Transport Demand

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Executive Summary

This report examines the demand for transport in Ireland. The emphasis is on identification of the spatial distribution of demand and the shares of different modes of transport. Consideration is also given to the future level of demand.

From the point of view of the development of a National Spatial Strategy, car ownership levels will largely determine the extent to which the capacity of regional and inter-regional road infrastructures will come under pressure, necessitating both further investment in road infrastructures and measures to encourage a transfer to public transport modes. This study presents forecasts of car ownership at the national, regional and county levels.

Freight Traffic: Modal Shares and Spatial Distribution

Based on available data, the rail share of total traffic for 1994 is estimated at 9.77 per cent of tonne kilometres and 3.8 per cent of tonnes carried. The rail share of total traffic declined during the 1980s (in terms of tonne kilometres), but has apparently stabilised since then. These figures understate the rail share in the long-distance freight market in which it largely competes. If the rail system is regarded as competing in the greater than 150 kilometre freight market only, its share in tonne kilometres rises to 19 per cent.

In spatial terms, the bulk (70 per cent) of road freight movements is intra-regional involving short trip lengths. Inter-regional flows are dominated by the East sub-region, which accounts for 30 per cent of all tonnes originating and terminating. Thus, the major flows are to and from the East sub-region.

Rail freight movements are focussed on Dublin to a considerable extent. However, there are significant movements that are not Dublin originating or terminating.

Passenger Traffic: Modal Shares and Spatial Distribution

Total passenger kilometres of travel are estimated at 56,140m in 1996. Over the period 1987-1996, passenger kilometres have been growing at rate of 5.4 per cent per annum. In 1996, road modes accounted for 97.7 per cent of all passenger kilometres, with the rail mode accounting for the residual 2.3 per cent. The rail share is estimated to have declined by just over 30 per cent in the nine years. The private car accounts for 87 per cent of all travel, and is tending to increase its share.

However, the rail market share is significantly higher in some markets, particularly the inter-urban market. For example, it is estimated that the rail share of travel between Dublin and the cities of Cork, Galway and Limerick is more than 25 per cent.

There is considerable variation in road traffic volumes on the National Road system. In the approaches to cities and towns, volumes increase significantly and then decline between towns. Simulation of origin-destination flows indicates that the major town-to-town flows are between Dublin and the major urban areas. The only other large flows are between Cork and Limerick, Cork and Waterford, and Limerick and Galway. Inter-city flows are low relative to the average traffic level on interurban route sections.

Almost 80 per cent of inter-county rail trips originate in the SE region. This is because of the nature of the rail system and the distribution of the population. Dublin and the Mid East sub-regions dominate, with 63.2 per cent of all trips originating in these two sub-regions.

With regard to rail, the major rail passenger movements are between Dublin and other counties particularly those in the Mid-East sub-region i.e. they are radial in nature. This pattern partly reflects the increased use of mainline rail services for long distance commuting to Dublin. Use of suburban rail services is undergoing a significant increase.

Passenger movements between counties other than Dublin are much lower. The top ten such movements account for only 0.4m trips or 4 per cent of all movements. The only non-radial routes that figure are Cork-Kerry and Cork-Limerick.

National Car Ownership Forecasts

There are now almost 1.2m private cars in the country and car ownership has exceeded 50 cars per 100 persons for the first time. It is predicted that, over the period 1996-2001, car ownership will increase by 50 to 55 per cent, depending on the saturation level adopted.

Car numbers are expected to double between 1996 and 2016, from 1.1m to 2.1m. For the period 1996-2001, car numbers are expected to grow at 5.2 per cent per annum, falling to in excess of 4 per cent in the period 2001-2006. In the more distant future, the growth rates will fall to around 2 per cent per annum. Over the period 1996-2016 as a whole, car numbers will grow by some 3.5 per cent on average.

Regional and County Car Ownership Forecasts

There is little difference in car ownership levels between the BMW region (49.5 cars per 100 adults) and the SE region (51.7). The rate of growth in car ownership over the period 1981- 1998 has also been similar at 27.6 per cent and 28.6 per cent respectively. The Border sub-region has the lowest car ownership level (47.1) followed by the Dublin sub-region (48.0). Car ownership is highest in the Mid-East (55.2).

Based on a saturation level of 90 cars per 100 persons, the BMW region will have 529,800 cars in 2016, while the SE region will have 1,608,400, representing, in each case, a doubling of car numbers.

One of the interesting features of the results is that because by year 2016, saturation will be fast approaching, there is a levelling up of car ownership across counties. This means, in turn, that in the long term the population distribution will be more important than income levels in determining differences in growth in car numbers across counties and regions.

The strength of the county car ownership model employed in this study is that it can predict the impact of different spatial distributions of populations and incomes. When regional population projections become available from other studies within the National Spatial Strategy, it will be possible to assess their impact on future car ownership, car numbers and car travel.

Travel Forecasts

Increases in car numbers may not translate into corresponding increases in car travel if average car use declines. However, there is no evidence as yet to support this view. In these circumstances, the best approach may be to assume that the projected increase in car numbers represents an upper limit in terms of growth in car traffic.

Apart from cars, goods vehicles are the other principal constituents of road traffic. A recent forecast of goods vehicle kilometres is available which forecasts an average 2.3 per cent rate of growth up to the year 2011.

A traffic growth rate of 3.3 per cent per annum is predicted for the period 1996-2016 as a whole.

Iarnrod Eireann predicts an increase in demand for mainline rail passenger travel of 24 per cent between 1999 and 2005, or 3.7 per cent per annum. As the prediction of car numbers (and thus car travel) is for an increase of just over 4 per cent per annum in the same period, the implication is that the rail modal share may continue to slowly decline. However, the future rail modal share will reflect the extent to which new and expanded services are introduced.

Future rail freight traffic growth is likely to be dependent on the expansion of industrial sectors with low value to weight goods. The prospects for a significant increase in rail freight traffic are not good.

Policy Implications

The current policy priority given to investment in transport infrastructure on radial routes is therefore warranted by the structure of transport demand. A high level of investment in inter-regional (non-radial) transport links would not be warranted by existing transport volumes. Such a policy must therefore be seen as a stimulus to regional development, not a reaction to predicted demand.

The relatively low modal share of rail in both freight and passenger markets raises questions about the appropriate role for this mode in the context of regional development. Unless, road infrastructure investment is matched by similar level of service enhancing investment in rail, the decline in the mode share of the latter is likely to accelerate.

The problem of urban congestion will be exacerbated by the doubling of car numbers expected over the period to the year 2016. Policies will be required to minimise car use, so as to ensure that urban road systems operate efficiently. A range of traffic management, public transport enhancement and sustainable land use policies, targeted largely at restraining local road traffic growth, will be required. In this situation, maximising the use of the rail mode, especially in a commuter context, will be a key issue.

1 Introduction

This report examines the demand for transport in Ireland. The emphasis is on identification of the spatial distribution of demand and the shares of different modes of transport. Consideration is also given to the future level of demand.

The level of car ownership is the single most important determinant of travel demand. On a national basis, the car accounts for almost 80 per cent of road vehicle kilometres [1], and is thus the main determinant of increases in road traffic volumes. Increases in car ownership also tend to reduce use of sustainable transport modes, including public transport.

From the point of view of the development of a National Spatial Strategy, car ownership levels will largely determine the extent to which the capacity of regional and inter-regional road infrastructures will come under pressure, necessitating both further investment in road infrastructures and measures to encourage a transfer to public transport modes.

This study presents forecasts of car ownership at the national, regional and county levels. It was thought necessary to set the regional and county forecasts within the context of a national forecast largely because national car ownership forecasting methodologies are better established than regional or county methodologies. National forecasts can thus provide a check of the validity of more disaggregated forecasts.

Section 2 examines freight traffic modal shares and spatial distribution. Section 3 repeats this exercise for passenger traffic. Section 4 of the report presents forecasts on national car ownership. Regional and county car ownership forecasts are discussed in Section 5. Section 6 presents the conclusions. Overall travel forecasts are considered in Section 6. Section 7 presents conclusions and some implications for policy.

1. See:Traffic Station Counts and Road Travel (Various issues). National Roads Authority

2 Freight Traffic: Modal Shares and Spatial Distribution

2.1 Introduction

This section of the report considers the breakdown of freight traffic in Ireland by mode and the spatial distribution of that traffic across the country. The various data sources are first briefly considered, before the modal shares are estimated and the spatial distribution is analysed.

2.2 Data Sources

Freight traffic is usually measured in terms of tonnes carried or tonne kilometres performed. The following analysis employs both measures.

Relevant data on freight activity are available from three sources:

- The Road Freight Transport Survey (RFTS) conducted by the CSO;
- The road Vehicle Kilometres of Travel reports (VKT) issued by the National Roads Authority; and
- Rail freight statistics compiled by Iarnrod Eireann

With regard to the RFTS, the last year for which data are available is 1994. This gap in statistics has arisen because of resource constraints in the CSO. This meant that while the surveys have taken place each year since 1994, the data from them has not been analysed. Currently, the CSO is working on bringing this data series up to date, but it is unlikely that results will be available before end 2001. In addition, since 1989, freight activity by vehicles of unladen weight of two tonnes and over only has been recorded. This creates a discontinuity in the data series that complicates the analysis of trends.

The VKT reports have also been temporarily halted, as the NRA is undertaking a review of the methodology to address concerns that have arisen regarding the accuracy of the data for regional and local roads. Data are available up to 1996.

A recent report calculated road fuel consumption on the basis of the road vehicle fleet mix and the kilometres of travel as given by the VKT reports. When the resulting fuel consumption estimate was compared to the actual fuel consumption as measured by the Revenue Commissioners, the former was found to exceed the latter by some 13 per cent for 1996[2]. There is concern, therefore, that the VKT data may exaggerate the total vehicle kilometres travelled to a significant degree. This renders some of the modal share estimates in this report subject to considerable error.

2. Study of the Environmental Implications of Irish Transport Growth and of Related Sustainable Policies and Measures. Oscar Faber, ESRI, Goodbody Economic Consultants, Ecotec, 1999

In addition, it is worth noting that, in keeping with the objectives of the survey, the VKT report provides data on freight vehicle kilometres only, and not on tonnes or tonne kilometres.

2.3 Estimating Modal Shares

Tables 2.1 and 2.2 present the available data. Apart from the discontinuity in 1989, there are other worrying aspects of the RFTS data. Total tonne kilometres, as measured by the RFTS, are unchanged between 1989 and 1994, despite reasonable growth in the economy. Moreover, the volume of activity appears to be very low. For example, the RFTS indicates that the total road freight vehicle kilometres amounted to 826m in 1994. The VKT report for that year indicates an equivalent figure of 1,778m. [3]

Table 2.1: Freight Market Modal Shares (Tonne Kilometres)

Year	Road Freight (Million Tonne kms)	Rail Freight (Million Tonne kms)	Total Freight (Million Tonne kms)	Rail Share (Million Tonne kms)
1980	5,010.5	624.2	5,634.7	11.08
1981	4,817.7	678.5	5,496.2	12.34
1982	4,530.9	653.7	5,184.6	12.61
1983	4,669.2	582.5	5,251.7	11.09
1984	4,581.3	600.9	5,182.2	11.60
1985	4,520.2	601.1	5,121.3	11.74
1986	5,089.3	574.4	5,663.7	10.14
1987	4,959.3	563.1	5,522.4	10.20
1988	4,999.6	544.5	5,544.1	9.82
1989	5,342.0	555.9	5,897.9	9.43
1990	5,130.0	588.6	5,718.6	10.29
1991	5,138.0	602.6	5,740.6	10.50
1992	5,150.0	633.3	5,783.3	10.95
1993	5,095.0	574.6	5,669.6	10.13
1994	5,258.0	569.3	5,827.3	9.77

Sources: The Road Freight Transport Survey and Iarnrod Eireann

Table 2.2: Freight Market Modal Shares (Tonnes)

Year	Road Freight (Million Tonnes)	Rail Freight (Million Tonnes)	Total Freight (Million Tonnes)	Rail Share (Million Tonnes)
1980	102.5	3.6	106.1	3.5
1981	98.7	3.6	102.3	3.6
1982	95.1	3.6	98.7	3.8
1983	93.5	3.3	96.8	3.5
1984	93.5	3.4	96.9	3.6
1985	91.4	3.1	94.5	3.4
1986	95.0	3.0	98.0	3.2

3. The VKT distinguishes between HGVs and LGVs. The figure quoted refers to the former

Table 2.2: Freight Market Modal Shares (Tonnes) ***(continued)***

Year	Road Freight (Million Tonnes)	Rail Freight (Million Tonnes)	Total Freight (Million Tonnes)	Rail Share (Million Tonnes)
1987	87.6	3.0	90.6	3.4
1988	82.4	3.1	85.5	3.8
1989	83.5	3.3	86.8	4.0
1990	79.6	3.3	82.9	4.1
1991	81.4	3.3	84.7	4.1
1992	83.9	3.1	87.0	3.7
1993	80.7	3.0	83.7	3.7
1994	84.6	3.2	87.8	3.8

Sources: The Road Freight Transport Survey and Iarnrod Eireann

The RFTS also implies an average annual vehicle kilometres of 21,736 for 1994. This is very low, being not much above the average for a private car.

According to the RFTS, tonnes carried by road remained static during the early 1990s. However, during this period the carrying capacity of the road freight fleet increased at a rate of 3.7 per cent per annum[4]. This was due to the trend towards larger vehicles. The RFTS thus implies a substantial fall in load factors, which is open to question.

This analysis raises the possibility that the RFTS considerably understates the extent of road freight activity. The strong possibility is that the rail share is lower than that presented. As a consequence, the data may be a better guide to trends in modal shares rather than their absolute levels.

With regard to tonne kilometres, the data show that there was a decline of one percentage point between 1980 and 1988, but little change since then. In respect of tonnes carried, there has been little change in the rail share over the whole period.

Because the costs of interchanging from road to rail are high, consignors of goods will tend to consider the rail mode for relatively long trip lengths only. Rail therefore competes for long distance and not all traffic. The RFTS data contains information on the volume of freight that is carried long distances. Table 2.3 presents rail market shares on the assumption that rail alternatively competes in the greater than 50 kilometre and greater than 150 kilometre markets. When calculated against the latter market the rail share rises to 19 per cent of tonne kilometres. Figure 2.1 summarises the alternative estimates of rail freight modal share.

4. Revised Forecast of the Size and Structure of the Commercial Vehicle Fleet, 1996-2011. Goodbody Economic Consultants. 1998.

Figure 2.1: Rail Freight Modal Shares in Tonne Kilometres, 1994

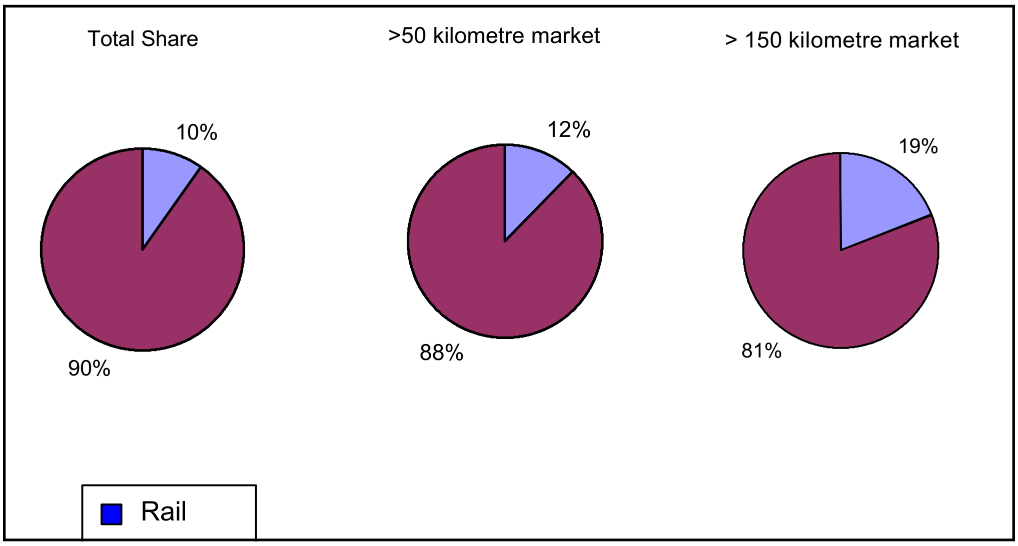


Table 2.3: Alternative Rail Market Shares

Year	Road (Million Tonne kilometres)	Rail (Million Tonne kilometres)	Total (Million Tonne kilometres)	Rail Share %
>50 Kilometre Market	4,128	569	4697	12.1
>150 Kilometre Market	2,403	569	2,972	19.1

Source: Goodbody Estimates

2.4 Spatial Distribution of Freight Traffic

2.4.1 Introduction

This sub-section examines the spatial distribution of freight traffic. The focus initially is on road freight traffic, followed by an analysis of rail traffic.

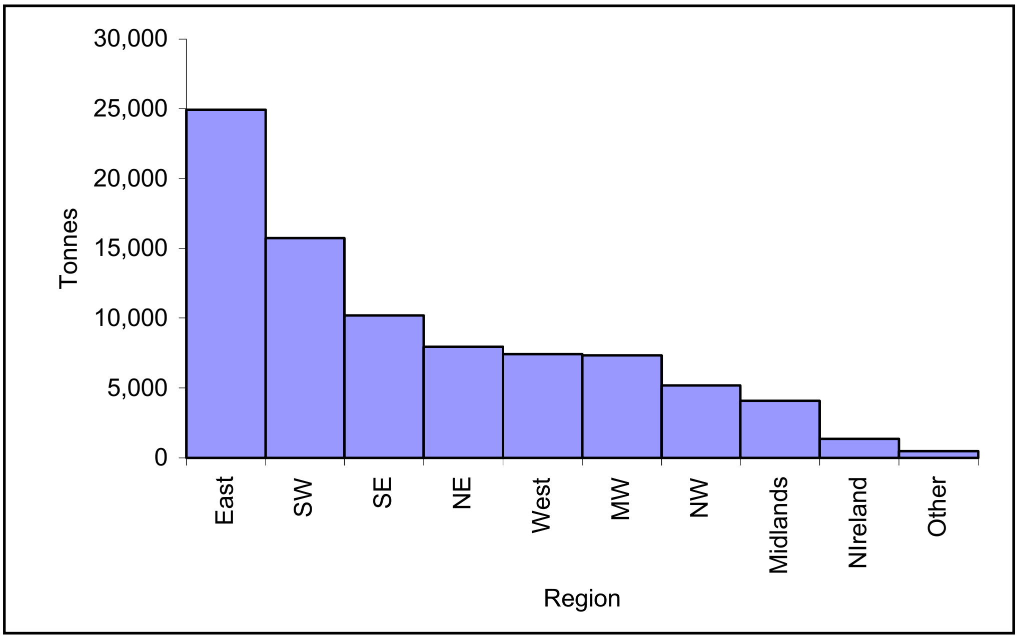
2.4.2 Major Regional Road Freight Traffic Flows

Data on road freight traffic are not available at the county level. The RFTS presents data for regional freight flows, although its definition of regions differs somewhat from that in current use. Table 2.4 presents data on road freight movements between the regions in terms of tonnes carried.

One of the most obvious features is the extent to which freight is intra rather than inter-regional. Thus, 70 per cent of all tonnes moved are internal to the region, with only 30 per cent being between regions. This reflects the short trip length of many road freight movements.

The East Region accounts for almost 30 per cent of all tonnes originating and terminating (see Figure 2.2). Thus, the major flows are from the East to the other regions and vice-versa. Of the inter-regional flows, one quarter originate in the East Region. Figure 2.3 depicts the twenty largest inter-regional road freight movements. This confirms the dominance of movements to and from the East region. However, there are significant road freight movements along a western corridor from the south-west region to the west and north-west. [5]

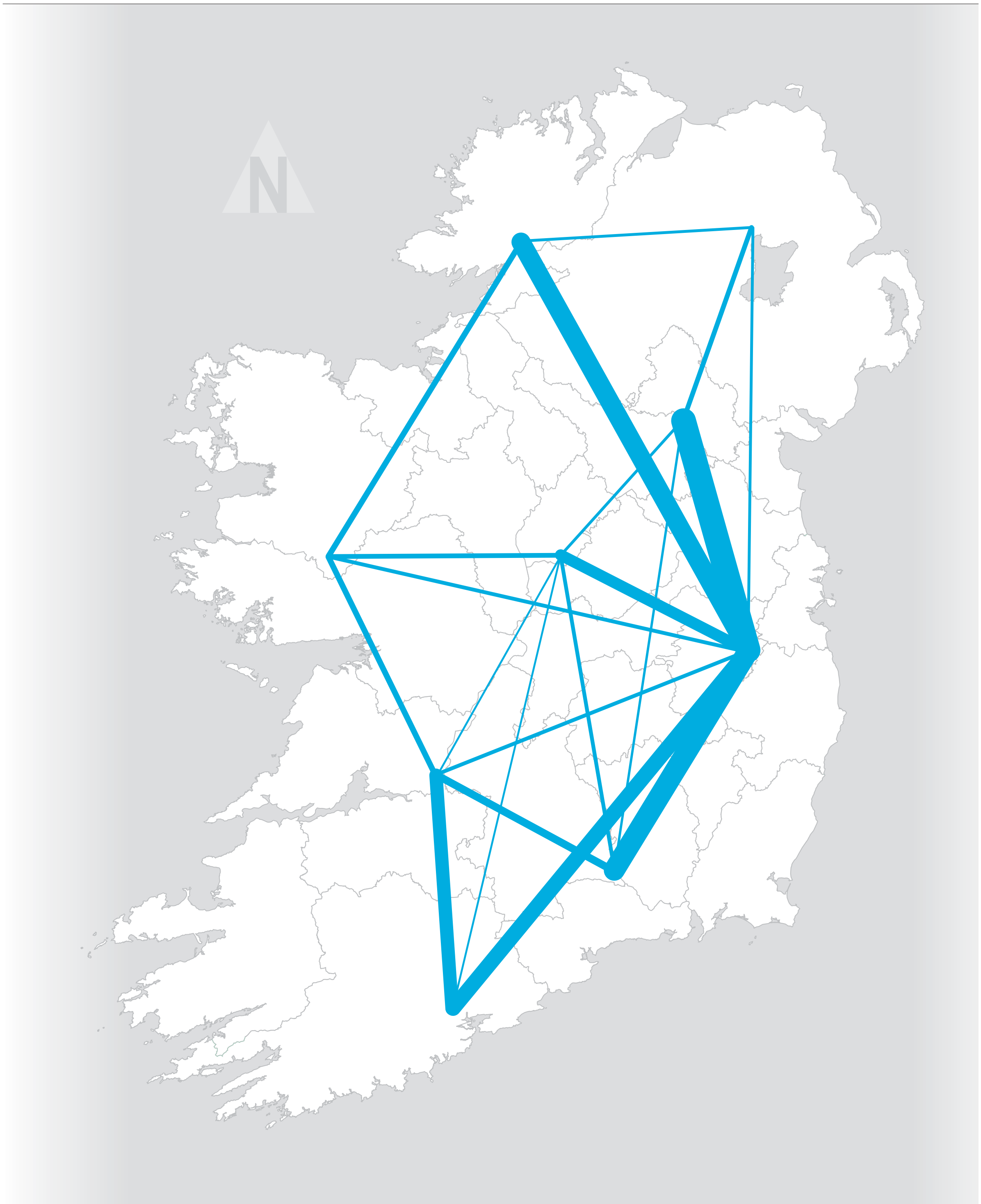
Figure 2.2: Tonnes of Road Freight Traffic by Region of Origin, 1999



Measured in terms of tonne kilometres, the intra–regional flows are lower at 33 per cent of the total, reflecting the influence of the longer trip lengths involved in inter-regional movements (see Appendix 1).

5. The 1994 RFS indicates very substantial movements between Dublin and the North West, which are at an unusually high level compared to other years. There is a possibility therefore that the high level observed may be a statistical artefact rather than a reflection of reality.

Figure 2.3: Major Inter–Regional Road Freight Movements, 1994



2.4.3 Intensity of Road Freight Traffic by Region of Origin

Table 2.5 and Figure 2.4 compare the tonnes generated in each region to regional Gross Value Added. This shows that while the South East region accounts for 70 per cent of all tonnes of freight generated, it is a less intensive generator of freight than the BMW region, when account is taken of the relative size of the two regional economies. Thus, in terms of tonnes generated per £m of gross domestic output, the BMW region (3,100 tonnes per £m) is 76 per cent above that of the SE region (1,760 tonnes per £m). This disparity in performance arises from the low intensity of the East sub-region (1,300) and the extraordinarily high intensity of the Border sub-region (3,690). The low intensity of the East sub-region no doubt reflects the dominance of the service sector in that region (64 per cent of GVA arises in that sector). The high intensity of the Border sub region is more difficult to understand. While it has a relatively large agricultural sector (high transport intensity) and a small services sector (low transport intensity), it is no different to the South East and Midlands sub-regions in this regard. While it is impossible to rule out statistical errors, the explanation may partly lie in the composition of industry in the border region. For example, the construction and food processing industries are intensive in their use of transport and are well represented in the Border sub-region. However, further research would be needed to arrive at a definitive answer.

Figure 2.4: Intensity of Originating Freight Traffic by Region in Tonnes per £m Gross Value Added, 1994

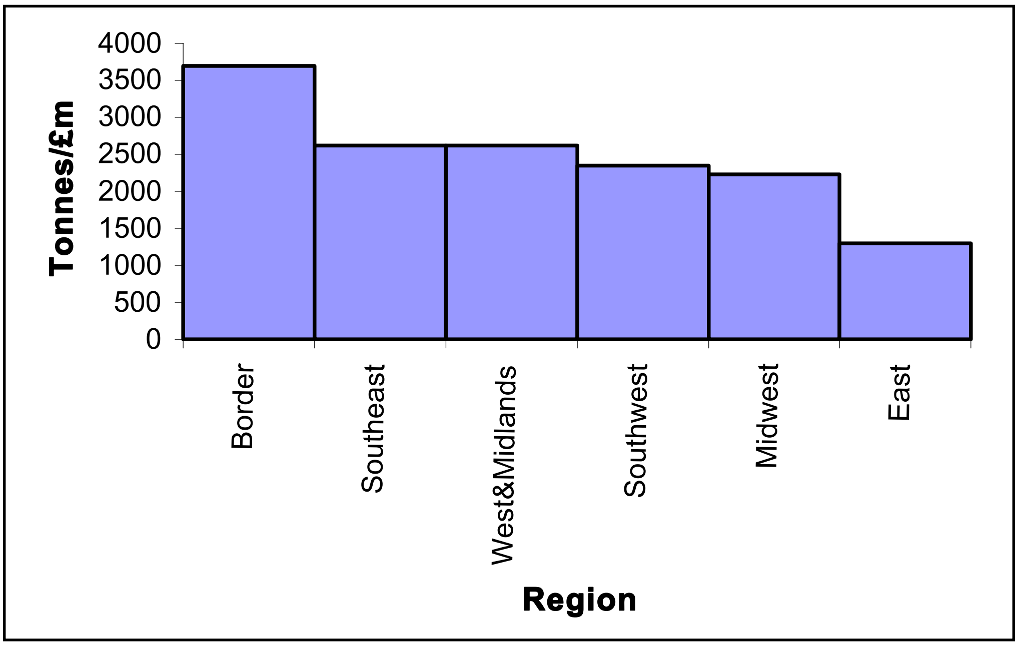


Table 2.4: Regional Distribution of Road Freight by Origin in Tonnes, 1994

Region of Origin	Region of Destination										
	East	Southeast	Southwest	Midwest	West	Northwest & Donegal	Northeast	Midlands	Northern Ireland	Other	Total
	Tonnes Carried (thousand)										
East	18,277	1,767	693	330	347	256	1,956	979	228	78	24,911
Southeast	1,142	6,568	1,210	609	166	17	144	267	26	45	10,194
Southwest	488	701	13,147	886	115	9	85	203	35	45	15,714
Mid-west	191	609	926	4,929	386	9	37	219	10	24	7,339
West	105	67	116	395	5,560	765	107	285	8	6	7,414
Northwest & Donegal	2,450	40	3	16	89	2,272	101	33	93	82	5,178
Northeast	1,465	104	150	35	65	105	5,307	161	433	101	7,926
Midlands	511	309	107	146	367	155	181	2,162	114	36	4,087
Northern Ireland	145	16	16	11	29	238	258	63	555	25	1,356
Other	276	27	74	14	2	22	12	5	2	35	468
Total	25,049	10,208	16,443	7,371	7,126	3,847	8,186	4,377	1,504	476	84,587

Source: the Road Freight Transport Survey

Table 2.5: Regional Distribution and Intensity of Freight Traffic by Origin, 1994.

	Tonnes Originating (000s), 1994	Gross Value Added at Market prices (£m) 1995	Tonnes per £m Gross Value Added
SE	58,158	32,994	1,760
East	24,911	19,134	1,300
Mid West	7,339	3,288	2,230
South East	10,194	3,890	2,620
South West	15,714	6,682	2,350
BMW	24,605	7,940	3,100
West and Midlands	11,501	4,390	2,620
Border	13,104	3,550	3,690
Total	82,763	40,934	2,020

Source: Goodbody Estimates

2.4.4 Spatial Distribution of Rail Freight

Iarnrod Eireann's rail freight business comprises bulk freight, unit load type business and a parcel service. Rail is particularly suited to the transport of bulk traffics. Iarnrod Eireann provides a key service to many of the bulk commodity producers throughout Ireland. Bulk traffics include cement, liquid ammonia, fertiliser, timber, beet, petroleum products, shale and gypsum, and zinc and lead minerals. As may be seen from Table 2.6, relatively few traffics account for the bulk of rail freight movements.

Table 2.6: Rail Freight Traffic by Commodity (000 tonnes)

	1992	1993	1994	1995	1996	1997	1998	1999
Ale, Beer, Stout	201	215	209	209	203	274	303	338
Beet & Beet Pulp	181	156	166	173	175	163	168	158
Cement	554	583	659	679	683	707	719	694
Fertiliser	180	169	177	192	165	150	137	139
Mineral Ores	695	675	618	628	563	583	534	530
Petrol & Oil	46	48	50	49	55	52	38	30
General Freight	1,476	1,215	1,136	1,249	1,286	988	891	1,012
Total	3,333	3,061	3,015	3,179	3,130	2,917	2,790	2,901

Source: Iarnrod Eireann

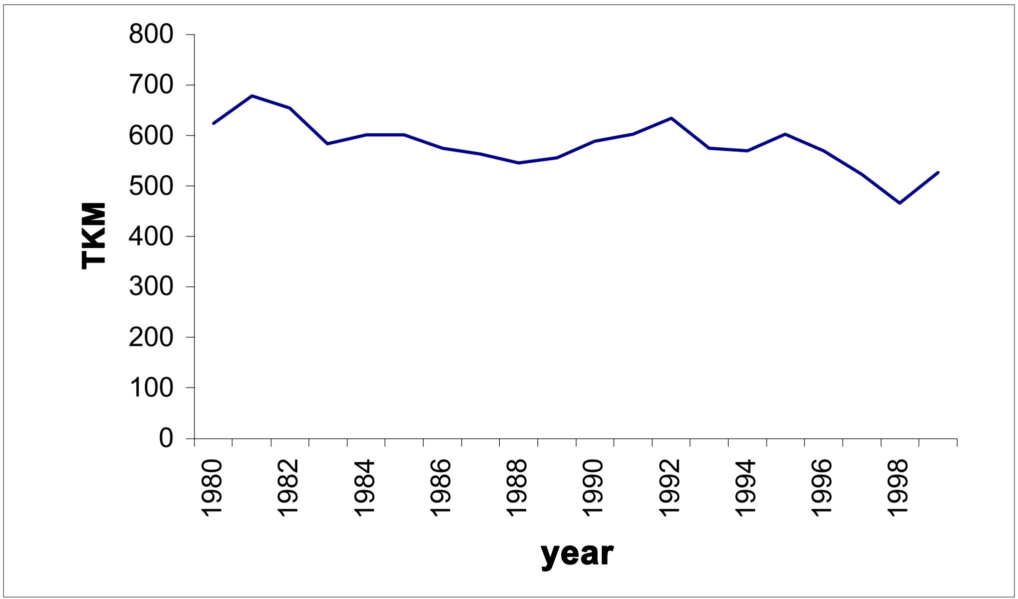
Table 2.7 and Figure 2.5 below show the trend in rail freight over the period 1980-1999. While there have been fluctuations over the period, in broad terms rail tonne kilometres have remained largely unchanged. Tonnage carried has declined somewhat.

Table 2.7: Rail Freight Traffic

Year	Rail Freight TKMS (m)	Rail Freight Tonnes (m)
1980	624.2	3.6
1985	601.0	3.4
1990	588.6	3.3
1995	602.5	3.2
1999	526.0	2.9

Source: Iarnrod Eireann

Figure 2.5: Trend in Tonnes Kilometre Rail Freight Traffic, 1980-1999



Fluctuations in carryings arise because of the loss of significant traffics from time to time. For example, in more recent years Iarnrod Eireann's rail freight operations have encountered a number of setbacks including the closure of Bell Lines and Asahi.

Because of the concentration of rail freight on a few commodities, the spatial distribution of rail freight traffic is a function of where the industries producing these commodities are located. This may be seen from the rail freight origin-destination matrix in Appendix 2. For example, freight movements from Louth reflect the transport of bulk cement for Irish Cement Ltd from its factory outside Drogheda. Similarly movements from Cork are influenced by the transport of liquid Ammonia to Arklow, Co. Wicklow, on behalf of Irish Fertiliser Industries (IFI) from its factory at Marino Point, Co. Cork. Despite these factors, over 30 per cent of all tonnes originate in Dublin. Rail freight movements are, therefore, focussed on Dublin to a considerable extent (see Figure 2.6). However, it will also be seen that there are significant movements that are not Dublin originating or terminating.

2.5 Conclusions

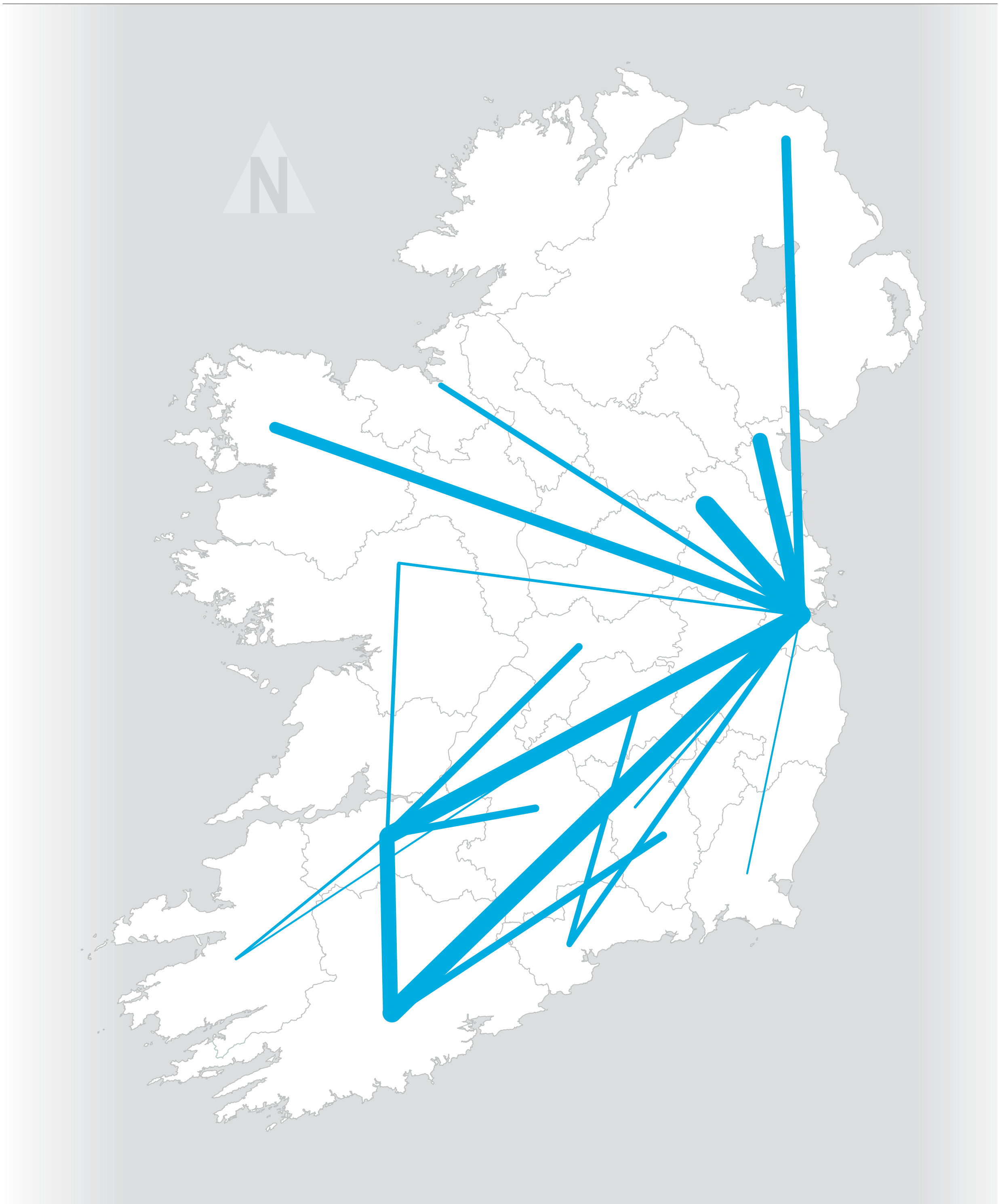
Data sources on road freight traffic are particularly poor and this raises doubts about the accuracy of modal split estimates. However, based on available data, the rail share of total traffic for 1994 is estimated at 9.77 per cent of tonne kilometres and 3.8 per cent of tonnes carried. The rail share of total traffic declined during the 1980s (in terms of tonne kilometres), but has apparently stabilised since then.

These figures understate the rail share in the long-distance freight market in which it largely competes. If the rail system is regarded as competing in the greater than 150 kilometre freight market only, its share in tonne kilometres rises to 19 per cent.

In spatial terms, the bulk (70 per cent) of road freight movements is intra-regional involving short trip lengths. Inter-regional flows are dominated by the East sub-region, which accounts for 30 per cent of all tonnes originating and terminating. Thus, the major flows are to and from the East sub-region. This dominance reflects the scale of the economy in that region relative to others. However, the SE region as a whole is a less intensive generator of freight traffic than the BMW region. This disparity in performance arises from the low intensity of the East sub-region on the one hand and the extraordinarily high intensity of the Border sub-region on the other.

Rail freight movements are, therefore, focussed on Dublin to a considerable extent. However, there are significant movements that are not Dublin originating or terminating.

Figure 2.6: Major Inter-County Rail Freight Flows, 1999



3 Passenger Traffic: Modal Shares and Spatial Distribution

3.1 Introduction

This section of the report considers the breakdown of passenger traffic in Ireland by mode and the spatial distribution of that traffic across the country. While there are data available on road traffic volumes, these are in terms of vehicle kilometres rather than passenger kilometres. Because of this, the modal share must be estimated using assumptions about travel characteristics. The methodology for making these estimates is first set out, and the various data sources are considered. Modal shares are then estimated and the spatial distribution is analysed.

3.2 Methodology

There is no comprehensive database on personal travel in Ireland that would facilitate an analysis of modal shares for the various passenger transport markets. The CSO does not undertake a national household travel survey, which is a feature of travel data collection in other countries.

As a result, estimates of passenger market shares must be built up from other data. In doing this, the focus is usually on passenger kilometres, as there is no reliable source of data on passenger journeys, with the exception of the data compiled by CIE and its constituent companies in respect of the public transport services that they operate.

The approach usually adopted for estimating market shares in terms of passenger kilometres is to:

- Make assumptions about road vehicle occupancy rates;
- Apply these occupancy rates to the vehicle kilometres of travel performed by the different vehicle categories to estimate road passenger kilometres;
- Add rail passenger kilometres to road passenger kilometres thus calculated to get total passenger kilometres;
- Express passenger kilometres for each mode as a proportion of this total.

This approach is subject to error arising especially from the partial nature of information on vehicle occupancies. More recently, as indicated above, the NRA’s VKT report, which is the source of information on vehicle kilometres, has come under review. Because of this, the estimates presented below must be regarded as indicative only.

3.3 Passenger Traffic Mode Shares

Passenger kilometres of travel were estimated for the years 1987, 1992 and 1996. More recent estimates cannot be made because VKT reports for later years have not been compiled. Table 3.1 and Figure 3.1summarise the results and the assumptions in relation to vehicle occupancies are set out in Appendix 3.

Total passenger kilometres are estimated at 56,140m in 1996. Over the nine-year period 1987-1996, they are estimated to have grown at a rate of 5.4 per cent per annum. In 1996, road modes accounted for 97.7 per cent of all passenger kilometres, with the rail mode accounting for the residual 2.3 per cent. The rail share is estimated to have declined by just over 30 per cent in the nine years. The private car accounts for 87 per cent of all travel, and is tending to increase its share.

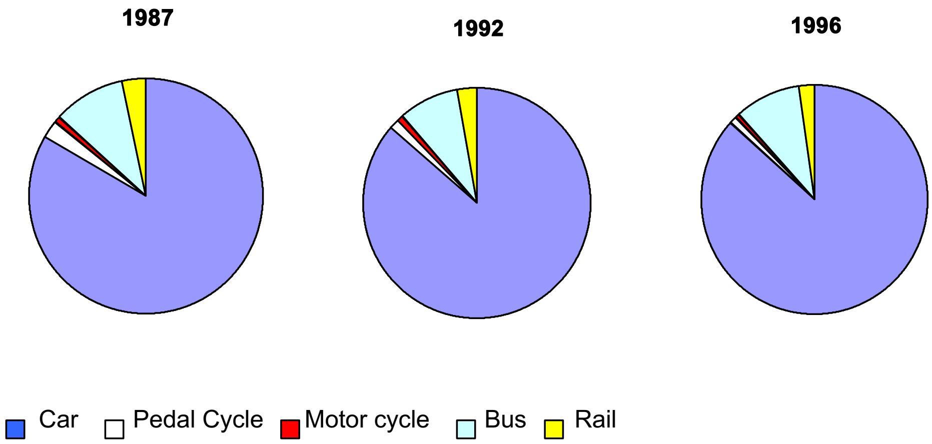
The bus mode has retained a stable market share of approximately 9 per cent over the period. However, it should be noted that the bus share may be misleading as an estimate of the bus public transport share. This is because the VKT report includes buses, coaches and minibuses in this category, where the latter are adjudged to have seating for eight or more passengers. Thus, a significant amount of private travel by individuals and institutions may be included in this total.

Table 3.1: Estimated Modal Shares of Passenger Kilometres, 1987 –1996

Mode	1987 Pkm (m)	Modal Share (%)	1992 Pkm (m)	Modal Share(%)	1996 Pkm (m)	Modal Share(%)
Pedal Cycle	872	2.5	661	1.6	662	1.2
Motor Cycle	273	0.8	249	0.6	295	0.5
Car	29,242	83.4	36,433	86.4	48,614	86.6
Buses	3,463	9.9	3,614	8.6	5,274	9.4
Total Road	33,850	96.6	40,957	97.1	54,845	97.7
Rail	1,196	3.4	1,226	2.9	1,295	2.3
Total	35,046	100.0	42,183	100.0	56,140	100.0

Source: Goodbody Estimate

Figure 3.1: Modal Shares of Passenger Kilometres, 1987-1996



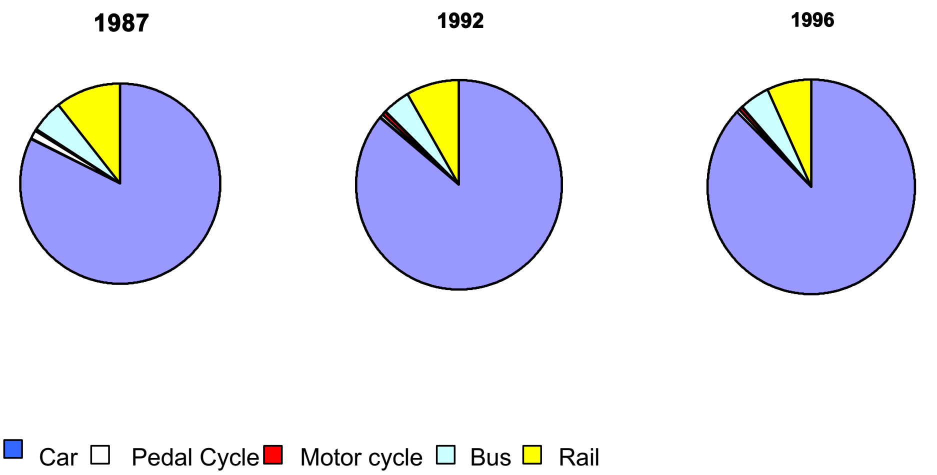
One of the problems with the above analysis is that not all modes compete in all markets. Therefore, the figures may understate the role of some modes in terms of the markets that they serve. This is particularly true of the rail network, which has both limited coverage of the country and caters largely for longer distance travel. In order to illustrate the effect of market definition on mode shares, the interurban market only was considered. This market was defined as all travel on the non-urban portion of the National Road network plus all rail travel. The results are set out in Table 3.2 and Figure 3.2. The rail share of this market rises to 6.9 per cent in 1996. However, the Table indicates a similar decline in the rail share of just over 35 per cent during the period 1987-1996.

Table 3.2: Estimated Modal Shares of "Inter Urban" Passenger Kilometres, 1987-1996

Mode	1987 Pkm (m)	Modal Share(%)	1992 Pkm (m)	Modal Share(%)	1996 Pkm (m)	Modal Share(%)
Pedal Cycle	140	1.2	94	0.6	105	0.6
Motor Cycle	50	0.4	58	0.4	79	0.4
Car	9,357	82.6	12,747	86.1	16,365	87.2
Buses	584	5.2	688	4.6	928	4.9
Total Road	10131	89.4	13,587	91.7	17,477	93.1
Rail	1,196	10.6	1,226	8.3	1,295	6.9
Total	11,327	100.0	14,813	100.0	18,772	100.0

Source: Goodbody Estimate

Figure 3.2: Modal Shares of "Inter-Urban" Passenger Kilometres, 1987-1996



It could be argued that even this analysis underplays the role of rail in the market that it serves. Many trips on the National Road network are short (this explains the use of the cycle mode in the above Table), and the rail network would not compete for them. The role of rail in the long distance market can be illuminated by considering city to city trips. For example, OD surveys indicate that there are approximately 1600 vehicle trips per day between Galway and Dublin cities. Based on a typical traffic composition on National Primary routes, this would indicate some 1,300 cars and 26 buses. Using typical occupancy rates and expanding to a full year indicates a total travel between the two cities by road of 1,030,000 persons per annum. In 1994, there were an estimated 279,000 rail passengers making this journey, giving rise to a rail share of approximately 27 per cent.

Equivalent calculations may be made for Dublin-Cork and Dublin-Limerick as set out in Table 3.3.[6] Thus, it is clear that the role of rail in the inter-city passenger market is a significant one. In the context of the spatial strategy, this is an important finding as good inter-regional transport links will be required.

Table 3.3: Rail Share of City to City Passenger Markets

Market	Rail Share (%)
Dublin - Galway	27
Dublin - Cork	35
Dublin - Limerick	30

Source: Goodbody Estimate

6. These calculations are subject to considerable errors. However, the general thrust of the results is confirmed by Iarnrod Eireann market research for 1990, which gave market share figures of 39 per cent (Dublin-Cork); 18 per cent (Dublin-Limerick); and 17 per cent Dublin-Galway.

3.4 The Spatial Distribution of Passenger Traffic

3.4.1 Introduction

This sub-section examines the spatial distribution of passenger traffic. The focus initially is on road passenger traffic, followed by an analysis of rail traffic.

3.4.2 Road Passenger Travel

Table 3.4 shows that traffic, as measured by vehicle kilometres of travel, has been growing at a long term rate of 4 per cent per annum. More recently, growth rates in excess of 7 per cent have been recorded, although there is some doubt as to the accuracy of the data for 1995 and 1996.

There are more recent data available for traffic volumes on National Routes. These show strong growth in travel post 1996. A growth rate of 8.7 per cent occurred on National Routes in 1997 and 6.6 per cent in 1998.

The road network is categorised into National, Regional, County and Local Urban Roads. While National Roads, which are effectively the inter-regional links, comprise just over 5 per cent of network by length but account for almost 37 per cent of all traffic. There is a tendency for traffic on the National Road network to grow at a slightly faster rate than total traffic.

Table 3.4: Growth Rates in National Route Traffic

Year	Growth Rate in National Route Traffic (%)
1992	6.5
1993	5.4
1994	4.5
1995	7.8
1996	8.4
1997	8.7
1998	6.6

There is considerable variation in traffic volumes by road section on the National Roads. In the approaches to cities and towns, volumes increase and then decline between towns. For example, on the Dublin – Limerick (N7) road, Average Annual Daily Traffic volumes (AADT) range from over 57,000 at Newlands Cross to just over 6,000 south of Borris-in-Ossory. Figure 3.3 depicts the scale of the traffic volumes on different parts of the National Primary network in terms of AADT.

Table 3.5: Vehicle Kilometres of Travel by Type of Road Network (1977 – 1996)

Year	National	Regional/ County	Local Urban	Total
1996	12,619	17,407	4,505	34,532
1990	9,327	11,928	3,642	24,896
1986	7,441	10,750	3,030	21,224
1980	6,815	10,118	2,959	19,893
1977	5,724	8,575	2,118	16,417
Average Annual Growth Rate (%)	+4.2	+3.8	+4.2	+4.0

* Note that the National Road Network was revised in 1995.

Source: Traffic Station Counts and Road Travel (the Vehicle Kilometres of Travel Report) various issues.

Given the variation in AADT by route section, it is apparent that average trip lengths on the Irish road system must be relatively low.

From the perspective of the National Spatial strategy, the extent of inter-regional trip making is very important as an indicator of the economic nexus between regions. To illustrate the extent of inter-regional trip-making would require origin-destination travel data. The last comprehensive origin-destination (O-D) survey of travel in Ireland was undertaken in 1979. Given the substantial changes in the demographic and economic structure since that date, those data are no longer useful.

Since that time, some partial O-D data have been collected, most notably recently in the context of the Dublin Transportation Initiative, the Galway Land Use Transportation Study, and the Roads Needs Study. O-D information is also currently being collected as part of the planning of major inter-urban road schemes. Unfortunately, these data cannot readily be combined to give even a partially comprehensive view of O-D flows. This is because, in keeping with the objectives set for them, these studies have concentrated on depicting O-D movements of relevance to the issues in hand. Typically, for example, trips originating or terminating outside the core study area have been coded to very large zones. While it would be possible, say, to code the data on a county basis, this would require reprocessing of the O-D data sheets, which would require substantial resources. [7]

7. Going forward, it might be useful to write into the terms of reference of road planning studies, the requirement to code to county level at least, thus building up a repository of information on O-D flows.

The only data on O-D flows between the major centres are those collected in the course of the Roads Needs Study. During this study, survey stations were set up on the N6, N7, N8, N9, and N11. Again, the data from these surveys were coded in such a way that in only three cases can O-D data for inter-city movements be identified, as in Table 3.6 following. The inter-city flows are low relative to the AADT in the road sections in which the survey took place (about 20 per cent typically).

Figure 3.3: Daily Traffic Volumes on National Routes (AADT),1997

Table 3.6: Road Traffic Origin-Destination Flows

O-D Pair	Vehicles per Day
Dublin – Cork	1,636
Dublin – Galway	1,648
Dublin – Limerick	1,427

Source: compiled from data collected as part of the National Roads Needs Study (NRA, 1998).

The brief for this study places emphasis on providing an overview of inter-regional traffic flows. Given the paucity of the data, it is not possible to do this to any degree of accuracy. However, to give some indication of the possible scale of flows, the above data were used to calibrate a simple and crude gravity-type model and to use it to predict inter-town flows.

The model took the form:

$$V_{ij} = P_I P_j e^{-dij}$$

Where V_{ij} = the daily vehicle flow between i and j

P_I = the population if city i in 000s

P_j = the population of city j in 000s; and

d = the distance in kilometres between i and j.

As there is only one parameter d to be calculated, this equation could be solved for each O-D pair. The average value of d thus estimated was -0.01781.[8]

Table 3.6 presents the results. Because of the crude nature of the model and the errors arising, the results are presented in the following ranges:

<100 vpd

>100<500 vpd

>500<1,000vpd

>1,000<1,500 vpd

>1,500vpd

The model suggests that the major town-to-town flows are between Dublin and the major urban areas. The only other large flows are between Cork and Limerick, Cork and Waterford, and Limerick and Galway.

8. One of the problems with the model is that because there is only one parameter, it tends to predict implausibly low and high values in some instances.

Table 3.7: Simulated Town-to-Town Daily Traffic Volumes, 1997

	Dublin	Cork	Limerick	Galway	Waterford	Sligo	Wexford	L'kenny	Ballina	Castlebar
Dublin		>1,500	>1,500	>1,000	>1,500	>100	>1,000	>100	>100	>100
Cork			>1,500	>100	>500	<100	<100	<100	<100	<100
Limerick				>500	>100	<100	<100	<100	<100	<100
Galway					<100	<100	<100	<100	<100	>100
Waterford						<100	>100	<100	<100	<100
Sligo							<100	<100	<100	<100
Wexford								<100	<100	<100
L'kenny									<100	<100
Ballina										<100
Castlebar										

Source: Goodbody estimate

3.4.3 Rail Passenger Travel

A detailed data origin-destination matrix of rail passenger traffic between counties was made available by Iarnrod Eireann and is set out in Appendix 4. This matrix shows that almost 80 per cent of inter-county rail trips originate in the SE region. This is because of the nature of the rail system and the distribution of the population. Dublin and the Mid East sub-regions dominate, with 63.2 per cent of all trips originating in these two sub-regions (see Table 3.8).

The top ten county to county movements account for 7.9m trips or 75 per cent of the total These data show that the major rail passenger movements are between Dublin and other counties i.e. they are radial in nature. This is confirmed by Table 3.9, which lists the ten top county to county movements in rank order. The major movements are seen to be between Dublin and counties in the Mid-East sub-region. This partly reflects the increased use of mainline rail services for long distance commuting to Dublin (see Figure 3.4)

Table 3.8: Number of Rail Passengers Originating in Each Region, 1999

Region	Number of Passengers	% of Total
BMW	2,182,023	20.5
Border	991,347	9.3
Midlands	724,064	6.8
West	466,612	4.4
SE	8,483,159	79.5
Dublin	3,706,425	34.8
Mid East	3,031,520	28.4
Mid West and South East	1,036,822	9.7
South West	708,392	6.6
Total	10,665,182	100.0

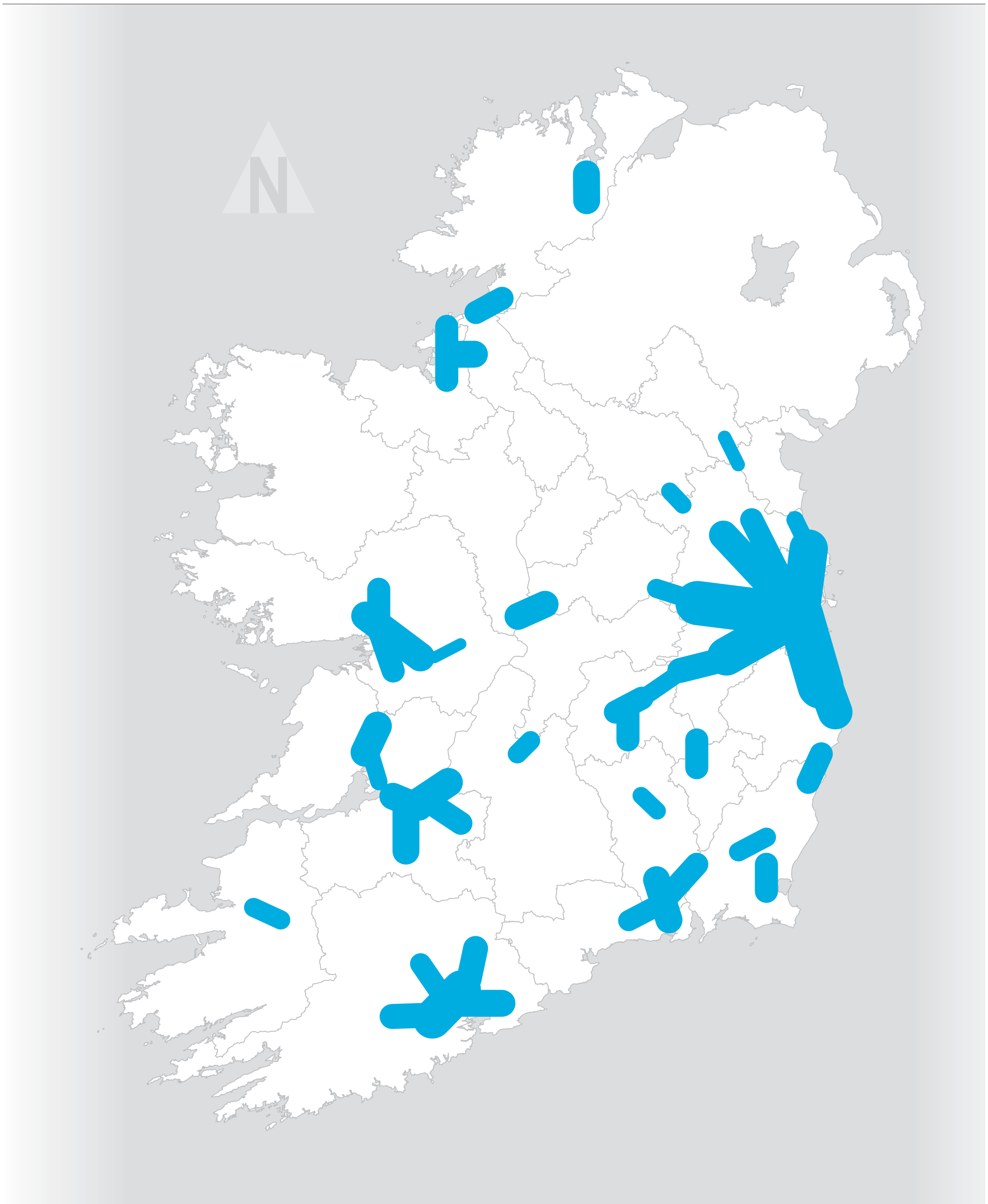
Source: Goodbody estimate from Iarnrod Eireann data

Table 3.9: The Top Ten County to County Rail Passenger Flows, 1999

County to County Movements	Passenger Numbers
Dublin – Wicklow	2,951,662
Dublin – Kildare	1,229,589
Dublin – Louth	992,165
Dublin – Cork	824,235
Dublin – Galway	391,222
Dublin – Limerick	386,331
Dublin – Laois	322,162
Dublin – N Ireland	305,500
Dublin – Kerry	264,726
Dublin – Mayo	262,796
Total	7,930,388

Source: Goodbody estimate from Iarnrod Eireann data

Figure 3.4: Major Rail Passenger County to County Flows, 1999



Passenger movements between counties other than Dublin are much lower. The top ten such movements account for only 0.4m trips or 4 per cent of all movements. It is interesting to note that most of the movements listed are along radial routes between Dublin and other centres, and are no doubt facilitated by the relatively high levels of service on such routes. The only non-radial routes that figure are Cork-Kerry and Cork-Limerick.

Table 3.10: The Top Ten Non-Dublin County to County Rail Passenger Movements, 1999

County to County Movements	Passenger Numbers
Cork – Kerry	77,967
Limerick - Tipperary	59,055
Cork – Limerick	53,202
Louth – Meath	52,864
Cork – Tipperary	40,502
Galway - Westmeath	32,557
Waterford – Kilkenny	29,985
Wexford – Wicklow	26,856
Kilkenny - Carlow	26,754
Laois - Westmeath	23,991
Total	423,733

Source: Goodbody estimate from Iarnrod Eireann data

3.4.4 Suburban Rail Travel

The increased use of the mainline rail system for long distance commuting is a reflection of the increased use of the rail mode generally for the journey to work. This is reflected not only in the Census data on the journey to work[9] but also in the data on suburban rail travel. Despite the fact that the suburban rail system has been at least partially capacity constrained in the peak, suburban passenger numbers have risen by 25 per cent in five years.

Table 3.11: Suburban Rail Passenger Demand, 1992-1999

Year	Passenger Numbers (000s)	Growth Rate (%)
1992	18,207	-
1993	18,240	0.2
1994	17,963	-1.5
1995	18,812	4.7
1996	19,537	3.9
1997	20,507	5.0
1998	22,315	8.8
1999	22,546	1.0

Source: Iarnrod Eireann

9. See the report on Sustainable Travel Demand.

3.5 Conclusions

Total passenger kilometres of travel are estimated at 56,140m in 1996. Over the period 1987-1996, passenger kilometres have been growing at rate of 5.4 per cent per annum.

In 1996, road modes accounted for 97.7 per cent of all passenger kilometres, with the rail mode accounting for the residual 2.3 per cent. The rail share is estimated to have declined by just over 30 per cent in the nine years. The private car accounts for 87 per cent of all travel, and is tending to increase its share.

However, the rail market share is significantly higher in some markets, particularly the inter-urban market. For example, it is estimated that the rail share of travel between Dublin and the cities of Cork, Galway and Limerick is more than 25 per cent.

Vehicle kilometres of travel have been growing at a long-term rate of 4 per cent per annum. More recently, growth rates in excess of 7 per cent have been recorded. The road network is categorised into National, Regional, County and Local Urban Roads. While National Roads, which are effectively the inter-regional links, comprise just over 5 per cent of network by length but account for almost 37 per cent of all traffic. There is a tendency for traffic on the National Road network to grow at a slightly faster rate than total traffic.

There is considerable variation in traffic volumes by road section on the National Roads. In the approaches to cities and towns, volumes increase and then decline between towns. It is apparent that average trip lengths on the Irish road system must be relatively low.

Simulation of origin-destination flows indicates that the major town-to-town flows are between Dublin and the major urban areas. The only other large flows are between Cork and Limerick, Cork and Waterford, and Limerick and Galway. Inter-city flows are low relative to the AADT.

Almost 80 per cent of inter-county rail trips originate in the SE region. This is because of the nature of the rail system and the distribution of the population. Dublin and the Mid East sub-regions dominate, with 63.2 per cent of all trips originating in these two sub-regions.

With regard to rail, the major rail passenger movements are between Dublin and other counties particularly those in the Mid-East sub-region i.e. they are radial in nature. This pattern partly reflects the increased use of mainline rail services for long distance commuting to Dublin. Use of suburban rail services is undergoing a significant increase.

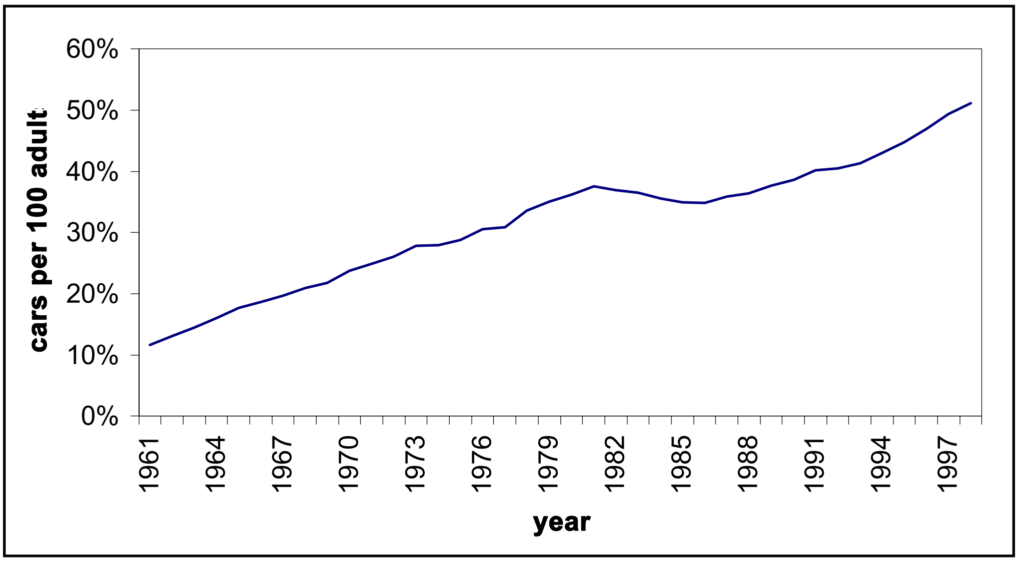
Passenger movements between counties other than Dublin are much lower. The top ten such movements account for only 0.4m trips or 4 per cent of all movements. The only non-radial routes that figure are Cork-Kerry and Cork-Limerick.

4 National Car Ownership Forecasts

4.1 Introduction

In considering car ownership, it is normal to measure it on a per capita basis. These per capita values are then combined with population levels to derive forecasts of car numbers. Throughout this report, car ownership is measured in terms of cars per 100 adults. [10]

Figure 4.1: Car ownership (cars per 100 adults), 1961-1998



4.2 Recent Trends in Car Ownership

Table 4.1 sets out the trend in both car numbers and car ownership at five-yearly intervals since the 1960s, together with data for 1997 and 1998. There are now almost 1.2m private cars in the country and car ownership has exceeded 50 cars per 100 persons for the first time. In general terms, the growth rate in car ownership has slowed down as car ownership levels have increased (see Figure 4.1). However, there is also a close correlation between car ownership and economic growth. For example, car ownership stagnated in the early 1980s, when the economy was performing poorly. In recent years, car ownership has grown rapidly, in line with the exceptional performance of the economy.

10. This is in line with the most recent major car ownership forecasting exercise: Forecasts of Vehicle numbers and Traffic Volumes. DKM January 1994.

4.3 Saturation Levels

In theory, car ownership levels could rise until a rate of 100 or more was reached: in other words, until every adult in the country owned at least one car. In practice, this level is unlikely to be reached, as some adults will chose not to own a car because of lack of need, or incapacity. DKM, in the study cited in the footnote, employed three alternative saturation assumptions of 75, 80 and 85 cars per adult. Because of the strong growth in car ownership in recent years, the lower value of 75 now looks unlikely. In this study, therefore, alternative saturation levels of 80 and 90 were assumed.

Table 4.1: Trends in Car Numbers and Car Ownership

Year	Car Numbers	Cars Per Adult	Annual Growth Rate in Cars Per Adult (%)
1961	183,302	11.6	-
1966	296,372	18.7	10.0
1971	414,053	24.9	6.0
1976	551,117	18.7	4.1
1981	729,002	37.6	4.2
1986	711,087	34.8	-1.5
1991	836,583	40.1	2.9
1996	1,057,383	46.9	3.2
1997	1,134,429	49.4	5.3
1998	1,196,901	51.2	3.5

Note: Growth rates are average 5 year, with the exception of 1997 and 1998

4.4 Factors Influencing Car Ownership Levels

There is general acceptance that income levels are the prime influence on car ownership. Previous studies have attempted to assess the impact of motoring costs on car ownership with relatively little success[11]. As a result, in this study, income was the only explanatory variable considered. Two alternative measures of income were used: Gross National Product (GNP) and Domestic Demand (DD).

11.See DKM (op.cit); and B P Feeney. Car Ownership Forecasts 1995-2005. An Foras Forbartha Report. RT262, 1984.

4.5 The Forecasting Model

The forecasting model related national car ownership to income over the period 1961 to 1998. Two alternative functional forms were tested – the Logistic and the Gompertz.

The Logistic function took the following form:

Car ownership = $S/(1+ a_0 \text{Exp } a_1 X)$

Where:

S = the saturation level; and

X = the income measure.

Essentially, this function assumes that car ownership grows with income levels, but that the impact of income declines as the saturation level is approached. Our analysis indicated that Domestic Demand was a better explanator of car ownership than GNP, and that there was little difference between the Logistic and Gompertz formulations. The results indicated that for every 10 per cent increase in domestic demand, car ownership increased by 7 per cent.

The model was calibrated on annual data covering the period 1961-98 with following results.

80 cars per 100 adults

Car ownership = 80/(1+ 4.754Exp –0.0000958X)

90 cars per 100 adults

Car ownership = 90/(1+ 4.468Exp –0.0000795X)

The full model results and the various statistical tests that were applied are set out in Appendix 5.

4.6 Forecast Assumptions

Forecasts of car ownership and car numbers were made for five-year intervals to the year 2016. As Domestic Demand per adult is the key explanator of growth in car ownership, projections of the number of adults in the country are required. The CSO provides projections of the population up to the year 2031 based largely on assumptions relating to fertility and immigration. [12]Table 4.2 presents projections for the total and adult population based on an assumption of a moderate decline in fertility (F2) and continuing but diminishing immigration (M1). The total population is predicted to rise by 19.4 per cent, from 3.6m in 1996 to 4.3m in 2016. However, the adult population will grow more strongly – by 30.5 per cent over the same period. This reflects the ageing of the population, as the birth rate falls and immigration continues.

Table 4.2: Population Projections 2001- 2016

Year	Total Population	Adult Population	Annual Rate of Growth in Adult Population (%)
1996	3,626,087	2,252,525	1.6
2001	3,834,000	2,492,100	2.0
2006	4,031,000	2,700,367	1.6
2011	4,201,000	2,846,700	1.1
2016	4,331,000	2,941,500	0.7

Note: Annual growth rates refer to five-year averages

Analysis of trends in Domestic Demand and GNP indicated that while there were short-term divergences, the two measures experienced similar growth rates over the long term. Accordingly, Domestic Demand was assumed to grow in future at the rate of growth in GNP. The most comprehensive assessment of future GNP growth is that provided by the ESRI.[13] As the ESRI forecasts have been overtaken by the extraordinary growth in the economy, they are not a good guide to the rates of growth now anticipated over the very short term (to 2006). As a result, the forecasts for this period are based on internal Goodbody estimates. The forecasts for the post 2006 period are those indicated by the ESRI. The assumed rates of growth in Domestic Demand are summarised in Table 4.3. The table also contains estimates of the growth in Domestic Demand per adult.

12.CSO. Population and Labour Force Projections 2001-2031. 1999.
13.See ESRI Medium Term Review, 1999-2005, October 1999.

Table 4.3: Assumed Annual Growth in Domestic Demand

Period	Average Annual Rate of Growth in Domestic Demand (%)	Average Annual Growth Rate in Domestic Demand per Adult (%)
1996-2001	8.9	6.8
2001-2006	5.5	3.8
2006-2011	4.3	3.2
2011-2016	3.2	2.5

Table 4.4 presents car ownership forecasts for the period up to 2016 based on assumed saturation levels of 80 and 90 cars per 100 adults respectively. It is predicted that, over the period 1996-2016, car ownership will increase by 50 to 60 per cent, depending on the saturation level adopted. In the short term (2001-2006) the average annual rate of growth will be some 2.7 per cent, as compared with 3.2 per cent in the previous five years. Thereafter, the rate of growth in car ownership is predicted to slow down as the rate of economic growth moderates and the impact of approaching car ownership saturation levels is felt.

Table 4.4: Car Ownership Forecasts 1996-2016

Year	Saturation Level of 80 Cars per 100 Adults		Saturation Level of 90 Cars per 100 Adults	
	Cars per 100 Adults	Average Annual Growth Rate in Cars per 100 Adults (%)	Cars per 100 Adults	Average Annual Growth Rate in Cars per 100 Adults (%)
1996	46.9	3.2	46.9	3.2
2001	54.8	3.2	54.8	3.2
2006	62.2	2.6	62.7	2.7
2011	67.8	1.7	69.6	2.1
2016	71.7	1.1	74.7	1.4

4.7 Forecasts of Car Numbers

Forecasts of car numbers were obtained by multiplying the predicted car ownership levels by the predicted adult population. Car numbers are expected to double between 1996 and 2016, from 1.1m to 2.1m. Different saturation levels have little impact on this forecast. For the period 1996-2001, car numbers are expected to grow at 5.2 per cent per annum, falling to in excess of 4 per cent in the period 2001-2006. In the more distant future, the growth rates will fall to around 2 per cent per annum. Over the period 1996-2016 as a whole, car numbers will grow by some 3.5 to 3.7 per cent on average.

Table 4.5: Forecasts of Car Numbers 1996-201

Year	Saturation Level of 80 Cars per 100 Adults		Saturation Level of 90 Cars per 100 Adults	
	Number of Cars (000s)	Average Annual Growth Rate in Number of Cars (000s)	Number of Cars (000s)	Average Annual Growth Rate in Number of Cars (000s)
1996	1,057.4	4.8	1,057.4	4.8
2001	1,364.5	5.2	1,363.9	5.2
2006	1,677.0	4.2	1,692.0	4.4
2011	1,932.4	2.9	1,981.1	3.2
2016	2,109.7	1.8	2,198.4	2.0

5 Regional and County Car Ownership Forecasts

5.1 Introduction

This section presents forecasts of car ownership and car numbers on a regional and county basis. The forecasting procedure adopted was to develop car ownership models to predict county car ownership levels, and then to derive regional forecasts by aggregation. Trends in county and regional car ownership levels are first reviewed, followed by development of the forecasting model and forecasts.

5.2 Trends in Regional and County Car Ownership Levels

Table 5.1 presents the trends in car ownership by region since the early 1980s. There is little difference in car ownership levels between the BMW region (49.5 cars per 100 adults) and the SE region (51.7). The rate of growth in car ownership over the period 1981- 1998 has also been similar at 27.6 per cent and 28.6 per cent respectively. The SE region accounts for 75 per cent of all cars in the country (see Figure A).

The Border sub-region has the lowest car ownership level (47.1) followed by the Dublin sub-region (48.0). Car ownership is highest in the Mid-East (55.2).

In the early 1980s, the West sub-region and not the Border sub-region had the lowest car ownership level. However, since that time, the Border sub-region has experienced the lowest rate of growth (22.7 per cent).

Car ownership at county level is depicted in Table 2.2 and Figure 5.1. The most notable feature is that car ownership is low in Dublin, despite the fact that incomes per adult are typically some 20 per cent above that for other counties. This is most probably due to the greater population density in Dublin and the higher level of public transport provision. Car ownership tends to be highest in low-density counties with above average incomes, such as Tipperary NR and Meath.

Table 5.1: Trends in Car Ownership (Cars per 100 Adults) by Region 1981-1998

Region	1998	1996	1991	1986	1981
Border, Midland and Western	**49.5**	**45.9**	**39.0**	**34.2**	**38.8**
Border	47.1	43.6	37.5	33.4	38.4
Midland	52.4	48.4	41.0	36.6	41.8
West	50.4	47.0	39.6	33.8	37.5
Southern and Eastern	51.7	47.3	40.5	35.1	40.2
Dublin	48.0	43.7	38.0	31.9	37.7

Table 5.1: Trends in Car Ownership (Cars per 100 Adults) by Region 1981-1998 *(continued)*

Mideast	55.2	50.0	41.9	36.5	42.6
Midwest	53.7	49.0	41.6	37.3	40.8
Southeast	54.4	49.7	41.9	37.7	41.7
South West	54.2	50.3	43.1	37.3	42.2
State	51.2	47.0	40.1	34.8	39.9

Figure 5.1: Car ownership per 100 adults by county, 1996

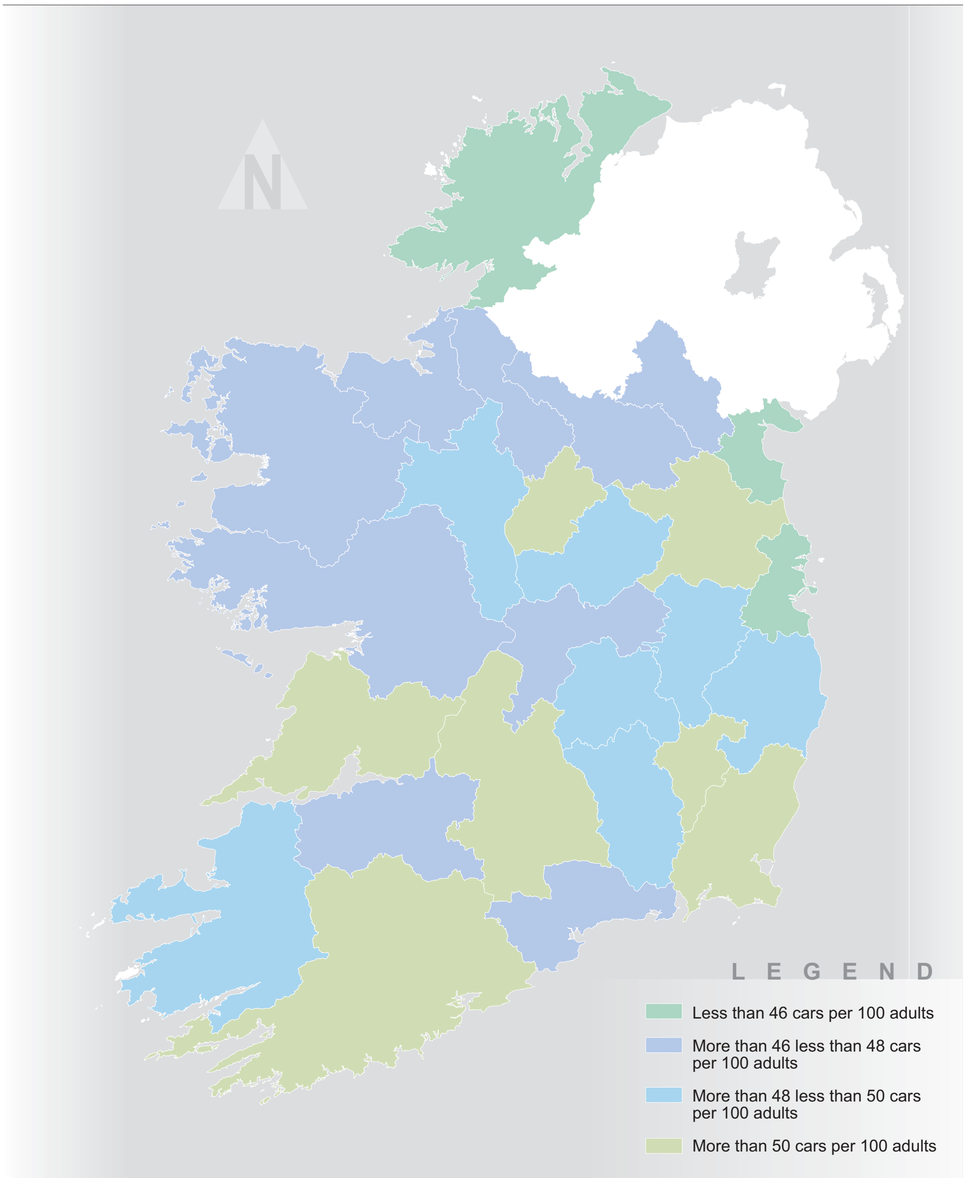
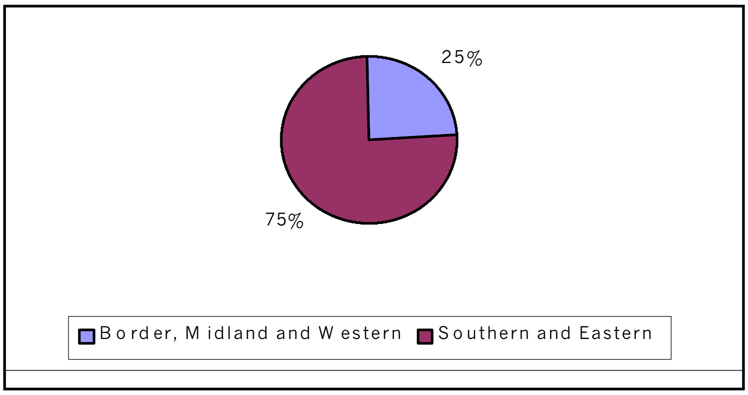


Figure 5.2: Proportion of Cars in BMW and SE Regions



5.3 Forecasting Methodology

The forecasts of national car ownership levels, which were described above, employed a time series approach with Domestic Demand as the explanatory variable. Such an approach is not feasible in the context of county car ownership forecasting, because of the absence of time series data on income or GNP by county. In fact, measurement of county incomes has been undertaken only occasionally and at substantial intervals.

The last county car ownership forecasting exercise, which was undertaken over twenty-five years ago, relied on cross-sectional data.[14] County car ownership levels were related to county incomes and county population density for a given year. This analysis established the extent to which high population density served to reduce car ownership rates. This information was then used to propose different saturation levels for each county. Separate car ownership forecasting models were then devised for each county, using the assumed saturation level and relating the rate of growth in car ownership to a time trend.

This approach is less than attractive in the context of spatial strategy development. This is because the lack of a causal relationship between car ownership and income prevents an analysis of the impact of differential regional income growth on car ownership. That is, the extent to which county and regional car ownership may change, for different scenarios with respect to county incomes, cannot be evaluated. Also, when this analysis was re-estimated for 1997, it was found that there was insufficient variation in incomes across counties to enable development of a viable model. In order to overcome these problems, this report takes a different approach.

The CSO has recently produced estimates of county incomes for each year from 1991 to 1997.[15] As incomes grew rapidly in this period, a range of income levels and associated car ownership levels can be observed. This allows the relationship between these two variables to be gauged.

14.Car Ownership Projections by County for 1985 and 1995. C. McCarthy. An Foras Forbartha Report RT115, 1974
15.CSO. Household Incomes: Regions and Counties, 1991-1997. 2000

Table 5.2: Car ownership and Income Levels by County, 1996

County	Cars per 100 Adults	Car Numbers (000s)	Disposable Income per Adult
Carlow	51.5	13.0	11,275.0
Cavan	48.0	15.1	11,546.3
Clare	50.3	28.5	11,702.7
Cork	50.7	133.1	11,978.9
Donegal	40.4	30.8	11,138.0
Dublin	43.7	300.9	13,508.6
Galway	46.6	53.5	12,188.4
Kerry	49.1	37.8	10,760.2
Kildare	50.0	40.9	12,494.0
Kilkenny	49.2	22.5	11,178.9
Laois	48.5	15.4	10,999.7
Leitrim	47.7	7.2	11,106.7
Limerick	47.1	48.4	12,395.6
Longford	50.3	8.9	11,645.2
Louth	40.3	22.9	11,962.1
Mayo	46.4	30.5	11,191.4
Meath	51.5	33.9	11,805.9
Monaghan	46.3	14.1	11,935.5
Offaly	46.6	16.5	10,795.8
Roscommon	49.7	15.5	10,613.8
Sligo	48.0	16.4	11,556.6
Tipperary NR	52.6	18.6	12,112.6
Tipperary SR	51.3	23.6	11,057.1
Waterford	46.7	27.5	11,934.5
Westmeath	49.2	18.8	11,944.3
Wexford	50.8	32.3	10,973.0
Wicklow	48.6	30.7	11,676.2
AVERAGE	48.2	39.2	11610.3

The approach adopted was to calibrate a model of the type:

Car ownership = $S/(1+ a_0 \mathrm{Exp}\,(a_1 X1+ a_2 X_2))$

where X_1 and X_2 are real income and population density measures respectively.

This was calibrated for a combined cross section and time series data set of counties embracing the Census years 1991 and 1996, for saturation levels of 80 and 90 cars per 100 persons. The assumptions behind this approach are:

- that the individual counties are approaching a common saturation level (80 or 90 cars per 100 persons);
- that the fundamental relationship between car ownership, income and population density is the same for all counties; but

- that the speed at which this saturation is approached varies from county to county according to income and density levels.

This implies in particular that a high density county like Dublin will eventually achieve a saturation level of car ownership of 80 or 90 cars per 100 persons, depending on the assumption made. However, because of the higher population density of Dublin, that ultimate saturation may be a long way off.

This approach differs from that employed by McCarthy who assumed a lower saturation level for Dublin than for the country as a whole, but also assumed that the speed at which that saturation will be approached is unrelated to county incomes and density.

In fact, both this and the McCarthy analysis are driven by data inadequacies, which prevent a more comprehensive model specification. However, the approach adopted in this report has the benefit of illustrating the impact of alternative regional income distributions and, to a lesser extent, settlement patterns.

5.4 Model Estimation

The model was estimated using county level data for the years 1991 and 1996. County car ownership for these years was related to disposable income and a population density variable. Two variants of the population density variable were tested. The first was simply population density in terms of persons per square kilometre. The second was the proportion of the population living in urban areas within the county. In practice, the former variable was found to perform better.

The estimated equations were as follows:

Saturation level of 80 cars per 100 persons:

Car ownership = 80/(1+ 22.021Exp (-0.000352X1+ 0.000698X2))

Saturation level of 90 cars per 100 persons:

Car ownership = 90/(1+ 18.174Exp (-0.000305X1+ 0.000602X2))

The models indicate that population density is a much less important factor than incomes in determining car ownership levels.

5.5 Forecast Assumptions

In making forecasts of car ownership at regional and county level, it is necessary to make assumptions about the future spatial distribution of population and incomes. The strength of the model is that a number of different scenarios in relation to these variables may be explored.

At the time of writing, the regional population forecasts being prepared under the National Spatial Strategy are not to hand. For the purposes of illustrating the use of the model, a naïve 'current trends' scenario of no-change in the spatial distribution of population and incomes was employed. That is, it is assumed that the 2016 distribution of population and incomes across counties is the same as for 1996. This is likely to be unrealistic, for example, because the population growth of Dublin County will be constrained, and there may be a natural process of convergence in per capita incomes between the SE and BMW regions. A range of alternative scenarios will be tested when the spatial population projections become available.

5.6 Regional and County Car Ownership Forecasts

Table 5.3 presents regional car ownership forecasts based on saturation levels of 80 and 90 cars per 100 adults. The relative ranking of the sub-regions in terms of car ownership is little changed. Based on a saturation level of 90 cars per adult, the Border sub-region still has the lowest level of car ownership in the year 2016 (68.9), while Dublin continues to have a relatively low level (73).

The detailed results by county are presented in Table 5.4. The broad pattern of car ownership across counties is the same as for the base year 1996. This is unsurprising given the 'current trends' scenario adopted. However, it is notable that, under the 80-cars saturation assumption, some counties, such as Meath, Tipperary, Carlow and Wexford will be at saturation by 2016.

Table 5.3: Forecasts of Car ownership per Adult by Region

Region	Saturation Level of 80 Cars per 100 Adults		Saturation Level of 90 Cars per 100 Adults	
	Year 2011	Year 2016	Year 2011	Year 2016
Border, Midland and Western	65.6	69.1	67.2	71.9
Border	62.9	66.2	64.4	68.9
Midland	69.2	73.2	70.7	75.9
West	66.6	70.0	68.4	72.9
Southern and Eastern	68.7	72.6	70.4	75.7
Dublin	65.6	70.2	66.9	73.0
Mid-east	71.6	74.6	73.8	78.2
Mid-west	68.4	71.1	70.7	74.7
South-east	71.9	76.2	73.3	79.0
South West	71.0	74.6	72.9	77.8
State	67.8	71.7	69.6	74.7

Table 5.4: Car Ownership per Adult by County

County	Saturation Level of 80 Cars per 100 Adults		Saturation Level of 90 Cars per 100 Adults	
	Year 2011	Year 2016	Year 2011	Year 2016
Carlow	75.4	79.9	76.9	82.8
Cavan	67.9	71.4	69.6	74.4
Clare	72.5	76.0	74.5	79.3
Cork	70.6	73.6	72.8	77.2
Donegal	59.8	63.6	60.9	65.7
Dublin	65.6	70.2	67.0	73.0
Galway	64.5	66.9	66.8	70.4
Kerry	72.6	77.9	73.5	80.0
Kildare	69.4	71.7	72.1	75.7
Kilkenny	70.9	75.3	72.3	77.9
Laois	70.8	75.6	72.0	77.9
Leitrim	69.2	73.6	70.5	76.1
Limerick	64.7	66.9	67.2	70.6
Longford	71.4	74.9	73.3	78.2
Louth	58.8	61.6	60.5	64.4
Mayo	67.1	71.2	68.4	73.7
Meath	75.6	79.1	77.8	82.7
Monaghan	64.3	67.1	66.3	70.3
Offaly	67.6	72.5	68.6	74.6
Roscommon	73.4	79.1	74.3	81.1
Sligo	67.7	71.2	69.4	74.2
Tipperary NR	72.9	75.7	75.4	79.6
Tipperary SR	74.4	79.3	75.7	81.8
Waterford	65.9	68.8	67.9	72.0
Westmeath	68.2	71.1	70.3	74.5
Wexford	75.1	80.0	76.3	82.7
Wicklow	70.3	73.8	72.1	77.0

Table 5.5: Forecasts of Car Numbers by Region (000s)

Region	Saturation Level of 80 Cars per 100 adults		Saturation Level of 90 Cars per 100 adults	
	Year 2011	Year 2016	Year 2011	Year 2016
Border, Midland and Western	480.0	522.7	491.8	543.8
Border	194.0	211.3	198.8	219.8
Midland	107.7	117.8	110.1	122.2
West	178.2	193.6	183.0	201.8
Southern and Eastern	1452.4	1587.0	1489.3	1,654.6
Dublin	570.7	631.2	583.1	656.9
Mid-east	190.7	205.5	196.8	215.4

Table 5.5: Forecasts of Car Numbers by Region (000s) *(continued)*

Region	Saturation Level of 80 Cars per 100 adults		Saturation Level of 90 Cars per 100 adults	
	Year 2011	Year 2016	Year 2011	Year 2016
Mid-west	168.5	181.0	174.2	190.2
South-east	217.8	238.6	222.3	247.2
South West	304.7	330.7	313.0	344.9

5.7 Forecasts of Car Numbers by County

Table 5.5 presents forecasts of car numbers by region. Based on a saturation level of 90 cars per 100 persons, the BMW region will have 543,800 cars in 2016, while the SE region will have 1,654,600, representing, in each case, a doubling of car numbers.

Equivalent figures for counties are given in Table 5.6. One of the interesting features of the results is that because saturation will be fast approaching by year 2016, there is a levelling up of car ownership across counties over the long term. This means, in turn, that in the long term the population distribution will be more important than income levels in determining differences in growth in car numbers across counties and regions.

Table 5.6: Forecasts of Car Numbers by County for 2011 and 2016

County	Saturation Level of 80 Cars per 100 Adults		Saturation Level of 90 Cars per 100 Adults	
	Year 2011	Year 2016	Year 2011	Year 2016
Carlow	24.1	26.4	24.6	27.4
Cavan	27.0	29.3	27.7	30.5
Clare	52.0	56.3	53.4	58.8
Cork	234.2	252.5	241.5	264.6
Donegal	57.7	63.4	58.8	65.5
Dublin	570.7	631.2	583.1	656.9
Galway	93.6	100.3	96.9	105.6
Kerry	70.5	78.2	71.5	80.3
Kildare	71.8	76.6	74.5	80.9
Kilkenny	41.0	45.1	41.8	46.6
Laois	28.4	31.3	28.9	32.3
Leitrim	13.2	14.5	13.4	15.0
Limerick	83.9	89.7	87.1	94.6
Longford	16.1	17.5	16.5	18.2
Louth	42.2	45.6	43.4	47.7
Mayo	55.7	61.1	56.8	63.2
Meath	62.9	68.0	64.7	71.1
Monaghan	24.7	26.7	25.5	27.9
Offaly	30.3	33.5	30.7	34.5

Table 5.6: Forecasts of Car Numbers by County for 2011 and 2016

County	Saturation Level of 80 Cars per 100 Adults		Saturation Level of 90 Cars per 100 Adults	
	Year 2011	Year 2016	Year 2011	Year 2016
Roscommon	28.9	32.2	29.3	33.0
Sligo	29.2	31.8	30.0	33.1
Tipperary NR	32.6	35.0	33.7	36.8
Tipperary SR	43.2	47.6	44.0	49.1
Waterford	49.0	52.9	50.5	55.4
Westmeath	33.0	35.5	34.0	37.2
Wexford	60.4	66.7	61.4	68.7
Wicklow	56.1	60.8	57.5	63.5
Average	71.6	78.1	73.4	81.4

6 Travel Forecasts

6.1 Car Travel Forecasts

Increases in car numbers may not translate into corresponding increases in car travel if average car use declines. It might seem reasonable to assume that, as car ownership approaches saturation levels and the number of cars in average household increases, average use will decline. However, there is no evidence as yet to support this view. Table 6.1 calculates the average annual kilometres per car from the VKT estimates and car numbers. Over a ten-year period to 1996, average car use increased by 15 per cent.[16] Similarly, examination of the Household Budget Surveys reveals that average car use does not decline with increasing household car ownership.[17] Thus, there is no basis at present to predict a decline in average car use, although intuitively it may be felt that this will occur. In these circumstances, the best approach may be to assume that the projected increase in car numbers represents an upper limit in terms of growth in car traffic.

Table 6.7: Total and Average Annual Car Kilometres

Year	Total Car Kilometres (m)	Car Numbers (000s)	Average Annual Kilometres per Car	Growth Rate (%)
1996	27,357	1,067	25,639	3.01
1995	24,864	999	24,889	2.78
1994	22,933	947	24,216	0.69
1993	21,597	898	24,050	1.12
1992	20,572	865	23,783	1.59
1991	19,735	843	23,410	-2.73
1990	19,302	802	24,067	1.90
1989	18,398	779	23,617	4.97
1988	16,987	755	22,499	0.65
1987	16,587	742	22,354	-

Source: Goodbody Estimate based VKT report and Irish Bulletin of Vehicle and Driver Statistics

16. It is recognised that the estimate of average car use of approximately 25,000 kilometres is very high. One factor that would tend to inflate this figure is the underestimation of car numbers due to the fact that at any point in time some cars are unlicensed because of evasion or delay in complying with licensing requirements. However, even making reasonable assumptions about under-reporting of car numbers would still leave the average usage on the high side.
17. Forecasts of Vehicle Numbers and Traffic Volumes. DKM, 1994.

6.2 Goods Vehicle Travel Forecasts

Apart from cars, goods vehicles are the other principal constituent of road traffic. A recent forecast of goods vehicle kilometres is available which forecasts an average 2.3 per cent rate of growth up to the year 2011.[18]

In Section 4 above it was predicted that car numbers would increase at an average rate of 3.5 per cent over the period 1996 –2016. Taking account of the lower growth rate predicted for goods vehicles, a traffic growth rate of 3.3 per cent per annum is predicted for the period as a whole.

6.3 Rail Passenger Forecasts

Iarnrod Eireann makes forecasts of mainline rail passenger traffic based on an econometric model that relates demand to consumer spending and the rail fares level. This model shows that for every 1 per cent increase in consumer spending, there will be an 0.87 per cent increase in mainline rail travel.

When the model results are combined with the expectation of considerable economic growth in the short term, the Iarnrod Eireann predicts an increase in demand of 24 per cent between 1999 and 2005, or 3.7 per cent per annum. As the prediction of car numbers (and thus car travel) is for an increase of just over 4 per cent per annum in the same period, the implication is that the rail modal share may continue to slowly decline.

However, one of the problems with making predictions especially for a longer period is that the rail system may become capacity constrained. Thus, forecasts will be realised only if required investments are put in place. Similarly, it is also the case that if a major expansion of rail services were to take place, then rail patronage could be significantly higher than these forecasts. Thus, the future rail modal share will reflect policy choices and particularly investment choices that are made.

This is very evident in relation to suburban rail services in Dublin. The recent strategic review of the Dublin suburban rail system predicts a threefold expansion in demand by 2016, representing an annual increase of 6 per cent per annum. However, as the report points out this growth cannot be achieved by the current system and significant investment is required.

18. Revised Forecast of the Size and Structure of the Commercial Vehicle Fleet, 1996-2011. Goodbody Economic Consultants. September 1998.

6.4 Rail Freight Forecasts

There are a number of factors that inhibit the future development of rail freight in Ireland. These include:

- The geography of the country and the short trip lengths;
- The changing structure of industry and the concentration of high value to weight goods;
- The emphasis on just in time logistics, and
- The fact that rail has to bear the full costs of infrastructural development and ancillary expenditure associated with the provision of operating equipment, rolling stock, land acquisition and on-going track maintenance

In these circumstances, future traffic growth is likely to be dependent on the expansion of industrial sectors with low value to weight goods. The prospects for a significant increase in freight traffic are not good.

7 Conclusions and Policy Implications

7.1 Freight Traffic: Modal Shares and Spatial Distribution

Data sources on road freight traffic are particularly poor and this raises doubts about the accuracy of modal split estimates. However, based on available data, the rail share of total traffic for 1994 is estimated at 9.77 per cent of tonne kilometres and 3.8 per cent of tonnes carried. The rail share of total traffic declined during the 1980s (in terms of tonne kilometres), but has apparently stabilised since then.

These figures understate the rail share in the long-distance freight market in which it largely competes. If the rail system is regarded as competing in the greater than 150 kilometre freight market only, its share in tonne kilometres rises to 19 per cent.

In spatial terms, the bulk (70 per cent) of road freight movements is intra-regional involving short trip lengths. Inter-regional flows are dominated by the East sub-region, which accounts for 30 per cent of all tonnes originating and terminating. Thus, the major flows are to and from the East sub-region. This dominance reflects the scale of the economy in that region relative to others. However, the SE region as a whole is a less intensive generator of freight traffic than the BMW region. This disparity in performance arises from the low intensity of the East sub-region on the one hand and the extraordinarily high intensity of the Border sub-region on the other.

Rail freight movements are focussed on Dublin to a considerable extent. However, there are significant movements that are not Dublin originating or terminating.

7.2 Passenger Traffic: Modal Shares and Spatial Distribution

Total passenger kilometres of travel are estimated at 56,140m in 1996. Over the period 1987-1996, passenger kilometres have been growing at rate of 5.4 per cent per annum.

In 1996, road modes accounted for 97.7 per cent of all passenger kilometres, with the rail mode accounting for the residual 2.3 per cent. The rail share is estimated to have declined by just over 30 per cent in the nine years. The private car accounts for 87 per cent of all travel, and is tending to increase its share.

However, the rail market share is significantly higher in some markets, particularly the inter-urban market. For example, it is estimated that the rail share of travel between Dublin and the cities of Cork, Galway and Limerick is more than 25 per cent.

Vehicle kilometres of travel have been growing at a long-term rate of 4 per cent per annum. More recently, growth rates in excess of 7 per cent have been recorded. The road network is categorised into National, Regional, County and Local Urban Roads. While National Roads, which are effectively the inter-regional links, comprise just over 5 per cent of network by length but account for almost 37 per cent of all traffic. There is a tendency for traffic on the National Road network to grow at a slightly faster rate than total traffic.

There is considerable variation in traffic volumes by road section on the National Roads. In the approaches to cities and towns, volumes increase and then decline between towns. It is apparent that average trip lengths on the Irish road system must be relatively low.

Simulation of origin-destination flows indicates that the major town-to-town flows are between Dublin and the major urban areas. The only other large flows are between Cork and Limerick, Cork and Waterford, and Limerick and Galway. Inter-city flows are low relative to the AADT.

Almost 80 per cent of inter-county rail trips originate in the SE region. This is because of the nature of the rail system and the distribution of the population. Dublin and the Mid East sub-regions dominate, with 63.2 per cent of all trips originating in these two sub-regions.

With regard to rail, the major rail passenger movements are between Dublin and other counties particularly those in the Mid-East sub-region i.e. they are radial in nature. This pattern partly reflects the increased use of mainline rail services for long distance commuting to Dublin. Use of suburban rail services is undergoing a significant increase.

Passenger movements between counties other than Dublin are much lower. The top ten such movements account for only 0.4m trips or 4 per cent of all movements. The only non-radial routes that figure are Cork-Kerry and Cork-Limerick.

7.3 National Car Ownership Forecasts

The level of car ownership is the single most important determinant of travel demand. There are now almost 1.2m private cars in the country and car ownership has exceeded 50 cars per 100 persons for the first time.

It is predicted that, over the period 1996-2001, car ownership will increase by 50 to 60 per cent, depending on the saturation level adopted. In the short term (2001-2006) the average annual rate of growth will be some 2.7 per cent, as compared with 3.2 per cent in the previous five years. Thereafter, the rate of growth in car ownership is predicted to slow down as the rate of economic growth moderates and the impact of approaching car ownership saturation levels is felt.

Car numbers are expected to double between 1996 and 2016, from 1.1m to 2.1m. For the period 1996-2001, car numbers are expected to grow at 5.2 per cent per annum, falling to in excess of 4 per cent in the period 2001-2006. In the more distant future, the growth rates will fall to around 2 per cent per annum. Over the period 1996-2016 as a whole, car numbers will grow by some 3.5 to 3.7per cent on average.

7.4 Regional and County Car Ownership Forecasts

There is little difference in car ownership levels between the BMW region (49.5 cars per 100 adults) and the SE region (51.7). The rate of growth in car ownership over the period 1981- 1998 has also been similar at 27.6 per cent and 28.6 per cent respectively. The Border sub-region has the lowest car ownership level (47.1) followed by the Dublin sub-region (48.0). Car ownership is highest in the Mid-East (55.2).

In the early 1980s, the West sub-region and not the Border sub-region had the lowest car ownership level. However, since that time, the Border sub-region has experienced the lowest rate of growth (22.7 per cent).

With respect to county car ownership levels, the most notable feature is that car ownership is low in Dublin, despite the fact that incomes per adult are typically some 20 per cent above that for other counties. This is most probably due to the greater population density in Dublin and the higher level of public transport provision. Car ownership tends to be highest in low-density counties with above average incomes, such as Tipperary NR and Meath.

For the purpose of forecasting car ownership on a regional and county basis, a naïve ‘current trends’ scenario of no-change in the spatial distribution of population and incomes was made. The relative ranking of the sub-regions, in terms of year 2016 car ownership levels, is unchanged. Based on a saturation level of 90 cars per adult, the Border sub-region still has the lowest level of car ownership in the year 2016 (68.9), while Dublin continues to have a relatively low level (73.0).

Based on a saturation level of 90 cars per 100 persons, the BMW region will have 543,800 cars in 2016, while the SE region will have 1,654,000, representing, in each case, a doubling of car numbers.

One of the interesting features of the results is that because by year 2016, saturation will be fast approaching, there is a levelling up of car ownership across counties. This means, in turn, that in the long term the population distribution will be more important than income levels in determining differences in growth in car numbers across counties and regions.

The strength of the county car ownership model employed in this study is that it can predict the impact of different spatial distributions of populations and incomes. When regional population projections become available, it will be possible to assess their impact on future car ownership, car numbers and car travel.

7.5 Travel Forecasts

Increases in car numbers may not translate into corresponding increases in car travel if average car use declines. However, there is no evidence as yet to support this view. In these circumstances, the best approach may be to assume that the projected increase in car numbers represents an upper limit in terms of growth in car traffic.

Apart from cars, goods vehicles are the other principal constituent of road traffic. A recent forecast of goods vehicle kilometres is available which forecasts an average 2.3 per cent rate of growth up to the year 2011.

Car numbers are predicted to increase at an average rate of 3.5 per cent over the period 1996-2016. Taking account of the lower growth rate predicted for goods vehicles, a traffic growth rate of 3.3 per cent per annum is predicted for the period as a whole.

Iarnrod Eireann predicts an increase in demand for mainline rail passenger travel of 24 per cent between 1999 and 2005, or 3.7 per cent per annum. As the prediction of car numbers (and thus car travel) is for an increase of just over 4 per cent per annum in the same period, the implication is that the rail modal share may continue to slowly decline. However, the future rail modal share will reflect policy choices and particularly investment choices that are made.

Future rail freight traffic growth is likely to be dependent on the expansion of industrial sectors with low value to weight goods. The prospects for a significant increase in rail freight traffic are not good.

7.6 Policy Implications

Transport demand, both passenger and freight, is dominated by radial movements to and from Dublin. The current policy priority given to investment in transport infrastructure on radial routes is therefore warranted by the structure of transport demand. It is argued in a companion report to this one that a high level of investment in inter-regional transport (non-radial) links has an important role to play in regional development.[19] It is clear that investment in such links would not be warranted by existing transport volumes. Such a policy must therefore be seen as a stimulus to regional development, not a reaction to predicted demand.

19.see Transport and Regional Development. Goodbody Economic Consultants, 2000

The relatively low modal share of rail in both freight and passenger markets raises questions about the appropriate role for this mode in the context of regional development. This is especially the case given the continuing reduction in the rail passenger share over time. A significant investment in renewal of the rail system will take place in the context of the current national development plan. However, unless, road infrastructure investment is matched by similar level of service enhancing investment in rail, the decline in the mode share of the latter is likely to accelerate.

The analysis of road travel showed that the very high traffic volumes are observed in the approaches to the major cities. It is also clear that the vast bulk of this traffic is generated in the hinterland of these cities and that the contribution of long distance inter-urban traffic to urban congestion is relatively low.

The problem of urban congestion will be exacerbated by the doubling of car numbers expected over the period to the year 2016. Policies will be required to minimise car use, so as to ensure that urban road systems operate efficiently. A range of traffic management, public transport enhancement and sustainable land use policies, targeted largely at restraining local road traffic growth, will be required. In this situation, maximising the use of the rail mode, especially in a commuter context, will be a key issue.

Appendices

Appendix 1

Regional Distribution of Road Freight by Origin in Tonne Kilometres, 1994

	Region of Destination										
Region of Origin	East	Southeast	Southwest	Mid-west	West	Northwest & Donegal	Northeast	Midlands	Northern Ireland	Other	Total
	Tonne-km (million)										
East	411	174	176	63	67	56	125	118	34	77	1,302
Southeast	149	209	82	62	33	5	32	35	10	35	651
Southwest	134	87	503	89	24	2	20	29	15	33	937
Mid-west	29	61	76	146	57	2	8	36	5	23	444
West	23	10	8	32	132	72	19	28	1	7	332
Northwest & Donegal	108	11	1	3	7	70	20	2	6	83	312
Northeast	96	21	48	7	14	25	164	23	42	76	516
Midlands	54		21	14	34	11	28	73	19	16	311
Northern Ireland	25	5	4	3	7	16	17	14	9	11	111
Other	214	25	20	10	3	15	11	5	2	37	342
Total	1,243	645	939	429	378	274	445	363	144	398	5,258

Source: the Road Freight Transport Survey

Appendix 2

Origin and Destination of Rail Freight Tonnages by County for 1999

FROM:	ANTRIM	CARLOW	CAVAN	CLARE	CORK	DONEGAL	DUBLIN	GALWAY	KERRY	KILDARE	KILKENNY	LAOIS	LIMERICK	LONGFORD	LOUTH	MAYO	MEATH	OFFALY	ROSCOMMON	SLIGO	TIPPERARY	WATERFORD	WESTMEATH	WEXFORD	WICKLOW	TOTAL
ANTRIM		-	-	1,578	17,391	-	137,443	-	11,270	-	12,879	25,033	224	31	20,965	2,945	-	3,366	-	61	5,014	9,140	-	-	14,270	261,609
CARLOW			-	-	-	-	13,034	-	-	-	-	-	92	-	3,313	-	-	-	-	-	-	-	-	-	-	16,439
CAVAN				-	-	-	-	-	-	-	-	-	20,785	-	21,867	-	-	-	-	-	-	-	-	-	-	42,652
CLARE					646	-	9,088	-	-	-	-	-	9,919	-	-	-	-	-	-	-	-	-	-	-	1,648	21,300
CORK						-	302,337	2,552	4,563	-	139,339	-	204,588	2,289	1,166	401	-	-	-	61	-	7,241	-	-	1,157	665,694
DONEGAL							6,624	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,624
DUBLIN								34,743	38,199	-	41,988	31,010	264,615	15,968	234,904	177,923	292,808	-	-	86,467	6,035	100,229	12,965	25,260	-	1,363,114
GALWAY									-	-	-	-	58,121	-	1,195	31	-	-	-	292	-	111	-	587	386	60,722
KERRY										-	-	-	11,337	470	5,123	-	-	-	-	-	-	2,195	-	411	9,572	29,107
KILDARE											-	-	50,273	-	-	-	-	-	-	-	-	-	-	-	-	50,273
KILKENNY												-	2,900	-	4,716	-	-	-	-	215	-	16	-	-	175	8,021
LAOIS													7,574	-	-	-	-	-	-	-	-	-	-	-	2,980	10,554
LIMERICK														-	153	973	-	98,486	1,095	123	122,452	97,305	1,967	940	-	323,493
LONGFORD															-	-	-	-	-	859	1,175	292	-	-	-	2,325
LOUTH																31	-	-	-	1,779	-	1,611	2,805	8,853	-	15,079
MAYO																	-	-	-	153	-	108	-	292	1,648	2,201
MEATH																		-	-	-	-	-	-	-	-	-
OFFALY																			-	-	-	-	-	-	4,497	4,497
ROSCOMMON																				-	-	-	-	-	-	-
SLIGO																					-	660	-	-	-	660
TIPPERARY																						-	-	-	6,241	6,241
WATERFORD																							-	-	6,311	6,311
WESTMEATH																								-	-	-
WEXFORD																									-	-
WICKLOW																										-

Appendix 3

Vehicle Occupancy Rates

Mode	Rural Travel Occupancy Rate	Urban Travel Occupancy Rate
Pedal Cycle	1	1
Motor Cycle	1	1
Car	1.85	1.45
LGV	-	-
Tractors	-	-
Misc	1	1
Buses	8	35
Trucks	-	-

Appendix 4

Rail Passenger Matrix, 1999

FROM	DUBLIN	KERRY	CORK	WATERFORD	WEXFORD	KILKENNY	CARLOW	WICKLOW	OFFALY	LAOIS	KILDARE	LOUTH	MEATH	WESTMEATH	SLIGO	GALWAY	LIMERICK	TIPPERARY	MAYO	CLARE	LONGFORD	LEITRIM	ROSCOMMON	N. IRELAND	TOTAL
DUBLIN		157,363	392,811	78,366	80,383	74,063	41,281	1,095,227	56,798	64,498	278,241	212,287	78,738	62,755	64,004	210,077	148,488	90,531	126,556	177	27,050	9002	52,229	305,500	3706425
KERRY	107,363		42,285	435	513	181	370	231	216	2,413	1,681	977	228	260	111	348	3,546	3,602	239	27	33	5	171	798	166033
CORK	431,424	35,682		246	417	83	363	904	903	6927	5839	4219	575	1266	555	1530	17793	24235	1270	164	179	13	740	7032	542359
WATERFORD	117,563	323	91		8486	14485	1499	60	291	1499	2849	100	267	101	96	371	119	123	560	2	14	7	190	125	149221
WEXFORD	57,315	169	281	6374		12	2	5861	19	3	249	320	1469	80	111	122	488	498	90	8	23	1	27	333	73855
KILKENNY	80,436	268	102	15500	142		10449	92	200	72	1762	117	329	138	37	700	94	30	260	6	2	0	87	154	110977
CARLOW	84,946	743	749	3,379	45	16305		30	287	216	4836	72	12	190	46	798	584	289	693	24	8	0	195	78	114525
WICKLOW	1,856,435	402	663	100	20995	118	47		177	93	1,418	1987	2049	338	231	430	271	104	202	9	158	56	72	1692	1888047
OFFALY	129,328	404	836	488	42	172	325	48		1,868	1,958	152	43	13728	0	11002	506	234	2449	7	1	0	457	226	164274
LAOIS	257,664	4,120	10,068	367	17	234	390	42	7,826		6,212	212	137	3223	25	8286	4452	3914	2086	141	14	0	499	348	310277
KILDARE	951,348	3,897	7,573	288	509	4,030	13,373	1,037	1,731	2,302		730	344	5555	4731	11193	4546	2218	3457	160	2622	374	2309	450	1024777
LOUTH	779,878	2,059	3910	337	827	242	170	7390	165	271	2033		33652	205	399	1879	1436	481	414	34	93	16	127	55158	891176
MEATH	98,318	25	299	12	50	16	11	117	4	10	41	19212		25	33	38	75	64	22	6	6	1	4	307	118696
WESTMEATH	141,444	481	1697	195	68	145	555	217	10263	1320	4720	92	98		3838	20239	221	210	6910	5	2349	48	3629	90	198834
SLIGO	80,842	136	597	53	215	36	84	210	9	13	4446	212	150	2914		23	27	81	1	2	439	601	4967	15	96073
GALWAY	181,145	360	1093	230	82	383	616	109	9209	4844	6755	750	421	12318	1		29	455	643	0	3	0	419	524	220389
LIMERICK	237,843	2,797	35409	746	896	146	491	184	484	4253	2798	1710	1214	193	46	132		23064	137	330	51	7	146	2446	315523
TIPPERARY	160,499	6,166	16267	605	167	34	265	135	288	7574	2030	539	503	535	74	529	35991		357	181	4	3	107	791	233644
MAYO	136,240	321	1050	490	160	221	510	65	1977	1340	1764	247	708	7373	0	534	112	298		1	1	2	4638	79	158131
CLARE	37,653	12	530	10	65	3	24	3	4	95	34	38	235	2	0	1	240	123	4		1	0	0	0	39077
LONGFORD	39,298	32	102	5	67	0	18	98	0	1	2796	27	38	3660	3690	3	17	6	2	0		73	727	19	50679
LEITRIM	3,406	2	8	0	3	0	0	9	0	0	131	4	0	36	416	0	8	0	0	0	54		17	4	4098
ROSCOMMON	64,325	249	580	302	66	70	227	59	600	334	1922	106	72	5481	8270	587	112	141	3247	0	1247	89		6	88092
N. IRELAND	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		0
	6,034,713	216,011	517,001	108,528	114,215	110,979	71,070	1,112,128	91,451	99,946	334,515	244,110	121,282	120,376	86,714	268,822	219,155	150,701	149,599	1,284	34,352	10,298	71,757	376,175	10665182

Appendix 5

Regression Results

National Forecasts

Forecasts of car ownership were estimated via a logistic function of the following form:

$$\mathbf{Y = S/(1+ a_0 Exp\ a_1 X)}$$

where,

Y = car ownership per adult

S = saturation level

X = Domestic demand per adult

a_o and a_1 are parameters

Time series data for domestic demand for the years 1961-1998 were used. The parameters in the above function were then linearised so that Ordinary Least Squares could be used to estimate the regression equation. The transformed equation was:

$$\mathbf{Ln\ (S/Y\text{-}1) = Ln\ a_0 + a_1 X}$$

In estimating this equation, it was found that there was auto-correlation present, as indicated by a Durbin-Watson (D-W) of approximately 0.4. The application of Ordinary Least Squares in the presence of auto-correlation produces inefficient results. The Cochrane-Orcutt iterative method was therefore used to correct for this. It was found that two iterations were necessary to remove the auto-correlation.

The regression results correcting for auto-correlation were as follows:

	Saturation level of 80 per 100 adults	Saturation level of 90 per 100 adults
a_o	0.198 (8.541)	0.169 (8.92)
a_1	-0.0000958 (-8.112)	-0.000079 5 (-7.371)
R^2	0.659	0.615
F	65.797	54.332
D-W	1.511	1.5995

Note: t values in parenthesis

The Durbin-Watson for the revised equation of 1.5 is consistent with the null hypothesis of no auto-correlation. The parameter estimates were then used in the following equation to predict car ownership for saturation levels of 80 and 90 cars per 100 adults.

Car ownership = 80/(1+ 4.754Exp (-0.0000958X_1)).

Car ownership = 90/(1+ 4.468Exp (-0.0000795X_1)).

Where X_1 are the predicted values of domestic demand per adult.

Regional Forecast

The forecasts of national car ownership levels, which were described above, employed a time series approach with Domestic Demand as the explanatory variable. Such an approach was not feasible in the context of county car ownership forecasting, because of the absence of time series data on income or GNP by county.

The approach adopted was to calibrate a logistic model of the type:

Car ownership = S/(1+ a_0Exp (a_1X_1+ a_2X_2))

where X_1 and X_2 are real income and population density measures respectively.

This was calibrated for a combined cross section and time series data set of counties embracing the Census years 1991 and 1996, for saturation levels of 80 and 90 cars per 100 persons. The function was estimated via Ordinary least squares, again using the linearised equation in the regression. The transformed equation in this case was of the following form:

Ln (S/Y-1) = Lna_o + a_1X_1+a_2X_2

The results were as follows:

	Saturation level of 80 per 100 adults	Saturation level of 90 per 100 adults
a_o	3.092 (7.557)	2.900 (8.206)
a_1	-0.000352 (-8.344)	-0.000305 (-8.361)
a_2	0.000699 (4.302)	0.000602 (4.289)
R^2	0.580	0.581
F	35.187	35.308

Note: t values in parenthesis

These estimates were then used to forecast car numbers and car ownership levels across counties with the following formula:

Saturation Level of 80

Car ownership = 80/(1+ 22.02Exp (-0.000352X1+ 0.000698X2))

Saturation Level of 90

Car ownership = 90/(1+ 18.17Exp (-0.000304X1+ 0.000602X2))

We used the predicted values of income and density (method outlined in main text) for each county to derive results on a county and then regional level.