The Italian expenditure in transport infrastructure: a survey

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THE ITALIAN EXPENDITURE IN TRANSPORT INFRASTRUCTURE: A SURVEY

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The aim of the paper is to analyse the most important quantitative data on Italian expenditures in transport infrastructures (investment and maintenance costs), linking the expenditure with traffic flows. The analysis concerns rail and road networks (both for national and local roads), over the last ten years, and a possible forecast for the next years, thanks to the official previsions of the "Objective Law". The whole analysis is based on official data.
The planned infrastructures will analyzed with taxonomical and cost – benefit approaches, in order to provide a ranking of priority.
The results show how the planning of the investment expenditure is still based on different criteria than efficiency. So, the foreseen expenditure will not able to give relevant effects in order to improve the efficiency of the transport system and to obtain better allocative issues.

Thanks to the Objective Law (L443/01), the Italian infrastructural system is going to be significantly strengthened and developed in the next years. The law L 443/01 is in fact a national plan for major infrastructures; it sets these public investments in a special context of high priority, simplified environmental rules, reduced role for local approval, etc. In general, a "fast lane" approach dominated the proposal. But, during the bureaucratic development of the law, the content of the list immediately begun to inflate, at first to more than eighty projects (from the original number of twenty), than to over two hundred, under the pressure of local and sectoral interests. Special emphasis was put on private financing, given the limits of the public purse. Altogether, almost no relation was visible with the previous (and formally still valid) National Transport Plan. At the end, the project included in the L443/01 were chosen without strong relationship with data of traffic flows, and without the definition of a rank of priority[1]. So, a more deeply based on data analysis could be not unuseful.
The aim of the paper is to analyse the present situation of the Italian infrastructural transport sector, to provide elements for a debate and an international benchmarking[2]. Some policy indications about infrastructural planning will be also derived. The input data are extracted by official documents, as the CNIT – Conto Nazionale delle Infrastrutture e dei Trasporti (the national statistics book provided by the Ministry of Transport) and the AISCAT (the association of Italy's tolled tunnel and motorways) bulletins, or specific documents and laws of the Italian state.
The paper is built up trough two chapters. The former shows the most important data about traffic flows in Italy. In particular, the analysis concerns the rail and road modes (as two inter – dependent modes in land transport and as the two main modes in the Italian context), both for freight transport and for passenger transport. The main data will concerns the market share of each mode, the distance classes of the transports and the role played by the motorways. The latter will analyse the transport infrastructural expenditure in rail and road network (investment and maintenance costs), providing some indications for the next years; the future expenditure will be linked with the forecasted traffic flows, to underline the efficiency and the effectiveness of the expenditure.

1 TRAFFIC DATA

The section shows the most important data about traffic flows in Italy. In particular, the analysis concerns the rail and road modes and about the last thirty years. The traffic flow data will be linked, in the next section, with the expenditure data to provide a critical analysis of the expenditure in infrastructures, both for the past and, mainly, for the future. At the and of the section, some policy indications will be provided.

[1] An analysis of the L443/01 and of its projects can be found in Ponti (2003) and in Brambilla&Erba (2004).
[2] Anyway, this paper does not provide international comparison

1.1 Freight traffic[3]

As it is possible to see in Table 1 and Graph 1, the national traffics have been continuously increasing since the ‘70s, as happened during the last fifty years in Italy. The road is the most important mode and the rail transportations show a not relevant increasing trend. The market shares are unbalanced to the road system and in particular the road freight traffics are produced on the highway network.

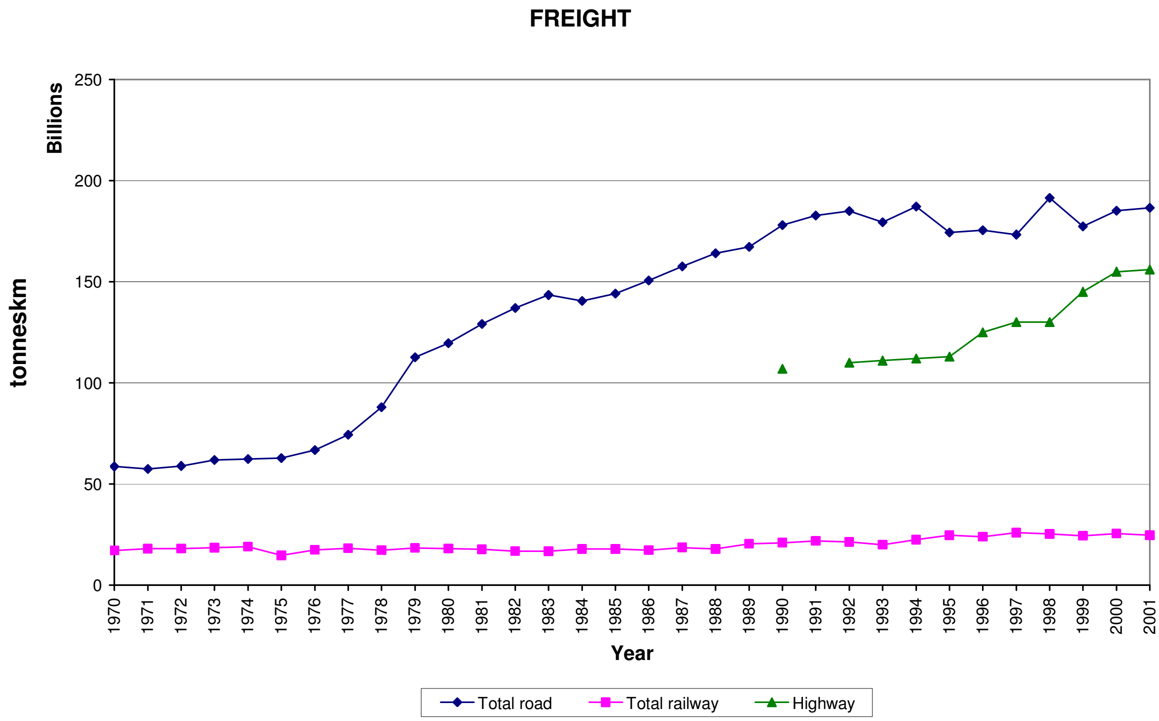
Table 1 Freight traffic by railway and road in Millions of tonneskm

Year	Railway	Total road	Highway
1970	17.190	58.658	N.A.
1971	18.022	57.481	N.A.
1972	18.124	58.986	N.A.
1973	18.561	61.929	N.A.
1974	19.038	62.426	N.A.
1975	14.667	62.795	N.A.
1976	17.400	66.708	N.A.
1977	18.245	74.361	N.A.
1978	17.337	88.022	N.A.
1979	18.399	112.701	N.A.
1980	18.157	119.629	N.A.
1981	17.735	129.136	N.A.
1982	16.904	137.071	N.A.
1983	16.746	143.441	N.A.
1984	17.870	140.494	N.A.
1985	17.853	144.129	N.A.
1986	17.303	150.648	N.A.
1987	18.626	157.630	N.A.
1988	17.863	164.026	N.A.
1989	20.498	167.228	N.A.
1990	20.988	177.945	106.974
1991	21.879	182.746	N.A.
1992	21.349	184.929	110.000
1993	19.983	179.381	111.000
1994	22.488	187.148	112.000
1995	24.673	174.432	113.000
1996	23.994	175.450	125.000
1997	25.917	173.353	130.000
1998	25.366	191.481	130.000
1999	24.440	177.358	145.000
2000	25.534	185.101	155.000
2001	24.617	186.509	156.000

Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

[3] All the data from CNIT for the road sector are referred only to vehicles matriculated in Italy, no specific official data are available for vehicle matriculated abroad. Moreover, the provided data consider only vehicles able to transport more than 3,5 tonnes. No official data are available for light commercial vehicles. Anyway, these data can be usefully used to analyse the role played by motorways.

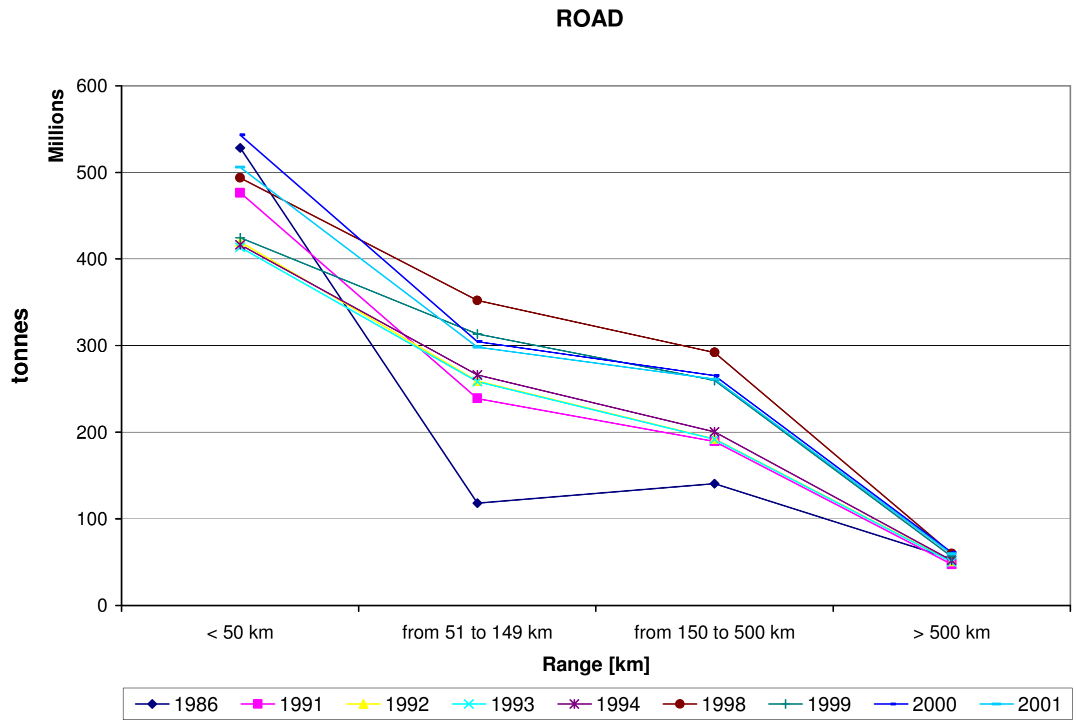
Graph 1 Freight traffic by railway and road networks in tonneskm



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

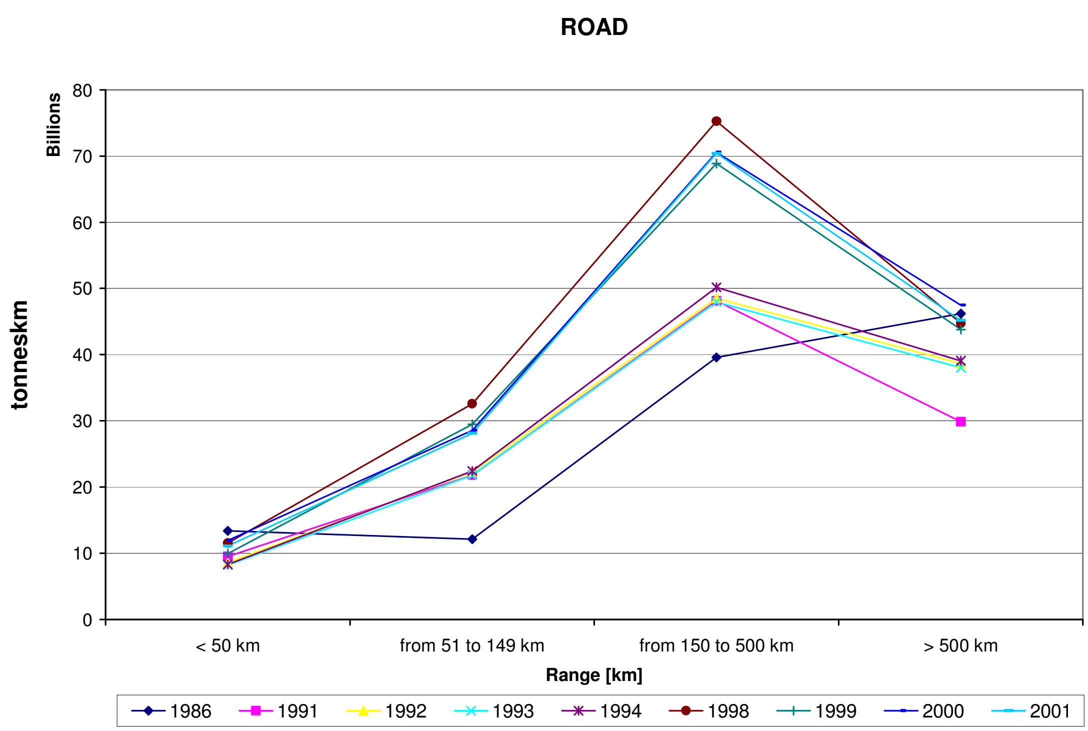
A relevant role, in order to provide elements for a policy analysis, is played by the distribution of the distances of the transport (see Graph 2, Graph 3, Graph 4 and Graph 5). Considering the available data (the last two decades), it is clear how the largest part of the transport is on short and medium distances both for rail and road systems.

Graph 2 Road transport – distance distribution in tonnes



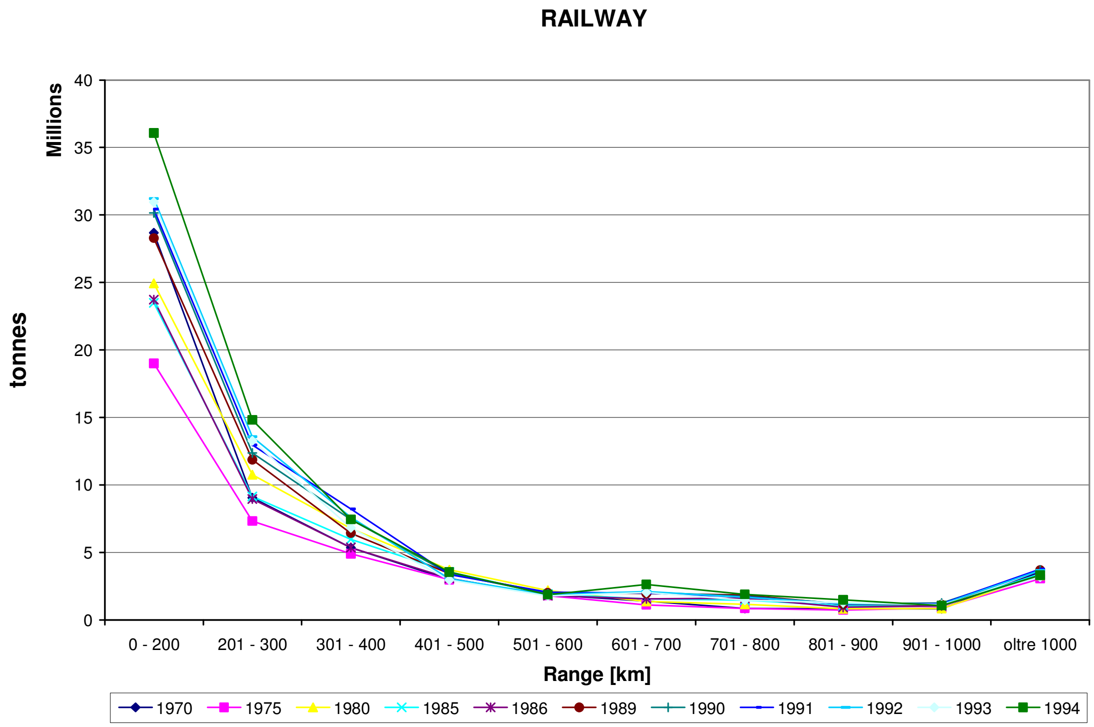
Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 3 Road transport – distance distribution in tonneskm



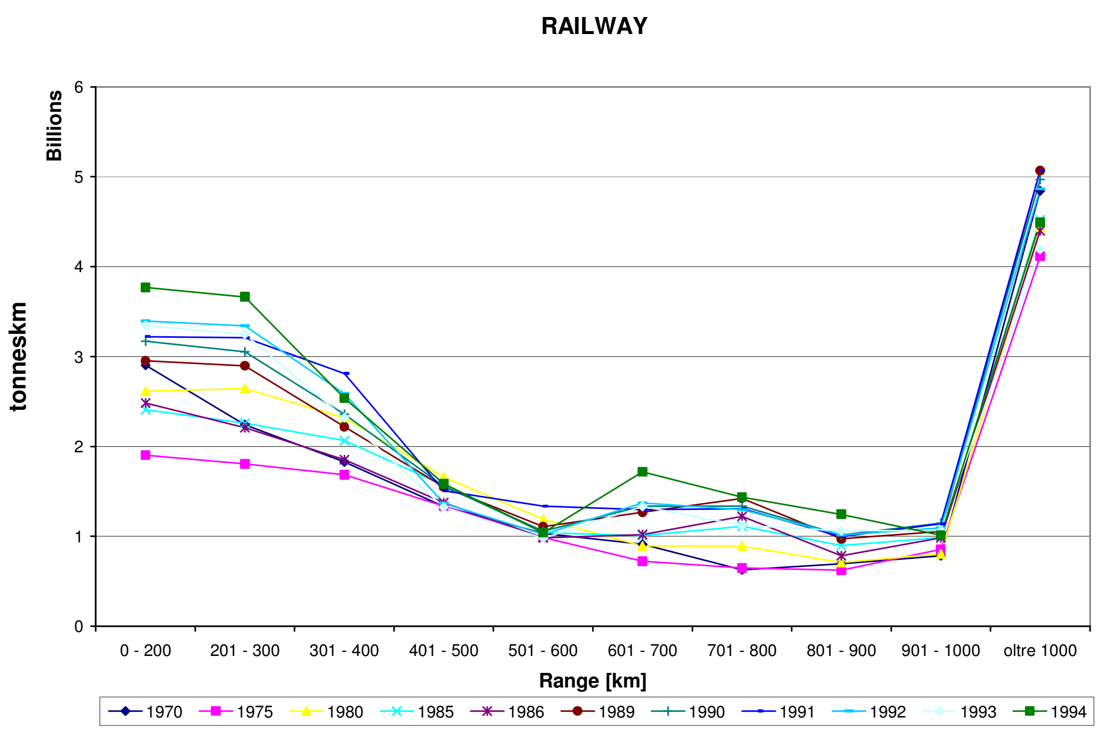
Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 4 Rail transport – distance distribution in tonnes



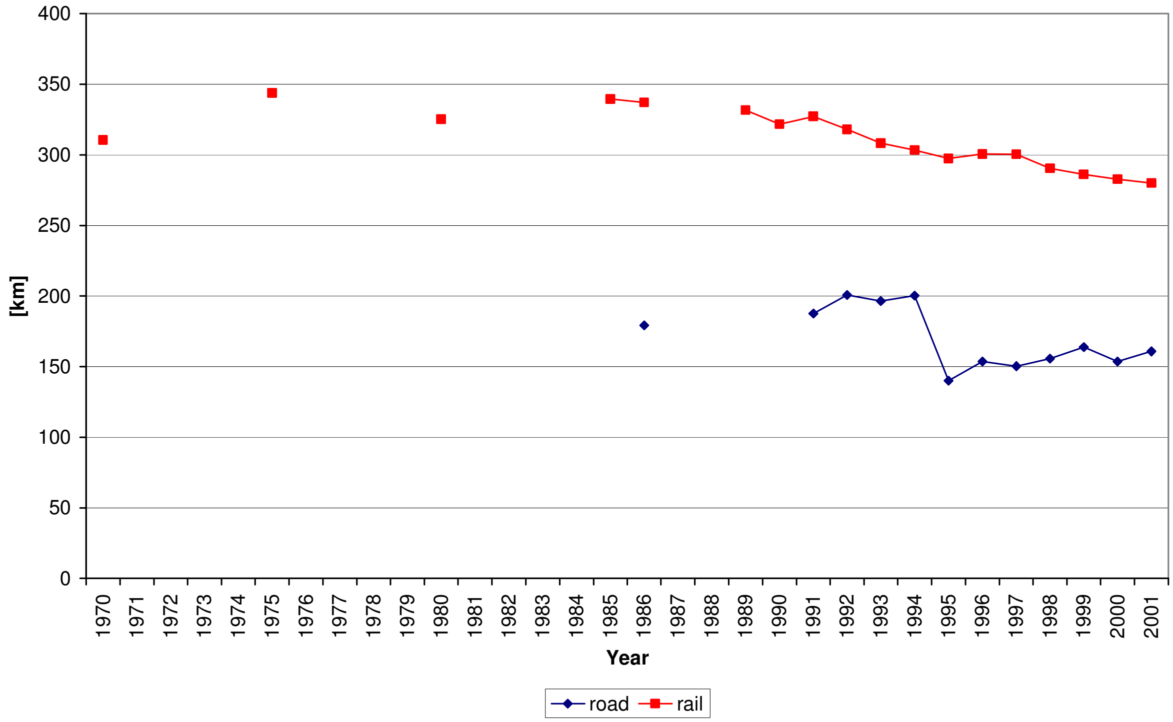
Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 5 Rail transport – distance distribution in tonneskm



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 6 Average distances for tonne by rail and road



Source: our elaboration on data CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

The role of the motorways, in freight transport, can be easily understood by the data provided in Table 1 and Graph 1.

Is it clear how the role of the motorway is continuously increasing, despite of the invariance of the network extension and the "up and down" evolution of the total traffics. Remembering how the average length of the transport (national and international) was 160km in year 2001 (see Graph 6), and remembering how motorways are interested by the 80% of the total traffic[4] (in tonneskm), it is possible to conclude about the relevance of the motorways for short distance transports.

The role of the international road transport is approximately 20% of the national transport in tonneskm and 0,3% in tonnes.

[4] The flow data on tolled motorways seem to be critic: even though the total traffic is built considering only vehicles able to transport more than 3,5tonnes, a so relevant share of transport on tolled motorways seems to be in contrast with the relevant role of short distance road transport. Nevertheless, no explanation is provided about the chosen load factor. Anyway, the data allow to show the trends.

Table 2 Road freight traffic year 2002

Distance	National		International		Total	
	Mtonnes	Mtonneskm	Mtonnes	Mtonneskm	Mtonnes	Mtonneskm
< 50km	558	12.079	1	37	559	12.116
51-100km	203	15.087	1	65	204	15.152
101-150km	120	15.199	1	119	121	15.319
151-200km	86	15.285	1	169	87	15.454
201-300km	108	26.921	2	574	110	27.496
301-400km	56	19.657	2	822	59	20.479
401-500km	28	12.723	2	972	30	13.695
> 500km	57	43.084	27	29.883	83	72.967
Total	**1.217**	**160.037**	**37**	**32.641**	**1.254**	**192.678**

Source: CNIT 2002

In order to provide policy indications, interesting results can be defined comparing the national and international (Italian import and export) traffic flows (see Table 2, Table 3 and Table 4). The national flows are bigger of a magnitude than the international flows: the sum of the rail and road international flows is about 26% of the only national road traffic in terms of tonneskm, and about 8% in terms of tonnes. Despite of the relationship in national traffic, the modal share of the rail can be compared to the modal share of the road in the international market. The official data provides also the quantification of the rail freights with origin and destination out of Italy: this category (rail transit) seems to be negligible.

Table 3 National and international freight traffic year 1998 – 2002 a comparison in Millions of tonnes

	1990	1995	1998	1999	2000	2001	2002
road national	N. A.	N. A.	1.198,000	1.179,000	1.054,000	1.125,000	1.217,000
rail national	N. A.	N. A.	34,000	34,000	36,000	33,000	31,000
road international	N. A.	N. A.	33,000	33,000	29,000	35,000	37,000
rail international	N. A.	N. A.	50,000	49,000	52,000	53,000	52,000
rail transit	N. A.	N. A.	0,052	0,052	0,062	0,039	0,020

Source: our elaboration on data CNIT 1999 – 2002

Table 4 National and international freight traffic year 1998 – 2002 a comparison Millions of tonneskm

	1990	1995	1998	1999	2000	2001	2002
road national	N. A.	N. A.	164.151	172.380	152.054	154.787	160.037
rail national	N. A.	N. A.	12.632	12.267	12.942	12.015	11.269
road international	N. A.	N. A.	27.330	29.712	25.304	31.722	32.641
rail international	N. A.	N. A.	12.052	11.488	12.028	12.322	11.782
rail transit	N. A.	N. A.	20	26	25	15	9

Source: our elaboration on data CNIT 1999 – 2002

1.2 Passengers traffic

The official data about passenger traffic are less detailed than the data for freight traffic. In particular, no information are provided in order to link the number of passengerkilometres to the classes of distances[5], and to show national and international traffic.
As shown in Table 5 and Graph 7, the national passenger traffic (in paxkm) is mainly related to the private mode (car and motorcycle) and since 1989 the bus charter services overcame the rail mode.

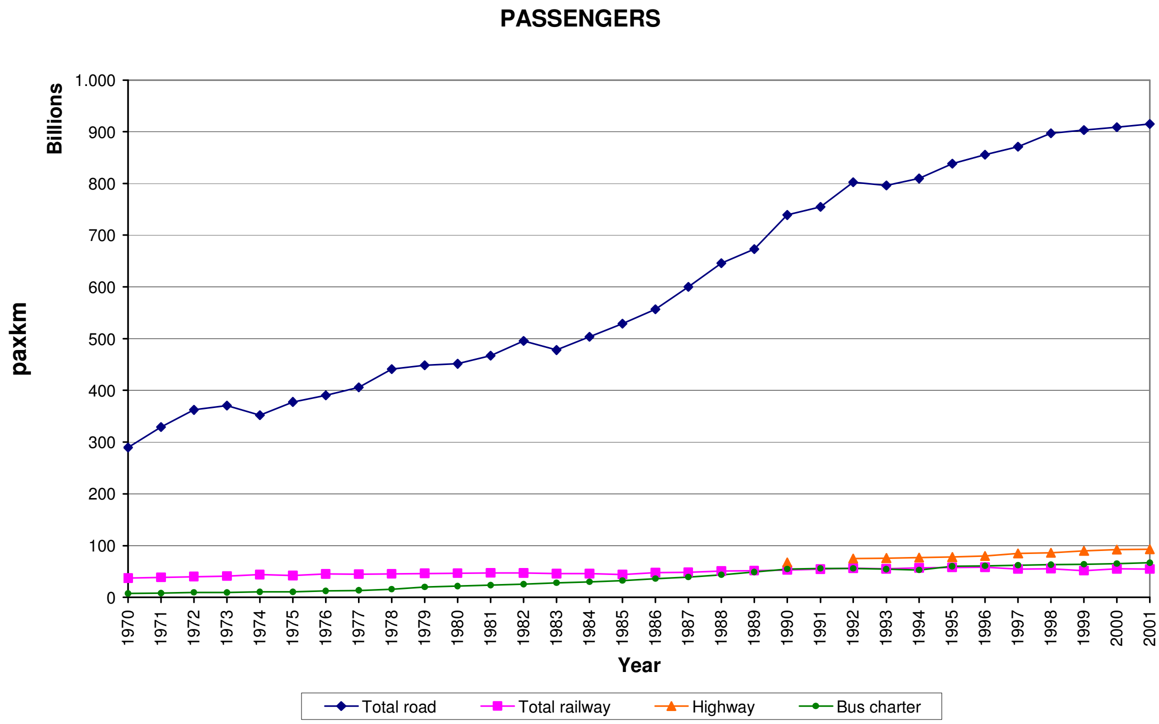
Table 5 Total passenger traffic years 1970 – 2001 in Millions of paxkm

Year	Bus and trolley - bus)	Tram and underground	Bus charter	Car	Motorcycle	Railway
1970	48.312	2.210	7.179	211.934	22.488	34.863
1971	49.448	2.210	8.010	248.781	23.087	36.400
1972	53.431	2.232	9.500	273.326	26.138	37.839
1973	56.289	2.284	9.347	278.184	26.544	38.918
1974	58.690	3.047	10.251	258.440	25.098	40.795
1975	60.939	3.046	10.520	279.259	27.054	39.166
1976	63.558	3.128	12.223	287.519	27.043	42.115
1977	66.405	3.062	13.577	296.548	29.355	41.665
1978	69.888	3.386	15.686	327.033	28.714	42.141
1979	75.659	3.489	19.942	320.424	32.860	42.864
1980	78.848	3.657	21.632	324.034	26.915	42.943
1981	80.091	3.999	23.517	335.791	27.845	43.482
1982	82.944	3.977	25.620	358.696	28.635	42.891
1983	84.083	3.827	28.130	334.754	31.092	42.017
1984	84.407	3.861	29.942	355.231	33.772	42.112
1985	87.944	4.139	32.310	373.700	34.876	40.309
1986	90.154	4.257	36.301	394.375	36.326	43.354
1987	92.312	4.367	39.392	427.202	41.220	44.248
1988	92.511	4.762	43.461	465.430	44.576	46.202
1989	96.177	4.458	48.860	480.615	47.477	47.197
1990	101.460	4.570	54.834	522.593	60.124	48.293
1991	103.110	5.334	55.944	538.265	57.662	49.196
1992	102.290	5.263	55.870	590.449	53.452	51.149
1993	96.591	5.385	54.334	588.279	57.289	49.775
1994	95.075	5.462	52.839	600.326	61.192	51.674
1995	103.976	5.200	59.968	614.713	59.882	52.492
1996	105.997	5.282	61.029	627.383	61.063	53.092
1997	107.363	5.319	62.046	638.837	62.913	49.501
1998	107.634	5.251	63.077	662.545	63.996	50.137
1999	110.158	5.219	64.116	663.319	65.512	46.301
2000	111.823	5.382	65.150	665.206	66.931	49.571
2001	113.907	5.411	66.623	666.366	68.350	49.426

Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

[5] According to Conto Nazionale dei Trasporti (CNIT, 2002), in year 2002, the average lenght of a passenger travel is 382km for long distance trains and 47km for local transport.

Graph 7 Total passenger traffic years 1970 – 2001 in paxkm



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

The role of (tolled) motorways in passenger transport is more and more relevant. Despite of the highway network constant extension, the total traffic (in passengerskm) and the market share of the tolled motorway is increasing (see Table 6).

Table 6 Total passenger traffic on conceded motorways year 2002 in Millions of paxkm

Year	1990	1995	1998	1999	2000	2001
on tolled motorways traffic	68.085	78.573	86.397	88.381	91.164	95.005
total traffic	739.011	838.539	897.252	903.105	909.110	915.246
	km	**km**	**km**	**km**	**km**	**km**
motorway extension	6.185	6.435	6.465	6.469	6.478	6.478

Source: our elaboration on data CNIT, 2002; AISCAT, 2003

1.3 Traffic on motorways

Some indications can be derived analysing the traffic data of the specific sections of the Italian tolled motorway network[6]. In Table 7 a "density of traffic" index has been elaborated, in order to link the traffic data (in vehicleskilometre) to the extension of the section and the number of lanes; obviously, higher is the density index, higher is the utilization of the infrastructure.

[6] No data are provided for the untolled motorway network, directly managed by ANAS. In particular, no official data are available for the motorway rings of Milano and Roma and for the A3 Motorway Salerno – Reggio Calabria.

Table 7 Tolled motorways density index year 2003, light and heavy vehicle

Code	Relation	km	Lanes	kind	veh/day	vehkm	vehkm/laneskm
	TANGENZIALE DI NAPOLI	20,2	3	Tot	257.222	1.021.400.000	23.089
A4	MILANO – BRESCIA	93,5	3	Tot	260.957	3.450.700.000	16.852
A4	BRESCIA – PADOVA	146,1	3	Tot	271.362	4.574.600.000	14.297
A8/A26	A8/A26 link	24	2	Tot	54.391	500.000.000	14.269
A10	SAVONA – GENOVA	45,5	2 (3)	Tot	86.763	903.800.000	13.605
A3	NAPOLI – SALERNO	51,6	3	Tot	153.077	1.529.900.000	13.538
A4	PADOVA – VENEZIA	23,3	3	Tot	93.881	673.600.000	13.201
A1	MILANO – BOLOGNA	191,2	3	Tot	232.477	5.519.300.000	13.181
A12	GENOVA – SESTRI L	48,7	2	Tot	51.898	922.500.000	12.974
A8/A9	MILANO – Lakes	77,7	3 (2/4)	Tot	276.684	2.199.800.000	12.928
A1	BOLOGNA – FIRENZE	91,1	2 (3)	Tot	92.590	1.706.000.000	12.826
A11	FIRENZE – PISA	81,7	2	Tot	159.597	1.511.000.000	12.667
A1	FIRENZE – ROMA	273	2	Tot	213.907	4.919.800.000	12.343
A1	ROMA – NAPOLI	202	3	Tot	198.905	4.724.700.000	10.680
A14	BOLOGNA-ANCONA	236	3	Tot	256.742	5.330.200.000	10.313
A14	ANCONA – PESCARA	133,8	2	Tot	97.747	2.014.600.000	10.313
A22	VERONA – MODENA	90	2	Tot	71.384	1.327.400.000	10.102
A13	BOLOGNA-PADOVA	127,3	2	Tot	114.564	1.847.900.000	9.943
A24	ROMA – TORANO	79,5	2	Tot	130.779	1.148.600.000	9.896
A22	BRENNERO – VERONA	224	2	Tot	125.080	3.037.200.000	9.287
A4/A23/ A28	VENEZIA – TRIESTE dir. Palmanova – Udine dir. Portogruaro – Conegliano	180,3	2	Tot	211.712	2.368.000.000	8.996
A12	SESTRI L – L IVORNO and La Spezia link	133,4	2	Tot	112.363	1.736.300.000	8.915
A14	PESCARA – LANCIANO	49,7	2	Tot	54.966	629.900.000	8.681
A30	CASERTA – SALERNO	55,3	2	Tot	71.225	692.700.000	8.580
A7	GENOVA – SERRAVALLE	50	2	Tot	135.704	614.300.000	8.415
A21	TORINO-PIACENZA	164,9	2 (3)	Tot	42.830	2.017.900.000	8.382
A4	TORINO-MILANO	127	3	Tot	110.139	2.171.900.000	7.809
A11dir	VIAREGGIO-LUCCA	21,5	2	Tot	31.372	242.200.000	7.716
A10	VENTIMIGLIA – SAVONA	113,3	2	Tot	122.353	1.270.000.000	7.678
A18	MESSINA – CATANIA	76,8	2	Tot	76.699	847.500.000	7.558
A7	MILANO – SERRAVALLE	86,3	3 (2)	Tot	92.348	1.422.600.000	7.527
A12	ROMA – CIVITAVECCHIA	65,4	2	Tot	66.013	637.900.000	6.681
A21	PIACENZA – BRESCIA and A1/A21link	88,6	2	Tot	61.756	847.400.000	6.551
A1	FIANO R – SAN CESAREO	45,3	3	Tot	47.484	584.200.000	5.889
A26	GE VOLTRI – ALESSANDRIA and Predosa – Bettole link	83,7	3 (2)	Tot	59.855	1.054.800.000	5.754
A15	PARMA-LA SPEZIA	101	2	Tot	41.110	837.300.000	5.678
A16	NAPOLI – CANOSA	172,3	2	Tot	69.198	1.381.000.000	5.490
A5	TORINO – QUINCINETTO	51,2	2	Tot	42.107	397.700.000	5.320
A31	TRENTO – VICENZA – ROVIGO	36,4	2	Tot	38.021	282.600.000	5.318
A27	VENEZIA – BELLUNO	82,2	2	Tot	52.333	612.100.000	5.100
A14	LANCIANO – CANOSA	189,6	2	Tot	42.256	1.327.000.000	4.794
A6	TORINO – SAVONA	130,9	2 (1)	Tot	48.350	886.500.000	4.639
A5	QUINCINETTO – AOSTA	59,5	2	Tot	30.164	401.500.000	4.622
A28	UDINE – TARVISIO	101,2	2	Tot	68.263	675.200.000	4.570
A12	LIVORNO – CIVITAVECCHIA	36,6	2	Tot	19.432	239.000.000	4.473
A4/A5	IVREA – SANTHIÀ	23,6	2	Tot	18.283	145.900.000	4.234
A14dir	RACCORDO DI RAVENNA	29,3	2	Tot	19.452	180.500.000	4.219
A14	CANOSA – TARANTO	143	2	Tot	32.581	825.400.000	3.953

A20	MESSINA – PALERMO Messina –Torrente Furiano	114,8	2	Tot	51.752	636.500.000	3.798
A25	TORANO – PESCARA	114,9	2	Tot	41.334	620.500.000	3.699
A32	TORINO – BARDONECCHIA	72,4	2	Tot	8.209	338.100.000	3.199
A24	TORANO – TERAMO	87	2 (3)	Tot	31.734	385.200.000	3.033
T4	Frejus Tunnel	6,8	1	Tot	5.774	14.310.000	2.883
A26	ALESSANDRIA – GRAVELLONA TOCE and A26/A4link	161,2	3 (2)	Tot	69.884	1.003.900.000	2.844
A5	SARRE – MORGEX	27	2	Tot	25.591	80.600.000	2.045
A20	MESSINA – PALERMO Buonfornello – Castelbuono	25,8	2	Tot	6.793	60.700.000	1.611
T1	Monte Bianco Tunnel	5,8	1	Tot	4.244	6.720.000	1.587
T2	Gran San Bernardo Tunnel	12,8	1	Tot	1.723	8.070.000	864
	all network total			**Tot**		**77.436.200.000**	

Note: lane number in brackets indicates changes in the numbers of the lanes in some points of he motorways; "Tot" means light and heavy vehicle summed, considering light and heavy vehicle with the same weight

Source: our elaboration on data AISCAT, 2003

The provide data "take up a picture" of an average day, not showing the peak load phenomena or the seasonal fluctuation. Anyway, the result can be used to define a ranking of utilisation (as a proxy of the congestion). The most critical situations can be seen in the north of Italy, approaching the most important cities[7].

1.4 Some considerations

Road transport has a dominant role in the Italian context; in particular, the national freight road flows are a magnitude bigger than the international road flows and the whole rail flows. Data consistent policies should reflect this situation, focusing mainly on the road network instead of rail network.

The role of the international freight transport is less relevant than the role of the national transport, in particular according to the data in tonnes. The transport originating out of Italy with destinations out of Italy seems to be irrelevant. This is not consistent with the idea of the European corridor (playing a relevant role in the allocation of the public funds), in particular for rail traffic. Some doubts can be shown about the realization of long distance international infrastructure[8], in order to capture international flows whose existence seems to be not demonstrated[9] in the Italian case. On the other side, also international flows whit origin or destination in Italy have a less than 30% weight (in tonneskm) in relation with national flows.

Short distance flows (passengers and freight) play always a relevant role and determinate a large part of the congestion phenomena, with effects also on long distance routes. As shown, the most critical situation on the highway network is on motorways near to the most important cities (located mainly in the North) and, for long distance, along North – Centre main links (Venezia – Milano and Milano – Roma) with some spokes.

[7] The link "tangenziale di Napoli" can be considered as a urban tolled link.

[8] Obviously, the realization of new infrastructures can modify the network assignation; but a relevant role in played by the liberalization process, whose effect could have the same magnitude of the effects of the infrastructural programmes.

[9] The long distance international transports have a real alternative in maritime shipping, in particular on east – west routes (corridor Lisboa – Kiev).

2 INFRASTRUCTURE NETWORKS AND EXPENDITURES

The purpose of this section of the paper is to show the Italian extension and expenditure data series for road and rail networks, and to evaluate - by means of a cost–benefit approach - the suitability of some projects included in the suggested transportation planning by the Law 443/01 Act.
Since 1984, with reference of the CNIT – Conto Nazionale delle Infrastrutture e dei Trasporti, it has been possible to give some quantitative overviews.
As shown in the next tables and graphs, the available data takes different types of infrastructure into consideration, both for roads and for railways.

2.1 Roads

Road network extensions

The entire Italian road network can be divided into three categories:

- highways
- national roads
- provincial roads

The Italian highway network is mainly based on a toll system and is actually managed by concessionaries (see Table 11); the rest of the network, on the other hand, is a toll free system and is managed by the Italian National Roads Agency (ANAS).
After the promulgation of the Decree 112/98[10] the Italian Government transferred the authority for administrating national roads from ANAS to the local governments (Regioni); provincial roads are actually managed by the second level of local governments (Province).
As show in Table 8, Graph 8, Graph 9, Graph 10 and Graph 11 it is possible see the Italian road network extension trends between 1984 and 2002.

Table 8 Italian road network 1984 – 2002 in Kilometres

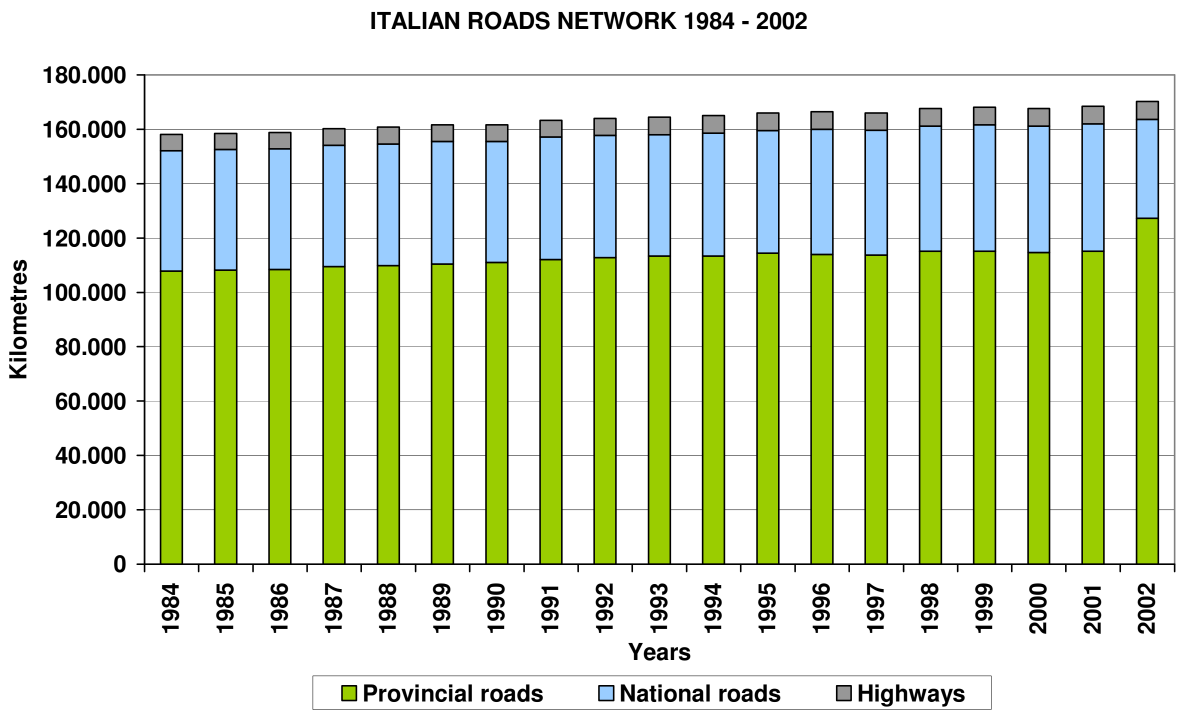
Years	Highways	National roads	Provincial roads	Total
1984	5.941	44.372	107.849	158.162
1985	5.964	44.359	108.191	158.514
1986	5.979	44.450	108.404	158.833
1987	5.999	44.658	109.523	160.180
1988	6.136	44.752	109.893	160.781
1989	6.193	45.005	110.468	161.666
1990	6.185	44.472	111.011	161.668
1991	6.214	45.076	112.111	163.401
1992	6.289	44.888	112.875	164.052
1993	6.401	44.757	113.353	164.511
1994	6.469	45.237	113.349	165.055

[10] *Decreto Legislativo 112/98*
Art. 101 – Trasferimento delle strade non comprese nella rete autostradale e stradale nazionale
1. Le strade e autostrade, già appartenenti al demanio statale ai sensi dell'articolo 822 del codice civile e non comprese nella rete autostradale e stradale nazionale, sono trasferite, con il decreto del Presidente del Consiglio dei Ministri di cui all'articolo 98, comma 2, del presente decreto legislativo, al demanio delle regioni, ovvero, con le leggi regionali di cui all'articolo 4, comma 1, della legge 15 marzo 1997, n. 59, al demanio degli enti locali. Tali leggi attribuiscono agli enti titolari anche il compito della gestione delle strade medesime.
2.In seguito al trasferimento di cui al comma 1 spetta alle regioni o agli enti locali titolari delle strade la determinazione dei criteri e la fissazione e la riscossione, come entrate proprie, delle tariffe relative alle licenze, alle concessioni e alla esposizione della pubblicità lungo o in vista delle strade trasferite, secondo i principi definiti con atto di indirizzo e di coordinamento ai sensi dell'articolo 8 della legge 15 marzo 1997, n. 59.

1995	6.435	45.130	114.442	166.007
1996	6.465	46.043	113.924	166.432
1997	6.469	45.819	113.790	166.078
1998	6.478	46.009	115.125	167.612
1999	6.478	46.483	115.222	168.183
2000	6.478	46.556	114.691	167.725
2001	6.478	46.870	115.180	168.528
2002	6.487	36.453	127.314	170.254

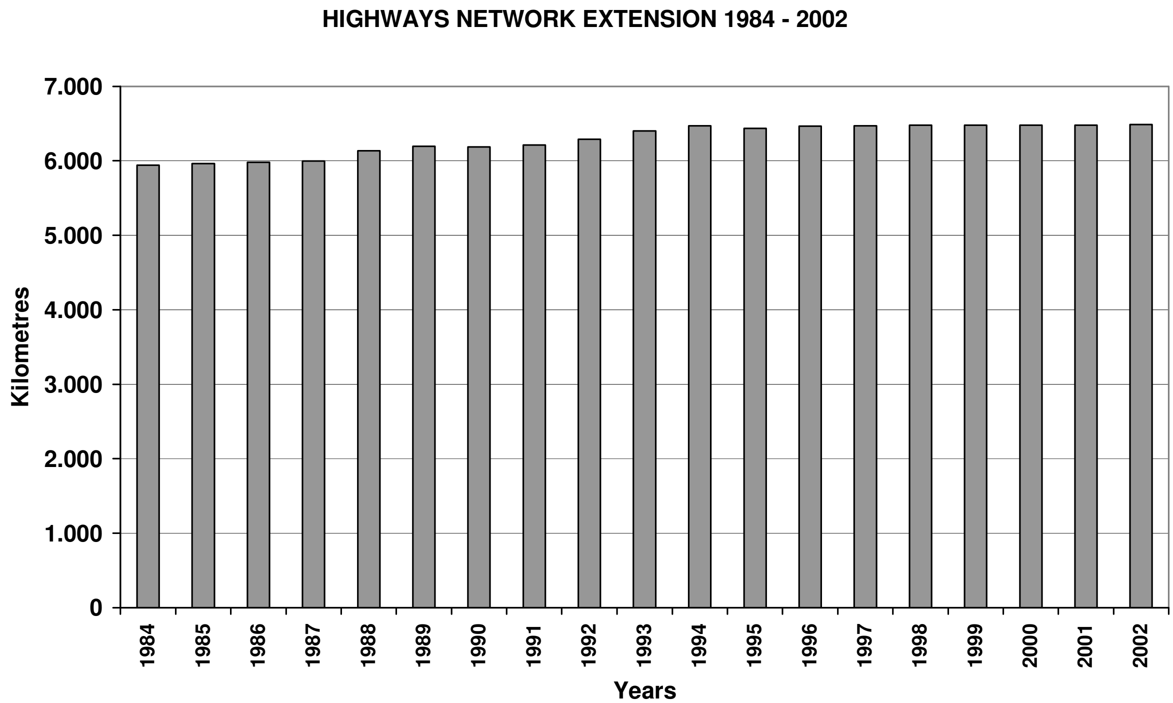
Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 8 Italian road network 1984 – 2002



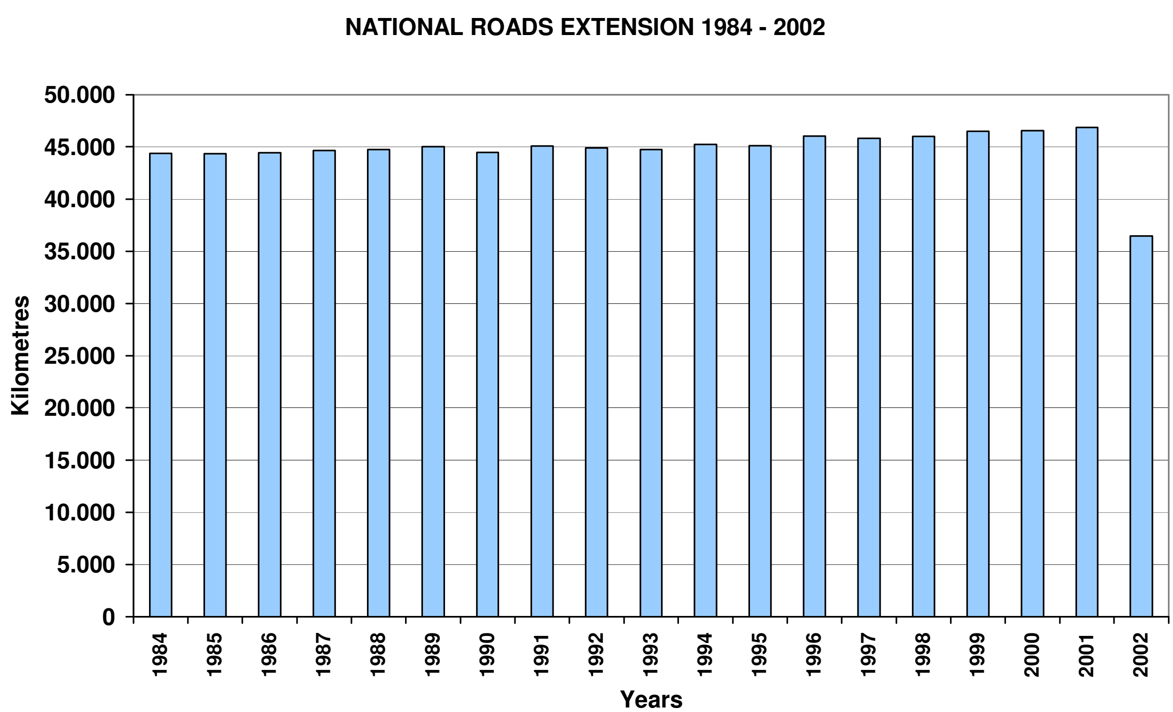
Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 9 Highway network extension 1984 – 2002



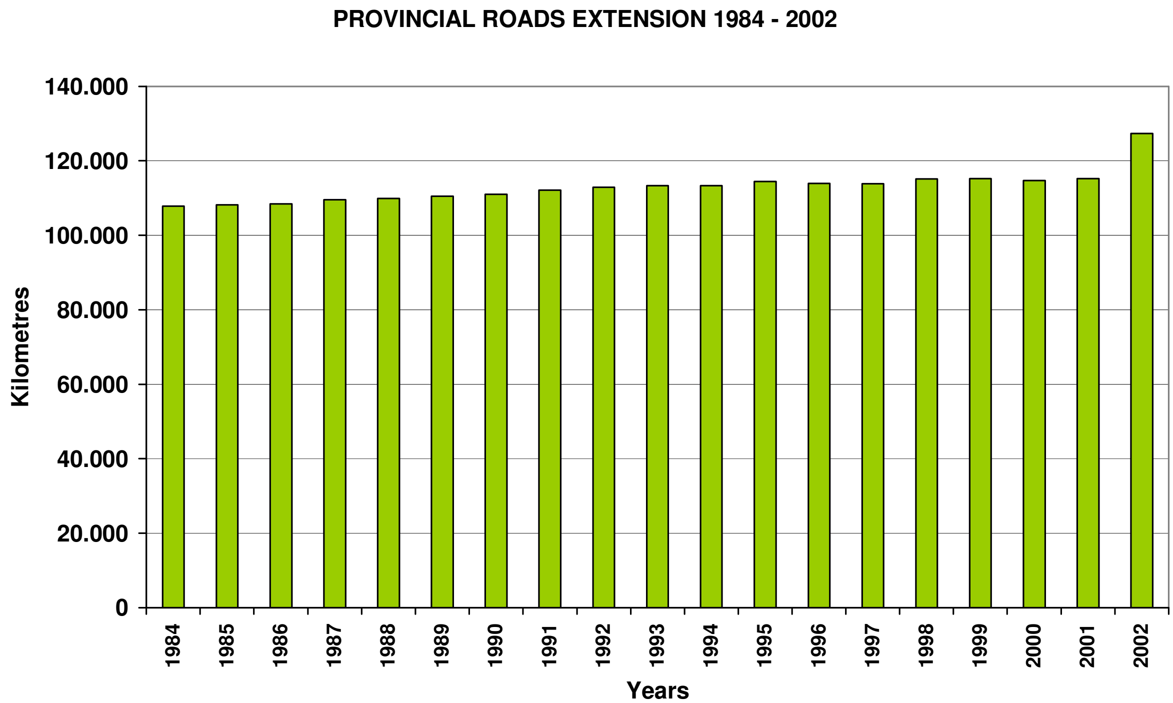
Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 10 National roads extension 1984 – 2002



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 11 Provincial roads extension 1984 – 2002



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Road network expenditures

For a thorough description of the Italian case it is useful to investigate the expenditure trends for the different road infrastructures during the same period.

Always with reference to the institutional data source (CNIT), it is possible to describe the expenditures made by the Italian Government; though, since the available data is presented in an extremely aggregate form, it is not easy to understand.

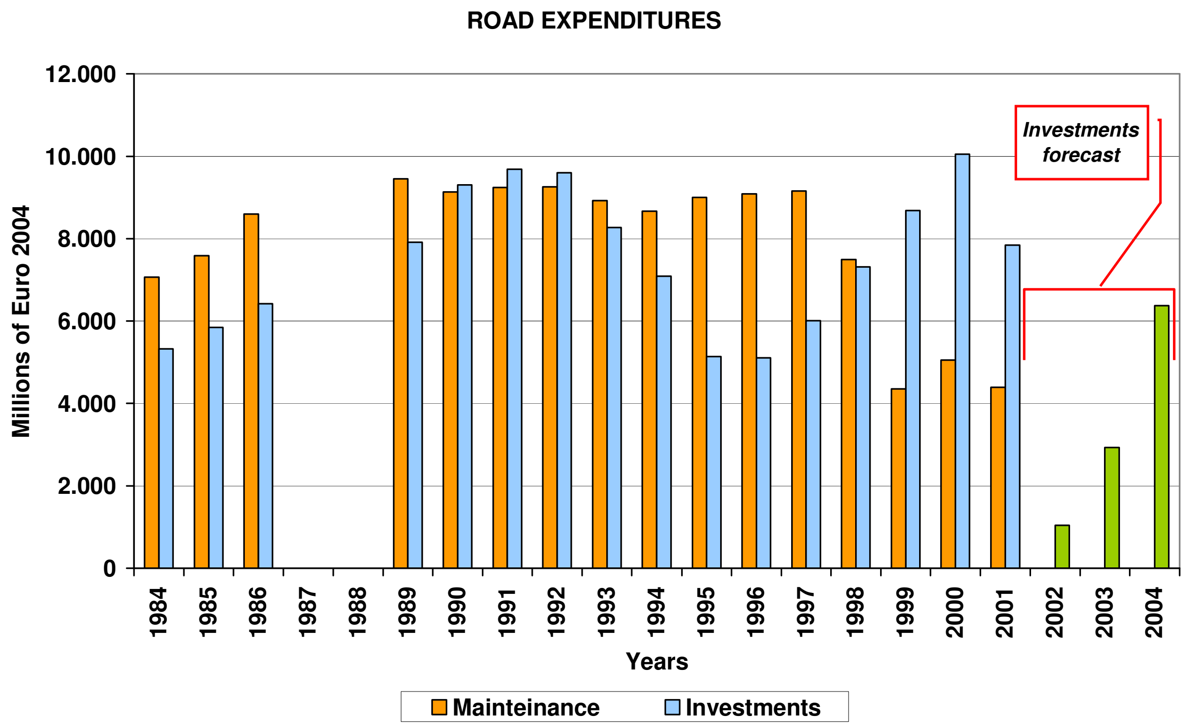
Table 9 Road network – Expenditures made by the Italian Government for maintenance and investments 1984 – 2004 in Millions of Euro 2004

Year	Maintenance	Investments	Total
1984	7.069,73	5.323,77	12.393,50
1985	7.587,22	5.846,70	13.433,93
1986	8.594,48	6.420,34	15.014,82
1987	N.A.	N.A.	N.A.
1988	N.A.	N.A.	N.A.
1989	9.452,71	7.913,75	17.366,46
1990	9.134,24	9.310,87	18.445,11
1991	9.247,22	9.686,80	18.934,01
1992	9.262,61	9.606,48	18.869,09
1993	8.927,07	8.271,42	17.198,48
1994	8.668,85	7.086,77	15.755,63
1995	9.001,50	5.134,00	14.135,50
1996	9.088,06	5.106,94	14.195,00
1997	9.154,08	6.007,74	15.161,82
1998	7.496,15	7.318,24	14.814,38
1999	4.355,44	8.684,03	13.039,48
2000	5.053,82	10.049,07	15.102,89
2001	4.388,96	7.847,11	12.236,08

2002	N.A.	(*) 1.037,28	N.A.
2003	N.A.	(*) 2.927,49	N.A.
2004	N.A.	(*) 6.371,33	N.A.

Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002 and "Legge Obiettivo" e Grandi Opere – L'impatto sul valore delle società

Graph 12 - Road expenditures made by the Italian Government 1984 – 2004



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002 and "Legge Obiettivo" e Grandi Opere – L'impatto sul valore delle società

The CNIT provides the value of the funds transferred from the Ministry of the Economy to the ANAS and local governments (see Table 9 and Graph 12), but it is unclear how these funds are used and it is unknown the level of expenditures made by highway concessionaires.
The roads national Agency actually manages 20.216 km of national roads and 890 km of highways. The concessionaries manage 5.583 km of highways and Autostrade per l'Italia is the most important company with 3.500 km of highways and a traffic of 55 billions of vehicleskm in 2003 (60% of the total traffic).

* Investments forecast from Law 443/01

Table 10 Investments made by ANAS and Società Autostrade in Millions of Euro 2004

Year	ANAS			Autostrade per l'Italia		
	forecast	delivered	in use	forecast	delivered	in use
1996	1.515	N. A.	N. A.	N. A.	N. A.	N. A.
1997	1.765	N. A.	N. A.	100	N. A.	N. A.
1998	1.812	N. A.	N. A.	500	114	N. A.
1999	1.969	N. A.	N. A.	750	226	N. A.
2000	1.931	N. A.	N. A.	800	276	166
2001	2.045	N. A.	N. A.	1.750	536	161
2002	2.030	1.297	994	1.800	1.048	262
2003	1.500	2.093	1.041	2.800	1.122	255

Source Ministry of the Economy, ANAS and Autostrade per l'Italia

Analyzing the expenditures made by the Italian highway concessionaries (see Table 11) in 2002 in more detail and comparing these to the growth trend of the highway network, it appears there hasn't been significant variation in the network's length since 1993. Examining this data one could also conclude there were no relevant expenditures for the investments, as the length of the highway stayed the same for that time period, and further, that maintenance expenses likely remained the same since 1993, making it therefore possible to infer what the remaining data was.

Table 11 Maintenance expenditures in 2002 for highway concessionaries in Millions of Euro

Companies	Maintenance expenditures
ATIVA	20,868
Autostrade	222,703
Autovie Venete	20,700
Brennero	66,082
Brescia – Padova	42,111
Centropadane	12,435
Cisa	15,150
Consorzi siciliani	12,300
Autostrada dei Fiori	16,795
RAV	1,165
SALT	18,676
SAM	8,818
SAT	3,500
SATAP	24,238
SAV	4,046
Serravalle	39,143
SITAF	19,882
Tangenziali di Napoli	7,360
Torino – Milano	17,992
Torino – Savona	7,535
Venezia – Padova	5,980
Traforo del Monte Bianco	2,352
Total	**589,831**

Source: ANAS, 2004

2.2 Railways

Rail network extensions

During the past twenty years the rail network was left substantially unchanged and the network extension remained of around 16.000 Kilometres. It is more relevant to show the rail network

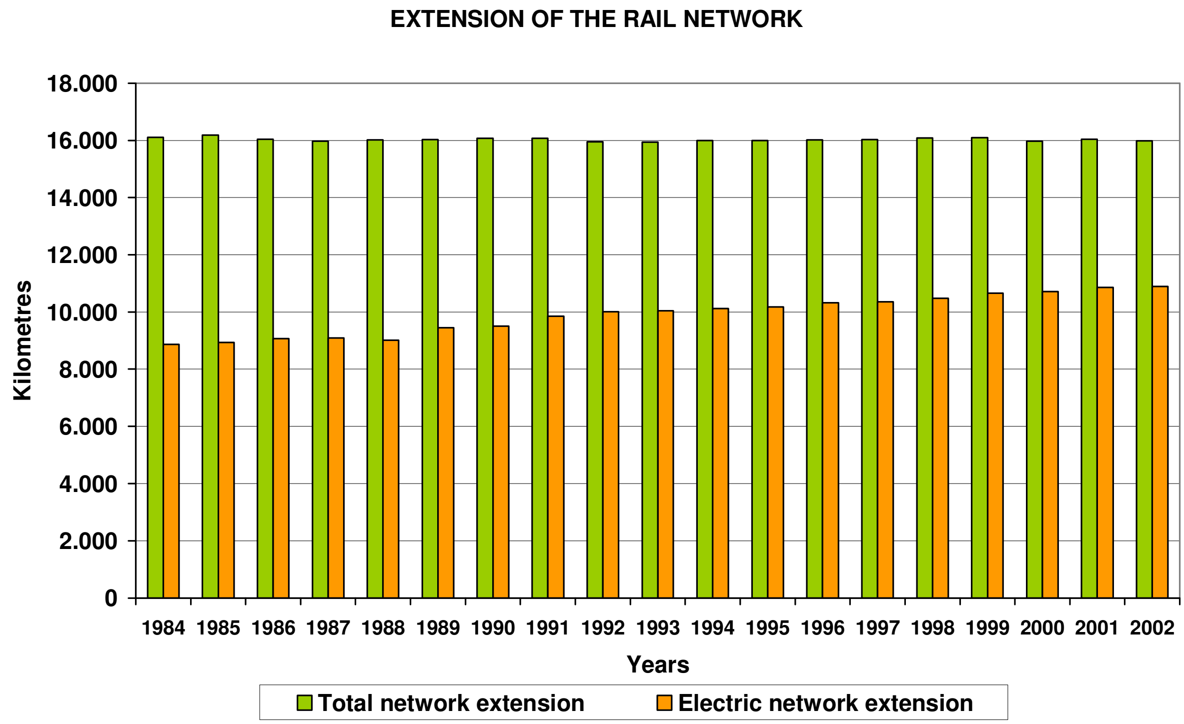
development with reference to the traction and track types actually in use (see Table 12, Graph 13 and Graph 14).
The available data shows that single – track lines constitute 60% of the network and double – track lines 40%. Of the single – track lines 50% are electric; whereas all the double – track lines use electric traction.

Table 12 Italian rail networks 1984 – 2002 in Kilometres

Year	Single – track lines	Electric Single – track lines	Double – track lines	Electric Double – track lines	Total extension	Total electric extension
1984	10.708	3.547	5.395	5.320	16.103	8.867
1985	10.709	3.537	5.474	5.399	16.183	8.936
1986	10.501	3.618	5.533	5.450	16.035	9.068
1987	10.378	3.604	5.596	5.496	15.973	9.100
1988	10.394	3.790	5.622	5.223	16.017	9.013
1989	10.345	3.850	5.686	5.594	16.030	9.443
1990	10.295	3.832	5.771	5.679	16.066	9.512
1991	10.292	4.164	5.774	5.683	16.066	9.848
1992	10.058	4.214	5.893	5.800	15.951	10.014
1993	10.003	4.219	5.937	5.835	15.939	10.046
1994	10.012	4.245	5.989	5.877	16.001	10.122
1995	9.977	4.267	6.021	5.909	15.998	10.176
1996	9.969	4.319	6.044	5.999	16.014	10.318
1997	9.924	4.298	6.106	6.061	16.030	10.358
1998	9.914	4.991	6.127	6.094	16.080	10.488
1999	9.935	4.549	6.173	6.138	16.092	10.661
2000	9.818	N.A.	6.156	N.A.	15.974	10.714
2001	9.805	N.A.	6.230	N.A.	16.035	10.864
2002	9.720	N.A.	6.230	N.A.	15.985	10.891

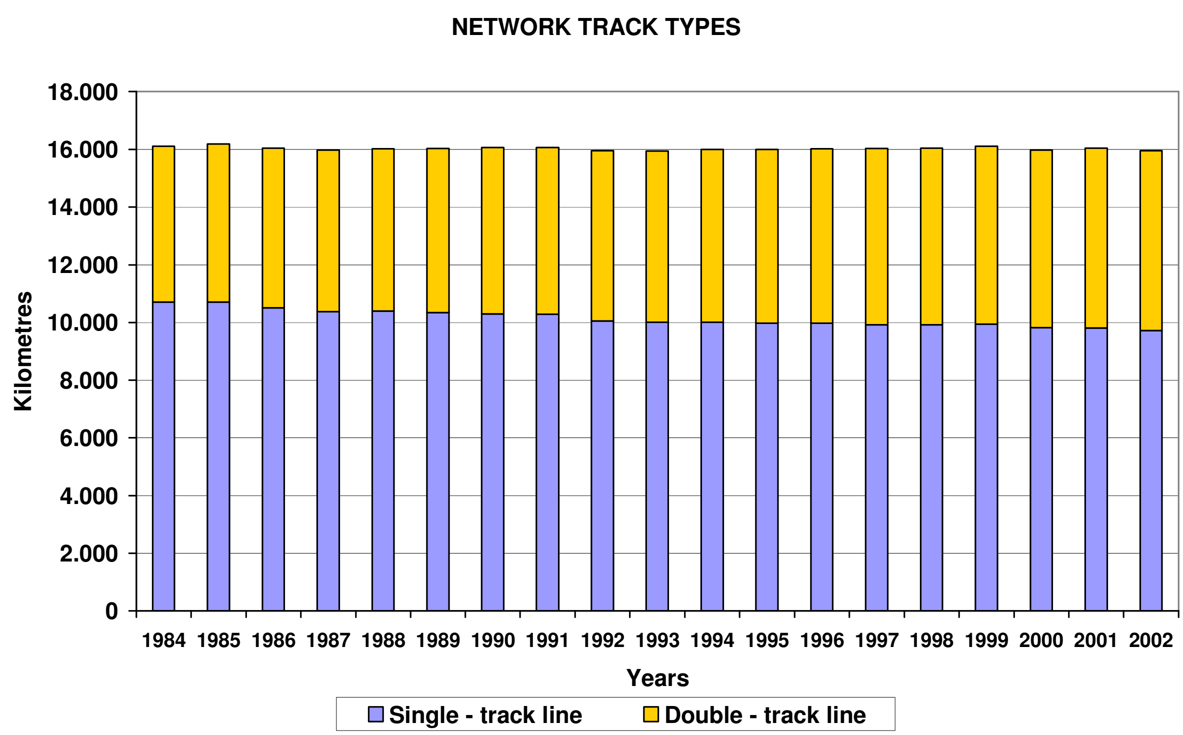
Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 13 Italian rail networks 1984 – 2002



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Graph 14 Italian network track types 1984 – 2002



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002

Through the construction of a High Speed Lines (HLS) network, the Italian railway system will substantially improve within the next few years (2012). At the moment only one HSL is operated between Firenze and Roma (see Table 13).
The rest of the national HSL network is still under construction, and in some sections, very close to being completed. It will consist of a "T" shaped layout: the vertical line will link Milano, Bologna, Firenze, Roma and Napoli and will be completed first; the horizontal line will link Torino, Milano, Venezia and Trieste (the Italian part of "Corridor 5").

Table 13 High speed lines in kilometres

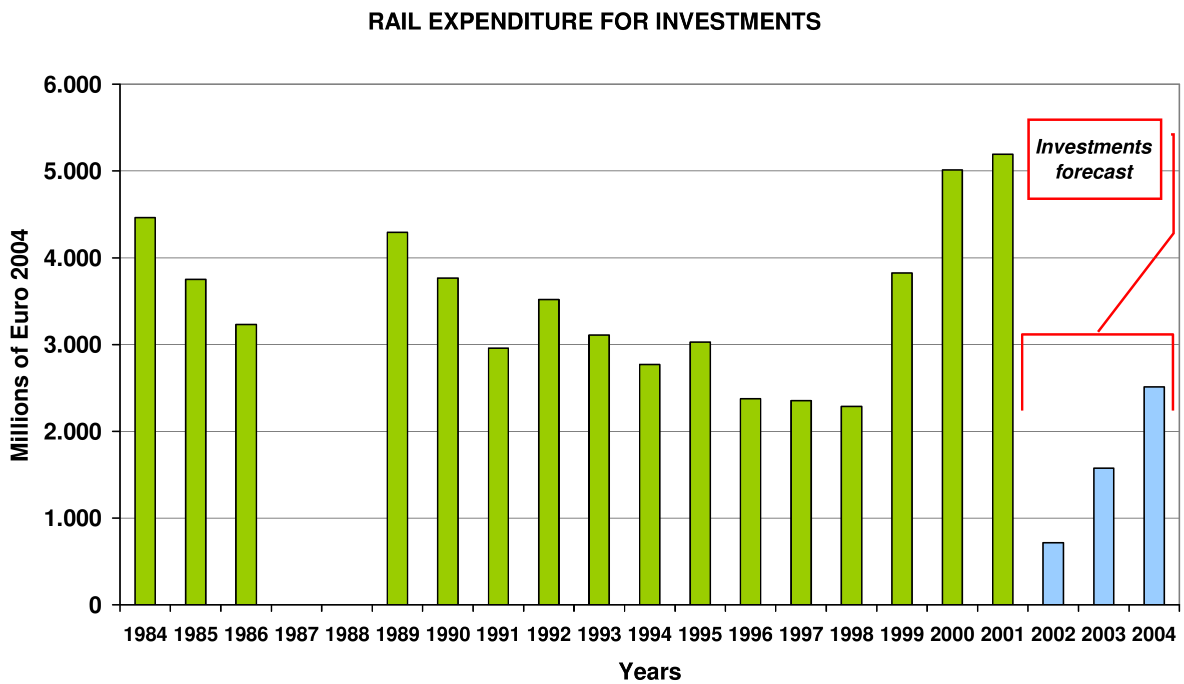
HSL	Total	Operating	% completed	100% completed within
Firenze – Roma	254,0	254,0	100%	-
Torino – Milano	125,0	0,0	63%	2006 – 2008
Milano – Bologna	182,0	0,0	48%	2007
Bologna – Firenze	78,5	0,0	77%	2008
Roma – Napoli	204,6	0,0	90%	2005
Verona – Padova	75,0	0,0	0%	2011
Padova – Venezia	24,0	0,0	0%	-
Milano – Verona	112,0	0,0	0%	2010
Milano – Genova	54,0	0,0	0%	2012
Total	**1.109,0**	**254,0**		

Source: TAV website, July 2004; Italferr, 2003

Rail network expenditures

The data about the Italian expenditures for the railway system is available with reference to the operating, maintenance and investment costs.
The CNIT presents a single aggregate value regarding the expenditures, both for the operating and maintenance costs and, as was the case for the road network, it is not possible to separate this value in order to represent the data.
The Graph 15 illustrates only the investment costs, showing the rail network expenditure trends bypassing the problematic incidence evaluation of the operating costs inside the total expenditure. It is possible to see that between 1984 and 1998 the investment expenditures sunk and that afterwards, due to the HSL system implementation, the trend rebounded positively.

Graph 15 Rail expenditure for investments 1984 – 2004



Source: CNIT 1986, 1993, 1994, 1995, 1996, 1999, 2000, 2001, 2002 and "Legge Obiettivo" e Grandi Opere – L'impatto sul valore delle società

3 INVESTMENT FORECASTS

3.1 A taxonomical approach

As described in the introduction, the Italian infrastructural system will be extensively developed during the next years.
After the promulgation of the Law 443/01 the Italian Governments (central and locals) compiled a list of high – priority transportation projects regarding roads, railways and urban systems; the available data illustrates the different types of project, the investment costs for each infrastructure and the available funds from 2002 to 2004 (see Table 14).

Table 14 Objective Law projects: investment costs in Million of Euro 2004

Project type	Number of projects	Total investment costs	Expenditure forecasts		
			2002	2003	2004
Railways	18	42.654	716	1.576	2.513
Road systems	59	48.462	1.037	2.927	6.371
Urban systems	32	15.062	535	1.274	1.997
Other projects	7	19.387	475	1.845	2.939
Total	**116**	**125.565**	**2.764**	**7.623**	**13.821**

Source: "Legge Obiettivo" e Grandi Opere – L'impatto sul valore delle società

In order to analyse this high – priority projects list, it is useful to create different categories with a taxonomical approach, based on the geographical location and the function, with reference to the following criteria:

- Number of projects for geographical macro – regions
- Expenditure for geographical macro – regions
- Type of project
- Expenditure for type of project

The adopted methodology first divides the Italian territory into five macro – regions, starting from the administrative zones, and then divides the projects based on their function (see Table 15 and Table 16).

Table 15

Macro–regions:	Regions
North West	Valle d'Aosta, Piemonte, Lombardia and Liguria
North East	Veneto, Friuli Venezia Giulia and Trentino Alto Adige
Centre	Emilia Romagna, Toscana, Umbria, Marche, Abruzzo and Lazio
South	Campania, Molise, Puglia, Basilicata, Calabria, Sicilia and Sardegna

Table 16

Function	Description
International Pass	Link between two countries across Alps and part of a long distance infrastructure for passengers and freight
Access to International Pass	Access infrastructures to the international link indispensable to connect the pass to the national rail and road networks
Corridor	Long distance infrastructures for passengers and freight (< 150 km)
Multiregional link	Medium distance infrastructures for passengers and freight (from 150km to 500 km)
Regional link	Short distance infrastructures for passengers and freight (> 500 km)

Table 17 Railway projects in or across macro – regions

	North – West	North – East	Centre	South	**Total**
North – West	7				**7**
North – East	2	2			**4**
Centre	1	1	2		**4**
South	0	0	1	2	**3**
Total	**10**	**3**	**3**	**2**	**18**

Table 18 Expenditure for railway projects in or across macro – regions in Millions of Euro

	North – West	North – East	Centre	South	**Total**
North – West	11.752				**11.752**
North – East	9.412	3.254			**12.666**
Centre	1.291	1.466	2.262		**5.019**
South	0	0	742	12.473	**13.216**
Total	**22.456**	**4.720**	**3.004**	**12.473**	**42.654**

Table 19 Railway projects function

	Number of projects	**Expenditure for projects in Millions of Euro**
International Pass	3	6.197
Corridor	7	29.583
Access to international Pass	2	1.915
Multiregional	3	3.242
Regional	3	1.717
Total	**18**	**42.654**

Table 20 Road projects in or across macro – regions

	North – West	North – East	Centre	South	**Total**
North – West	8				**8**
North – East	3	1			**4**
Centre	0	0	26		**26**
South	0	0	1	20	**21**
Total	**11**	**1**	**27**	**20**	**59**

Table 21 Expenditure for road projects in or across macro – regions in Millions of Euro

	North – West	North – East	Centre	South	**Total**
North – West	5.122				**5.122**
North – East	4.269	1.368			**5.637**
Centre	0	0	11.413		**11.413**
South	0	0	291	25.999	**26.291**
Total	**9.390**	**1.368**	**11.704**	**25.999**	**48.462**

Table 22 Road projects function

	Number of projects	**Expenditure for projects in Millions of Euro**
International Pass	3	1.521
Corridor	6	16.478
Access to international Pass	0	0
Multiregional	19	12.674
Regional	31	17.789
Total	**59**	**48.462**

Table 23 Road and railway projects in or across macro – regions

	North – West	North – East	Centre	South	**Total**
North – West	15				**15**
North – East	5	3			**8**
Centre	1	1	28		**30**
South	0	0	2	22	**24**
Total	**21**	**4**	**30**	**22**	**77**

Table 24 Expenditure for road and railway projects in or across macro – regions in Millions of Euro

	North – West	North – East	Centre	South	**Total**
North – West	16.874	0	0	0	**16.874**
North – East	13.681	4.622	0	0	**18.303**
Centre	1.291	1.466	13.675	0	**16.432**
South	0	0	1.034	38.473	**39.507**
Total	**31.846**	**6.088**	**14.709**	**38.473**	**91.116**

Table 25 Road and railway projects function

	Number of projects	**Expenditure for projects in Millions of Euro**
International Pass	6	7.718
Corridor	13	46.061
Access to international Pass	2	1.915
Multiregional	22	15.916
Regional	34	19.506
Total	**77**	**91.116**

Graph 16 Expenditures for road and railway projects in percentage

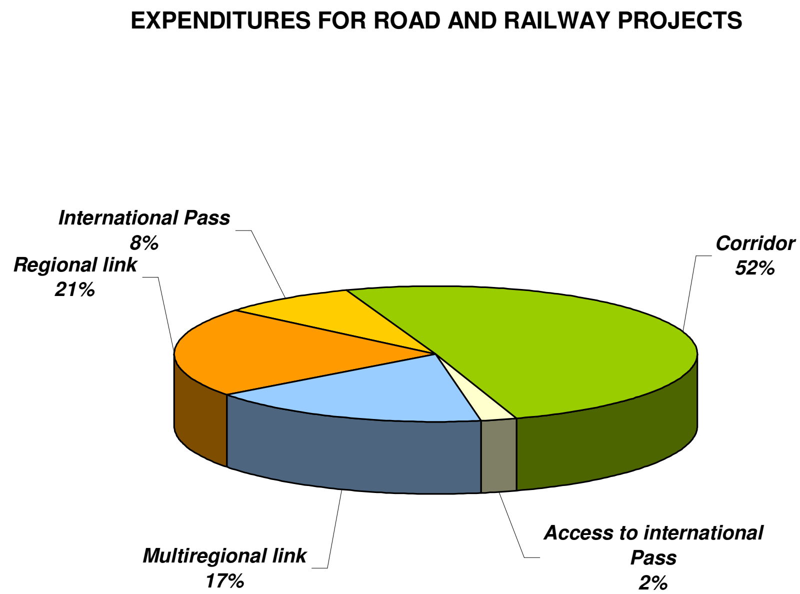


Table 26 Summary for each project type

	Number of projects	Expenditure for projects in Millions of Euro
Projects in macro regions	68	73.644
Projects across macro regions	9	17.472
Total	**77**	**91.116**

Tables 17 to 25 show the following results based on the applied categories:

- Railway projects favour the Corridor (see Table 19); with reference to the expenditure intensity the forecast investments are located in the South macro – region, but by evaluating the project from a numbers perspective, it is possible to see that these are located in the North macro – region (see Table 17 and Table 18).
- Road projects favour medium and short distance investments (see Table 22); with reference to the expenditure and the number intensity, the projects are concentrated in the Centre and South macro – regions (see Table 20 and Table 21).

Final considerations: the taxonomical approach show that the long – distance investments (Corridors) are a small part of the new infrastructure systems, but their costs represent about 50% of the total expenditures. The medium and short distance investments (Multiregional and Regional links) are the main part of the forecast infrastructures and present a low intensity with reference to the expenditures.
These results show that the planned projects are oriented to achieve a new modal share between rail and road systems with a strong expenditure for long distance infrastructures. As one can see in the

first section of this paper the traffic trends on railways are substantially constant and not justify this level of investments.

3.2 A cost – benefit approach

A second and possible approach to analyse the planned infrastructures is to evaluate, through a cost – benefit analysis, the economic and financial performance of those projects that seem more important, and to evaluate the priorities inside the transportation planning set by the Law 443/01.
By analyzing the new infrastructure list, it can be seen how, on the one hand, the railway projects are predicting the construction of new lines to satisfy the increasing long distance passenger and freight traffic, while on the other hand, the road projects are predicting improvements of the short and medium distance links.
We will evaluate four projects that present the characteristics explained above:

- the Tuscany toll highway (Cecina – Civitavecchia)
- the high–speed rail line from Venice to Trieste (part of "Corridor 5" in North East of Italy)
- the high–speed rail line Salerno – Messina Strait – Sicily (part of "Corridor 1"in Southern Italy)
- the Brenner rail basis tunnel (international pass and part of "Corridor 1")

The methodological approach

The cost – benefit analysis of the infrastructural projects is built using a common methodology, the same analytical model and the same entry data; in this way it is possible to guarantee the consistency of the analysis in order to create a hierarchic array of the projects. The following results are obtained using a simplified but still rigorous methodology, always "on the safe side", which is a trade – off between the project scenarios and the reference solution.
The indicators of economic and financial efficiency (net present value and internal rate of return) are the output data of a model which evaluates the project through the cost–benefit methodology, starting from the following kind of entry data (see Table 27):

- Physical data of the project and of the old infrastructure
- Traffic flow referring to passenger and freight traffic, both for the road and for the rail (if available) mode
- Economic and financial data
- Other data (demand elasticity, social discount rate, …)
- The analysis is developed for a 30 year period, according to: the main international literature which states that the last years' benefits can be neglected when compared to the total benefits, and to the uncertainty of the traffic model over time
- The Italian legislative scenario, according to the L109/94 (Merloni law) and L443/01(Objective law) bonds

The traffic flow

The traffic flow is the critical datum of the whole analysis. It is clear how a wrong datum can invalidate the whole study. The chosen projects can be seen as an upgrade of existing links: so, their main aim is to widen the link capacity instead of creating new links, providing, at the same time, higher commercial speed for the passenger traffic and more reliability for the freight traffic. Therefore, the basic traffic data is the traffic flow of the actual infrastructure, parallel to the new project.

All the projects concentrate primarily on long distance traffic, which in a particular segment is no heavier than the traffic in the less loaded section. To be on the safe side, we assume that traffic is the long distance traffic in the infrastructure, and overestimate the long distance flow. In fact, in the less loaded section there is also a share of short distance traffic that will not use the new infrastructure.
Moreover, we assume that long distance traffic uses the whole infrastructure; so it is possible to counterbalance the traffic on partial links, generated by middle turn–offs or stations.
A growth rate allows to evaluate the traffic flow starting from the first year traffic. The growth rate is taken from similar economic or transportation studies or evaluated from a similar context (i.e. passengers and freight flow through the Alps), where historical development is available. In general, we use a constant growth rate, overestimating the long term flow (to be on the safe side): in fact, it is possible to see how, after the new project's realisation, there is a high growth rate during the first years, which over time decreases to the "normal" growth rate.
We also take the generated traffic into consideration, thanks to the total transportation costs reduction: this traffic currently has a surplus in travelling, because its willingness to pay is lower than the total cost in the do – nothing scenario, but higher than the one in the project scenario; this traffic depends only on the project's realisation, and is independent of the growth rate. We conservatively estimate the generated flow using the demand curve and an average elasticity from literature.

The traffic assignation to the new links, or to the alternative modes, is done using two different methods:

- For new road infrastructure, we use an AON – all or nothing strategy, where the entire traffic is assigned on the less expensive link (for the most part, the new route)
- For new rail infrastructure, we use a probabilistic criterion, defined by a binomial logit model; the model allows to estimate the rail–road modal shift after the new line realization; the entry data is the existing modal shift. The result is a probability of choosing the j – mode $p_j = \frac{e^{-\lambda v_j}}{e^{-\lambda v_i} + e^{-\lambda v_i}}$ where λ is the Gumbel variable spread, defined by literature, and v_i and v_j the utilities of the modes.

Costs and benefits

As in the classical cost–benefit analysis, the benefits are given by the social surplus changes. We estimate the yearly benefits, through the separation of the passengers and freight flow mode. For each mode, we calculate the benefits for the existing traffic and for the generated traffic. Moreover, we use three cost data: the value of time, the external costs and the operative costs.
As we saw, the benefits are evaluated using the demand curve. The demand curve equation is taken as a straight line, assuming an average elasticity value from literature. The use of an average elasticity should be referred to an hyperbolic demand curve; under this hypothesis, assuming a straight line for the demand curve, we overestimate the social benefits, in order to be on the safe side.
The economical costs are built by: value of trip time; long run economical vehicle costs; economical infrastructure costs; external costs. The perceived user costs are built by: value of trip time; railway fare or motorway toll; short run financial vehicle cost.
The internal and external costs for the cars have been evaluated for a theoretical vehicle as an average between petrol and diesel vehicles (Brambilla, 2002). The external costs, as defined by the most important studies (in this case, INFRAS – IWW, 2000), are caused by: accidents, noise, air pollution (local effects), climate changes, landscape, urban effects, upstream process.

Some less traditional elements

The performed analysis presents some innovative elements, not frequently included in the traditional cost – benefit analysis scheme. In particular, we introduce:

- marginal opportunity cost of public funds
- switch values
- labour shadow prices

The marginal opportunity cost of public funds is linked to the financial pressure and the public expenditures; it allows to introduce financial elements in economic analysis, reducing two historically separated worlds to a unitary scheme. Evaluation has to take into account the shadow cost of financial constraints; in this way, a precise 'bridge' has to be built between financial and economic analysis: the traditional cost–benefit scenarios are no longer valid.
In fact, in Europe (and in Italy) a financial objective has been assumed to be especially relevant for welfare: fiscal pressure reduction. Fiscal pressure, linked with public deficit (and debt), is in fact assumed to reduce welfare, if it reaches extremely high levels. This could be a possible 'limit' of the Keynesian policies (probably generated by asymmetric public spending and recovering in expansion and recession periods). This observation, in turn, defines the 'Maastricht constraints', that are obviously highly differentiated among countries with different public debts.
We assume that the State finances part of the financial costs, also according to Italian laws. We include the marginal opportunity cost of public funds assuming, as for the loss in welfare, a fixed percentage (derived by macro economic models) of the uncovered (by users' charges) financial costs, estimating the amount of public expenditure.
The switch values are a methodology aimed to test the analysis robustness. The switch value of a given variant is that value which may turn a unprofitable project into a feasible one. The methodology is used to carry out sensitivity analysis in cost benefit analysis assessments. Switch values can be estimated for any critical parameter in a given project, from level of demand to shadow prices.
When more than one variable is considered, and more than one decision maker is involved, estimating switch values does not reduce the need for explicit quantification of economic values (in order to reduce the possible inconsistency in the judgement of an individual decision maker and/or among different decision makers).
We introduce the switch values concerning: value of time, traffic speed, traffic growth rate, always referring both to passengers and freight flow. For every project, we consider only a critical parameter each time, testing its variation *coeteris paribus*.
We introduce the labour shadow prices in a parametric way, operatively as a reduction of the economic investment cost. It is however important to remember how the role of unskilled workers is declining in the large infrastructural projects, being now the sector capital intensive; therefore the weight of this type of labour costs is low.

The outcomes

The economical net present value (NPV) represents the most interesting results, because it is able to show the effects of a project on the social welfare. Likely, the internal rate of return (IRR) shows the project remunerativeness. At the same time, we estimate the financial net present value (NPV) and the financial internal rate of return (IRR), to show also the effects of a project's financial performance on the social welfare (Evaluating the marginal opportunity costs of public funds).
The main results are shown in the annex tables.

Table 27 Main data, used for every project

category	mode	pax/freight	value	unit
Elasticity to Perceived Cost	all mode	passenger freight	-1 -1	
Value of Time	all mode	passenger trip passenger waiting freight	10 20 2,07	€/hour·pax €/hour·pax €/hour·ton
Load factors	road	LV HV (drivers) loading real loading	1,7 1 50 26	pax/vehicle pax/vehicle % tons/vehicle
	rail	freight (reference) freight (project)	315 450	tons/train tons/train
External Costs	road	passenger freight	0,100 0,083	€/paxkm €/tonkm
	rail	passenger freight	0,023 0,029	€/paxkm €/tonkm
Marginal Economic Infrastructure Costs	road	all (free road) all (toll road)	0,019 0,025	€/vehiclekm €/vehiclekm
	rail	all	0,338	€/trainkm
Vehicle Operation Costs (economic long run)	road	passengers freight	0,21 1,05	€/vehiclekm €/vehiclekm
	rail	pax (reference) pax (HST) freight	0,06 0,08 0,011	€/paxkm €/paxkm €/tonkm
Vehicle Operation Costs (financial short run)	road	passengers	0,19	€/vehiclekm
Vehicle Operation Costs (financial long run)	road	freight	1,55	€/vehiclekm
	rail	freight (reference) freight (project)	0,0124 0,0087	€/tonkm €/tonkm
Marginal Opp. Cost of Public Funds			0,13	

HIGHWAY A12 CECINA – CIVITAVECCHIA

Table 28 Traffic and physical data, economical and financial data

alternatives		Reference Solution	Project	Ministry's Project (see text)	units
Traffic and physical data					
Length		197	200	200	km
Commercial speed	light vehicle	90	130	130	km/h
	heavy vehicle	70	90	90	km/h
Travel time	light vehicle	2,18	1,54	1,54	hours
	heavy vehicle	2,81	2,22	2,22	hours
Reference traffic	light vehicle	9.850			vehicles/day
	heavy vehicle	2.800			vehicles/day
Traffic growth rate		1,45	1,45	1,45	%
Economical and financial data					
Investment Cost (financial)		0	1.980	2.898	M€
Residual Value		0	792	1.159	M€
Investment Costs (economic)			1.812	2.489	
Period of Analysis		30	30	30	years
Construction Time		0	4	6	years
Toll	light vehicle	0	0,048	0,048	€/vehiclekm
Toll	heavy vehicle	0	0,116	0,116	€/vehiclekm
Transport tariff	heavy vehicle	1,705	1,705	1,705	€/vehiclekm
Total Perceived Cost	light vehicle	74,49	73,75		€/pax
	heavy vehicle	410,78	424,00		€/ton
Total Economic Cost	light vehicle	115,53	107,10		€/pax
	heavy vehicle	378,10	368,75		€/ton

Table 29 Principal results (economic discount rate 4,50% and financial discount rate 6,00%)

alternatives		Reference Solution	Project	Ministry Project	units
Economic NPV			-584,594		M€
Marginal Opp. Cost of Public Funds			-102,940		M€
Economic NPV with MOCPF			-687,535		M€
Financial NPV			-791,847		M€

Table 30 Switch values

	Growth rate	Value of time		Commercial speed	
	Traffic	Passengers	Cargo	Passengers	Cargo
Switch value	%	€/hour·pax	€/hour·ton	Km/h	Km/h
Economic NPV	5,809	20,66	4,91	Not admissible	Not admissible
Economic NPV with MOCPF	6,018	22,16	5,33	Not admissible	Not admissible

HIGH SPEED RAILWAY LINE VENICE – TRIESTE

Table 31 Traffic and physical data, economical and financial data

alternatives		reference solution	project	units		main alternative mode (highway)	units
Traffic and physical data							
Length		120	120	km		115	km
Commercial Speed	pax train	80	200	km/h	LV	130	km/h
	freight train	60	80	km/h	HV	90	km/h
Travel Time	pax train	1,50	0,60	hours	LV	0,88	hours
	freight train	2,00	1,50	hours	HV	1,28	hours
Passenger's Waiting Time	passenger train	0,25	0,25	hours	LV	0,00	hours
Reference Traffic	pax train	38		trains/day	LV	6500	vehicles/day
	Pax train	1.387.000	1.581.428	pax/year	LV	4.033.250	pax/year
	freight train			trains/day	HV	2500	vehicles/day
	freight train	3.000.000	4.185.269	tons/year	HV	11.862.500	tons/year
Traffic Growth Rate	Pax train	1,45	1,45	%	LV	1,45	%
	freight train (ante 2010)	7,30	7,30	%	HV (ante 2010)	7,30	%
	freight train (post 2010)	2,00	2,00	%	HV (post 2010)	2,00	%
Load Factors	pax train	100	100	pax/train	LV	1,7	pax/vehicle
Economical and financial data							
Investment Cost (financial)			4.300	M€			
Residual Value			1.720	M€			
Investment Costs (economic)			3.935	M€			
Period of Analysis		30	30	Years			
Construction Time			3	Years			
Transport Tariff	pax	6,82	12,39	€/pax			
	freight train	0,0137	0,0096	€/tonkm	HV	0,1312	€/tonkm
Access Track Charging	Pax train	0,0185	0,0254	€/paxkm	LV	0,0282	€/paxkm
	freight train	0,0048	0,0048	€/tonkm	HV	0,0089	€/tonkm
Total Perceived Cost	Pax train	44,91	41,48	€/pax		42,30	€/pax
	freight train	29,13	27,60	€/ton		27,38	€/ton
Total Economic Cost	pax train	51,54	44,94	€/pax		46,60	€/pax
	freight train	29,00	27,93	€/ton		31,96	€/ton

Table 32 Principal results (economic discount rate 4,50% and financial discount rate 6,00%)

alternatives		reference solution	project	units		main alternative mode (highway)	units
Economic NPV			-2.543.443	M€			
Marginal Opp.Cost of Public Funds			-439,811	M€			
Economic NPV with MOCPF			-2.983,254	M€			
Financial NPV			-3.383,165	M€			

Table 33 Switch values

	Growth rate	Value of time		Commercial speed	
	Traffic	Passengers	Cargo	Passengers	Cargo
	%	€/hour·pax	€/hour·ton	Km/h	Km/h
Economic NPV	15,98	119,35	68,30	Not admissible	Not admissible
Economic NPV with MOCPF	16,51	137,99	78,13	Not admissible	Not admissible

HIGH SPEED RAILWAY LINE SALERNO – SICILY

Table 34 Traffic and physical data, economical and financial data

alternatives		reference solution	project	units		main alternative mode (highway)	units
Traffic and physical data							
Length		609	600	km		625	km
Commercial Speed	pax train	130	180	km/h	LV	130	km/h
	freight train	60	80	km/h	HV	90	km/h
Travel Time	pax train	4,68	3,33	hours	LV	4,81	hours
	freight train	10,15	7,50	hours	HV	6,94	hours
Passenger's Waiting Time	Pax train	0,25	0,25	hours	LV	0,00	hours
Reference Traffic	pax	38		trains/day	LV	6.966	vehicles/day
	pax train	3.661.680	4.087.194	pax/year	LV	4.322.403	pax/year
	freight train	50		trains/day	HV	4.467	vehicles/day
	freight train	5.748.750	7.001.906	tons/year	HV	21.195.915	tons/year
Traffic Growth Rate	pax train	1,77	1,77	%	LV	2,65	%
	freight train (ante 2010)	2,38	2,38	%	HV (ante 2010)	2,68	%
	freight train (post 2010)	2,38	2,38	%	HV (post 2010)	2,38	%
Load Factors	Pax train	264	264	pax/train	LV	1,7	pax/vehicle
Economical and financial data							
Investment Cost (financial)			12.291	M€			
Residual Value			4.916	M€			
Investment Costs (economic)			11.249	M€			
Period of Analysis		30	30	Years			
Construction Time			3	Years			
Transport Tariff	Pax train	35,95	45,00	€/pax			
	freight train	0,0137	0,0096	€/tonkm	HV	0,1312	€/tonkm
Access Track Charging	pax train	0,0070	0,0096	€/paxkm	LV	0,0282	€/paxkm
	freight train	0,0048	0,0048	€/tonkm	HV	0,0089	€/tonkm
Messina bridge toll	pax train	274,20	274,20	€/vehicle	LV	10,80	€/vehicle
	pax train	4,15	4,15	€/pax	LV	6,35	€/pax
	freight train	165,80	165,80	€/vehicle	HV	41,30	€/vehicle
	freight train	11,05	11,05	€/ton	HV	3,18	€/ton
Total Perceived Cost	pax train	110,04	105,58	€/pax		199,18	€/pax
	cargo train	74,72	66,60	€/ton		113,73	€/ton
Total Economic Cost	pax train	124,35	122,08	€/pax		201,33	€/pax
	freight train	76,36	70,31	€/ton		128,19	€/ton

Table 35 Principal results (economic discount rate 4,50% and financial discount rate 6,00%)

alternatives		reference solution	project	units		main alternative mode (highway)	units
Economic NPV			-8.598,750	M€			
Marginal Opp.Cost of Public Funds			-1.261,727	M€			
Economic NPV with MOCPF			-9.860,478	M€			
Financial NPV			-9.705,594	M€			

Table 36 Switch values

	Growth rate	Value of time		Commercial speed	
	Traffic	**Passengers**	**Cargo**	**Passengers**	**cargo**
	%	€/hour·pax	€/hour·ton	Km/h	Km/h
Economic NPV	22,92	98,29	Not admissible	Not admissible	Not admissible
Economic NPV with MOCPF	22,51	110,91	Not admissible	Not admissible	Not admissible

BRENNERO RAIL BASIS TUNNEL TUNNEL

Table 37 Traffic and physical data, economical and financial data

Alternatives		reference solution	project	units		main alternative mode (highway)	units
Traffic and physical data							
Length		225	210	km		224	km
Commercial Speed	pax train cargo train	90 60	120 80	km/h km/h	LV HV	120 80	km/h km/h
Travel Time	pax train freight train	2,50 3,75	1,75 2,63	hours hours	LV HV	1,87 2,80	hours hours
Passenger's Waiting Time	Pax train	0,25	0,25	hours	LV	0,00	hours
Reference Traffic	pax train pax train freight train freight train	 4,200 10,700	 4,448 12,614	trains/day Mpax/year trains/day Mtons/year	LV LV HV HV	8.000 4,964 4,100 25,000	trains/day Mpax/year trains/day Mtons/year
Traffic Growth Rate	pax train freight train (ante 2010) freight train (post 2010)	1,45 4,20 2,00	1,45 4,20 2,00	% % %	LV HV (ante 2010) HV (post 2010)	1,45 4,20 2,00	% % %
Load Factors	pax train	200	200	pax/train	LV	1,7	pax/vehicle
Economical and financial data							
Investment Cost (financial) Residual Value Investment Costs (economic)			2.582 1.032 2.181	M€ M€ M€			
Period of Analysis Construction Time		27	27 6	Years Years			
Transport Tariff	pax train freight train	15,80 0,0137	15,80 0,0096	€/pax €/tonkm	 HV	 0,1312	 €/tonkm
Access Track Charging	pax train freight train	0,00925 0,00521	0,0127 0,00521	€/paxkm €/tonkm	LV HV	0,0282 0,0089	€/paxkm €/tonkm
Total Perceived Cost	pax train freight train	45,80 26,15	38,30 22,68	€/pax €/ton		67,55 37,17	€/pax €/ton
Total Economic Cost	pax train freight train	46,56 26,71	41,24 22,59	€/pax €/ton		69,40 42,91	€/pax €/ton

Table 38 Principal results (economic discount rate 4,50% and financial discount rate 6,00%)

alternatives		reference solution	project	Units		main alternative mode (highway)	units
Economic NPV			3.017,540	M€			
Marginal Opp. Cost of Public Funds			-216,089	M€			
Economic NPV with MOCPF			2.799,174	M€			
Financial NPV			-1.662,228	M€			

Table 39 Switch values

	Growth rate	Value of time		Commercial speed	
	Traffic	**Passengers**	**Cargo**	**Passengers**	**cargo**
	%	€/hour·pax	€/hours·ton	Km/h	Km/h
Economic NPV	(to be calc.)	"	"	36,72	29,19
Economic NPV with MOCPF	(to be calc.)	"	"	40,49	30,92

4 CONCLUSIONS

After having analysed the official data and evidences of Italian rail and road systems, one can trace some conclusions and policy recommendations.

Traffic data show a strong predominance of road towards rail in terms of traffic units (passengerkm and tonneskm) and short distance travels towards long distance ones. Long distance and international traffic is a minor part of total Italian traffic. Traffic intensity gets lower from North to South, with the exclusion of urban areas.

To analyze the investments planned in the Italian context it was followed two different approaches.

The first and taxonomical approach appear that the forecast investments in the Italian transport planning are focused on long distance corridors without any distinction for more congested areas.

Rail investments are very similar in terms of monetary value to road ones, although the radical disparity between traffic volumes (see Table 40) and it is very hard to justify these projects, on the basis of a new modal switch with the available data that, in the last thirty years, show an average short distance for trips both for freight and passengers by road and rail.

Table 40 Traffic data (year 2002) and investment expenditures summary

Transport modes	Transport unit	Value	Expenditure for investments [€]
Road passengers	Paxkm	711.733.000.000	48.462.000.000
Road freight	Tonneskm	192.678.000.000	
Rail passengers	Paxkm	48.835.000.000	42.654.000.000
Rail freight	Tonneskm	23.197.000.000	

With reference the second alternative approach, the cost – benefit analysis applied to long distance and international links, show different results about the selected projects.

One can see that, if the infrastructures show a high level transport demand, the economic performance is positive and that, if the projects provide only an increasing of capacity starting from an oversize of the real demand the economic performance produces a decreasing of the social welfare. The financial performances evidence that all the evaluated projects have a negative financial present value (see Table 41).

These results show that the to build an oversized infrastructure, with reference to the real level of transport demand, both for freight and passengers, produce two different social costs.

In one hand one have the production of environmental costs not compensate by the benefits. The damages are very relevant where the landscape has an high value (for example tourism).

In the other hand these infrastructures produce an opportunity cost with reference to the employed resources linked to the public funds cost. The produced effects are not always balanced by the labour market (actually capital intensive and not labour intensive) because to build a new infrastructure generates an employment demand not constant.

Moreover, it is not realistic to deduce that the benefits produced by the new infrastructure will grow thanks to the transportation demand generate with the effect of the supply side.

Table 41 Cost – benefit analysis principal results in Euro

Project	Financial investment cost	Economic NPV	Financial NPV
Highway A12 Cecina – Civitavecchia	1.980.000.000	-584.594.000	-791.847.000
HSL Venezia – Trieste	4.300.000.000	-2.543.443.000	-3.383.165.000
HSL Salerno – Sicilia	12.291.000.000	-8.598.750.000	-9.705.594.000
Brennero rail basis tunnel	2.582.000.000	3.017.540.000	-1.662.228.000

Referred to a context of limited public funds and if exist a private capital market not attracted by the low level (or inexistent) of financial revenues, deferred during infrastructure life cycle, a better use

and allocation of the resource appears decisive. Avoiding idealistic point of view of preclusion, a better public funds allocation and, as a consequence more efficiency, can be reached.
The quantitative comparisons produced, derived from numbers given before, can underline these sentences.
The Italian transport policy should provide elements to improve the conditions of the road transport system. Nevertheless, the external costs of transport should be considered and, eventually, according to the political set of preferences, included in the definition of the price of the transport, to introduce also distributive issues.
A consistent infrastructural policy should reflect these data while planning new infrastructures and upgrades, instead of investment distributed in the whole Italy. This does not mean that projects must not be realized, but that a rank of priority, based on transparent and independent quantitative analysis (made *ex – ante*) may be defined.

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