PUBLIC TRANSPORT IN LONDON AND PARIS

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Acronyms :

G€ : Billions euros
Mh : Millions d'habitants
GLA : Greater London Authority
IAUIDF : Institut d'Aménagement et d'Urbanisme de la Région I-de-F.
K : Capital
OMNIL : Observatoire de la mobilité en Ile-de-France
GDP : Gross Domestic Product
PDUIF : Plan de déplacements urbain de l'Ile-de-France
p*k : passenger*km
STIF : Syndicat des transports de l'Ile-de-France
TfL : Transport for London
PT : Public Transport

Equivalences :

1 £ = 1,21 €
1 mile = 1,6 km

I- Introduction

London and Paris[2] are the two most important European agglomerations, in terms of population, of output, and consequently of public transportation. This paper is an attempt to compare the public transport (PT) systems of the two agglomerations. Three contextual elements throw some light on this comparison.

Demographic context – The first is demographic, and refers to the spatial structure of the two cities. Population and employment density profiles are markedly different. The curve representing density as a function of distance to the centre is near the centre much higher (two or three times) in Paris than in London. It declines rapidly, reaching rural levels at about 30 km from the centre. In London, by contrast, the density curve has a much lower slope and remains high 50 km away from the centre. The two curves intersect at about 15 km from the centre. In other words, there is more sprawl in London

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[2] In what follows, « London » and « Paris » designate the socio-economic agglomerations, not the Greater London Authority and area, and even less so the municipality of Paris.

than in Paris. CEBR & L'OEIL (1997, p. 96) calculated the average potential job-home distance[3] in the two agglomerations, defined as circles of different radiuses. For a circle with a radius of 40 km, this average distance was 24 km for London and 18.3 for Paris, a 30% difference.

The London sprawl measured by this indicator cannot be explained by geography: both agglomerations are located in large and flat plains, along major rivers. It is in part a consequence of the "green belt" policy developed after World War II to "contain" urban development, which in fact encouraged leap frogging beyond the green belt. It is also explained in part by the history of railroads, which developed earlier and to a greater extent in England than in France. Do PT follow, or precede, urban development? In the case of London, it seems clear that the first railway lines were designed to satisfy the demand for goods transportation, not passengers transportation. Only in a second stage were they utilised for passengers, and structured urban development.

Administrative context – A discussion of public transport cannot ignore the geography of public institutions. How define our two agglomerations to make them roughly comparable? An agglomeration, or a metropolis, is primarily a large labour market, a zone which is such that most of the workers of the area can access most of the jobs of the area. In the case of Paris, this socio-economic agglomeration coincides roughly with a politico-administrative entity: the Ile-de-France region. The fringes of the region do not always participate with a great intensity to the Paris labour market, but they do not weight much in terms of population, employment and output. Data available for the region and its 11.9 M inhabitants provide abundant and meaningful information on the Paris agglomeration.

Not so with London. The Greater London Authority (GLA), with its 8.3 M people, which is a political entity, is much too small to define the London agglomeration[4]: a

[3] The agglomeration considered is divided into n zones. Let Wi the number of jobs in zone i, with $W=\Sigma_i W_i$; Lj the number of workers in zone j ; and dij the as the crow flies distance between i and j. For zonej, Dj, the average distance to all jobs in the agglomeration is $D_j=(\Sigma_i d_{ij})/W$. For the entire agglomeration, the average distance D is $D_j=(\Sigma_i d_{ij})/W$.

[4] This is why we will systematically avoid the expression « Greater London » to designate the GLA area ; this expression is misleading since the London agglomeration is goes much beyond the GLA zone, which should rather be named « Smaller London ».

significant share of the labour force working in the GLA reside outside this GLA, in the administrative region called South-East, which is home to 8.7 M people. A number of statistical information is available for the GLA, and for the South-East (both are Eurostat NUTS 2 regions). Unfortunately, the set composed of the GLA and the South-East, with 17 M inhabitants, is certainly too large to define the London agglomeration. This agglomeration consists of the GLA plus only a certain part of the South-East.

What part? We decided to take 41%, or 3.6 M inhabitants. The main interest of this percentage is to equate the population of London agglomeration thus defined with the population of Paris agglomeration (8.3 + 3.6 = 11.9). This facilitates direct comparisons between London and Paris, without having to calculate per capita values. We will use the expression "periphery" to refer to that part of London located outside the GLA, in the South-East. Admittedly, this ratio of 41% is arbitrary. But it is reasonable and meaningful. Above all, we can show that, because of the weight of GLA, results obtained for the agglomeration are not very sensitive to the exact ratio retained (as will be seen shortly on the GDP case)

Economic context – According to Eurostat, the GDP of Ile-de-France in 2011 amounts to 609 billion euros (G€ in what follows): this is the GDP of our Paris. By adding the GDP of the GLA (395 G€) and 41% of the GDP of the South-East (105 G€), we obtain 500 G€: this is the GDP of our London. Output, and therefore output per capita, in Paris is 22% higher than in London. The difference in labour productivity is even more important: 26%.

This 22% (as a measure of the difference in output between London and Paris) is fairly robust. A comparison made in purchasing power parity reduces this peercentage: to 15%, which remains a noteworthy difference. This 22% is not very sensitive to the percentage of South-East (41%) incorporated in our definition. With different percentages, the comparison must be made per capita, since the population of the two metropolises is no longer the same. With 50%, one obtains an output differential of 24%; with 60%, of 26%; with 70%, of 28%. Our calculation makes the implicit hypothesis that output per capita is the same in all the sub-regions of the South-East. This hypothesis is not quite confirmed by an examination of Eurostat sub-regions (NUTS 3) output per capita. Three of the four regions adjacent to the GLA (Berkshire, Buckinghamshire, Surrey) have a per capita output higher than the output per capita of the entire South-East; the fourth sub-region

(Kent) has on the contrary an output per capital lower than that of the South-East. On the whole, our procedure might under-estimate the output of the London periphery by perhaps 10%; it could be (in G€) closer to 115 than to 105, and the total for London near 510 rather than 500.

By way of comparison, the GDP of the Netherlands – a country much more populated than London or Paris (16.6 M inhabitants), and supposed to have a high productivity – is only 599 G€, about equal to the GDP of Paris.

This output differential between London and Paris contributes to explain PT differences, and is in part explained by them. It is therefore an important contextual element.

Table 1 summarises this information.

Table 1 – London and Paris, Population et GDP, 2011

	Population (Mh)		PIB G€)	
	London	Paris	London	Paris
GLA	8,3		395	
Periphery (41% South-East)	3,6		105	
Agglomeration	11,9	11,9	500	609

Sources : Eurostat. For the South-East, Office of National Statistics, *Key Statistics.*

The paper is organised as follows. The supply of PT in our two agglomerations is first examined in terms of infrastructure and institutions (section II). The importance and structure of PT patronage is then presented and discussed (section III). The next section is a comparative evaluation of operation and capital costs (section IV), followed by an analysis of financing modes (section V). We then look at recent and projected investments (section VI), and at PT efficiency (section VII). A final section attempts to draw some conclusions from this comparative analysis

II – Public Transport Supply

In general, the supply of PT in London and Paris is similar, with (i) a subway in the centres, (ii) bus lines everywhere, particularly in the peripheries, and rail lines, mostly radial, and in some cases non-radial. In detail, however, significant differences appear between the two agglomerations.

Subways and tramways – The London subway (402 km) is twice as long as that of Paris (202 km). It covers a much larger area. Subway stations are closer to each other in Paris than in London. One can add, for London, two recent tramway lines: the Docklands Light Rail (40 km) and Tramlink (28 km), and also a light rail system, Overground (86 km); and for Paris, seven recent tramway lines (82 km).

Buses – The supply of bus transportation is greater in London than in Paris. There are 8,500 buses in the GLA, plus around 1,800[5] in the periphery, i.e. about 10,300 buses. In Paris, there are 4,300 buses owned and managed by RATP mostly in the centre of the agglomeration, plus 4,200 private buses operated in the periphery in the framework of an entity called "Optile", i.e. about 8,500 buses.

Trains – In both agglomerations, rail lines are primarily radials, leaving from (or arriving in) stations located in the centre, servicing areas in the periphery, as well as other agglomerations in the rest of the country. In London, as in the rest of the UK, these lines utilise the infrastructure of Network Rail (a not for money private entity) and are operated by private companies, the Train Operating Companies (TOCs). In Paris, as in the rest of France, rail lines utilise the infrastructure of RFF (Réseau Ferré de France), and are operated by SNCF.

The main difference between London and Paris relates to non-radial lines. In the 1970-90ies, Paris created a "regional express network" (réseau express regional, or RER) consisting of five high capacity lines (587 km) crossing the agglomeration from east to west and from north to south. London is presently engaged in a comparable line, Crossrail (118 km), that will transverse the centre east-west, and will be completed in 2017.

Table 2 summarises this description.

[5] This number is estimated as the number of buses in non metropolitan zones of England (according to the Department of Transport) multiplied by the population of the « periphery » (3.6 M) and divided by the population of the non-metropolitan zones of England (34.1 M).

Table 2 – Public transport infrastructure, London & Paris, 2012

	London	Paris
Subways & tramways (km)	556	284
Buses (number)	10.200	8.500
Trains		
radial (km)	2.956	1.743
non-radial (km)	118	587

Sources : see text. The length of London train lines (2,956 km) is a fragile estimate; we allocated Great Britain rail lines between London and the rest of Great Britain pro-rata train patronage in passengers*km (see next section)

Institutions – The institutional set up is simpler in Paris than in London. The Ile-de-France region (which, as mentioned earlier corresponds roughly to the Paris agglomeration) has a transport arm, the STIF (Syndicat des transports de l'Ile-de-France) with a global responsibility for public transport. STIF negotiates directly with (i) RATP which operates the subway, buses, and two RER lines, (ii) SNCF which operates trains and the remaining RER lines, and (iii) the private buses of the Optile system. Both RATP and SNCF are State-owned companies. STIF negotiations are greatly helped by the subsidies it grants to RATP and SNCF.

In London, the GLA has also a transport arm, Transport for London (TfL). TfL differs from STIF on three important points. First, TfL does not control the entire agglomeration area: it has no authority on the periphery (the part of the South East which is home to the 3.6 M people considered here as living and working in the London agglomeration). Second, TfL, unlike STIF, is also responsible for automobile transport (in the GLA area); it is, for example, TfL that created and manages the London congestion charge. Third, TfL has no authority to negotiate with the train actors (Network Rail and TOCs) operating in London, nor with the bus companies operating in the periphery. TfL statistics and analyses, which are easily accessible and very useful, relate only to the domains covered by TfL: they can be misleading, since they offer but an incomplete view of public transport in London.

*Seats*kilometres offered* – The supply of PT goes beyond the capital utilised to produce the service, even though the role of this capital is key. One should also take into account the labour utilised, and the partial or total productivity. We failed to find the adequate labour force data required. We could however estimate the seats*km offered, broken down by sub-modes, which provide an indicator of the PT supply.

Table 3 – Public transport supply in seats*km offered, London and Paris, 2012

	London	Paris
		(in G SKO)
Subway et tramway	57,4	65,8
Buses	47,7	23,7
Trains		
radial	112,0	45,6
non-radial	-	83,9
Total	217,1	219,0

Sources & notes : For Paris : STIF. For London subways and buses, calculations made by IAUIF, resulting from the multiplication of vehicles*km (TfL) by average capacity of vehicles. For London trains, the *National Transport Survey* provides the number of trips originating from the GLA area and from the South-East, and the destination of trips the origin of which is the South-East (55% are bound to London, 38% for the South-East itself); which makes it possible to estimate the number of trips in the London agglomeration, and its ratio relative to the total of GLA and South East (93%). This ratio is applied to the total of seats*km for GLA and South-East.

Globally, it appears that the quantity of public transport supply is similar in the two agglomerations. The structures, however, as mentioned above, are different: twice as many seats in buses and radial trains in London, compensated by more seats in non-radial trains (RER) in Paris. Whereas STIF has authority over all the compartments of the Paris PT supply, more than half the London PT supply (the trains) escapes the control of TfL. The seats*km indicator, however, ignores the qualitative characteristics of this supply, such as frequency, punctuality, or comfort.

III – Public transport patronage

Table 4 indicates the inter-modal (between PT and private vehicles) and intra-modal (between the various PT sub-modes) resulting from the interaction of supply and demand in our two agglomerations. Numbers are presented in passengers*km (p*k), the unit that best represents the relative importance of modes and sub-modes. We ignored walking, bicycle and two-wheelers: these modes do not weight much in terms of p*km, and do not raise major issues for transport policy. Table 4 calls for four comments.

First, trips (measured in p*k) in London are more important in London than in Paris, by 16%. This is probably caused by higher density, and more mixed patterns of homes and workplaces, in Paris relative to London.

Second, and contrary to what is often stated, the role of public transport is less important in London (29% of motorised transport) than in Paris (33%). The London of banks, tourism, media, where private automobiles are indeed very few, is not quite representative of the entire agglomeration.

Tableau 4 – Importance and structure of public transport, London and Paris, 2012

(in billions p*k/year & %)

	London			Paris		
	p*k	%	%	p*k	%	%
Motorized trips:						
Private cars	72,4[a]	71		59,3[b]	67	
Public transport	29,7	29	100	28,9	33	100
Subways & tramways	10,8[c]		36	7,7[d]		27
Trains (incl. RER)	9,5[e]		32	16,8[d]		58
Buses	9,4[f]		32	4,3[d]		15
Total	102,1	100		88,1	100	

Sources et notes : [a]For the GLA, number of vehicles*km in the GLA (TfL 2011, p. 67) multiplied by the occupancy rate (1,56, according to NTs Table 0905), plus; for the periphery, mileage per capita in the South-East (NTS Table 9904) multiplied by the share of the share of mileage in trips of less than 50 miles (76%, NTS Table 0390) multiplied by the population (3.6 M). [b]ENTD 2010. [c]TfL 2011, p.67, including the subway, the Docklands line, and Tramlink. [d]STIF (OMNIL). [e]TfL (2011, p.67) gives the number of passengers*km of national trains in the GLA and South-East (27.4 M); one must deduct p*k in the non-London part of the South-East (7.7 M) obtained by multiplying the number of p*k per capita (NTS Table 9904) by the population of the area considered (5.1 M);we multiply by the share of the distance covered in trips of less than 50 miles (44%, Table NTS Table 0309); and we add p*k on the Overground line (0,8 M). [f]Number for TfL buses (8.3 M, TfL 2011, p.67),plus distance per capita in local South-East buses (NTS Table 9904) multiplied by the population of the periphery (3.6 M inh).

Third, the importance of bus tranport, in absolute and in relative terms is much greater in London than in Paris. This is probably a consequence of the lower density of much of London.

Fourth, the importance of trains is much greater in Paris than in London. This is the direct consequence of the RER success.

IV – Public transport costs

The supply of massive public transport services in London and Paris is obviously done at a cost, which is difficult, but necessary, to evaluate. The focus is often on operating costs. However, in a capital-intensive sector like public transport, capital costs cannot be ignored.

Operating costs — We are interested here in economic, not accounting, costs; and on purely operating costs, excluding depreciation, or interests paid on loans that financed the capital utilized.

For Paris, we can use the national *Comptes de transport en 2012* (CCTN 2013). They offer data on the components (wages, purchases) of operating costs for RATP and SNCF: 3.6 G€ for RATP; 16.3 G€ for SNCF. The latter number refers to SNCF at large, not to Paris trains. The allocation of SNCF expenditures to its various types of activities is not public. Different keys or criteria can be utilized to distribute these expenditures between Paris and the rest of France. We utilize the criterion of passengers*km (14.6%), and obtain an operating cost of rail transport in the Paris agglomeration of 2.4 G€. One has to add the operating costs of the Optile Paris private buses. This is done by multiplying the number of bus*km (144 M) by a unit operating cost (3 €/bus*km) and produces an operating cost of 0.4 G€. The total operating cost of public transport in Paris is therefore 6.4 G€[6].

For London, our starting point is the accounts of Transport for London (TfL), that describe at some length the costs of the subway and of GLA buses, but ignore the costs of trains and of periphery buses. The TfL *Annual Report* includes *Financial Statements*. The most relevant is a "segmental analysis" presenting operational expenditures, excluding depreciation, which consists mostly of wages and purchases. They amount to 6.8 G€[7]. This amount is too high for our purpose. It comprises, for 2.7 G£ or 3.2 G€, operating expenditures for « surface transport » that include buses operating expenditures, but also street cleaning and congestion charge related expenditures. A correction must be made to eliminate street cleaning and congestion charge expenditures which do not provide public transport[8]. It reduces the amount of TfL operational costs from 6.8 to 5.3 G€.

[6] This number is much lower than the number given by STIF: 8.6 G€, which is produced by adding subsidies granted to operators and users (5.0 G€) with fares paid by users to operators (3.6 G€). It makes no reference to the costs actually borne by operators, and includes accounting components (depreciation, interests) and even capital expenditures (rolling stock) that we want to exclude.

[7] The evaluation in euros is done with the following rate of exchange: 1 £ = 1,21 €. The source provides the following break up (in M @): London Underground : 1845 ; Tube Lines : 374 ; London Rail : 345 ; Surface transport : 2661 ; Divers : 375.

[8] This correction consists of a direct evaluation of bus operating expenditures ; it is done by muliplying the number of bus*km (490 M) by the per km cost of bus operation (3.5 €/bus*km), to obtain 1.7 G€.

To evaluate the operating costs of the periphery buses, we take the total operating cost of buses in the non-metropolitan areas of England, as published by the Ministry of Transportation (1.8 G£), and allocate it to the London periphery buses pro rata the share of the population of the London periphery (3.6 M) to the population of the non-metropolitan areas of England (34.1 M). One obtains a cost of 228 M€, or 0.2 G€.

To evaluate the operating costs of trains in the London agglomeration, we use a similar approach. The operating cost of all TOCs is 6.5 G£ for the country, according to the Ministry of Transportation. This amount is allocated to London with the ratio of train trips in London (in p*k) to train trips in the country (26%). One obtains an operating cost of 1.7 G* or 2.1 G€.

Total public transport costs in London are the sum of the three costs thus evaluated (5.3 + 0.2 + 2.1 G€), and amount to 7.6 G€.

Capital costs – To estimate the yearly cost of the capital utilised to produce PT services (in order to add it to operating costs), we begin by estimating the value of the capital stock. This is done for infrastructure and for rolling stock, for subways, trains, and buses. This rather complex operation is detailed in Annex A. For infrastructure, it consists in the multiplication of kilometres of lines by per kilometres costs, taking into consideration the sur-costs caused by kilometres of tunnel. For the rolling stock (buses, subway and train carriages) we also multiply the number of units by the unit costs, which are not necessarily identical in London and Paris. The value of the capital thus estimated is a gross value. It is multiplied by a coefficient of 0.5 to take into account the obsolescence of the capital considered; it produces a net value.

The yearly cost of using this capital has two components: the opportunity cost of this capital, and its depreciation. (i) The opportunity cost is the resources forgone by using this capital, what it could have produced had it been utilized otherwise. We retain a rate of 5%, which is applied to the net value of the PT capital. (ii) Depreciation is a measure of the physical wear and tear of the capital elements. It is obtained by dividing, for each type of element, the gross value of this element by its life span (30 years for subways and trains carriages, 10 years for buses). The tunnel sur-costs (an important share of subway infrastructure) are not depreciated, because tunnels do wear and tear; well maintained they can be used for centuries.

Table 5 presents the main results obtained. The estimated numbers must be interpreted with care. They obviously depend upon: the data collected on the various elements of the capital stock; hypothesis made about the value of these elements, their life span, the interest rate retained. One should note, however, that these variables have the same value for London and for Paris (occasionally adjusted to take into consideration well established differences, such as the diameters of subway tunnels), and therefore that comparisons between the two agglomerations are much less uncertain that the absolute numbers produced.

Table 5 – Capital costs of public transport, London & Paris, 2012

	(In billions euros)	
	London	Paris
Capital stock:		
Subways & tramways (gross)	13,5	12,1
Trains, incl. RER (gross)	45,5	34,0
Rolling stock (gross)	36,3	27,6
Total (gross)	95,3	73,5
Total (net)	47,7	36,8
Annual capital cost:		
Opportunity cost of K	2,4	1,8
Depreciation of K	2,8	2,0
Total	5,1	3,8

Sources & notes : Unit costs of infrastructure and of rolling stock come from RATP. Physical magnitudes (length of rail lines, number of vehicles, etc.) come from various sources, including Wikipedia (richer in information than the RATP and SNCF sites), and of estimations on the case of London. Depreciation is calculated on the basis of a life span of 30 years for infrastructure, subway and train carriages, and 10 years for buses. The opportunity cost is calculated with a 5% interest rate.

It is interesting to note two ratios, which have roughly similar values in London and Paris, and probably a rather general meaning. One is that the capital stock of trains is about twice as large as the capital stock of subways. The second is that the value of rolling stock is about half the value of infrastructure for both trains and subways; projects that consider only infrastructure costs (and they are not rare, at least in France) underestimate costs by about a third.

Estimated costs of the production of public transport in the two agglomerations are presented in Table 6.

Table 6 – Production costs of public transport services, London and Paris, 2012

	London	Paris	L/P
Operating costs (G€)	7,6	6,4	+19%
Capital costs (G€)	5,1	3,8	+34%
Total costs (G€)	12,7	10,2	+25%
GDP (G€)	500	609	-18%
PT costs/GDP (%)	2,5%	1,7%	+47%
Passengers*km (G)	31,1	28,9	+8%
Unit costs (€/p*k)	0,41	0,35	+17%

Sources & notes : see text

Table 6 shows an important element of comparison: the cost of public transport is significantly higher in London than in Paris – by about 25%. This difference cannot be explained by a greater *relative* role of public transport in London. On the contrary, public transport accounts for only 30% of motorised trips (in p*k) in London, as opposed to 33% in Paris. It is in part explained by a greater *absolute* role of public transport in London: PT moves 8% more travellers (in p*k) in London than in Paris. It is also, and mostly, explained by a higher unit cost (per p*k) of about 17% in London than in Paris.

This cost differential of about 2.5 billion euros is all the more remarkable since the GDP of London is lower than the GDP of Paris, as mentioned above. It follows that the share of GDP allocated to public transport is significantly higher in London. It is 2.5% in London, as opposed to 1.7% in Paris.

V – Financing public transport

In all developed countries, PT is heavily subsidised. Is it more heavily subsidised (in euros, and relative to user fees) in London or in Paris? In both cases, user fees are far from covering all operating expenditures. We can therefore consider that capital costs are entirely paid by taxpayers.

Paris – For Paris, data is fairly easily obtained. It concerns mostly two agents, RATP and SNCF, and is presented in *Les Comptes de Transports en 2012* (CCTN 2013, pp. 11-128). We can start from user fees paid, and subtract it from estimated operating expenditures, in order to obtain taxpayers contribution. PT users paid 1.1 to SNCF for Paris trains, 2.2 G€ to RATP for subways and buses (minus 0.8 G€ reimbursed by enterprises), and 0.2 to Optile buses. In total, out of pocket expenditures amount to 2.7 G€. The difference between operating expenditures (6.4 G€) and user fees payments (2.7 G€) is the taxpayers contribution to operating expenditures: it amounts to 3.7 G€[9].

In addition, taxpayers pay or bear the burden of all capital costs, i.e. 3.8 G€. In total they contribute 7.5 G€ for the PT services provided in Paris.

London – Payments by users for the usage of public transport under the control of Transport for London (subway, GLA buses, other) are given in the financial annexes of the yearly report of TfL: 4.7 G€. We have to add payments by users for trans and for periphery buses. For trains, we take the national ratio of payments to operating expenditures (58%) and apply it to London trains operating costs evaluated above (2.1 G€), to obtain payments of 1.2 G€. For periphery buses, we use the same ratio, and apply it to estimated operating costs (0.2 G€), and obtain payments of 0.1 G€. Total user fees paid in London (4.7 + 1.2 + 0.1 G€) are therefore estimated at 6.0 G€.

The difference between the estimated cost (7.6 G€) and users payments (1.6 G€) is an estimation of subsidies to PT operating costs in London: 1.6 G€. When capital costs (5.1 G€), entirely borne by taxpayers (or additional indebtedness), are taken into consideration, taxpayers contribute 6.7 G€ to the provision of public transport services in London. Table 7 summarises results obtained.

Two differences - The comparison between London and Paris reveals two major differences. First, users contribution is much more important in London than in Paris, in absolute and in relative terms. In absolute terms, user fees are twice as high in London (6 G€) as in Paris (2.7 G€). Relative to operating costs, user fees are about 80% in London, as opposed to only 42% in Paris. Relative to total costs, the respective shares are 47% and 26%. Users pay about half of public transport costs in London, and only about one quarter in Paris.

Second, the origin of public subsidies is national in London, as opposed to regional in Paris. In London, subsidies come mostly from the central government, in two

[9] An alternative evaluation method adds subsidies directly paid to RATP (2.6 G), to SNCF for its Paris metropolitan activities (1.9) and to Optile buses (0.6 G€), a total of 5.1 G€. This number is higher than the 3.7 G€ given above because it includes subsidies to capital expenditures.

forms. The central government grants every year a "transport subsidy" (3.4 G€ in 2012) to TfL. In addition, it subsidises in part the trains used in London. In Paris, subsidies, which are channelled through STIF, come mostly from the so-called "versement transport" (transport tax), for an amount of 3.3 G€, which is in fact a wage tax, based on the wages actually paid by Ile-de-France enterprises, at a rate decided by the regional council (2.6% in 2012). Enterprises also pay for the reimbursement of 50% of the public transport expenditures of their employees (0.8 G€). These taxes are of course shifted, and borne by employees (lower wages), consumers (higher prices), capitalists (reduced dividends) and even central government (lower corporate income taxes). The last three categories are largely located out of the Paris agglomeration.

Table 7 – Financing of public transport costs, London & Paris, 2012

(in billions euros)

	London	Paris
Operating costs	7,6	6,4
users	6,0	2,7
taxpayers	1,6	3,7
Capital costs	5.1	3.8
taxpayers	5.1	3.8
Total costs	12.7	10.2
users	6,0	2,7
taxpayers	6,7	7,5

Sources: see text
Note: strictly speaking, taxpayers financing, which is obtained by difference, also include debt financing

VII – Investments in public transport

As mentioned above, capital stock plays a major role in public transport. Investments - that define the quantitative and qualitative evolution of the capital stock - obviously determine the evolution of transport supply. How did they behave in London and Paris in recent years? How are they expected to behave in the coming years?

Past investments – For London, one finds (in the financial annexes of TfL yearly reports) the amount of annual investments for 2011-2012 and 2012-2013 in TfL managed capital stock: about 4 G€ per year. Investment in Crossrail, the east-west rail line, accounts for about half that amount. These investments are financed (up to more than 90%) by two central government subsidies: a general transport grant, and a specific Crossrail subsidy.

In addition, there has been investments in periphery buses and in radial trains. We unfortunately failed to find estimates of such investments, and postulated an amount of 1 G€. We obtain a total 5 G€.

For Paris, that is for RATP and for the Paris activity of SNCF and RFF, *Comptes de Transports 2012* (CCTN 2013) provide series of infrastructure investments and rolling stock investments (which are, by the way, of similar magnitude), which did not fluctuate much over the past five years. The average investment is about 2.5 G€.

Planned investments - For London, for public transport managed by TfL, one finds, in the TfL *Business Plan 2013* a schedule of programmed investments for the 2012-2020 period. These expenditures amount to 4.0 G€ in 2012, increase in the following two years up to 5.0 G€, then decrease to settle around 3 G€ in the last years of the decade; on average they amount to 3.8 G€ per year[10]. This expenditure profile is largely determined by expenditures on Crossrail, an 18 billion euros project, expected to be completed in 2017 or 2018. To this amount, one should add planned investments for periphery buses and London railways. In the absence of data on these investments, we will (arbitrarily) assume that they will amount to about 1 G€ per year.

For Paris, the basic document seems to be the PDUIF (Plan de Développement Urbain en Ile-de-France), prepared in 2010, and in the process of approval. In this 200 pages long rather literary document, only seven pages deal with the "costs and financing" of an ambitious "programme". It mentions, for the 2010-2020 period, 14 infrastructure investments projects, for an amount of 20.4 G€. The most important (in costs terms) are the extension of RER lines (3.1 G€) and of subway lines (3.8 G€), tramways (3.8 G€), the TZen[11] (2.0 G€). It also mentions 8 investments in rolling stock projects, for an amount of 11.2 G€. The document is vague and short on financing, and merely mentions the financing entities (STIF, region, Central government, etc.). The total of these "planned" investments is 31.5 G€, or 3.2 G€ per year on average.

[10] We are not sure that these investments include investments in rolling stock.
[11] A sort of tram on wheels

Table 8 – Passed and planned investments in public transport, London & Paris

(In billion euros per year, or in%)

	London	Paris
Recent investments	5,0	2,5
Planned investments:		
in value	4,8	3,2
in % capital stock	10,0%	8,7%
in % of GDP	1,0%	0,5%
depreciation/investments	56%	63%

Sources & notes : For Paris, *CCTN (2013)* pour the past, PDUIF for the future. For London, TfL yearly report for TfL networks (4,0 G€), plus 1,0 G€ postulated radial railway lines, for the past; TfL *Business Plan* for the future, plus 1,0 G€ per year postulated for radial railway lines.

In recent years, public transport investments have been more important in London than in Paris, in absolute terms and relative to the GDP of each agglomerations. This can probably be explained by a catching-up effect. Until the 1980ies, the UK in general, and London in particular, underinvested in public transport (and in roads). France, and especially Paris, by contrast invested significantly in rail infrastructure (and in roads as well). The RER in particular, that plays such an important role in the Paris supply, was created in the 1970-90.

In the coming years, London should (according to existing plans) continue to invest more than Paris in public transport, even though the differential is likely to diminish. Planned investments account for about 1% of GDP in London, and only 0.5% of GDP in Paris.

It is interesting to compare planned investments with depreciation of existing capital. More than half planned investments only serve to compensate the physical wear and tear of the existing capital. In other words, capacity and quality improvements of public transport represent only about 40% of the programmed investments in our two agglomerations (a little more in London than in Paris).

VII – Efficiency of public transport

The notion of efficiency of a public transport system is not clear. It can be defined as the capacity of a PT system to effectively meet the public transport demand in terms of speed, comfort, punctuality, and obviously of costs. To put it otherwise, it is the capacity to minimise the generalised cost of public transport. Efficiency therefore is a multidimensional concept. On the cases of London and Paris, we have discussed the cost dimension. Amongst the other dimensions, time (or speed) is probably the most important, and in any case the most easily measurable. Table 8 presents data compiled on this topic.

Tableau 8 – Trips duration, length and speed, London and Paris, 2010

	London	Paris
Trip duration (minutes) :		
in PT	49	48
in train	*67*	
in subway	*54*	
in bus	*40*	
in car	26	23
Trip length (km)		
in PT	8,8	9,0
in train	*20,8*	
in subway	*9,4*	
in bus	*4,6*	
in car	8,1	6,2
Trip speed(km/h)		
in PT	10,7	11,2
in train	*18,6*	
in subway	*10,4*	
in bus	*6,9*	
in car	18,7	16,2

Sources & notes : For London, TfL(2011). The source gives duration and lengths for the three PT sub-modes; numbers for PT in general are a weighted average. For Paris *Enquête Générale de Transport 2010, Résultats (dits) détaillés*. The two sources being households surveys, one can expect that duration refer to total time, including access time to transport modes. Distances are as the crow flies distances. Data refers to all trips, not only to journey to work trips.

The source utilised for London refers only to the residents of the GLA, and is therefore not quite in line with our definition of London. Nevertheless, one can think it does not distort too much the comparison. The trips undertaken by the 3.6 M inhabitants of the London part of the South-East are dichotomic: they consist of trips to/from London, longer than trips within the GLA; and of trips within the South-East which are most probably shorter than GLA trips.

Table 8 suggests a rather striking similitude between London and Paris. In both agglomerations (as everywhere else actually) the speed of car trips is much higher than the speed of public transport trips: by 45% in Paris, and by 70% in London. London is often considered as more congested than Paris. This might be true in the centres, but table 8 suggests it is not true for the agglomerations as a whole.

Above all, and this is what interests us most here, the two public transport systems seem to produce very similar outcomes: on average, trips have practically the same length, the same duration, and (consequently) the same speed.

This finding could and should be refined and qualified. Are these similar averages hiding different distributions? Are things different for journeys to work? This finding is nevertheless remarkable. It suggests a similar efficiency of the public transport systems of the two agglomerations.

It might even suggest a greater efficiency of the London system. In this race for achievements (in which London and Paris arrive *ex aequo*) London starts with the historic handicap of a greater dispersion of people and activities. Public transport demand is therefore more difficult to satisfy in London than in Paris. If it satisfied to the same level, isn't it the proof of a greater efficiency?

Perhaps not, for two reasons. First, as mentioned, the London PT system operates at a higher cost than the Paris PT system. It is this economic sur-cost that compensates the London sprawl handicap.

Second, it is not sure that demand is satisfied to the same extent or level. Households surveys measure only effective trips. They ignore potential trips that do not take place because they would be too long or too costly. It is likely that the effective Paris labour market is larger and deeper than the effective London labour market. The percentage of existing jobs which are accessible at a reasonable time and money cost is greater in Paris than in London. The choice range of workers and enterprises is greater. This makes it easier for both of them to find what they want. This better match of labour demand and supply improves the income of workers and the productivity of enterprises.

This point is illustrated (on UK data) by the relationship between journey-to-work duration and hourly wages, given in table 9, for Great Britain and in particular for London. The longer (in time) the journey-to-work, the higher the income. For London, the income associated with the longest trips is twice as high as the income associated with nearby employment. Those who cannot or do not want to go and work very far from home (in part because of the PT system) deprive themselves of high incomes, and deprive enterprises of productive workers.

The fact that they are probably more numerous in London than in Paris explains in part the higher productivity/outcome of Paris emphasized above in the introduction.

Table 9 – Median hourly wage and median duration of journey-to-work, London and Great Britain

	London	Rest de GB
	£	£
Duration (minutes)		
1-15	10	8
16-30	13	10
31-45	17	12
45-60	16	12
>60	19	14

Source : Labor Force Survey

VIII – Conclusion

In order to compare the public transport systems of London and Paris agglomerations, we first defined two comparable zones, with in particular the same population.

A first conclusion is that public transport is in both agglomerations much less important than private car transportation: 30% in London, 33% in Paris (of motorised trips).

A second conclusion is that public transport in London is more abundant (in terms of capital), more utilised (in terms of passengers*km), and more costly (in terms of economic cost) than public transport in Paris. This difference is a consequence of the spatial distribution of people and activities in the two agglomerations: London is more spread out than Paris.

Third, the economic cost of the London PT system is higher than that of Paris, absolutely and relative to patronage (i.e. per passenger*km). Nevertheless, the London system seems more productive per km of subway or train than that of Paris. It offers faster subways because of a greater distance between stations; smaller, and therefore cheaper, trains; narrower tunnels. This reduces costs, but occasionally also performance. Narrower tunnels, for instance, make it impossible for London to use the two levels carriages that are increasingly used in Paris to augment the carrying capacity of many trains.

Fourth, in the two agglomerations, public transport is largely financed by taxpayers: totally for investments and capital costs, largely for operating costs. London operating costs, higher than Paris operating costs, are much less subsidised. As a result, users pay twice as much in London than in Paris, for a comparable service. Subsidies do not have the same origin in the two agglomerations: in London, they are contributed by national taxpayers, in Paris by local taxpayers.

Fifth, in recent years, London has invested more than Paris in public transport, and should continue to do so in the coming years. This is in part because it has invested less in the past, and also because it is presently developing faster than Paris in population and activities.

A comparison is not a match that ends with a winner and a looser, or even a tie. What strikes us is the weight of history in matters of spatial development and transport. The greater length of PT infrastructure networks, and the greater degree of sprawl in London relative to Paris, are largely the consequence of what the economy and railways were in 1850 in the two zones. Today, these two characteristics of London (longer networks and more sprawl) are probably a handicap for London, or to put it otherwise a competitive advantage for Paris, in terms of economic efficiency. London has been trying to compensate this strategic handicap by a more efficient tactical management. This compensation is probably not (yet) total, since Paris, with a similar population has a 15-20% greater output. Obviously, the explanatory factors of comparative productivity are many, and this comparison, limited to public transport systems, has ignored most of them.

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Annexe A — Evaluation of capital costs

Tableau A1 - Evaluation des coûts de capital

	Londres	Paris
Valeur du stock de K utilisé		
1) Infrastructures		
Métros et tramways		
Longueur (km)	556	284
dont: tunnels (km)	199	186
Coût unitaire (M€/km)	10	10
Coût supplémentaire tunnels (M€/km)	40	50
Valeur du K hors tunnels (M€)	5560	2840
Valeur du K y compris tunnel (M€)	13520	12140
Trains, y compris RER		
Longueur (km)	2956	1741
dont: tunnels (km)	13	88
Coût unitaire (M€/km)	15	15
Coût supplémentaire tunnel (M€/km)	90	90
Valeur du K, hors supplément tunnel (M€)	44340	26115
Valeur du K, y compris supplément tunnel (M€)	45510	34035
2) Matériel roulant		
Metros & tramway:		
Nombre de rames	834	707
Coût unitaire (M€/rame)	11,3	9
Valeur du K (M€)	9424	6363
Trains, yc RER:		
Nombre de rames	2150	1215
Coût unitaire (M€/rame)	11,3	16
Valeur du K (M€)	24295	19440
Autobus:		
Nombre	12200	8700
Coût unitaire (M€/bus)	0,21	0,21
Valeur du K (M€)	2562	1827
Total valeur du stock de K, yc matériel roulant		
Valeur brute (M€)	95311	73805
Valeur nette (M€)	47656	36903
Coût annuel de l'utilisation du K		
Coût opportunité (à 5%) du capital utilisé (M€)	2383	1845
Amortissements (en M€):		
des métros (sur 30 ans)	185	95
des trains (sur 37 ans à Londres, 30 à Paris)	1198	871
des rames de métro (sur 30 ans)	314	212
des rames de trains (sur 30 ans)	810	648
des autobus (sur 10 ans)	256	183
Total amortissements	2764	2008
Total coût annuel d'utilisation du K (M€)	5147	3853