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Capital Stock and Productivity in French Transport : An International Comparison

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SUMMARY

The efficiency of service providers is often approximated by labour productivity. This partial measure is considered as a proxy of overall efficiency as many services use relatively little capital. However, in many services such as transport, capital is a major production factor. To judge the overall efficiency of these services, labour productivity measures should therefore be complemented by measures of capital and total factor productivity (TFP). For France, to date capital productivity and TFP could not be estimated for individual branches of transport as no capital input estimates were available at this level.

This paper aims to fill this gap by providing new detailed estimates of capital input in French transport from 1970 onwards. These data are used in combination with series on output and labour input to estimate productivity. Finally, the French performance is compared with that of Germany, the United Kingdom and the United States.

In contrast to many other studies on productivity, the contribution of capital to production is *not* measured by the value of the stock of assets but by the volume of services rendered by this stock (as employed in Jorgenson *et al*., 1987). An inconvenience of using (gross or net) capital *stocks* for productivity analysis is that all other variables (such as value added and hours worked) are *flows*. Capital services are the flows of a capital good into production. Capital services are the product of the quantity of capital (supposed proportional to the net stock) times the rental price of capital (the sum of depreciation, the real interest rate and capital gains).

Ideally the way to measure net capital stocks is by comprehensive direct surveys. Contrary to for example the Netherlands, no such surveys exist in France. The second best method, also used in this study, is the perpetual inventory method (PIM) which sums several years of capital formation and deducts assets that reached the end of their service life. Detailed series were compiled of acquisitions and sales of capital assets in eight different parts of transport, showing for each a breakdown into infrastructure, transport equipment, and other machinery and equipment.

In various parts of transport, producers increasingly lease or rent transport equipment instead of buying them. In air transport for example, in 1998 more than 80 per cent of the new aircraft were leased. For the purpose of productivity analysis, capital stock estimates should include not only owned assets, but also those which are rented and leased for more than one year. However, national accounting conventions imply that the PIM frequently fails to include non-owned assets. In the branches where leased and rented transport equipment were the most common, e.g. air and maritime transport, registers were used instead of the PIM as the former allows to account for non-owned assets.

In the second part of the paper productivity results are presented. Labour, capital and total factor productivity is estimated using the Tövrnqvist discrete approximation to the Divisia index. Between 1970 and 1997, labour productivity grew fastest in air and maritime transport. On the contrary, trucking, urban and interurban passenger transport, and transport services performed poorly. In the 1970s and the 1990s, capital productivity fell in

all branches except air and maritime transport. In the 1980s, all branches showed minor capital productivity gains. Air and maritime transport also showed the best TFP performance. In the past decades, the good performance in air transport was accompanied by an increase in capital services and employment. In maritime transport, on the contrary, labour and capital inputs fell sharply.

The variance of productivity patterns across transport sectors found in France was not unique, as illustrated by a comparison with Germany, the United Kingdom and the United States. Overall productivity gains in the Germany and the United Kingdom were similar to those in France. The three European countries outperformed the USA. At the sectoral level, it turns out that air transport was the branch with the highest growth rates of capital productivity in all countries. The USA was the only country with large productivity gains in railways. France outperformed other countries in terms of productivity growth in air and maritime transport. In the other branches, productivity growth in France was below that of the other countries.

JEL Classification : D24, L91

Keywords : Transport, Capital Stock, Total factor productivity, France, International comparisons.

RÉSUMÉ

L'efficacité des producteurs de services est souvent approchée par la productivité du travail. Cette mesure, partielle, est alors considérée comme un bon indicateur de l'efficacité globale des prestataires dans la mesure où de nombreux services utilisent relativement peu de capital. Cependant, dans certaines activités de services, tels que les transports, le capital est un facteur de production essentiel. En conséquence, juger de l'efficacité globale dans ces services suppose de compléter les mesures de productivité du travail par celles relatives au capital et à la productivité globale des facteurs. En France, la productivité du capital et la productivité globale des facteurs ne peuvent être estimées pour chacun des secteurs de transport en raison de l'indisponibilité d'estimations du capital utilisé dans la production.

L'objectif du présent travail est de combler ce déficit en proposant de nouvelles estimations détaillées du facteur capital mobilisé dans la production des services de transports en France. Ces données sont exploitées, en association avec des statistiques relatives aux productions et au facteur travail, afin d'estimer les productivités. Enfin, les résultats enregistrés par la France sont confrontés avec ceux des mêmes activités en Allemagne, au Royaume-Uni et aux Etats-Unis.

A la différence de plusieurs autres études sur la productivité, la contribution du capital à la production n'est pas ici mesurée à partir de la valeur du stock des actifs mais par le volume de services rendus par ce stock. En d'autres termes, la méthode mise en œuvre est celle de Jorgenson et ses collaborateurs. Un inconvénient majeur du recours aux stocks de capital - brut ou net – en vue d'une analyse des productivités réside dans le fait que toutes les autres variables sont des flux : valeur ajoutée, consommations intermédiaires et heures travaillées. Certes, les changements dans le stock brut ou net, peuvent être vus comme des flux, mais ce sont alors des flux de premier ordre alors que les changements dans les autres variables sont des flux de second ordre. Afin d'étudier la productivité, l'intérêt se porte donc non pas sur le stock de capital mais sur les services rendus par ledit stock de capital. Les services du capital sont mesurés par le produit entre du volume de capital, approché par le stock de capital net et son coût d'utilisation. Ce dernier étant estimé à partir de la somme des dépréciations, le taux d'intérêt réel et les gains du capital.

Les enquêtes directes sont les voies préférables pour mesurer les stocks nets de capital. Cependant, à la différence par exemple des Pays-Bas, de telles enquêtes ne sont pas conduites en France. La meilleure approche est alors de recourir à la méthode de l'inventaire permanent qui a pour principe d'additionner plusieurs années de formation de capital et de déduire les actifs ayant atteint la fin de leur durée de vie. Dans le cadre de la présente étude, sont utilisées les statistiques relatives aux investissements et aux déclassements de huit catégories différentes d'activités de services. Pour chacune d'elles, une désagrégation entre les infrastructures, les équipements de transports et les autres machines et équipements est pratiquée.

Toutefois, la méthode de l'inventaire permanent produit des résultats avec des biais dans les secteurs caractérisés par une proportion importante de rotation des actifs de capital et par un taux élevé d'actifs loués ou en crédit bail. Dans diverses activités de transports les producteurs utilisent de plus en plus de capitaux loués ou en crédit au lieu de les acquérir. Par exemple, en 1988, plus de 80 pour cent des nouveaux avions entrant dans le stock du secteur des transports aériens étaient des actifs en crédit bail. En conséquence, étudier la productivité suppose d'estimer le stock de capital comprenant non seulement les actifs possédés mais également ceux qui sont loués ou en crédit bail. Pour ce faire, une autre méthode a été utilisée dans les transports maritime et surtout aérien, c'est-à-dire les branches où les actifs loués et en crédit bail sont les plus importants.

Les résultats relatifs aux productivités obtenus sont présentés dans le deuxième partie du travail. La productivité globale des facteurs est estimée à partir des indices Tövrnqvist. Au cours de la période sous étude, à savoir 1970 – 1997, la productivité du travail s'est accrue plus vite dans les secteurs maritime et aérien. A l'opposé, le transport routier de marchandises, le transport urbain et interurbain de passagers et les services annexes aux transports montrent des résultats beaucoup plus modestes. Dans toutes les branches, à l'exception du maritime et de l'aérien, la productivité du capital enregistre une tendance à la baisse sur toute la période même si les années quatre-vingt sont marquées par une légère croissance. Les activités de transports aérien et maritime ont également les meilleures performances dans la productivité globale des facteurs.

La diversité de l'évolution des productivités entre les secteurs constatée dans le cas de la France, ne lui est pas spécifique ainsi que le montre les comparaisons avec l'Allemagne, le Royaume-Uni et les Etats-Unis. En effet, s'il est vrai que les gains de productivité globaux dans les deux autres pays européens, sont similaires à ceux de la France, il est vrai également que le transport aérien y apparaît comme le secteur avec les plus grands gains de productivité. Les pays européens ont en général des résultats supérieurs à ceux des Etats-Unis, où le transport ferroviaire est celui avec les gains de productivité les plus élevés. La France enregistre ses meilleures performances relatives en termes de croissance de productivité dans les transports aérien et maritime.

Classification JEL : D24, L91.

Mots clés : Transport, stock de capital, productivité total des facteurs, France, comparaisons internationales.

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CAPITAL STOCK AND PRODUCTIVITY IN FRENCH TRANSPORT: AN INTERNATIONAL COMPARISON

***Bernard Chane Kune and Nanno Mulder*[1]**

INTRODUCTION

Until the late 1980s, many parts of French transport operated in a relatively protected environment, as they were either state-owned or/and they were sheltered against competition from foreign firms. The competitive environment has substantially changed over the past decade, as state-owned enterprises were (partly) privatised and foreign firms were increasingly allowed to compete with French transport firms. Under these new circumstances, the French firms are under a much stronger pressure to increase their performances, of which productivity is an essential part.

The efficiency of transport firms is often approximated by labour productivity. This partial measure is considered as a proxy of overall efficiency as many services use relatively little capital. However, in many services such as transport, capital is a major production factor. To judge the overall efficiency of these services, labour productivity measures should therefore be complemented by measures of capital and total factor productivity (TFP). For France, to date capital productivity and TFP could not be estimated for individual branches of transport as no capital input estimates were available at this level.

This paper aims to fill this gap by providing new detailed estimates of capital input in French transport from 1970 onwards. Ideally the way to measure net capital stocks is by comprehensive direct surveys. Contrary to for example the Netherlands, no such surveys exist in France. The second best method, also used in this study, is the perpetual inventory method (PIM) which sums several years of capital formation and deducts assets that reached the end of their service life. Detailed series were compiled of acquisitions and sales of capital assets in eight different parts of transport, showing for each a breakdown into infrastructure, transport equipment, and other machinery and equipment. In addition to the PIM, we also used administrative records to measure the stock of aircraft and maritime vessels. These records were used instead of the PIM as the only the former allows to take fully account of non-owned, i.e. leased and long term rented, assets.

The capital input data are used in combination with series on output and labour input to estimate productivity. The comparison of the productivity performances between branches fails to account for the fact that technological progress, and as a result productivity gains, strongly differ between sectors of transport. Therefore, we also compared France with three other countries, Germany, the UK and the USA, in order to confront the French performance in a particular transport sector with that of comparable countries.

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This paper is organised as follows. Section one presents an overview of the different measures and methods of capital input, of which the perpetual inventory method (PIM) and registers are retained for this study. For the PIM, special attention is paid to the measurement of service lives, retirement and depreciation patterns, the estimation of the benchmark stock, as well as the treatment of leased and rented assets. Section two deals with the measurement of capital formation and capital stocks in France using the PIM. The measurement of the stock of aircraft in France using administrative records is presented in section three. Section four combines the results for France with those of Germany, the United Kingdom and the United States to measure labour, capital and total factor productivity, followed by a conclusion.

1. MEASURES AND MEASUREMENT OF CAPITAL

1.1. The Scope of Gross Fixed Capital Formation

The scope of data on capital formation is sometimes very narrow (see for example the Australian Bureau of Industry Economics, 1995c) and limited to fixed capital goods, whereas official recommendations such as the System of National Accounts[2] include a much wider range of assets, such as natural resources and intangible capital such as patents, purchased goodwill and computer software. In this study, we adopted the definition of gross capital formation of FIXED ASSETS of the System of National Accounts (1993): the value of acquired assets by resident production units used at least for one year in the production process; as well as incorporated goods and services in existing fixed capital goods. Excluded from capital formation are expenses related to research and development and marketing. Three major categories of fixed capital goods can be distinguished: (a) residential structures such as houses and apartment buildings, and non-residential structures such as office and apartment buildings and infrastructure; (b) machinery and (transport) equipment; (c) miscellaneous investments such as:

- goods and services incorporated in capital goods aimed to lengthen the asset life or improve the productive capacity of the assets such as major maintenance. Current maintenance is excluded from investment and included in intermediate expenses.
- additions to the existing capital goods resulting from mergers and acquisitions of firms;
- expenses linked to the acquisition of capital goods, such a notary costs and value added tax (VAT);
- intangible fixed assets such as computer software (excluding research and development).

1.2. Measures and Methods

1.2.1. The Contribution of Capital to Production: Stocks or Services

[2] A manual aimed at harmonising the construction of national accounts prepared by a working group of various international organisations such as the United Nations, Eurostat and OECD.

A controversial issue in the national accounts and productivity analysis is whether the contribution of capital stock to production is best measured by the gross stock, the net stock or by the services rendered by the capital stock. The gross stock equals the value of all fixed assets in use evaluated as if they were new, i.e. without taking account of obsolescence, depreciation, deterioration and price changes. The gross stock concept has been used in prior studies on productivity which assumed that the productive capacity of assets remains constant over time. This seems realistic for some goods such as computers. However, the productive capacity of most assets decreases over time and so gross stock may not be a very useful concept. At best the gross stock is an intermediate statistical measure which is used to estimate net capital stocks. Gross stocks can be measured by either physical measures, administrative records and the perpetual inventory method (PIM).

The net capital stock equals the gross stock less depreciation or the decline in value of the assets as they age. Net stocks can be estimated by either balance sheets or the PIM.

A disadvantage of using (gross or net) capital stocks for productivity analysis is that all other variables (such as value added, intermediate consumption and hours worked) are flows. The dimensions of the variables are therefore inconsistent. Productivity analysis focuses on *changes* in output and *changes* in inputs. Changes in gross or net stocks may be viewed as flows, but in fact these are first-order flows, as they indicate changes in *stocks*, whereas the others variables are of the second-order indicating changes in *flows*. Instead of stocks, we should use the second-order flow concept of *services* rendered by the capital stock to production.

1.2.2. How to Measure Capital Stocks and Services?

Physical Measures

Gross capital stock can be approximated by physical measures. For example in transport, one could use the length of canals, the number of ports and airports, the surface of office buildings and the number of trucks and buses. Data on physical measures are often readily available in most countries. For historical analyses, especially in the pre World War II period, capital formation data are also often restricted to physical measures.

The major inconvenience of physical measures is that they are not additive and it is therefore impossible to estimate aggregate capital stocks. Moreover, physical measures do not allow the distinction between different vintages, each having a different technology, within a capital stock. Therefore one has to assume that all capital goods are strictly identical in terms of productive capacity. This seems very unrealistic.

Administrative Records

Another way to estimate gross stocks is the use of administrative records. In many countries records exist of most types of transport equipment such as aircraft, buses, ships, and trucks. These records can be used to measure the stock in one year as well as flows of investment and discards. In combination with data on asset prices, the build year of assets and price deflators, the value of gross stocks can be estimated.

Balance Sheets

Balance sheets are frequently used to estimate the value of net stocks as they register assets on a net basis. For corporate firms, these are readily available. Unfortunately balance sheets have various disadvantages which render their use almost impossible. Firstly, companies register assets at their historical values which means that the capital stock is valued at a mixture of prices. Moreover, depreciation is estimated using fiscal accounting principles. Fiscal depreciation rates are generally larger than economic depreciation rates. This means that even though the residual value of assets equals zero according to tax authorities, assets continue to be used in production. Moreover, accounting rules vary from country to country and net stocks on this basis therefore are not internationally comparable. From balance sheets it is also difficult to know the vintages of which the capital stock is composed.

Surveys

Questionnaires can be used to ask firms to report historic values of their assets and the dates when they were installed. Assets are subsequently re-valued to constant prices using revaluation coefficients. An advantage of surveys, contrary to other methods, is the possibility of including leased assets. The reliability of the surveys depends on the quality of the survey procedures and the ability of firms to supply the necessary information.

Within the OECD, surveys are used in Japan, Korea and the Netherlands. In the latter country, representatives of the statistical office visit firms as mail questionnaires give little satisfactory results. Due to the high costs of this method, the survey is carried out only once every five years. Stocks in intermediate years are estimated using the PIM. Often large discrepancies were found between PIM projections and survey results. These inconsistencies are interpreted as shortcomings of PIM and in particular the adopted asset live assumptions. However, the survey method is not without problems either, as firms often do not register small amounts of investments, alterations to existing assets, and whether the assets are new or second hand.

Perpetual Inventory Method

As the most relevant concept for productivity analysis is the net capital stock, physical measures and administrative records are unsuitable as they allow only the evaluation of the gross stock. Values listed on balance sheets are a net measure, but also unsuitable for the reasons outlined above. The best measurement method is therefore direct surveys. However, in most countries, such as France, these surveys are not carried out. As a second-best solution the ”perpetual inventory method” (PIM) is used. The PIM sums several years of investment and deducts assets that have reached the end of their service life.

The PIM has been developed by Raymond Goldsmith (1951) in the United States. It has subsequently been used by growth accountants such as Simon Kuznets (1957), Edward Denison (1967) and Angus Maddison. In France, this method has been introduced by Jacques Mairesse at the INSEE in the early 1970s (see Mairesse, 1972).

The PIM has several advantages. Firstly, the PIM requires investment data which are more easily available than capital stock data. Secondly, the PIM produces many characteristics on capital stocks, such as gross stocks, capital consumption, net stocks and the average age of capital assets. Thirdly, the PIM is simple to apply and is fully transparent. Finally, identical retirement and depreciation patterns render capital stocks internationally comparable.

A major inconvenience is that the application of the PIM requires various assumptions on the length of asset lives, retirement and depreciation patterns which are often not very robust. Moreover, the PIM produces biased stock estimates when firms sell investment goods before they reach the end of their service life. This occurs often in the case of transport equipment. To account for this, Gillen *et al.* (1985), INSEE (1994) and O'Mahony (1999) propose to use real net (e.g. investment minus the sale of assets[3]) instead of gross investment series. A drawback of this method is that the price deflator used for sold assets differs from the deflator used for the initial investments, which may bias the results. Moreover, the value of the assets sold corresponds to the second-hand market value which differs from the economic value of the asset as estimated by the PIM.

Below the PIM is explained in more detail.

Capital Services Approach

Many growth accountants such as Edward Denison and Angus Maddison have assumed that services are proportional to the size of the capital stock. This is not realistic. A possible solution is the use of the depreciation instead of the capital stock. This is insufficient as it leaves out the net return of capital assets[4]. The best-known approach that

[3] The sale of assets before they reached the end of the asset life is also referred to as *disposals*.

[4] The value of an asset equals the sum of services rendered over its expected service life (assuming a scrap value equal zero): $V_t = \sum_t^T \frac{f_t}{(1+r)^t}$; (1), where V_t equals the value of the asset; f are the capital services of each period from t to T; service flows are discounted by the interest rate r ; (1) can be rewritten as $V_t = \frac{f_t}{(1+r)} + \frac{f_{t+1}}{(1+r)^2} + + \frac{f_T}{(1+r)^T}$ (2). The value of V_t in the next period equals $V_{t+1} = \frac{f_{t+1}}{(1+r)} + \frac{f_{t+2}}{(1+r)^2} + + \frac{f_T}{(1+r)^{T-1}}$ (3). Dividing (3) by (1+r) gives: $\frac{V_{t+1}}{(1+r)} = \frac{f_{t+1}}{(1+r)^2} + \frac{f_{t+2}}{(1+r)^3} + + \frac{f_T}{(1+r)^T}$ (4). Subtracting (4) from (2): $V_t = \frac{V_{t+1}}{(1+r)} = \frac{f_t}{(1+r)}$ equals

uses capital services to measure the contribution to production is that used by Jorgenson and his collaborators, which is outlined below. He measures the volume of capital services using the net capital stock as estimated by the PIM.

1.3. Perpetual Inventory Method

The PIM is one of the most frequently used methods to estimate capital stocks, e.g. the summing of several years of investments and the deduction of investments that have been discarded:

$$K_t = \sum_{t=0}^{s} d_t I_{t-t} \qquad (1)$$

where K_t equals the capital stock at year *t*; I_t investment at year *t*; and d_t is the relative efficiency weight (e.g. the combination of retirements and depreciation) attached to each year's investment and *s* the maximum service life. The application of PIM requires assumptions on service lives, retirement and depreciation patterns. The literature often distinguishes between gross and net stocks. The gross stock equals the sum of past investments still in existence and does not account for depreciation, i.e. the loss of productive value due to use, obsolescence, damage and ageing. For the gross stock, the age composition of the stock is irrelevant as each asset is supposed to have the same productive capacity. The net stock equals the gross stock minus the value of depreciation on the vintages in the gross stock. Assumed retirement and depreciation patterns strongly differ across studies, as discussed below.

1.3.1. Service lives

The economic service life is the period an asset is used in production. Technical progress or changes in fiscal laws may induce firms to withdraw an asset from production before it is technically worn out. This means that the economic service life is below the technical one. Assumptions on service lives strongly differ between OECD countries, as illustrated by Tables 1.A to 1.D. In the 1980 version of the French national accounts, assumed asset lives only varied between assets, e.g. 13 years for machinery and equipment and 40 years for buildings and other structures, but not across sectors. France adopted shorter service lives than Australia and the UK, but longer ones than Belgium.

Studies on transport often assume different service lives than national accounts. For aircraft in Canada, Gillen *et al.* (1985) assumed an asset life of fifteen years compared to ten years by Statistics Canada. For infrastructure in French railways, canals and ports, Quinet *et al.* (1994) also suggest longer service lives than INSEE.

$f_t = V_t - V_{t+1} + rV_t$ (6) Since $V_t - V_{t+1} \equiv D_t$ (depreciation in year *t*); (6) can be rewritten as $f_t = (d_t + r)V_t$.

1.3.2. Retirement patterns

The decline in the productive capacity of an asset when it ages is described by retirement or decay patterns. A capital asset may require more inputs when it ages without losing its productive capacity (input decay). It is also possible that the volume of productive services produced decreases over time (output decay). Some studies assume that capital goods suffer neither from input nor from output decay. The retirement of these assets follows a so-called one-hoss shay pattern. The asset is scrapped completely at the end of its service life.

More often assets are not retired instantaneously but instead some are withdrawn before and some after the average service life. This is especially the case for heterogeneous asset categories. To spread discards, formula (1) (O'Mahony, 1999) can be rewritten to:

$$K_t = \sum_{t=0}^{s+m+1} I_{t-t} + \sum_{s+m}^{s-m} d_t I_{t-t} \qquad (2)$$

Several patterns are used to spread discards. In France, the national accounts use log-normal functions as estimated by Mairesse (1972). These functions require assumptions on the average service life as well as the standard deviation. The US national: accounts (BEA,1993) used until recently adapted S-3 Winfrey[5] curves for non-residential and residential capital. This curve follows a bell-shaped distribution centered on the average service life. For durable consumer goods, the BEA used the Winfrey L-2 curve, which is asymmetrical (e.g. large discards before the average service life and small ones

[5] Robley Winfrey, an engineer of the Iowa Engineering Experimentation Station, collected information on dates of installation and retirement of 176 groups of industrial assets during the 1930s. He calculated 18 "type" curves representing their retirement patterns. Winfrey curves are one of the few retirement patterns based on extensive empirical reasearch.

Table 1.A: Average service lives of machinery and equipment (excluding vehicles) (years)

	Canada	United States	Japan	Australia	Belgium	France	Germany	Iceland	Norway	Sweden	United Kingdom
Railways	28	27	-	30	15	13	23	-	12	35	25
Road: passenger	10	15	-	-	15	13	11	-	15	-	25
Road: freight	10	11	-	-	15	13	11	-	15	-	25
Air: aircraft	10	16	-	18	15	13	11	14	15	-	8
Air: airports etc.	10	-	-	18	15	13	11	-	-	-	15
Water: vessels	35	27	-	19	15	13	21	-	17	-	10
Water: harbours, docks, canals	-	-	-	19	15	13	-	-	25	40	25
Warehousing	25	11	10	-	15	13	-	-	15	-	25

Table 1.B: Average service lives of buildings and other construction separately (years)

	Buildings						Engineering construction				
	Canada	United States	Finland	Italy	Norway	Sweden	Canada	United States	Finland	Norway	Sweden
Railways	50	47	-	-	75	80	55	51		75	75
Road: passenger	50	38	-	-	-	60	55	31		-	80
Road: freight	60	38	-	-	-	60	65	31		-	80
Transport by air	40	39	-	-	75	75	50	31		-	80
Transport by water	50	39	-	-	-	-	50	31		75	80
Warehousing	50	38	-	-	-	-	-	31		-	80

Table 1.C: Average service lives of buildings and other construction (years)

	Australia	Belgium	Germany	France	Iceland	United Kingdom
Railways	67	30	41	40	-	100
Road: passenger	-	30	43	40	75	50
Road: freight	-	30	43	40	75	50
Transport by air	32	30	43	40	75	40
Transport by water	48	80	43	40	45	20
Warehousing	-	-	-	-	45	50

Table 1.D: Average service lives of other fixed assets (years)

	Canada	United States	Belgium	Finland	France	Germany	Iceland	Norway	Sweden	United Kingdom
Other ships	35	27	15	10	22	26	37	-	-	20
Buses	10	14	7	10	10	10	14	7	6	10
Rolling stock	28	28	15	10	25	34	14	35	35	30
Road freight vehicles	10	10	7	10	10	8	14	7	3	10
Aircraft	10	16	15	10	16	10	14	15	15	10

Source: OECD (1993).

afterwards). In contrast the UK statistical office assumes a uniform distribution around the average service life.

1.3.3. Depreciation patterns

Depreciation is the decline in value of an asset as it ages. Financial depreciation refers to the decline in value whereas retirements (decay, discards) correspond to a fall in productive capacity. A number of different depreciation patterns have been used in the literature. The most common is straight-line depreciation corresponding to a smooth deterioration over the life of an asset, i.e. depreciation in the first year is the same as that in the second, which equals that in the third, etc.:

$$\boldsymbol{d}_{s,SL} = \frac{1}{1-(s-1)} \tag{3}$$

where $\boldsymbol{d}_{,SL}$ is the straight-line depreciation rate and s the asset life. The annual depreciation $d_{s,SL}$ equals:

$$d_{s,SL} = 1/s \tag{4}$$

The national accounts of various countries such as France have adopted linear depreciation.

Geometric deprecation is also frequently used, and is an accelerated pattern, i.e. the depreciation in the first year is higher than in the second year, which in turn is higher than that in the third, etc (Jorgenson, 1987, Hulten and Wykoff; 1981). The rate of depreciation δ_G depends on the declining balance rate R and the asset's service life s:

$$\boldsymbol{d}_G = \frac{R}{s} \tag{5}$$

$\boldsymbol{d}_G$ is constant over the asset's lifetime. Depreciation $d_{s,G}$ equals:

$$d_{s,G} = \boldsymbol{d}_G (1-\boldsymbol{d}_G)^{s-1} \tag{6}$$

The higher is R, the higher the geometric rate of depreciation $\boldsymbol{d}_G$, and the higher the depreciation in the early years of an asset's service life. The use of a declining balance rate equal to one is also referred to as the single declining balance method. Christensen and Jorgenson (1969) adopted the double declining balance method (e.g. R = 2). The replacement rate equals 2/s.

A drawback of geometric depreciation is that after the end of the service life of an asset, a very small share (going to infinity) of the asset value remains in the stock. Some authors have redistributed this residual value over the depreciation in the earlier years so that the remaining value after the expiration of the service life equals zero. This solution was not adopted here, as it complicates the mathematics and the calculations. Moreover, the residual value is too small to bias the net stock estimates.

Several studies, cited by Fraumeni (1997), found that geometric depreciation corresponds closely to the evolution of prices of used assets. These studies, including some on transport equipment[6], collected price data from second-hand markets, dealers, insurance records and rental companies. Another advantage of geometric depreciation is that is method is easily applicable (see O'Mahony, 1999). The relative efficiency function is $d_\tau = (1-d_G)^\tau$. Substituting this in equation (1) gives:

$$K_t = I_t + (1-d)K_{t-1} \qquad (7)$$

1.3.4. Estimation of the Benchmark Stock

The application of the PIM methodology is often limited by the availability of investment series. Data on capital formation do often not go back much further than the period for which one would like to estimate the capital stock. This complicates the measurement of the initial year stock using the PIM. Two alternatives are available to measure benchmark stocks, Firstly, book values of the capital stock, as derived from balance sheets, can be used. Harberger (1978) proposed another shortcut method which requires the average annual investment I_t and GDP growth γ over the period for which investment data are available, and an assumption on the depreciation rate d Subsequently, the capital stock at the starting year t is implicitly derived by:

$$I_t = (\delta + \gamma)K_{t-1} \qquad (8)$$

1.3.5. Treatment of leased and rented assets

Since the 1970s, transport firms increasingly lease or rent capital assets instead of buying them. Often, like in the American national accounts, only owned assets are included in the capital stock. However, in productivity analysis all assets used in production should be considered including leases and long-term rentals. This practice was adopted by the British national accounts since 1987 as well as the French national accounts. For countries which adopted the principle of capital ownership like the United States, leased and rented assets can be transferred from the sector of ownership to the industry of use on the basis of assumptions on which sectors leased the assets (see O'Mahony, 1999[7]).

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[6] E.g. Hall (1971) and the Office of Tax Analysis (1991) on trucks and Cockburn and Frank (1992) on oil tankers.

[7] For example, she assumed for the USA that 80 per cent of aircraft and ships owned by the financial sector were leased to the transport sector and re-allocated them accordingly.

1.4. Capital Services Approach[8]

This approach is an extension of the PIM. Its most well known proponent is Prof. Dale Jorgenson at Harvard University. The main difference is that according to the PIM the contribution of capital to production is best measured by the value of the stock, whereas according to Jorgenson it is not the stock itself, but the *services* rendered by the stock that matter. The advantage of measuring capital input by services instead of stocks is that the flow dimension of the former is coherent with the other variables in productivity analysis, i.e. gross output or value added , intermediate inputs and labour input.

Capital services have both a quantity and a price component. Ton kilometres provided by trucks or square meters of storage space provided by a warehouse are paid by a user cost or rental price of capital. Services of some capital goods, such as aircraft, buildings, cars, and trucks, are traded between asset owners and producers who need to use them on a lease market. However, most capital services are produced for own consumption and there is no explicit market transaction. In general it is not possible to observe quantities and prices of capital services. Capital differs in this respect from labour as for the latter the remuneration (market wages) can be observed. User costs represent the amount of rent charged in order to cover the cost of *q* monetary units worth of assets.

Fortunately, economic theory (see Jorgenson and Griliches, 1967; Jorgenson *et al*., 1987; Hulten, 1990) provides the main elements of the user cost of capital:

- an *internal rate of return*, which is the value of an asset times a rate of return. The rate of return accounts for the opportunity cost of using capital elsewhere than in production. Opportunity costs and rates of return are equal in equilibrium;
- *depreciation*, represents the loss of value of an asset as it ages;
- *capital gains or losses*, i.e. the change in the value of an asset due to a increase or a decrease in the price of an asset which are unrelated to ageing. Capital gains or losses are measured by the change in the price of a new asset from t to t+1.

In summary, the user cost of capital or service price S_t is determined as follows:

$$S_t = \left(\frac{1 - u_t z_t - k_t}{1 - u_t} \right) \left[q_{t-1} r_t + q_{t-1} d - (q_t - q_{t-1}) \right] + q_t T_t \qquad (9)$$

where:

u_t = corporate tax rate at year t

[8] The presentation of capital services is based on Jorgenson's joint 1969 article with Christensen, see also Gilles *et al.* (1985) and Jorgenson *et al.* (1987).

z_t = resent value of depreciation deductions for tax purposes on one currency unit's worth of investment over the life-year of the investment at year t

k_t = nvestment tax credit at year t

q_t = asset price index at year t

r_t = opportunity cost of capital at year t

d = depreciation rate of asset reflecting economic life

T_t = property tax rate at year t

The first term is brackets corresponds to the rate of return, the second to depreciation, and the third to the capital loss or gain of the asset. In summary, to determine the service price, one should take account of the corporate income tax, savings in corporate income tax due to capital cost allowances, investment tax credit, rate of return of the asset, economic depreciation, capital gains or losses due to asset price changes, and the property tax rate.

1.5. Sectoral Studies

1.5.1. Specifics of Transport

The transport sector differs from other sectors in several respects. Firstly, transport companies often sell transport equipment before their asset life ends. When this is not accounted for, the stock estimates overstate the true value of the stock. Secondly, a growing share of transport equipment is no longer owned by transport firms but leased or rented. If this is not considered, the capital stock used in production will be underestimated.

Currently a number of studies on the estimation of capital stocks in transport have been undertaken by researchers in Australia, Canada, the United States and France, as discussed below. Table 2 summarises these studies.

1.5.2. The Canadian Centre for Transportation Studies

Over the past two decades, the University of British Columbia's Centre for Transportation Studies has produced several studies dealing, amongst other issues, with the measurement of the capital stock in Canadian air and railway transport. The methodology used is based on Chistensen and Jorgenson (1969). Gillen *et al.*'s (1985) study on Canadian aviation distinguished eight types of capital assets. The volume of

Table 2: Overview of Studies on Capital Formation and Capital Stocks in Transport

Author	Countries	Sectoral detail	Types of assets	Period	Methodology	Retirement pattern	Depreciation pattern	Remarks
Pereira da Silva (198?)	France	Total of transport only	Infrastructure and transport equipment	1959-1980	Mairesse (1972)	Log-normal function	Linear depreciation	
Lorentz (1987)	France	Routes, public road passenger transport, railways, airlines, airports, waterways, and ports	Infrastructure and transport equipment	1971-85	--	--	--	Investment only
Quinet *et al.* (1994)	France	Roads, railways, urban passenger transport, ports, and canals	Infrastructure only	Investment: 1952-91; stock-1991 only	Log-normal function	Log-normal function	Linear depreciation	
O'Mahony (1999)	France, Germany, Japan, UK & USA	Railways, other inland, water and air; France & Japan: only aggregate	Non-Residential structures, and machinery and equipment	Investment and Stock 1950-96	Fraumeni (1997), Jorgenson *et al.* (1987, 1989)	Spread over several years (NOT "one-hoss shay")	Geometric decay	
Gillen *et al.* (1985)	Canada	Airlines	Eight categories	1963-81	Jorgenson *et al* (1969)	No distinction between gross and net stock; single declining balance method		
Tretheway *et al.* (1997)	Canada	Railways	Three categories: way and structures, equipment and land	1956-91	Jorgenson *et al* (1969)	See Gillen *et al.* (1985)		Incorporation of rented and leased capital
Hooper and Hensher (1997)	Australia	Airports	Non-specified	1988/89-1991/92	PIM	Non-specified	Non-specified	Unclear how PIM was with four years of investment
Bureau of Industry	Australia, Canada, UK	Road freight transport	Trucks and trailers	1992	--	Trucks (5 years), trailers (8 years); at the end of working	Straight-line	This study only calculates capital cost= depreciation

Economics (1992)	and USA					life residual value of 21 per cent of initial purchase cost.		+ opportunity cost of 7 percent.
Bureau of Industry Economics (1992-1995)	Australia, several European countries, Canada USA	Locomotives and freight wagons in railways, vessels in coastal shipping, cranes, berths and loaders in ports, aircraft and seat kilometres in airlines, and runway capacity and gates at airports.		1992-1993	Physical measures only	--	--	

capital services was calculated by the net stock (estimated by the PIM) times its user cost as derived by equation (9). For the estimation of user-costs, the authors used asset-specific data on depreciation, corporate and property tax rates, tax allowances for the deduction of depreciation, interest rates and the net appreciation of assets.

Tretheway *et al*. (1997) estimated the 1956-91 capital stock in railways using the same methodology as for aviation. The authors included owned and leased assets. They distinguished structures, equipment and land. As the productivity of land remains unchanged, depreciation was excluded from its user cost.

1.5.3. The Australian Bureau of Industry Economics

From 1992 to 1995, the Australian Bureau of Industry Economics (BIE) evaluated the performance of rail freight transport, coastal shipping, ports, airlines and airports as part of the project *International Performance Indicators*. For the measurement of capital productivity, the BIE relied mostly on physical measures of the capital stock: locomotives and freight wagons in railways, trucks and trailers in road freight transport, vessels in coastal shipping, cranes, berths and loaders in ports, aircraft and seat kilometres in airlines, and runway capacity and gates at airports. Though physical measures can be relatively easily observed, they can be poor measures of the true capital stock. Moreover, the capital stock in each branch encompasses many more assets than the ones considered by the BIE. In railways, for example, they omitted infrastructure. Physical measures are also unsuitable in estimating capital services.

1.5.4. Capital Stock Estimates in American Transport

The earliest estimates of the capital stock in US transport were made by Ulmer (1960). For the period 1870 to 1950, he estimated stocks for steam railways, street and electric railways, local bus lines and other transport. The final category groups trucking, other motor vehicle transportation, pipelines, water transport, air transport, and transport services. The 1870 stocks were based on book values. Subsequent years were estimated by adding net capital expenditures to the 1870 stock values. Net capital expenditures equalled gross capital expenditures less capital consumption. Gross capital expenditures include investment expenditure, excluding land but including organisation cost, taxes and legal expenses. Capital consumption equals retirements and depreciation. Ulmer did not provide separate estimates for the two but combined them in one estimate of straight-line depreciation.

The country with the most detailed capital accounts since the 1950s is the USA. The BEA (1993, 1999) provides investment and capital stocks for more than sixty branches. For seven branches in transport, the BEA provides a breakdown by six types of transport equipment and five types of non-residential structures. Investment starts in 1929 and stocks in 1947. The 1947 benchmark stocks are based on Ulmer (1960). Until 1997, the BEA estimated gross and net stocks using the PIM. The BEA assumed that retirements were spread according to Winfrey curves and that depreciation was linear. Since the 1997 revision, the retirement and depreciation functions were merged into a combined function of geometric decay and the BEA no longer publishes gross stocks (see Fraumeni, 1997).

2. CAPITAL FORMATION AND CAPITAL STOCK IN FRENCH TRANSPORT

2.1. Delimitation of the transport sector

The transport sector includes many activities, of which the boundaries according to the industrial classifications vary from one country to another. For example, public urban passenger transport is included in transport in most European countries whereas in the USA it is part of the government sector. Sector classifications also classify differently supporting services: Canada and the USA consider airports and ports as part of air and maritime transport respectively, whereas in France these are part of a separate category "supporting services to transport". As this study focuses on France, we adopted the French Industrial Classification (*Nomenclature des activités et des produits*, NAP) to define the boundaries and sectoral breakdown of transport.[9] The French national accounts provide a breakdown into seven sectors (see Appendix 1), even though the NAP is more detailed. For these seven sectors, consistent series on GDP and employment from 1970 onwards are available. For our international comparisons, inland water and maritime transport, as well as road freight transport, road passenger transport and transport services, had to be merged due to a lack of detail in other countries.

Roads, bridges and tunnels are excluded from capital formation in transport, as they are part of capital formation of the central and local governments.

2.2. Sources of Gross Fixed Capital Formation and Capital Stocks

2.2.1. National and Satellite Accounts

The French national accounts, produced by INSEE, publish sectoral capital stock estimates since the early 1970s as pioneered by Mairesse (1972). He presents gross and net capital stock estimates of Non-residential structures and machinery and equipment for 21 sectors for the period 1950-70. No breakdown for transport is provided. Retirements were spread over several years using a log-normal function[10] and depreciation was assumed to be linear.[11] The 1980 revision of the national accounts presently in use in France presents

[9] The NAF replaced the NAP (*Nomenclature d'activité et de produit*) only in the mid 1990s. Long run series are only available in the NAP nomenclature.

[10] For a given year *n*, and an investment *I* with age of *p* years, the retirement *SB(n)* equals $SB(n) = \sum_{p=0}^{n} I(n-p) f(p)$ and the gross stock *CB(n)* equals $CB(n) = \sum_{p=0}^{n} I(n-p)\left[1-\sum_{q=0}^{p} f(p)\right]$.

[11] The depreciation *A(n)* in year *n* equals $A(n) = \sum_{p=0}^{n} I(n-p)g(p)$ and the net stock C*N(n)* equals $CN(n) = \sum_{p=0}^{n} I(n-p)\left[1-\sum_{q=0}^{p} g(p)\right]$.

capital formation by total transport and by government firms in transport [SNCF (railways), RATP (passenger transport in Paris and surroundings), and Air France and Air Inter (air transport)]. From 1970 to 1977, the only asset breakdown available is non-residential structures and machinery and equipment. Since 1977, more detail is provided into 17 asset types. These series are available both at constant and current prices. Currently the INSEE is changing its series and base year to 1995. These new results will become available early 2001.

Another series on investment and disposals is provided by the satellite accounts on transport which are jointly produced by INSEE and the Ministry of Transport since the early 1950s. These accounts provide a breakdown into seven sectors for the 1970s and into six sectors (excluding urban and interurban passenger transport) from 1980 onwards. Before 1970 only partial information is available on investment in railways, road freight transport (vehicles only) and road passenger transport. Since 1980 information is also provided on public investment in infrastructure (railways, urban passenger transport, ports, airports, inland water transport). The satellite accounts also provide series on GDP at constant and current prices, employment and hours worked by sub-sector since 1970.

2.2.2. Firm Data

For the four largest transport firms (SNCF, RATP, Air France, Air Inter), long run investment series were partly derived from company data. The company data of RATP listed in its annual reports are close to those of INSEE. However, this is not the case for the SNCF as the INSEE data are 30 per cent higher than those of the SNCF. The SNCF underestimated investment as they excluded leased equipment and major maintenance. Air France and Air Inter did also excluded leased equipment from their investment figures.

2.2.3. Annual Firm Survey (EAE)

Since the early 1970s, the Ministry of Transport surveys investment undertaken by transport firms annually. This survey presents a breakdown into 18 transport sectors and covers almost the entire sector except railways (included only since 1993) and several transport services. The *Enquête annuelle d'entreprise* shows five types of assets and distinguishes purchases of new and used capital goods. For firms with less than five employees, the only available asset breakdown is transport equipment and other investments. The investment data refer to total acquisitions meaning that disposals have not been deducted. Only the total of disposals is provided by the EAE, without an asset breakdown. It is therefore impossible to derive gross fixed capital formation (e.g. acquisitions less disposals) by asset type.

The EAE and the satellite accounts investment data show important discrepancies. Moreover, the EAE series show major breaks. These discrepancies and breaks originate from frequent changes in sample methods and coverage of the EAE survey. The EAE data are therefore inadequate to construct long run series. However, they were used to disaggregate total investment data of the satellite accounts by asset type.

2.2.4. Administrative Records

The perpetual inventory method yields biased capital stock estimates in sectors which sell most assets before their service life ended, and in industries that rely heavily on leased and rented capital. This is because gross fixed capital formation, which is the main ingredient to the PIM, does not correctly measure discards and rented and leased assets are only partially taken into account.

Air and maritime transport are characterised by a high turnover of their transport equipment. Moreover, these activities rely heavily on leased and rented capital. In these sectors, administrative registers of capital assets were used instead of the PIM. These records permit coherent estimates of capital formation, gross and net stocks, independently of whether assets are owned or not.

2.2.5. Studies on Capital Formation

In France, few studies are available on investment and capital stock in transport covering the period before 1970. Villa (1993) estimated gross fixed capital formation in non-residential structures on the one hand and machinery and equipment on the other in transport (and other sectors) from 1870 onwards. His major source is the *Annuaire Statistique de la France* of INSEE. Toutain (1967) estimated investment at current prices in railways in the nineteenth and first half of the twentieth century. For other sectors, only physical measures of the capital stock are available, such as the length of canals and roads in use and the number of aircraft, ships, and vehicles.

Several studies exist on investment and capital stocks in transport in recent decades. Lorentz (1987) evaluated investment in transport in the period 1971-86. He distinguished infrastructure and transport equipment in public transport activities, and private ports, highways, airports, ports and maritime transport. To convert the series at current prices to constant 1985 prices, he used a single price deflator for capital formation by the French (local and federal) government. The data sources are well documented. He made no capital stock estimates.

Quinet, Roy, Schwartz and Taroux (1994) measure the gross and net stocks of parts of the transport infrastructure (roads, railways, urban passenger transport, ports, and canals) in 1991. They apply the perpetual inventory method by accumulating investments at constant prices from 1950 onwards. The investment series at current prices for all branches were deflated by using the same price index as Lorentz (1987). It is, however, quite unlikely that price increases were the same for all types of infrastructure. The Mairesse (1972) methodology is used to estimate retirements and depreciation. The asset life for each group of assets was estimated as a weighted average of its components. For example, the asset life of non-residential structures in railways is a weighted average of the lives of buildings, surfaces, tracks, electrical wire, signalling equipment and miscellaneous structures.

The construction of series of gross fixed capital formation at current prices on the basis of the sources mentioned above is discussed in detail in Appendix B. For the SNCF and RATP, series start in 1946 and 1950 respectively. For road freight transport, urban and interurban passenger transport (except RATP), inland water transport and transport services, series were constructed back to the early 1950s. Series only start in the 1960s for maritime and air transport. Three asset types are distinguished in this study: non-residential investment (mostly buildings and transport infrastructure), transport equipment, and other machinery and equipment.

A summary of statistical sources on gross fixed capital formation and capital stocks in transport is given in Table 3.

The deflators for the 1970-97 period were extrapolated backwards to 1959 using capital formation deflators for the total economy provided by INSEE. These are broken down by infrastructure, road and rail transport equipment, aircraft and ships, and other machinery and equipment. Finally, the 1959 deflators were extrapolated to earlier years using the deflators used by O'Mahony (1999) which distinguish between infrastructure on the one hand and transport and other equipment on the other.

2.4. Measurement of Gross Stocks

Two methods are used to estimate gross stocks. Administrative records were used to measure the stock of transport equipment in air and maritime transport (see section 3). For all other assets and sectors, we adopted the perpetual inventory method. The PIM requires assumptions on asset lives and retirement patterns. For France, estimates are available only by large groups of asset types but not by sub-sector of transport. Instead we used detailed assumptions by asset type of the Department of Commerce, Bureau of Economic Analysis (1999). These are based on a large body of empirical research and are summarised in Fraumeni (1997). The specific asset-life assumptions were converted to sector-specific asset lives using detailed investment data by sector and asset for the United States (see O'Mahony, 1999). Non-residential structures, transport equipment, and other machinery and equipment consist each of several asset types. Non-residential structures comprise different types of buildings (commercial, industrial, etc.), but also pipelines, railway structures and railway replacement track. Transport equipment distinguishes aircraft, cars, ships, tractors and trucks and buses. The other machinery and equipment category includes communication equipment, different types of computer and office

Table 3: Statistical Sources on Gross Fixed Capital Formation in Transport

Source	Sectoral Detail	Asset Breakdown	Period	Comments
Mairesse (1972)	Total transport only	NRS and ME only	1950-70	Constant prices
INSEE (annually)	Total transport, SNCF, RATP, Air France, Air Inter	Two types until 1977, 17 types since 1977	1970-97	Both constant and current prices
INSEE/ Ministry of Transport (SES) (annually)	Total transport, SNCF, RATP, Air France, Air Inter, road freight transport, inland water transport, maritime transport, air transport	no	1970-97	Current prices only; urban and interurban pas-senger transport excluded
INSEE/ Ministry of Transport (SES) (annually)	Railways, urban passenger transport, ports, airports, inland water transport	Public infrastructure only	1980-97	Current prices only
Ministry of Transport-Annual Enterprise Survey (EAE) (annually)	Very detailed breakdown into 18 sectors; railways and taxis are included since 1993; few transport services are included	Seven types (new and used transport equipment, new and used equipment, land, office buildings and other investements)	1972-97	Current prices only; series show major breaks due to changes in coverage and sampling methods
Firm data (annually)	SNCF, RATP, Air France, Air Inter	Between four and ten types of capital assets	From 1950 or 1970 onwards	Current prices; little information on rented and leased capital and disposals
Toutain (1967)	Railways	Total only	1846-1950	Current prices
Lorentz (1987)	Railways, urban passenger transport, inland water transport, maritime transport, air transport, airports, ports, private highways	Two types only: infrastructure and transport equipment	1971-86	Both and constant and current prices
Quinet *et al.* (1994)	Railways, urban passenger transport, ports, and canals	Infrastructure only	Starting between 1948 to 1970; end 1991	Both and constant and current prices
Airclaims	Air transport	Aircraft only	1960-97	Stock data

equipment, furniture and fixtures. Asset lives for the three asset categories within each sector were calculated as a weighted average. Suppose transport equipment *T* in sector *J* is composed of *i* types of assets, and let *A* equal the asset life for asset *i*. Then the asset life *A* for transport equipment *T* in sector *J* is given by:

$$A_{TJ} = \sum s_{ij} A_{ij} \tag{8}$$

where $s_{ij} = I_{ij} / \sum I_{ij}$ is the share of asset *i* in total real transport equipment investment. The average investment shares for non-residential structures were estimated for the period 1950-97, and for transport equipment and other machinery and equipment for the period 1970-97. The results of the weighting procedures show that asset lives of non-residential structures and other machinery and equipment are similar across sectors. In contrast, service lives of transport equipment are very different across sectors because of the varying composition of this asset group by sector as well as the large differences in service lives of components: trucks (10 years) are the largest part of transport equipment in road goods transport whereas rolling stock (28 years) is the main asset in railways. Our estimates are similar to those of O'Mahony, as the same method and data were used (see Table 4). Small differences are due to the use of US data up to 1994 by O'Mahony and 1997 in this study. The supposed service lives by INSEE, which will be adopted in a new series of wealth estimates to be published in 2000, are considerably longer for non-residential structures (60 years), and somewhat shorter for transport (15 years) and other types of equipment (13 years). Retirements were spread over several years around the average service life of an asset category, as illustrated by formulae (2) of Section 1.

Table 4: Asset Live Assumptions in Transport

<table>
<tr><th rowspan="2">Sector</th><th colspan="3">This Study</th><th colspan="2">O'Mahony (1998)</th></tr>
<tr><th>Non-residential structures</th><th>Transport equipment</th><th>Other machinery and equipment</th><th>Non-residential structures</th><th>Transport and other equipment</th></tr>
<tr><td>Railways</td><td>45</td><td>27</td><td>16</td><td>45</td><td>23</td></tr>
<tr><td>Road passenger transport</td><td>40</td><td>16</td><td>14</td><td rowspan="2">38</td><td rowspan="2">14</td></tr>
<tr><td>Road goods transport</td><td>38</td><td>10</td><td>14</td></tr>
<tr><td>Water transport</td><td>39</td><td>26</td><td>13</td><td>38</td><td>24</td></tr>
<tr><td>Air transport</td><td>39</td><td>20</td><td>13</td><td>39</td><td>15</td></tr>
<tr><td>Transport services</td><td>36</td><td>25</td><td>12</td><td>39</td><td>12</td></tr>
<tr><td>TOTAL</td><td>42</td><td>17</td><td>14</td><td>43</td><td>17</td></tr>
</table>

Source: Dept. of Commerce, Bureau of Economic Analysis (1999) and O'Mahony (1998).

Gross capital stocks are thus obtained by summing gross fixed capital formation over the life of assets. The major results, in terms of the sectoral composition of capital stocks, are presented in Figure 1. Railways and transport services (among which airports, ports, toll highways) account for the largest part of the gross capital stock of infrastructure (see panel A). Their shares changed little over time. The share of RATP has risen and that of air transport declined somewhat over the past decades. The composition of the stock of transport equipment changed radically with rising shares of air transport and trucking and declining shares of maritime and inland water transport (see Panel B). The stock of other equipment is dominated by railways; airlines is the only branch that increased its share.

2.5. Measurement of Net Stocks

Net stocks take account of the wear and tear of use over the live of an asset. They equal gross stocks minus depreciation. Among the large variety of depreciation functions, the one retained here is geometric depreciation, as presented by formula (7) in Section 1. As no detailed data are available on depreciation patterns of assets in French transport, detailed depreciation rates provided by Hulten and Wykoff (1981) and Fraumeni (1997) were transformed into sectoral depreciation rates in the same way as was done to estimate sectoral service lives. For this purpose, A_{ij} was replaced in formula (8) by asset specific depreciation rates D_{ij}. The depreciation rates by sector and asset group used here are similar to those of O'Mahony (1999) as illustrated in Table 5.

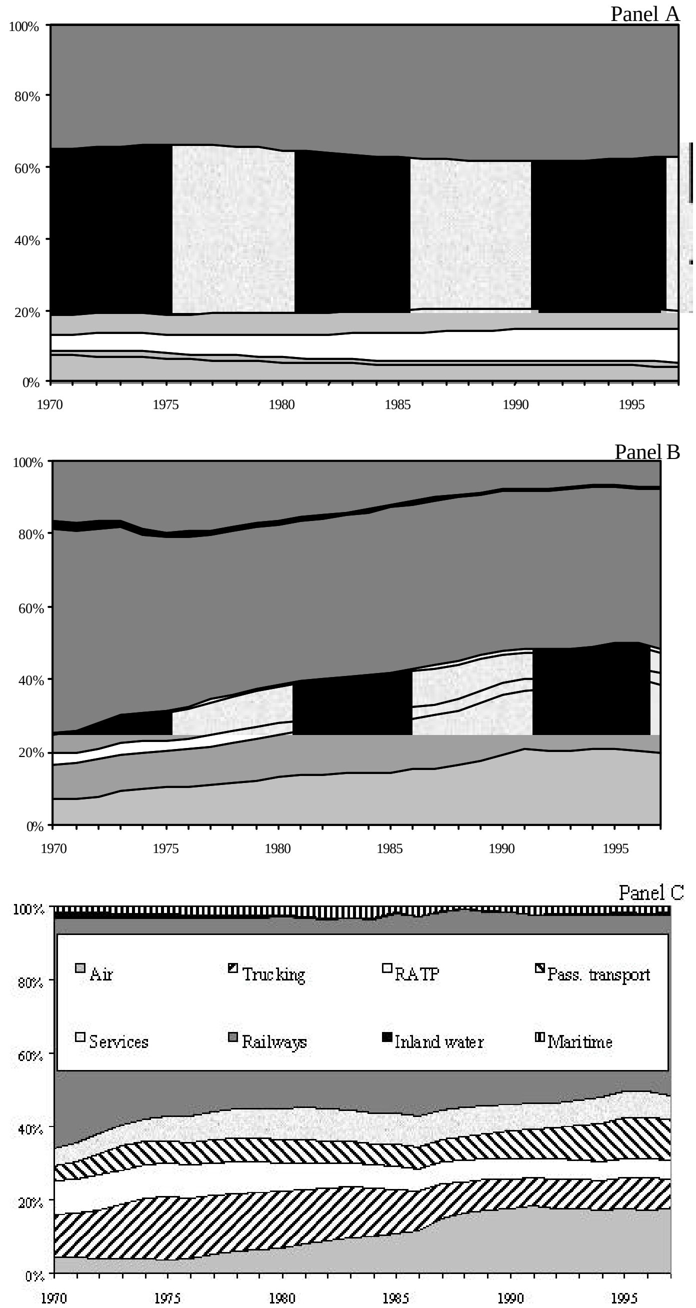
Table 5: Geometric Depreciation Rates in Transport

Sector	This study			O'Mahony (1999)	
	Non-residential structures	Transport equipment	Other machinery and equipment	Non-residential structures	Transport and other Equipment
Railways	0,0229	0,0523	0,1134	0,0228	0,144
Road passenger transports	0,0238	0,1120	0,1225	0,0242	0,144
Road goods transports	0,0240	0,1716	0,1207		
Water transport	0,0239	0,0638	0,1437	0,0248	0,078
Air transport	0,0238	0,0817	0,1220	0,0234	0,135
Transport services	0,0250	0,0564	0,1300	0,0237	0,158
TOTAL	0,0235	0,0481	0,1213	0,0261	0,134

Source: Dept. of Commerce, Bureau of Economic Analysis (1999) and O'Mahony (1999).

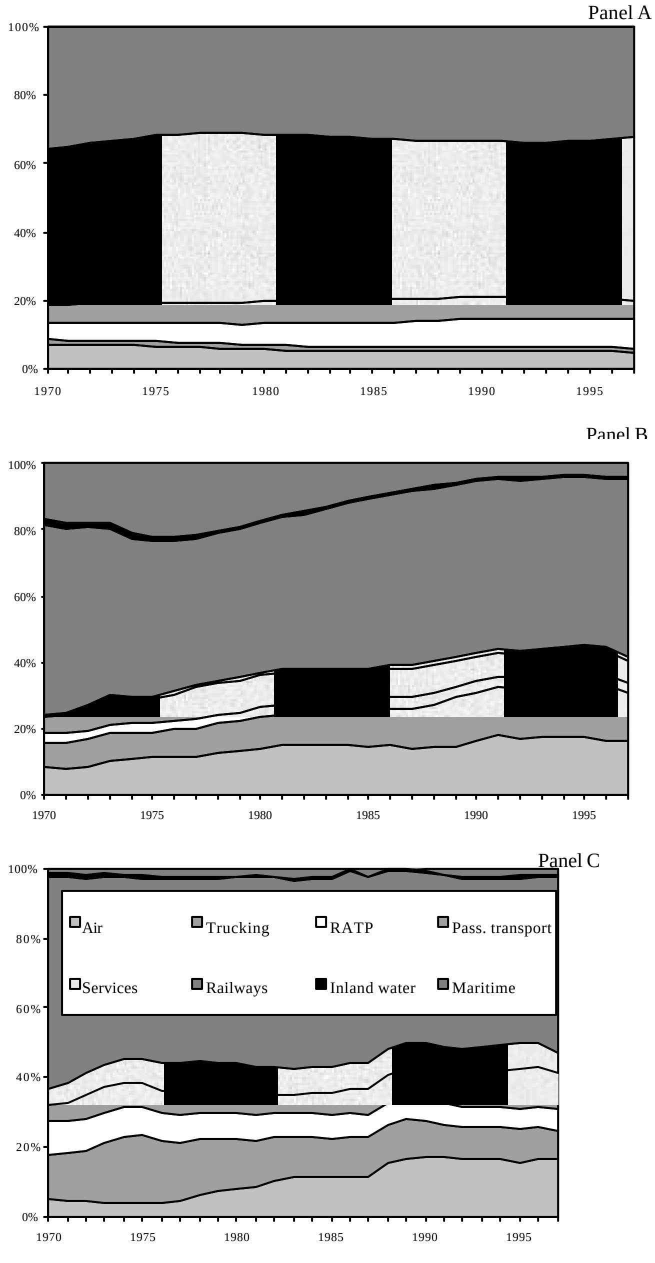
The composition of net stocks is similar to that of the gross stocks for all three groups of assets, as illustrated by Figure 2. This is because depreciation rates are not very different between branches for one capital good. However, this is not the case for transport equipment: the depreciation rate of railways was less than a third of that of trucking. The share of trucking in the net stock is therefore smaller than in the gross stock and that of railways larger.

Figure 1: Gross Stock Composition: Infrastructure (Panel A), Transport Equipment (Panel B) and Other Equipment (Panel C)



Sources: See Annex D.

Figure 2: Net Stock Composition: Infrastructure (Panel A), Transport Equipment (Panel B) and Other Equipment (Panel C)



Sources: See Annex D.

2.6. Measurement of Capital Services

Capital services equal the volume of capital services, approximated by the net capital stock, times the user cost of capital. The latter are estimated by a simplified version of formula (9), following O'Mahony (1999):

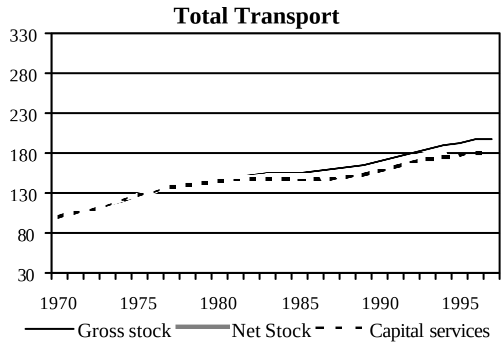
$$S_t = [q_{t-1} r_t + q_{t-1} d - (q_t - q_{t-1})] \tag{10}$$

The user cost S_t thus equals the real interest rate as a proxy of the rate of return ($q_{t-1}\ r_t$) plus depreciation ($q_{t-1}\ d$) minus real capital gains (q_t - q_{t-1}). For various countries during several periods, such as France in the 1970s, the use of real interest rates leads to negative user costs as these rates were highly negative. As negative user costs are unrealistic, other proxies should be used which provide more plausible estimates of the rate of return on capital. These proxies are often based on complex indirect estimation methods and are little robust (see Harper *et al.*, 1989). As this issue is beyond the scope of this paper, we have, as O'Mahony (1999), assumed a real interest rate of 5 per cent for all countries and all sectors. Real capital gains are estimated by the increase in the price of asset *i* minus the price increase of all assets.

For individual assets, the growth rate of capital services is the same as that of the net capital stock. This is not the case for the total capital stock, as the net stock of non-residential structures is weighted by its user cost, as well as the net stock of transport equipment and other machinery and equipment. For the total transport sector, the use of capital services instead of the gross or net stocks does not yield very different growth rates (see Figure 3). However, at the level of branches, capital services grew at a slower pace particularly in Parisian passenger transport (RATP) and to a lesser extent in maritime transport. The result for the RATP is explained by the large investments in infrastructure. These have long asset lives and therefore low depreciation rates. The growth of capital stocks depends on new investment, while the growth of capital services is largely determined by depreciation rates. As the former was relatively high, the capital stock grew fast, but since depreciation rates are low capital services grew more slowly.

When most investment is in only one type of capital, the growth of capital services largely coincides with that of the net capital stock. This was the case in transport services and air transport, which invested mostly in non-residential structures and aircraft respectively.

Figure 3: Indices of Gross Capital Stock, Net Capital Stock, Capital Services (1970=100)



Sources: See Annex D, see text for derivation capital services.

From 1970 to 1997, capital input grew most rapidly in the RATP, followed by road freight transport. The largest decline in capital services occurred in inland water and maritime transport. The latter result should be interpreted with care, as the stock of capital decreased less than shown in Figure 4. The large fall in the stocks and services of owned ships was partly compensated by an increase in the use of ships under flags of convenience and leases. Due to data constraints, these were excluded from the capital stock and services estimates of this study.

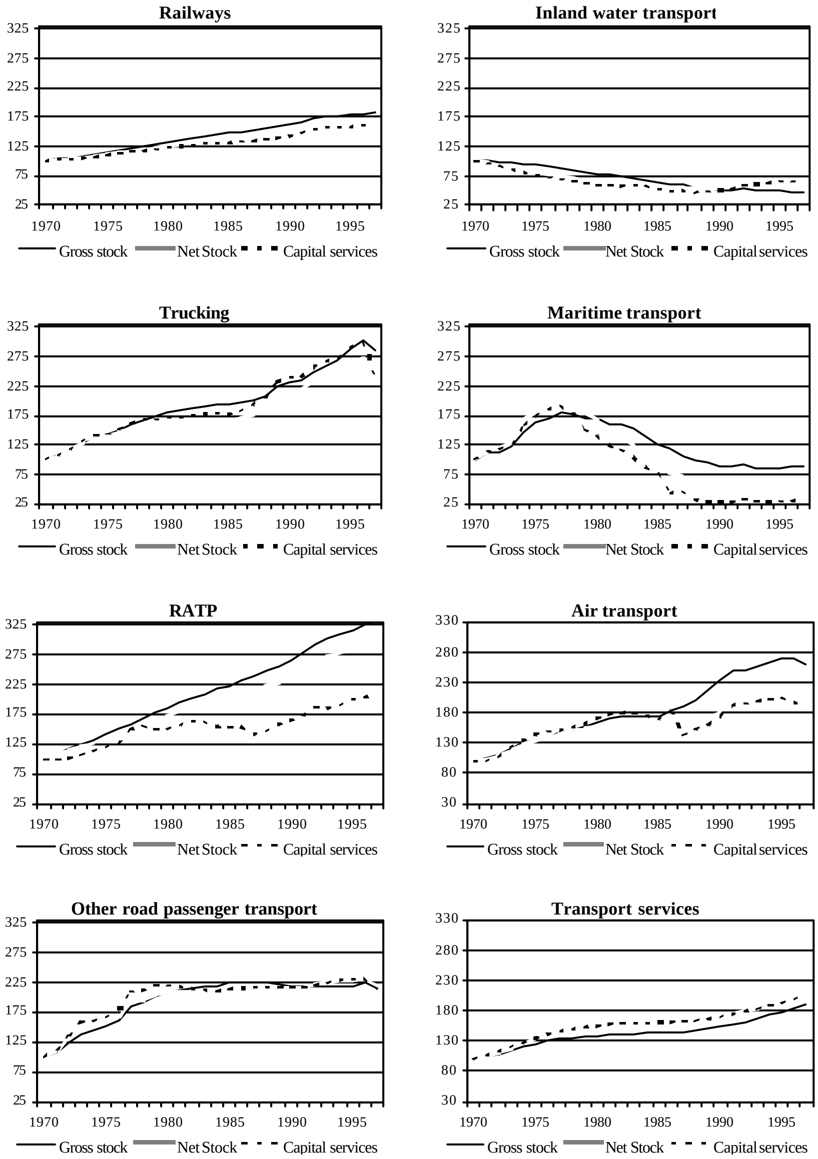
3. THE AIRCRAFT STOCK MEASURED BY ADMINISTRATIVE RECORDS

3.1. Introduction

The perpetual inventory method produces biased capital stock measures in sectors characterised by a large turnover of capital assets and important shares of leased and rented assets. When administrative records are available for capital assets, these biases can be corrected as illustrated in this Section for the stock of aircraft. Registers were also used to measure the stock of vessels in maritime transport, see Annex B for more details.

This section concentrates on the measurement of capital stocks, even though, as with most national accounts and productivity analysts, we agree that it is capital services what we are really interested in. We focus nevertheless on stocks because they are an important element in the estimation of capital services. Errors in the measurement of the capital stock will bias the estimate of capital services.

Figure 4: Indices of Gross Capital Stock, Net Capital Stock, Capital Services (1970=100)



Sources: See Annex D, see text for derivation capital services.

3.2. Treatment of Discards and Disposals

Discards (also referred to in the literature as retirements or scrapping) are assets withdrawn from production. When service lives are estimated correctly, assets are removed from the capital stock at or around the end of their service life. Their residual value thus equals zero. Discards are different from disposals, as the latter are sales of assets to other producers who continue to use them. Disposals have a value above zero and are supposed to be removed from the capital stock *before* their service life ends. Firms sell these asset at the prevailing second-hand prices, which, in principle, correspond to the net value, e.g. the constant replacement value[12] minus depreciation.

In the standard PIM approach, they are deducted from *acquisitions* to estimate *gross* fixed capital formation (GFCF). The latter should not to be confused with *net* fixed capital formation which equals GFCF minus depreciation. The measurement of GFCF poses several problems. Firstly, assets older than their service life may be sold while according to the PIM they have a zero value. The second-hand value of these assets is deducted from *acquisitions.* This is inconsistent with the PIM, and GFCF is thus underestimated.

Secondly, the concept of GFCF is not consistent with the concept of gross capital stocks. This is because acquisitions and disposals are valued at their second-hand value, which takes account of depreciation, instead of at their constant replacement value. GFCF may also be biased for the measurement of net stocks when second-hand prices, used to estimate the value of disposals and second-hand goods entering the capital stock, substantially differ from the net value of assets as estimated by the PIM methodology.

To resolve these biases detailed information is required on the age of assets, the years when they enter and leave the stock and their constant replacement value. For a coherent application of PIM it would be useful to distinguish between two types of GFCF: non-depreciated and depreciated GFCF. Non-depreciated GFCF measures acquisitions and disposals at their constant replacement value and is consistent with the gross stock concept. Depreciated GFCF, calculated by the depreciated values of acquisitions and disposals, is consistent with the net stock concept. In practice it is difficult to estimate both types of GFCF as often only aggregate data are available of the value of acquisitions and disposals without information on the build year, entry, exit and replacement value of each asset. In many cases only data on GFCF is available without a distinction between acquisitions and disposals. Nevertheless, for some assets, such as aircraft, administrative records and prices are available, and the above mentioned biases can be eliminated, as discussed below.

[12] The constant replacement price equals the historical price of the asset revalued to the prices of a selected year (1980 in this study).

3.3. Treatment of Leased and Rented Assets

Another difficulty in capital stock estimation is the treatment of leased and rented assets. One difficulty is whether leased assets should be attributed to the owner or the user industry. Another is the measurement of the gross and net stocks, and capital services of leased assets.

Rented assets are classified to owners instead of users in the capital stocks estimates of the national accounts of most countries. However, for productivity and other types of analyses it is necessary to estimate the total capital stock *used* in production. These should include assets leased and rented for at least a year. In various industries, such as air transport, long term rentals are increasingly common. The omission of these assets leads to an underestimation of the available capital stock.

In this paper, we focus on leased assets as they are more common than long term rentals.

3.3.1. Allocation of Leased Assets

The allocation of leased assets depends on the type of analysis. For profitability analysis, it is preferable to allocate them to the owner industry, whereas for productivity analysis assets are attributed to user industries. The practice of the national accounts also differs between OECD countries which complicates international comparisons. The French national accounts and the System of National Accounts manual-1993 (paragraphs 13.23 and 13.24) attribute leased assets to the capital formation of the user. The US national accounts, on the contrary, consider leases as part of the owner industry. As we aim to estimate the capital stock *used* in production, we attributed assets to the user industries.

3.3.2. Measurement of the Leased Capital Stock using the PIM

Including leased assets in the capital stock of the user-industry is difficult as in most countries only data on leasing cost are available. The major part of these costs correspond to the cost of capital, but they also include financing and storage cost. Leasing cost can be used to measure capital *services* but not to measure capital stocks. In order to estimate the stock of leased assets of the user industry, it is necessary to reallocate capital formation or the value of the stock from the owner to the user industry. This is sometimes done on the basis of arbitrary rules. For example, O'Mahony (1999) re-classified the largest part of investment in aircraft from the financial sector to air transport. She supposed that 20 per cent of aircraft was for own-use while the rest was leased to air transport.

In France, the national accounts attribute leased assets to the user industry on the basis of annual surveys. These show the domestic suppliers and domestic users of leased capital. The value of an investment equals the sum of future payments plus the specified value at which the user buys the asset at the end of the lease (as specified in the lease contract). An inconsistency in the French national accounts is that these end values are double counted: once in the year the lease contract is signed and once again in the year when the lease expires and the firms acquires the asset. This is because INSEE cannot separate purchases of leased assets from other acquired assets. Another shortcoming of the INSEE data is that they only cover assets leased from domestic firms and exclude assets leased from foreign companies.[13]

3.4. Using Administrative Records to Measure Gross and Net Capital Stocks

The use of the PIM leads to biased results for the measurement of the capital stock in industries which are characterised by frequent disposals and large shares of leased and rented assets for the reasons outlined above. Air transport is an example of such an industry. International competition forces air companies to regularly update their fleet and therefore they sell most of their aircraft long before the end of their service life. Moreover, instead of purchasing, companies increasingly lease or rent their aircraft. The importance of disposals, leases and rentals is difficult to assess with aggregate data on gross fixed capital formation as they are net flows and do not separate acquisitions and disposals. Moreover, even when rented and leased assets are included, they cannot be isolated within the acquisitions.

Instead, administrative records provide many characteristics as they present information on each asset. As such, they show when assets enter and leave the capital stock, when the asset was built and whether it is owned or not by the operator. In this study, the administrative records of aircraft are taken from the Airclaims database. Airclaims is one of the major insurance companies of aircraft. Their monthly updated database contains data on the stock of aircraft of most countries in the world starting in the 1950s. It presents detailed information of all aircraft *operated* by resident companies of each country, including those leased and rented from domestic and foreign firms.

The Airclaims database provides no data on (historical) construction cost. These were mostly taken instead from the *Airliner Price Guide* which contains prices paid by the first purchaser of each type of aircraft in US$. After the conversion to French francs, these historical cost data were deflated to constant prices using the French deflator of aircraft in capital formation of the transport sector.[14]

[13] For Air France and Air Inter, INSEE included foreign leases in the GFCF as they had access to company accounts showing both domestic and foreign lease contracts. This was impossible for other private firms in air transport.

[14] Annex B provides more details on the construction of the aircraft stock on the basis of registers.

Robust estimates of the gross stocks can be made with the register data. This is because, contrary to the PIM, no assumptions are necessary on the length of asset life and retirement patterns, as the registers shows exactly when asset enter and leave the stock. Net stocks are more relevant than gross stocks, as the value of aircraft within the fleet also diminishes over time. Moreover, not all aircraft are new when they enter the fleet. The estimation of net stocks is more difficult than gross stock as little, easily exploitable, information is available of how the market price of particular aircraft develop over time. Assumptions have to be made on depreciation patterns. The evolution of second-hand prices of transport equipment follows a geometric pattern, as illustrated by Fraumeni (1997). We did however not use this pattern, as the register data exclude an important element of capital formation in aircraft, e.g. major maintenance and revision. Therefore the net value of the aircraft is underestimated over its life time. To compensate for this, we assumed straight-line instead of geometric depreciation, which produces smaller reductions in the constant replacement value during the early life of the aircraft.

3.4.1. Gross Fixed Capital Formation

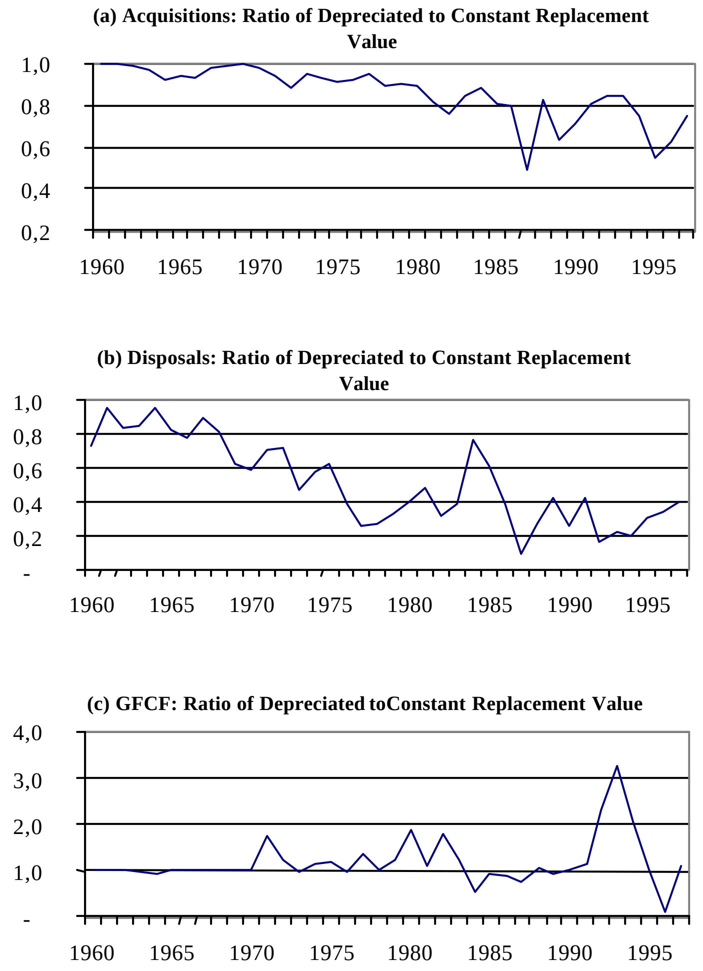
In the literature, gross fixed capital formation is defined by acquisitions less disposals of assets. Both acquisitions and disposals are valued at market prices. In combination with the PIM, these series of capital formation are used to estimate both gross and net capital stocks. However, as pointed out above, this concept is unsuitable to measure gross stocks as depreciation is deducted from the constant replacement value of acquisitions and disposals.

To assess the impact of this bias on the gross stock estimates, we constructed two series of capital formation: one compatible with the estimation of gross stocks, referred to as non-depreciated GFCF, and one adapted to estimate net stocks, referred to as depreciated GFCF. The former values all assets at their constant replacement value, whereas the latter takes account of depreciation.

Paradoxically, non-depreciated GFCF is frequently below depreciated GFCF. The easiest way to understand this it to analyse the two components of GFCF, e.g. acquisitions and disposals. Depreciated values of disposals – compared to constant replacement values - are relatively lower than depreciated values of acquisitions, as the former are mostly older than the latter. This is illustrated in Figures 5-a and 5-b, which show the ratio of the depreciated to the constant replacement values of assets. Going from depreciated to non-depreciated values, the proportional increase in the value of disposals is bigger than that in acquisitions. As disposals are deducted from acquisitions to calculate GFCF, non-depreciated GFCF is lower than depreciated GFCF.[15]

[15] The following example helps to understand the paradox. Suppose that in year *t* a firm acquires an asset of two years old with a constant replacement value of 100 and a depreciated value of 80. The same year the firm sells an asset of eight years old with a constant replacement value of 70 and a depreciated value of 10. Going from depreciated to non-depreciated values, the proportional increase in the value of disposals (70/10) is much more than that in acquisitions (20/80). As disposals are deducted from acquisitions to calculate GFCF, non-depreciated GFCF (e.g. 10) is lower the depreciated GFCF (70).

Figure 5: Ratio of Depreciated to Constant Replacement Values, 1980 prices



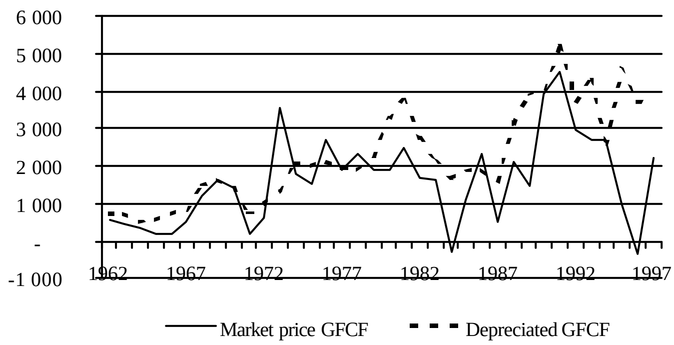
Source: Airclaims' CASE database and *Airliner Price Guide* as described in Annex B.. Depreciated values were estimated assuming linear depreciation over the 20 years asset life.

This is only partially confirmed by Figure 5-c, as the ratio of depreciated GFCF to non depreciated GFCF is not always above one. This is explained by composition effects: the above reasoning holds when there is only one acquisition and one disposal and when the acquisition is younger than the disposal. However, when acquisitions and disposals consists of a large variety of assets in terms of number, age and value, the difference between depreciated GFCF and non-depreciated GFCF may be positive or negative. Figure

5-c thus confirms that non-depreciated GFCF may substantially differ from depreciated GFCF and the resulting gross capital will be also quite different.

The standard definition of GFCF, referred to here as market-price GFCF, is also inappropriate to measure net capital stocks. This is because market-price GFCF measures acquisitions and disposals at market prices, whereas assets of the same build-year within the stock have a hypothetical value, i.e. the constant replacement value less depreciation. A mixture is thus used of both market and hypothetical prices. Within the PIM framework, it would be more appropriate to use depreciated values for assets within the stock as well as those acquired and sold. This is the concept of depreciated GFCF. The difference between market GFCF and depreciated GFCF is illustrated in Figure 6.

Figure 6: Depreciated Gross Fixed Capital Formation and Standard Gross Fixed Capital Formation, Aircraft, million 1980 Francs

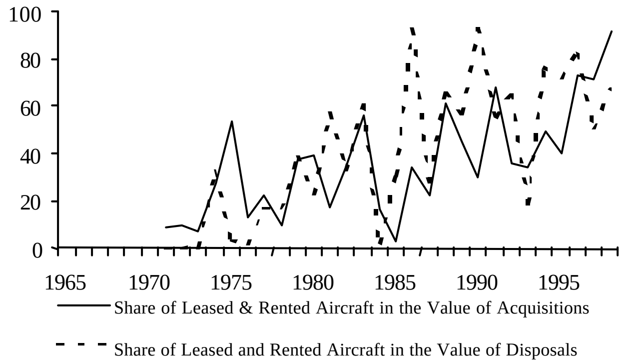


Sources: Standard gross fixed capital formation from Annex C. Depreciated gross fixed capital formation from Airclaims' *CASE* database and *Airliner Price Guide* as described in Annex B.

3.4.2. Leased and Rented Assets

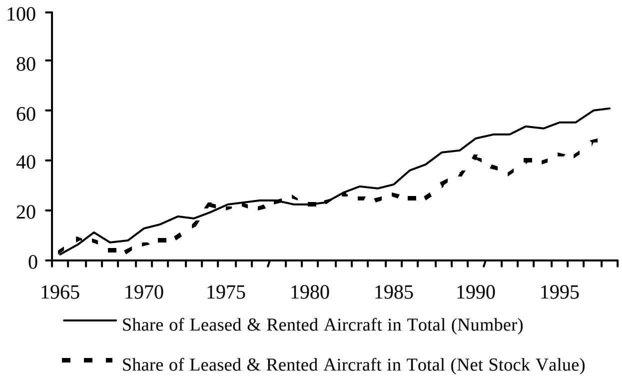
Leased and rented aircraft have become a major part of capital formation in air transport. Their share in acquisitions and disposals has strongly risen over time (see Figure 7). By the late 1990s, ninety percent of the aircraft entering the capital stock was leased or rented. Leased and rented aircraft also strongly increased their share in the stock (see Figure 8). In quantity terms, its share rose from 3 per cent in 1965 to more than 60 per cent in 1998. The share of leased assets in the net stock has risen by almost as much. Nowadays, leased and rented aircraft thus account for a larger share than owned aircraft in air transport. Moreover, they are an important determinant of overall capital formation in air transport, as aircraft accounts for almost eighty percent of total capital formation in this sector.

Figure 7: Share of Leased and Rented Aircraft in the Value of Acquisitions and Disposals (1980 French francs)



Sources: Airclaims' *CASE* database and *Airliner Price Guide* as described in Annex B.

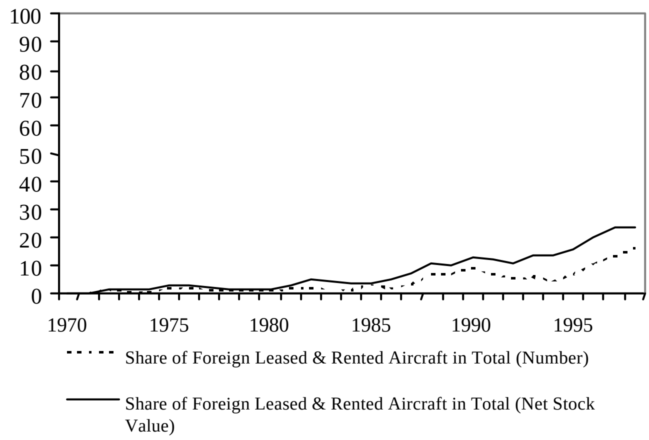
Figure 8: Share of Leased and Rented Aircraft in Capital Stock (Number and Value of Net Stock in 1980 French francs)



Sources: See Figure 7.

The volume and value of leased assets is often underestimated. For example, the national accounts in France included only domestically leased assets which were reallocated to the user-industry. The only foreign leases included are those of the two largest air transport companies (Air France and Air Inter). The national accounts ignored all other aircraft leased by French operators from foreign leasing companies. Their share in the total stock of French aircraft increased substantially to a quarter in terms of numbers and to 15 per cent in terms of the value (see Figure 9).

Figure 9: Share of Foreign Leased and Rented Aircraft (except Air France & Air Inter) in Capital Stock (Number and Value of Net Stock in 1980 French francs)



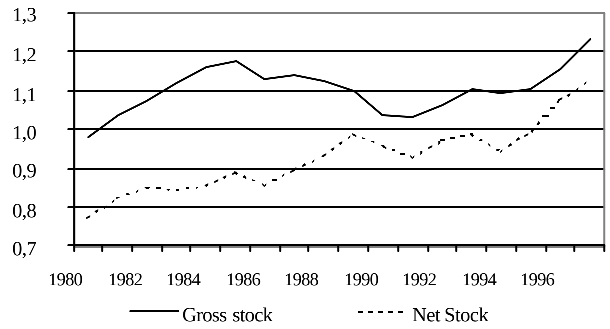
Sources: See Figure 7.

3.5. Comparison of Capital Stocks Based on the PIM and on Registers

Capital stock estimates obtained with register data are confronted with estimates of the perpetual inventory method. Capital formation at current prices in aircraft are taken from INSEE and the Ministry of Transport and cover the period 1962-97. The conversion to constant prices was done with the same deflator as used for the register data. We assumed an asset life of twenty years (Fraumeni, 1997). Retirements were supposed to be spread around the expected life year. The net stock was estimated assuming a geometric depreciation rate of 13.5 per cent per year (Fraumeni, 1997).

The PIM gross capital stock estimates were above those estimated using administrative registers, whereas the net stock estimates were mostly lower (see Figure 10). The maximum difference between the two was about twenty per cent. Two reasons explain the larger gross stock estimated by the PIM compared to the register value. Firstly, the GFCF in the PIM is overestimated, and thus also produce overestimated stocks, for the reasons outlined above. Secondly, the GFCF data used for the PIM include major revisions which are excluded from the register values of the stock. The lower PIM estimates for the net stock may originate from the assumed geometric depreciation compared to the linear depreciated used for the stocks estimated by the registers.

Figure 10: Ratios of Capital Stocks Estimated by Perpetual Inventory Method to Administrative Record Stocks: Gross Stock and Net Stock



Sources: Stock estimates using the PIM: see Annex B. Stock estimates obtained by administrative records: Airclaims' *CASE* database and *Airliner* Price Guide (see also Annex B).

3.6. Conclusion

The perpetual inventory method is unsuitable for estimating capital stocks in industries with large turnovers of assets and/or large shares of rented and leased assets. When most assets are sold before they reached the end of their asset life, gross fixed capital formation based on market prices of acquisitions and disposals is unsuitable for the estimation of gross stocks. It underestimates the value of disposals relative to acquisitions and therefore overestimates GFCF. "The market-price" GFCF is also unsuitable for the estimation of net stocks, as it mixes hypothetical depreciated values for assets within the stock and market prices for assets entering or leaving the capital stock. The PIM is also unsuitable when a large part of the capital stock used in production is leased or rented, as GFCF in most countries ignores or only partly includes leased and above all rented assets.

For these industries, administrative registers of capital assets may provide a good alternative to the PIM. These registers permit coherent estimates of capital formation, gross and net stocks.

4. INTERNATIONAL PRODUCTIVITY COMPARISONS

4.1. Introduction

The series of capital services as presented in Section 2 are used here to measure capital, labour and total factor productivity (TFP). Capital and labour productivity measure the relative efficiency at which those inputs are used, while total factor productivity indicates how well labour and capital are jointly used. TFP is also interpreted as the contribution of technology to production, although it also captures other determinants of production not accounted for by capital and labour productivity such as international trade and structural change.

TFP is measured using traditional growth accounting. Suppose country *J* has the following production function:

$$Q_{Jt} = f_{Jt}(L_{Jt}, K_{Jt})$$

where *Q* is real value added, *L* is labour input (measured by hours worked) and *K* is capital input (measured by capital services, see Section 2). Under the neo-classical assumptions, e.g. perfect competition and payments of factor inputs equal their marginal productivity, total factor productivity growth can be estimated using the Tövrnqvist discrete approximation to the Divisia index:

$$\ln(TFP_t^J / TFP_{t-s}^J) = \ln(Q_t^J / Q_{t-s}^J) - a^J(t,t-s)\ln(L_t^J / L_{t-s}^J)$$
$$-(1 - a^J(t,t-s))\ln(K_t^J / K_{t-s}^J)$$

where $a^J(t,t-s)$ is the average of the shares of labour compensation in value added in period *t-s* to *t*. The growth accounting methodology is embedded into the neo-classical theory of production.

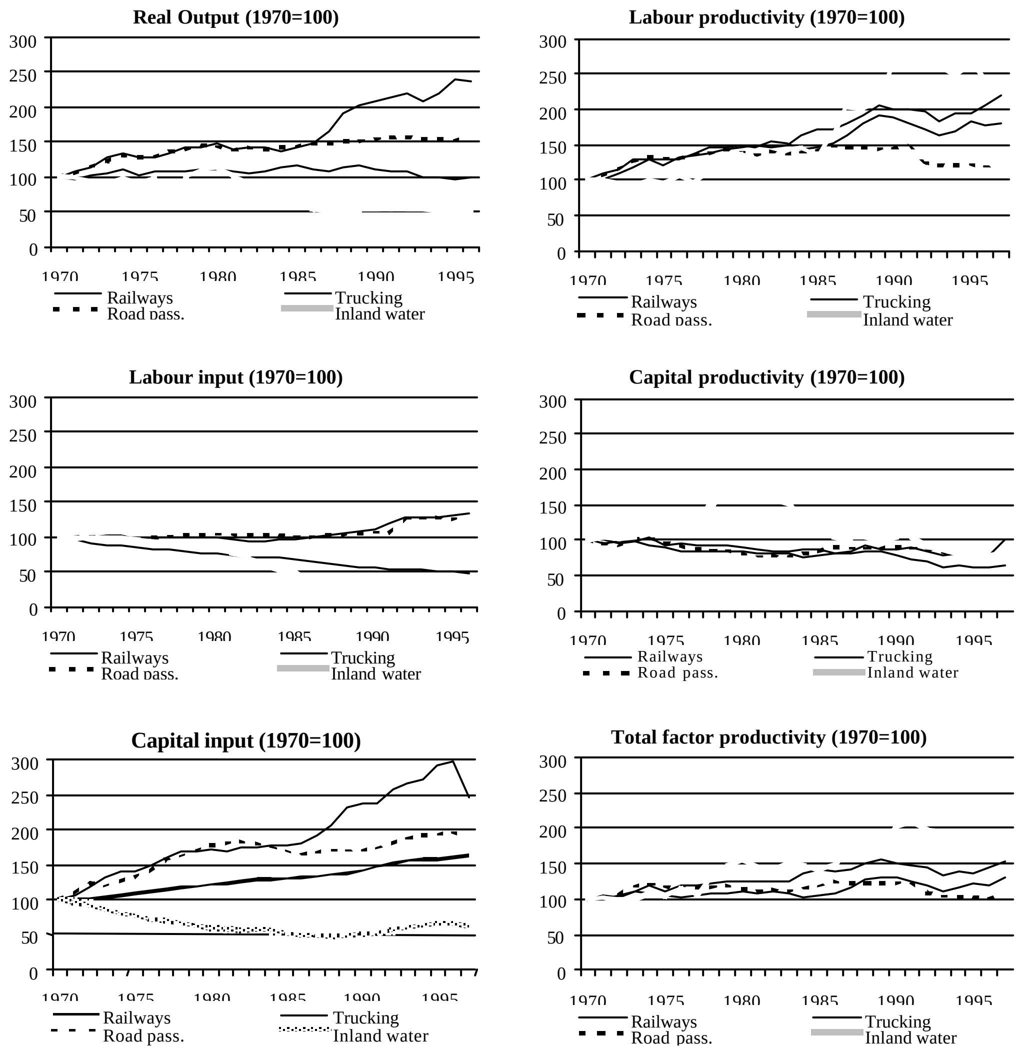
This Section will present the growth and productivity performance of France by sub-sector of transport in the period 1970-96. Subsequently, the French performance is compared to that of the Germany, the United Kingdom and the United States.

4.2. Productivity Performance: A Comparison Between the French Sectors

The growth rates of output, factor inputs and productivity are summarised in Table 6 (see also Figures 11 and 12). Three periods are distinguished: 1973-79 - the period between the two oil crises -, the 1980s and the 1990s. After a period of high output and productivity growth in transport in the 1970s, the 1980s and 1990s were characterised by a slowdown. This pattern was not unique for transport, but also found in other parts of the French economy (see O'Mahony, 1999). The overall transport performance hides large variations across sub-sectors: whereas output and productivity in air transport grew at high rates during all three sub-periods, that of other transport sectors sharply declined after the 1970s.

Labour input in terms of hours worked declined in the 1970s and 1980s due to a reduction in annual working hours and a decline in the number of persons engaged in railways, water transport and, surprisingly, air transport in the 1990s. This overall negative trend was reversed in the 1990s, mainly due to an employment increase in trucking which accounts for the largest share of employment in transport.

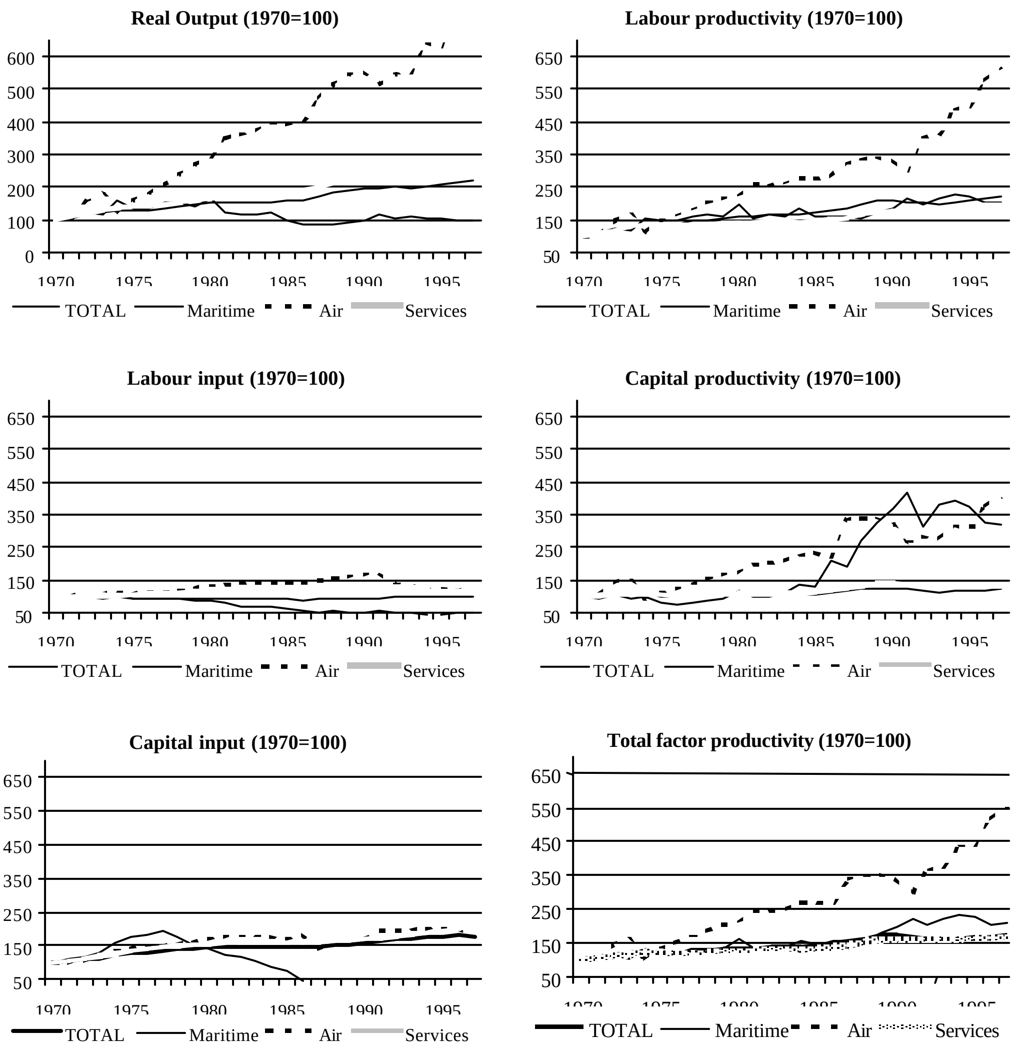
Figure 11: Indices of Factor Inputs and Productivity, French Transport, 1970 = 100



Sources: See Annexes D and E.

The growth of capital services also slowed down in all parts of transport after the 1970s with the exception of air transport. The largest fall in capital services in maritime transport was partly due to the large substitution of owned ships for ships managed under a "flag of convenience" construction. This means that the owner transfers the register of the ship from France to mostly developing countries such as Liberia, Malta and Panama.[16] The downsizing of the maritime transport is also due to the falling share in the world market for maritime goods transport.

Figure 12: Indices of Factor Inputs and Productivity, French transport, 1970 = 100



Sources: See Annexes D and E.

[16] The more flexible and less burdensome administrative and tax legislation of these countries allow for important reductions of operating cost. Ships registered in other countries are no longer part of a firm's owned capital stock.

The labour productivity performance of the total transport sector was similar in the 1970s and 1980s, but dropped sharply in the 1990s. Air transport had the highest productivity growth throughout the 1970s to the 1990s. Maritime transport and railways were also among the better performing sectors. In railways, labour productivity growth disappeared in the 1990s. Maritime transport and railways partly achieved their high productivity growth due to sharp cuts in their labour force which largely unaffected output growth. Air transport was one of the few sectors that managed to create both employment and labour productivity growth simultaneously.

Airlines were not only the best performers in terms of labour productivity growth, but also in terms of capital productivity growth which exceeded 7 per cent in the 1980s. Capital productivity grew also at high rates in maritime transport in the 1980s. However, this outcome resulted from a large reduction of the owned shipping fleet which had a proportionally small impact on output.

The growth of total factor productivity in total transport increased in the 1980s compared to the 1970s, but became negative in the 1990s. Again airlines outperformed other sectors. Maritime transport had also relatively high TFP growth rates. Railways, trucking and urban and interurban passenger transport performed similarly to overall transport.

Airlines, the most rapidly expanding transport sector in terms of capital and labour inputs, jointly with inland water and maritime transport were thus the branches with the best productivity performance. Productivity growth in railways and road passenger and road goods transport was poor and turned negative in the 1990s. The performance of trucking and transport services was in between.

4.3. International Comparisons of Productivity in Transport

To evaluate its productivity performance, France is compared to three countries with similar levels of economic development: (former Western) Germany, the United Kingdom and the United States. Germany and the UK are of a similar geographical size and population as France, whereas the United States is several times larger. Compared to the European countries, the United States can realise more scale economies due to its larger size. In particular in railways, the much larger network provides the US with a real advantage. It can load a train in New York which runs all the way to San Francisco. As the railways of each European country operates almost entirely on its own territory , trains need to be loaded and unloaded several times to generate the same quantity of ton kilometres as in the USA. The much smaller proportion of loading and unloading relative to the pure movement of goods in the USA compared to European countries is also true for road haulage which is the most important branch in transport. For other branches such as air and maritime transport, European countries benefit as much from scale economies as the USA as these activities are essentially international.

Table 6: Total Transport: Growth of Output, Factor Inputs and Productivity (annual average growth rates)

	Railways	Road freight	Road Passenger	Inland water	Maritime transport	Air transport	Transport Services	Total
				Value Added				
1973-79	1.0	1.6	3.0	3.3	3.3	6.8	3.8	2.9
1979-89	0.5	3.7	0.3	-7.8	-4.6	7.4	3.5	2.7
1989-96	-2.2	2.2	0.5	0.5	1.3	4.4	1.7	1.6
				Hours worked				
1973-79	-2.2	-0.5	0.7	-2.4	-2.4	2.5	2.1	-0.3
1979-89	-3.0	0.9	0.3	-12.2	-5.1	2.5	1.4	-0.3
1989-96	-2.2	3.3	3.3	-1.5	-1.1	-3.1	0.0	1.2
				Capital services				
1973-79	2.3	4.1	6.2	-5.2	3.0	4.8	4.3	3.8
1979-89	1.5	3.3	-0.1	-2.4	-15.8	-0.1	0.8	0.7
1989-96	2.1	3.7	2.1	4.3	1.3	3.0	2.6	2.4
				Labour productivity				
1973-79	3.3	2.1	2.2	5.8	5.9	4.3	1.7	3.3
1979-89	3.7	2.8	0.1	5.0	0.5	4.7	2.1	3.0
1989-96	0.0	-1.1	-2.7	1.9	2.4	7.8	1.6	0.4
				Capital productivity				
1973-79	-1.2	-2.4	-3.1	8.9	0.3	2.0	-0.5	-0.8
1979-89	-1.0	0.4	0.4	-5.5	13.3	7.4	2.7	2.0
1989-96	-4.2	-1.5	-1.6	-3.7	0.0	1.4	-0.9	-0.7
				Total Factor Productivity				
1973-79	2.0	-0.3	0.3	6.9	4.0	3.6	0.9	1.8
1979-89	2.3	1.8	0.2	1.9	2.8	5.7	2.3	2.7
1989-96	-1.1	-1.3	-2.5	0.0	1.9	5.6	0.6	-0.1

Sources: See Annexes D and E.

Data for the three other countries were taken from O'Mahony (1999). She presents a four sector breakdown: railways, water (e.g. maritime and inland water) transport, air transport and "other transport" (e.g. trucking and urban and interurban transport, and services related to transport). Due to data problems, no series were available for water transport in the UK and air transport in Germany as well for "other transport" in both countries. O'Mahony's series start in 1950 compared to 1970 in this study. She provides a breakdown into two types of capital assets: non-residential structures on the one hand and machinery and equipment on the other.

4.3.1. Total Transport

France had the highest growth rates of output in the 1970s and 1980s but the lowest ones in the 1990s. Germany was the output growth leader in the 1990s. During most of the period 1970-95, the volume of labour services shrank in all three European countries in contrast to the United States where employment grew at modest rates throughout. The largest employment cuts were in France. On the other hand, capital services grew faster in France than elsewhere (see Table 7 and Figure 13).

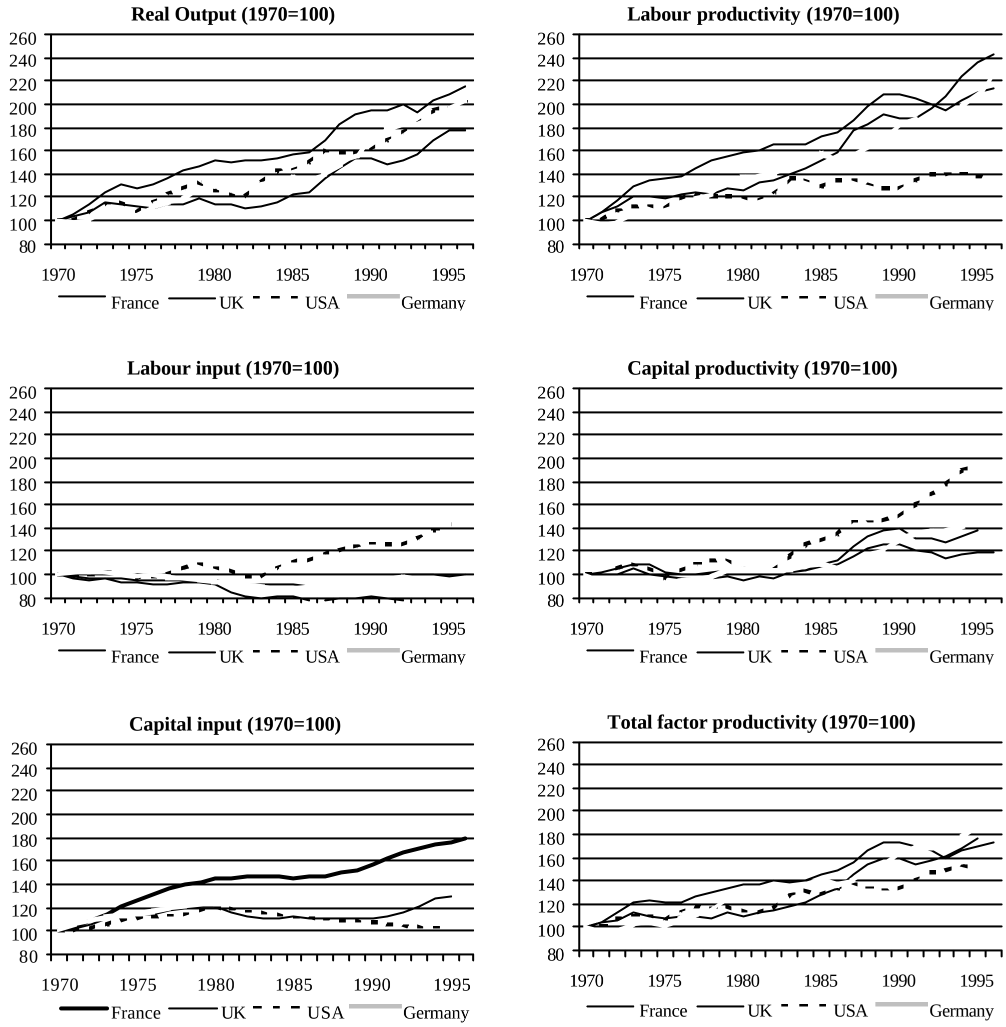
The France productivity performance was mixed compared to the other countries: it performed better in terms of labour productivity growth but worse in terms of capital and total factor productivity gains. Labour productivity growth in France was amongst the highest in the 1970s and 1980s, after which it declined relative to the other countries. The UK showed the highest capital productivity growth in the 1970s and 1980s. France performed poorly with respect to capital productivity and showed a mediocre total factor productivity performance.

Table 7: Total Transport: Growth of Output, Factor Inputs and Productivity (annual average growth rates)

	Value added				***Labour productivity***			
	France	**Germany**	**UK**	**USA**	**France**	**Germany**	**UK**	**USA**
1973-79	2.9	2.9	0.4	2.5	3.3	4.2	1.0	1.3
1979-89	2.7	2.0	2.6	1.8	3.0	2.4	4.1	0.6
1989-95	1.4	4.0	2.6	3.7	0.2	3.5	3.6	1.3
	Hours worked				***Capital productivity***			
	France	**Germany**	**UK**	**USA**	**France**	**Germany**	**UK**	**USA**
1973-79	-0.3	-1.2	-0.6	1.2	-0.8	1.3	-1.1	0.7
1979-89	-0.3	-0.4	-1.4	1.3	2.0	1.5	3.5	2.7
1989-95	1.2	0.5	-1.0	2.4	-1.1	3.3	-0.1	4.6
	Capital services				***Total factor productivity***			
	France	**Germany**	**UK**	**USA**	**France**	**Germany**	**UK**	**USA**
1973-79	3.8	1.6	1.4	1.8	1.8	3.3	-0.1	1.1
1979-89	0.7	0.5	-0.9	-0.8	2.7	2.1	3.6	1.2
1989-95	2.5	0.7	2.6	-0.9	-0.4	3.4	1.7	2.2

Sources: See Annexes D, E and F.

Figure 13: Indices of Factor Inputs and Productivity, Total transport, 1970 = 100



Sources: See Annexes D, E and F.

4.3.2. Railways

Railways are very different in Europe and the United States. In Europe, most revenue is generated by passenger transport, whereas in the United States, freight transport accounts for almost all output. In the United States, geographical distances are the most important reason for the low share of passenger travel as most people travel by air. Its large surface also allows for economies of scale as the average distance over which freight is carried is much longer than in the European countries. As such, the Europeans need relatively much more loading and unloading services to generate the same number of ton kilometres as the USA.

In all countries, the volume of labour services has been cut. This is mainly due to the closure of many regional rail tracks in all countries, and the large decline in passenger travel by trains in the United States. In the European countries, employment in rail freight transport has been cut as trucks have taken over a large part of freight transport. Finally, modern rolling stock requires less maintenance which reduced the number of mechanics.

Capital services grew most in France (see Table 8 and Figure 14). This is mostly explained by the massive construction of fast speed train (TGV) networks which is unprecedented in the other three countries. Nowadays most of the inter-city travel is by TGVs running at 300 km per hour. The modernisation of the rail network in the other countries was much slower.

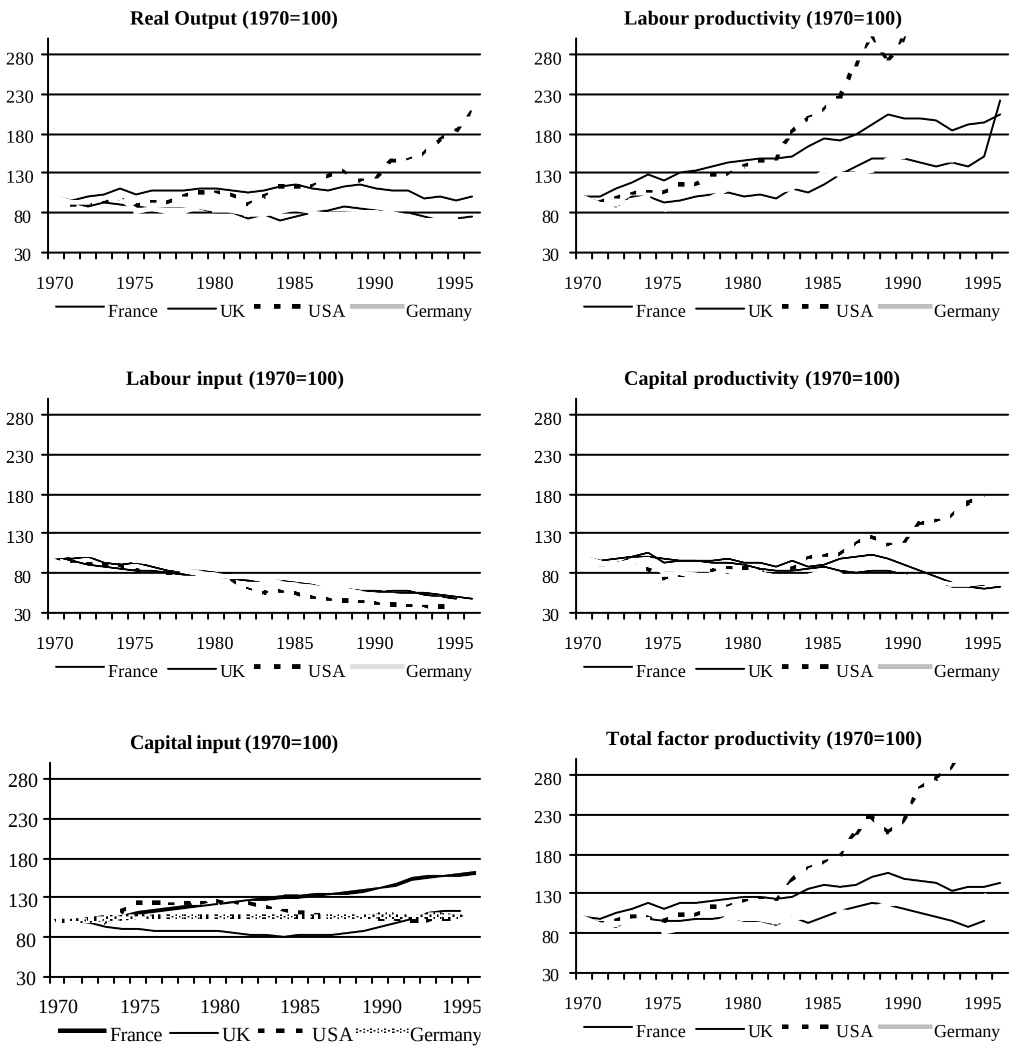
Table 8: Railways: Growth of Output, Factor Inputs and Productivity (annual average growth rates)

	Value added				***Labour productivity***			
	France	**Germany**	**UK**	**USA**	**France**	**Germany**	**UK**	**USA**
1973-79	1.0	-1.8	-1.2	1.8	3.3	2.6	1.0	3.7
1979-89	0.5	-0.9	-0.2	1.3	3.7	2.8	3.6	7.8
1989-95	-3.1	-1.6	-2.7	7.5	-0.9	2.7	0.2	10.2
	Hours worked				***Capital productivity***			
	France	**Germany**	**UK**	**USA**	**France**	**Germany**	**UK**	**USA**
1973-79	-2.2	-4.2	-2.2	-1.8	-1.2	-2.3	-0.3	-2.0
1979-89	-3.0	-3.6	-3.6	-6.0	-1.0	-0.9	-0.1	3.1
1989-95	-2.2	-4.2	-2.9	-2.5	-5.3	-1.6	-6.6	7.5
	Capital services				***Total factor productivity***			
	France	**Germany**	**UK**	**USA**	**France**	**Germany**	**UK**	**USA**
1973-79	2.3	0.5	-0.9	3.9	2.0	0.9	0.3	2.1
1979-89	1.5	0.0	0.0	-1.7	2.3	1.6	1.5	6.1
1989-95	2.4	0.0	4.2	-0.1	-2.1	1.4	-3.4	8.9

Sources: See Annexes D, E and F.

The USA outperformed the European countries in terms of labour, capital and total factor productivity mostly because of scale economies. Moreover, as freight transport requires relatively less labour and capital than passenger transport, the USA has an advantage over the European countries where the share of passenger transport in total output is a lot higher. Among the European countries, France performs rather well in terms of labour productivity but poorly in capital and total factor productivity.

Figure 14: Indices of Growth of Factor Inputs and Productivity, Railways, 1970=100



Sources: See Annexes D, E and F.

4.3.3. Water Transport

Water transport consists of inland water and maritime transport. In all three countries, inland water transport is by far smaller than maritime transport. Moreover, inland water transport is slowly disappearing in France and Germany as their goods transport is taken over mostly by truck transport. Maritime transport is also in decline in the three countries. Output growth was close to zero in all three countries. Employment in the two branches combined fell by more than 50 per cent in France and Germany, while the decrease in the United States was somewhat smaller in the period 1970-95. In France, the capital stock in water transport was also reduced by half. On the contrary, in Germany and the United States, the capital stock even slightly increased between 1970 and 1995 (see Table 9 and Figure 15).

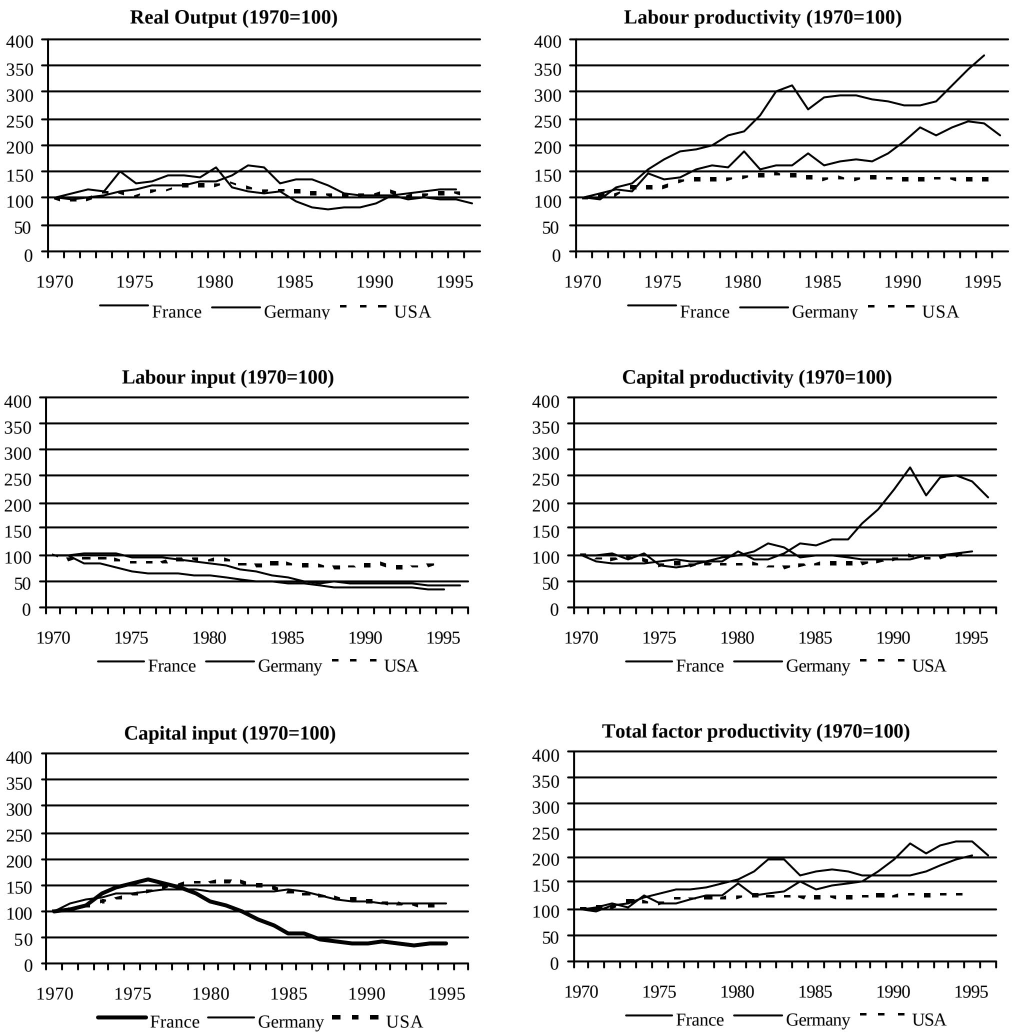
Table 9: Water Transport: Growth of Output, Factor Inputs and Productivity (annual average growth rates)

	Value Added			*Labour productivity*		
	France	**Germany**	**USA**	**France**	**Germany**	**USA**
1973-79	3.5	3.7	2.0	6.0	9.0	2.1
1979-89	-4.9	-2.2	-1.6	1.6	2.6	0.2
1989-95	2.4	1.8	0.7	4.5	4.6	-0.3
	Hours worked			*Capial productivity*		
	France	**Germany**	**USA**	**France**	**Germany**	**USA**
1973-79	-2.4	-4.9	-0.1	-1.1	2.1	-2.4
1979-89	-6.5	-4.6	-1.8	8.0	-0.5	0.8
1989-95	-2.0	-2.7	1.0	4.4	2.7	2.6
	Capital services			*Total factor productivity*		
	France	**Germany**	**USA**	**France**	**Germany**	**USA**
1973-79	4.6	1.6	4.5	3.2	5.5	0.8
1979-89	-12.0	-1.6	-2.3	3.3	0.8	0.4
1989-95	-1.9	-0.9	-1.9	4.7	3.7	0.5

Sources: See Annexes D, E and F.

Germany was the country with the largest labour productivity increase, followed by France. Productivity increased very little in the USA. In terms of capital and total factor productivity, France outperformed Germany and the USA. The French performance was achieved through a large reduction of the shipping fleet while it managed to maintain output.

Figure 15: Indices of Factor Inputs and Productivity, Waterways, 1970=100



Sources: Annexes D, E and F.

4.3.4. Airlines

The main results for airlines are summarised in Table 10 and Figure 16. Between 1973 and 1979, labour input and capital input grew faster in France than in the UK and the USA. From 1979 onwards, labour input increased most in the United States. In the 1970s, the growth of employment in France was accompanied by substantial labour productivity growth. In the 1980s and 1990s, French airlines continued to improve their labour productivity at higher rates then those in the UK and the USA. However, in the 1990s, productivity growth went together with a large personnel cut by 20 percent. In the UK and the USA, employment continued to increase, albeit at lower rates than in the 1980s.

Table 10: Airlines: Growth of Output, Factor Inputs and Productivity, (annual average growth rates)

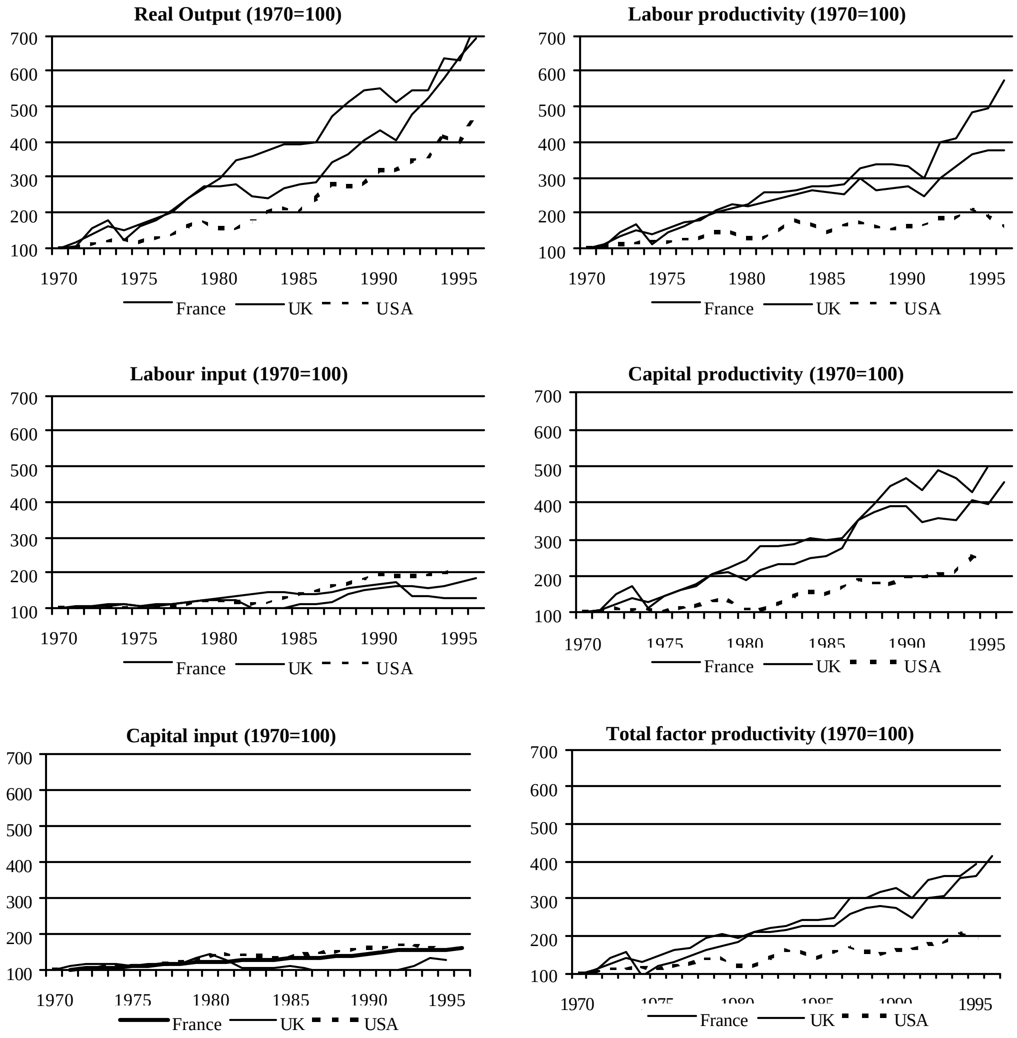
	Value Added			*Labour productivity*		
	France	**UK**	**USA**	**France**	**UK**	**USA**
1973-79	6.8	9.1	6.7	4.3	7.1	4.2
1979-89	7.4	4.0	4.8	4.7	1.8	0.6
1989-95	2.4	7.9	6.2	6.5	5.6	3.9
	Hours worked			*Capial productivity*		
	France	**UK**	**USA**	**France**	**UK**	**USA**
1973-79	2.5	1.9	2.4	2.0	6.8	3.7
1979-89	2.5	2.2	4.3	7.4	7.8	2.9
1989-95	-3.9	2.1	2.3	-1.7	2.1	5.8
	Capital services			*Total factor productivity*		
	France	**UK**	**USA**	**France**	**UK**	**USA**
1973-79	4.8	2.2	2.9	3.6	6.4	3.8
1979-89	-0.1	-3.5	1.9	5.7	4.4	0.8
1989-95	4.2	5.7	0.4	3.8	3.5	4.3

Sources: Annexes D, E and F.

In France, the growth of capital services in the 1970s was higher than that in other periods, as well as higher than in other countries. In the 1980s, capital services grew more slowly in all countries and became even negative in the UK; in the 1990s growth recovered except for the United States where it dropped to almost zero. Capital productivity grew fastest in France and the UK in the 1980s, compared to the 1990s in the United States. In France, capital productivity fell until 1995 when it started to grow again.

Total factor productivity grew always at rates above three percent, except for the USA in the 1980s. France experienced very high TFP growth in the 1980s, while the British airlines showed rapid progress in the prior decade.

Figure 16: Indices of Factor Inputs and Productivity, Airlines, 1993=100



Sources: Annexes D, E and F.

4.3.5. Road Freight, Road Passenger and Services Related to Transport

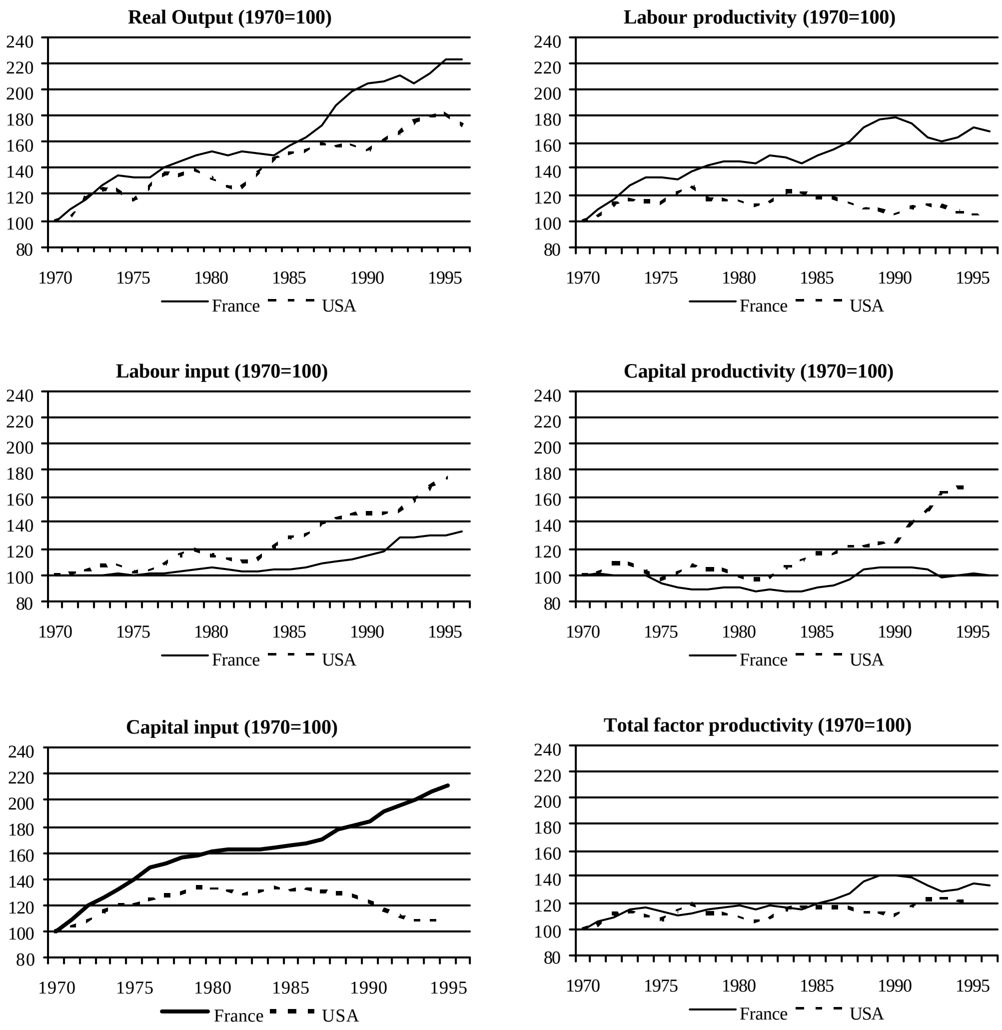
No series on labour and capital inputs are available for the other parts of transport in Germany and the United Kingdom. For the United States, O'Mahony (1999) merged the other transport sectors: trucking, urban and interurban passenger transport and transport services. Compared to the United States, employment in this part of transport grew at a far slower rate. The opposite was for the growth of output and volume of capital services. Labour productivity grew faster in France, and capital productivity increased less than in the USA. Total factor productivity gains were similar in both countries (see Table 11).

Table 11: Road Freight, Road Passenger, Transport Services: Growth of Output, Factor Inputs and Productivity (annual average growth rates)

	Value added		*Labour productivity*	
	France	**USA**	**France**	**USA**
1973-79	2.8	1.9	2.2	0.0
1979-89	2.9	1.3	2.0	-0.7
1989-95	1.9	2.4	-0.6	-0.5
	Hours worked		*Capital productivity*	
	France	**USA**	**France**	**USA**
1973-79	0.6	1.8	-1.7	-0.7
1979-89	0.8	2.0	1.6	1.8
1989-95	2.6	2.9	-0.7	5.1
	Capital services		*Total factor productivity*	
	France	**USA**	**France**	**USA**
1973-79	4.6	2.6	0.4	-0.3
1979-89	1.3	-0.5	1.8	0.1
1989-95	2.6	-2.6	-0.7	1.0

Sources: Annexes D, E and F.

Figure 17: Indices of Factor Inputs and Productivity, Other transport, 1970=100



Sources: Annexes D, E and F.

CONCLUSION

The main novelty of this study is the construction of a series of capital stocks and services for eight sub-sectors in French transport, hitherto unavailable, and the comparison of the productivity performance both between transport sectors and between France and other countries from 1970 onwards. Within a productivity framework, all variables are flows and therefore capital input should be measured by capital *services* and not by *stocks.* Only the former is consistent with other measures such as GDP and hours worked. Capital services are the product of the volume of capital services, at the level of individual assets assumed proportional to the net capital stock, and the cost of capital utilisation. The user cost equals the sum of depreciation, real interest and capital gains. In the first part of this study the variety of methods available to measure net capital stocks is discussed, of which direct surveys are considered the most reliable. As such surveys are not carried out in France, a second-best method was used which is referred to as the Perpetual Inventory Method (PIM). The PIM consists of cumulating gross fixed capital formation (GFCF) over the assumed asset life of an asset. GFCF equals acquisitions minus disposals. Net stocks were estimated by assuming geometric depreciation, a pattern that coincides with the evolution of prices of second-hand assets in transport.

The PIM has been used to measure net capital stocks in all sectors except for the stock of transport equipment in air and maritime transport. This is because airlines rely heavily on leased and (long term) rented capital. Capital stock estimates obtained with the PIM only cover *owned* assets and exclude leases and rentals. The PIM thus underestimates the capital stock *used* in production. The PIM also produces biased capital stock estimates for firms selling large shares of their assets before they reach the end of their asset life, because disposals are often not measured or underestimated. High asset turnovers are common in air transport, but also in maritime transport. In both sectors, instead of the PIM, administrative records were used.

For each of the eight sub-sectors of transport, the net stocks of infrastructure, transport equipment and other types of machinery and equipment were estimated for the period 1970-97. In fact, railways account for one third and transport services (airports, ports, toll roads) for one half of all transport infrastructure. Half of the stocks of transport equipment and other types of machinery and equipment are part of railways. In the past three decades, the shares of air transport and trucking in transport equipment increased, whereas that of water transport decreased. Capital services, i.e. the sum of net stocks of non-residential structures, transport and other equipment weighted by their user cost, grew fastest in air transport and trucking, whereas in inland water and maritime transport the volume of capital services fell.

The capital services estimates were used to analyse the productivity performance since the 1970s. Total factor productivity is estimated using the Tövrnqvist discrete approximation to the Divisia index. Between 1970 and 1997, labour productivity grew fastest in air and maritime transport. In the 1970s and the 1990s, capital productivity fell in all branches except air and maritime transport. In the 1980s, all branches showed minor capital productivity gains. Air and maritime transport also showed the best TFP performance.

The French performance was compared with that of Germany, the UK and the United States. It was found that the variance of productivity patterns across transport sectors in France resembled that of the other countries. Overall productivity gains in Germany and the United Kingdom were similar to those in France and the three European countries outperformed the USA. In all countries air transport was the branch with the highest productivity growth rates. The USA was the only country with large productivity gains in railways. France outperformed other countries in terms of productivity growth in air and maritime transport. In the other branches, productivity growth in France was below that of the other countries.

The net capital stock and services estimates presented here may be refined in various ways. Firstly, in the absence of specific information on asset lives and depreciation patterns by sub-sector of transport, American assumptions were used. This bias could be corrected if more information would be collected on the practices of French firms. Secondly, the use of administrative records to estimate stocks , which is more reliable than the PIM, could be extended to other sectors, such as railways, trucking, and urban and interurban passenger transport, as well as other countries. Thirdly, the estimation of benchmark stocks could be improved by extrapolating further backwards the GFCF series or by reviewing information contained in company's balance sheets. Fourthly, the estimation of capital services can be refined by including sector-specific data on interest and tax rates.

ANNEX A - FRENCH INDUSTRIAL CLASSIFICATION: NAP AND NAF

International Comparisons	French National Accounts	Nomenclature d'activité et de produit		Nomenclature des activités françaises
Railways	Rail transport	68 Transports ferroviares		601 Transports ferroviaires
Other inland transport	Road freight transport	6911 Transports de marchandises zone longue		602M Transports routiers de marchandises interurbains
		6912 Transports de marchandises zone courte		602L Transports routiers de marchandises de
		6924 Démenagements		602N Démenagements
		6925 Location de véhicules industriels		602P Locations de camions avec
	Road passenger transport	6921 Transports urbains de voyageurs		602A Transports urbains de voyageurs
		6922 Transports routiers de voyageurs	{	602B Transports routiers réguliers de voyageurs
			{	602G Autres transports routiers de voyageurs
		6923 Services de taxis		602E Transports de voyageurs par taxis
		6926 Transports par conduites		603 Transports par conduites
Water transport	Inland water transport	70 Navigation intérieure		612 Transport fluviaux
	Maritime transport	71 Transports maritimes et côtiers		611 Transports maritimes et côtiers
Air transport	Air transport	72 Transports aériens		62 Transports aériens
Other transport	Transportation Services	7302 Ports fluviaux et voies fluviales	}	632C Services portuaires, maritimes et fluviaux
		7303 Ports maritimes	}	
		7304 Aéroports		632E Services aéroportuaires
		7305 Exploitation d'ouvrages routiers à péages	}	632A Gestion d'infrastructures de transports terrestres
		7306 Exploitation des parkings	}	
		7307 Entrepôts autres que frigorifiques		631E Entreposage non-frigorifique
		7308 Entrepôts frigorifiques		631D Entreposage frigorifique
		7404 Manutention portuaire		631A Manutention portuaire
		7405 Manutention terrestre et fluvial		631B Manutention non-portuaire
		7401 Collecte de frèt maritime		634B Affretement
		7402 Collecte de frèt aérien		634A Messagerie, fret express
		7403 Collecte de frèt terrestre et fluvial		
		7406 Activitités spécifiques d'auxiliaires des transports	}	634C Organisation de transports internationaux
		7407 Activitités spécifiques d'auxiliaires des transports aériens	}	
		7409 Agences de voyage		633Z Agences de voyage
		Excluded from transport in NAP:		
				602C Téléphériques, remontées mécaniques
		Excluded from transport in NAF:		
		7410 Routage		
		Non-matched:		
		7301 Gares routières		
		7309 Remorquage et pilotage		
		7408 Autres auxiliares de transports		

ANNEX B - SERIES OF GROSS FIXED CAPITAL FORMATION

SNCF

The Société National de Chemin de Fer (SNCF) is the main railway company and had until recently the monopoly of rail transport. Five sources on investment and GFCF are available. Firstly, SNCF's annual report (*Rapport sur les comptes d'excercise* and *Bilan Annuell*) shows investment in sixteen types of assets both in Paris and surroundings (*Ile de France*) and the rest of the country. Investment in infrastructure is available only since 1970. Moreover, the report excludes major revisions and leased assets, which accounted for 30 to 50 per cent of total investment.

The second source is INSEE's national accounts, which provide gross fixed capital formation in two types of assets in 1970-76 and nine types from 1977 onwards. These data are the most comprehensive, as they include investment and disposals, major revisions and leased assets. The satellite accounts, a joint effort of INSEE and the Transport Ministry, show total GFCF from 1954 onwards. Moreover, for 1959 to 1967, a breakdown is presented into new investment and major revisions. Unfortunately national and satellite accounts data are poorly documented.

The remaining sources are individual studies, of which the most comprehensive is Quinet *et al.* (1994). They list investment in four types of infrastructure from 1946 to 1994. Lorentz (1987) shows investments in infrastructure and equipment for the 1971-85 period. Finally, Toutain (1967) presents total investment for the 1846-1950 period.

The investment data presented by INSEE surpass those of the other studies, mainly because INSEE is the only source which includes revisions and leased assets. For the period 1970-97 we therefore used the INSEE data. Total GFCF was extrapolated to 1954 using the satellite accounts data. GFCF in infrastructure for 1962-67 was also taken from the satellite accounts, while the 1946-62 period was estimated by the trend given by Quinet *et al.* (1994). GFCF in transport equipment in 1954-76 period was estimated by extrapolating the 1977 figure by the trend in investment in transport equipment given by the SNCF.

RATP

The *Régie Autonomne de Transports Parisiens* (RATP) provides rail, metro and bus transport in metropolitan Paris (*Ile de France*). Four sources on investment and GFCF at current prices of the RATP are available. Firstly, the RATP's annual report (*Rapport d'activité*) shows investment in four types of transport equipment, other equipment and infrastructure from 1950 onwards. Major revisions of infrastructure are included but not those of equipment. The report also excludes leased and rented assets, as well as disposals.

The second and most comprehensive source is INSEE's national accounts which show gross fixed capital formation in two asset types in 1970-76 and nine asset types from 1977 onwards. INSEE includes leased assets and major maintenance. An inconvenience is that INSEE's estimation methods are little transparent. The satellite accounts, co-produced by INSEE and the Transport Ministry, provide data on total investment from 1954 onwards.

The third type of sources available are individual studies: Quinet *et al.* (1994) show investment in infrastructure from 1960 to 1990, and Lorentz (1987) covers infrastructure and equipment investments in 1971-85.

A comparison shows that Lorentz, Quinet and INSEE's estimates on infrastructure investment are close. Those of RATP are substantially lower, mostly because it excluded several assets. The RATP shows larger investments in rolling stock than INSEE from 1977 to 1992 because the RATP excluded disposals. After 1992, the RATP data are inferior to those of INSEE, which originates from the exclusion of the former of leased equipment.

Our final series of GFCF are those of INSEE for 1977-97. Total and infrastructure GFCF in 1970-76 were also taken from INSEE. The residual was allocated over rolling stock and other equipment using RATP's investment data. Total GFCF in 192-69 was taken from the satellite accounts, and infrastructure investment from Quinet. The residual was allocated over rolling stock and other equipment as for the 1970-76 period. GFCF in 1950-1961 was estimated by extrapolation of the 1962 values by investment series of RATP.

OTHER URBAN AND INTERURBAN PASSENGER TRANSPORT

Urban and interurban passenger transport consists of public (except RATP) and private passenger transport by bus, subway and tramway, including taxis. Pipeline transport is also included in this category. The national accounts provide no data on this sector, while the satellite accounts, co-produced by INSEE and the Ministry of Transport, provide data on total investment and disposals in 1970-84, and total investment for the period 1954-69.

GFCF in 1985-97 was estimated using trends on public and private investment. Investment in urban transport (except roads) outside Paris is published by the CERTU (Centre d'Etudes sur les Reseaux, les Transports et l'Urbanisme", in *L'annuaire statistique des transports collectifs urbains*) from 1995 onwards. For earlier years, the only source on total investment is Lorentz (1987)[17], which covers the 1971-84 period. Infrastructure investment is available from the satellite accounts from 1980 onwards, and accounted for 60 per cent of total investment (as estimated by CERTU) in 1995 to 1997. Total investment was imputed using this share from 1985 to 1994. The difference between total and infrastructure investment was allocated over transport and other equipment using the private passenger transport shares.

Investment in private passenger transport is shown in the *Enquête annuelle d'entreprise* which covers the 1973-96 period. The EAE distinguishes three sub-sectors

[17] Quinet (1994) also shows investment in metro and tramway systems of several cities for 1974-90 period.

(urban passenger transport, other road passenger transport and taxis) and eight asset types. This survey covered all firms except those with less than 5 employees operating taxi services in the pre-1993 period. Investment data for taxis were only available for 1986, 1989 and 1993 to 1996. The 1993-96 data show that taxi firms with less than five employees accounted for eighty percent of total investment. The same share was used to estimate investment of taxi firms with less than five employees in 1986 and 1989. The years 1987-88 and 1990-92 were interpolated. Investment of all taxi firms from 1973 to 1985 was supposed to grow at the same rate as investment in the other two sub-sectors.

The total GFCF series for 1954-72 were disaggregated over infrastructure, transport and other equipment using the breakdown provided for the 1973-97 period. The data for the recent period show that of 40 per cent of total capital formation was in infrastructure, 50 per cent in transport equipment and 10 per cent in other equipment.

ROAD FREIGHT TRANSPORT

The national accounts provide no data on gross fixed capital formation in trucking. However, GFCF can be approximated by subtracting disposals from acquisitions as provided by the satellite accounts for the period 1970-96. Investment in trucks, as listed in the satellite accounts, was used to extrapolate the 1970 GFCF figure backwards to 1954. Trucks accounted for around 85 per cent of total investment, and are therefore representative for overall investment.

A second source is the annual firm survey *EAE* which distinguishes four sub-sectors (long and short distance trucking, removal companies, and rental companies for trucks and drivers), eight asset types and starts in 1973. For firms with less than five employees, the only breakdown available is between transport equipment and other assets. GFCF by asset type from 1973 to 1996 was estimated by using the EAE investment structure. The average investment shares in infrastructure, transport vehicles and other equipment for the 1973-96 period were applied to disaggregate total GFCF series for 1954-72.

Trucking firms increasingly lease or rent their equipment. Rentals were excluded here as they are mostly for less than a year and therefore are excluded from the capital stock. The ratio of leasing expenses to investment increased from 13 to 44 per cent between 1984 and 1996 (EAE, various issues). The Ministry of Transport (1995, 1998)[18] shows that the share of lease expenditure increased by the same proportion. Lease expenditures were entirely attributed here to GFCF in trucks. They were taken from the EAE and extrapolated back to 1973 using the 1984-93 trend.

Inland Water transport

Inland water transport is the smallest sector. Moreover, its size, in terms of its relative share in GDP and employment, declined continuously since the 1950s. The national

[18] It was supposed that 80 per cent of the leasing expenditure and 70 per cent of rentals corresponded to investment in transport equipment, while the remaining shares represent the cost of finance.

accounts provide no data on GFCF. Instead the satellite accounts provide data on investment and disposals for the period 1979-96, from which GFCF was estimated. No data were available on disposals between 1994-96, but it was assumed that they were the same as the average of 1990-93 (e.g. 60 million francs). Before 1970, total investment is available for 1954-60 and 1965-69. Total investment in 1961-64 was estimated using trends in purchases of vessels.[19]

A second source on investment is the annual firm survey *EAE*, available since 1974, which covers only firms with more than five employees. It provides a breakdown into eight asset types. Missing EAE data were missing for 1977, 1978 and 1981 were estimated by interpolation. The EAE data were used to extrapolate the 1979 GFCF figure to the period 1974-78. GFCF in 1970-73 was estimated by interpolation of the 1969 satellite accounts figure and the 1974 EAE data. Total GFCF data were disaggregated using the asset breakdown of the EAE. Before 1986, the EAE provides no breakdown of investment in infrastructure and other equipment. We used the averages of the 1986-96 shares to estimate investment in each of the two categories, e.g. one third of all investment less transport equipment was in infrastructure and two third was in other equipment.

Maritime Transport

The national accounts do not provide data on GFCF in maritime transport. Nevertheless, GFCF was estimated from data on investment and disposals in the satellite accounts for the period 1970-96. GFCF was extrapolated to 1962 with satellite accounts data on total investment. No data were available on disposals in 1994-96. They were estimated by the average ratio (e.g. 90 per cent) of disposals to investment in 1992 and 1993.

The EAE distinguishes two sub-sectors, sea and coastal transport. It is available since 1976 and covers only firms of more than five employees. The EAE was used to disaggregate total GFCF over the three asset categories for the period 1976-96: 97 per cent of total investment was in vessels and 3 per cent in other types of equipment. Infrastructure investment was almost zero. These shares were also used to allocate total GFCF over the three asset types in the period 1962-75.

Lorentz (1987) estimated investment in transport equipment which included the purchases of new and second hand ships, transformations and major reparations. His sources include a survey of the organisation of maritime transport (Comité Français des Armateurs de France, CCAF) and the annual firm survey EAE.

Satellite accounts and EAE data are unsuitable to estimate the stock of vessels, mostly because they do not account (or underestimate) the number and value of ships that leave the capital stock. As in the case of aircraft, numerous ships are sold long before their service life ends. Instead the stock of ships was estimated on the basis of administrative records. These registers on paper, maintained by the Secretariat of Maritime Transport, list

[19] Data for 1959-60 and 1965 showed that ships accounted for 70 per cent of total investment. This ratio was used to estimate total investment between 1961-64.

all vessels registered in France. The 1970 benchmark stock was estimated using the 1970 complete register with the following characteristics for each vessel: name, previous names, build year, ship type, transport capacity, names of current and former owners. Changes in the stock after 1970 were traced by quarterly published documents of the Transport Ministry showing ships that entered and left the stock, as well as changes of names, owners and transport capacity of vessels present in the stock.

The value of the vessel stock was estimated as follows The new value of vessels was derived Barry Rogliano Salles, which provided price information of vessels built between 1961 and 1998, broken down by vessel type, build year and transport capacity. Price information of ships built before 1961 was derived from various sources: *Etude sur les transports maritimes* (UNCTAD, various issues), *Lloyd's Shipping Economist* (Lloyds, various issues) and *Fearnleys Review* (Fearnleys, various issues). For some vessels, no price information was available. Instead their new value was estimated by prices of similar ships. When prices were not available for a particular build year of a ship, the missing year was estimated by extrapolation using a price deflator of similar ships. The historical construction values were in US$ and converted to French francs using the current exchange rate. The construction values at current prices were converted to constant prices using price deflators for investment in ships (see section 2.3).

These records include all vessels registered in France no matter in which economic activity they are used (e.g. fishing, maritime transport, etc.). For the purpose of this study, all vessels not owned by firms part of maritime transport had to be excluded. A list of maritime shipping companies was constructed on the basis of four business registers (ASTREE/DIANE[20], DAFSALIENS[21], SIRET and SIRENE[22]) Only those ships owned by firms present in at least on one of the registers were retained.

Finally, the gross stock of vessels was estimated by summing the constant replacement values of the vessels. For the estimation of the net stock, it was assumed that the productive capacity of ships decreased linearly over their lifetime. Although the productive capacity of ships probably follows a geometric pattern (see Fraumeni, 1997), we used a linear pattern. This is to compensate for the underestimation of investment in ships as major ship maintenance was not taken into account in our investment data.

[20] Database covering balance sheet data of half a million French firms edited by Van Dijk/SCRL.
[21] Database covering 100,000 subsidiaries of the 500 largest French firms edited by DAFSA.
[22] SIREN shows the identification number of firms, while SIRET presents identification numbers of establishments. Both databases are managed by INSEE.

Air Transport

Air transport is the fastest growing branch of transport, in terms of value added, employment, and capital formation. The two major airlines are Air France and Air Inter. The latter was absorbed by Air France in 1997 and renamed Air France Europe. Air France is a public firm, even though a minority share is privatised. Since deregulation in the late 1980s, new companies emerged such as Air Liberté, Air Outre Mer and Nouvelles Frontières. Several sources exist on capital formation. Firstly, INSEE provides GFCF data, broken down by thirteen asset types, for Air France and Air Inter separately since 1977. Total and infrastructure capital formation are also available for the 1970-76 period. INSEE includes both domestic and foreign leased assets. INSEE provides no data on other companies part of air transport. However, their investment in aircraft can be derived implicitly by the difference between GFCF in aircraft of the entire transport sector and that of Air France and Air Inter. INSEE data were used to estimate the stock of infrastructure and other equipment in Air France and Air Inter.

The INSEE data were used to derive a first estimate of the stock of aircraft of all airlines.[23] However, INSEE data on aircraft are incomplete as they exclude aeroplanes leased by companies other than Air France and Air Inter from foreign firms. These have become increasingly important over time and accounted for almost twenty percent of the value of the stock of aircraft in 1998 (see Section 3). In combination with other shortcomings, discussed in Section 3, administrative records were used in instead of INSEE figures to estimate the stock of aircraft (see below).

The second source is the transport satellite accounts which show GFCF in Air France and Air Inter, and investment and disposals of other air transport companies since 1970. The accounts also show total investment in air transport, used to extrapolate GFCF from 1970 to 1962. Total GFCF in 1962-70 was disaggregated with the average shares of the 1970s: 50 per cent in aircraft and other transport equipment, 10 per cent in other machinery and equipment and 40 per cent in infrastructure.

The third source is balance sheets of Air France and Air Inter (*Bilan annuel)*. Air Inter provides a more detailed asset breakdown than Air France. However, Air France also shows investment whereas Air Inter only publishes stock values. GFCF was estimated by the difference of the stock values of two consecutive years. These data were used to extrapolate GFCF data of Air Inter from 1970 to 1965.

The fourth source is the Annual Firm Survey EAE which covers all air transport firms including Air France and Air Inter. It provides a breakdown into eight asset types. EAE data were used to estimate GFCF in infrastructure and other equipment by airlines other than Air France and Air Inter in 1977-97. Moreover, the 1973 EAE was used to disaggregate total GFCF over the three asset categories for 1970-72.

[23] These series were extrapolated to 1962 using data on total investment in air transport (excluding leases) provided by the satellite accounts. As four-fifth of all investment is in aircraft, as illustrate the 1977-97 series, trends in total investment are representative for investment in aircraft alone.

The fifth source is administrative records used to estimate the stock of aircraft. The aircraft register, maintained by Airclaims, covers the majority of aircraft operated world-wide since the mid-1950s. Although updated on a monthly basis, we only used the listings of December 31st as aircraft have to figure at least one year in the registers in order to be considered part of the capital stock. Airclaims covers all aircraft operated in France, including leases and rentals. For each aircraft, the following characteristics are available: brand name and category (for example Airbus 319 or Boeing 727); status (on order, in use or in stock); serial number (specific to each model and builder); model; registration number; year of construction; motor type; name of the owner; name of the manager; name of the operator; year of registration. The age of the aircraft is given by the difference between the registration and build year.

The stock of aircraft in air transport was estimated as follows. Firstly, aircraft *operated* by firms not part of air transport were excluded using annual registers of airlines furnished by the Ministry of Transport. Subsequently the worth of the stock of aircraft had to be estimated, as the Airclaims database provides no information on values. Each aircraft's value was estimated as follows. Firstly, the historical construction cost of each aeroplane, specified by brand, model, build year, and serial number was taken from the *Airliner Price Guide*. Prices of those models excluded from the *Airliner Price Guide* were estimated by Airclaims on the basis of other sources or prices of similar aircraft. All prices were in US dollars, and converted to French francs with the current exchange rate (drawn from CEPII's CHELEM database).

Secondly, historical construction prices were converted into constant replacement prices by deflators on investment in aircraft by airlines provided by INSEE for the period 1977-97. These deflators were extrapolated to 1959 by price deflators for investment in aircraft, ship and arms manufacturing. For the 1950-59 period, it was supposed that aircraft prices increased at the same rate as those all transport equipment as given in O'Mahony (1999). Thirdly, the gross stock was estimated by summing the values of all aircraft at constant prices. For the net stock, it was supposed that the value of aircraft decreased constantly over its lifetime (see Section 3 for more details).

Transport Services

Transport services is a mixture of activities. It contains the operation of large parts of the transport infrastructure: airports and other air navigation systems, canals, car parks, ports, and toll roads. Moreover, this sector includes many supporting services to transport, such as the organisation and handling of goods transport, travel agencies, warehouses, and miscellaneous supporting services.

The national as well as the satellite accounts provide no data on GFCF, acquisitions or disposals of this sector as a whole. However, the satellite accounts provide information on public investment in transport infrastructure such as airports, canals, ports and toll roads. These series start at different dates between 1965 and 1980. Other sources on infrastructure investment include organisations such as *Aéroports de Paris* (owner and operator of the

Charles de Gaulle and Orly airports), and specific studies such as Quinet *et al.* (1994) who estimated investment in canals and ports.

Investment by goods handling services, travel agencies[24] and non-refrigerated warehouses[25] can be estimated using data of the annual enterprise survey EAE for the period 1982-96. No data are available for miscellaneous supporting services.

[24] Investment data from started only in 1982. For the period 1973-81, it was assumed that infrastructure investment by travel agencies as a share of total infrastructure investment in transport services was the same as the period 1982-95. Investment in transport and other equipment from 1973 to 1981 was estimated by assuming that their proportion to investment in infrastructure was the same as for the 1982-96 period: 16 and 50 per cent respectively.

[25] Non-refrigerated warehouses were included in the EAE only since 1993. The data for the 1993-96 period show that investment in infrastructure represented 3 per cent of total investment. This share has been assumed representative for the periods 1973-92 and 1997-98. Investment in transport and other equipment from 1973-92 was estimated by assuming that their proportion to investment in infrastructure was the same as for the 1993-96 period: 13 and 25 per cent respectively.

ANNEX C - CAPITAL FORMATION AT CONSTANT AND CURRENT PRICES

Table C.1: Gross Fixed Capital Formation at Current & Constant Prices, SNCF

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment
1946		487				4 419		
1947		686				6 231		
1948		595				5 401		
1949		664				6 027		
1950	1 042	531	383	128	7 961	4 825	2 288	847
1951	727	403	243	81	4 568	3 040	1 115	413
1952	519	410	82	27	2 892	2 471	307	114
1953	1 004	535	352	117	5 256	3 260	1 457	539
1954	1 897	589	544	764	9 471	3 589	2 299	3 583
1955	1 777	819	666	293	8 977	4 854	2 771	1 352
1956	1 818	904	814	99	8 787	5 153	3 202	433
1957	2 008	837	996	174	8 848	4 392	3 730	725
1958	2 214	1 011	1 082	121	8 855	4 909	3 509	437
1959	2 352	1 057	1 658	304	10 982	4 947	5 014	1 020
1960	2 552	1 134	933	486	9 586	5 249	2 760	1 577
1961	2 600	1 054	959	587	9 149	4 587	2 700	1 862
1962	2 648	1 324	996	328	9 226	5 471	2 743	1 012
1963	2 944	1 522	1 045	377	9 764	5 849	2 794	1 120
1964	3 357	1 547	1 219	591	10 600	5 625	3 254	1 722
1965	3 564	1 498	1 481	585	10 919	5 298	3 958	1 663
1966	3 627	1 529	1 608	490	10 840	5 269	4 200	1 370
1967	3 669	1 578	1 639	452	10 740	5 249	4 269	1 223
1968	3 479	1 668	1 276	535	10 363	5 266	3 554	1 544
1969	3 451	1 763	1 142	546	9 925	5 332	3 066	1 527
1970	3 514	1 863	1 174	477	9 502	5 276	3 004	1 222
1971	3 512	1 887	1 208	416	8 902	5 017	2 888	997
1972	3 264	1 555	1 345	364	7 749	3 880	3 045	824
1973	3 930	1 737	1 503	690	8 733	3 962	3 268	1 503
1974	4 723	2 098	1 997	628	9 157	4 129	3 824	1 204
1975	6 077	2 533	2 509	1 035	10 273	4 392	4 161	1 720
1976	6 657	2 653	2 828	1 176	10 078	4 089	4 228	1 761
1977	7 618	3 364	3 431	823	10 327	4 613	4 607	1 107
1978	8 683	4 314	3 492	877	10 906	5 441	4 376	1 089
1979	9 238	4 851	3 433	954	10 489	5 538	3 881	1 070
1980	10 668	5 678	3 810	1 180	10 668	5 678	3 810	1 180
1981	12 701	6 352	4 914	1 435	11 405	5 749	4 351	1 305
1982	13 260	6 659	5 109	1 492	10 679	5 415	4 035	1 229
1983	14 314	6 974	5 681	1 659	10 564	5 270	4 062	1 232
1984	13 853	6 997	5 190	1 666	9 638	4 967	3 512	1 159
1985	13 388	6 693	5 070	1 625	8 866	4 524	3 272	1 070
1986	15 800	8 064	5 860	1 876	10 194	5 320	3 678	1 196
1987	15 594	8 970	4 985	1 639	9 922	5 738	3 164	1 020
1988	18 192	9 321	6 779	2 092	10 921	5 778	3 899	1 244
1989	18 107	9 277	6 757	2 073	10 731	5 606	3 938	1 187
1990	23 117	11 844	8 652	2 621	13 369	6 991	4 898	1 480
1991	27 354	14 114	10 176	3 064	15 219	8 010	5 492	1 717
1992	30 148	12 833	13 332	3 983	16 559	7 185	7 131	2 243
1993	24 272	12 926	8 715	2 631	13 148	7 138	4 509	1 501
1994	20 404	10 102	7 913	2 389	10 799	5 530	3 911	1 358
1995	19 286	9 718	7 351	2 217	10 185	5 258	3 679	1 248
1996	22 953	10 664	9 453	2 836	12 090	5 699	4 773	1 618

1997	22 957	8 235	11 333	3 389	12 200	4 333	5 963	1 904

Table C.2: Gross Fixed Capital Formation at Current & Constant Prices, RATP

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment
1950	78	71	7	1	583	511	65	7
1951	51	39	11	1	323	233	84	6
1952	80	68	10	2	402	327	59	15
1953	57	41	13	2	309	200	89	20
1954	153	135	14	3	784	654	99	31
1955	117	91	24	2	611	429	161	21
1956	86	52	31	2	455	235	200	19
1957	48	9	37	3	280	36	222	21
1958	118	72	42	4	527	278	220	29
1959	88	34	52	3	399	126	254	19
1960	76	52	14	10	323	191	69	63
1961	106	83	6	17	418	288	29	101
1962	174	136	10	28	658	448	43	167
1963	233	139	54	41	887	425	233	229
1964	234	181	23	31	792	524	98	170
1965	394	283	74	37	1 320	798	322	200
1966	603	443	108	51	1 951	1 218	460	273
1967	764	578	123	63	2 378	1 533	520	325
1968	921	707	119	95	2 839	1 781	536	521
1969	960	724	124	111	2 881	1 748	541	593
1970	798	719	49	30	1 974	1 624	204	145
1971	852	792	43	17	1 916	1 545	251	121
1972	887	751	88	48	1 698	1 194	305	198
1973	1 219	1 032	133	54	1 834	1 220	415	200
1974	1 321	1 100	153	68	1 921	1 271	426	224
1975	1 465	1 173	201	91	2 112	1 352	496	264
1976	1 708	1 386	226	96	2 031	1 259	516	256
1977	1 861	1 577	236	48	2 121	1 420	566	135
1978	1 811	1 588	208	15	2 345	1 675	538	133
1979	2 005	1 586	325	94	2 312	1 705	477	131
1980	2 360	1 748	468	144	2 360	1 748	468	144
1981	2 251	1 556	547	148	2 464	1 770	534	159
1982	2 456	1 639	643	174	2 313	1 667	496	150
1983	2 443	2 023	329	91	2 272	1 622	499	150
1984	2 087	2 018	53	16	2 102	1 529	431	141
1985	2 684	1 872	639	173	1 925	1 393	402	131
1986	2 197	1 852	271	74	2 236	1 638	452	146
1987	2 659	1 558	869	232	2 280	1 766	389	124
1988	2 321	2 074	190	57	2 410	1 779	479	152
1989	2 209	1 974	180	55	2 354	1 726	484	145
1990	3 240	2 895	269	76	2 934	2 152	602	181
1991	3 456	3 101	277	78	3 350	2 466	675	210
1992	3 873	2 820	837	216	3 362	2 212	876	274
1993	5 070	2 840	1 779	451	2 935	2 197	554	183
1994	4 983	2 220	2 200	563	2 349	1 702	480	166
1995	5 680	2 135	2 827	718	2 223	1 619	452	152
1996	4 985	2 342	2 091	552	2 538	1 754	586	197
1997	5 147	1 809	2 655	683	2 299	1 334	732	232

Table C.3: Gross Fixed Capital Formation at Current & Constant Prices, Other Urban and Interurban Passenger Transport (excl. RATP)

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment
1954	136	54	68	14	731	390	279	62
1955	145	58	73	15	776	418	292	65
1956	160	64	80	16	761	388	305	68
1957	174	70	87	17	775	389	316	71
1958	193	77	97	19	750	378	303	68
1959	234	94	117	23	851	431	343	77
1960	252	101	126	25	901	460	361	80
1961	267	107	133	27	919	473	364	82
1962	308	123	154	31	1,023	518	411	93
1963	342	137	171	34	1,069	527	443	99
1964	342	137	171	34	1,035	496	442	97
1965	350	140	175	35	1,033	483	453	97
1966	385	154	193	39	1,109	516	487	105
1967	415	166	208	42	1,179	546	524	110
1968	456	182	228	46	1,315	572	615	128
1969	506	202	253	51	1,390	594	658	138
1970	529	212	265	53	1,387	599	656	132
1971	1,094	438	547	109	2,683	1,164	1,265	255
1972	1,989	796	995	199	4,606	1,985	2,181	439
1973	1,782	479	1,099	204	3,947	1,093	2,404	450
1974	1,003	391	533	79	1,944	770	1,022	153
1975	1,522	644	766	112	2,606	1,117	1,298	191
1976	2,266	862	1,337	67	3,439	1,328	2,009	101
1977	4,597	1,778	2,643	176	6,268	2,438	3,589	241
1978	1,943	646	1,213	84	2,435	815	1,516	104
1979	3,238	1,596	1,569	73	3,670	1,822	1,765	83
1980	2,477	1,042	1,370	65	2,477	1,042	1,370	65
1981	2,427	1,072	1,303	52	2,200	970	1,183	47
1982	2,507	1,563	878	66	2,041	1,271	718	52
1983	2,851	1,531	1,187	133	2,141	1,157	888	96
1984	2,600	1,342	992	266	1,848	953	714	181
1985	4,265	2,173	1,589	503	2,894	1,469	1,100	325
1986	3,406	1,382	1,560	464	2,200	912	1,002	286
1987	3,512	1,509	1,569	434	2,188	964	965	259
1988	3,389	1,249	1,601	539	2,052	773	961	318
1989	3,229	971	1,627	631	1,876	585	931	360
1990	3,326	983	1,621	722	1,874	579	897	398
1991	3,646	1,117	1,750	779	1,981	633	939	410
1992	5,299	2,351	1,905	1,043	2,844	1,315	986	543
1993	4,427	1,214	2,377	836	2,341	670	1,235	437
1994	4,820	1,413	2,460	947	2,513	772	1,239	502
1995	4,231	1,129	2,106	997	2,153	610	1,014	529
1996	4,955	1,807	2,293	855	2,524	964	1,109	451

Table C.4: Gross Fixed Capital Formation at Current & Constant Prices, Road Goods Transport

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment
1954	138	14	96	28	620	99	395	126
1955	173	17	121	35	770	125	489	156
1956	201	20	141	40	830	122	537	171
1957	238	24	166	48	929	133	604	193
1958	254	25	178	51	862	125	559	178
1959	271	27	190	54	860	125	557	178
1960	295	29	206	59	912	134	591	186
1961	363	36	254	73	1,078	161	693	224
1962	396	40	277	79	1,145	166	740	238
1963	480	48	336	96	1,334	185	871	278
1964	545	55	382	109	1,495	198	988	310
1965	507	51	355	101	1,376	175	920	281
1966	558	56	391	112	1,480	187	989	304
1967	602	60	421	120	1,578	198	1,063	317
1968	661	66	463	132	1,828	207	1,249	372
1969	733	73	513	147	1,951	215	1,336	400
1970	820	82	574	164	2,066	232	1,424	410
1971	969	97	678	194	2,277	258	1,568	451
1972	1,207	121	845	241	2,688	301	1,853	533
1973	1,536	127	906	504	3,382	290	1,981	1,111
1974	1,521	123	929	469	2,929	242	1,781	906
1975	1,157	65	683	409	1,968	112	1,157	698
1976	1,990	78	1,787	125	2,994	121	2,684	189
1977	2,295	111	2,034	150	3,121	153	2,762	206
1978	2,422	93	2,161	167	3,025	118	2,701	207
1979	2,116	119	1,878	120	2,383	135	2,112	136
1980	2,931	182	2,570	179	2,931	182	2,570	179
1981	2,575	158	2,268	148	2,335	143	2,059	133
1982	3,567	193	3,157	217	2,909	157	2,582	169
1983	3,638	197	3,183	258	2,716	149	2,382	186
1984	3,906	195	3,445	265	2,797	139	2,478	181
1985	3,575	137	3,184	255	2,462	93	2,205	164
1986	4,794	230	4,174	390	3,073	152	2,682	240
1987	6,211	338	5,389	483	3,819	216	3,315	288
1988	7,068	412	6,125	531	4,246	255	3,677	314
1989	10,187	586	8,888	713	5,842	353	5,082	407
1990	7,738	434	6,840	463	4,296	256	3,784	256
1991	6,929	336	6,298	295	3,724	190	3,379	155
1992	10,660	359	9,613	689	5,536	201	4,977	359
1993	9,121	265	8,325	532	4,749	146	4,325	278
1994	9,427	446	8,441	540	4,780	244	4,249	287
1995	12,845	710	11,250	885	6,269	384	5,416	469

1996	10,933	855	9,530	547	5,355	456	4,610	289

Table C.5: Gross Fixed Capital Formation at Current & Constant Prices, Inland Water Transport

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment
1954	34	3	24	7	148	24	93	31
1955	42	4	29	8	181	30	113	38
1956	42	4	29	8	168	25	107	36
1957	51	5	36	10	193	28	123	41
1958	60	6	42	12	197	29	126	42
1959	65	3	57	5	189	12	159	17
1960	57	7	37	13	176	30	104	42
1961	61	6	43	12	184	27	118	38
1962	61	6	43	12	181	26	118	37
1963	80	8	56	16	230	31	152	46
1964	73	7	51	15	208	26	140	41
1965	73	6	56	11	203	20	152	31
1966	72	7	50	14	198	24	135	39
1967	72	7	50	14	195	24	133	38
1968	75	8	53	15	205	24	139	42
1969	85	9	60	17	225	25	154	46
1970	54	5	38	11	136	15	94	27
1971	34	3	24	7	81	9	56	16
1972	22	2	15	4	48	5	33	10
1973	14	1	10	3	30	3	21	6
1974	9	0	8	0	17	0	16	1
1975	20	3	11	6	34	5	18	10
1976	22	0	21	1	33	0	31	1
1977	21	1	18	2	29	1	25	3
1978	21	2	15	3	24	2	17	4
1979	20	2	13	4	24	3	16	5
1980	26	2	19	5	26	2	19	5
1981	67	6	49	12	60	5	44	11
1982	55	5	40	10	43	4	32	8
1983	138	20	79	40	97	15	54	28
1984	96	6	78	12	77	4	64	8
1985	- 41	- 1	- 38	- 2	- 31	- 1	- 29	- 1
1986	11	1	7	3	7	1	5	2
1987	146	9	125	11	100	6	87	7
1988	- 12	- 1	- 10	- 0	- 4	- 1	- 3	- 0
1989	98	13	81	5	109	8	99	3
1990	91	13	63	15	95	8	79	8
1991	123	5	101	18	124	3	112	9
1992	244	10	147	86	208	6	158	45
1993	175	39	67	69	125	22	67	36
1994	164	23	76	66	118	12	71	35
1995	177	9	70	97	123	5	67	52
1996	152	7	34	111	95	4	33	59

Table C.6: Gross Fixed Capital Formation at Current & Constant Prices, Maritime Transport

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment
1962	476		461	14	1,310		1,267	43
1963	229		222	7	623		604	20
1964	347		337	10	955		926	30
1965	353		343	11	963		933	29
1966	457		444	14	1,226		1,188	37
1967	410		397	12	1,083		1,051	32
1968	446		432	13	1,182		1,145	38
1969	501		486	15	1,298		1,257	41
1970	728		706	22	1,818		1,763	55
1971	1,453		1,409	44	3,382		3,280	102
1972	714		693	21	1,576		1,529	47
1973	1,746		1,694	52	3,846		3,730	115
1974	2,062		2,000	62	3,981		3,861	120
1975	2,364		2,293	71	4,033		3,912	121
1976	1,963		1,911	52	2,968		2,890	78
1977	1,984		1,929	55	2,712		2,637	75
1978	1,810		1,720	90	2,047		1,936	111
1979	- 328		- 310	- 18	- 397		- 377	- 21
1980	343		296	47	343		296	47
1981	887		790	97	797		709	87
1982	1,941		1,658	283	1,515		1,293	221
1983	144		138	5	99		95	4
1984	1,025		923	102	828		759	70
1985	-1,220		- 489	- 731	- 841		- 370	- 472
1986	1,086		332	754	683		218	464
1987	- 938		- 233	- 705	- 582		- 162	- 420
1988	- 141		- 74	- 67	- 62		- 22	- 40
1989	816		333	483	685		409	275
1990	1,287		944	343	1,369		1,180	189
1991	1,969		1,318	651	1,807		1,465	342
1992	396		318	78	380		340	41
1993	374		225	149	305		227	78
1994	243		159	84	194		150	44
1995	178		119	59	144		113	31
1996	344		248	96	286		235	51

* These series were not used to estimate the stock of ships in maritime transport. Instead administrative records were used as described in Section 3.

Table C.7: Gross Fixed Capital Formation at Current & Constant Prices, Air Transport (Including Air France and Air Inter)

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment
1962	370	148	185	37	1,162	611	443	109
1963	371	148	185	37	1,114	570	440	105
1964	266	106	133	27	779	386	319	74
1965	280	112	140	28	803	395	332	76
1966	380	152	190	38	1,070	524	445	101
1967	428	171	214	43	1,173	569	494	110
1968	780	312	390	78	2,101	985	902	214
1969	870	348	435	87	2,265	1,052	982	231
1970	773	572	184	17	2,062	1,621	401	40
1971	496	187	286	23	1,137	498	586	54
1972	764	576	174	14	1,782	1,437	315	29
1973	1,210	615	541	54	2,674	1,403	1,143	128
1974	1,498	557	856	84	2,935	1,097	1,656	182
1975	1,466	562	841	63	2,623	975	1,521	128
1976	2,090	249	1,716	126	3,217	383	2,618	215
1977	1,981	395	1,633	398	3,041	542	1,963	536
1978	1,664	407	1,663	291	2,759	512	1,894	353
1979	2,376	109	2,060	244	2,641	124	2,246	271
1980	3,413	507	3,315	340	4,163	507	3,315	340
1981	4,977	595	4,214	570	4,854	540	3,794	520
1982	4,218	480	3,534	541	3,580	390	2,747	442
1983	3,627	527	3,173	466	2,877	399	2,128	350
1984	2,427	661	2,490	287	2,338	466	1,674	199
1985	3,164	473	3,019	344	2,433	320	1,882	231
1986	4,612	286	4,018	505	2,426	188	1,903	335
1987	6,788	1,568	3,787	1,913	3,815	1,002	1,593	1,219
1988	8,220	1,927	7,854	1,156	5,085	1,191	3,169	725
1989	9,187	1,918	8,920	1,086	5,725	1,157	3,904	663
1990	9,175	1,910	8,950	984	5,784	1,130	4,061	593
1991	12,161	2,461	11,677	1,330	7,393	1,395	5,211	787
1992	10,018	974	8,883	989	4,886	546	3,756	585
1993	11,436	1,408	10,683	889	5,597	777	4,302	519
1994	6,338	2,225	6,610	480	4,036	1,218	2,556	262
1995	14,409	3,173	11,447	1,312	7,090	1,714	4,612	764
1996	11,457	386	9,478	920	4,406	207	3,738	461
1997	11,446	547	9,993	908	4,513	288	3,689	536

* These series were not used to estimate the stock of aircraft. Instead administrative records were used as described in Section 3.

Table C.8: Gross Fixed Capital Formation at Current & Constant Prices, Air France

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment
1970	547	100	8	655	1,786	1,549	219	18
1971	158	219	16	393	906	420	448	38
1972	548	120	9	677	1,604	1,368	218	18
1973	504	129	10	643	1,447	1,150	273	23
1974	317	666	50	1,033	2,023	624	1,290	109
1975	346	719	54	1,119	2,012	600	1,302	110
1976	135	1,257	95	1,487	2,292	208	1,921	162
1977	151	1,070	104	1,325	1,633	207	1,286	140
1978	50	825	160	1,035	1,198	63	940	195
1979	52	1,411	120	1,583	1,732	59	1,539	134
1980	89	2,005	133	2,227	2,227	89	2,005	133
1981	169	2,220	163	2,552	2,300	153	1,999	148
1982	169	2,120	156	2,445	1,912	137	1,648	127
1983	99	1,600	117	1,816	1,236	75	1,073	88
1984	95	1,350	97	1,542	1,042	67	907	68
1985	86	2,119	153	2,358	1,481	58	1,321	102
1986	137	2,865	209	3,211	1,585	90	1,357	138
1987	779	693	51	1,523	823	498	292	33
1988	373	3,763	278	4,414	1,925	231	1,520	174
1989	318	3,215	236	3,769	1,745	192	1,408	145
1990	305	3,085	228	3,618	1,718	180	1,400	138
1991	545	5,532	408	6,485	3,020	309	2,470	241
1992	496	4,567	335	5,398	2,407	278	1,931	198
1993	500	3,290	241	4,031	1,741	276	1,325	140
1994	390	-1,202	- 87	- 899	- 299	213	- 468	- 44
1995	376	1,856	137	2,369	1,030	203	748	79
1996	413	- 588	- 43	- 218	- 33	221	- 232	- 22
1997	319	2,835	207	3,361	1,337	168	1,047	122

* These series were not used to estimate the stock of aircraft. Instead administrative records were used as described in Section 3.

Table C.9: Gross Fixed Capital Formation at Current & Constant Prices, Air Inter

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment *	Other machinery & equipment
1965	3	2	-1	2	10	8	-2	4
1966	75	31	42	2	212	105	102	4
1967	171	-5	174	2	404	-17	415	6
1968	7	-15	20	2	7	-47	48	6
1969	-4	1	-7	2	-8	2	-16	6
1970	9	5	4	0	23	14	8	1
1971	27	15	11	1	65	40	23	2
1972	29	17	11	1	64	42	20	2
1973	22	9	12	1	48	21	25	2
1974	256	191	60	5	500	376	114	9
1975	248	209	36	3	431	362	64	5
1976	173	81	86	6	264	125	128	11
1977	241	91	113	37	310	125	136	49
1978	357	12	328	17	408	15	373	20
1979	26	6	4	16	28	7	4	17
1980	386	9	355	22	386	9	355	22
1981	211	13	179	19	192	12	161	19
1982	176	13	148	15	139	11	115	13
1983	282	8	249	25	191	6	167	18
1984	530	10	471	49	357	7	317	33
1985	352	10	310	32	222	7	193	22
1986	102	33	62	7	57	22	29	6
1987	247	113	120	14	130	72	50	8
1988	1432	25	1260	147	614	15	507	92
1989	1442	25	1270	147	658	15	555	88
1990	1408	23	1239	146	662	14	562	86
1991	1744	32	1531	181	807	18	682	107
1992	435	29	364	42	196	16	154	26
1993	813	29	701	83	348	16	282	50
1994	1571	23	1383	165	653	13	538	102
1995	803	22	698	83	345	12	281	52
1996	-357	24	-340	-41	-148	13	-134	-27
1997	0	19	-18	-1	2	10	-7	-1

* These series were not used to estimate the stock of aircraft. Instead administrative records were used as described in Section 3.

Table C.10: GFCF at Current & Constant Prices, Transport Services

	Gross fixed capital formation at current prices (million French francs)				Gross fixed capital formation at constant prices (million 1980 French francs)			
	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment	TOTAL	Non-residential structures	Transport equipment	Other machinery & equipment
1950		555				5,035		
1951		364				2,745		
1952		379				2,285		
1953		403				2,457		
1954		447				2,723		
1955		474				2,811		
1956		458				2,609		
1957	448	431	4	13	2,329	2,261	16	52
1958	508	488	5	15	2,438	2,372	15	51
1959	726	698	7	21	3,353	3,264	20	69
1960	889	855	9	26	4,063	3,958	25	81
1961	924	888	9	27	3,973	3,866	24	82
1962	852	819	8	25	3,479	3,384	22	74
1963	944	908	9	27	3,592	3,489	24	79
1964	1,031	991	10	30	3,714	3,604	26	84
1965	1,240	1,192	12	36	4,346	4,216	31	99
1966	1,626	1,563	16	47	5,555	5,388	40	128
1967	1,985	1,909	19	57	6,549	6,350	48	151
1968	2,207	2,122	21	64	6,936	6,700	57	179
1969	2,298	2,210	22	66	6,922	6,684	57	181
1970	2,639	2,537	25	76	7,438	7,185	63	190
1971	3,600	3,461	35	104	9,525	9,203	80	242
1972	3,915	3,765	38	113	9,726	9,394	83	250
1973	4,820	4,646	53	121	10,981	10,600	115	266
1974	5,981	5,746	81	155	11,762	11,308	154	300
1975	7,736	7,489	70	177	13,406	12,984	119	303
1976	7,163	6,863	74	226	11,032	10,579	111	342
1977	7,671	7,363	96	212	10,516	10,096	131	289
1978	6,665	6,407	75	183	8,401	8,080	94	227
1979	7,091	6,809	100	182	8,093	7,774	112	207
1980	5,880	5,588	97	195	5,880	5,588	97	195
1981	8,878	8,473	149	256	8,033	7,668	135	229
1982	8,407	8,091	116	200	6,832	6,580	95	156
1983	7,242	6,957	107	179	5,465	5,257	80	129
1984	7,335	7,050	94	190	5,202	5,004	68	129
1985	7,344	6,941	172	231	4,960	4,691	119	149
1986	8,021	7,600	156	266	5,278	5,014	100	164
1987	9,303	8,721	192	390	5,921	5,570	118	232
1988	11,031	10,370	182	479	6,810	6,417	109	283
1989	13,305	12,626	233	446	8,003	7,616	133	254
1990	14,809	14,124	239	445	8,701	8,323	132	246

1991	16,961	16,202	280	479	9,580	9,179	150	252
1992	18,497	17,751	265	481	10,314	9,926	137	251
1993	19,633	18,822	288	523	10,807	10,384	149	273
1994	19,763	18,693	507	564	10,776	10,221	255	299
1995	21,554	20,747	259	549	11,625	11,209	125	291
1996	24,388	23,761	244	383	12,994	12,674	118	202

ANNEX D – GROSS AND NET CAPITAL STOCKS

Table D.1: Gross and Net Capital Stocks, Railways (SNCF), 1970-97 (million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	104 656	85 180	71 617	47 894	19 683	11 260	195 957	144 334
1971	109 421	88 246	73 502	48 275	19 525	10 981	202 448	147 501
1972	113 024	90 105	75 336	48 793	19 045	10 560	207 405	149 458
1973	116 684	92 003	77 291	49 507	19 490	10 865	213 464	152 375
1974	120 486	94 024	79 774	50 739	19 684	10 838	219 944	155 601
1975	124 525	96 263	82 461	52 244	20 297	11 329	227 283	159 836
1976	128 236	98 146	85 007	53 737	20 808	11 806	234 051	163 690
1977	132 446	100 511	87 680	55 532	20 489	11 574	240 616	167 617
1978	137 459	103 650	89 831	57 001	20 103	11 351	247 393	172 002
1979	142 569	106 814	91 348	57 898	19 748	11 134	253 666	175 846
1980	147 819	110 045	92 759	58 677	19 549	11 052	260 127	179 774
1981	153 140	113 273	94 500	59 957	19 402	11 104	267 042	184 334
1982	158 127	116 093	95 949	60 853	19 163	11 074	273 239	188 021
1983	162 969	118 704	97 387	61 730	19 031	11 051	279 387	191 485
1984	167 508	120 952	98 127	62 010	18 946	10 957	284 581	193 919
1985	171 604	122 705	98 401	62 036	18 753	10 785	288 758	195 527
1986	176 496	125 215	98 917	62 467	18 689	10 758	294 102	198 440
1987	181 805	128 084	98 769	62 361	18 424	10 559	298 998	201 004
1988	186 856	130 928	99 226	62 996	18 349	10 606	304 431	204 530
1989	191 569	133 535	99 625	63 636	18 234	10 590	309 427	207 762
1990	197 480	137 467	101 000	65 203	18 398	10 870	316 878	213 540
1991	204 150	142 328	103 009	67 282	18 765	11 354	325 924	220 965
1992	209 717	146 253	106 840	70 891	19 703	12 310	336 260	229 454
1993	215 004	150 041	108 037	71 689	19 885	12 416	342 927	234 146
1994	218 419	152 134	108 605	71 847	19 995	12 366	347 019	236 348
1995	221 297	153 907	108 893	71 766	20 070	12 212	350 260	237 885
1996	224 332	156 081	110 182	72 782	20 507	12 446	355 021	241 308
1997	225 756	156 838	112 578	74 935	21 233	12 939	359 567	244 712

Table D.2: Gross and Net Capital Stocks, Road Freight Transport, 1970-97 (million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	4 636	3 670	11 994	6 090	3 681	2 334	20 312	12 094
1971	4 830	3 839	12 993	6 613	3 951	2 504	21 774	12 956
1972	5 060	4 048	14 245	7 331	4 293	2 735	23 598	14 114
1973	5 273	4 241	15 599	8 054	5 202	3 515	26 074	15 810
1974	5 432	4 381	16 690	8 453	5 887	3 997	28 009	16 831
1975	5 455	4 388	17 070	8 159	6 338	4 213	28 863	16 761
1976	5 478	4 403	18 912	9 443	6 261	3 893	30 651	17 740
1977	5 524	4 451	20 772	10 584	6 184	3 629	32 481	18 664
1978	5 525	4 462	22 507	11 468	6 093	3 398	34 125	19 328
1979	5 544	4 490	23 577	11 612	5 912	3 124	35 034	19 226
1980	5 610	4 564	25 036	12 189	5 757	2 926	36 403	19 679
1981	5 639	4 597	25 882	12 156	5 529	2 706	37 051	19 459
1982	5 684	4 644	27 137	12 652	5 309	2 549	38 129	19 844
1983	5 724	4 681	28 032	12 862	5 061	2 427	38 818	19 970
1984	5 755	4 708	28 878	13 132	4 661	2 315	39 294	20 154
1985	5 740	4 687	29 361	13 083	4 143	2 200	39 245	19 970
1986	5 782	4 726	30 375	13 519	3 643	2 174	39 800	20 420
1987	5 886	4 829	31 798	14 514	3 244	2 200	40 929	21 542
1988	6 027	4 968	33 402	15 700	2 936	2 248	42 365	22 915
1989	6 264	5 202	36 267	18 087	2 901	2 383	45 432	25 672
1990	6 402	5 333	37 768	18 767	2 870	2 351	47 040	26 451
1991	6 473	5 395	38 580	18 924	2 841	2 222	47 895	26 542
1992	6 554	5 467	41 117	20 653	3 028	2 313	50 698	28 432
1993	6 578	5 481	43 037	21 433	3 140	2 311	52 755	29 226
1994	6 697	5 594	44 945	22 003	3 266	2 319	54 909	29 916
1995	6 951	5 844	47 947	23 643	3 566	2 508	58 464	31 995
1996	7 273	6 160	50 216	24 194	3 688	2 494	61 177	32 848
1997	7 132	6 012	47 750	20 042	3 500	2 193	58 382	28 247

Table D.3: Gross and Net Capital Stocks, Urban Passenger Transport in Paris & Surroundings (RATP), 1970-97 (million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	13 264	11 689	3 881	2 463	2 831	1 862	19 975	16 013
1971	14 803	12 955	3 953	2 438	2 922	1 754	21 678	17 147
1972	15 991	13 842	4 084	2 470	3 074	1 738	23 148	18 050
1973	17 204	14 733	4 333	2 608	3 198	1 724	24 735	19 065
1974	18 468	15 654	4 610	2 741	3 306	1 737	26 384	20 133
1975	19 812	16 635	4 953	2 930	3 425	1 788	28 190	21 353
1976	21 062	17 498	5 334	3 118	3 507	1 825	29 904	22 441
1977	22 473	18 503	5 751	3 335	3 434	1 736	31 658	23 574
1978	24 139	19 738	6 109	3 499	3 328	1 657	33 576	24 894
1979	25 834	20 974	6 343	3 583	3 160	1 584	35 337	26 142
1980	27 573	22 224	6 495	3 650	2 922	1 534	36 989	27 408
1981	29 333	23 466	6 642	3 776	2 710	1 505	38 685	28 747
1982	30 990	24 576	6 755	3 848	2 519	1 471	40 264	29 895
1983	32 590	25 615	6 849	3 916	2 354	1 441	41 793	30 972
1984	34 078	26 535	6 878	3 909	2 244	1 406	43 199	31 850
1985	35 418	27 298	6 884	3 873	2 197	1 364	44 498	32 535
1986	36 965	28 287	6 953	3 891	2 141	1 343	46 059	33 521
1987	38 616	29 382	6 965	3 844	2 037	1 303	47 619	34 528
1988	40 267	30 463	7 070	3 892	1 973	1 295	49 311	35 650
1989	41 863	31 465	7 129	3 940	1 916	1 281	50 908	36 686
1990	43 869	32 870	7 265	4 100	1 913	1 305	53 047	38 275
1991	46 182	34 555	7 449	4 315	1 963	1 354	55 594	40 225
1992	48 231	35 946	7 827	4 708	2 096	1 462	58 154	42 116
1993	50 249	37 290	7 868	4 734	2 136	1 466	60 252	43 490
1994	51 746	38 107	7 835	4 684	2 155	1 452	61 735	44 243
1995	53 134	38 820	7 775	4 611	2 158	1 427	63 068	44 858
1996	54 629	39 653	7 870	4 681	2 209	1 449	64 707	45 783
1997	55 656	40 045	8 130	4 889	2 298	1 504	66 084	46 438

Table D.4: Gross and Net Capital Stocks, Other Urban and Interurban Passenger Transport, 1970-97 (million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	15 989	12 704	6 623	3 902	1 304	813	23 917	17 419
1971	16 851	13 566	7 625	4 729	1 487	968	25 963	19 263
1972	18 513	15 229	9 493	6 381	1 851	1 289	29 856	22 899
1973	19 261	15 960	11 570	8 070	2 221	1 581	33 052	25 611
1974	19 664	16 351	12 249	8 188	2 288	1 540	34 200	26 079
1975	20 392	17 080	13 183	8 568	2 389	1 543	35 964	27 191
1976	21 303	18 002	14 812	9 618	2 396	1 455	38 511	29 075
1977	23 291	20 013	17 998	12 129	2 539	1 518	43 828	33 660
1978	23 621	20 352	19 091	12 287	2 542	1 436	45 254	34 074
1979	24 967	21 691	20 410	12 675	2 517	1 342	47 894	35 709
1980	25 542	22 218	21 297	12 625	2 467	1 243	49 306	36 086
1981	26 055	22 660	21 962	12 394	2 391	1 137	50 408	36 191
1982	26 878	23 393	22 133	11 723	2 290	1 050	51 300	36 166
1983	27 596	23 994	22 355	11 299	2 167	1 017	52 119	36 309
1984	28 117	24 377	22 157	10 747	2 065	1 073	52 339	36 196
1985	29 162	25 267	22 071	10 643	2 104	1 266	53 337	37 176
1986	29 651	25 578	21 816	10 453	2 092	1 397	53 559	37 428
1987	30 195	25 935	21 426	10 247	2 084	1 484	53 704	37 666
1988	30 544	26 092	20 839	10 060	2 175	1 621	53 558	37 773
1989	30 706	26 057	19 803	9 864	2 377	1 782	52 885	37 703
1990	30 857	26 018	18 697	9 655	2 631	1 962	52 185	37 635
1991	31 057	26 032	17 692	9 513	2 922	2 131	51 671	37 676
1992	31 933	26 729	16 883	9 433	3 357	2 413	52 173	38 575
1993	32 162	26 763	16 299	9 611	3 724	2 554	52 185	38 929
1994	32 496	26 900	15 802	9 773	4 158	2 744	52 456	39 417
1995	32 672	26 871	15 240	9 692	4 599	2 936	52 511	39 500
1996	33 206	27 196	15 184	9 716	4 910	3 027	53 300	39 939
1997	32 773	26 551	14 079	8 627	4 722	2 656	51 574	37 834

Table D.5: Gross and Net Capital Stocks, Inland Water Transport, 1970-97 (million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	866	687	2 736	1 671	492	262	4 093	2 620
1971	853	680	2 766	1 620	472	240	4 091	2 540
1972	837	669	2 767	1 550	445	215	4 050	2 434
1973	817	656	2 749	1 473	416	190	3 982	2 319
1974	801	641	2 717	1 395	380	163	3 898	2 199
1975	778	631	2 680	1 324	350	150	3 807	2 105
1976	754	616	2 647	1 271	312	130	3 713	2 016
1977	728	603	2 598	1 214	276	114	3 601	1 931
1978	701	590	2 531	1 154	241	102	3 473	1 847
1979	674	579	2 458	1 097	207	92	3 339	1 768
1980	651	567	2 383	1 046	173	84	3 206	1 697
1981	626	559	2 325	1 024	145	82	3 096	1 665
1982	614	550	2 251	990	118	78	2 983	1 617
1983	591	551	2 196	981	119	95	2 906	1 627
1984	564	542	2 148	983	106	90	2 818	1 615
1985	538	529	2 001	891	92	75	2 632	1 495
1986	517	517	1 882	839	86	66	2 486	1 422
1987	490	510	1 841	873	87	64	2 418	1 447
1988	470	497	1 708	814	83	54	2 260	1 366
1989	451	493	1 674	861	81	49	2 206	1 403
1990	426	489	1 618	885	85	50	2 129	1 424
1991	405	480	1 593	940	91	52	2 088	1 473
1992	399	474	1 620	1 038	130	90	2 149	1 602
1993	385	485	1 560	1 039	160	113	2 105	1 637
1994	363	486	1 513	1 044	183	131	2 059	1 661
1995	342	479	1 469	1 044	223	164	2 034	1 687
1996	316	471	1 404	1 010	271	199	1 992	1 680
1997	291	460	1 318	946	262	170	1 871	1 576

Table D.6: Gross and Net Capital Stocks, Maritime Transport, 1970-97 (million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	0	0	20 828	13 648	427	234	21 255	13 881
1971	0	0	23 126	15 651	510	255	23 637	15 906
1972	0	0	23 547	16 106	534	320	24 081	16 426
1973	0	0	25 137	17 642	616	321	25 754	17 963
1974	0	0	30 646	22 515	705	390	31 352	22 905
1975	0	0	33 939	24 893	796	454	34 735	25 347
1976	0	0	35 520	26 212	844	510	36 364	26 721
1977	1	0	37 523	27 271	887	515	38 410	27 786
1978	1	1	36 578	25 918	968	515	37 546	26 434
1979	1	1	35 111	24 373	914	552	36 025	24 926
1980	1	1	34 913	22 717	926	452	35 840	23 170
1981	2	1	32 879	19 859	972	435	33 853	20 295
1982	2	2	33 228	18 902	1 139	459	34 369	19 363
1983	2	2	31 251	16 358	1 087	614	32 340	16 974
1984	2	2	28 817	13 980	1 085	530	29 903	14 512
1985	2	2	26 136	11 931	525	523	26 664	12 456
1986	3	2	24 648	10 704	888	-23	25 539	10 683
1987	3	2	22 149	9 301	372	444	22 524	9 747
1988	3	2	20 911	8 054	230	-40	21 145	8 016
1989	3	2	19 876	6 911	405	-74	20 284	6 839
1990	3	2	18 234	5 973	521	212	18 759	6 187
1991	3	2	17 884	5 531	805	371	18 692	5 904
1992	3	2	18 405	5 925	786	659	19 193	6 586
1993	3	2	17 652	5 263	775	605	18 430	5 870
1994	3	2	16 963	4 765	752	596	17 717	5 363
1995	3	2	16 968	5 018	697	555	17 668	5 575
1996	3	2	17 934	5 617	766	507	18 703	6 126
1997	3	2	18 312	5 916	709	485	19 023	6 403

Table D.7: Gross and Net Capital Stocks, Air Transport, 1970-97
(million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	21 646	17 582	9 277	7 028	1 400	971	32 323	25 581
1971	22 626	17 661	9 739	7 042	1 394	893	33 758	25 596
1972	23 536	18 678	11 082	7 842	1 343	838	35 962	27 357
1973	24 105	19 636	13 720	10 120	1 369	765	39 195	30 521
1974	24 517	20 266	15 982	11 659	1 448	799	41 947	32 724
1975	24 291	20 759	17 761	12 958	1 479	884	43 531	34 600
1976	24 171	20 648	19 158	13 751	1 601	904	44 931	35 303
1977	23 965	20 699	21 057	14 776	2 044	1 008	47 067	36 483
1978	23 320	20 719	23 083	16 068	2 305	1 421	48 707	38 208
1979	23 073	20 349	25 125	17 021	2 460	1 601	50 658	38 971
1980	22 875	20 373	27 527	18 517	2 654	1 676	53 057	40 566
1981	22 564	20 428	29 442	19 613	3 035	1 812	55 041	41 853
1982	22 297	20 332	30 618	19 693	3 347	2 111	56 263	42 136
1983	22 127	20 247	30 884	19 662	3 583	2 296	56 594	42 205
1984	21 843	20 231	30 860	18 750	3 685	2 365	56 388	41 347
1985	21 449	20 070	31 322	17 716	3 830	2 275	56 600	40 061
1986	21 892	19 780	33 574	18 138	4 061	2 229	59 527	40 147
1987	22 543	20 312	33 857	16 752	5 143	2 292	61 544	39 355
1988	23 165	21 019	36 161	17 305	5 630	3 232	64 956	41 556
1989	23 754	21 676	39 688	18 098	6 011	3 562	69 453	43 336
1990	24 580	22 290	44 872	20 401	6 303	3 790	75 755	46 482
1991	24 548	23 155	48 835	23 824	6 747	3 921	80 130	50 900
1992	24 757	23 149	49 434	23 520	6 928	4 230	81 118	50 899
1993	25 427	23 375	50 142	24 354	7 061	4 298	82 630	52 028
1994	26 625	24 037	51 515	24 820	6 938	4 292	85 078	53 149
1995	26 345	25 179	53 573	24 906	7 332	4 030	87 249	54 115
1996	26 161	24 786	52 922	23 455	7 445	4 302	86 528	52 544
1997	25 695	24 484	50 772	22 611	7 670	4 239	84 137	51 334

Table D.8: Gross and Net Capital Stocks, Transport Services, 1970-97
(million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	140 355	110 915	529	404	1 435	906	142 320	112 225
1971	146 532	117 345	602	462	1 627	1 030	148 760	118 836
1972	152 604	123 805	676	518	1 809	1 146	155 089	125 468
1973	159 508	131 309	781	604	2 003	1 263	162 292	133 176
1974	166 669	139 335	924	724	2 226	1 399	169 820	141 458
1975	175 047	148 835	1 030	802	2 449	1 519	178 526	151 157
1976	180 594	155 693	1 127	868	2 708	1 664	184 429	158 225
1977	185 278	161 896	1 242	950	2 904	1 737	189 424	164 584
1978	188 008	165 929	1 317	990	3 023	1 738	192 347	168 657
1979	190 631	169 555	1 410	1 047	3 101	1 719	195 142	172 320
1980	191 336	170 903	1 486	1 084	3 149	1 691	195 970	173 678
1981	194 304	174 299	1 599	1 159	3 212	1 700	199 115	177 158
1982	196 338	176 521	1 670	1 188	3 180	1 635	201 187	179 345
1983	197 129	177 365	1 723	1 201	3 100	1 551	201 952	180 117
1984	197 783	177 935	1 760	1 201	3 004	1 479	202 547	180 615
1985	198 265	178 177	1 844	1 253	2 904	1 436	203 013	180 866
1986	199 206	178 736	1 904	1 282	2 795	1 413	203 906	181 432
1987	200 782	179 838	1 976	1 328	2 736	1 462	205 493	182 628
1988	203 315	181 759	2 031	1 362	2 719	1 555	208 065	184 676
1989	207 239	184 831	2 103	1 418	2 681	1 607	212 023	187 857
1990	212 104	188 533	2 163	1 471	2 653	1 644	216 920	191 647
1991	218 018	192 998	2 226	1 538	2 652	1 682	222 896	196 217
1992	224 820	198 099	2 267	1 588	2 674	1 714	229 761	201 401
1993	232 134	203 530	2 313	1 648	2 744	1 764	237 192	206 942
1994	239 110	208 663	2 455	1 810	2 860	1 834	244 425	212 307
1995	246 802	214 655	2 464	1 832	2 984	1 887	252 250	218 374
1996	255 676	221 962	2 463	1 847	3 027	1 844	261 166	225 653
1997	265 633	230 434	2 346	1 743	2 882	1 604	270 861	233 780

Table D.9: Gross and Net Capital Stocks, Total Transport, 1970-97 (million 1980 French francs)

	Non-residential structures		Transport equipment		Other machinery & equipment		All assets	
	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock	Gross stock	Net stock
1970	301 412	242 427	127 485	83 098	31 254	18 641	460 151	344 166
1971	315 915	254 292	134 307	86 829	31 887	18 624	482 109	359 746
1972	329 565	266 376	141 230	90 991	32 393	18 839	503 189	376 206
1973	342 852	278 539	151 180	98 077	34 515	20 225	528 547	396 841
1974	356 035	290 652	163 592	106 415	35 926	20 863	555 553	417 930
1975	370 300	304 590	173 078	111 879	37 522	21 880	580 899	438 349
1976	381 599	315 007	182 518	118 018	38 437	22 186	602 553	455 212
1977	393 706	326 676	194 621	125 790	38 758	21 832	627 085	474 298
1978	402 773	335 441	201 046	128 385	38 601	21 617	642 420	485 443
1979	413 294	344 453	205 781	129 306	38 021	21 149	657 096	494 907
1980	421 407	350 895	211 896	130 506	37 596	20 658	670 898	502 059
1981	431 663	359 284	215 232	129 936	37 395	20 482	684 290	509 702
1982	440 931	366 111	219 740	129 849	37 065	20 427	697 735	516 387
1983	448 729	371 159	220 678	128 008	36 502	20 491	705 908	519 658
1984	455 650	375 281	219 624	124 712	35 795	20 214	711 069	520 208
1985	462 178	378 734	218 020	121 427	34 548	19 925	714 746	520 086
1986	470 513	382 842	220 069	121 293	34 396	19 357	724 978	523 492
1987	480 320	388 892	218 782	119 220	34 127	19 807	733 228	527 918
1988	490 647	395 728	221 349	120 184	34 095	20 570	746 091	536 482
1989	501 848	403 262	226 166	122 815	34 605	21 181	762 619	547 258
1990	515 722	413 003	231 617	126 455	35 374	22 184	782 712	561 641
1991	530 836	424 946	237 269	131 867	36 786	23 088	804 891	579 901
1992	546 414	436 119	244 392	137 755	38 702	25 191	829 508	599 066
1993	561 941	446 968	246 909	139 772	39 626	25 528	848 476	612 268
1994	575 459	455 922	249 632	140 747	40 307	25 735	865 398	622 404
1995	587 546	465 757	254 330	142 512	41 628	25 720	883 504	633 989
1996	601 596	476 311	258 175	143 302	42 823	26 268	902 593	645 881
1997	612 940	484 825	255 284	139 708	43 275	25 790	911 499	650 324

Table D.10: Indices of Capital Services (1993=100)

	Railways	Road goods transport	Urban & interurban passenger transport	Inland water transport	Maritime transport	Air transport	Transport services	TOTAL
1970	64.0	37.5	53.4	165.6	344.2	50.5	54.7	58.3
1971	65.1	40.3	58.4	159.7	390.9	50.4	57.9	60.8
1972	65.7	44.1	66.7	151.7	404.5	53.7	61.1	63.3
1973	67.0	49.6	63.6	142.9	440.3	61.3	64.8	66.2
1974	68.3	52.9	67.7	133.9	547.2	67.6	68.8	70.5
1975	70.2	52.4	70.9	127.3	602.9	72.7	73.4	73.9
1976	72.0	56.5	75.3	120.7	635.3	74.9	76.8	76.5
1977	73.6	60.3	84.3	114.6	659.9	75.8	79.9	79.6
1978	75.2	63.2	86.5	108.9	607.1	78.1	81.8	81.2
1979	76.6	63.0	91.3	103.9	525.0	81.0	83.5	82.9
1980	78.0	64.8	94.8	99.1	484.4	85.7	84.1	84.1
1981	79.9	64.0	96.7	97.2	422.2	89.2	85.8	84.7
1982	81.3	65.7	97.5	94.2	403.2	90.5	86.8	85.4
1983	82.7	66.2	96.5	96.1	357.7	91.0	87.1	85.8
1984	83.6	67.0	94.2	95.3	301.7	88.9	87.3	85.5
1985	84.0	66.5	90.7	86.8	256.4	85.3	87.4	85.0
1986	85.2	68.2	87.7	82.4	148.1	92.3	87.7	85.4
1987	85.9	72.2	90.0	82.8	153.3	71.3	88.3	85.9
1988	87.4	77.2	90.7	77.1	110.8	76.9	89.3	87.1
1989	88.7	86.8	90.8	81.4	93.8	80.5	90.9	88.9
1990	91.0	89.6	91.5	83.3	90.8	87.7	92.7	91.4
1991	94.2	89.9	93.0	85.9	93.8	97.4	94.9	94.6
1992	98.2	96.9	96.8	95.9	112.4	97.8	97.4	97.9
1993	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1994	100.8	102.4	102.3	103.7	92.8	102.0	102.6	101.5
1995	101.3	109.6	103.7	108.2	94.6	102.9	105.5	103.1
1996	102.8	112.1	105.3	109.3	102.7	99.1	108.9	104.7
1997	104.8	92.5	103.7	101.1	106.9	96.7	112.4	104.3

ANNEX E – GDP, EMPLOYMENT, AND LABOUR SHARES IN FRANCE

The time series for France were derived from the satellite accounts on transport (INSEE/Ministry of Transport, various issues, *Les transports en 19..*).

Table E.1: GDP at Constant Prices (million 1980 French francs)

	Railways	Road goods transport	Urban & interurban passenger transport	Inland water transport	Maritime transport	Air transport	Transport services	TOTAL
1970	16,916	18,167	13,608	685	2,953	2,409	17,892	72,630
1971	16,315	19,731	14,337	684	3,239	2,551	19,576	76,433
1972	17,080	20,793	15,665	646	3,668	4,050	21,550	83,452
1973	17,614	23,791	16,835	625	3,515	4,776	23,314	90,470
1974	19,025	24,432	17,950	686	5,041	3,465	24,917	95,516
1975	17,493	23,299	17,563	627	4,370	4,689	25,703	93,744
1976	18,459	23,393	17,839	677	4,398	5,353	25,687	95,806
1977	18,469	24,764	18,761	593	4,902	6,177	26,781	100,447
1978	18,594	26,424	19,178	708	4,834	7,204	27,604	104,546
1979	18,891	26,247	20,145	790	4,588	8,160	29,340	108,161
1980	18,740	27,196	19,814	813	5,424	9,043	29,999	111,029
1981	18,384	26,007	19,141	727	4,160	10,883	30,555	109,857
1982	18,001	26,354	19,621	653	4,006	11,182	31,346	111,163
1983	18,333	26,303	19,180	632	3,858	11,662	31,167	111,135
1984	19,397	25,205	19,683	544	4,099	12,319	31,025	112,272
1985	19,827	26,255	19,839	518	3,352	12,220	33,108	115,119
1986	18,819	27,379	20,435	403	3,093	12,509	34,484	117,122
1987	18,683	30,727	20,463	383	2,947	14,958	36,233	124,394
1988	19,655	36,011	20,779	372	3,033	16,304	39,047	135,201
1989	19,961	38,553	20,896	377	3,117	17,310	41,940	142,154
1990	19,191	39,744	21,379	404	3,386	17,596	43,145	144,845
1991	18,661	40,831	21,573	423	4,068	16,308	42,810	144,674
1992	18,505	41,631	21,730	407	3,689	17,484	44,224	147,670
1993	16,917	39,434	21,273	408	3,971	17,545	43,927	143,475
1994	17,235	41,812	21,254	383	3,803	20,666	45,246	150,399
1995	16,611	45,917	21,159	400	3,733	20,352	46,760	154,932
1996	17,226	45,252	21,620	392	3,503	24,193	47,252	159,438
1997	18,162	47,154	22,056	389	3,601	25,265	48,735	165,362

Table E.2: GDP at Current Prices (million French francs)

	Railways	Road goods transport	Urban & interurban passenger transport: TOTAL	Urban & interurban passenger transport: of which: RATP	Inland water transport	Maritime transport	Air transport	Transport services	TOTAL
1970	13,286	5,276	4,942	1,848	n.a.	1,990	2,414	n.a.	27,908
1971	14,097	5,895	5,587	1,989	n.a.	2,192	2,681	n.a.	30,452
1972	14,612	6,577	6,330	2,186	n.a.	2,257	3,166	n.a.	32,942
1973	16,540	8,145	7,441	2,460	n.a.	2,490	3,386	n.a.	38,002
1974	19,224	9,366	8,083	2,494	n.a.	3,291	3,413	n.a.	43,377
1975	20,897	10,199	10,594	2,930	n.a.	3,194	4,575	n.a.	49,459
1976	22,218	11,910	12,265	3,349	n.a.	3,699	5,538	n.a.	55,630
1977	24,907	13,655	14,487	3,866	n.a.	4,098	6,995	n.a.	64,142
1978	27,488	15,533	14,786	4,424	n.a.	4,010	8,473	n.a.	70,290
1979	31,548	18,450	n.a.	5,014	364	4,211	9,398	n.a.	68,985
1980	34,444	21,087	n.a.	5,855	416	4,701	10,561	n.a.	77,064
1981	38,563	23,478	n.a.	7,082	410	5,199	12,239	n.a.	86,971
1982	43,124	26,900	n.a.	8,185	457	4,916	14,067	n.a.	97,649
1983	45,887	29,472	n.a.	9,468	504	5,232	16,941	n.a.	107,504
1984	53,427	30,874	n.a.	10,360	515	5,751	18,865	n.a.	119,792
1985	56,694	31,809	n.a.	11,293	382	6,025	20,433	n.a.	126,636
1986	56,486	36,156	n.a.	12,104	296	5,441	21,811	n.a.	132,294
1987	57,465	40,394	n.a.	12,398	405	4,401	21,913	n.a.	136,976
1988	59,947	44,081	n.a.	12,808	566	5,090	23,351	n.a.	145,843
1989	62,385	45,239	n.a.	12,439	705	5,013	23,112	n.a.	148,893
1990	60,265	47,952	n.a.	12,862	449	4,348	21,930	n.a.	147,806
1991	58,327	49,964	n.a.	13,285	467	5,090	24,382	n.a.	151,515
1992	60,129	71,921	57,805	14,210	453	4,448	27,825	71,625	*222,581*
1993	56,830	70,302	58,778	14,350	537	4,323	26,059	71,258	*216,829*
1994	56,914	73,239	61,762	15,074	507	3,692	29,164	73,938	*225,278*
1995	54,859	76,172	61,433	15,448	503	2,587	27,268	77,949	*222,822*
1996	58,913	74,571	68,505	16,269	478	3,511	27,153	78,056	*233,131*
1997	60,957	80,792	68,696	16,716	549	4,030	30,552	95,644	*245,576*

Table E.3: Labour Compensation at Current Prices (million French francs)

	Railways	Road goods transport	Urban & interurban passenger transport		Inland water transport	Maritime transport	Air transport	Transport services	TOTAL
			TOTAL	of which: RATP					
1970	8,381	2,003	3,184	1,404	n.a.	1,347	1,540	n.a.	16,455
1971	8,947	2,353	3,548	1,537	n.a.	1,496	1,770	n.a.	18,114
1972	9,763	2,678	3,888	1,677	n.a.	1,524	2,047	n.a.	19,900
1973	10,777	3,351	4,494	1,875	n.a.	1,735	2,349	n.a.	22,706
1974	12,631	4,058	5,460	2,143	n.a.	1,942	2,760	n.a.	26,851
1975	14,691	4,692	6,552	2,521	n.a.	2,197	3,335	n.a.	31,467
1976	16,990	5,500	7,636	2,867	n.a.	2,872	3,930	n.a.	36,928
1977	19,062	6,772	8,453	3,281	n.a.	2,975	4,522	n.a.	41,784
1978	20,706	7,717	9,670	3,642	n.a.	3,076	5,243	n.a.	46,412
1979	23,106	9,320	n.a.	4,134	252	3,461	5,949	n.a.	46,222
1980	26,261	11,019	n.a.	4,745	294	3,742	7,073	n.a.	53,134
1981	29,726	12,617	n.a.	5,481	336	3,990	8,003	n.a.	60,153
1982	34,175	14,816	n.a.	6,409	350	4,448	9,370	n.a.	69,568
1983	37,455	16,340	n.a.	7,319	389	4,735	10,565	n.a.	76,803
1984	38,366	17,370	n.a.	7,839	368	4,702	11,567	n.a.	80,212
1985	39,734	17,925	n.a.	8,402	301	4,855	12,523	n.a.	83,740
1986	39,471	19,411	n.a.	8,622	260	4,315	13,292	n.a.	85,371
1987	39,182	23,014	n.a.	8,821	329	3,965	13,683	n.a.	88,994
1988	39,448	25,164	n.a.	9,029	341	3,770	14,790	n.a.	92,542
1989	40,725	27,064	n.a.	9,636	370	3,352	16,112	n.a.	97,259
1990	40,946	29,164	n.a.	9,989	344	3,466	17,579	n.a.	101,488
1991	42,122	31,165	n.a.	10,319	366	4,063	18,223	n.a.	106,258
1992	43,811	41,120	32,030	10,739	378	3,740	21,463	n.a.	121,251
1993	44,006	41,428	32,668	10,966	379	3,536	21,041	n.a.	121,356
1994	43,920	42,406	33,824	11,219	344	3,247	20,515	n.a.	121,651
1995	43,886	45,181	33,962	11,407	331	3,168	19,726	n.a.	123,699
1996	44,460	45,953	36,960	11,757	338	3,239	20,260	n.a.	126,007
1997	45,337	49,491	38,323	11,999	336	3,216	21,056	n.a.	131,435

Table E.4: Share of Labour Compensation in Value Added

	Railways	Road goods transport	Urban & interurban passenger transport: TOTAL	Urban & interurban passenger transport: of which: RATP	Inland water transport	Maritime transport	Air transport	Transport services*	TOTAL*
1970	0.63	0.38	0.64	0.59	0.68	0.64	0.59	0.59	
1971	0.63	0.40	0.64	0.59	0.68	0.66	0.59	0.59	
1972	0.67	0.41	0.61	0.58	0.68	0.65	0.60	0.60	
1973	0.65	0.41	0.60	0.60	0.70	0.69	0.60	0.60	
1974	0.66	0.43	0.68	0.51	0.59	0.81	0.62	0.62	
1975	0.70	0.46	0.62	0.60	0.69	0.73	0.64	0.64	
1976	0.76	0.46	0.62	0.67	0.78	0.71	0.66	0.66	
1977	0.77	0.50	0.58	0.63	0.73	0.65	0.65	0.65	
1978	0.75	0.50	0.65	0.66	0.77	0.62	0.66	0.66	
1979	0.73	0.51	0.65	0.69	0.82	0.63	0.67	0.67	
1980	0.76	0.52	0.64	0.71	0.80	0.67	0.69	0.69	
1981	0.77	0.54	0.61	0.82	0.77	0.65	0.69	0.69	
1982	0.79	0.55	0.62	0.77	0.90	0.67	0.71	0.71	
1983	0.82	0.55	0.61	0.77	0.91	0.62	0.71	0.71	
1984	0.72	0.56	0.60	0.71	0.82	0.61	0.67	0.67	
1985	0.70	0.56	0.59	0.79	0.81	0.61	0.66	0.66	
1986	0.70	0.54	0.56	0.88	0.79	0.61	0.65	0.65	
1987	0.68	0.57	0.56	0.81	0.90	0.62	0.65	0.65	
1988	0.66	0.57	0.56	0.60	0.74	0.63	0.63	0.63	
1989	0.65	0.60	0.61	0.52	0.67	0.70	0.65	0.65	
1990	0.68	0.61	0.61	0.77	0.80	0.80	0.69	0.69	
1991	0.72	0.62	0.61	0.78	0.80	0.75	0.70	0.70	
1992	0.73	0.57	0.55	0.83	0.84	0.77	0.54	0.54	
1993	0.77	0.59	0.56	0.71	0.82	0.81	0.56	0.56	
1994	0.77	0.58	0.55	0.68	0.88	0.70	0.54	0.54	
1995	0.80	0.59	0.55	0.66	0.88	0.72	0.56	0.56	
1996	0.75	0.62	0.54	0.71	0.88	0.75	0.54	0.54	
1997	0.74	0.61	0.56	0.61	0.88	0.69	0.54	0.54	

*The labour income shares in transport services and total transport were estimated by the weighted average of labour income shares of the other sub-sectors.

Table E.5: Persons Engaged (000s) in Transport by Branch

	Railways	Road goods transport	Urban & interurban passenger transport	Inland water transport	Maritime transport	Air transport	Transport services	TOTAL
1970	303.0	185.9	159.8	8.6	26.5	31.2	128.5	843.5
1971	296.4	188.5	160.8	8.5	27.0	32.6	130.6	844.4
1972	289.3	193.5	163.5	8.6	27.9	34.3	134.4	851.5
1973	285.4	198.8	166.5	8.7	28.8	36.1	138.3	862.6
1974	284.6	205.5	170.8	8.9	29.8	37.4	143.1	880.1
1975	281.7	202.3	170.4	8.8	28.2	37.4	146.1	874.9
1976	274.1	203.5	171.6	8.4	27.9	37.8	147.9	871.2
1977	268.8	204.4	175.1	8.2	28.1	38.9	153.0	876.5
1978	263.0	204.5	177.4	8.0	27.1	41.0	158.3	879.3
1979	258.9	204.4	178.9	8.0	26.5	43.3	161.2	881.2
1980	254.4	204.5	180.9	7.8	25.4	45.8	165.0	883.8
1981	248.5	202.6	181.7	7.5	23.9	48.0	167.6	879.8
1982	252.4	203.6	184.9	7.1	22.5	51.3	172.6	894.4
1983	252.2	206.0	187.7	6.1	22.3	52.3	173.8	900.4
1984	248.4	211.4	186.4	5.2	21.2	53.0	177.3	902.9
1985	242.1	214.2	185.0	5.3	19.5	52.9	180.6	899.6
1986	233.4	220.6	184.4	3.7	18.3	53.4	185.5	899.3
1987	222.4	226.9	188.3	2.9	17.2	55.1	189.8	902.6
1988	213.2	233.5	191.1	2.7	17.8	56.8	195.6	910.7
1989	206.4	239.0	194.0	2.6	16.7	60.2	198.5	917.4
1990	204.0	246.2	197.9	2.7	17.1	62.9	204.0	934.8
1991	198.6	265.6	195.3	2.7	17.4	64.1	205.9	949.6
1992	196.0	306.7	215.4	2.7	17.2	52.7	203.8	994.5
1993	192.1	304.4	216.6	2.7	17.0	51.8	201.4	986.0
1994	184.0	309.1	218.0	2.5	15.0	51.6	198.9	979.1
1995	180.0	318.2	213.8	2.8	15.5	50.2	205.0	985.5
1996	176.0	324.8	226.9	2.9	16.0	50.8	210.7	1,008.1
1997	174.0	328.4	226.7	2.9	16.1	50.2	214.2	1,012.5
1998	173.0	339.5	231.7	2.9	16.2	50.6	220.4	1,034.3

Note: The *branch* concept differs from the *sector* concept, as the latter includes only employment in firms for which that particular transport activity is their main business. The *branch* concept also covers workers engaged in the same activity but whose firm they belong to does not have this type of transport as their main business. The sector concept is preferred tot the branch concept, as the latter corresponds to the concept used for the construction of the other aggregates such as GDP. However, comprehensive employment series for all sub-sector do not exist. Nevertheless, the Transport Ministry confirmed that the employment estimates of both concepts are close for all transport activities except for railways. For this sector, series on a *branch* concept were used.

Table E.6: Employees (000s) in Transport by branch

	Railways	Road goods transport	Urban & interurban passenger transport	Inland water transport	Maritime transport	Air transport	Transport services	TOTAL
1970	172.7	160.4	132.8	2.5	26.1	31.0	124.5	650.0
1971	168.9	163.2	134.0	2.5	26.6	32.4	126.6	654.2
1972	164.9	168.4	136.9	2.6	27.5	34.1	130.4	664.8
1973	162.7	173.8	140.0	2.7	28.4	35.9	134.4	677.9
1974	162.2	180.1	143.8	2.8	29.4	37.2	139.1	694.6
1975	160.0	177.0	143.6	2.8	27.8	37.2	142.1	690.5
1976	156.2	179.2	145.1	2.8	27.6	37.7	144.1	692.7
1977	152.6	180.3	147.8	2.9	27.8	38.8	149.5	699.7
1978	147.3	180.4	149.4	2.9	26.8	40.9	154.9	702.6
1979	145.0	180.3	150.3	3.0	26.2	43.2	157.9	705.9
1980	142.7	180.5	151.4	3.0	25.1	45.7	161.8	710.2
1981	145.4	178.8	151.7	3.0	23.7	47.9	164.6	715.1
1982	143.4	180.2	154.6	3.1	22.3	51.1	169.7	724.4
1983	144.0	181.4	157.1	3.1	22.1	52.2	170.7	730.6
1984	142.1	185.5	155.6	3.1	21.0	52.9	173.9	734.1
1985	138.8	188.2	154.1	3.2	19.3	52.8	177.2	733.6
1986	133.7	193.2	154.2	2.7	18.1	53.3	181.8	737.0
1987	127.9	198.6	158.5	2.2	16.9	54.9	186.0	745.0
1988	124.6	204.0	161.2	2.2	17.5	56.6	191.4	757.5
1989	121.3	208.3	164.2	2.3	16.4	60.0	194.1	766.6
1990	119.0	214.5	168.2	2.4	16.8	62.8	199.3	783.0
1991	116.0	238.4	166.2	2.4	17.1	63.9	202.5	806.5
1992	127.7	272.4	187.6	2.4	16.9	52.6	200.2	859.8
1993	123.7	270.5	189.1	2.4	16.7	51.7	197.8	851.9
1994	122.6	275.3	190.7	2.2	14.7	51.5	195.3	852.3
1995	118.3	283.4	185.6	2.5	15.2	50.1	201.3	856.4
1996	119.9	289.3	198.1	2.6	15.7	50.7	207.0	883.3
1997	117.9	293.2	198.1	2.6	15.8	50.1	210.5	888.2
1998	120.3	304.3	203.1	2.6	15.9	50.5	216.7	913.4

Note: The *branch* concept differs from the *sector* concept, as the latter includes only employment in firms for which that particular transport activity is their main business. The *branch* concept also covers workers engaged in the same activity but whose firm they belong to does not have this type of transport as their main business. The sector concept is preferred tot the branch concept, as the latter corresponds to the concept used for the construction of the other aggregates such as GDP. However, comprehensive employment series for all sub-sector do not exist. Nevertheless, the Transport Ministry confirmed that the employment estimates of both concepts are close for all transport activities except for railways. For this sector, series on a *branch* concept were used.

Table E.7: Annual Hours worked per Employee

	Railways	Road goods transport	Urban & interurban passenger transport	Inland water transport	Maritime transport	Air transport	Transport services	TOTAL
1970	1,953	2,169	2,050	2,416	2,102	1,956	1,940	2,041
1971	1,910	2,124	2,008	2,400	2,059	1,911	1,899	1,998
1972	1,871	2,084	1,983	2,395	2,022	1,872	1,894	1,969
1973	1,830	2,046	1,921	2,345	1,986	1,831	1,819	1,919
1974	1,808	2,011	1,886	2,303	1,953	1,807	1,780	1,887
1975	1,770	1,937	1,874	2,261	1,875	1,769	1,786	1,851
1976	1,788	1,968	1,891	2,274	1,909	1,789	1,808	1,875
1977	1,780	1,937	1,875	2,241	1,875	1,782	1,782	1,853
1978	1,770	1,933	1,868	2,235	1,871	1,770	1,770	1,845
1979	1,771	1,931	1,867	2,210	1,872	1,772	1,769	1,844
1980	1,758	1,929	1,879	2,190	1,867	1,757	1,793	1,847
1981	1,740	1,916	1,858	2,160	1,852	1,741	1,765	1,827
1982	1,682	1,841	1,797	2,100	1,777	1,682	1,693	1,760
1983	1,684	1,834	1,781	2,100	1,772	1,683	1,660	1,747
1984	1,663	1,821	1,803	2,098	1,751	1,663	1,711	1,754
1985	1,645	1,814	1,787	2,107	1,743	1,647	1,689	1,739
1986	1,634	1,791	1,772	2,086	1,734	1,636	1,686	1,727
1987	1,632	1,801	1,762	2,076	1,750	1,635	1,680	1,727
1988	1,660	1,835	1,762	2,197	1,829	1,661	1,638	1,737
1989	1,639	1,808	1,772	2,182	1,799	1,641	1,652	1,730
1990	1,646	1,818	1,766	1,852	1,754	1,647	1,617	1,721
1991	1,646	1,838	1,776	1,852	1,782	1,640	1,599	1,725
1992	1,659	1,695	1,956	1,852	1,744	1,632	1,601	1,721
1993	1,664	1,698	1,951	1,852	1,765	1,622	1,615	1,725
1994	1,679	1,705	1,956	2,000	1,800	1,609	1,640	1,736
1995	1,647	1,678	1,950	1,724	1,742	1,594	1,651	1,721
1996	1,650	1,681	1,933	1,786	1,750	1,594	1,563	1,700
1997	1,653	1,687	1,943	*1,786*	*1,750*	1,574	1,566	1,704
1998	1,653	1,688	1,940	*1,786*	*1,750*	1,561	1,564	1,703

ANNEX F - TIME SERIES FOR OTHER COUNTRIES

The time series for Germany, the United Kingdom and the United States were taken from O'Mahony (1999).

Table F.1: Index of Value Added at Constant Prices (1993=100)

	Germany			United Kingdom			United States				
	Transport	Railways	Water transport	Transport	Railways	Air transport	Transport	Railways	Water transport	Air transport	Other inland transport & transport services
1970	54.7	143.5	87.7	64.2	132.7	19.1	54.5	64.9	94.2	28.1	56.9
1971	53.6	133.8	84.3	66.3	121.4	22.2	54.3	58.4	90.0	28.6	59.5
1972	54.9	133.3	89.0	68.5	116.0	26.6	58.6	58.8	92.8	31.3	66.3
1973	58.7	139.7	92.4	74.3	123.4	31.1	62.3	61.5	104.2	33.2	70.7
1974	59.8	144.9	99.3	72.8	120.4	28.8	63.0	63.1	104.2	34.9	70.4
1975	56.6	117.4	101.9	71.6	115.7	32.0	58.6	57.7	97.1	33.0	65.6
1976	60.8	122.0	108.8	71.3	112.2	35.6	63.2	60.9	107.1	35.6	71.3
1977	63.1	116.7	107.8	72.8	112.1	38.3	67.0	60.6	108.5	38.2	77.5
1978	64.4	117.7	109.9	73.0	113.1	46.4	69.3	66.3	116.1	45.0	76.3
1979	69.7	125.5	115.0	75.9	114.8	52.5	72.2	68.6	117.4	48.8	79.0
1980	70.4	120.9	116.2	73.3	107.1	52.2	68.8	69.7	117.4	43.2	75.2
1981	70.1	119.9	126.6	72.6	105.4	53.4	66.6	67.4	122.4	43.0	71.5
1982	70.1	113.5	141.6	70.2	96.2	47.1	66.0	58.8	113.6	48.4	71.2
1983	71.1	114.1	137.6	71.8	103.7	46.0	72.7	65.2	107.3	57.4	77.9
1984	72.9	114.6	113.3	74.2	94.3	51.1	78.1	73.8	108.5	59.6	84.0
1985	75.2	123.1	119.2	77.9	99.4	53.2	78.6	73.8	106.0	57.4	86.1
1986	73.3	115.9	118.1	79.6	105.5	54.4	81.7	73.5	103.5	67.9	87.1
1987	76.1	111.4	108.2	87.4	110.8	65.2	87.3	81.5	100.6	78.9	90.2
1988	81.8	112.6	96.8	93.3	115.3	69.7	86.5	86.4	98.3	76.5	89.0
1989	84.9	115.1	92.4	97.8	113.0	77.5	86.6	78.2	100.0	78.3	90.1
1990	92.7	114.5	92.4	98.4	110.0	82.9	87.9	81.2	101.2	89.4	87.6
1991	97.8	113.1	92.8	94.5	107.1	77.7	92.3	94.3	105.8	89.0	91.9
1992	100.0	106.1	97.0	97.5	105.2	91.9	95.9	95.8	97.7	97.2	95.2
1993	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1994	103.2	101.7	102.0	107.9	94.3	111.3	106.6	112.5	102.3	116.3	102.4
1995	107.4	104.6	103.0	113.8	96.1	122.4	107.6	120.5	104.1	112.7	103.7
1996	111.0			114.1	101.1	132.0	110.5	134.5	101.8	133.4	98.5

Table F.2: Persons Engaged (000s)

	Germany			United Kingdom			United States				
	Transport	Railways	Water transport	Transport	Railways	Air transport	Transport	Railways	Water transport	Air transport	Other inland transport & transport services
1970	506	413	93	1,224	212	39	2,836	583	219	358	1,676
1971	518	427	91	1,218	214	41	2,800	556	201	348	1,696
1972	512	432	80	1,194	216	42	2,824	536	204	353	1,732
1973	516	437	79	1,177	198	42	2,914	533	204	372	1,806
1974	513	440	73	1,161	195	43	2,967	540	206	375	1,847
1975	497	429	68	1,170	201	42	2,841	511	195	372	1,764
1976	477	410	67	1,145	193	43	2,865	492	195	377	1,802
1977	457	390	67	1,155	182	44	2,963	492	196	391	1,885
1978	438	372	66	1,178	184	47	3,129	487	208	413	2,021
1979	422	358	64	1,189	182	49	3,263	499	211	448	2,106
1980	415	352	63	1,183	181	51	3,223	484	211	464	2,064
1981	412	351	61	1,114	175	50	3,209	457	219	465	2,068
1982	403	344	59	1,074	167	43	3,092	398	204	451	2,040

Table F.2: Persons Engaged (000s) (cont.)

	Germany			United Kingdom			United States				
	Transport	Railways	Water transport	Transport	Railways	Air transport	Transport	Railways	Water transport	Air transport	Other inland transport & transport services
1983	387	331	56	1,049	159	39	3,080	358	193	458	2,072
1984	371	317	54	1,053	154	42	3,248	358	195	493	2,203
1985	357	304	53	1,050	146	45	3,338	335	191	528	2,283
1986	346	294	52	1,027	142	47	3,380	308	184	564	2,324
1987	334	286	48	1,014	139	48	3,529	287	181	607	2,454
1988	319	275	44	1,047	134	57	3,678	278	176	647	2,577
1989	306	263	43	1,065	131	63	3,775	273	180	694	2,628
1990	299	255	44	1,098	130	67	3,829	260	185	751	2,633
1991	293	248	45	1,072	133	70	3,838	251	194	737	2,656
1992	288	243	45	1,050	134	69	3,850	243	179	729	2,699
1993	275	233	42	1,031	125	68	4,000	238	182	742	2,838
1994	263	224	39	1,017	120	68	4,192	233	187	756	3,016
1995	244	207	37	1,021	112	73	4,319	232	189	787	3,111
1996	236	200	36	990	80	78	4,462	224	185	1,126	2,927

Table F.3: Annual Hours Worked per Person Engaged

	Germany			UK	United States				
	Total transport	Railways	Water transport	Total transport	Total Transport	Railways	Water transport	Air transport	Other inland transport & transport services
1970	2,079	1,922	2,203	2,007	1,972	1,958	1,963	1,961	1,980
1971	2,075	1,922	2,183	2,014	1,969	1,955	1,960	1,958	1,977
1972	2,037	1,885	2,144	1,988	1,969	1,956	1,961	1,959	1,976
1973	2,004	1,855	2,108	2,003	1,965	1,954	1,958	1,956	1,971
1974	1,978	1,832	2,082	2,048	1,932	1,919	1,923	1,922	1,939
1975	1,931	1,783	2,037	2,072	1,905	1,890	1,893	1,893	1,913
1976	1,959	1,826	2,002	2,050	1,901	1,888	1,891	1,890	1,908
1977	1,928	1,796	1,970	2,043	1,892	1,879	1,883	1,881	1,898
1978	1,916	1,780	1,962	2,016	1,887	1,875	1,877	1,876	1,893
1979	1,886	1,748	1,928	2,046	1,880	1,868	1,873	1,870	1,886
1980	1,852	1,723	1,903	2,049	1,833	1,818	1,821	1,821	1,841
1981	1,840	1,719	1,887	2,026	1,800	1,781	1,785	1,784	1,809
1982	1,831	1,719	1,853	1,990	1,774	1,751	1,755	1,753	1,786

Table F.3: Annual Hours Worked per Person Engaged (cont.)

	Germany			UK	United States				
	Total transport	Railways	Water transport	Total transport	Total Transport	Railways	Water transport	Air transport	Other inland transport & transport services
1983	1,822	1,712	1,841	2,035	1,785	1,762	1,769	1,764	1,795
1984	1,817	1,700	1,833	2,032	1,823	1,806	1,812	1,808	1,831
1985	1,800	1,677	1,809	2,028	1,864	1,851	1,856	1,853	1,869
1986	1,796	1,680	1,808	2,012	1,852	1,837	1,845	1,839	1,857
1987	1,793	1,675	1,786	1,994	1,874	1,863	1,868	1,863	1,879
1988	1,800	1,681	1,792	2,007	1,834	1,819	1,823	1,820	1,840
1989	1,772	1,650	1,788	2,023	1,842	1,829	1,835	1,831	1,847
1990	1,724	1,623	1,777	1,944	1,851	1,840	1,847	1,842	1,855
1991	1,707	1,616	1,761	1,898	1,832	1,821	1,828	1,823	1,836
1992	1,725	1,633	1,779	1,901	1,828	1,817	1,819	1,818	1,832
1993	1,718	1,625	1,771	1,941	1,835	1,822	1,829	1,824	1,839
1994	1,724	1,631	1,777	1,923	1,843	1,836	1,839	1,837	1,845
1995	1,715	1,622	1,767	1,898	1,855	1,850	1,853	1,851	1,857
1996	1,719	1,626	1,772	1,890	1,853	1,847	1,850	1,847	1,856

Table F.4: Index of Capital Services (1993=100)

	Germany			United Kingdom			United States				
	Total transport	Railways	Water transport	Total transport	Railways	Air transport	Total transport	Railways	Water transport	Air transport	Other inland transport & transport services
1970	74.8	93.8	87.7	82.2	90.6	89.7	96.6	98.7	89.7	58.8	92.4
1971	78.6	95.1	98.4	84.3	90.1	99.3	97.1	98.1	92.1	57.6	95.4
1972	81.3	95.9	107.2	87.3	88.5	103.4	98.4	97.3	96.8	59.0	99.1
1973	83.3	96.8	111.4	90.8	84.5	103.1	102.2	97.3	105.4	64.4	105.9
1974	85.0	97.7	117.2	93.1	81.9	103.7	105.6	110.9	110.0	66.2	111.2
1975	86.1	98.4	117.0	94.0	81.0	101.5	107.1	121.7	117.0	67.2	110.9
1976	87.4	99.0	118.7	94.4	80.3	104.5	108.1	120.7	122.4	66.2	114.6
1977	89.1	99.5	122.4	95.8	80.2	105.9	109.2	120.3	129.5	68.2	117.2
1978	90.6	99.9	124.0	97.7	80.5	106.5	110.1	120.7	134.1	71.3	118.8
1979	91.5	99.7	122.3	98.9	79.9	117.2	113.6	122.3	137.7	76.2	123.4
1980	91.9	99.5	120.3	98.7	78.6	128.1	115.8	123.5	138.6	82.2	123.4
1981	92.5	99.2	119.9	95.3	76.9	116.7	115.3	122.5	140.3	84.4	120.9
1982	92.4	99.0	118.4	92.4	75.4	95.7	113.0	120.5	138.8	82.7	117.8

Table F.4: Index of Capital Services (1993=100) (cont.)

	Germany			United Kingdom			United States				
	Total transport	Railways	Water transport	Total transport	Railways	Air transport	Total transport	Railways	Water transport	Air transport	Other inland transport & transport services
1983	93.1	98.9	121.1	91.1	74.3	93.5	111.3	116.2	133.7	82.3	120.0
1984	93.3	98.8	121.4	91.3	73.7	96.2	109.9	112.6	128.7	79.7	123.2
1985	94.1	98.9	121.6	91.7	74.3	98.7	107.7	110.1	123.2	79.3	120.7
1986	94.9	99.2	119.9	90.8	74.2	93.0	107.8	107.9	119.0	85.2	122.3
1987	95.0	99.6	114.7	90.6	74.9	86.7	106.1	105.6	115.2	86.8	120.4
1988	95.2	99.8	107.3	90.6	76.7	82.6	105.4	104.2	111.5	89.1	119.1
1989	96.0	99.8	103.8	90.7	79.7	81.9	104.8	102.9	108.8	92.0	117.8
1990	97.4	100.0	101.7	90.7	83.1	83.6	103.9	102.1	106.1	95.2	113.5
1991	99.1	100.1	100.3	92.5	87.6	83.4	101.7	100.9	103.3	95.1	107.8
1992	99.8	99.9	99.6	95.5	94.0	87.9	100.7	99.9	101.0	99.1	102.8
1993	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1994	99.9	100.1	99.2	104.8	102.8	121.3	99.2	101.6	98.3	96.4	99.7
1995	100.1	99.9	98.4	105.9	102.3	114.4	99.3	102.5	97.2	94.2	100.7

Table F.5: Shares of Labour Income in Value Added

	Germany		UK	USA				
	Total transport	Water transport	Total transport	Total transport	Railways	Water transport	Air transport	Other inland transport& transport services
1970	0.724	0.612	0.807	0.708	0.695	0.804	0.737	0.693
1971	0.737	0.616	0.832	0.709	0.711	0.822	0.703	0.698
1972	0.752	0.639	0.829	0.699	0.699	0.816	0.683	0.692
1973	0.755	0.614	0.813	0.712	0.741	0.807	0.680	0.700
1974	0.755	0.493	0.835	0.703	0.751	0.738	0.676	0.688
1975	0.774	0.498	0.861	0.722	0.783	0.739	0.733	0.693
1976	0.753	0.502	0.821	0.705	0.749	0.731	0.693	0.688
1977	0.746	0.544	0.808	0.700	0.774	0.738	0.687	0.674
1978	0.753	0.581	0.805	0.699	0.760	0.757	0.690	0.674
1979	0.720	0.538	0.847	0.710	0.777	0.707	0.754	0.674
1980	0.712	0.527	0.884	0.718	0.760	0.719	0.779	0.684
1981	0.713	0.503	0.898	0.717	0.734	0.729	0.815	0.681
1982	0.714	0.526	0.864	0.734	0.802	0.769	0.826	0.683
1983	0.714	0.604	0.820	0.698	0.740	0.728	0.735	0.670
1984	0.689	0.548	0.828	0.679	0.709	0.735	0.676	0.665
1985	0.685	0.508	0.824	0.685	0.712	0.707	0.728	0.661
1986	0.711	0.567	0.798	0.681	0.708	0.717	0.731	0.653
1987	0.716	0.582	0.774	0.672	0.690	0.718	0.663	0.668
1988	0.709	0.527	0.777	0.680	0.675	0.675	0.661	0.688
1989	0.684	0.479	0.787	0.700	0.766	0.668	0.724	0.682
1990	0.683	0.527	0.819	0.716	0.757	0.702	0.772	0.690
1991	0.703	0.554	0.838	0.702	0.664	0.679	0.775	0.684
1992	0.699	0.563	0.839	0.713	0.728	0.678	0.762	0.695
1993	0.701	0.524	0.829	0.710	0.680	0.749	0.691	0.720
1994	0.787	0.551	0.814	0.701	0.633	0.757	0.675	0.718
1995	0.739	0.505	0.814	0.702	0.625	0.769	0.660	0.727

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