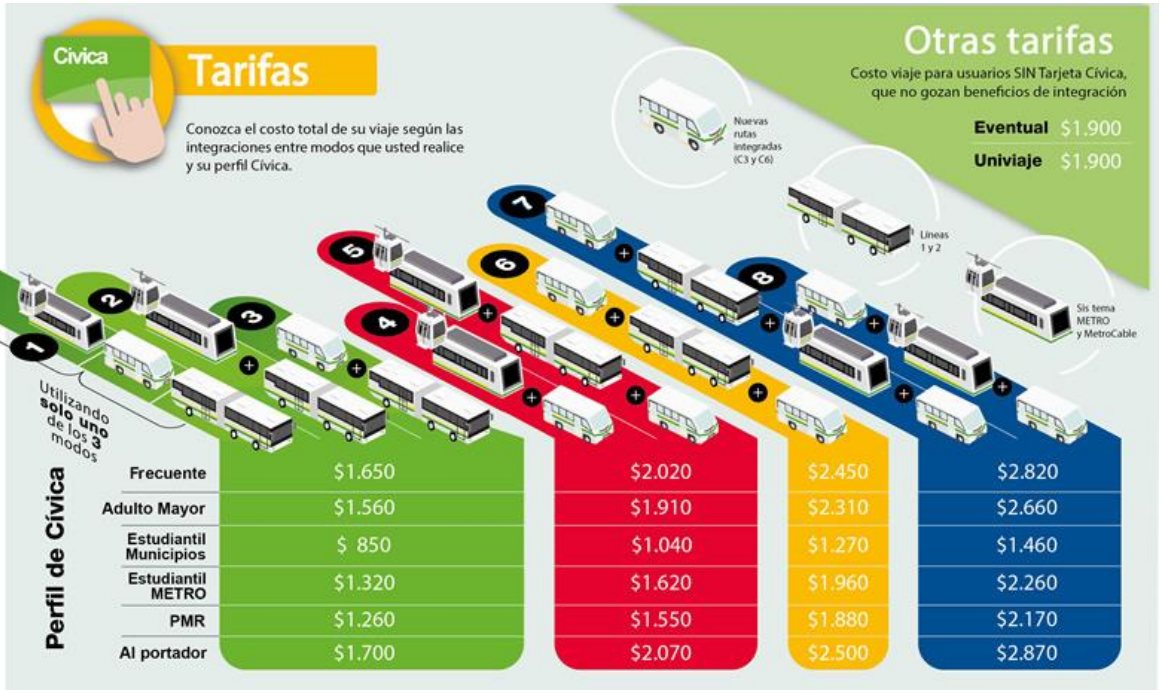


Figure 6: Public transport fares in Medellin (currency: pesos[17]) – Source: Medellin Metro, 2014

2.7. Hong Kong

Hong Kong, a special administrative region of the People's Republic of China, has 7.2 million inhabitants. It is a world-class financial and trading centre. The region primarily consists of the island of Hong Kong, to the south: this is the political and economic heart of the region, though it represents less than 10% of the region's geographical area. The Kowloon peninsula, opposite the island, is today densely populated, with an standard of living lower than on the island. The term "New Territories" generally refers to the region's other territories.

There are very few private cars, with an ownership rate of 82 per 1,000 inhabitants. Car trips' modal share is 16% versus 38% for non-motorised modes and 46% for public transport. Cars are developing in the New Territories, which are less densely populated and less well served by public transport. Numerous transport projects willl be delivered by 2020, including five train lines and seven road infrastructure projects.

The public transport system is diverse and multimodal. It primarily comprises 13 train lines, 12 metro lines and 394 bus lines, which serve all of the region's densely populated areas. There are many ferry lines for travelling between the islands, and two funiculars and a moving walkway system for easier travel up and down gradients. In addition there are minibuses that carry less than 16 people.

[17] Exchange rate for Colombian peso (COP): 1 USD ≈ 2,400 COP.

All public transport is in the private sector, and receives no direct government subsidy. There are two main private transport companies: Kowloon Motor Bus (KMB), which operates nearly 70% of the bus network; and Mass Transit Railway (MTR), which runs the rail network. The share of user revenue in total revenue is 90% for KMB and 50% for MTR. MTR must also deal with higher operating costs: it must cover the cost of rail infrastructure maintenance, while KMB does not contribute to road maintenance. To offset its revenue shortfall, MTR benefits from the increases in land values generated by a public transport line. The government grants it exclusive rights to the 50 to 70-year leases controlled by the State, and related rights to develop property above and around stations and depots. MTR subdivides the large plots leased from the State into smaller plots that are marketed to private developers. The price of these plots reflects the higher land values due to being near stations. Profits from property sales, as well as the rents and commercial revenues from the premises that the company keeps, contribute 22% of MTR's revenues.

	2013 (HK$ Million)	
Revenue before depreciation, amortisation and variable annual payment	38,707	
Revenue from Hong Kong transport operations	*15,166*	39%
Revenue from Hong Kong station commercial business	*4,588*	12%
Revenue from Hong Kong property rental and management businesses	*3,778*	10%
Operating expenses before depreciation, amortisation and variable annual payment	24,308	
Operating profit before depreciation, amortisation and variable annual payment	14,399	
Operating profit before interest and finance charges	11,176	
Operating profit before tax	15,027	
Profit for the year	13,208	

Figure 7: Coverage of MTR's costs in 2013 – Source: Announcement of audited results for the year ended 31 December 2013, MTR

The main operator of the KMB bus lines enjoys an exemption from fuel tax, vehicle registration fees, and new vehicle licensing costs.

As for coverage of operating costs, the profitable bus lines (30%) subsidise the loss-making lines (70%). As the bus network has not reached break-even in previous years, it is currently being restructured to adapt it to the new competing metro infrastructure. In parallel, KMB has asked the Ministry of Transport to authorise a 4% fare rise.

The road network is congested. Drivers pay to use the tunnels and bridges linking the islands. The Ministry of Transport is in charge of vehicle registration and of collecting the annual vehicle tax, based on horsepower and fuel type. This tax includes an assistance fund for victims of traffic accidents.

Taxi operation requires a licence. The number of licences has been frozen since 1994, but ownership is transferrable for a cost of about 5MHK$ (48,000 euros). These licences are subject to geographical restrictions; taxi colour indicates the operating zone:

- Red urban taxis can operate throughout the region;
- Blue taxis operate only on Lantau Island;
- Green taxis operate in rural areas and the New Territories.

2.8. Mumbai

The urban region of Mumbai is a vast composite space comprising planned, developed territories; districts that have seen unregulated development; and in-between zones containing slums and informal employment areas. Nearly one in two inhabitant lives in a slum. The city centre is in the south of the peninsula, and is linked with its suburbs via severely overloaded roads and railways. The challenges for the city's development are a shortage of space and reducing socio-spatial inequality.

Private car use is very limited, as ownership is low (31 vehicles per 1,000 inhabitants), but it is growing strongly. The road network is congested, and jammed by all sorts of vehicles (illegal parking, ox-drawn carts, street vendors' hand-drawn carts). Road investment strategies make up a large part of the conurbation's congestion-fighting policy.

Inhabitants typically travel on foot or by public transport. The conurbation has heavy rail infrastructure (suburban trains) and many buses. The transport supply is completed by taxis and auto-rickshaws. The auto-rickshaws are only allowed to operate in the suburbs. A project to build three metro lines is in progress, and the first was to open in 2014.

The bus network operator, BEST, also operates the electricity grid. The former activity makes a loss (fares cover 70% of operating costs) while the latter is supposed to be profitable; the results of these two activities are therefore thought to balance each other out so that the company at least achieves break-even; but this has not happened in recent years.

	Financial results 2011-2012		
In INR millions	Electricity	Transport	Total (MRs)
Revenues	26,293	11,754	38,047
Expenditure	- 30,854	- 17,094	- 47,947
Total	- 4,560	- 5,340	- 9,900
Revenue from bus station/depot devt:			1,423
Result			- 8,478

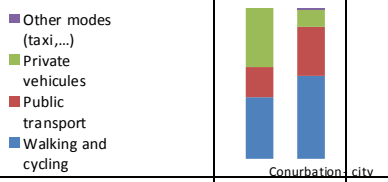
Figure 8: Coverage of bus network operating costs in 2011-2012 – Source: Financial highlights and budget estimates 2011-2012, BEST

Operation of the suburban trains covers operating costs excluding depreciation, but actually also a fair proportion of these depreciation and interest costs: in 2005/2006, the deficit was only 1.2%.

In INR millions	2005/2006 (MRs)
Fare revenue	9,936
Operating costs	8,949
Depreciation and interest	1,111
Total costs	10,060
Ratio Revenue/Costs	0.99

Figure 9: Coverage of Mumbai suburban train network costs in 2005/2006 – Source: Annual Report 2012-2013, MRVC

2.9. Summary

	France	United Kingdom	Egypt	Morocco	Nigeria	Brazil	Colombia	China	India
	Paris	London	Cairo	Rabat	Lagos	Sao Paolo	Medellin	Hong Kong	Mumbai
									
City population	2 273 305	8 400 000	9 225 541	646 000		11 400 000	2 499 080	1 290 000	12 478 447
Conurbation population	11 978 363	13 614 409	19 075 438	2 000 000	18 000 000	20 309 647	3 592 100	7 071 576	20 998 395
City density (pop/sq. km)	21 651	5 344	5 639	5 475		7 485	6 565	16 045	20 680
Conurbation density (pop/sq km)	997	1 195	4 368	2 463	5 032	2 557	3 118	6 405	4 822
GDP per country inhabitant (€PPP)	31 196	30 595	9 370	6 086	4 531	4 601	10 457	44 971	4 573
Local currency	Euro	Pound sterling	Egyptian pound	Moroccan dirham	Naira	Brazilian real	Colombian peso	Hong Kong dollar	Indian rupee
GDP per country inhabitant (local currency)	31 196	25 162	21 367	26 130	466 606	8 755	14 624 513	295 701	90 685
Income per conurbation inhabitant (€PPP)	24 920	26 154	7 749	8 448	5 080	10 135	7 048	45 864	6 040
Income per conurbation inhabitant (local currenc	24 920	21 509	17 672	36 271	523 186	19 286	9 856 932	301 576	119 778
Public expenditure/inhab (€PPP)	18 979	13 402	3 408	2 093	618	5 208	3 134	9 179	1 243
Public expenditure/inhab (local currency)	18 979	11 022	7 772	8 984	63 688	9 910	4 383 511	60 359	24 642
International poverty line (local currency, PPP)	1,14	0,85	3,69	6,13	115,51	2,35	1 666,33	5,30	26,42
Life expectancy at birth (years)	83	82	71	71	52	74	74	75	66
Challenges	Increase density of inner ring of counties. Reduce peak-time saturation of some infrastructure.	Continue to reduce car use by developing new public-transport infrastructure.	Fight fast-growing congestion and pollution, which already cost 1.4% of national GDP.	Continue integration across the conurbation, and strengthen public-transport supply.	Address conurbation's exponential growth, and fight congestion caused primarily by minibuses.	Control sprawl and fight congestion. Social, security and public-health Issues.	Continue to develop an efficient public-transport system, to support city's redevelopment.	Serve a very dense territory consisting of islands and mountains.	Reduce sociospatial inequalities. Control urbanisation. Fight congestion.
Urban mobility Index 2.0 - UITP (note 0-100)	55,4	53,2	37,4		37,1	45,7		58,2	43,9
Overall breakdown									
Number of trips per day	3,9	2,2	1,7	1,6		2,0	1,7		1,3
Average trip distance	4,4	9,3			8,0				11,9

	France	United Kingdom	Egypt	Morocco	Nigeria	Brazil	Colombia	China	India
	Paris	London	Cairo	Rabat	Lagos	Sao Paolo	Medellin	Hong Kong	Mumbai
									
Bus/BRT: Trips (millions/day)	3,84	7,09	3,50	0,04	0,28	10,72	2,70	6,34	3,80
Fare (€PPP)	1,70	1,76	0,80	0,93	0,92	1,68	1,22	0,76	0,50
Fare (local currency)	1,70	1,45	1,83	4,00	5,60	3,20	1700,00	5,00	10,00
Number of vehicles	RATP : 4490	8600	5400	360	3000	16 290	4 750	5 690	4 336
Distance travelled per day (thousands of km)		1342,465753	688,0596342						
Number of operator employees / veh	RATP : 5		9		5				9
Bus fare / GDP per country inhab	1,99%	2,10%	3,13%	5,59%	7,43%	13,34%	4,24%	0,62%	4,02%
Metro/Trains: Trips (millions/day)	7,2	7,2	4	No metro	Not significant until metro is in service	3,1	0,5	4,6	7,2
Fare (€PPP)	1,70	2,7	0,48			1,72	1,20	2,43	0,50
Fare (local currency)	1,70	2,20	1,00			3,00	1 650	15	10,00
Network length (km)	1 704	3504,3	87,0			336,9	31,3	218,2	427,5
Taxis: Number /1000 inhab.	8,4	9	13	7,7	Informal	2,89	5,37	2,56	4,34
Other		Tramway, Ferry	Shared taxi, Minibus, Tram, Ferry	Shared taxi, Tram	Minibus, Motorbike, Tram, Ferry		Cablecar		
Roads: Length (km/1000 inhab)	1,98	2,03				1,96		0,28	0,16
Cost of one litre of petrol / per capita income in conurbation	1,86%	2,30%	4,70%	16,76%	7,12%	11,25%	5,56%	2,08%	28,94%
Type of public transport operation	public (with private bus concession)	private	public	public	PPP	public (with private concession)	public	private	public
Rate of coverage by fare revenue (or other revenues)	30% of operation	69% of operation	30% of bus operation, 50% of metro investment	99% of tram operation	Majority of bus operating costs covered by revenue	80% of bus operation, 102% for metro, 80% for suburban trains	100% for metro	50% for metro (rest from property revenues)	68% of bus operation, 110% for metro
Notable features of public-transport subsidies	Payroll tax for urban transport	High for investment, low for operation (metro surpluses offset bus deficits).	Subsidy covering 70% of bus operating costs (+ investment)	Re-investment in buses, which were in decline.	Heavily weighted towards infrastructure.	Fares based on income band.	Operation breaks even thanks to advertising-space sales and commercial operation of stations.	Operation breaks even thanks to commercial operation of stations.	Same entity provides transport services and distributes electricity
Average bus fare / daily international poverty line calculated at PPP	150%	171%	50%	65%	5%	136%	102%	94%	38%

A review of urban-transport subsidy practices in these nine large conurbations highlights several core trends in the funding of both investment and operation.

Although individual transport is less widespread than collective public transport throughout the sample, the reasons vary somewhat. In the cities in developed countries, urban density and fine-mesh coverage make public transport more competitive (policies to restrict car use reinforce this, with an urban toll in London and parking restrictions in Paris). The share of individual transport in the cities of emerging countries is primarily related to issues of income and, therefore, of access to cars.

	Private vehicles (car, two wheel, taxi)	Public transport
Paris	12%	32%
Ile-de-France	*39%*	*20%*
London	35%	43%
Cairo	18%	52%
Rabat	18%	15%
Lagos *(motorised travel only)*	18%	82%
Sao Paulo	27%	36%
Medellin	24%	40%
Hong Kong	16%	46%
Mumbai	15%	52%

Figure 10: Modal split (private car/public transport) in the nine conurbations studied – Setec International and Nodalis Conseil

Although some countries, such as Morocco and Egypt, were advocating subsidies for individual transport just a few years ago, most of them have gradually abandoned this assistance and reformed their fuel subsidy system. Of the nine conurbations, only Lagos is maintaining this type of financial aid, despite a January 2013 attempt to abolish it, which failed through lack of acceptance by the population. The federal government has nevertheless cut these subsidies heavily.

For this reason, it is noteworthy that, with the two North African cities in our sample having fully or partly abandoned fuel subsidies recently, the cities that least counterbalance fuel affordability with public-transport affordability are now those with the highest-earning inhabitants (except Hong Kong):[18]

[18] Definition of indices: see appendix 3 “Methodology of construction of the indices”.

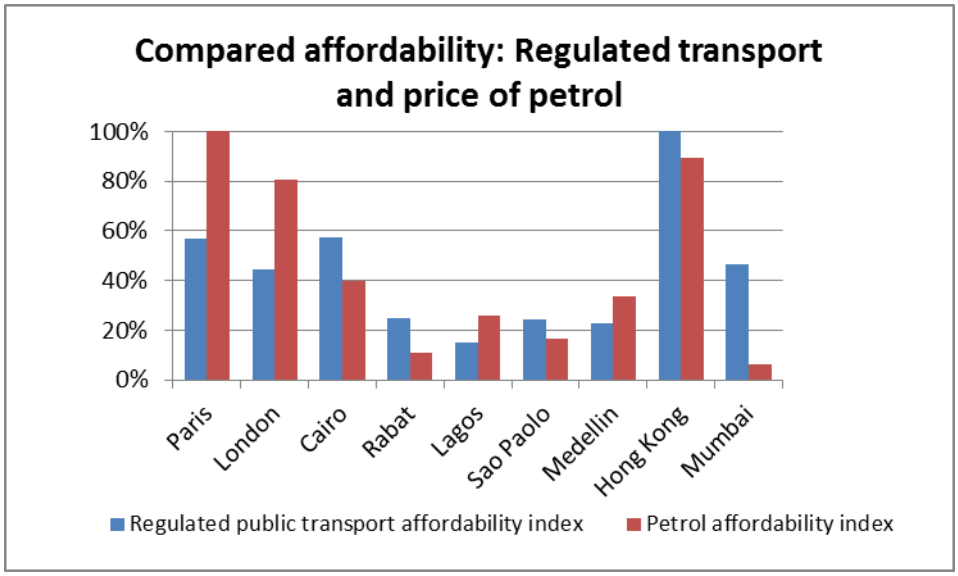


Figure 11: Compared affordability of regulated transport and petrol - Nodalis

This is the case despite higher affordability for the inhabitants of the wealthiest conurbations, which, though, only partly offsets the fuel-affordability differential. We can however note the efforts of Cairo, Rabat and Mumbai to maintain a fairly high level of transport affordability, sometimes to the detriment of other important aspects, which we will consider in the chapter on recommendations.

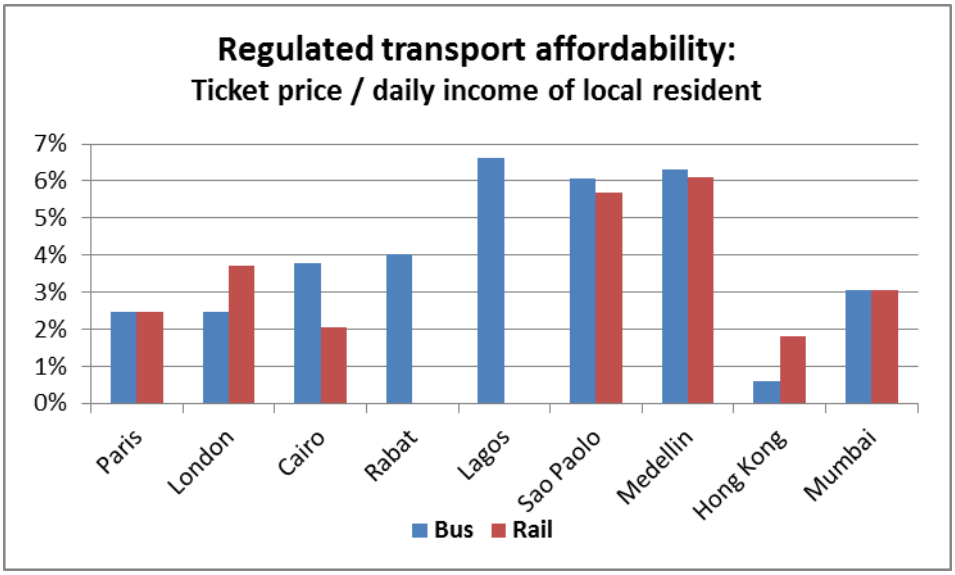


Figure 12: Affordability of regulated transport - Nodalis

All nine cities use urban individual transport as a tool to fund collective public transport: revenues from taxes on fuel, vehicles or traffic (tolls) are frequently reinvested in (building or maintaining) public-transport infrastructure. Otherwise, revenues serve to maintain road infrastructure.

In every conurbation in the sample, initial investment in public-transport infrastructure, requiring considerable financial resources, almost systematically involves public funding (State, municipalities, metropolitan government…). In some cases, which are increasingly

frequent in developing countries, public-private partnerships (PPPs) enable funding to be shared: in a conventional concession contract, as with line 4 of the São Paulo metro or rail projects in Lagos, the public authorities fund the investment in transport infrastructure, whereas the concessionaires fund the investment in rolling stock, and even signalling.

Part of the cost of investment in fleet maintenance and renewal may be self-funded by transport companies (public or private); the public authorities typically grant investment subsidies across all or part of their CAPEX (Cairo, Paris, London…). These subsidies may in particular come from revenues generated by road use: in Lagos, 50% of revenues from new vehicle registration, car tax, road tax, car parks and tolls goes towards investment in urban public transport.

It is therefore no surprise to observe that rail investment has occurred mainly in the wealthiest conurbations, whereas Medellin and São Paulo have relied more heavily on buses.

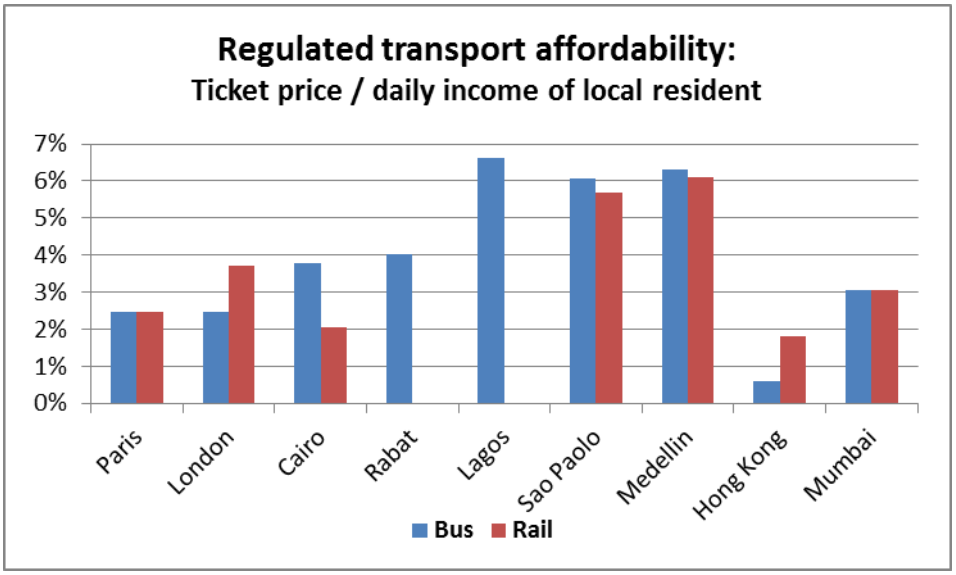


Figure 13: Density of regulated transport supply – Nodalis

Coverage of operating costs varies greatly between cities and modes of transport. Some systems in developing cities, such as the metros of Medellin, Mumbai and São Paulo, achieve OPEX coverage, whereas expansive transport systems in developed cities such as Paris and London are operated at a loss. A concern for “universal” transport for all social classes is strongly embedded in transport policies in developed countries, prompting transport authorities to set fares well below actual costs and applicable to all users, with no real targeting of the most deprived categories. However, analysis of the Colombian and Brazilian practices shows that taking the social dimension of transport into consideration, with proper targeting, does not necessarily entail operating at a loss: the cities of Medellin and São Paulo, through the application of low fares based on SISBEN (System for Identification and Classification of Potential Beneficiaries of Social Programmes) in Medellin and on gross salary in Sao Paulo, take account of deprived population groups thanks to subsidies aimed directly at them. Funds to offset this differential fare pricing may come from sources other than public money: they could be provided by users from higher social classes (cross subsidies in Medellin) or by employers (Vale Transporte scheme in Sao Paulo).

Yet a degree of caution is required regarding this type of practice, and especially the differential pricing applied in Medellin: although the subsidies are targeted, the methodology used to classify the population according to a well-being index and the updating of household information over time may entail inclusion errors (individuals receiving the subsidy though not

initially targeted) and exclusion errors (individuals who receive no subsidy but should) and above all require the implementation of a heavy administrative process.

In general, fare revenue alone does not fully cover operating costs; and in cases where the public authorities pay no subsidy, revenue is supplemented by streams from related activities (rental of retail units and advertising space), the most notable example being Hong Kong, where urban public transport receives no public subsidy, thanks to profits from the increase in land values near rail stations and other public-transport stations.

In the cases studied here, if the higher initial investment is not taken into account, rail (metros, trams, trains) generally appears more profitable than bus networks, which suffer from a lack of coordination, poor management, and fares set too low by the transport authorities. Small-business transport modes, such as minibuses, which compete directly with authorised bus services but receive no subsidy, seem more efficient and better performing because they are better adapted in terms of routes, fares and costs. This type of transport therefore serves a large proportion of urban mobility needs, but also generates a large proportion of the negative externalities associated with the road mode.

3 — Review and critical analysis of the rationales given for subsidising urban transport

3.1. Micro-economic justifications: restoring real-cost pricing so that equilibrium occurs at the optimal level of supply

3.1.1. The price signal: a complex tool

➢ Economic optimality: a theoretical concept that is hard to implement

One micro-economic rationale for subsidies is that they can be necessary to achieve an optimal level of supply. But what does the concept of optimality actually mean?

Micro-economic optimality in the sense of public economics, as covered in this subsection, except for the occasional contrary reference, corresponds to the maximisation of the aggregate welfare of the actors in a given market, in which the aggregate welfare is defined as:

- the total of what consumers are ready to pay in addition to what they paid, including the value of service quality (consumer surplus);
- plus the total of producers' profits (producer surplus);
- minus the costs imposed on society (or plus the benefits enjoyed by society) without it being possible to allocate them to a particular actor (externalities);
- the level of subsidy (or the level of tax) that had to be applied, if necessary, insofar as the source (or recipient, for taxes) was considered as external to the market being analysed.

However, the share of subsidy (or taxes) funded (or received, for taxes) by an entity deemed to be an actor on the given market corresponds to a transfer at community level, except for the opportunity cost of public funds (OCPF) which is a net cost, or a net gain in the event of an increase in taxes collected by the public authorities (see subsection 3.1.3). It is noteworthy, though, that their effects on modal split and mobility have a direct impact on the level of aggregate welfare.

However, in its implementation, the concept of optimality fluctuates between studies and between lines of reasoning, for three reasons:

- The scope of the externalities included in analyses fluctuates (occasional absence of this consideration, varying definitions of pollution, divergent values of lost time, inclusion or not of longer-term externalities, etc.);
- The market chosen for the analysis can be delimited in several ways: analysis specific to one mode, to public transport, to all transport, etc. Moreover, how the specificities of each mode are taken into account varies;
- The multiplicity of variables that determine agents' utilities may make the optimisation calculation very complex. Simplifications are therefore always necessary, which distorts the result. Passengers' utility is most often estimated on the basis of a single variable: the number of single trips. But other demand metrics (passenger-km, passes) and supply metrics (number of vehicles in operation, km travelled, offered seat-km, stations served) may be selected. The "trip" unit encompasses a wide range of service: depending on destinations, distance, and comfort, there is no real unit of what is sold, nor a consistently defined cost of production. This consideration is made even more complex by the fact that the analysis must follow different approaches depending on whether you consider peak hours, which are subject to saturation phenomena, or the rest of the service.

- Automatic adjustment of supply and demand to an optimal level through price variation: a theory that is hard to apply to public transport, where public intervention is often necessary

The demand function represents the relationship between the unit price of a good and the quantity that the market actors are willing to buy for the set price. It therefore depends on consumers' preferences. In a similar way, the supply function is the relationship between the unit price of a good and the quantity that the market actors are willing to sell for the set price. In the simplest case, the quantity of goods traded is naturally determined by the famous "invisible hand" at the point where the demand curve and the supply curve intersect. It is at this point of equilibrium that there is agreement on both quantity and price.

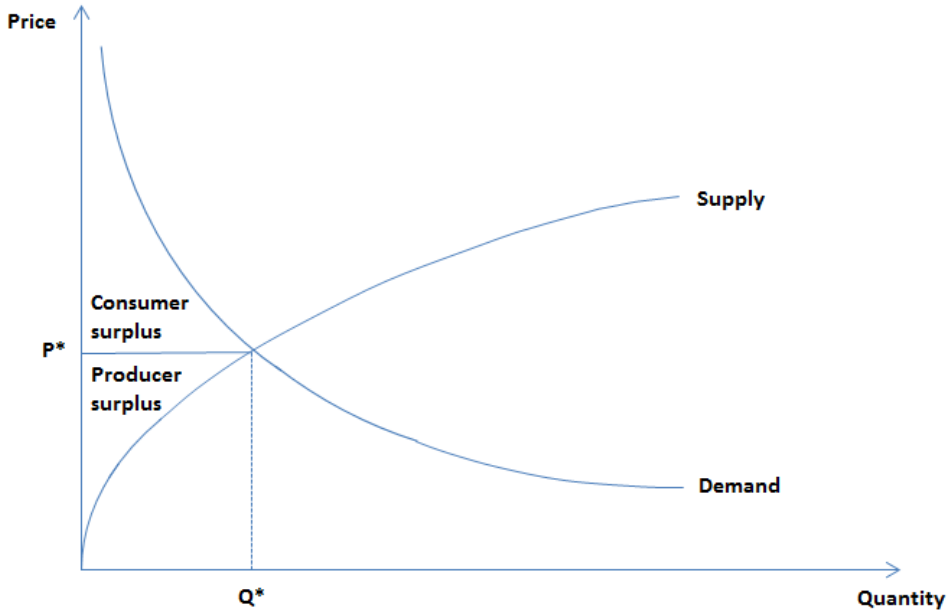


Figure 14: Equilibrium of supply and demand – Setec International

This lower level of complexity is applicable without restriction only in the case of pure and perfect competition, which corresponds to a certain number of characteristics:

- × Agents are fragmented, i.e. there are so many buyers and sellers that each of them individually has no impact on price;
- × Agents are fully informed;
- × Agents transact without constraints or costs.

In addition, for equilibrium to occur naturally in pure and perfect competition, the supply and demand functions must be sufficiently "standard": ideally, supply should be an increasing function of price, and demand should be a decreasing function of price; or, at least, their characteristics should enable price, starting at its initial level, to converge at a single point.

The characteristics listed above can be applied, to a greater or lesser degree, to certain modes of transport, provided that: there are very many operators, they have not formed any cartels, and they set their prices freely enough. This is true of minibuses and taxis (cars and motorbikes) in some cities.

However, they are not often applicable to the other modes, which are closer to being monopolistic or oligopolistic markets. This is the basis of some micro-economic theories for

intervention in the sector: the public authorities must re-establish optimal equilibrium, which is not guaranteed by the market. Subsidy is one of these intervention modes; taxation is another.

- Determining the supply curve: a function of costs

The supply curve is determined by a relationship between costs, quantity and revenue: the producer agrees to produce a unit of a good or a service if selling it increases his profit.

In the simplest case, it is considered that activities have a diminishing return, i.e. each unit produced costs slightly more than the previous one. In a market of pure and perfect competition, where producers have no impact on prices, one can reason very simply in terms of marginal cost: the producer agrees to produce an extra unit provided that the cost of producing this extra unit (the marginal cost) is lower than the price he can obtain for it. Unless there is an oligopoly or regulation, a taxi driver accepts an extra journey provided that it earns him more than his remuneration for his effort, the cost of fuel, and the cost of the wear that the journey causes to his car.

It is noteworthy that this marginal cost differs from the variable cost of the production company. Substantial threshold phenomena related to possible network saturation are observed: an extra unit produced may, depending on the circumstances, require a minimal extra energy cost, the recruitment of an extra employee, the purchase of an extra vehicle, investment in an extra station, or even strengthening the infrastructure on the right-of-way. This consideration is all the more important as the acquired assets, including buses, are rarely transferable. The acquisition of rolling stock is thus practically irreversible. Once a vehicle is bought, its depreciation must be taken into account whether or not it is used, and it can no longer be sold.

To enable significant analyses, a portion of the investment costs, especially with regard to rolling stock, must be re-included in the calculation of marginal cost. To borrow Marcel Boîteux's expression, "selling at marginal cost is equivalent to selling at the average cost of marginal equipment",[19] i.e. "marginal-cost selling prices must be set with reference to facilities that will constantly remain adapted, irrespective of the successive phases of over-equipment and under-equipment experienced by the company".

- Distinction between short- and long-term marginal cost (Appendix 1)

The apparently simple notion of marginal cost proves complex when analysed. The fundamental distinction between short- and long-term marginal cost is subject to complex implementation in the case of transport, owing to the indivisibilities that characterise the sector.

If capacity remains adequate for the traffic, the short-term marginal cost is equivalent to the long-term marginal cost. In transport, the existence of indivisibilities with regard to infrastructure thus leads to short-term marginal-cost pricing.

Indeed in the case of transport, capacity can often only be set at certain thresholds (presence of indivisibilities). In this case, a given capacity is adapted for a range of levels of traffic, and not for one specific value. As a result, short-term marginal cost and long-term marginal cost coincide throughout the range in question, and the notion of long-term cost fades away. The rule usually provided when capacities are continuously adapted is then expressed as follows: in the presence of indivisibilities, the pricing rule is that of marginal-cost pricing with adapted capacity.

[19] Marcel Boïteux, "La vente au coût marginal" ("Selling at Marginal Cost"), Bulletin de l'Association Suisse des Électriciens, pages de l'U.C.S., XLVII,24 (1956), republished in *Revue Française de l'Énergie*, VIII, 81 (1956)

The distinction is described in Appendix 1.

- Different optimisation approaches in the presence of monopolies and oligopolies

In the transport sector in general, the market is not fragmented. Whether the market is a monopoly or oligopoly (i.e. with a limited number of producers), producers can nearly always influence price individually by changing their level of production. Optimising the operator's profit involves equating marginal cost not to price but to marginal revenue, because one extra unit potentially changes the price of all the other units on sale in the market. This leads to prices higher than marginal cost:

- In the case of oligopolies, which often behave like private actors, partial competition between producers results in pricing that is often higher than marginal cost, and in a lower level of supply, with a resulting reduction of consumer surplus greater than the increase in producer surplus; overall this impairs aggregate welfare on the market. Subsidies can intervene to support the level of supply and to obtain a decrease in fares.[20] The net effect of the subsidy mechanism on overall welfare depends on the constraints imposed on operators and on the shape of the supply and demand curves. But in this case, overall welfare cannot exceed that which would be observed if the public authorities set prices at the level that would occur in competitive equilibrium.

- Transport monopolies are nearly always public companies, for which the first objective is not to maximise profit. We will therefore not address the case of private monopoly. These public monopolies are often natural monopolies, which amounts to saying that their show increasing returns, at least during their initial period of development, owing to high initial investment but limited variable costs. The implications of this phenomenon of increasing returns will be discussed below.

Other transport-specific factors make micro-economic analysis more complex:

- Another assumption not verified in urban transport is that agents are fully informed. Indeed, there are often substantial uncertainties, whether to do with public-transport service information (waiting time between two segments, for example) or travel time for individual-transport users (variability of travel time due to congestion). This factor increases the generalised cost of transport for the user, and thus reduces demand at a given fare, without possibility to directly correct this fact through subsidies or taxes. However, the advent of new information and communication technology applications, including ones for less formal modes, has started to transform this issue.

- In the transport market, there are various possible segmentations of the customer base. Students, retirees, etc., may have behaviours sufficiently different from other consumers to justify specific pricing. Accordingly, measures that are often presented as social may help to maximise the operator's revenues.

- The various modes are not pure competitors. Intermodality is a recurring phenomenon. Modes are therefore partly complementary, which can result in the search for joint pricing so as to encourage combined use of modes, including privately. Micro-economic modelling of profit-optimisation strategies varies greatly according to the degree to which modes are complementary. Intermodality, which is often pursued by the public authorities with heavy public subsidies or cross subsidies, may also meet private logics, but calibrating the corresponding analysis is highly complex.

[20] We know that prices in the case of a profit-maximising monopoly (and in Cournot's duopoly) will be set higher when costs are high too. Subsidising a monopoly or a duopoly reduces the costs that it bears, thus leading it to reduce its price; the subsidy can be calibrated so that, ultimately, the monopoly sets a price equal to marginal cost. But this way of incentivising the monopoly (or the oligopoly) to set an optimal price may be very costly for the public finances.

- The multiple lines of reasoning at work in micro-economic rationales for transport subsidies ultimately seem too complex to all be taken concurrently into account in a single quantitative analysis. Moreover, although some elements argue in favour of subsidies, others limit their impact. A qualitative analysis of the most significant elements appears more realistic.

3.1.2. The issue of increasing returns

While individual transport might be deemed to have constant returns[21] (although little-used road infrastructure with low congestion has increasing returns), it is widely accepted that collective public transport has increasing returns. This encourages historical operators, who enjoy a cost benefit over potential entrants, to reduce supply (in coverage and quantity) and focus on the most profitable lines. In this case, subsidies may be desirable to raise the transport system to a supply level closer to the economic optimum.

Economists typically distinguish two sources of increasing returns in urban public transport. One is simply a cost function that includes a large fixed share (private increasing returns); the other is a special form of club effect called the “Mohring effect”, named after the economist who described it in a 1972 article.[22]

Lastly, one can identify a third effect closely related to an increasing return, which does not seem to have been the subject of any published generic analysis[23] but which is well known to modellers and operators, and which we will call the “coverage effect”.

In the presence of private increasing returns, i.e. a cost function that includes a large share of fixed costs, marginal-cost pricing is not viable because in entails losses for the operator. Research by Ramsey (1927) and Boîteux (1956) led to a calculation formula for optimising the aggregate welfare of market actors under a balanced budget constraint.

- Cost functions of public transport

The various public-transport modes can be classified by their peak-hour capacity, as in the figure below.

[21] If one internalises the externality of congestion in its cost function, one can even consider that, for a given conurbation, it yields a diminishing return above a certain level of production – see 3.1.3. It is necessary to distinguish the return from the operator’s perspective and from the collective perspective. From the operator’s perspective, the cost consists of fixed construction expenses and variable expenses for infrastructure maintenance and operation; these expenses are, with regard to annual construction spending, fairly low and proportional to traffic. It results from this that returns practically increase for all levels of traffic. The same is not true from a collective perspective; in this case, it is necessary to add to the operator’s operating and maintenance costs the external costs, foremost among which are congestion costs; these are negligible in uncongested areas, especially rural areas, where as a result there are increasing returns; but they are high and increase very strongly with traffic in congested areas, especially in cities, where there is a diminishing collective return.

[22] Mohring, 1972 (Mohring, H. (1972). "Optimization and Scale Economies in Urban Bus Transportation," American Economic Review, 591-604.

[23] At least in the case of public transport, as network effects have been addressed in many publications.

	Mode	Type of rolling stock	Vehicle capacity (manufacturer)	Peak-time frequency	Hourly capacity per direction	Hourly capacity per direction
Bus	Standard bus (12m)	MAN Lion's City, HEULIEZ ACCESS'BUS GX 337, Citelis 12, etc.	90 people (varies according to interior layout)	5 mins (without own corridor)	1 080	1 100
	Articulated bus (18m)	HEULIEZ ACCESS'BUS GX 437, MAN Lion's City G, Citelis 18, etc.	130 people (varies according to interior layout)	5 mins (without own corridor)	1 560	1 600
	Articulated bus in own corridor (18m)	HEULIEZ ACCESS'BUS GX 437, MAN Lion's City G, Citelis 18, etc.	130 people (varies according to interior layout)	3 mins (own corridor)	2 600	2 600
	Bi-articulated bus in own corridor	Volvo B340M bi-articulated	250 people (varies according to interior layout)	3 mins (own corridor)	5 000	5 000
Tram	Tram (25m)	Lohr STE3	127	4 mins	1 905	1 900
	Tram (29.4m)	TFS	178	4 mins	2 670	2 700
	Tram (32m)	Citadis 302 (T2 and T7 RATP)	213	4 mins	3 195	3 200
	Tram (43.7m)	Citadis 402 (T3 RATP)	304	4 mins	4 560	4 600
LRT	VAL (26m)	VAL 208 (2 cars)	160	80 seconds	7 200	7 200
	VAL (52m)	VAL 208 (2x2 cars)	320	80 seconds	14 400	14 400
HRT	Metro (90.28m)	MP 05 (6 cars)	698	85 seconds	29 562	29 600
	RER (112m)	MI 09 (5 cars)	1305	20 trains per peak-time hour	26 100	26 100
	RER (2x112m)	MI 09 (2x5 cars)	2610	20 trains per peak-time hour	52 200	52 200

Figure 15: Standard capacity of various transport modes – Sources: STIF, RATP

The fixed part of the cost function of these various modes, i.e. the cost of the infrastructure they require, increases with capacity, roughly speaking. The average cost of a metro seat-kilometre is thus much higher than the marginal cost of the same seat-kilometre.

However, this increasing-return effect only has real relevance in a public-transport system that is largely undeveloped, insofar as one can more “freely” make a choice of investment between modes. This is true of large conurbations in developing countries. But for conurbations such as Paris, London or Hong Kong, the system has reached such a stage of development, and even of saturation, that “marginal equipment” as defined by Marcel Boîteux most often includes infrastructure investment determined by considerations of a technical nature and of compatibility with what already exists.

As for bus transport, it cannot validly be deemed to have a cost function that creates increasing returns. Even if the cost function of a given production includes a fixed part (fixed facilities such as garages, workshops and bus-stop shelters), one can reasonably consider that any professional operator would adapt its fixed facilities so as to maximise their use. These facilities have an easily substitutable purpose. A city-centre bus depot that is only partly used does not indicate an insufficient subsidy but rather poor management of public assets! Moreover, if road use is taken into in the cost function, the induced congestion is a source of diminishing returns.

In particular, the persistent use, in most large African conurbations (like Rabat, Lagos and Cairo) of small vehicles (minibuses, collective taxis) would be wrongly interpreted as a problem of increasing returns, where the deployment of larger, more efficient and more comfortable vehicles (i.e. standard buses like those found across Europe, which cost more to buy) would require a public subsidy. The decision of operators in the small-business sector to use small vehicles likely stems from a preference for reducing the risk attached to the fixed costs of vehicles and from the "frequency" effect: minibuses or collective taxis, which are more flexible to operate, can serve bus stops more regularly, and skim the market to the detriment of higher-capacity vehicles. The hypothesis of increasing returns thus mostly valid for conurbations where the transport system is growing, unsaturated, and designed for infrastructure-intensive modes.

Ramsey pricing

In the presence of increasing returns related to the cost function (high initial investment), the first mover in the market has an advantage, which promotes the formation of natural monopolies. This intrinsic characteristic is often reinforced by the actions of the public authorities, which regulate or grant themselves these monopolistic positions in order to offer a service that is not governed by a profit-maximising logic, which would find its equilibrium at a low level of service and a high fare, but rather by the logic of maximising general wellbeing.

Even without the monopoly's will to maximise profit, marginal-cost pricing, which decreases and is therefore lower than average cost, loses its sense because it intrinsically causes losses for the company. Another pricing system must therefore be found. The research by Ramsey (1927) and Boîteux (1956), revisited by Baumol and Bradford (1970), yielded a principle: to stay as close as possible to the optimal level of supply, marginal-cost pricing must be increased just enough to cover the company's costs and impair the level of demand and the consumer surplus as little as possible. To do this, the most effective method is to raise trip fares in proportion to the sensitivity of demand to price (price elasticity of demand).

If, for political reasons, the public authorities do not wish to see their operators apply such a pricing system, which deviates from marginal cost and puts at a disadvantage the populations with the lowest price elasticity (i.e. those most captive of the service), they may contribute the corresponding revenue supplement through subsidies.

- "Mohring effect"

This effect may occur as follows: when, for a given trip, an operator quantitatively increases the means of transportation (buses, for example, but also rail vehicles) in order to meet demand, service frequency also rises, making it more beneficial for all users to use these means of transport (because waiting time is shorter). This is a sort of club effect through an intermediary operator.

Mohring (1972), then Jansson (1979), concluded that this effect justified the subsidising of urban public transport because private operators, in the absence of subsidies, would have a rational interest in running buses less frequently. Unlike the previous case, the increasing return here comes not from the form of the production function but applies to the cost borne by the user (time cost). Yet the argument of Mohring and Jansson, based essentially on micro-economic modelling, is subject to debate.[24] If the marginal increase in traffic causes an increase in frequency, it produces a benefit for the existing users. But it all depends on the operator's reaction: if he keeps supply unchanged, there is no impact.

It should be noted that all these models are based on assumptions that are questionable in the reality of networks; in particular, the operator is supposed to set prices freely and

[24] Van Reeven (2008) refutes this on the basis of another model in which the operator can adjust the price of transport to capture the value of the consumer utility surplus related to the increase in frequency; Savage and Small (2009) refute Van Reeven's contradictory model, but do not conclude that Mohring's analysis is valid; Basso and Jara-Díaz (2010) re-use van Reeven's model while changing it (in particular by introducing an elasticity of demand relative to price, which was not the case overall in van Reeven's model), and thus arrive at Mohring's initial analysis.

maximise profit (whereas in reality its fares are most often regulated at too low a level, even including the fare subsidy).

These various models generally ignore the trade-off between the frequency and unit capacity of vehicles. But this trade-off is a particularly important subject for developing countries: salary costs are low, thus shifting the equilibrium towards greater frequency and lower capacity, and the existing situation of urban public transport in these countries is characterised by the very large market share of small-business or semi-public transport using low-capacity vehicles (see the cases of Cairo, Lagos and Rabat in particular). In these situations, the "formal" operator is often the only one receiving subsidies, but is equipped with standard buses, and to meet the same demand will thus offer lower frequencies. In other words, one could argue that eliminating subsidies would increase the market share of small vehicles (the fares of which are not necessarily higher than those of the subsidised "big" buses) and thus improve frequencies…

In addition, analyses based on the "Mohring effect" concept assume that an increase in frequency necessarily improves user utility. But with regard to buses, this frequency increase may create or aggravate congestion, and thus reduce the collective utility of users and other road occupants.

- Coverage effect: spatial coverage

Serving a place by public transport may be unprofitable in itself (the marginal revenue of the line in question is apparently lower than the marginal cost of the service) but increases the marginal profit across the whole system by meeting, through public transport, all demand for transport from the users in question, thus increasing the number of trips made on the whole system. The effect is mainly valid for users who must choose between buying their own vehicle and using public transport. This effect only justifies subsidies in a competitive market, as the operator of the loss-making line cannot in this case capture through commercial revenue the increase in use that it causes across the whole system. In an uncompetitive market, this translates into equalisation and cross subsidies.

- Coverage effect: time coverage

Public-transport occupancy rates are a key factor of system profitability. High occupancy rates are naturally easier to achieve at peak hours. However, if one wishes to provide a public-transport service at other times of day (off-peak period, evening…), it will be necessary to implement a frequency that is of a minimum level to ensure that public transport is attractive, but probably higher than the one required just to carry demand during these off-peak periods. This causes occupancy rates to deteriorate, thus leading to a cost-revenue imbalance that can justify subsidies. The off-peak service level must therefore be set fairly, without forgetting that most trips are two-way, and too great a reduction in off-peak frequency would risk losing peak-time passengers.

In the case of a competitive market without any fare equalisation, the rollout of fare integration throughout a public-transport system, with multiple operators, may be deemed a valid rationale for paying public subsidies: the development of intermodal travel primarily involves fare harmonisation (single ticket for all modes, ticket valid for one hour across modes, etc.) which induces a price drop for each participating operator. The induced traffic arising from this enhanced system coordination does not generally offset the loss of revenue, and so subsidies become necessary.

3.1.3. Price correction: internalisation of externalities

➢ Externalities

An "external" effect is the impact of an action by agent A that causes a change in the welfare of agent B without any monetary consideration in return. In the case of transport, agent A is the traveller and agent B may, for example, be a local resident, another traveller or a company. The externalities may be:

× Negative externalities: the impacted people are disadvantaged by the action. In the case of transport, these externalities are mainly:
  - environmental effects: sound nuisances, local air pollution, greenhouse-gas emissions. These effects have impacts and produce extra costs for the community: investments to fight noise, health impacts, deterioration of buildings, etc.
  - accident-related effects which have several types of impacts on the community: interventions by the emergency services, medical treatment, repair of damaged equipment, price of human life, etc.
  - congestion effects: above a certain threshold[25] (the capacity limit), adding one person has a negative impact on the other travellers.
  - effects related to the wear and tear of shared infrastructure.
  - effects related to land use: vehicle owners occupy a certain area when parking, to the detriment of other facilities which could benefit everyone; sprawl, etc.
× Positive externalities: the action benefits the impacted people. In the case of transport, these externalities are mainly:
  - agglomeration effects: mobility has repercussions on the economy which are not internalised.
  - effects related to land use and the urban form: transport modes that promote a compact urban form may generate savings in the operation of public services and in the associated investments.

➢ A particular externality: the cost of public funds

Subsidies are paid from public budgets, which are financed more or less directly by taxes. Collecting taxes causes a loss of efficiency, so that one public euro levied as tax has a negative effect on collective welfare greater than one euro (for example, one euro levied on salaries will cause a reduction in employment and production, and will not simply be a transfer).

Macro-economic studies allow for measuring this loss, which obviously depends on the nature of the extra tax; studies done in the case of France show that one euro of "average tax" (a weighted average of the different sources of budget funding) costs about 1.3 euros. When one decides on a subsidy of X euros, one must therefore consider that it is not simply a taxpayer-to-user transfer that would be collectively neutral, but that there is a collective loss of surplus of 0.3 euros.

[25] In the case of individual road transport, the negative effects occur even before one reaches the capacity limit, because travel time on a section of road increases with flow; this is represented in traffic models by flow-speed functions.

Obviously, if the subsidy in question is funded from a different source, for example a tax with lower-than-average distorting effects, it is advisable to use the coefficient relative to this special tax.[26]

- Bias in supply and demand equilibrium

In an economy with pure and perfect competition, the quantity of a good traded between producer and consumer is determined by the point where the demand curve and supply curve intersect. It is at this point of equilibrium that there is agreement on both quantity and price.

If positive or negative externalities are not internalised through subsidies or taxes, the price actually paid by the user corresponds to the internal cost. Figure 16 shows a fictitious supply curve including all externalities. The point of optimal equilibrium is where the demand curve and the fictitious total cost supply curve intersect. The actual equilibrium thus consumes a quantity of the good that is larger than what would yield the optimal equilibrium for society. Theoretically, positive externalities should be subsidised and negative externalities should be taxed. In practice, it is difficult to estimate the positive externalities and to sufficiently tax the negative externalities.

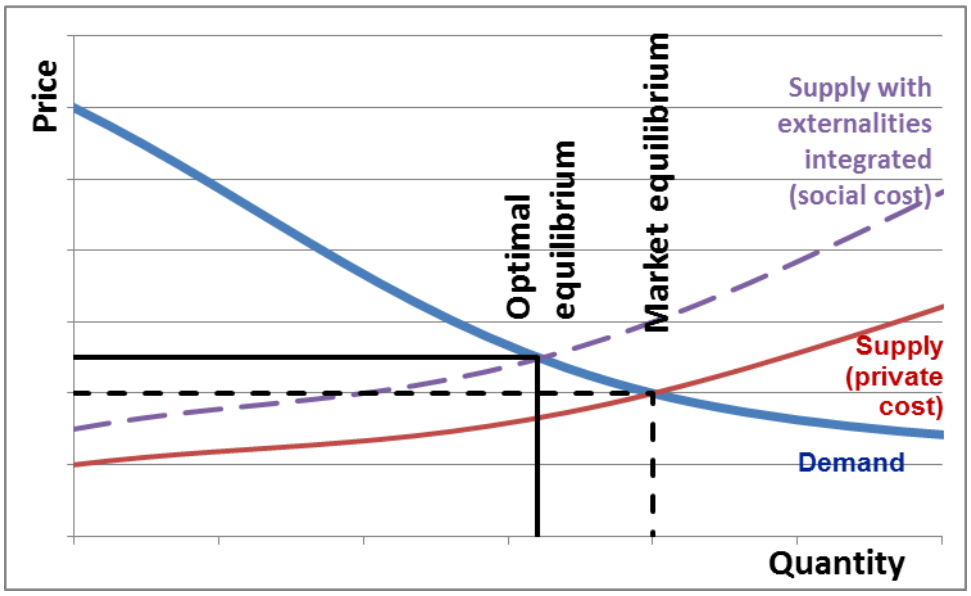


Figure 16: Equilibrium of supply and demand in the presence of externalities - Setec International

3.1.4. Price correction: internalisation of agglomeration effects

It is quite easy to understand which negative externalities are connected to urban transport, and many studies have been conducted to examine these externalities. It is somewhat more difficult to get a sense of what the positive externalities may be.

For individuals who undertake a trip, the time and costs associated with transport have an upside, which is the utility they get from the trip. But for the past few years, the economic evaluation of transport projects has been attempting to go beyond merely estimating cost and

[26] If, for example, the subsidy is covered by a neutral tax, or by an environmental tax, the distortion is eliminated.

time variations, because it has been established that improving mobility generates advantages, not only for the people who make a trip, but also for the entire community, through what are called the wider economic benefits of transport projects. These are thus positive externalities, which should be subsidised in a price correction process, both for private vehicles and public transport.

- Difficult-to-quantify effects

Wider economic benefits are not always quantifiable. Certain impacts, such as the increased attractiveness of the cities with the best transport, can be appreciated through surveys, but it remains difficult to place a monetary value on these impacts.

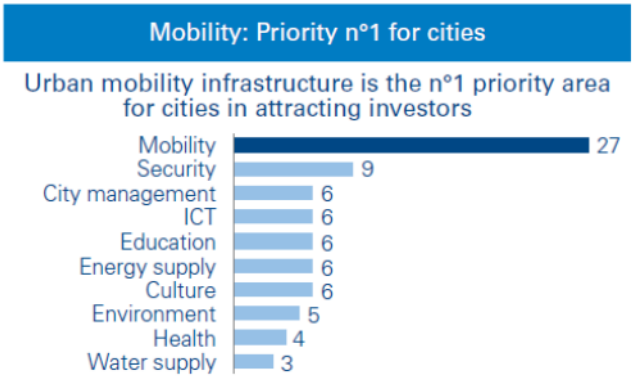


Figure 17: Attractiveness criteria of cities for investors (source: Siemens "Megacity Challenge Study")

Likewise, access to health and education are some of the means used to expand the human capital of current and future workers. An abundant literature demonstrates the importance of human capital accumulation for economic growth.[27] Promoting access to these services represents an investment for the city, which, in the long term, will profit from having more efficient workers. This second effect is also very tricky to quantify.

Numerous studies demonstrate the positive economic impacts of empowering women.[28] This can be attributed in part to the fact that women often spend more resources on children and investment. In many developing countries, women travel more than men, if we include walking and motorised transport, but less if we only include motorised transport: they travel more on foot.[29] The extension and/or reduction of the costs of public transport can thus, in certain cases, enable women to use it to travel, thereby increasing their speed of transport and consequently their economic activities, so they can participate more in the economic life of the household and the city, with all the benefits that this implies. Although it is difficult to get a sense of this greater involvement of women in the economy promoted by transport, there are more general methods of quantifying the effects of transport on the economy.

- Other effects for which we now have evaluation methods

[27] Starting with the famous: A Contribution to the Empirics of Economic Growth; Gregory Mankiw; David Romer; David N. Weil; Quarterly Journal of Economics, May 1992
[28] In particular: Women Empowerment and Economic Development, Esther Duflo, Journal of Economic Literature 2012;
[29] Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities, GTZ 2007

The Wider Economic Benefits, or WEBs, are now an integral part of the economic evaluation procedure implemented in the United Kingdom for major transport infrastructure projects. Thus, in English guidelines, we find a method for calculating several quantifiable economic impacts. The difficulty arises from the availability of data and in particular the adaptation of the parameters estimated in the socio-economic context of the United Kingdom.

The results obtained may be added in total to the standard surpluses of users calculated otherwise. The objective is to take account of externalities neglected in the conventional calculation of time savings based in particular on the assumption of pure and perfect competition. They are what may justify subsidies for transport projects.

Three WEBs are usually calculated:

- the **agglomeration effects:**[30] correspond to the gain in GDP enabled by a reduction in the commute time between home and workplace, as well as between workstations, thanks to an improvement in the transport networks. The agglomeration effects correspond to the fact that the higher the effective job density, the higher the productivity. The improvement of transport conditions brings jobs closer together and contributes to increasing productivity. This productivity increase benefits businesses and employees but is not attributed to transport. Quantifying the agglomeration effect thus amounts to putting a figure on one of the reasons that form the basis for urbanization: the clustering of activities and its economic value.
- the **effects on imperfectly competitive markets:** in a situation of perfect competition, the generalised cost savings of business trips (BUB: Business User Benefits) are equal to the benefits from the increase of production outputs and prices are adjusted to the marginal cost of production. In a situation of imperfect competition, the benefits of decreasing the cost of transport are greater than the BUBs, because the selling price of the outputs is not automatically readjusted to the marginal cost of production. The studies conducted on this theme show, almost systematically, a positive multiplicative effect between the initial advantage in transport gains and its transmission downstream in the chain of economic actors, due to the market power of certain actors, and due to the improvements of transport conditions which generally reduce these margins by accentuating competition. As a result, the corresponding effects only apply to business travel and to the transport of goods, since they play out in the context of the production sector.
- the **effects on the labour market:** the effect is comprised on the one hand of economic gains resulting from the return to work of certain persons due to variations in the generalised costs of transport, and on the other hand, of productivity gains generated when individuals decide to change jobs, favouring areas where productivity is higher.

The tables below present a few estimates of the wider economic benefits in the case of the Crossrail project and other transport projects in Great Britain.

[30] Agglomeration effects are among the most documented wider economic benefits, in the work of M. Lafourcade and P.P. Combes or the economic evaluation method of accessibility developed by J. Poulit, which generally measures analogous effects even if in the latter case, the focus is on the world of extended choices enabled by transport projects.

Benefits	High Scenario		Mid Scenario		Low Scenario		Feb 2005	
	Welfare (£bn)	GDP (£bn)	Welfare (£bn)	GDP (£bn)	Welfare (£bn)	GDP (£bn)	Welfare (£bn)	GDP (£bn)
Conventional User Benefits	**12.8**	**4.8**	**12.8**	**4.8**	**12.8**	**4.8**	**12.8**	**4.8**
Labour force participation		0.9		0.9		0.9		0.9
Move to more productive jobs		46.2		29.9		19.6		7.8
Pure agglomeration	9.3	14.3	8.2	12.6	6.8	10.4	3.8	5.8
Imperfect competition	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tax Implications	19.2		13.7		9.9		4.7	
Wider Economic Benefits	**29.0**	**61.9**	**22.4**	43.9	**17.1**	**31.4**	**9.0**	**15.0**
Total (User and WEBs)	**41.9**	**66.7**	**35.3**	**48.7**	**29.9**	**36.2**	**21.8**	**19.8**

Figure 18: Socio-economic evaluation of the Crossrail project - Source: Buchanan 2007

Mode	System	Conurbation
Road	Leeds-Bradford road improved	21%
Road	Road improved in urban area of Leeds	22%
Public transport	Public transport improved between Leeds and Bradford	15%
Bus	Subsidy for buses within Leed city boundary	11%
Road	Leeds-Sheffield road improved	19%
Road	M6 slip road	12%
Bus	Subsidy for buses in county of West Yorkshire	9%
Public transport	Main investment in public transport in urban area of Leeds	9%
Bus	Subsidy for buses in South and West Yorkshire	7%
Bus	Subsidy for buses in South Yorkshire	3%

Figure 19: Share of wider economic benefits in total benefits of various transport projects (Ministry of Transport of the United Kingdom) - Source: ITF Round Tables: The Wider Economic Benefits of Transport (OECD)

In the case of Crossrail, the wider economic benefits represent from 0.7 to 2.3 times the conventional benefits of the project, and mostly consist of agglomeration effects and of the impacts in terms of GDP growth from returns to employment and from the transfer of jobs towards more productive areas. But these effects are not limited to large-scale projects, as shown in the second table, where the agglomeration effects alone reach as much as 22% of total benefits.

It must be noted that this positive externality is not limited to public transport projects. As long as traffic congestion does not have adverse effects, enabling access through individual modes of transport also contributes to the agglomeration effects, but with more negative externalities of pollution and safety. However, in the long term, it is likely that the effects of traffic congestion completely cancel out the benefits obtained by the agglomeration effect, if only individual modes of transport are considered.

- What level of subsidy for these agglomeration effects?

As we have seen, the order of magnitude of the wider economic benefits is far from negligible. It is helpful to try to imagine what level of subsidy could match these externalities in order to internalise them into the price of transport.

In the case of the East-West Link project in Melbourne (traffic link including a tunnel of more than 4 kilometres), the estimated wider economic benefits represented 35% of the standard benefits and covered 165% of the operating expenses.

The study conducted on a micro-economic basis by Richard Arnott in 2007 is also very telling. It concerns an urban economy with two types of externalities: negative traffic congestion externalities and positive agglomeration externalities. Although it is a relatively simple model and some of its assumptions could be refined, this study demonstrates that optimal congestion tolling varies with the magnitude of the agglomeration effects. Without taking agglomeration effects into account, congestion tolling reaches 10% of daily wages when the congestion effects are significant. If the agglomeration effects are significant, this optimal congestion tolling may be reduced to less than 3% of daily wages. In the extreme case where the agglomeration effects are high and the congestion is lower, the optimal congestion tolling becomes negative, i.e. it becomes necessary to implement a subsidy in connection with the agglomeration effects, which the author estimates at 4% of daily wages.

3.1.5. Price correction: internalisation of nuisances

The cost to be taken into account corresponds to all of the costs borne, for a given activity, by the agents who benefit from it as well as by others. The total social cost is the sum of the internal costs, necessary to complete the activity, and of the external costs. Figure 20 itemizes the various factors of the total cost in the case of urban transport, whether individual or public.

Total cost	External costs	Environmental costs	Plants and wildlife Climate Noise Local pollution of air, water and soil Severance effects and biodiversity effects Use of space Landscape and heritage Vibrations …
		Social costs	Health Severance effects Quality of life
		Economic costs	Safety (accidents, police) Rarity : congestion, construction of the infrastructure Maintenance, repair of the infrastructure
	Internal costs	Fixed costs	Depreciation of the vehicle (or rolling stock) Fixed operating expenses
		Variable costs	Energy Variable operating expenses Vehicle maintenance Taxes Transport time

Source: Quinet (1998), adaptation CGDD

Figure 20: Total cost of a mode of transport - Source: Quinet (1998)

➢ Principle of bias correction: preventing, reducing and compensating for negative externalities

The State has a very broad scope of intervention to fight against the negative externalities produced by the transport of people. The principle generally adopted in many countries consists of preventing the negative externalities, reducing them and/or if this is not feasible, then internalising them into the costs.[31] These measures involve State interventions that may take several forms depending on the country. The various measures cited below have effects that overlap, so it is not necessary to implement them all to avoid, reduce or compensate for externalities.

× Externalities related to the environment:
  - Regulations on vehicles for automakers: limits in terms of volume and types of emissions, limits on the level of noise generated, etc.
  - Regulations on vehicles for users: checking the emissions and noise, introduction of a compulsory technical inspection.
  - Taxes on the possession of a vehicle (at time of purchase, at time of registration or periodical)
  - Taxes on the right to drive (road tax stickers, green stickers, etc.)
  - Taxes on fuel consumption (paid at the pump)
  - Taxes on the distance driven (tolls on certain roads, etc.)
  - Aid for investments and operations, in lower impact modes.
  - Urban tolling in dense population areas.
× Externalities related to the safety hazards associated with transport:

[31] Fully in line with economic theory, it is important, by comparing the costs and benefits, to determine the technical resource to be implemented, within the framework of marginal-cost pricing while taking into account the external costs.

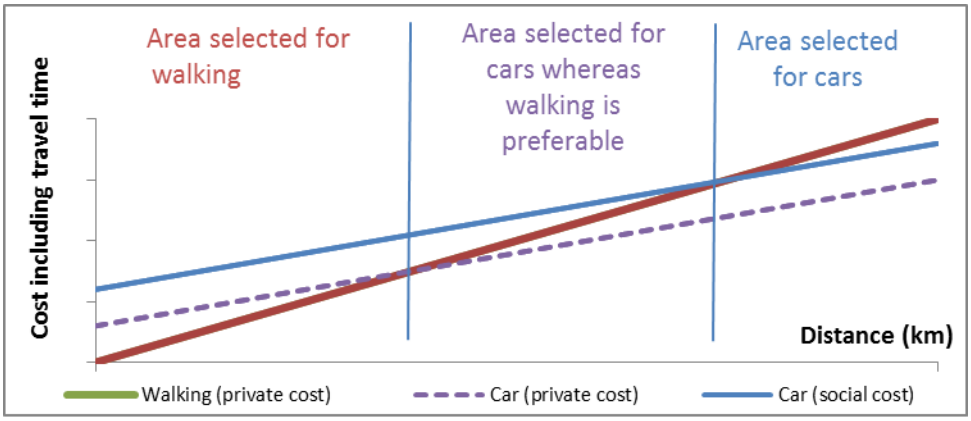
  - Regulations on vehicles (technical inspection, highway code, driver's license)
  - Standards for transport operators (legal obligations)
  - Tax on compulsory liability insurance policies: charging for the risk incurred.
- Externalities related to traffic congestion:
  - Urban tolling in areas subject to traffic jams;
  - Aids for investment in lower impact modes (public transport)
- Externalities related to the wear of infrastructure
  - Axle tax: a road vehicle wears the road infrastructure in the proportion of the fifth power of its weight per axle.
  - Same types of taxes as those presented for externalities related to the environment.
- Externalities related to land use:
  - Quota for parking construction.
  - Paid parking.

Some of these externalities correspond to de-facto subsidies, because they have an immediate impact on the State budget, in particular regarding road wear.

➢ Desirable effect of cost correction through taxes: choosing the right mode of transport

The measures outlined above make it possible to re-establish "correct" prices, so that the micro-economic equilibrium may be achieved at the optimal level. Among the first impacts is modal choice: the cost paid for individual modes of transport (excluding taxes) is significantly underestimated in relation to the actual social cost (internalising the externalities that cannot be prevented or reduced through regulations, standards or public policy).

This mode of transport is thus deceptively attractive in certain cases, as shown in Figure 21.



Choice of the model according to the lowest cost

Figure 21: Bias in the choice of the mode of transport if externalities are not internalised – Setec International

The money collected through taxes can either:

- Be used to directly correct for the externality: this is the case in particular of some of the accident-related externalities (accidents involving equipment covered by liability insurance),
- Be used to indirectly correct for the externality: investments in projects likely to correct for the externality, such as the development of public transport infrastructure to reduce traffic congestion.

× Be used for something else: the money that was collected has helped the traveller make the right choice. It is then reintegrated into the State budget to be redistributed to the community or to a certain category of people. Initially, the annual vehicle tax (the road tax sticker) levied in France was created to fund the elderly care budget.

➢ What coverage for external costs?

Figure 22, created by the French General Commission for Sustainable Development (CGDD), presents the current balance between externalities and levies for urban transport in France. The cost of tickets, fuel, trip times, etc. do not appear in this table. It is clearly specified in the CGDD's report that the costs indicated concerning safety hazards are external costs, not internalised by users through insurance policies taken out to cover property damage.

The use of transport systems by certain users results in a marginal cost related to the wear of the infrastructure which may cause a deterioration of the quality of service affecting all users. Generally, this cost is only partially borne by the concerned users. This is the case of the publicly-managed road network that is free to use for motorists and that is maintained and repaired at the expense of the entire community. The use of the infrastructure is thus considered as an externality.

	Road (Dense urban)		RER (express regional train)	Urban public transport		
	Private car petrol	Private car diesel	RER	Metro	Tramway	Bus
Environment	1.79	2.63	0.04	0.05	0.13	1.30 to 2.00
of which C02	*0.54*	*0.54*	*0.017*	*0.02*	*0.021*	*0.30 to 0.55*
of which local pollution	*0.59*	*1.43*	*0.021*	*0.025*	*0.026*	*0.80 to 1.00*
of which noise	*0.65*	*0.65*	*0*	*0*	*0.087*	*0.20 to 0.45*
Safety hazards	4.78	4.78	0.35	0.35	0.96	0.70 to 1.35
Congestion	16.75	16.75				4.60 to 6.20
Use of infrastructure	0.58	0.58				
Total external costs	**23.9**	**24.75**	**0.4**	**0.4**	**1.1**	**7.9 to 8.2**
Levies	**5.15**	**3.53**	**0**	**0**	**0**	**1.2 to 2.2**
BALANCE	**-18.75**	**-21.2**	**-0.4**	**-0.4**	**-1.1**	**-5.8 to -7.0**

Figure 22: Coverage of the external costs[32] associated with transport in euro-cents/passenger.km (France, 2010) – Source: "Les comptes de transports en 2011", General Commission for Sustainable Development

The figure shows that, in spite of levies, the urban traveller does not pay the actual cost to society of his or her transport, whether using private vehicles or public transport.[33] In any case, urban transport produces negative externalities; nevertheless, these externalities are significantly lower in the case of public transport, which is all the more true in the case of rail transport.

Generally speaking, as soon as mobility increases, the negative externalities associated with transport increase: however, if a public transport project generates a big enough modal shift from the car to public modes of transport, then the negative externalities may be reduced.

By paying only the private or internal cost according to the table in Figure 20, the user receives an implicit financial incentive corresponding to the difference between the total social cost and the private cost. Figure 22 shows that such incentives are much more important for individual modes of transport than for public transport. In order to re-establish "correct" prices, it would be necessary to tax all modes of transport, with individual modes of transport being

[32] The external safety hazard costs corresponding to the share not covered by insurance. The cost of using the infrastructure applies only to the cost of maintenance and repairs (OPEX).

[33] These are general conclusions based on average evaluations; the figures and conclusions that can be drawn differ sharply according to local specifics and the period, which means that even in conurbations, the marginal cost can be covered by the costs paid, i.e. for night-time traffic.

taxed more heavily than public transport. In practice, the choice is generally made to subsidise public transport.[34]

Levies concerning road transport correspond to revenue from tolls and taxes: taxes on fuel (TICPE – a domestic tax on the consumption of energy products), motorway tolls as well as various other taxes (axle tax, tax on company vehicles, tax on insurance policies, taxes on car registration and penalties for the most polluting vehicles).

Public transport operators pay the TICPE on the fuel consumed by buses. These levies cover almost all of the negative externalities except for traffic congestion. This lack of coverage of traffic congestion reveals that congestion tolls are rare in France.

Using France as an example, a large-scale and detailed study has been conducted to develop this assessment of external cost coverage. It depends on the systems of taxation associated with urban transport and, of course, on the assumptions made for the evaluation of the external costs that may differ significantly according to the evaluation methods used: the variations in the reference values applied in some countries reveals the difficulty of monetizing externalities. Furthermore, certain countries such as Mexico have not yet set up a monetization method, and so they are using reference values set by Europe. The question then arises of the adequacy of these values in a South American country (see *La importancia de reduccion del uso del automovil en Mexico,* Instituo de Politicas para el Transporte y el Desarollo, October 2012). It is thus practically impossible to find a complete assessment of the external cost coverage associated with urban transport in emerging and developing countries.

However, it is possible to obtain a few elements, in particular when focusing on the main factors that generate external costs, i.e. safety hazards and traffic congestion.

In a study conducted in 2000, Miller determined the value of human life in various South American countries based on reference values of statistical life set in certain countries and a linear regression method. This value is evaluated based on “the willingness of individuals to pay for risk reduction”, so it varies significantly between individuals according to their income level and thus between countries, based on their income per inhabitant.

Country	Range of Values		Best Estimate	GDP/capita
	Lower Threshold	Upper Threshold		
Argentina	1000	1500	1200	8.72
Brazil	500	900	680	4.82
Chile	600	900	650	4.598
Mexico	500	800	500	3.529
Peru	300	800	360	2.49
Uruguay	700	1100	820	5.857
Venezuela	400	800	520	3.678
Global Average	630	900	650	4.608
United States	3300	4500	3670	28.206
European Union	2500	3600	2730	20.714

Source: Miller (2000). The values are expressed in thousands of dollars 1995.

Figure 23: Values of statistical life in certain countries of Latin America (in $US 1995) – Source: “Variations between Countries in Values of Statistical Life”, Journal of Transport Economics and Policy, Miller, 2000

[34] In developed countries, the first method is generally more effective than the second for reducing individual transport modes: the introduction of paid parking or the implementation of an urban toll has a bigger effect than the introduction of fare-free public transport.

With values of statistical life that represent a relatively stable percentage of individual wealth regardless of the country, and accident rates much higher than those observed in cities in developed countries,[35] the cost of safety hazards associated with road transport in countries where the AFD is active also appears as one of the main sources of external costs. Even though in these cities buses and minibuses often represent a larger share of the vehicles on the road, the comparative cost of safety hazards in an individual vehicle vs. a bus or minibus, calculated in terms of passengers x km, will always favour public transport.

In order to illustrate the importance of traffic congestion, which represents 70% of external costs for a private vehicle in urban France, one can look at the cost of congestion estimated in a few of the world's largest cities; the tables below provide some figures.

The cost of congestion,[36] presented in the tables below, is calculated based on:

- the direct costs, or the value of fuel and time spent in traffic jams in relation to labour productivity;
- the indirect costs, including the opportunity cost of the lost time, the costs borne by third parties due to late deliveries of goods, and the environmental costs.

	Total cost of congestion (billions of $US)	Share of country GDP	Cost per inhabitant ($US)	Reference year
Sao Paulo	28.2	1.29%	1,354	2013
Rio de Janeiro	11.8	0.54%	972	2013
Cairo	7.9	3.61%	416	2010
London	8.5	0.34%	1,012	2013
Paris	11.7	0.43%	5,154	2013
Stuttgart	3.2	0.09%	5,237	2013
Los Angeles	23.2	0.14%	1,264	2013

Figure 24: Cost of traffic congestion in various cities of the world – Source: The Economic Impact of Congestion in Europe and the US: 2013 – 2030, INRIX, 2014 and Federation of Industries of the State of Rio (Firjan), 2012

	Total cost of congestion (billions of $US)	Share of GDP	Cost per inhabitant ($US)	Reference year
United Kingdom	20.5	0.82%	320	2013
France	22.5	0.63%	341	2013
Germany	33.4	1.22%	414	2013
United States	124.2	0.76%	393	2013

Figure 25: Cost of traffic congestion in 4 countries in 2013 – Source: The Economic Impact of Congestion in Europe and the US: 2013 – 2030, INRIX, 2014

[35] In Sao Paulo, the number of traffic fatalities compared with the number of modes of transport is eight times higher than the rate observed in the Paris region. In Medellin, there are nearly 300 fatalities a year on the road, compared with 50 in Paris with a quite similar victim profile, as pedestrians and two-wheel vehicles represent the majority of victims.

[36] The cost of congestion tends to be overestimated, as the estimation is made in a context of totally smooth traffic. But, it would be uneconomic, because too socially costly, to size infrastructure ensuring totally smooth traffic during rush hours.

For Cairo and São Paulo, conurbations in our sample, traffic congestion results in costs 3 to 9 times higher, measured against GDP, than those estimated for Paris. The external cost of traffic congestion is thus also a very important stake in these conurbations.

In the case of pollution and greenhouse gases, estimates are harder to find. The comparison of the cost of one ton of carbon, on one side as estimated in the Robien circular for France, and on the other side applying the European HEATCO procedure, demonstrates that monetary value differs greatly depending on which method is used:

- According to the Quinet report,[37] the cost per ton of carbon does not correspond to the cost of the damages that the CO_2 emissions in France cause worldwide. Rather, it corresponds to the evaluation of the cost to the French economy of the measures that must be taken to reach national emission reduction targets. The cost of a ton of CO_2 thus depends on each country's environmental policy. The 2010 value of the ton of CO_2 was thus set at €32 (in 2010 euros), the target value in France being €100/ton of CO_2 in 2030. After 2030, the price per ton of CO_2 rises with the discount rate.
- The HEATCO procedure evaluates emission variations in tons of greenhouse gases, then identifies the emission area according to its elevation (for example, on the ground, airplanes) and finally calculates the impact by multiplying the emissions of pollutants by the reference values listed in the table below, which are assumed to be constant over time because they are independent from GDP.

	Central guidance
Year of emission	
2000-2009	22
2010-2019	26
2020-2029	32
2030-2039	40
2040-2049	55
2050	83

Figure 26: HEATCO reference values for the cost of the greenhouse effect (per ton of CO_2 in € 2002)

In any case, it is clear that in cities where the stock of vehicles is older than in developed countries, emissions of pollutants are likely to be even higher, correspondingly increasing environmental costs.

The estimates presented in Figure 22 were calculated based on the price of carbon for the year 2010. According to the latest assumptions about future trends made in the Quinet report, the price of carbon is expected to triple by 2030 and then to increase at the applicable discount rate (approximately 4%). Thus, the present exercise in covering externalities might see its balances modified by the rise in the price of carbon. Even if the main generators of externalities will remain safety hazards and traffic congestion, the share of environmental externalities is likely to increase, further accentuating the gap between road and rail transport.

In terms of levies, in France fuel taxes account for a large share of the coverage of external road costs.

The following graph presents the price of a litre of diesel fuel at the pump in 2012 in various countries. It includes the cost of crude oil, transport and distribution as well as the refining margin and fuel taxes. The variation observed in the different countries, although partially

[37] The guidance value of carbon, Centre d'Analyse Stratégique presided by A. Quinet, 2008

explained by the costs of transport and distribution, is mainly due to disparities in taxes, sincefuel taxation policies are very different from country to country: the price of one litre of petrol in Norway is more than 200 times higher than in Venezuela, and European countries are in the highest price range.

When reading this graph, one may assume that a large share of the coverage of external road costs disappears in countries such as Morocco, Brazil,[38] Colombia or Nigeria, not to mention Venezuela or Iran.

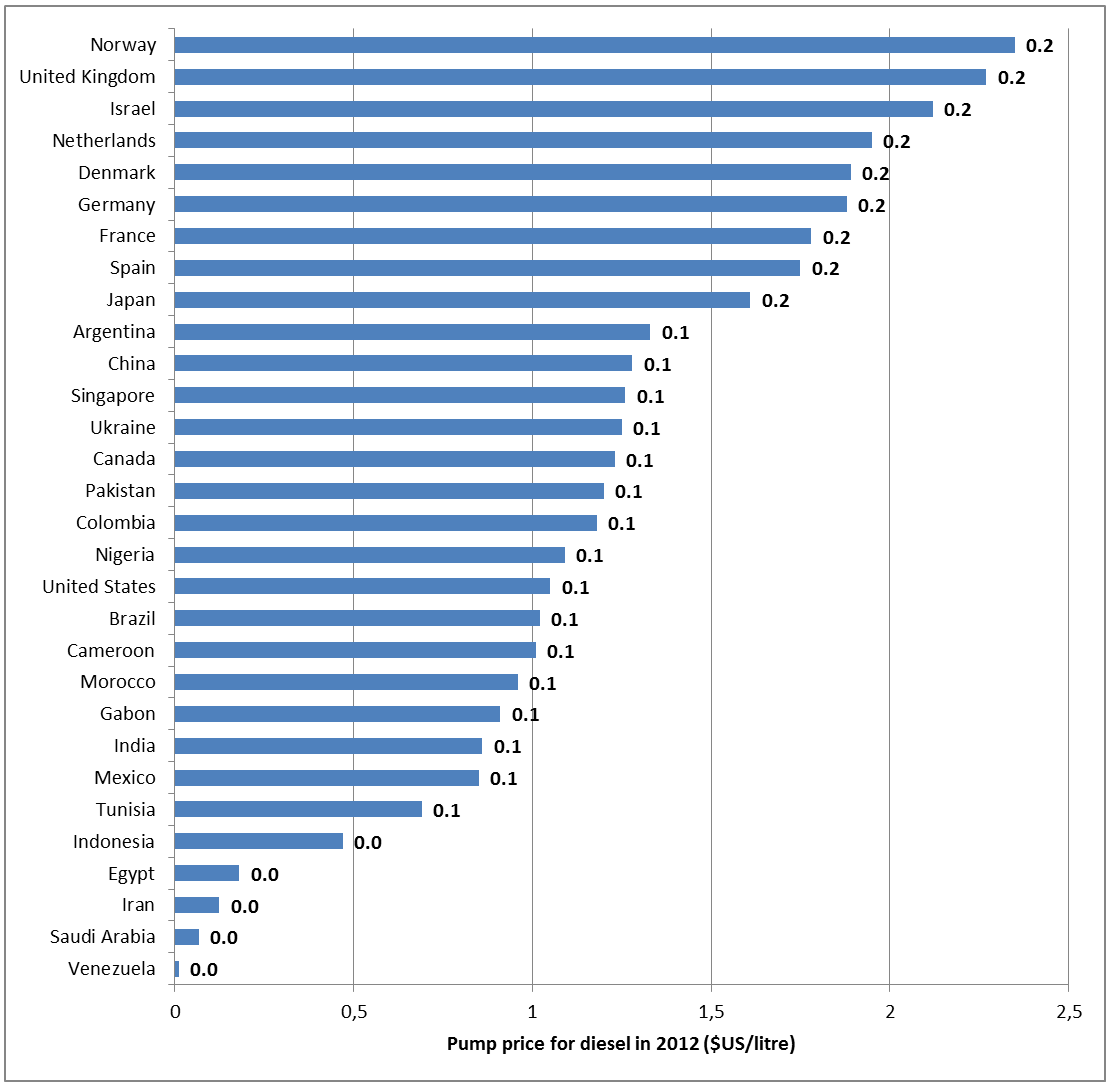


Figure 27: Pump price for diesel in 2012 in various countries ($US/litre) – Source: World Development Indicators, German International Cooperation Agency (GIZ)

➢ Conclusions in the cases of emerging and developing countries

Even if it is difficult to obtain complete assessments of the overall coverage of the costs of nuisances generated by urban transport in developing countries, the data above point to the following conclusions:

[38] Whereas in European countries the fuel taxes reach at least 60%, they are limited to 35% in Brazil.

- For urban road transport, be it collective or individual, the main factors that generate external costs (safety hazards and congestion) are always present and reinforced in particular in the major conurbations where traffic congestion is endemic and where a lack of safety on the road is also significant. Unlike what is observed in Europe, rail transport can in certain cases of extreme traffic congestion be very accident-prone (Mumbai, for example).

- Road-based collective transport, whether formal or small-business, serves a large share of mobility needs and generates extensive external costs.

  - In São Paulo, small-business collective transport using minibuses was a major source of negative externalities (pollution, noise, congestion and accidents). The reorganisation and integration of the minibuses with the rail system significantly improved the situation by increasing the number of travellers while significantly reducing the number of vehicles on the road.
  - In Lagos, the same holds true for the 75,000 minibuses that contribute significantly to traffic congestion and to the negative externalities of pollution.
  - A study on Santiago by Estache and Gomez-Lobo (2005)[39] shows that the cost of public transport may also be underestimated in certain cases, and in particular in the case of buses. This was demonstrated during a strike by bus drivers: on that day, the particle emission pollution was half of what it was on days when buses ran normally.

- But when these external costs are calculated in terms of passengers x km, collective transport always maintains its advantage over individual modes of transport.

- Finally, given that fuel taxes are often much lower in emerging or developing countries compared with the fuel taxes in European countries, the overall balance of externality coverage is doubtless still very deeply negative and favouring individual modes of transport, where the externality coverage deficit remains the highest.

  - Limitations of the rationale for taxing individual modes of transport and subsidising public transport

Taxation of individual modes of transport obviously comes up against resistance from the public. If, as a result, individual modes of transport cannot be taxed, a compensating measure to maintain economic equilibrium may be to lower the taxes on competing public transport, or even to subsidise public transport. The amount of the tax reduction depends on two parameters: the gap between optimal taxation of individual modes of transport and the actual taxation that is applied, and the degree of substitution (measured by the cross elasticity of demand) between individual and collective modes of transport:

- If there is no substitution, the two markets are independent and the underpricing of individual modes of transport has no impact on the patronage of public transport systems, and so there is no reason to reduce the taxes on public transport.

- If, on the contrary, the two types of transport are highly substitutable, it is natural for the forced underpricing of one to lead to the underpricing of the other, in order to avoid distorting the modal distribution in relation to the optimal situation.

Furthermore, increasing prices through levies limits mobility. This issue is explored in sub-section 3.2.1 below.

Finally, combining the taxation of individual modes of transport with subsidies for public transport makes it possible to partially solve the problem of access to public transport for the

[39] 'The limits to competition in urban bus services in developing countries', Transport Reviews, vol.25(2), March, 139.158

poorest people, but we will see that the practical implementation of subsidies of a social nature does not always result in efficient results in terms of redistribution (errors of exclusion or inclusion, weak redistributive effect). Capping prices through subsidies alters the market equilibrium and can encourage the mobility of certain classes of population without, nonetheless, having significant effects on income redistribution.

3.1.6. The promotion of sustainable urban development (internalisation of future externalities)

The nuisances generated by transport at the time of its production – in larger or smaller quantities depending on the mode of transport – such as traffic congestion, accidents, noise, particle pollution, greenhouse gases, etc., can be estimated with varying accuracy. But as an additional environmental rationale for the need to favour – and so to subsidise – public transport, it is increasingly common to hear about promoting a compact urban form. This notion is associated with a growing objective for parts of civil society and the political class: achieving sustainable urban development that is energy-efficient and produces less greenhouse gas.

Such a policy must be examined from several angles, and raises numerous questions: is the compact city really more sustainable? How does the promotion of public transport favour a more compact city? On the contrary, doesn't subsidising public transport distort the decisions of people and businesses to settle in the city, and doesn't it favour urban sprawl, and the segregation of activities, by reducing the economic obstacle of transport?

- Compactness, sustainability and efficiency

The compact city has not always been the model favoured by urban planners.

Quite on the contrary, the emergence of the private car, and the earlier realisation in Europe of the need to "aerate" very dense traditional city centres, resulted in de-densification policies from about 1850 to 1975, culminating with the separation of functions promoted by the modern movement.

The two oil price shocks of the 1970s made energy efficiency a key concern, before awareness about climate change made it even more important.

On initial examination, compactness, or urban density, enables increased efficiency of the various urban infrastructure services: water and electricity distribution, sanitation, even heating, are cheaper per inhabitant served. When it comes to transport, the comparison is compelling, as shown in the graph below, which illustrates the density effect as well as the underpricing of fuel (US cities):

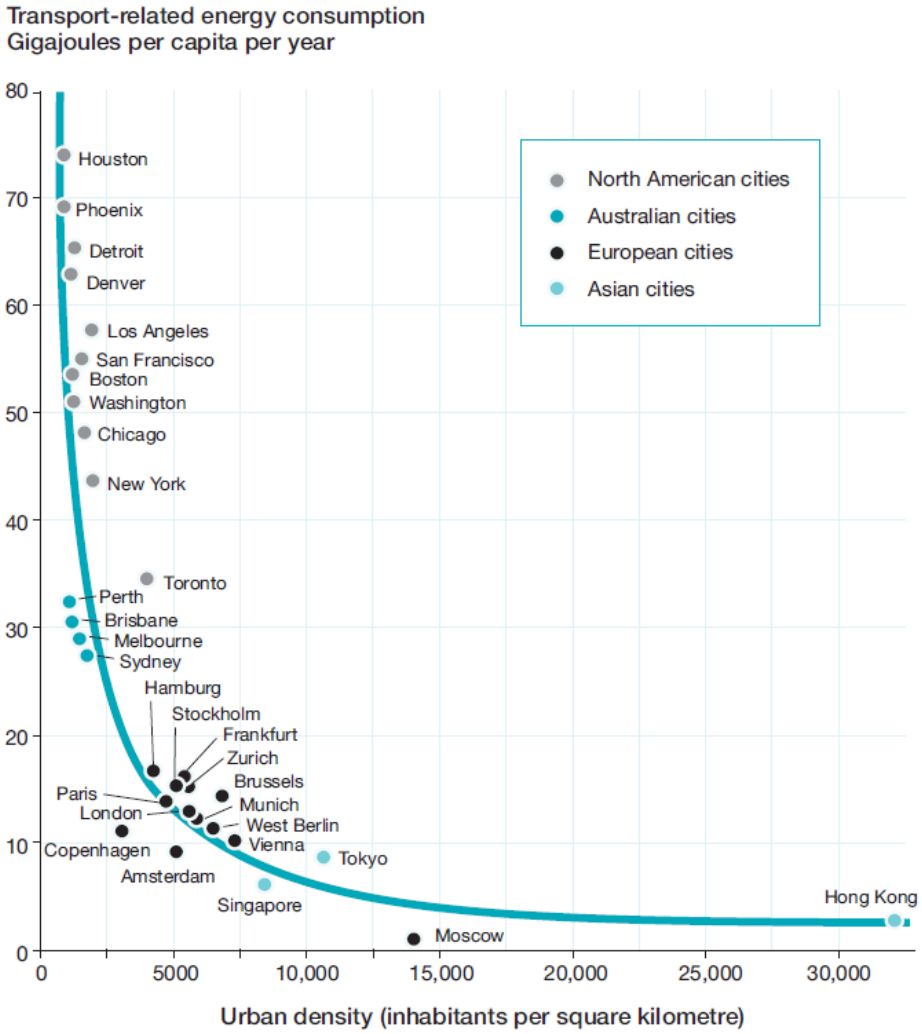


Figure 7

Influences of urban densities on transport-related energy consumption (1989)

Source: Newman and Kenworthy, 1989.

Figure 28: Urban density and transport-related energy consumption – Source: Newman and Kenworthy, 1989

It is important to note that, on this graph of transport-related energy consumption as a function of urban density, the largest gains (a factor of six to two) are obtained by going from very low-density urban sprawl (of the American or Australian type) to an average density of townhouses and medium-rise buildings such as those common in Western Europe. The ratio between cities of Europe and Asia (the densest) is smaller.[40]

A study conducted by the BTS (Bureau of Transportation Statistics) in 1991 reveals the correlation between the urban form of a city and the favourable use of certain modes of transport: the case study of several American cities leads to the conclusion that urban sprawl favours intensive car use.

[40] Compactness may also reduce the cost of amenities for sports, culture, education and health by facilitating the distribution and accessibility of services.

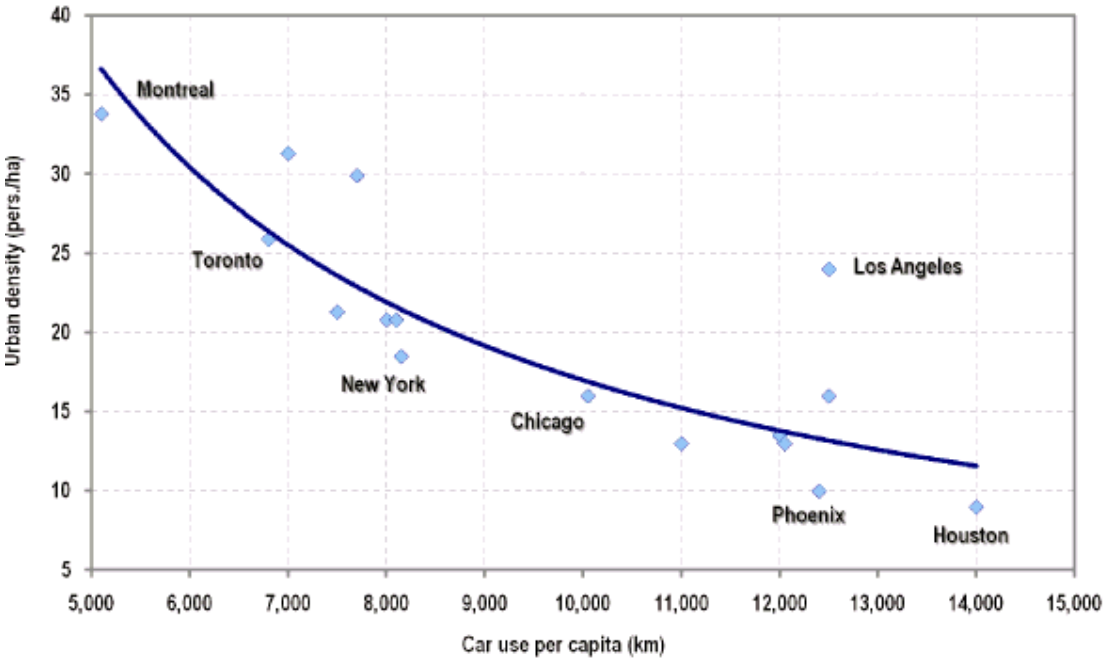


Figure 29: Car use in km per year and per person as a function of the urban density of the cities studied – Source: Density and Car Use in North American cities, BTS, 1991

However, these comparisons at a given point in time should be interpreted with caution, because they neglect dynamic aspects. From this point of view, a distinction should be made between the creation of a city out of nothing or the case of a rapidly expanding conurbation, and the transformation of a slowly-expanding existing city. In the latter case, the transformation of what already exists may be very costly, and the initial choices virtually impossible to modify: at the beginning there were flexible possibilities; the choice could be made between a compact or non-compact city; after a certain time, due to the rhythm of development, the initial choice is no longer reversible and turning back would be too costly.

- Subsidising transport and urban sprawl – the models

If we may assume intuitively that subsidising urban transport (in general) modifies price signals, thereby changing businesses' location decisions and people's housing decisions, resulting in more spread-out cities and more segregated activities, very few studies explore this issue in detail, as the modelling required is complex.

Among the many models, both theoretical[41] and applied, that have explored this problem, an example is the one by Tscharaktschiew and Hirte (2011), who use a spatial numerical general equilibrium model calibrated to a German city. They study the impact of five forms of subsidising commutes: the tax deductibility of households' commuting transport expenses , a lump-sum subsidy to households, an investment in road infrastructure, a reduction in fuel taxes, and finally a reduced VAT rate on public transport only. In each case, they also test two methods of funding the subsidy (lump-sum or progressive). Their simulations produce the following results:

[41] Brueckner (2003) suggests, for example, a model that shows that urban transport subsidies, regardless of the mode of transport, lead to suboptimal urban sprawl. However, the very restrictive assumptions of the model (a monocentric model where jobs are in a single place, with constant-yield transports, with no congestion) lead to the conclusions. This model also studies the impact on sprawl of the modal choice in the absence of subsidies, but with limits that are even more detrimental to the relevance of the analysis, in particular regarding the choice of characterisation parameters of the modes. The work of Anas and Arnott on these subjects should be mentioned as well.

- the five subsidy policies increase the suburbanization of residences and jobs, but in minimal proportions;
- with the exception of the last one (subsidising public transport only), all forms of subsidy reduce aggregate welfare, in particular through congestion effects;
- only subsidies to public transport only increase aggregate welfare;[42]
- subsidies to public transport only are the only policy that reduces CO_2 emissions (in spite of the suburbanization effect; however, the impacts on CO_2 emissions are only estimated concerning transport); all the other subsidies increase CO_2 emissions.

Generally speaking, the LUTI models, the use of which is becoming more widespread, make it possible to gauge the impact of a transport measure on urban development. What they show overall is that public transport fosters densification, but not throughout the conurbation, and on the condition that accompanying and supporting measures, concerning in particular parking policy and land policy, are consistent.

➢ Sprawl and modes of urban transport

Whereas the heavy implicit subsidies to individual modes of transport observed in many cities of the world are thought to result in inefficient urban sprawl, there is a growing clamour for "transit-oriented development" (TOD), which, by encouraging public transport investments in cities, is thought to enable high densities to exist around high-capacity transport corridors. Of course, the most well-known case is Curitiba in Brazil. The Curitiba Master Plan adopted in 1966 defined the bases for controlled urban development along five main transport corridors. This concentration of development at the expense of a large part of the city not served by these major corridors nevertheless limited urban sprawl and created density around these corridors, since the public transport system is made more attractive and efficient. In parallel, the structure of the network and the special architecture of the bus stops facilitate transfers and make it possible to connect the entire city to the five main corridors.

In this concept, and contrary to an idea that is widely held, it is not primarily the promotion of public transport that creates compactness: it is primarily a land policy encouraging density around a corridor, through building rights made available, land assembly and subdivision, revised zoning and well-adapted infrastructure and facilities. Counting on transport policy alone to change the density of the conurbation would be inefficient and expensive. Public transport is only a technical means of enabling such densities to exist. Indeed, individual modes of transport occupy space in such a way that they do not enable a city to operate smoothly above a certain density.

In order to illustrate this occupation of space, in 1993 Marchand produced a table describing the per-capita use of space (in sq. m x hr) for a 5-km trip, using an infrastructure at optimal capacity, to commute to work (parking time 9 hours):

		Parking	Traffic	Total consumption
Pedestrian		0	2	2
Two-wheeled vehicles		13.5	7.5	21
Automobile (1.25 pers./vehicle)		72	18	90
Bus (50 persons/bus)				
Ordinary lane		0	3	3
Segregated lane	60 buses/direction/hr	0	6	6
	30 buses/direction /hr	0	12	12
Metro		0	1	1

Source: Marchand; 1993, p. 5

Figure 30: Use of space associated with different modes of transport – Source: Marchand, 1993

[42] It should be noted, however, that the application of a reduced rate of VAT is far from being the main public transport subsidy in Germany and, as a result, the total volume of subsidies used in the study is low compared to the reality of the situation.

This famous photomontage is also telling:

Figure 31: Respective occupation of road space by buses and cars

The cost of urban space use

The cost of land use has been the subject matter of many studies led by L. Marchand, considering that public space is a scarce resource and must be priced at the marginal social cost. As early as 1984, he demonstrated the equivalence between the costs per sq. m x hr of parking and traffic: the cost of creating square metres of new spaces for transport compared with the total number of hours of use corresponding to their lifetime are the same as those obtained for street parking, i.e. 0.60 francs in 1984.

This method was criticised in the Boiteux 2 Report in 2001, which considers that the pricing of street parking has other objectives than reflecting the social cost of public space. Furthermore, the report warns about the lack of distinction between the sq. m x hr cost in off-peak periods (the economic cost of use is zero) and the sq. m x hr cost in peak periods (the economic cost of use is equal to the marginal cost of road congestion).

But beyond these criticisms, other objections have been raised, leading to the following question: "Should the full cost of land use be considered as the value of a nuisance?" According to the CETUR (1994), transport generates positive externalities such as land value gains and "it seems excessive to assign the entire cost of the land to evaluate the cost of the use of space on an existing road." Consistent with these recommendations, in 1997 J. Vivier presented a method different from L. Marchand's, suggesting an approach based on the cost of land and a "normal" rate of return on capital assets. The results concerning the Ile-de-France (Paris) region are displayed in the table below:

Location	Average price per sq. m of land	"Normal" income of the real estate at the rate of 6%	Annual number of "useful" hours for traffic or parking	Cost sq. m / hr
Paris	10,000 F	600 F	3 600	0.167 F
First ring	5,000 F	300 F	3 600	0.083 F
Second ring	2,000 F	120 F	3 600	0.033 F

Source : Vivier , 1997, annexes, p.122.

Figure 32: Cost of land use per sq. m x hr according to location in the Paris area – Source: Vivier, 1997

According to the information in the appendix of the 1996 regional transport accounts report, following the assumptions of the CETUR, the cost of the use of road space in Ile-de-France represented at least 1.4% of regional GDP in 1996, or 15% of total regional transport expenditure (excluding transport of goods).

In spite of these numerous ways of quantifying it, the cost of land use has never been integrated into the calculation of the external costs of transport in France.

Nevertheless, the research continues, and the PREDIT published a report in 2008 exploring indirect valuation methods: the excessive use of space by a mode of transport actually does represent a nuisance, insofar as it restricts use by other modes in many ways. In this sense, the social cost of land use a compromise between:

The **cost of losses**, which corresponds, for example, to the additional cost of transport by car instead of being able to use alternative modes;

And the **costs of protection** related to the creation of new spaces, regulations on motorised traffic through quantity or price, or the reallocation of existing spaces.

➢ Land policy: a critical factor

Modern analyses such as those conducted by Glaeser, and illustrated for example by Bertaud (2002-1) consider that what determines the density of a city, is first and foremost land markets and the housing policy. Transport policies either facilitate or prevent the full realisation of agglomeration effects, and thus economic efficiency, in a given urban structure; but they only play a minor role in shaping this form itself. The promotion of a compact city, when it is still possible (see the lock-in considerations above), requires above all else adequate land policies. These land policies can lead to levels of density ranging from 1 to 50:

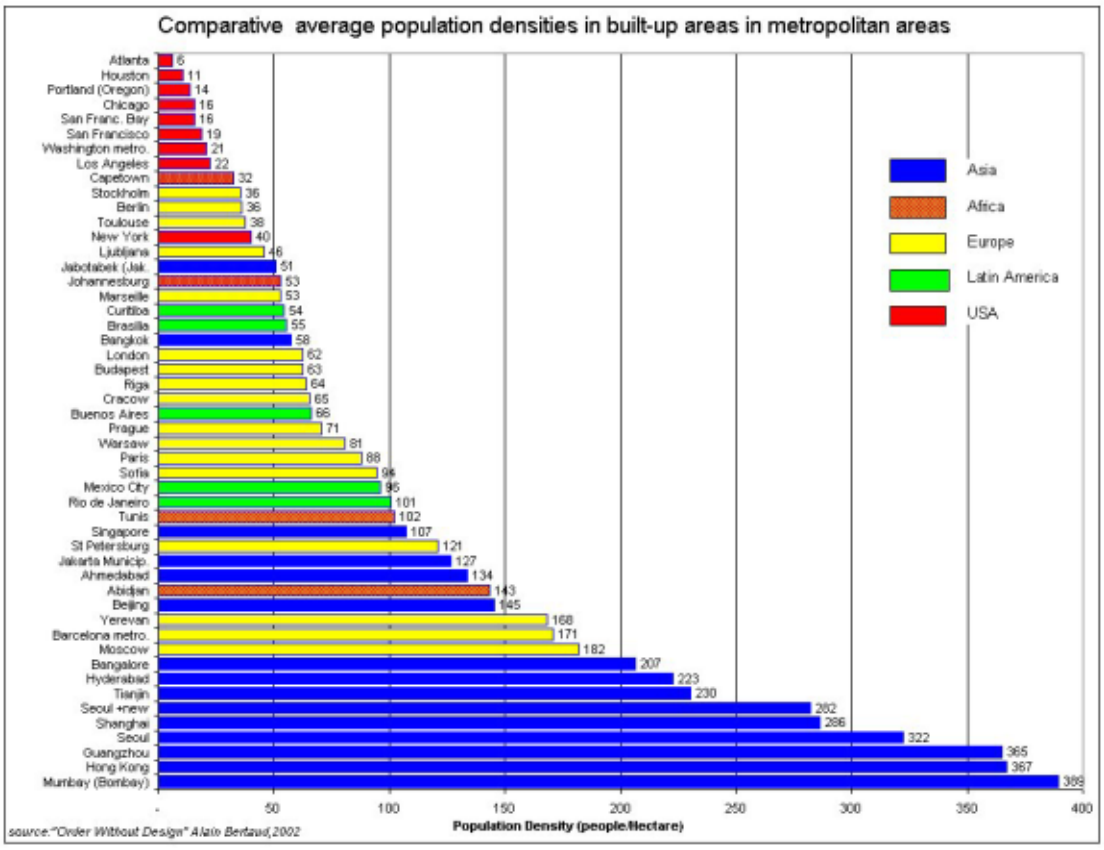


Figure 33: Population density in various cities in the world – Source: Order Without Design, Alain Bertaud, 2002

Bertaud (2002-2) also stresses that when urban density reaches a relatively low threshold, the transport system can only marginally impact the urban form. The case of Atlanta (see box) is extreme: its low density makes public transport so unattractive, even at equal full cost, that it prevents any possibility of influencing modal choice, regardless of how high subsidies for public transport or even the taxation of individual modes of transport are. The period between 1990 and 1998 is representative of this phenomenon: out of 700,000 inhabitants and 400,000 additional jobs, respectively 88% and 77% were located more than 800 metres away from the public transport system.

The public transport system of Atlanta is and will remain financially unsustainable, and therefore economically inefficient.

Public transport in Atlanta

The Metropolitan Atlanta Rapid Transit Authority (MARTA) is in charge of planning and operating and the system. The city, as well as two neighbouring counties (Fulton and Dekalb) is served by four metro lines and 120 bus lines. The agency is run by a board of directors consisting of representatives of the City of Atlanta, the counties of Fulton and Dekalb, the Georgia Department of Transportation and the Georgia Regional Transportation Authority (GRTA).

As the conurbation of Atlanta has one of the lowest urban densities in the world (6 inhab./hectare, see fig. 26), and poor distribution of jobs and housing, public transport does not serve the city well and is essentially used by the few inhabitants without cars (64% of public transport users have no alternative). Its market share is thus very low.

The public transport budget for Atlanta in 2012 was approximately $750 million, funded mainly from three sources:

- Passenger revenues
- A subsidy funded by a 1% portion of the sales tax in Fulton and Dekalb counties, which must be distributed equally between the operating budget and the investment budget. This subsidy represents 65% of the revenues of MARTA;
- Subsidies from the State of Georgia, which are excluded from funding operations.

In the 2000s, a decrease in revenue from the sales tax, closely correlated with the local economic situation, together with a drop in ridership, placed MARTA in a difficult financial situation, forcing the agency to lay off workers and limit service, thereby further reducing the attractiveness of the system. In 2012, an audit conducted by KPMG predicted that there would still be an operating deficit of $240 million in 2021, after subsidies, and concluded that the economic model of the operator was unsustainable.

The low expansion rates of cities in the developed world suggest that urban transport subsidy policies have no real influence on urban sprawl. In the cities of emerging and developing countries, however, which are characterised by high growth rates, new neighbourhoods essentially organised around individual modes of transport spread quickly and widely over land that is currently inexpensive. This use of land can have very long-term effects. Current economic incentives for modal choice, which can have consequences for decades to come (land used by road infrastructure), take no account whatsoever of the much higher future value of the occupied land.

In these cities, inconsistencies between land policies and transport policies (including transport subsidy policies) would thus have major effects that would be difficult to reverse in the long term.

3.1.7. Critical general conclusion on micro-economic rationales for subsidies

The rationale of increasing returns is not obvious and often exaggerated. The reality of high fixed costs (private increasing returns) combined with marginal-cost pricing which should be the rule, leads to losses for the operator, thereby justifying the payment of subsidies. But the increasing returns assumption is not always appropriate:

- Transport by bus does not have a cost function leading to increasing returns.
- The assumption is actually only valid in a public transport system that is not yet very developed, and so it is difficult to argue for it in major developed cities, where the

existing network has technical and financial constraints that dictate decisions about marginal equipment.

Likewise, the rationale for subsidies based on the Mohring effect in public transport must be put into perspective, together with the trade-off between frequency and vehicle capacity, in a context where formal and small-business modes of transport coexist.

Whether applied to individual modes of transport or collective transport, the theory has it that negative externalities (congestion, safety hazards, pollution, noise, greenhouse gases, urban sprawl) should be taxed and positive externalities (wider economic benefits – agglomeration effects) should be subsidised.

But, even if it is important in theoretical terms, taking account of agglomeration effects has mostly been put forward as a rationale for building infrastructure, but rarely as a basis for setting taxes and subsidies, in particular at the political level,[43] probably due to a lack of knowledge and of estimation of these positive externalities. For the past few years, an increasing number of studies on the subject of wider economic benefits suggest that this rationale could be put forward more than it currently is. In the conurbations where the AFD is involved, however, it is likely that it would be very difficult to have the databases and tools necessary for these evaluations of wider economic benefits; it is also likely that the structure of the economy is very different from that of the conurbations where the current methods were developed, and that these methods are not directly applicable. The large share of the informal economy is not included in the calculation of wider economic benefits, even though it also benefits from economies of agglomeration.

The rationale linked to reducing urban sprawl seems harder to support if it is not combined with land policy.

All transport economists agree that individual modes of transport have a very high level of negative externalities, be they immediate (congestion, environment) or more long-term (urban sprawl). The most economically efficient solution (first-best) would be to tax individual modes of transport to internalise these costs for the community, even if public transport, in particular road transport, also generates negative externalities. This supports the argument for urban tolling, such as the system used in London, taxes on vehicles and petrol, and the elimination of fuel subsidies, where they exist (examples of the elimination of fuel subsidies are given on page 74).

In practice, it must be acknowledged that political considerations make the implementation of a very sharp increase in transport taxes very unlikely, especially in low-income countries, Furthermore, the micro-economic optimum itself remains a theoretical model of welfare economics.

Even if public transport itself is not free from negative externalities, the strong differential, in urban environments, between these externalities and those of individual modes of transport makes it seem preferable to opt for a “second-best” solution: public transport subsidies.

However, the economic analysis shows that the form of these subsidies and their context are crucial. A modal shift does not occur simply on the basis of subsidy volume. As it involves an economically complex activity, the approach must take into account the operational aspects (cost functions and development stage of the system, for example), institutional aspects (monopoly or competition in or for the market) and political aspects (acceptability of taxation).

In particular, profound institutional reforms have complex effects; the effects of deregulation that occurred in urban transport in many countries have been the subject of numerous

[43] In particular the rationale for subsidies such as Vale Transporte in Brazil.

analyses, demonstrating the diversity of the consequences according to local specificities and the way in which the deregulation is implemented: according to van Goeverden, Rietveld, Koelemeijer and Peeters (2006)[44] the deregulation of buses in the UK in 2005 led both to a drop in subsidies, a rise in volume of supply, a drop in unit production costs on one side and a drop in the aggregate attractiveness of the system and on the other side a sharper drop than predicted in demand: a decrease of up to 45% in metropolitan areas. We will return to this issue when we propose recommendations.

3.2. The social rationales

3.2.1. Social equity and access to opportunities (jobs, services…) – the cost of transport

Even if mobility is sometimes presented as a primary good[45] in the sense of Rawls, i.e. a good to which access is considered a fundamental right and must therefore be guaranteed by the public authorities, above all else, transport is an intermediate good, nevertheless necessary to gain access to most activities, goods and services: work, education, culture, health, leisure and community life.

This creates a responsibility for the public authorities who must facilitate the mobility of various categories of people without socio-economic, geographical or physical segregation.[46]

A common rationale for public transport subsidies is the need to make transportation affordable for the poorest, by limiting its cost. This notion of affordability is very widely found in the literature. But subsidising transport is not necessarily the most efficient way to reduce poverty: there can be more efficient or easier ways, such as direct payments of allowances[47] to the poorest households, which can then use this money for their various needs, including transport. But if the goal is actually to improve the mobility of certain categories of people, such as women, children and the elderly, through affordable fares, transport subsidies appear much more justifiable, provided that they are well targeted and help redistribute income.

However, it is important to note that a subsidy granted to an agent does not necessarily correctly represent the advantage that this agent will derive from the measure targeting him. The economic interdependencies at play between markets may transfer all or part of the advantage to other agents. For example, when we subsidise transport in favour of an area inhabited by low-income residents, it is likely that the advantage granted to the inhabitants of this area will lead to an increase in the area's land values: the inhabitants will move around more, but they will lose part of the benefit to the property owners.

- <u>How should the degree of affordability of transport be defined for the poorest?</u>

In many cases, it is the share of monthly income of poor families that is dedicated to transport that is used as an indicator to measure this affordability. It is compared to threshold values

[44] They base this in particular on Gwilliam (1990), Matthews et al. (2001), White (1990), Balcombe et al. (2004), Fairhurst et al. (1996) and Tyson (1990).
[45] However, in developing countries, due to limited budgets, this right is often in competition with other primary goods: access to drinking water, access to electricity, education, a healthy diet, etc. The amount of effort that the public authorities put into transport thus depends very much on the context of each country.
[46] Regarding persons with reduced mobility, the measures are taken on a case-by-case basis through government actions (example in France, the SDA: transport accessibility guidelines) or by associations (example in Hong Kong of the HKSR: Hong Kong Society for Rehabilitation).
[47] In Chile, between 2004 and 2006, the rise in transport prices linked to the rise in the price of oil was offset, not by subsidies on fares, but by direct allowances to households, paid to nearly 40% of the population.

obtained from benchmarks, which range in the literature from 6% to 15%. However, this indicator is difficult to analyse: it is possible that a very small share of the budgets of the poorest households is dedicated to transport (and so remains below the limit from the benchmark) precisely because transport is too expensive and so the primary mode of transport of poor households is walking.

The indicator developed by Carruthers, Dick and Saurkar (2005) is much less biased and enables comparisons between conurbations: it is based not on actual expenditures but on the cost required to take sixty 10-km trips by public transport[48] per month and per household, compared with the per-capita income. This indicator is then calculated for the households in the bottom income quintile and possibly for the average. It can then be compared to a limit value, but it can also be used for measuring the effects of implementing a socially-oriented pricing policy.

	City	Per Capita Income U$PPP	Bottom Quintile Income as Percent of Average	Fare for 10 km Travel (PPP U$cents)	Affordability Index	
					Average	Bottom Quintile
1	Bangkok	20,386	31.0%	32.2	1%	4%
2	Prague	32,757	52.0%	88.0	2%	4%
3	London	53,057	30.5%	116.4	2%	5%
4	Shanghai	20,814	30.0%	55.1	2%	6%
5	Cairo	7,117	43.0%	26.1	3%	6%
6	Budapest	22,106	50.0%	89.3	3%	6%
7	Beijing	14,379	30.0%	55.1	3%	9%
8	Seoul	16,784	40.0%	85.5	4%	9%
9	Singapore	38,797	25.0%	130.3	2%	10%
10	New York	51,739	27.0%	200.0	3%	10%
11	Los Angeles	42,483	27.0%	160.0	3%	10%
12	Chicago	483	7.0%	180.0	3%	10%
13	Warsaw	26,024	36.5%	142.5	4%	11%
14	Guangzhou	9,165	30.0%	55.1	4%	14%
15	Moscow	16,154	24.5%	84.6	4%	15%
16	Amsterdam	2,817	36.5%	223.3	6%	16%
17	Manila	9,757	27.0%	63.0	5%	17%
18	Krakow	15,579	36.5%	130.6	6%	17%
19	Mexico City	982	15.5%	39.3	3%	19%
20	Chennal	3,717	41.0%	39.3	8%	19%
21	Kuala Lumpur	18,351	22.0%	121.6	5%	22%
22	Mumbai	8,585	41.0%	112.2	9%	23%
23	Buenos Aires	15,493	15.5%	87.6	4%	26%
24	Cape Town	14,452	10.0%	75.8	4%	38%
25	Brasilia	12,985	10.0%	106.8	6%	59%
26	Rio de Janeiro	14,325	10.0%	125.4	6%	63%
27	Sao Paulo	8,732	10.0%	130.1	11%	107%

Figure 34: Transport affordability index – Source: Carruthers, Dick and Saurkar, 2005

- The social rationale criteria: redistributive effects and inclusion and exclusion

As indicated earlier, to be justified, a subsidy of a social nature must have redistributive effects and be well targeted.

[48] Sixty is an estimate of the number of trips necessary to carry out basic activities (work, school, healthcare and other social services) plus a few additional trips (family or urgent visits, etc.).

The redistributive nature can be appreciated by analysing the distribution of the benefits resulting from the subsidy in light of the distribution of income. On the graph of the following figure, the first bisector indicates a neutral distribution of benefits, the curve above the bisector shows a progressive distribution (the poorest households get more benefits) and the curve below the bisector shows a regressive distribution (the wealthiest households get more benefits). Here, the analysis is done on the result: indeed, a subsidy mechanism that appears to be neutral can, after all, have progressive effects if most of the customers who use the public transport are poor, because the wealthiest classes use individual modes of transport.

Two indicators can be used to estimate the redistributive nature of the subsidy:

- The indicator Ω consists of calculating, for a given cumulative number of households, the ratio between the percentage of cumulative benefits and the number of households. The cumulative number of households to which the calculation is applied corresponds to the poverty level to be considered. An Ω greater than 1 indicates a progressive system, an Ω equal to 1 indicates a neutral system and an Ω lower than 1 indicates a regressive system.
- The quasi-Gini coefficient corresponds to the ratio between two surfaces: surface A corresponds to the area between the cumulative benefit curve and the first bisector: if this area is below the bisector, A is considered to be negative. Surface B corresponds to the entire area below the bisector. The quasi-Gini coefficient ranges from -1 (totally progressive system) to 1 (totally regressive system) through 0 (neutral system).

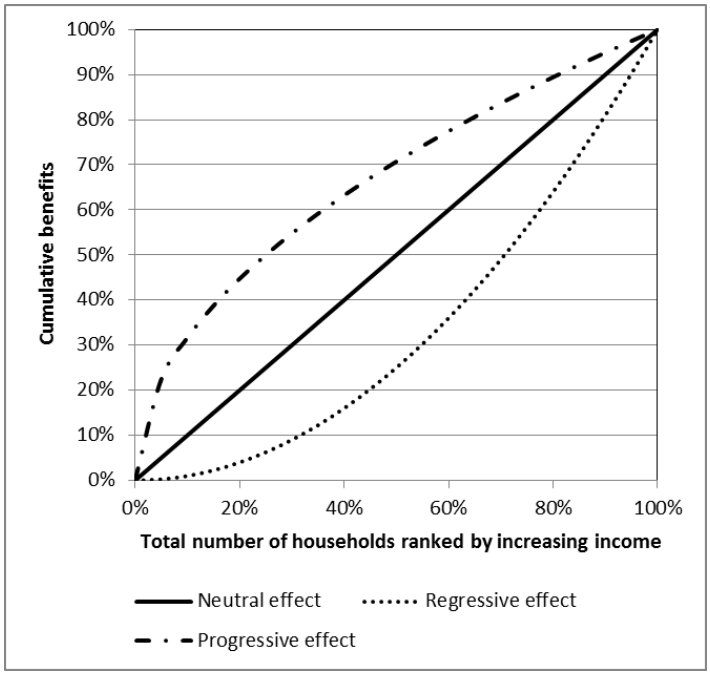


Figure 35: Progressive or regressive effects – Source: Setec International

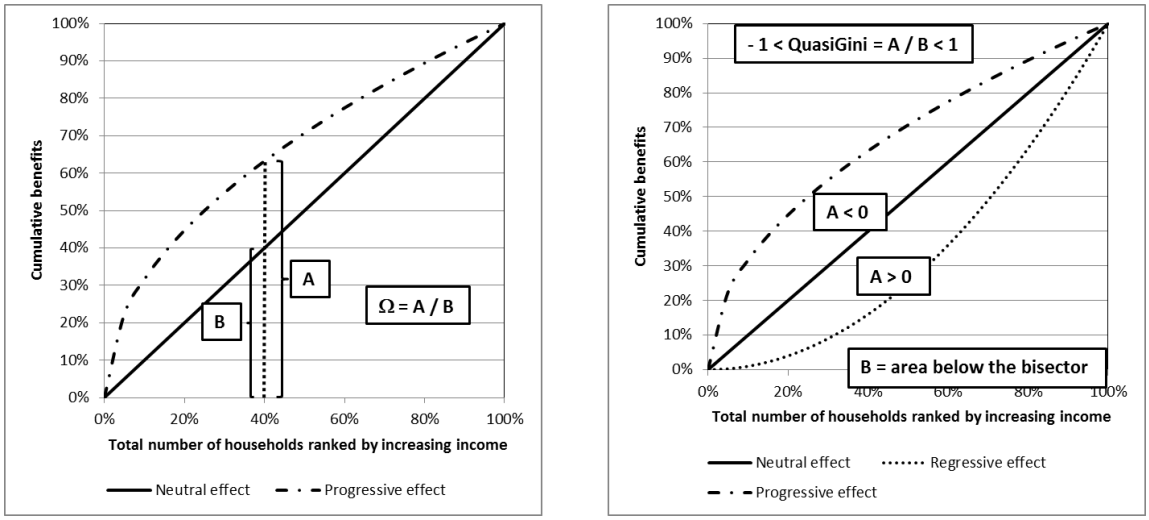


Figure 36: Indicators of redistributive effects: Ω and quasi-Gini – Source: Setec International

The second rationale for subsidies of a social nature consists of understanding if they properly target the poor: two indicators must be calculated. The objective of the first one is to measure the share of individuals who should benefit from the subsidy but who do not benefit (exclusion error). The second aims to measure the share of individuals who benefit from the subsidy when they should not initially have been targeted by the measure (inclusion error).

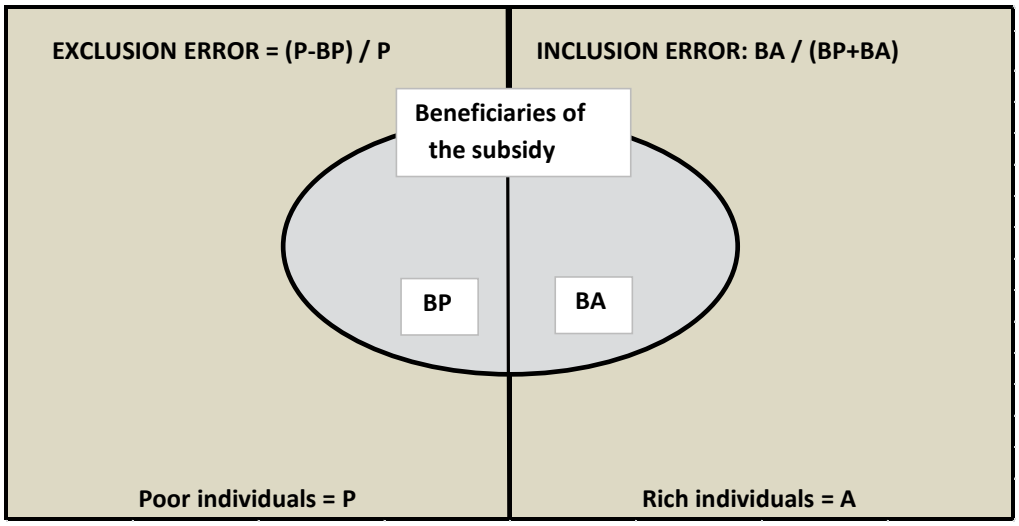


Figure 37: Exclusion error and inclusion error – Source: Setec International

In the field of transport, unlike in the water or electricity sectors, few studies have analysed the redistributive nature of subsidies and the way in which they are targeted. However, some data are available:

- The example of Brazilian travel vouchers: the Brazilian Vale Transporte, introduced in 1987 as a legal obligation valid for all urban centres, is a subsidy paid by employers, who are required to pay the portion of the cost of transport which exceeds 6% of the employee's salary. Each employer buys travel credits from the transport authority for its employees, in the form of vouchers which are only valid on the urban and inter-urban transport services for which fares are set by the public transport authority (excluding the very common small-business modes of transport).

To understand how the voucher system works, we will look at a specific case involving an employee who commutes 22 days a month, using a bus and the metro. His transport budget is R$205 per month.

Depending on the salary, the employer has to pay him a subsidy equal to the difference between the monthly cost of transport (R$205) and 6% of his gross salary, as the employee has to pay a share of his transport cost equal to 6% of his gross salary.

Gross monthly wage (in R$)	Monthly transport budget (in R$)	6% of gross wage (Amount paid by employee) (in R$)	**Amount of Vale Transporte per month (paid by the employer) (in R$)**
724	205	43	161
1,000	205	60	145
1,200	205	72	133
1,300	205	78	127
1,400	205	84	121
1,500	205	90	115
2,000	205	120	85
2,500	205	150	55
3,000	205	180	25
3,410	205	205	-
4,000	205	240	-

Figure 38: Value of the Vale Transport according to the gross salary of employees – Source: setec hydrobrasilera

If we consider our specific case of a monthly transport cost of R$205, the system enables all employees earning less than R$3,000 per month to receive transport aid. To establish an order of magnitude, the minimum wage is R$724 per month, the average wage is approximately R$1,200 for men / R$900 for women, whereas the minimum wage of an engineer is approximately R$6,000.

This Brazilian system has two principal advantages:

- It minimizes the impact of fare adjustments for its users, as their expenditures are limited to 6% of their wage; the employer covers them.
- This transport aid is progressive, insofar as the beneficiaries correspond to the poorest classes of workers, at least for workers in the formal sector of the economy.

In fact, the major disadvantage of this system in terms of redistribution lies in the fact that only workers in the formal economy benefit, whereas formal employment only represents 48% of the total labour force of the six major metropolitan areas of Brazil, so a large share of the users are excluded. Furthermore, as the system has developed, the travel vouchers have become tradeable on the black market, in particular to use in small-business modes of transport. This parallel trafficking has been reduced thanks to the deployment of electronic cards.

× The differential pricing of public transport in Medellin is set according to the SISBEN levels of the users. The SISBEN (Sistema de Selección de Beneficiarios) is a national identification instrument of the poorest and most vulnerable households and individuals of Colombia, potentially beneficiaries of social welfare programmes applying to certain public services and public transport in particular. Based on a survey conducted of Colombian households, the State collects information on various socioeconomic traits (home, education, health, etc.). Using software, each household or individual is given a score, resulting from the relative weight of the socioeconomic criteria, which is used for ranking

the population by SISBEN levels, ranging from 1 to 6 (from the poorest to the wealthiest). Only people in levels 1, 2 and 3 get aid for public services. This is thus a complex process which requires an extensive organisation, but which is part of a national programme not simply limited to transport services.

In the case of public transport in Medellin, and specifically the L line of the gondola lift serving Arvi Park, the fares that apply depend on the SISBEN level:

Profile	Fare for transfers from the subway	Fares for travel from the stations of the Arvi gondola lift
With the Civica card and a SISBEN level of 1, 2 or 3	250 Col$	600 Col$ per trip
Without the Civica card and a SISBEN level of 1, 2 or 3	600 Col$ per trip	600 Col$ per trip
Without SISBEN	4,600 Col$ per trip	4,600 Col$ per trip
Children under 1 m	Free	Free

Figure 39: Applicable fares for the Arvi to Medellin gondola lift (Line L) – Source: Metro de Medellin - 31 October 2014

Subsidies for people in SISBEN levels 1, 2 and 3 also apply to special fares in the entire public transport system, in particular for students (“Estudiantil Municipios” fares) and people over 60 (“Adulto mayor” fares). The institution called the “Secretariat of Social Welfare” gives out reduced-fare tickets to users in these two categories printed on a type of paper preventing the possibility of counterfeiting.

× Various examples of subsidies and their social efficiency criteria are presented in the table below.

Year	City	Type of subsidy	Distributive effects: Ω	Distributive effects: QuasiGini	Exclusion error	Inclusion error
2006	Buenos Aires	Supply-side subsidy: train		0.06	68%	71%
2006	Buenos Aires	Supply-side subsidy: subway		0.48	92%	89%
2006	Buenos Aires	Supply-side subsidy: bus		0.20	60%	75%
2007	Mexico	Supply-side subsidy: subway	1.00		68%	52%
2007	Mexico	Supply-side subsidy: bus	1.14		68%	45%
2007	Mexico	Supply-side subsidy: trolleys	0.96		68%	54%
2007	Santiago, Chile	Student pass bus		-0.16	70%	51%
2007	Santiago, Chile	Student fare subway		0.13	97%	76%
2007	Santiago, Chile	Subway investment subsidy		0.27	89%	78%
2007	Santiago, Chile	Direct transfer to poor households		-0.34	52%	37%
2007	Mumbai	Supply-side subsidy: bus	0.72/0.83		10%	93%
2007	Mumbai	Supply -side subsidy: train	0.81/0.85		26%	86%

Figure 40: Redistributive nature and targeting of various subsidies (source: Estupiñan, Gomez-Lobo, Munoz-Raskin and Serebrisky, 2007)

- Supply-side subsidies in Buenos Aires: to cope with the dramatic budget crisis that occurred in 2001/2002, the State implemented direct subsidies to the operators. It might have been preferable to grant demand-side subsidies, but this type of subsidy most certainly would have resulted in very large exclusion errors, as the eligibility criteria for aid are based on having a social security plan, and only 2 million of the 6 million poor people have access to such a plan. The analyses carried out in 2002 and 2006 showed that this type of subsidy was mainly neutral or regressive and that this

regressiveness even had a tendency to worsen. In 2006, the quasi-Gini was nearly 0 for the suburban trains, 0.2 for the buses and 0.5 for the metro. The exclusion errors fell between 2002 and 2006, but at the same time the inclusion errors increased significantly.

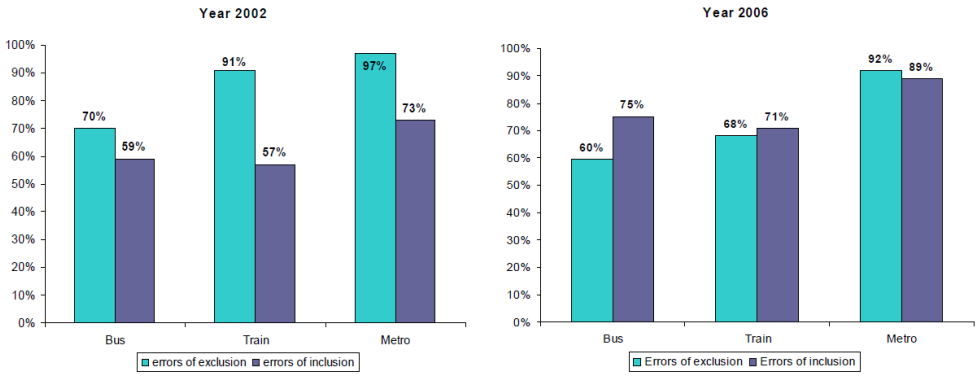


Figure 41: Exclusion errors and inclusion errors in the case of Buenos Aires between 2002 and 2006

- Supply-side subsidies in Mexico City: as can be seen, the various subsidies analysed are neutral in the case of the metro and trolleys and slightly progressive in the case of the buses. However, the exclusion errors are very high: this is explained by the fact that the small buses used mostly by the poor are excluded from the subsidy system.

- Various types of subsidies in Santiago: subsidies for students (passes for the buses, lower fares for the metro) appear slightly progressive or regressive when not taking into account the way the measure is funded (the figure shown in the table): when the funding mode, based on cross-subsidies, is taken into account, in both cases, the system is mainly neutral. It makes a transfer from rich or poor households without students towards rich or poor households with students. The income criterion is not taken into account in granting student fares. This results in significant effects of exclusion. The investment subsidy in the case of the metro is less efficient still from a social point of view, doubtless because the very poor mainly use other modes of transport. The direct transfers by allowances that were mentioned earlier (see footnote 47 page 68) have the best social performance indicators, however they are a general subsidy and not a transport subsidy.

- In the case of Mumbai, supply-side subsidies have a regressive character regardless of the level at which the poverty threshold is established (the two figures of the Ω indicator). The positive point here is that the exclusion errors are very low.

- There are also subsidies of a social nature that do not concern public transport: this is the case of fuel subsidies that, at one point, were a response to the various oil crises and were justified by social protection measures (importing countries) or wealth redistribution (exporting countries). However, this type of subsidy is very expensive for governments: on average, fuel subsidies before taxes represent 3.8% of GDP vs 0.7% of GDP for food subsidies. Furthermore, they do not contribute to social integration: in Egypt 40% of the poorest people have received only 3% of the total petrol subsidies. Thus, they are clearly regressive and poorly targeted, as the rich tend to benefit from them more than the poor due to their higher consumption of fuel for private vehicles, generators and taxis. Furthermore, they subsidise activities with very negative externalities that, on the contrary, should be taxed (see paragraph 3.1.3). In the Middle East and North Africa, recent eliminations of fuel subsidies had to be accompanied by measures to prevent social impacts:
    - Good planning and communication campaigns targeting the general public

- Adjustment mechanisms to bring domestic prices to international levels
- Compensation measures (wage rises in the public sector, expansion of social safety nets, improvement of education and health)
- Development of public transport.

In the case of Iran, the subsidy reform which began in 2010 consisted of gradually adjusting the domestic prices of oil, food, natural gas and electricity over a five-year period. Prior to these adjustments, monetary transfers were paid directly to households, into new bank accounts, opened for the occasion. These monthly compensation payments are non-targeted[49] and paid to all Iranians across all income levels, but they remain very progressive compared with the system of subsidies they are replacing. In 2014, the government conducted a televised campaign to convince the wealthiest families to give up the aid programme, which provides a monthly subsidy of 14 dollars per person. This communication campaign was not very efficient, since nearly 95% of Iranians finally claimed the financial aid, which represents approximately US$1 billion dollars a month for the authorities. This system of compensatory aid is in deficit, since the additional income from the rise in energy prices remains lower than the rise in spending generated by the compensation payments.

The reform of fuel subsidies in Ghana is another good example of taking account of the political acceptability of eliminating aid: the elimination of fuel subsidies that had become necessary since 2003 (due to the increasing cost of imported fuel) increased the price of petrol by 600% between 2000 and 2008. To compensate for these negative effects on consumers, the government set up subsidies for bus transport services, lump-sum subsidies and school-lunch programmes and aid for access to housing, funded by a fuel tax called the “Social Impact Mitigation Levy” (3.7% of the price of petrol at the pump). Other fuel taxes were introduced in order to fund road infrastructure in particular.

➢ <u>What conclusions can be drawn regarding the social rationale for subsidies?</u>

The first observation to be made regarding the above examples is that the social objectives in terms of income redistribution and targeting of poor populations are rarely reached through the use of public transport subsidies: the way in which the subsidy is implemented, however, must be studied in detail, because it has an impact on the degree of social efficiency. This issue of targeting varies between a country where the users of public transport are mainly “captive” users with low income, and a country where this mode of transport is used by the middle or even upper classes.

× In the case of investment subsidies and/or operating subsidies, the entire community benefits from the subsidy: its regressiveness or progressiveness is linked to the profile of the users of the public transport system. It is regressive when the middle classes use public transport the most, when the poorest are dissuaded due to issues of cost or physical accessibility of the system (remote areas lacking good service); it may be progressive if the poorest are the ones who use it the most. The above examples show, however, that this is rarely the case in developing countries.

  These investment subsidies and/or operating subsidies lead to an improvement in the accessibility of the areas served, which in turn may lead to an increase in land value. A share of the advantage generated by the subsidies is then transferred to the property owners, some of whom, though not all, are also users of the new transport service. This transfer phenomenon is detailed in Appendix 2 of this report.

[49] The government had initially planned payments based on income, but abandoned this idea due to the complexity of implementing this type of targeting, and the associated risks of fraud.

× Subsidies may be paid directly to the beneficiaries:

- Without any selection or income-testing: the results in terms of redistribution are analogous to what occurs in the case of operating subsidies. This may be even worse, because there can also be deadweight losses.[50] This is the case of fuel subsidies, as discussed above, which encourage individual modes of transport, thereby offering a temporary response in certain cases to the absence of public transport (low-density areas, investments too heavy for the economy etc.) in spite of the shortcomings of this type of subsidy (see previous paragraph).

- On the basis of a selection associated with socioeconomic criteria: specific fares by passenger category that are cheaper than the normal fare – reduced fares for youth, students, large families, veterans and the disabled, free fare for the poorest and the unemployed. This is the case in Medellin, where fares depend on the standard of living category, where the wealthiest fund the public transport of the poorest. When the selection takes account of income criteria or standard of living, it is generally progressive but often quite difficult to implement. When there is no income criterion, the measure does not necessarily lead to progressive results (example of student fares in Santiago). Attention must also be paid to the way the measure is funded, in particular in case of cross-subsidies.

- The case of commuting subsidies is a special case of selection: the payment of 50% of transit passes in Paris (not to mention the transport tax on employers based on the same selection but which goes to the entire community) does not target the poorest. The partial or full reimbursement of mileage expenses in private vehicles does not either, and the Vale-Transporte voucher supplied by the employer in Brazil, a self-selecting mechanism, would most likely be progressive if it applied to all workers. In the case of the Paris region, there can be a deadweight loss for the wealthiest.

- The measures discussed above are, furthermore, limited to people with jobs, but other measures exist for the unemployed or precariously employed: in Ile-de-France the Transport Solidarity Reduction (75% discount on transit passes) or the Free Transport Pass are granted under certain conditions (to the unemployed or minimum guaranteed income beneficiaries), “Vale-transporte social in Brazil” or indirect aid for household income (minimum income, grants for families, students grants, etc.) but these measures do not fall into the category of transport subsidies.

Beyond the issues of progressiveness or of deadweight loss, social pricing can have various side effects:

× Fuel subsidies show extremely perverse consequences: an overconsumption of fuel, which leads to an increase in externalities, a poor allocation of resources, discouraging investors in the energy sector, shortages, black market, etc.

× Likewise, public transport fares that are too low can result in deadweight losses or in an overconsumption of public transport, to the detriment of active modes. Pushed to the limit, this turns into totally free public transport. Such a policy, implemented in some cities,[51] has its proponents and opponents; other than the fact that nothing is free and if the users do not pay, the taxpayers or businesses will, one can observe that:

[50] A deadweight loss occurs when the person receiving a benefit had already planned on acting the same anyway, even if the benefit had not been granted.

[51] French conurbations that have implemented totally free fares are generally small conurbations where the share of fare revenues covering the costs was very low (from 10 to 15%). Increasing the transport tax on employers often made it possible to fund totally free fares.

- Price correction in relation to individual modes of transport is, of course, facilitated, which should result in a rebalancing of the modal shares and a decrease in nuisances.

- In practice, the rebalancing of modal shares has not been observed, because most of the new trips observed after the switch to a totally free system result from people who already took the bus before and who take advantage by using it more, or by using it to the detriment of active modes. The network is generally used more in off-peak hours, but this can require an increased supply in peak hours, which has a cost.

× In the case of an allowance paid to the household, there is no certainty that it will have an effect on the mobility of all of household members: thus, an allowance paid to the head of the household will not necessarily facilitate the transport of the women and children. However, in this case, it is not a transport-specific subsidy.

× The considerations presented here only focus on an analysis assuming all things remain equal, which is not necessarily the case: any public resources used to promote mobility through subsidies are not used for other spending that would have had an even greater economic impact. For example, resources could instead target one of the channels mentioned in this section i.e. the empowerment of women, the promotion of trade and services, access to jobs and the enhancement of human capital.

3.2.2. Social equity and access to opportunities (jobs, services…) – Geographic access

In the previous section, social equity and access to opportunities were addressed while leaving aside geographic aspects of access. In fact, the choice of the place of residence (which may be imposed by the price of land, social segregation etc.) has a great influence on the need for transport and may be discriminatory (impossibility of reaching a certain number of workplaces, etc.).

Social equity and access to opportunities translated into geographic terms mean that all the users of the conurbation must be able to have the same conditions of access to the transport service, as poor accessibility to urban resources can lead to the risk of social exclusion.

Isolated areas or areas with poor accessibility are often inhabited either by the rich, who can easily travel in their private vehicles, or by the poor, who can be helped by one of the subsidies presented in the previous section. However, in the latter case, a necessary condition is that public transport services are available. This is the reasoning behind area-based policies aiming to open up disadvantaged neighbourhoods, such as in Medellin, Colombia, where the municipality initiated a major investment programme to improve, amongst other things, mobility in poor, isolated neighbourhoods (gondola lifts and escalators). This resulted in a drop in crime rates and enabled the inhabitants of the city's hilly areas to reach the centre more easily.

➢ <u>Specific measures providing geographical access: private vehicles</u>

Urban development systematically includes the creation of transport infrastructure, and roads in particular. The cost of these investments is most often borne by the entire community, since they will be used by everyone. Thus, there is an implicit geographic subsidy. During the development of new cities or the rehabilitation of neighbourhoods, these costs are revealed.

- Specific measures providing geographical access: public transport

In the case of the supply of public transport services, the creation of an integrated multimodal system makes it possible to service the entire local area. Indeed, mass transit infrastructure (such as suburban trains and metros) can only serve sufficiently dense areas. Smart integration with a bus system brings people from less dense areas towards mass transit stations, thereby providing them with a wide range of destinations.

These multimodal services can only be used on a daily basis if the modal interfaces are designed optimally both in terms of the infrastructure, and in terms of the fares and the ticketing. To go from starting point to destination, it is not uncommon to have to make two transfers, and it would be too heavy a financial burden to pay the ticket price three times. The problems get even more complicated if each operator charges for the portion of the trip taken on their system. This is why many conurbations (Paris, London, São Paulo, Medellin and Hong Kong) have set up payment methods, common to all operators, that include free or discounted transfers.

Furthermore, the public transport services offered are not always priced according to the distance covered: the price of the ticket may be set according to a fare schedule defined by zones. The Paris region is divided up into five fare zones, depending on the distance from Paris, in order to set the price of transit passes. A 5-zone pass enables passengers to travel away from the centre of Paris in a radius of approximately 60 km at an annual cost of €1,170. In comparison, the basic 2-zone pass for Paris and its closest suburbs enables the passenger to travel in a radius of 6 to 8 km from the centre at an annual cost of €700. This type of measure is thus a geographic subsidy: people living in low-density areas can have access to the entire system at a unit price significantly lower than the price paid by people living in the densest area. On weekends and certain holidays, the transit passes are de-zoned, so that pass-holders of any type can travel throughout the region. In this case the reverse is true, as the subsidy is granted to the users with the least expensive passes.

3.2.3. General critical conclusion on the other environmental and social rationales for subsidies

Although the social rationale for public transport subsidies is a typical argument, the analysis of various real-life case studies shows that the expected effects are not always achieved, and depend critically on implementation details:

- When they are well targeted, user subsidies can be an efficient means of fostering the mobility of certain categories of people who would otherwise be excluded from accessing transport (women, children, people in precarious situations, etc.); however, the implementation of efficient methods of selection that limit the exclusion and inclusion effects can be difficult or costly.

- However, they are very rarely an efficient means of income redistribution to the poorest, either because they accrue to the entire community when they are paid to the operator, or because the poorest cannot gain access to the transport system, which is either too expensive or poorly designed (isolation of certain areas, no intermodal services offered, etc.).

The development of public transport in isolated areas, which are low-density or have poor accessibility, is also a hidden subsidy, but the same holds true for the road infrastructure.

In developed countries, the rationale for public transport subsidies as catalysts of compact and sustainable cities quite easily dismisses the fact that what shapes the city above all else are the pre-existing urban form and land policies. Indeed, public transport is necessary for the

operation of dense areas, but it cannot trigger the phenomenon alone. However, subsidies are still justified initially, in order to set up a public transport network. In developing countries, the very high growth rates and rapid urban transformation suggest considerable room for manoeuvre regarding the future urban form of cities. Public transport subsidies accompanied by proactive land policies would prevent irreversible effects of urban sprawl, even in the medium term.

There are few studies devoted to the impact of urban mobility on the growth of the urban population. A summary of the literature to date and an advance in this field can be found in Duranton and Turner (2010), who find that the elasticity of population growth with respect to mobility is approximately 10%. More numerous studies demonstrate the impact of mobility on business productivity (Graham, Combes and Lafourcade, Puga, in particular). They show that productivity is linked to accessibility, with an elasticity of a few percentage points. But the main thrust of these studies is geared more toward the consequences of a reduction in travel time than toward the reduction of transport costs. Therefore, it is difficult to draw direct conclusions from them in order to quantify the benefits of public transport subsidies as a tool for the promotion of economic growth in relation to other, competing uses of public resources.

3.3. Financial consequences

3.3.1. Financial equilibrium of operators faced with a fait accompli situation

- A recurrent financial imbalance

Empirically, the profitability “excluding subsidies” of public transport operators is widely observed to be negative. This observation is borne out in most modes of transport and in most emerging and OECD countries.

All the countries in our panel are concerned, except Hong Kong, but in this country the operators have exclusive property development rights, which is tantamount to a high-value subsidy. For example, in London and Paris, operational subsidies for public transport amount to €2.3 and €3.9 billion per year respectively, which is an essential share of operating budgets, and are supplemented with significant amounts in investment subsidies. In Cairo, all public transport modes receive subsidies that are indispensable for their financial balance; fare revenue covers a mere 31% of the operating expenses for the buses. In Rabat, the buses and the tramway are supported financially for investments and debt servicing, and the public authorities also cover operating losses during the ramp-up period. From one city of the panel to the next, the facts are similar.

But while this observation is easy, an analysis of the causes is more complex. And the appropriate response depends on the nature of these causes…

- Multiple causes

Generally speaking, these deficits can be explained by a difference between the fare caps imposed by the public authorities (usually for social reasons), and the costs of the service they require (scope, frequency, comfort). This difference may be justified by a positive social cost/benefit analysis (i.e. by taking account of the externalities). In particular, in the case of a heavy investment, it is often impossible to get a return on the investment and its use without external financial aid.

But the costs of the service do not depend exclusively on the level of supply. They also depend on the operator's financial and operational performance. Subsidy mechanisms can, themselves, have an impact on this performance, which will be unfavourable if they are poorly designed.[52] It is often difficult to determine which portion of uncovered costs is attributable to the inefficiency of the operator, and which portion corresponds to the gap between the recommended fares and the recommended service if the operator were actually efficient.

- A constrained political decision

Faced with this situation, the public authorities have little room for manoeuvre. If transport operators often need municipalities to survive, the reverse is also true: in most contexts, a major financial collapse in the transport sector can represent a serious threat to the political credibility of the city government, in particular in the case of monopolies, which are common.

A common reason behind public transport subsidies is thus that the operators are, like the banks during the global financial crisis, too big to fail. Thus, the public authorities are obliged to support the sector's providers no matter what, insofar as bankruptcy could considerably disrupt the service (even if, in fact, this is not necessarily the case), which would be a disaster for the local economy.

This virtually guaranteed support from the public authorities creates a decision-making bias which economists call a moral hazard: the entity that is of systemic size (and its managers, and shareholders in the case of private companies) does not have to bear the cost of its losses, because no matter what happens, they will be covered by the public authorities. Consequently, the entity does not particularly seek to be profitable.

Often, this lack of profitability imperative results in the production stakeholders receiving unwarranted benefits, or locked-in advantages. The employees, in particular, form groups which apply pressure to get more income or benefits than strictly necessary. This can result in higher salaries or various benefits, or, in cases where the salaries are strictly controlled (in particular when public-sector pay scales apply), by the hiring of more employees than are actually needed.

This often leads to a downward spiral: due to the inefficiency of the operator, the public authorities accept to compensate for the deficit, because they have no choice, but they refuse to add resources to fund additional investments. The company's equipment, especially the rolling stock, deteriorates due to aging and progressive cannibalisation. The level of service then worsens, which reinforces the decision of the public authorities to not allocate more resources than strictly necessary to the company… In many cases, such as the buses in Rabat in the early 2000s, just a few years are enough to damage an operator's assets extensively.

This is especially acute when the entity in debt is a state-owned company, as is very often the case. Indeed, the political responsibility of the public authorities is perceived as being accentuated. Furthermore, as shareholders, they are the ones who lose all or part of the capital in the event of bankruptcy. The least disastrous option for pulling out of the downward spiral is often privatization, which is not without risks or political costs.

This situation, where the public authorities repeatedly support loss-making operators every year, is a common one. In our sample, this is the case in particular for the São Paulo metro, the buses of Rabat, the buses of Cairo and the buses of Mumbai, where the practice of

[52] As noted by the European Conference of Transport Ministers in its RESOLUTION No. 1979/40 ON URBAN PUBLIC TRANSPORT SUBSIDIES

balancing the accounts with the revenue from electricity distribution seems to have reached its limit …

Reducing this inefficiency requires two mechanisms, which are often linked:

- The terms of the contract with the operator
- The way the subsidies are allocated.

The subsidies must be allocated according to clear and credible methods, incentivizing the operators to be efficient, as we will explain in detail in our recommendations below. The commonly observed mechanism of periodic deficit compensation is especially detrimental in this regard.

Two main challenges stand in the way of implementing these decisions:

- The credibility of their actual enforcement
- Sufficient comprehension by the public authorities of the financial characteristics of the sector, in order to establish the subsidy mechanisms that are appropriate both in terms of structure and amounts.

➢ Risks to be allocated between the operators and the public authorities

As discussed above, if the public authorities fully or largely assume technical and financial performance risks, the operators are not incentivized to be efficient nor effective.

But on the other hand, the commercial risk cannot be borne exclusively by the operator. If private operators work on a market regulated by the public authorities, the distribution of risks between public and private must be quantified: either the public sector assumes the commercial risk, which represents a hidden subsidy, or the operator assumes this risk, in which case the operator charges the public authorities for covering this risk, through an additional cost, which is an explicit subsidy. This risk, and thus the subsidy that is implicitly or explicitly linked to it, should be assumed by the public authorities given that through their intervention they impose on the market a balance that is different from the balance of the free market. The amounts are significant when the risk taken is high, such as in situations of heavy investment.

➢ Frequent support in the ramp-up period

The ramp-up periods are often long and uncertain in the transport sector. Thus, investments that are made over long periods might not provide returns until several years later. Indeed, after increasing the supply, the operator faces an increase in its outgoing cash flows, i.e. for debt servicing, before its sales rise through increased demand. A subsidy can be necessary to transition from one phase to the next.

➢ The recurring subsidy: a source of risk

The trade-off that is usually made is to grant a subsidy to operators rather than let them increase the fares enough to cover costs (asset overhauls, renewals and maintenance included).

But subsidy funding is in itself not free from risk, and raises the more general question of the financial solidity of the public authorities that provide the subsidies, as they can experience budget crises. They can find themselves in a position of having unsustainable obligations, which may lead them to default or cut back on their financial support commitments, causing the sudden or gradual collapse of the service.

In this case, in the medium or long term, the subsidy will have had an effect opposite to what was intended. This means that it is crucial to avoid basing the system on subsidies placing excess financial burden on the public authorities.

- OPEX coverage by the operator, supplemented by public support for full cost recovery

OPEX coverage is the operator's coverage of its operating expenses through its revenues. If OPEX coverage is not achieved, the company must continue to receive external funding on a regular basis, simply to cover its operating expenses. On the other hand, full cost recovery corresponds to the coverage of all of the company's costs.

The inability of an operator to achieve OPEX coverage on its own can be a symptom of poor economic and financial performance (especially in the narrower definition of OPEX), but depends above all else on the operators's actual function, the sources of revenue other than from subsidies, and the split between investment costs and operating expenses.

It is also important to note that the concept of OPEX coverage varies according to what is included in the definition of operating expenses. Whether the renewal of the rolling stock is included in this calculation or not can result in two concepts of OPEX coverage that are quite different from each other, but not always clearly identified.

Thus, the relevance of this concept fluctuates according to the mode of transport and the legal arrangements. It may be appropriate for certain projects with heavy investments, where the public authorities intend to fund the infrastructure but then expect it to be sufficiently profitable under the pricing conditions set by them, and they will therefore not be required to support the operators with their operating expenses. This creates a clear separation of costs and responsibilities. On the other hand, OPEX coverage is much less relevant for modes of transport where there is no heavy initial investment, in particular for buses, where the maintenance and renewal of the rolling stock are in a grey area between continuous re-investment and operating expenses.

3.3.2. The subsidy (financial leverage) is not a guarantee of an optimal supply level

Due to the environmental and social constraints that weigh on urban transport, a common rationale is that ensuring an optimal level of supply requires subsidies. Unfortunately, this is not a guarantee of success, because supply is also determined by parameters other than price, which were discussed above, such as:

- Factors of organisation and regulation of the sector.

- The urban form: regardless of the level of subsidy, it will never be possible to develop efficient public transport in conurbations where the density is very low (see box about Atlanta).

- The level of efficiency of the operators: when the operator is inefficient, subsidising the system may lead to deterioration of the quality of service and the level of supply. This is the case in particular when the subsidy is limited to periodically replenishing the operator's accounts but when the public authorities do not want to go beyond that by investing in the equipment.

- The principle of marginal-cost pricing implied by subsidies is sometimes criticized for issues of information asymmetry. In the discussion on the quantification of marginal costs (and thus of the subsidy that will compensate for the difference between marginal costs

and the average cost), the operator has every reason to put its information asymmetry to use, to give the impression that its marginal cost is low, in order to increase the share of its fixed costs and its subsidy, which will give the operator an operating margin that is often improperly used for superfluous expenditures.

× Subsidising loss-making public transport services hides fixed costs and allows operators to ignore the financial impact of excessively costly, loss-making services, since they are subsidised. This is what happens on lines with low ridership, for which the fixed capital expenditures may be high, and are subsidised, whereas only the variable expenses are paid by the user.

These reasons (underestimating the variable expenses, waste, keeping unprofitable services) lead some to prefer the principle of average-cost pricing, which has the advantage of making the operator directly responsible for its own management. Average-cost pricing, however, has some disadvantages and implementation difficulties:

- It eliminates services that are collectively advantageous but cannot be funded by a fare that will balance the budget.

- As soon as several services are in place, the average cost can no longer be calculated (how are the common expenses distributed?); this is compensated through Ramsey pricing, as explained above.

- The type and amount of the costs to be accounted for can be hard to determine:
    - What rate of depreciation of assets, for which there is often no market? This is a matter of evaluating their service life, and the risks of the activity.
    - Should externalities be introduced, as in marginal-cost pricing? The answer to this question is provided by Ramsey pricing, in which the budget constraint is that of the operator, but the function to be maximized is the collective welfare, which includes externalities.

3.3.3. Conclusions

In most countries, the public authorities are among the main contributors when it comes to funding public transport, both in terms of investment and operation. Making means of transportation available as part of public service obligations justifies public funding. The involvement of the public authorities in funding investments is relatively frequent in public transport, and mainly concerns the financing of infrastructure, and sometimes rolling stock.

As regards the operation of a transport system, insofar as the prices are set by the public authorities and do not systematically reflect the actual costs of the service (example of maintaining low fares for social reasons), OPEX coverage (coverage of the operating expenses) is possible but generally not achieved, and the operating companies, whether public or private, tend to find themselves in financial difficulty. The public authorities then come along and compensate for their deficit. This compensation may take various forms:

- The payment of compensation to cover the special fares granted to certain categories of users;

- Compensation for losses at the end of the fiscal year, to supplement the coverage of expenses by fare revenue alone;

- The payment of a remuneration per trip (or per kilometre covered) according to the operating expenses declared by the operator or estimated by the public authorities. An

OPEX target or standard value set by the public authorities incentivizes the operators to improve their performance and cut their operating expenses through preventive maintenance, staff training (drivers) etc.

In fact, the payment of public subsidies can almost systematically hinder the efficiency of the operators and their pursuit of enhanced performance, and deteriorate the level and quality of service: in the case of poor optimisation of the level of service, the public subsidies invested in the operation will not be used for financing necessary investments (aging infrastructure and rolling stock), progressively resulting in the deterioration of the network. The constant search for improvement and optimisation of public transport services by the operator can in particular be encouraged through compensations or public subsidies in exchange for productivity obligations, for fighting fraud and for improving the quality of service, by introducing bonus/penalty systems. Regardless of the method used, the public authorities have an interest in setting up a service agreement determining the rights and duties of the operators.

A compromise thus needs to be found between the price of the transport services, the users' ability to pay and the maintenance of a level and quality of service sufficient to offer transport services that are sustainable for the operator, the public authorities and the users.

4 — Recommendations

Urbanisation plays a central role in the economic and social development of the countries that are clients of the AFD. In this context, promoting agglomeration effects, among the rationales explored in Chapter 3, doubtless justifies supporting urban transport through subsidies in these countries – at least with respect to the modes of transport that generate the least nuisances, i.e. the collective modes of transport.

However, as the preceding chapters and the bibliography illustrate in detail, any subsidy can have unintended consequences. The social and political history of cities and of the players and organisations that supply urban transport infrastructure and services, be they government-provided or privately-provided, collective or individual, has often resulted in a drift towards subsidy levels and methods that are suboptimal from the economist's point of view, socially inequitable, or unsustainable from the point of view of public finance.

Two opposing types of pitfalls need to be avoided: excessive subsidies for private or public transport represent an inefficient use of limited public resources; insufficient or inappropriate public transport subsidies result in an undersized or poorly sized supply. Sometimes – and this is the case in many countries of the Middle East and North Africa – both cases exist simultaneously: there are fuel subsidies, unsustainable from a budgetary point of view and socially regressive, and at the same time public transport services receiving very little support. This results in levels of supply of public transport services that are sometimes lower by a factor of ten, in cities of similar sizes, than the levels observed in Latin American countries or in the countries of the OECD.

What's more, the unintended consequences of subsidies (and more generally speaking of a poorly designed urban transport policy) tend to occur over the long term, in ways that are hard to reverse. This risk is flagrant in the countries of the OECD, where past choices often limit the current scope of possibilities. For example, most cities in the United States have densities that are too low to ever be able to have efficient public transport services. On the other hand, in many countries of Western Europe, public transport services at low prices weigh significantly on the tax burden, which can paradoxically result in regressive effects in terms of distribution of income.

Emerging and developing countries present their decision-makers, and the financial institutions that support them, with both risks and opportunities. The risks arise particularly from deficiencies in governance and in the tools used for urban planning, as well as from the lower resilience of public finances. However, rapid urban growth provides opportunities: there is still enough time to orient the development of cities to make this development compatible with efficient modes of urban transport that are more respectful of environmental resources.

In this context, this chapter offers 18 concrete recommendations concerning public transport subsidies. They can be summarised in five principles:

- Promoting agglomeration effects but discouraging nuisances
- Arbitrating between priorities on the basis of evaluated impacts
- For better social impacts, having the courage to take counterintuitive measures
- Ensuring the sustainability of public transport services through fiscal discipline
- Reinforcing existing systems to ensure efficient implementation.

4.1. Promote agglomeration effects but discourage nuisances

As we saw in Chapter 3, the argument for promoting agglomeration effects, reinforced in the case of public transport by increasing returns and network effects, justifies regulatory and financial intervention by the public authorities, especially in the form of subsidies. The total cost of transport should thus be covered by adding commercial revenues to economically-justified subsidies.

However, transport, be it private or public, generates nuisances that may be considerable. Economic theory holds that these negative externalities should be reintegrated into the cost of transport through taxation, or at least regulated.

Although, in cities, individual modes of transport generate a disproportionate share of these nuisances, the subsidies they receive attract less attention than those intended for public transport. In addition to the explicit subsidies – i.e. fuel subsidies, possibly through tax exemptions (explored further in 4.3 below), and the programmes to support the replacement of old vehicles (taxis in Cairo for example, but also scrappage incentives in France) – the free use of roads and road infrastructure constitutes a high-value implicit subsidy.

Of course, the roads and associated infrastructure play multiple roles in a city and, in general, can only be provided for free. But their use can, in certain cases, be subject to a fee for cars, the users of which have a comparatively higher income. Although congestion tolls are complex from a technical and administrative point of view and the type used in London would be currently unrealistic in emerging and developing countries,[53] simpler formulas could be used: for example, imposing a road tax sticker to drive in the city or in the city centre.

It is also relatively easy, and politically more acceptable, to charge cars for the use of expensive infrastructure (bridges and tunnels), and parking spaces. There should be no hesitation about integrating the cost of traffic congestion into infrastructure tolls or into the price of parking, and therefore charging more for these than simply their direct cost. In the case of parking, however, this requires public regulation (taxation of private car parks) and a repressive policy regarding parking outside of designated areas.

> ➢ Recommendation 1 “Congestion charge”
>
> *If there is no actual congestion tolling, consider simpler systems, such as road tax stickers and create tolls on access infrastructure tolls and pay parking where none currently exist, integrating the cost of congestion created by their users.*

The feasibility of such arrangements must be confirmed in advance through a demand analysis, and requires an appropriate regulatory environment to prevent leakage effects.

Regarding scrappage incentives, which are explicit subsidies, they must be sized on the basis of a cost/benefit analysis very specifically integrating the environmental externalities. Subject to this condition, they can remain neutral from the point of view of modal shares, since they replace one vehicle with another one.

[53] We may assume that the rapid progress of information and communication technologies may make them technically and financially possible in the near future.

However, taxing individual modes of transport at the level that would be justified by this theory frequently encounters politically insurmountable obstacles. The economic considerations laid out in Chapter 3 then justify offsetting the implicit subsidies from which private modes of transport benefit, as well as the social costs of the externalities of private modes of transport, through explicit subsidies to public transport.

> ➢ Recommendation 2 “Subsidise public transport services"
>
> *Subsidise public transport to promote agglomeration effects, and as a second-best solution to the unfeasibility of taxing individual modes of transport at the level of their actual long-term social cost.*

However, the implementation or reform of public transport subsidy systems must be effective: decisions made to solve current problems should not result in inextricable problems for the future. This general recommendation must thus be broken down into specific recommendations for urban transport or for its reform in emerging and developing countries.

4.2. Determine priorities on the basis of evaluated impacts

4.2.1. How to reform?

First, it should be noted that the will to reform a public transport subsidy system is generally tempered by the desire to avoid suddenly disrupting a perhaps fragile social balance, not only among users but also among the producers (especially taxi operators and drivers, who often have considerable political leverage). Even subsidies attached to a specific project are a type of reform: any new subsidy impacts the urban transport system as a whole, and must thus be analysed as a reform of this system, and not simply as a factor that only affects the project it aims to finance.

The critical analysis in Chapters 2 and 3 illustrates that any recommendations concerning a method of subsidy necessarily depend on interlinked, complex factors. These factors characterise the initial situation and reflect a certain social balance. Making any changes to this social balance will create tension.

This is why, in what follows, rather than making “good practice” recommendations on the subsidy levels and methods themselves (which necessarily depend on the initial situation), we are recommending an approach and principles that should guide the detailed design of the reform.

As for any reform, it is crucial:

- to analyse the existing situation
- to set objectives
- to ensure consistency with other sector policies
- to check the feasibility and impacts of the proposed measures
- to devise a realistic road map for implementation.

4.2.2. An analytical framework for public transport

Though socioeconomic analysis can now quantify many externalities (congestion, pollution, etc.), it remains very difficult to quantify agglomeration effects, in spite of the recent advances discussed earlier. The rationale for subsidies based on these effects therefore remains essentially empirical and qualitative.

Furthermore, any in-depth analysis must be supplemented with qualitative data and key figures to facilitate communication with the decision-makers and the public. This is especially important in cases where the distributive effects of subsidies are counterintuitive: reaching a consensus on a "rational" decision requires a good dose of pedagogy. Simple answers must be given to questions such as "Who uses public transport? Who is excluded from it? Why?"

In this framework, comparisons with other cities, or benchmarking, remains a powerful tool for the decision-maker.

The effects of variations in public transport subsidies can be understood through three main objectives which conflict with each other in pairs:

- Affordability, i.e. the cost of transport in relation to users' income
- Supply density (quality and quantity)
- Budget sustainability

Thus, at a constant level of budgetary effort (i.e. subsidy volume) and at a constant level of productivity, increasing supply requires increasing fares, either to compensate for a higher deficit or to compensate for the operators' decreased margins (assuming that if the supply could have been increased at constant prices by increasing the marginal profit, this would have been done already). Reciprocally, and because the elasticity of demand for public transport services is always less than 1, lowering the fares means lowering the total revenue, which will inevitably lead to deteriorating supply: if the decision to do so is not made immediately, the operating deficit will make this decision inevitable in the medium term (assuming a constant level of budgetary effort). Regarding this last point, it should be noted that, when there is inflation, refusing to increase prices is tantamount to lowering them; it will lead to a reduction in supply, in one way or another.

Furthermore, lowering the price of transport or increasing supply is not feasible without an additional budgetary contribution.

Examples of indicators for measuring these three parameters are provided below. No measurement is perfect, so it may be helpful to use several, which can potentially be combined into an index.

- Affordability:

- The “affordability index” of Carruthers, Dick and Saurkar (2005) (see 3.2.1)
- Failing that, the average price of a trip over a given distance or the price of one ticket, for each mode of transport, in relation to the average or median income of households

× Supply density:
- The available seat-kilometres (ASK)
- The number of vehicles per 1,000 inhabitants (distinction to be made by mode of transport, possibly weighting by type of vehicle – rail, bus, minibus)
- Line-kilometres

× Budget sustainability:
- Subsidies (excluding infrastructure investment) per inhabitant in relation to public expenditure per inhabitant
- Subsidies (excluding infrastructure investment) per inhabitant in relation to GDP per inhabitant

> ➢ Recommendation 3 “Benchmark”
>
> *Conduct a benchmarking analysis of the three parameters (affordability, supply density, budget sustainability) in comparison with similarly sized cities in other countries.*

For the cities covered in Chapter 2, this benchmarking exercise can be depicted in a visual, synthetic and meaningful manner:

- By associating an index to each of the three identified dimensions,[54] and by graphically representing the respective weight of these indices for each conurbation, a comparison can be made of the balance observed between these elements in our sample:

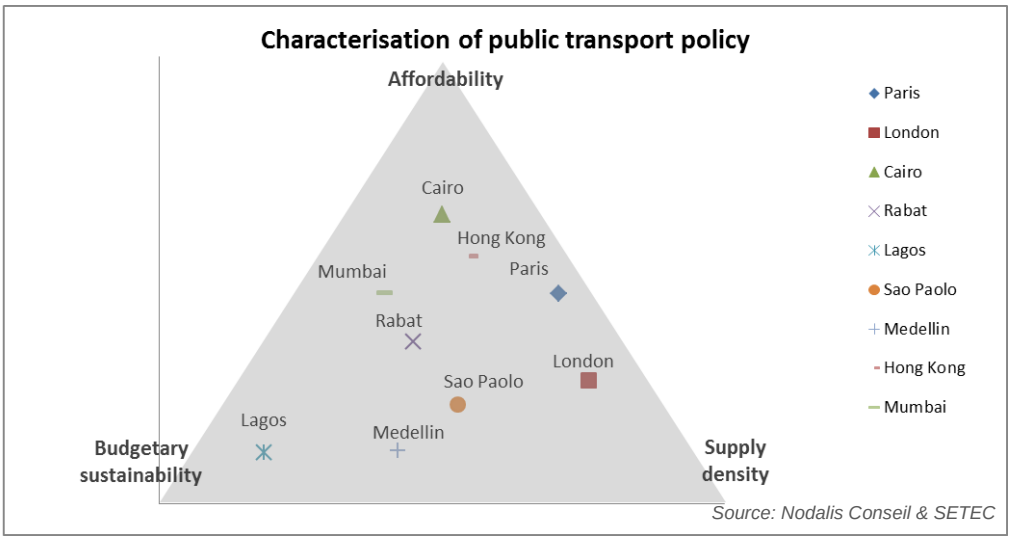
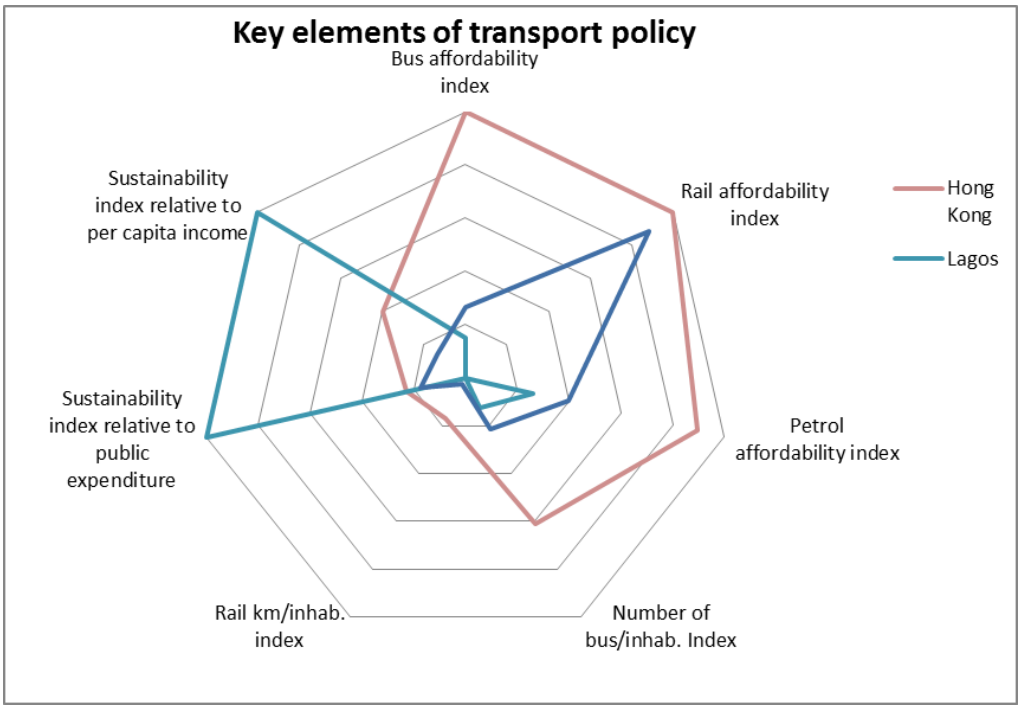


Figure 42: Characterising and comparing public transport policies in the study’s panel of cities

[54] See Appendix 3: “Index Construction Methodology”.

- By analysing a few indices in further detail,[55] we observe widely differing practices between the cities of our sample, inherited from political choices or from the historical construction of the sector:

    - Certain cities have a strategy focusing clearly on a given issue: affordability for the user in Hong Kong and Cairo (in particular for the metro, concerning Cairo), and budget sustainability in Lagos:



Source: Nodalis Conseil & SETEC

Figure 43: Key elements of public transport policies in Hong Kong, Lagos and Cairo

    - Other conurbations have experienced a stronger development of supply: the two conurbations of OECD countries presented in the sample emphasise rail, whereas Medellin has invested heavily in buses while limiting recurrent public financing.

[55] Also see Appendix 3: “Index Construction Methodology”.

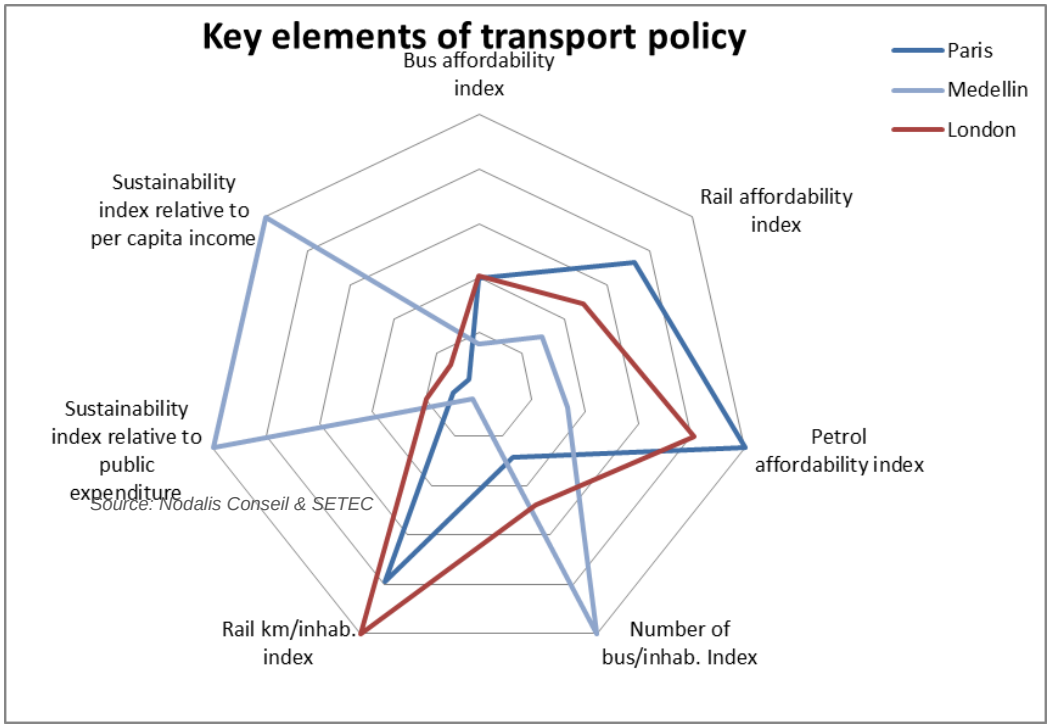


Figure 44: Key elements of public transport policies in Paris, Medellin and London

- Finally, the characteristics of the other conurbations in our sample do not reveal any oriented strategy, which, in the presence of limited revenue, translates into more average indices:

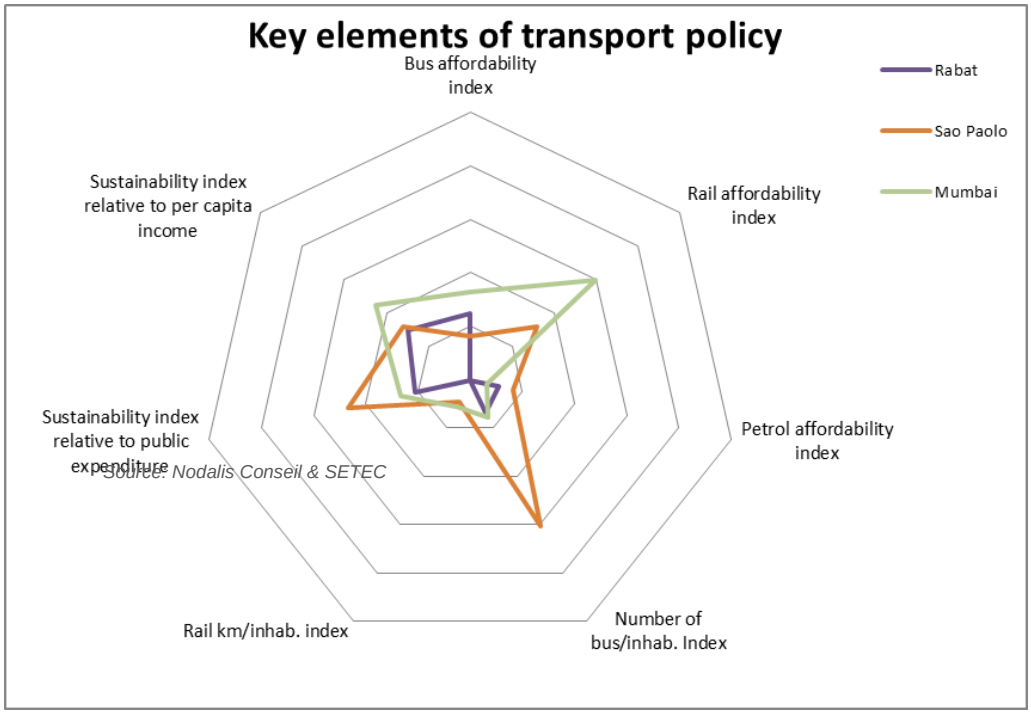


Figure 45: Key elements of public transport policies in Rabat, São Paulo and Mumbai

When setting the objectives of subsidy reform or of a public transport project, the simple analysis framework above (affordability – supply density – budget sustainability) not only characterises the initial situation and the objectives being set, but also reveals the trade-offs that these choices of objectives involve.

> ➢ Recommendation 4 “Trade-off”
>
> *Define a subsidy policy with clear objectives and explain the trade-offs they involve.*

The objectives expressed in terms of these three main themes can be supplemented with other objectives, in particular environmental ones. These objectives need not be limited to a given project, such as new infrastructure or a new public transport service, but they must reflect an integrated transport policy, independently from the project being considered or from a specific mode of transport: obviously, any measure associated with a mode of transport or a service will have effects on the entire urban transport system.

4.2.3. Transport policy and urban planning

Beyond even a policy dealing solely with transport, the links between transport policy and urban form, described in sub-section 3.1.6 above, not only require that the effects of subsidies on urban development be taken into account, but also, and more importantly, that the need for transport infrastructure in new neighbourhoods be taken into account. Transport policy and urban planning policy would be much more effective if they leveraged each other.

There are two quite different cases in the cities of emerging and developing countries:

- Congested or even hyper-congested city centres
- New neighbourhoods being built to respond to rapid urbanisation.

There is also a distinction to be drawn between countries where the supply of public transport services is relatively plentiful and countries where it is clearly lacking – whether for simple budgetary reasons, as in the less advanced countries, or for historic reasons in middle-income countries, such as in the Middle East and North Africa.

Once the new neighbourhoods have been built and structured around the automobile, it is very difficult to change this orientation. Therefore, it can be especially relevant to use the leverage of subsidies to encourage development that does not put the future at risk.

> ➢ Recommendation 5 “Transport and urban planning”
>
> *Especially in recently developed neighbourhoods, use urban transport subsidies as a tool to complement land policies; they can influence the nature of an urban development project, but also be financed by it.*

An investment subsidy that enables the construction of public transport infrastructure, e.g. a segregated right-of-way for bus or rail, as part of a new neighbourhood development project, constitutes a premium for the developers, and thus an instrument through which the public authorities can influence the nature of the project. This developers' premium can potentially be recovered to facilitate the financing of the initial subsidy. An example of this is the system of building rights implemented in certain cities in Brazil.

4.2.4. Evaluating the impacts

The complexity of the various effects of public transport subsidies and diversity of implementation possibilities require detailed data, without which projections may contain implicit assumptions and lead to false conclusions. This is especially true concerning social impacts, for which the detailed studies conducted in a few cities (see section 3.2) reveal non-trivial results. This is also the case for the economic analysis, which should, ideally, reflect environmental externalities; these may be difficult to quantify in countries where the government has not set reference values.

As the social objective is almost always a factor in the decision to subsidise public transport, the following recommendation can be made:

> ➢ Recommendation 6 "Survey and distributive analysis"
>
> *To determine the most effective subsidy mechanism in terms of a social objective (improving the mobility of certain categories of the population by reducing the cost of transport), conduct a distributive analysis of the use of public funds. Base it as much as possible on a detailed transport survey that cross-analyses different modes of transport, mobility, revenue, and origin/destination. Include it in particular in any feasibility study for a public transport project.*

These recommendations may seem obvious. However, they are only very rarely implemented properly. One reason is that studies are both costly and time-consuming; even more so in the case of detailed social surveys, compared with a simple demand analysis. However, the analyses referred to in Chapter 3 demonstrated to what extent a misunderstanding of the real social impacts of subsidies can lead to large public spending but with limited effect. Investing in knowledge of these impacts is without a doubt one of the most worthwhile investments within an urban transport policy.[56]

The tax increases made necessary by subsidies are one of these impacts. The financial recommendations presented below include the possible creation of dedicated tax resources, to compensate for the vicissitudes of discretionary resources in the event of a budget crisis. These dedicated resources can also target the reduction of nuisances (for example

[56] A good example of a distributive study is the one conducted by the World Bank for the City of Mumbai: Public Transport Subsidies and Affordability in Mumbai, India; Maureen Cropper and Soma Bhattacharya; The World Bank; November 2007

environmental pollution or traffic congestion). As for any tax,[57] it can have a social impact which must be evaluated, and a cost for the community, which translates into the opportunity cost of public funds representing the distortionary effect of taxes.

> ➢ Recommendation 7 "Dedicated resources"
>
> *In addition to the subsidy itself, the creation of new dedicated tax resources must be done on a basis justified by a cost/benefit analysis (concerning the reintegration of externalities) and/or a distributive analysis (concerning the social rationale), taking account of the opportunity cost of public funds.*

4.3. For better social impacts, have the courage to take counterintuitive measures

Improving the mobility of the least privileged classes may be a strong objective of an urban transport policy that includes the use of subsidies for public transport services. As indicated earlier, a detailed analysis of the existing situation (taking account of all modes of transport available) is a first step that cannot be skipped; if it is, unwanted effects may result.

Subsidies can improve access of the poorest to public transport services in two ways:

- improving geographic access by creating new routes (studies show that a lack of access may be a more penalising factor than price): the goal is to improve the access of the poorest neighbourhoods, which actually requires a supply-side subsidy, in various forms – investment subsidies for infrastructure serving these neighbourhoods (Metrocable in Medellin), subsidies for the bus lines serving them (as in the UK outside of London), or, in the case of a single operator, service obligations (this amounts to a cross-subsidy between more and less profitable lines, notwithstanding any network effects);
- making the service less costly.

A study must determine which of these two means, or which combination of the two, is the most efficient. For a given target (for example, the poorest 20% of the population), the inclusion errors will increase the cost of the subsidy policy (and thus, at equal resources, reduce the share that goes to the poorest). The exclusion errors will make it inequitable (reduce its social efficiency).

[57] With the exception of purely Pigouvian taxes aiming exclusively to bring the cost of an activity closer to its social cost.

> ➢ Recommendation 8 “Access”
>
> *If there is a social objective, consider the option of improving physical access to public transport (bringing lines into poorly served neighbourhoods) rather than simply improving affordability.*

As regards making transport less costly (the improvement of affordability), at equal subsidy volumes, targeting can achieve much better results than a uniform subsidy. It can operate on the basis of the following types of criteria:

- income (the least subject to inclusion and exclusion errors, but it may be very difficult to implement in an economy where many jobs are informal);[58]
- geographic: even if the neighbourhood is served, the specific route may be made cheaper through the use of subsidies;
- categories of users (youth, students, the elderly, unemployed, etc.);
- modal (example of the bus compared to the metro in Santiago).

> ➢ Recommendation 9 “Targeting”
>
> *Examine targeting possibilities to reduce subsidy inclusion and exclusion errors. If the subsidy cannot be targeted by income level, examine the possibility of geographic targeting (improving access or making usage less costly).*

A good illustration of the non-intuitive nature of the social effects of subsidies is the case in which an operator is in financial jeopardy due to low revenues. The social argument is often produced to refuse price increases that would enable the operator to recover. But the social impact of price increases is not at all evident.

Indeed, reducing the supply of public transport results in the users affected by the cuts either resorting to other modes of transport that are even costlier, or limiting their transport in an absolute manner, which deprives them of income opportunities and access to a set of crucial social services, such as education, in particular, or even health. A price increase for all users (the poor and the less poor) may, from a distributive point of view, be more favourable to the poor than the reduction of supply.

[58] In particular, we saw in Chapter 3 that targeting based on wages leads to high exclusion errors in countries where unemployment or informal work is high.

> ➢ Recommendation 10 “Safeguard the service”
>
> *In a growing city, and if budgetary resources and fares are insufficient, putting public transport operator(s) in financial jeopardy, it may be less detrimental for users, including the poorest ones, to raise fares rather than reduce supply.*

Furthermore, urban public transport subsidies cannot be put in place without taking account of the situation of the individual modes of transport. From a social point of view, one of the most important measures to take is to eliminate fuel subsidies. Their harmful effects have been studied widely. They inevitably lead to a budget impasse and are all the more unjustified because they are very socially regressive and act as counter-incentives to environmentally-responsible behaviour. Of course, from a political standpoint, they are very hard to eliminate or even reduce, but every opportunity to do so must be seized, gradually or in a single go, but with significant accompanying social measures. These measures can be based on recent successful reforms, such as in Morocco and Iran.

> ➢ Recommendation 11 “Eliminate fuel subsidies”
>
> *Eliminate fuel subsidies and fuel tax exemptions, which are highly regressive; and at the same time, implement suitable measures to at least offset the poorest people’s loss of income.*

However, it is important to remember that individual modes of transport can also play a social role, and in certain cases at a lower cost than public transport. And so, when the rate of car ownership is very high and the density is low (the extreme case being Atlanta), transport-on-demand services are, potentially in combination with school transport, an economical solution for the mobility of people without cars. Social and geographic targeting needs to be implemented in order to subsidise part of the cost. Paying this cost can likely be more economical for the community than a very unprofitable system of public transport. Generally speaking concerning taxi services, regulatory measures can be taken so that the least profitable areas from an economic point of view (remote areas, less dense areas, etc.) can be served as well. Examples include prohibiting drivers from refusing to take a customer, and assigning licences by geographic areas, identified by the colour of the vehicle, which is implemented in Hong Kong.

Finally, it is also necessary to bear in mind the importance of walking, which is the lot of the poorest, for whom motor-vehicle transport is unaffordable on a daily basis. Public mobility policies, and in particular investment programmes, must take walking into account; often, it can be facilitated significantly through simple measures.

4.4. Ensure the sustainability of public transport through fiscal discipline

The collapse of a public transport system due to bankruptcy affects the poorest more seriously than people who can afford costlier alternative means of transport.

But a crucial constraint of a sustainable public transport system is to avoid basing it on subsidies any more heavily than warranted by the financial solidity of the public authorities (see section 3.3.1 of this report).

The simple analytical framework presented in section 4.2 can help decision-makers become aware of the consequences of their choices, which necessarily include some trade-offs. In particular, this framework points to a recommendation on the risk of a de facto “slow drift policy”, frequently characterised by an aversion to any fare increase:

> ➢ Recommendation 12 “Avoid slow drift”
>
> *If there is no increase in budgetary effort (or no proven productivity gains), do not in any event lower real fares – which therefore means raising them at least by the rate of inflation of input costs – or face a reduction in supply either straight away, or in the medium term due to accumulated deficits.*

If, however, the goal is to increase net budget resources dedicated to public transport – in other words subsidise it, this must be done in such a way as to not jeopardize the economic benefits of the subsidy. As we saw in Chapter 3, two types of expenditures can be identified:

- The non-recurring expenses, which correspond to investments in long-lasting infrastructure and to temporary deficits during the ramp-up period when a new service is created
- The recurring expenses required for operation.

If there is no leeway in the budget, it is common to seek concessional financing. If it is used for investing in long-lasting infrastructure, or to ramp up new services, it is a relatively non-distortionary manner of subsidising the development of public transport services, subject to one important condition: a new investment will necessarily generate additional operating expenses. Therefore, it is crucial to carefully examine the net impact of the investments – even if they are completely financed by external resources – on the operating margin (including a realistic evaluation of ridership, and thus revenue gains).[59]

[59] It is important to note that, contrary to what is sometimes believed, the public funding of an investment is not incompatible with the private sector assuming significant risks, which can enable easier monitoring of the costs at a given level of quality, including during the construction period. The diversity of contracting models (DBO, DBFO, BOT etc.) and financing packages (assignment of receivables, refinancing at the end of construction, etc.) enables a wide variety of distribution of responsibilities, regardless of the subsidy mechanism.

> ➢ Recommendation 13 “Investment and concessional funds”
>
> *Allocate subsidies, and concessional funds, giving priority to investment, verifying through due diligence that other resources are available to ensure adequate operation and maintenance of this investment (as per the rule set out below).*

Discretionary resources that must be approved annually are de facto more fragile than dedicated recurring revenue from taxes and levies (such as local taxes specifically allocated to transport, i.e. the transport tax in France). Experience shows that, in most emerging and developing countries, discretionary resources do not resist well in times of budget crises, or even changes in political orientation at the local level. Yet (in particular if the investment is subsidised, as discussed below) some of the economic benefits of public transport subsidies are only valid if the system is sustainable. Hence the next recommendation:

> ➢ Recommendation 14 “Full cost recovery excluding funding of initial infrastructure”
>
> *Endeavour to follow a simple rule:*
>
> *Commercial revenues + dedicated resources*
>
> **>** *Operating, rolling stock and maintenance costs*
>
> *Rolling stock costs corresponds to the provisions to be set aside for its economic depreciation (the accounting depreciation is often higher because it is performed over a shorter period). The term “maintenance” is used in the broad sense, namely including provisions for major maintenance of the existing infrastructure. Dedicated resources are those that the law allocates directly to urban public transport.*

Maintaining this equilibrium makes it possible, in particular, to implement investment subsidies (for example through an exceptional budget allocation financed by concessional sources) without having a negative impact on the financial sustainability of the system.

What’s more, the experience of both developed countries and emerging and developing countries shows that basing financial equilibrium on resources for which the amounts are decided every year, i.e. soft budget constraints, has two risks:

- × The creation of locked-in advantages for the operators, in the broad sense of the term
- × Threats to reduce the level of supply in the event of a budget crisis, which is generally combined with a macro-economic situation that makes it difficult to raise fares.

The operators must be provided with a clear framework of incentives and a predictable economic equation:

> ➢ Recommendation 15 “Hard budget constraint”
>
> *When the public authorities provide funding to an operator, they must do so through multi-year contracts that set fixed funding amounts (in absolute terms or through a formula independent from the operator’s performance), and the renewal or negotiation of a new contract must be coupled with a re-evaluation of the costs, either by creating a situation of competition, or at least through benchmarking analysis.*

This recommendation does not contradict the preceding one: such budgetary contributions, unless they are used to finance investments in infrastructure, should come either from fares (if the commercial revenues are collected by the public transport authority, or are transferred to it before it pays the operators on a performance basis), or from dedicated resources.

Finally, if competition in or for the market does not take place on a regular basis and if recommendations number 7 (Dedicated resources) and 14 (Full cost recovery excluding funding of initial infrastructure) are unlikely to be followed, one way of imposing a certain amount of fiscal discipline on the operator is to require it to at least cover its operating expenses, i.e. cover the operating and maintenance costs with its commercial revenues. This protects the operation from variations in public budgets, and makes the creation of locked-in advantages more difficult.

4.5. Strengthen existing supply for efficient implementation

One key feature of the public transport sector in emerging and developing countries is the importance of the small-business, craft or semi-collective sector, i.e. minibuses, shared taxis, etc. In most African cities, they represent by far the largest share of motorised transport (72% in Lagos for minibuses). Yet these systems are mainly unregulated and unsubsidised. An urban transport policy cannot ignore them, either in terms of how the transport system functions or in terms of the economics of any potential sector reform.

> ➢ Recommendation 16 “Informal or unregulated sector”
>
> *Rather than destabilise the unregulated sector through unfair competition from subsidised modes, harness its strengths to develop services and improve overall transport quality.*

One option would be to bring it gradually under regulation and coordination, without, however, artificially limiting its services to make room for more costly “public” modes of transport.

At a time when the penetration rates of mobile phones in African cities is very high, another option would be to rely on information and communication technologies to improve user information, the coordination of services, and network effects (for example through better connections or integrated ticketing), all at a limited cost. In addition to facilitating price integration, the new technologies could also enable, in low-density areas, a better match between supply and demand, thereby improving the cost effectiveness of transport.

This is a version of formalising the informal which, instead of using regulation, uses organisation on a voluntary basis. Financial incentives that favour the emergence of such systems could also have significant benefits.

> ➢ Recommendation 17 “ICT”
>
> *Provide incentives (particularly financial ones) to leverage information and communication technology (ICT) to improve service at a lower cost (and thus with a lower subsidy).*

Finally, if there is no transport authority, a plan for reforming or building new public transport infrastructure, which features the implementation of subsidies, is a good opportunity to create an entity that, amongst other things, is charged with ensuring, through contractual and monitoring mechanisms, that the subsidies granted meet the stated objectives. Many examples have shown that the absence of this type of entity considerably increases the risk of operators capturing the subsidy, making it, to a certain extent, a locked-in advantage – regardless of whether the operators are private or public.

> ➢ Recommendation 18 “Transport authority”
>
> *Take advantage of a subsidy reform or a major project to set up or strengthen a transport authority endowed with contracting powers and monitoring capacity.*

However, when a transport authority does exist, it is essential when establishing the road map for subsidy implementation to take account of the types of contractual arrangements between this authority and the operators. Indeed, the optimal form of subsidy may vary between multiple solutions (see table in section 1.2.4) depending on the organisation for providing the service (single or multiple operators, open or contractual routes), legal and regulatory constraints, pricing methods (freely-set or regulated fares, whether there are transit passes or not, whether there is fare integration across the system or not, e-cards or single paper tickets), its financing (whether subsidies already exist or not), and depending on the methods of selection of the operator or arrangements for negotiating with the operator (periodic competitive bidding, periodic renegotiation or a public operator without a contract). Only by analysing the specific conditions will the most efficient form be determined, bearing in mind simple notions of game theory, as well as the principles of microeconomics and good management presented in this work.

4.6. Summary table

The following table lists the report's recommendations. It also gives a highly qualitative and general judgment on the degree of importance and difficulty of each of these 18 recommendations. Some are doubtless more widely acceptable, which certainly does not mean they are always implemented; but in developing countries, if a development finance institution supports their implementation they have a good chance of success. The recommendations that are both highest priority and least acceptable are those where the role of the political decision-maker will be the most important to ensure successful implementation.

	Degree of priority	Acceptability
Promote agglomeration effects but discouraging nuisances		
1. If there is no true congestion charge, consider simpler systems such as road tax stickers, and create tolls on access infrastructure and parking where none exists, integrating to such tolls the cost of congestion created by their users.	Top priority	Difficult
2. Subsidise public transport to promote agglomeration effects, and as a second-best solution to the unfeasibility of taxing individual modes of transport at the level of their actual long-term social cost.	Top priority	More widely acceptable
Determine priorities on the basis of evaluated impacts		
3. Conduct benchmarking analysis of the three parameters (affordability, supply density and budget sustainability) in comparison with similarly-sized cities in other countries.	Top priority	More widely acceptable
4. Set a subsidy policy with clear objectives and the trade-offs they involve.	Top priority	Difficult
5. Use urban transport subsidies as a tool to complement land policies; they can influence the nature of an urban development project, but also be financed by it.	Important	Difficult
6. To determine the most effective subsidy mechanism in terms of a social objective, conduct a distributive analysis of the use of public funds. Base it on a detailed transport survey.	Top priority	Difficult
7. New dedicated resources must be created on a basis justified by a cost-benefit analysis and/or a distributive analysis.	Important	More widely acceptable

For better social impacts, have the courage to take counterintuitive measures		
8. Consider the option of improving physical access to public transport (bringing lines into poorly served neighbourhoods) rather than simply improving affordability.	Important	More widely acceptable
9. Examine targeting possibilities to reduce subsidy inclusion and exclusion errors.	Important	More widely acceptable
10. In a growing city, when budgetary resources and fares are insufficient, putting public transport operator(s) in financial jeopardy, it may be less detrimental for users, including the poorest ones, to raise fares rather than reduce supply.	Important	Difficult
11. Eliminate fuel subsidies and fuel tax exemptions, which are highly regressive; and at the same time implement suitable measures to at least offset the poorest people's loss of income.	Top priority	Difficult
Ensure the sustainability of public transport through fiscal discipline		
12. If there is no increase in budgetary effort (or no proven productivity gains), do not in any event lower real fares – which therefore means raising them at least by the rate of inflation of input costs – or face a reduction in supply either straight away, or in the medium term due to accumulated deficits.	Top priority	Difficult
13. Give priority to investment in the allocation of subsidies and concessional funds, verifying through due diligence that other resources are available to ensure adequate operation and maintenance of this investment (as per the rule set out below).	Top priority	More widely acceptable
14. Endeavour to follow a simple rule of "full cost recovery excluding funding of initial infrastructure": Commercial revenues + dedicated resources > Operating, rolling-stock and maintenance costs	Top priority	Difficult
15. When public authorities provide funding to an operator, they must do so through multi-year contracts that set fixed funding amounts; and the renewal or negotiation of a new contract must be coupled with a re-evaluation of costs.	Top priority	More widely acceptable

Strengthen existing supply for efficient implementation		
16. Rather than destabilise the unregulated sector through unfair competition from subsidised modes, harness its strengths to develop services and improve overall transport quality.	Important	Difficult
17. Provide incentives (particularly financial ones) to leverage information and communication technology to improve service at a lower cost (and thus with a lower subsidy).	Important	More widely acceptable
18. Take advantage of a subsidy reform or an infrastructure project to set up or strengthen a transport authority endowed with contracting powers and monitoring capacity.	Top priority	Difficult

5 — Appendices

5.1. Appendix 1: Distinction between short-term and long-term marginal cost

The classical theory of economics takes the case of a company (or more generally, an entity in charge of production) that makes a good in quantity *q* from factors of production *x,y,z.* These variables are linked by the production function that determines the maximum quantity of the good *q* that may be produced from given quantities of factors of production *x,y,z*:

$q = f(x,y,z)$

From there, we determine a cost function as the minimum cost of production of the quantity *q*, with given prices of the factors of production p_x, p_y, p_z.

$C = Min(xp_x + y\,p_y + zp_z)$

as: $q = f(x, y, z)$.

With the undemanding assumption that the function (*-f*) is concave or quasi-concave, we solve this problem of minimization of *C* (that is to say the maximization of *-C*). By forming the Lagrangian, which is derived in relation to *x, y,* and *z,* we obtain the minimum cost *C*, which depends on parameters *q*, p_x, p_y, p_z:

$C = C(q, p_x, p_y, p_z)$

From the Envelope Theorem applied to the Lagrangian of the preceding programme, we deduce (Shephard's lemma):

$$x = \frac{\partial C}{\partial p_x}$$

and the similar equalities for *y* and *z.* These equalities provide the functions of demand for the factors of production.

Considering p_x, p_y, and pz_{as} being known, we define the marginal cost:

$$\frac{\partial C}{\partial q}$$

and the average cost:

$$\frac{C(q)}{q}$$

Of course:

$$\frac{dC}{dq} = p_x \frac{dx}{dq} + p_y \frac{dy}{dq} + p_z \frac{dz}{dq}$$

provided that *dq, dx, dy, dz* verify:

$dq = f'_x\,dx + f'_y dy + f'_z dz$

If *x* represents a factor of production with a slow adjustment rate, for example equipment, which, in the short term, may be considered as fixed, we define the variable cost function, that is to say for any given equipment *x*:

$$C(q,x) = xp_x + \underset{y,z}{Min}(yp_y + zp_z)$$

as: $q = f(x,y,z)$

We obtain the short-term marginal cost:

$$CmCT = \frac{\partial C(q,x)}{\partial q}$$

The long-term cost function, or adapted cost function will be:

$$C^*(q) = Min\,(C(q,x) + xp_x)$$

Based on which we can calculate the long-term marginal cost:

$$CmLT = \frac{dC^*}{dq}$$

The minimisation in question leads to:

$$\frac{\partial C(q,x)}{\partial x} = p_x$$

The correspondence from which we obtain the level of adapted equipment for a given volume of production *q*:

$$x^* = x(q)$$

Thus:

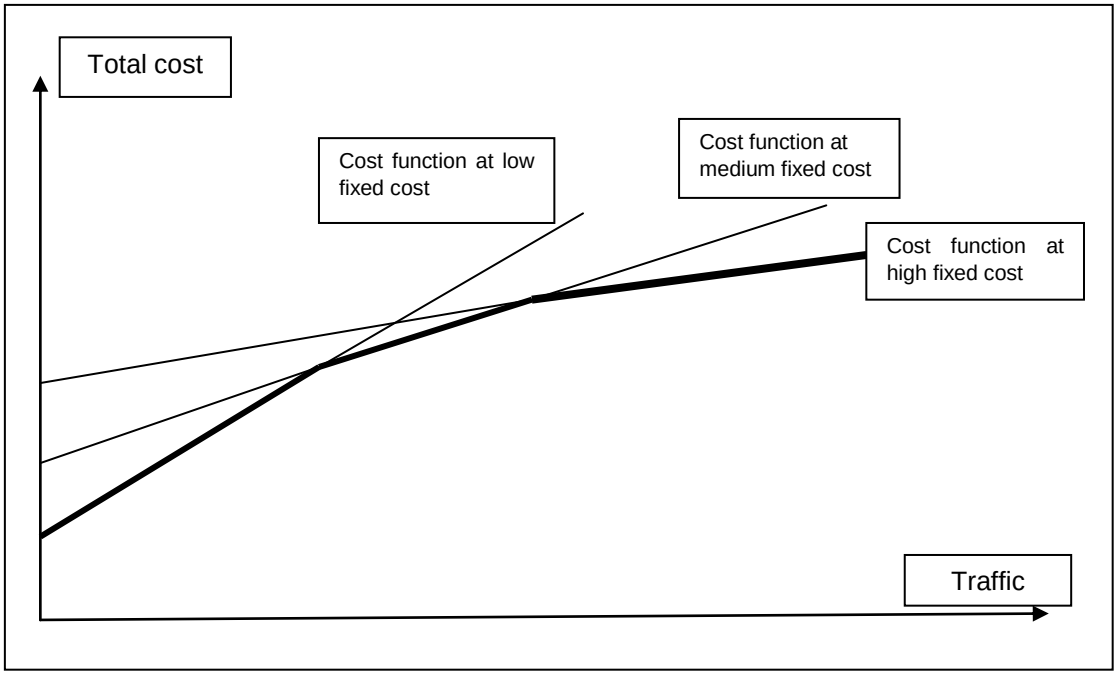
$$C^*(q) = C(q, x^*(q)) + x^*(q)p_x$$

The envelope theorem states that:

$$\frac{dC^*(q)}{dq} = \frac{\partial C(q, x^*(q)}{\partial q}$$

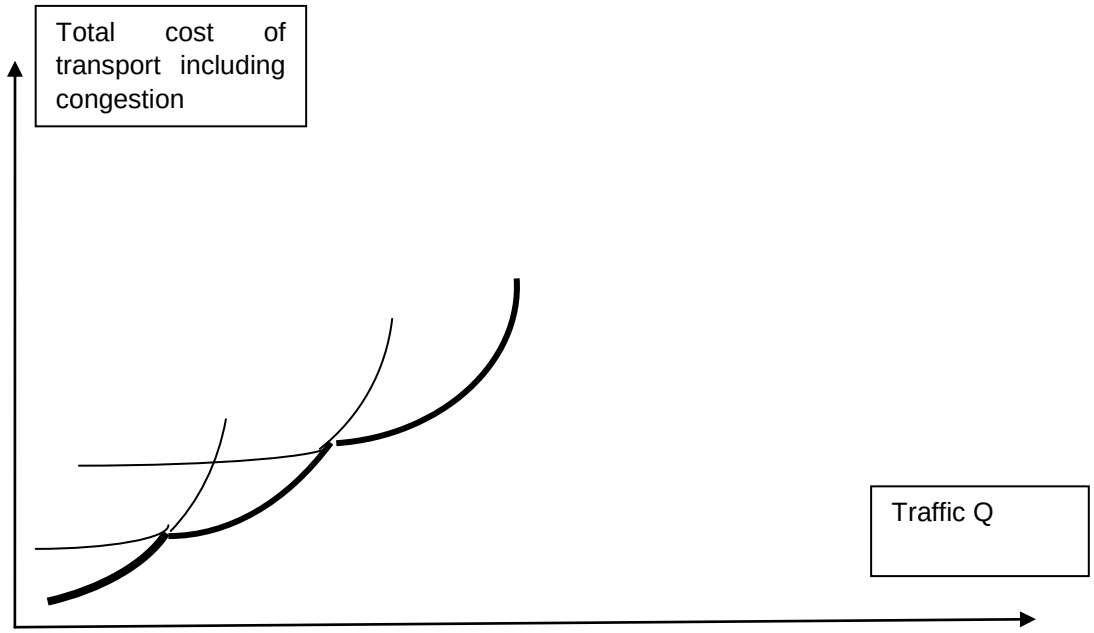
which we express by stating that for an adapted piece of equipment ($x=x^*(q)$), the long-term marginal cost is equal to the short-term marginal cost.

These well-known notions and developments cannot be easily applied to transport systems, due to their general indivisibility. A graph illustrates these special characteristics better, in the presence of three possibilities in terms of equipment: the medium-term cost function is constituted by pieces of the short-term cost functions (line segments here). Fore each level of equipment, the short-term marginal cost is equal to the slope of the corresponding cost function; as for the long-term marginal cost, it takes three values, represented by the slopes of the three segments marked in bold on the graph.



This graph quite clearly represents the situation of public transport services with a spectrum of modes going from buses, which are much less capital-intensive, to the metro, which is very capital-intensive, together with the tramway, which is situated between the two.

However, it is not well adapted to the case of individual automobile transport, where there are also indivisibilities in terms of infrastructure, less pronounced perhaps than for public transport (going from the one-lane road to the eight-lane highway, including all the classifications and numbers of lanes in between), but where, most importantly, there are congestion externalities: the journey time t depends on the traffic Q, and of course on the capacity K of the road: t=t(Q,K). Thus the short-term marginal cost, at a given road capacity, is the cost of the operator plus the marginal cost of congestion: $Q * \frac{dt}{dQ}|_{K\ donné}$; this is what represents the optimal pricing. Strictly speaking, we cannot determine a long-term marginal cost. When the traffic level increases, the optimal capacity varies in discrete peaks, successively taking several values. The marginal cost is represented by the slope of the tangent of the adapted cost function, indicated in bold in the following graph, and constituted, as in the preceding graph, by pieces of curves, each corresponding to a level of capacity.



One can demonstrate – it's Mohring's theorem – that in the presence of congestion phenomena, if capacity could be adapted continuously, then there would be a long-term marginal cost as in the base case examined first. At the optimum, for a capacity adapted to the traffic, the short-term marginal cost would be equal to the long-term marginal cost. Furthermore, if the capacity yields are constant (when traffic doubles, one can maintain an unchanged quality of service by doubling the capacity), then marginal-cost pricing ensures a balanced budget.

5.2. Appendix 2: Evaluation of the share of subsidies transferred to landowners

The benefits provided to transport users by a subsidy mechanism (or tax mechanism) do not only affect these users. A variably-sized share of the benefit is transferred to the other economic agents, and in particular the landowners. We can give several illustrations of this phenomenon, through more or less sophisticated explanations; we will present two here, on opposite ends of the sophistication range.

5.2.1. A simple model

First, we will consider an extremely simple monocentric model. We will assume that the inhabitants of a city all have the same utility function, the same income and live in housing of the same size; they travel twice a day to go to their jobs, which are all concentrated at a central point in the city; finally, we will assume that the costs of transport are calculated in proportion to the distance. This provides us with a scenario in which each individual bears land rent and transport costs of which the sum is constant, as shown in the graph below:

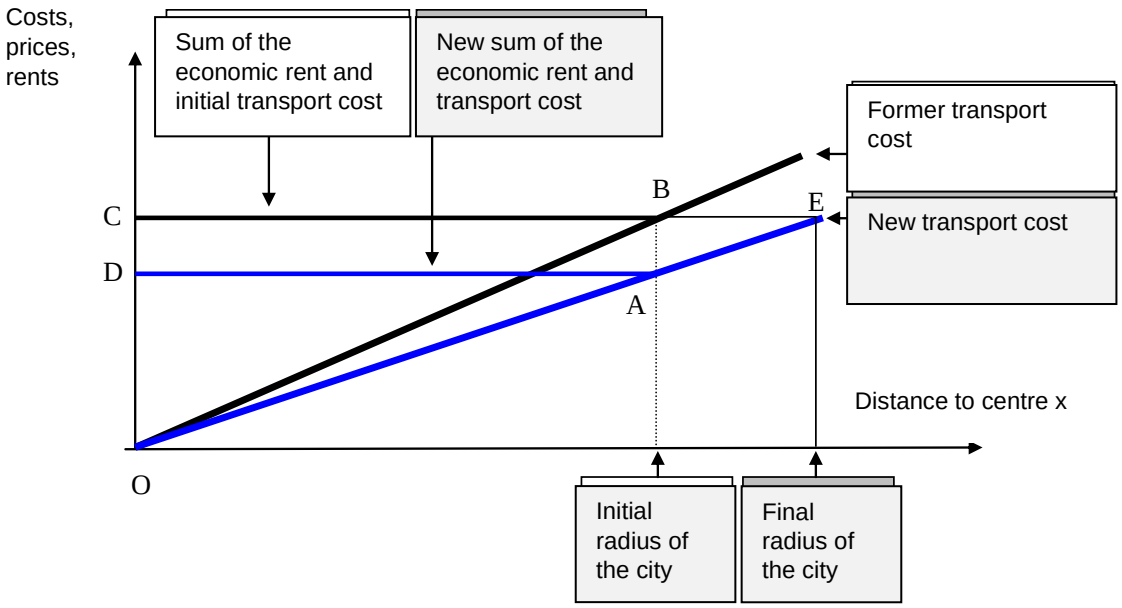


Figure 46: Collective surplus in the case of the simplified monocentric model[60]

If the cost of transport decreases, the gain that would be measured by the conventional surplus calculation is represented by the triangle OAB. But this total amount is distributed between a gain for the consumers, which is double (the rectangle ABCD), and a loss for the landowners, which is equal to half of this rectangle.

All in all, the standard formula gives a correct assessment of the collective surplus, but its appropriation is different from what would result from this formula.

If movements of population between cities occur, the city will attract inhabitants from other cities due to the fall in logistical costs (transport + housing), until these logistical costs reach their previous level. In total, the surplus will be the triangle OBE, corresponding to the previous assessment plus the induced traffic triangle (ABE). All this complies with the usual trapezium rule, and if the reduction in the cost of transport is “not too great” then the surplus will not be very different from the one calculated under the previous assumption. But its distribution will have changed dramatically: the users gain nothing, since the transport gains are exactly offset by the additional land charge, and the surplus will have been fully transferred to the landowners.

It should also be noted that in both cases, the time benefits enjoyed by the users are kept by them in kind; but they come along with variations in the price of land which affect the utility of the users and compensate, and sometimes overcompensate, for the monetary value of the time savings.

[60] This model is indeed simplified, because Fujita (and Thisse) established that, with a given utility function, the surface area of the housing S(x) increases with x, distance to the city centre. The price of housing decreases non-linearly with the distance. The sum of the cost of housing and the cost of transport is thus not constant. Fujita M. (1989) “Urban Economic Theory” Ed. Cambridge University Press

5.2.2. A more sophisticated model

We will present the results of a study conducted by Alex Anas and reproduced in the article: "The Economics of Cordon Tolling: General Equilibrium and Welfare Analysis" (A Anas and T Hiramatsu, Economics of Transportation 2013, 2, 18-37). It uses a LUTI model (Relutran) to analyse the consequences of a road toll in the conurbation. The use of a LUTI model makes it possible to reveal the consequences of the toll apart from transport, and in particular the manner in which they affect property values. It tests the consequences of three forms of tolls: a cordon toll around the conurbation, a cordon toll within the city, an intermediate cordon toll and a radial toll on all major roads. It also distinguishes between the situation in which there is substitution between the automobile and public transport and the situation in which there is no substitution. The results found are summarised in the table below, excerpted from the cited article.

Table 2a
Welfare analysis of a $5 cordon toll.

Per capita welfare components ($/yr)	All three travel modes are available				Only auto is available			
	(a) CBD cordon	(b) City cordon	(c) City & inner suburbs cordon	(d) Tolling all major roads	(a) CBD cordon	(b) City cordon	(c) City & inner suburbs cordon	(d) Tolling all major roads
CV	118	−208	−221	−290	332	−148	−303	−192
Revenue	70	187	103	283	127	249	127	698
Change in real estate income	174	449	344	834	555	953	689	2995
Total welfare	362	428	228	827	1014	1054	513	3502
Total welfare as percent of (d)	44	52	28	100	29	30	15	100

Figure 47: Impact of a toll on property values using a LUTI model – Source: "The Economics of Cordon Tolling: General Equilibrium and Welfare Analysis" (A Anas and T Hiramatsu, Economics of Transportation 2013, 2, 18-37)

In particular, we will consider the relationship between the total collective surplus (second-to-bottom line) and the income of the property owners (third-to-bottom line). We can clearly see that in every case, the landowners receive a large share of the total surplus, and sometimes more than the total surplus, depending on the type of toll.

On the basis of these two examples, it is clear that a variably-sized share of the surpluses generated by transport projects is ultimately captured by landowners (some of whom, but not all, are also users of the new transport service).

When these surpluses derive from the implementation of subsidies (for example, public transport subsidies that make it possible to reduce the fare or set up a faster new transport service), the landowners thus benefit indirectly from the subsidies that enabled the project to be completed. This may be an increase in already existing rental income, or the creation of new rental income for owners in areas that were not accessible prior to completion of the project.

5.3. Appendix 3: Methodology of construction of the indices (4. Recommendations)

5.3.1. Choice of variables

The choice of variables to be used for the graphic analytical representations was determined principally by three criteria:

- The representativeness of the variables in terms of the dimensions to be analysed: the variables used represent essential, defining elements of transport policy, and cover as broad a spectrum as possible of key points to be considered for the analysis of the regulated public transport sector:
    - Affordability for the user:
        - Price of a bus ticket in relation to the daily income per inhabitant of the conurbation
        - Price of a train ticket in relation to the daily income per inhabitant of the conurbation
    - Supply density:
        - Number of public buses / 1,000 inhabitants
        - Length of railway lines in km / million inhabitants
    - Financial sustainability for the public authorities:
        - Public transport subsidies excluding infrastructure investment per inhabitant, in relation to national public expenditure per inhabitant
        - Public transport subsidies excluding infrastructure investment per inhabitant, in relation to per capita income in the conurbation

  A variable concerning the affordability of one litre of petrol has been added, because it represents an interesting element to appreciate the other criteria, and a partial but useful indicator of the affordability of individual modes of transport.

- Comparability between conurbations: each variable is built as a ratio per inhabitant, and, where relevant, per income and per inhabitant, in order to guarantee optimal comparability within the sample.

- Availability of the data for the entire sample: as indicated in Chapter 4, other information would have been useful in this analysis; however, due to very uneven and heterogeneous sources of information between the conurbations, the availability of data was a significant constraint for the choice of variables.

5.3.2. Index construction

All the benchmarking variables were transformed into indices so that they could be compared easily, even though we also used them directly when they were comparable without transformation.

To ensure that the “best performance” is represented by the highest index, the ratios for which the desired result is the lowest possible number are represented by their inverse.

The indices of each variable were then built on the basis of a comparative principle: each ratio is expressed in % of the best performance found in the sample. In case of disproportionate performance of one or two conurbations in relation to the sample mean, the variables are

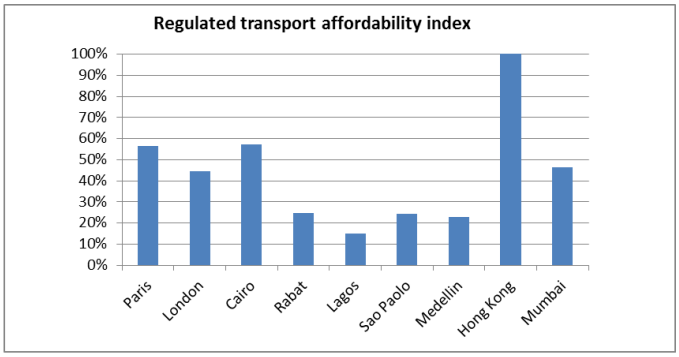
expressed in % of a normative value defined as the threshold from which the score attributed is 100%.

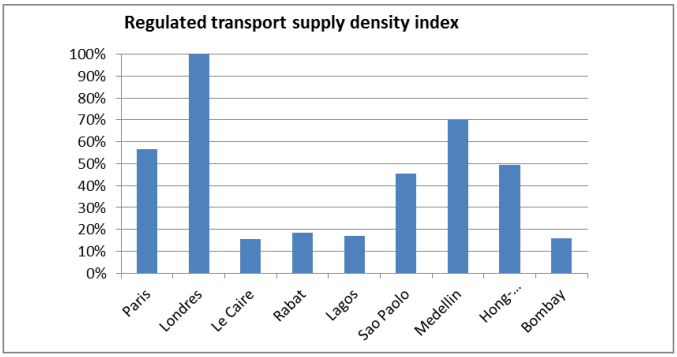
5.3.3. Construction of the aggregate indices

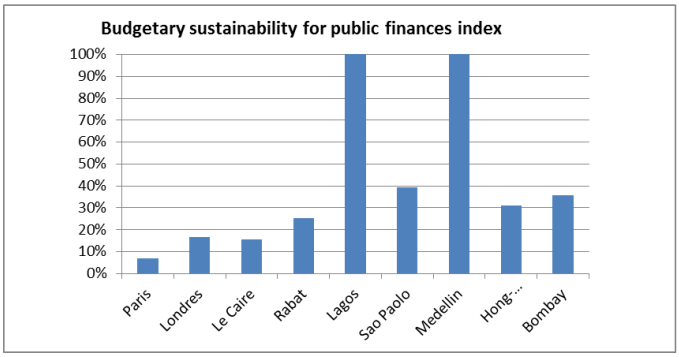
The aggregate indices aim to capture in a single variable the comparative performance of a city in one of the three dimensions.

The choice was made of an unweighted average of the indices corresponding to each area (as described above) because prejudging the relative importance of these elements would have corresponded to a prescriptive, and thus subjective approach, which we sought to avoid.

The aggregate indices are thus as follows for all of the cities:







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