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Population Growth and Other Statistics of Middle-sized Irish Towns

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Corrigendum

On page 40, Table 3.1 should read Table A 2.1

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General Summary

The basic aim of the study is the presentation of tables of comparative statistical data relating to 97 towns with population 1,500–10,000 in 1971 and analyses of such data. The exclusion of the four County Boroughs and Dun Laoghaire together with twelve other large towns and all small towns and villages, was to impart a degree of homogeneity to the inquiry, as regards function of town. The 97 towns range from Mullingar, the largest with a population of 9,245 to Cootehill with 1,542.

The most notable feature of the data was the great range of percentage changes in population 1961–71. Twelve towns, which were mainly virtual suburbs of Dublin or Cork—e.g., Tallaght, Lucan, Ballincollig-Carrigrohane—had over 75 per cent increase. The 85 old established towns had on average increased in population since 1962 although at a much slower rate. The number of these towns which declined in population between 1926–61 was 28; this had dropped to four in 1961–71.

The demographic features of the towns were examined. The number of males exceeded the number of females in only 21 towns of the sample. The sex ratio i.e., males/females, was lowest in Celbridge (903) and Clara (908), and highest in Cashel (1,241), Donegal (1,212) and Bantry (1,208). In practically every town the percentage married aged 15–44 increased between 1961 and 1971, although with considerable variation ranging from 87 per cent for Rathcoole to 37 per cent for Ballinasloe. The rate of marriage fertility, defined as number of children aged 0–4 per thousand married and widowed women aged 15–44, exceeded 1,000 in all towns but seven; the highest was 1,417 for Ballybofey-Stranorlar. The high dependency ratio (persons aged 0–14 and 65 or over per 1,000 persons 15–64) varied from 617 for Killarney in 1971 to 909 for Trim. The average dependency for that year was 762, compared with 745 in 1961. Migration rates in the 10–44 age group increased in more than half the towns.

The percentage of the population gainfully occupied was one of the least variable series in the tables, with on average just over one-third of the people gainfully occupied. The percentage of children aged 14–19 at school showed an almost universal increase between 1961 and 1971 although there was a highly significant variation between towns. Very few towns showed significant change in percentage unemployed between 1966 and 1971.

People in the great majority of middle-sized towns were, on average, well housed in 1971 when judged on the basis of a fairly constant 4·8 rooms per housing unit and more than one room per person. Social amenities varied; the percentage of houses with electricity was high, while the percentage with fixed bath or shower was closely related to the percentage of new houses built since 1961.

The data were tested for significant correlations between the variables and to identify the leading variables. By using component analysis it was possible to classify the towns on the basis of one single indicator which ranked towns according to "goodness" or high standards of housing, employment and amenities. It was found that towns with a high proportion of cars were also high in television licences and those with a high proportion of new houses had a higher proportion of baths. The correlation between the two unemployment variables 1966 and 1971 was as high as ·72, which infers that over the five year period the level of unemployment tended to persist at the given level.

Table 3·4 sets out the correlation co-efficients. A highly consistent picture of growth is shown. The characteristics of a growth town (large-population increase 1961–71) were, (i) it also grew in 1926–61 period; (ii) had a low percentage of elderly, confirmed by a high percentage of children; (iii) low dependency ratio in 1961 and again in 1971; (iv) high percentage of young married persons, such percentage being markedly increased 1961–71; (v) both male and female immigrants; (vi) low percentage in low-paid occupations and high percentage in professions; (vii) low percentage unemployment in 1966 and 1971; (viii) high in manufacturing, low in commerce; (ix) high proportion of large dwellings and a low proportion of large families; (x) a large proportion of dwellings were built since 1961 and a low proportion before 1900; (xi) a large number of dwellings rented; (xii) high amenities score; (xiii) more land for industry; (xiv) near a city or large town.

From Table 3.1 the characteristics of towns with a relatively large manufacturing work force tend to be (i) a low percentage of the population in institutions; (ii) high recent growth; (iii) more males than females; (iv) low percentage in post-primary education; (v) high in new houses; (vi) tendency to location near Dublin; (vii) low in retail sales. The last characteristic may be due to proximity of the towns to Dublin.

Component analysis is used to exhibit the inherent structure of a set of 32 original variables which were considered significant or relevant. Underlying the variegated picture presented by the 32 variables analysed, four basic factors account for over two-thirds of the variance: a growth-related factor, a social class factor, an institution factor and a factor associated with the function of a town. Table 4.3 on page 64 of the text lists all 97 towns in descending order of value of the first component. This classification according to a statistically derived index of "goodness" shows some very definite patterns, which are of importance in assessing the regional impact of economic growth in Ireland.

Towns which have grown fastest and obtained all the benefits demonstrated to be associated with economic growth are almost exclusively situated in the eastern part of the country. More significantly, of the top twenty towns, only three can be regarded as growing autonomously: Shannon, Naas and Arklow. Fourteen of the remaining seventeen are satellites of Dublin, one is a suburb of Cork, one a satellite of Drogheda and one a satellite of Waterford. Towns which shared least in development benefits are in general situated in the western part of the country.

Towns were divided into nine town clusters according to magnitude of the first four components, Table 4.4 page 66, with the following results. Cluster 1 contains only one town Portrane, which is dominated by the mental hospital. Cluster 2 has 11 towns with few industries, service type employment involving a high ratio of female workers, a large number of old people, few young people, low marriage rate. The towns tend to be isolated. Cluster 3 has 25 towns mostly service-orientated and having a high unemployment rate with a poor growth performance relative to other clusters. Cluster 4 towns have the common feature of a hospital situated in each town resulting in a high proportion of the population in institutions, a high percentage of people in professional occupations. Such towns tend to have few industries, to be low in amenities and growth has been slightly below average. Cluster 5 towns (16), are mainly industrial, high in manual occupations and in unemployment levels, with evidence of over-crowded accommodation and scarcity of amenities. Towns in cluster 6 (14) are mainly engaged in productive activities, have a low unemployment rate, are demographically high in the percentage of children, and are slightly below average in growth. Cluster 7 has 8 towns, high in professional occupations, commerce and transport, non-manual social groups amenities and the proportion of young persons attending post-primary schools, low in manufacture, manual social groups and unemployment, growth above average from 1926–61 but below average 1961–71. Cluster 8 towns are basically dormitory towns for Dublin or Cork. They have a high marriage rate, mainly young population, low fertility, low unemployment rate, high amenity score and rapid growth. Cluster 9 contains only 3 towns which have grown considerably from a small base. They are mainly engaged in productive activity, have a low unemployment rate, good living conditions and amenities.

Two interesting observations emerge from the study in addition to the growth factors; (i) the importance of the construction of new dwellings and (ii) the pattern of IDA grants and the resultant implications for regional development compared with stated regional policy.

The effect of new housing was quite substantial on the characteristics of towns and in addition to the obvious advantages of larger dwellings and improved amenities had strong association with many of the variables deemed to be characteristic of "good" towns; as (i) rapid population growth 1926–61 and 1961–71, (ii) many young and few old people, (iii) low dependency ratio, (iv) high marriage rate and low fertility, (v) high level of net immigration, (vi) low unemployment, (vii) high amenity variables of cars, TV, telephones, (viii) located near Dublin.

There was no significant relationship between IDA grant variables and the indicators of "goodness" of towns including growth. While not implying that IDA grants were ineffective in providing employment, they do not seem so far to have given towns sufficient impetus to improve their socio-economic structure. It is possible that grant-aided firms have merely been taking up the slack in the existing labour force.

There is little support in the results of the study for the policy of concentration of industrial development in a few major growth centres, population size being one of the least effective of the indicators used. Within the population range 1,500–10,000 there is little sign of the large town faring better than the small, whereas if the idea of growth centres were valid, one would expect a marked tendency towards foci of expansion autonomously in the very favourable economic conditions of 1961–71.

Two questions implicit in the study are (i) has every town potential and (ii) is industry necessary for the development of towns? Correlation coefficients between percentage population increases in periods 1926–61 and 1961–71 were ·41 on the overall 97 towns. These values, while highly significant statistically, are low in absolute value. It would appear that while any town may improve, future development should favour "good" towns which have advantages ensuring continued growth. The view that industry is essential to the development of towns has not been supported by evidence. While industrial towns had certain characteristics of the "good" town (recent population growth, new dwellings, high percentage married) they tended to be low in professions, amenities, post primary education. There is no significant relationship between percentage at work in manufacturing and the unemployment rate.

M. Dempsey

Chapter 1

Introduction

THERE is a vast amount of statistical information available in regard to individual Irish towns which, as far as we know, has never been used for analysis on anything like a comprehensive scale. This fact alone would seem to justify a systematic examination of these data. Are all these statistics useful? Can we select from the totality a few series which are reliable bell-wethers for indicating the woe or weal of towns? Can we safely order towns from the "best" to the "worst"?; such an ability would imply a considerable measure of internal consistency in these data. Does this obtain?

We are aware that urban studies are a well-developed discipline; we have no pretensions to expert knowledge thereof. All we have done, in text and appended tables, is to subject the raw data to primary analysis (percentages and the like for comparison between towns), make a big selection from these percentages etc. and apply statistical techniques of various sophistication (but by no means exhaustive) to these. Our primary purpose is to find relations between this very large set of data and to examine the extent to which they are consistent, with particular attention to recent growth.

We have therefore no hypotheses to start with, unless an assertion of the right of statisticians to examine any body of statistical data be construed as an "hypothesis". Rather, we hope that our work will permit of the setting up of hypotheses relating to Irish towns.

These opening paragraphs are self-justificatory. Some commentators on earlier drafts have misunderstood our aims—the fault may have been partly ours. So, we have changed our title and repeat: this is a presentation of statistics.

Much of our raw data consisted of computer prints-out for 97 towns for 1971 made available by CSO from the Census of Population. Collectively, with considerable experience of Irish demographic statistics and problems, we had no difficulty in selecting variables worthy of examination. These are the 71 listed in Table 3.1. We consider our selection justified by the degree of consistency we found between the variables.

While not presuming to have disposed of the topic we have devoted rather particular attention to the recent growth in population of towns.

Why these 97 *Towns?*

We decided to confine attention to the 97 towns with population 1,500–10,000 in 1971, therefore excluding the four County Boroughs and Dun Laoghaire together with twelve other large towns, and small towns and villages.

The general object of this limitation was to impart a degree of homogeneity to our inquiry as regards function of town. We hoped to include a field survey, extending to most of the 97 towns, in our whole inquiry (mainly to obtain additional statistics–it is expected that the survey will be reported on elsewhere–and we decided that such a survey would be ineffective in larger towns). The lower limit of 1,500 population is traditional as defining a "town" in the Irish Census of Population: available data are fewer for smaller places. At the same time we wanted to examine the effect of size, and towns included range in size from Mullingar with a population of 9,200 to Cootehill with little over 1,500, a range of 6:1. Range and homogeneity: we admit also an element of intuition in our size limitation but venture to maintain from results presented here that our judgement in this matter was right.

This work is mainly concerned with association between variables. We refrain from imputing causation though in some cases we speculate as to possible causes and effects. Hence we maintain that our rigorous statistical approach should not preclude us from the exercise of good (sometimes miscalled "common") sense—for others to confirm or deny—when this is warranted.

The Study in Wider Perspective

The outstanding feature of Table 1.1 is the upsurge of town population that began in 1961, closely coinciding therefore with the economic take-off. All provinces share nearly equally in this town growth in the latest period 1966–71, Ulster was a laggard in 1961–66. At the same time the rate of decline in rural areas was decreasing, only Connacht still maintaining a high rate. Leinster in 1971 had over a million persons in town areas, i.e. over one-third of the population of Ireland and two-thirds of the population in town areas (i.e. in towns of 1,500 population or over).

TABLE 1.1: *Percentage change in population of towns and rural areas in each province, 1951–1971*

	Town Areas				*Rural Areas*			
Province	1951–56	1956–61	1961–66	1966–71	1951–56	1956–61	1961–66	1966–71
Leinster	+1·6	+1·5	+9·6	+7·8	−2·3	−4·2	−0·4	+1·7
Munster	+0·3	−0·2	+7·2	+7·5	−4·0	−5·0	−2·7	−0·1
Connacht	−2·4	+1·2	+5·2	+6·8	−6·0	−7·4	−6·1	−5·9
Ulster (3 Cos.)	−2·2	−3·7	+1·5	+7·8	−7·4	−8·3	−5·0	−2·1
Ireland	+1·0	+1·0	+8·6	+7·7	−4·4	−5·7	−3·1	−1·2

Source: Census of Population, Vol. 1, 1971 and 1961.

Table 1.2 is confined to the 97 towns with population 1,500–10,000 in 1971. The picture is somewhat different from that of Table 1.1. The overall increase of 35 per cent in Table 1.2 is much greater than the increase of 19 per cent in the whole period 1951–71 for all towns. The large increase of 66 per cent for Leinster is mainly due to the growth of satellite towns of Dublin, a phenomenon to which we shall often have occasion to refer to many times. We have, in fact, provided many analyses for 85 towns, i.e., with satellites excluded.

TABLE 1.2: *Population of 97 towns 1951 and 1971 classified by province and total population*

Province	*No. of towns*	1951	1971	*Change*
		000		*per cent*
Leinster	41	98·4	163·2	+65·9
Munster	34	103·5	121·7	+17·6
Connacht	11	34·8	39·9	+14·9
Ulster (3 Cos.)	11	27·7	32·9	+18·9
Total	97	264·4	357·8	+35·3

Source: Census of Population, Vol. 1, 1951 and 1971.

As regards average population in 1971 and rate of growth 1951–71, towns in the provinces other than Leinster show some uniformity.

Definition of "Town"

Both the formal Census of Population (CP) definition of a "town", and the actual area regarded by the Census-takers as falling within a "town", have varied from Census to Census, and particularly extensive changes were made in relation to the 1971 Census. This raises some problems concerning the comparability of towns from one Census to the next; in particular it means that two alternative measures of population growth exist for each town for the period 1961–71. These problems are discussed in Chapter 2, but readers unacquainted with the meaning of the territorial and urban classifications used by the Census are referred to the section, "Administrative and Census Areas", in CP 1971 Vol. 1; this section also sets out the boundary and definition changes adopted for the 1971 Census.

Plan of Paper

In Chapter 2 there are descriptions of the data with comparisons between towns in their growth and other characteristics. Chapter 3 investigates the relationships between the variables; in particular, it focuses on the relationships associated with population growth, with construction of new housing, and with provision of extra employment in manufacturing industry. Estimates of the income arising in towns, or earned by residents in particular towns, are, unfortunately, unavailable, so that the prime indicator of economic growth has had to be approximated by a cluster of variables which have been assumed, with a high degree of probability, to be closely linked to income, these variables including the number of cars owned in a town, the number of television licences, telephone stations and the like.

Chapter 4 is an attempt to reduce to small bulk the essential features of the mass of statistics concerning these towns. Using the statistical technique of component analysis, which tries to capture the essence, as it were, of a large number of relationships with the greatest possible economy, it is found that it is possible to classify the towns on the basis of one single index, or indicator; this indicator ranks towns according to what we term "goodness". Subsequently, the results of the component analysis are used as input for a 'cluster analysis' —that is to say, a method of grouping the towns into separate clusters, each cluster having a set of characteristics common to each town in the cluster. The clusters obtained by this method appear to be very acceptable; for example, one of the cluster consisted of a highly homogeneous group of satellite dormitory towns. Clusters which accord with *a priori* expectations indicate the reliability of the component analysis approach, as well, of course, as providing results which are interesting and useful in themselves.

In Chapter 5 a partial updating of some results is attempted; in particular, the pattern of IDA grants since 1971 is investigated. Recent housing construction is also scrutinised, and its vital role in growth, underlined by findings in previous chapters, is examined. Some matters of government policy are raised by these sections, and the implications of these and possible alternative policies are discussed. The conclusions of the paper are summarised in the final chapter, Chapter 6, which includes reference to a table showing the rankings of the towns according to various criteria and indicators; this table condenses, for easy comparison, many of the results of previous chapters. Chapter 6 also lists some important, and occasionally original, points of statistical methodology, which have been involved in the paper in the form of appendices at the end of each relevant chapter.

Chapter 2

Statistics and Some Descriptive Comments Thereon

In this chapter we discuss the data we use in the study and illustrate some of the simple implications that can be derived from them. A description of the variables used is given in Appendix 1. The actual statistical data in stencilled form will be made available on request, at a nominal charge of £1 a copy.

Most of the data were provided by the Census of Population division of the Central Statistics Office who supplied us with detailed data on each town which were collected at the 1971 census of population. We also had available data from the 1966 census for each town. Our other sources of data include various government departments and the annual reports of some semi-state bodies.

The basic data, which were in absolute terms, was condensed by us into fewer categories, for example, we combined the eighteen five-year age cohorts into the more meaningful groupings for our purposes of young, early middle-age, late middle-age and old. Most of the variables we calculated were in terms of percentages and rates which would enable simple comparisons to be made between towns.

From this mass of data we made a selection of the variables most likely to be of use to us in this study: as to the basis of selection, see Chapter 3. The variables are listed in Table 3.1 of the text. In the Appendix 1 tables, four town sizes* are distinguished, namely, with populations in 1971 of (i) 5,000 to 10,000; (ii) 3,000 to 5,000; (iii) 2,000 to 3,000; and (iv) 1,500 to 2,000. Each table in the full Appendix 1 is divided into four pages, one page being devoted to the towns in each of the four size groups above. At the foot of each page we provide simple averages of the characteristic for each of the four town sizes. The overall average and standard deviation are provided on the last page of each table. This enables the position of each town with respect to towns of its own size and to all towns to be easily derived for any characteristic, by comparing its position with the corresponding average. With regard to any characteristic, a town may conventionally be regarded as significantly high or low if its value differs (in excess or in defect) from the overall mean by more than one standard deviation; of course such "significance" would not be statistical.

*Towns are numbered consecutively according to population in 1971, Mullingar, the largest, being numbered 1. In studying certain tables in this paper, it will be helpful to note that the larger its ordinal number, the smaller the town.

We would expect that the actual statistics of Appendix 1 would be useful to students and researchers in this field, and to local administrators.

An early problem which confronted us was how exactly a town should be defined. We felt it would be inadequate simply to take the area within the urban district boundary and ignore any built-up areas outside the boundary. With such approach we would also encounter the problem that some Irish towns have no legally defined boundaries. The result of such a procedure would be that large numbers of people who should be regarded as belonging to the communities of which these towns are the nuclei, would be, nevertheless, excluded from their population. This problem tends to become more pronounced over time because building activity extends further and further into the countryside, while revisions of the legally defined boundaries, which depend on other factors, tend to lag behind.

Because of this problem, we have in this study decided to include these contiguous build-up areas or environs in our definitions of towns. Towns without legally defined boundaries have had boundaries drawn by the Central Statistics Office for census purposes. Their definition is a cluster of fifty or more houses, not more than a certain distance from each other. For towns without boundaries included in our study, such a definition had to be accepted.

For the remainder of this chapter we merely call attention to certain descriptive features derived from the data of Appendix Tables A1.1 to A1.9. At this early stage no attempt is made at formal statistical analysis.

The 97 towns in our study range from Mullingar, the largest, with a population of 9,245, to Cootehill with 1,542. In all they contain 358,000 people which is about 12 per cent of the population of the Republic.

In what follows we refer to specific variables. Always the number in parentheses ( ) is the number as listed in Appendix 1 or Table 3.1.

Something of an embarrassment is the great range of percentage changes in population 1961–71 (4) our prime variable, between towns. Those with over 75 per cent increase (in order of population in 1971) are:— Clondalkin, Tallaght, Lucan, Swords, Malahide, Shannon, Blanchardstown, Portrane, Leixlip, Ballincollig-Carrigrohane, Rathcoole and Portmarnock. It is scarcely necessary to stress the outstanding characteristics of these towns: all but one of them are virtual suburbs of Dublin or Cork, owing their rapid expansion to the overspill policies of these cities, and are regarded as separate "towns" merely for Census convenience. The exception, Shannon, is also very much a special case as it owes its existence to artificially induced growth.*

*It was suggested to us that a relationship might exist between the size of a town and the expected variance of its growth which would make simple comparisons of growth rates invalid. (The smaller the base on which the growth rate was calculated the more it might be expected to vary: cf. B. Robson, Urban Growth: An approach, Methuen 1973.) On checking the variances for four town size growths we distinguished, we found there was no such tendency on either the 85 or 97 town basis. The figures are as follows:—

Town Size	5,—10,000	3,–5,000	2,–3,000	1,5–2,000
Var. on 97 town basis	68·4	269·4	103·0	110·0
Var. on 85 town basis	9·9	8·7	10·3	8·5

Special Towns

We are faced with a problem in deciding whether these twelve "Special Towns" should be included in our analysis proper because, as they tend to have consistently extreme values for most of the characteristics, they could bias our results. This problem is considered in more detail in the next chapter.

When we exclude these Special Towns we find that the remaining 85, which have in common the fact that they are old established and have grown (or declined) organically, have on average increased in population since 1926 although at a much slower rate. The improved population growth position in the Republic is reflected in the figures for these towns, as the growth rate since 1961 has accelerated and the number of towns whose population is declining has decreased. The number which declined between 1926-61 was 28; this had dropped to four in 1961–71.

Kilrush and Cahirciveen are the two worst cases of endemic decline, having decreased by 20% and 13% of their population since 1926. Clara is another interesting case, as its growth performance was quite substantial between 1926–61, but this was quite reversed in the post 1961 period where it recorded the largest decline.

A problem encountered here was that some revisions of town boundaries took place between 1966 and 1971. This left us with two possible ways of defining population increase (i) to apply a correction factor so as to get the 1966 population for the area as defined in 1971 or (ii) to regard all the population brought into the town by the boundary revision as a net increase in the population of the town. The latter was the approach adopted by us as we felt that most of the extra area included in the town would be new housing built just outside the old town boundary and if it had existed in 1966 would have been included in the environs of the town at that census. We may add that initially we used both concepts for analysis but (ii) was slightly better, statistically speaking. Concept (ii) tended to have slightly higher and more significant correlations with other variables. Cc between (i) and (ii) was ·99: it would not have mattered which concept we adopted in our analyses.

Demographic Features of Towns

The variable *percentage population in institutions* (2) reflects those towns which contain hospitals, *inter alia*. At a later stage it will be interesting to see how this is related to the economic and social characteristics of the town. Three groups are discernible, (*a*) towns with a high percentage (> 16%) are those with large regional or mental hospitals, (*b*) intermediate percentages reflecting smaller hospitals and (*c*) low percentages which are accounted for by the presence of convents, monasteries etc. in the town.

Sex ratios (6), to which considerable attention has always been devoted in Irish Census reports, give ample evidence of excess of females in towns. In only 21 out of 97 towns do number of males exceed number of females and this 21 includes 8 of the 12 mentioned above as having increased abnormally in population 1961–71. The sex ratio is lowest in Celbridge (903) and Clara (908), highest in Cashel (1241), Donegal (1212) and Bantry (1208).

In practically every town the *percentage married* (11, 12) aged 15–44 increased between 1961 and 1971, reflecting that remarkable feature of recent Irish demography, the increased marriage rate: only 7 of the 83 towns for which comparison was possible recorded declines. Still, there was in 1971 considerable variation in the total rate for towns, ranging from 87 per cent for Rathcoole to 21 per cent for Portrane (a special case due to the mental hospital being the dominating feature of the town—66 per cent of its population live in institutions), 37 per cent for Ballinasloe (34 per cent of population in institutions). That most of the towns with large population increases near Dublin show a high percentage married may be partly due to the fact that much of the new housing development around Dublin is taking place in such towns.

The rate of *marriage fertility* (13) (defined here as number of children aged 0–4 per thousand married and widowed women aged 15–44) is uniformly high, exceeding 1,000 in all towns but 7 (of which 4 were of the 12 Special Towns); highest was 1417 for Ballybofey-Stranorlar. This would indicate that the population in these towns would grow quite substantially if no emigration took place.

The high *dependency ratio* (9, 10), notoriously a feature of Irish demography in international comparisons, is also very evident in Irish towns. The fairly wide range (1971) varied from 617 for Killarney (except, of course, for Portrane (418)—a special case as stated earlier)—to 909 for Trim. The average dependency ratio in 1971 of 762 implies that 43% of the population are in the non-active age groups of young (0–14 years) and old (65 years and over). Another interesting feature is that the average dependency ratio has actually increased since 1961 (745) which could imply that the population growth in these towns has been due to an increase in the number of children, as illustrated by the huge increase in dependency in Tallaght and the low proportion of old people in that town.

Migration rates (14, 15, 16) for ages 10–44 (in 1966) for the intercensal period 1966–1971 were calculated on a survivorship basis allowing roughly for deaths,* which are very small at these ages. A plus sign(+) indicates net immigration and a minus sign (−) net emigration. It is remarkable that while nearly all the towns increased in population, there was net emigration from this 10–44 age group in more than half the towns. Of course, as will appear in the next chapter, there is a closer relationship between immigration and population

*A cohort analysis was carried out and migration was estimated by comparing actual age groups in 1971 with the five year younger age group of 1966 after it had been adjusted by the 1966 expected death rate of the mid-point of the age group.

increase; one may, however, suspect a generic difference between "immigration" and "emigration" towns. The remarkable fact highlighted later is the similarity of the rates for men and women.

Employment Features

The three, obviously related, classifications of (i) occupations, (ii) people at work by industries and (iii) social groups for the total population—which are based on occupations–are given in Appendix Tables A1.3 and A1.4 (18, 19, 28–32, 33–36). While the percentage within each classification varies greatly between towns, there seems to be little intercensal change within towns. For example, the correlation coefficient for the percentage in non-manual social groups between 1966 and 1971 is as high as ·93. The considerable differences show that these towns are by no means a homogeneous group as far as the livelihoods of their populations is concerned. For instance, the percentage at work in agriculture, mining or manufacturing industries ranges from a low of 14·4% for Mullingar (apart for Portrane—10·7%) to 64·6% for Shannon and 59·5% for Clara. The average figure of 31·6% shows that these towns do not depend directly to a large extent on these productive activities. In fact, over 50 per cent of the population are in the non-agricultural non-manual social groups.

The percentage of the population gainfully occupied (25) seems to be one of the least variable* series in these tables, with on average just over one-third (34·9%) of the people gainfully occupied. It varies only from a high of 41·6% in Kinsale to 29·4% in Castlebar. (Portrane is again exceptional with 25·1%.)

Rather surprisingly, the *female-male ratio among the gainfully occupied* (20) tends to be below average in those twelve Special Towns. This might be because so many of their potential female labour force participants are young married women with children.

Comparing the *percentage of children aged* 14–19 *at school* in 1966 (21) and 1971 (22), a remarkable feature is the almost universal increase in this percentage over the period—due, most likely, to the introduction of free post-primary education and the increase in the legal school-leaving age. Only four towns, Clonakilty, Tullow, Carrick-on-Shannon and Celbridge showed a decline. Here again, there is considerable variation between towns which will be seen, in later chapters, to be highly significant.

Attempts were made to obtain Social Welfare as well as Census figures for *unemployment* (26, 27 for CP figures) at about the same dates in 1971. The series from the two sources do not compare very well, mainly because the Social Welfare data pertain to unemployed who reside outside the towns as well as inside, whereas the Census figures relate only to residents. Obviously the

*A useful measure of comparative variability is the ratio of the standard deviation to the mean—the coefficient of variation. Its value for the percentage gainfully occupied is ·069. Only one series has less variability, namely the number of rooms per household, with a coefficient of ·060.

latter are more suitable for our purposes and indeed behave very well statistically in our analysis. One interesting fact thrown up by these CP figures for unemployment is that only very few towns showed significant change in the percentage unemployed between 1966 and 1971.

One variable we tried to construct from the data available to us was some measure of the *population density of the hinterland* (55) surrounding each town. We did this by taking the population and area, by District Electorial Divisions (DED), of the region within a five mile radius of the town. Our measures suffer from some drawbacks in that our basic unit, the DED, was too large and led to some arbitrary inclusions and exclusions, where our five mile dividing line cut across DED boundaries and also because the area of the hinterland of any town is likely to vary with its size and relative location. However, we feel that our end result is worthy of mention and as we have standardised it to unit area, it should give some information to those interested in such matters as market size or labour force supply.

Housing Conditions

The figures relating to household size (*rooms per permanent housing unit*) (41) and to living space per person (*rooms per person*) (42) show a fair amount of consistency. Indeed, at a fairly constant 4·8 rooms per housing unit and more than one room per person, people in the great majority of middle-sized towns were, on average, well housed (if by this standard only) in 1971.

There is a great variation between towns in regard to the percentage of houses built before 1900 (43). It is very small for places like Shannon (0%), Tallaght (2%) and Clondalkin (5%) for obvious reasons. At the other extreme is Rathkeale (61%). On the other side of the picture, over 80% of the *housing* has *been built since* 1961 (44) in three of the towns—Shannon, Tallaght and Rathcoole—these indeed are "new" towns.

One social amenity variable we have included in our appendix tables is the *percentage of housing units with fixed bath or shower* (46, 47). Comparison is made with 1946, the first Irish Census at which these particulars were obtained. The immense and universal improvement over the 25 year period is apparent. Of course the proportion of housing units with baths is closely related to the percentage of houses built since 1961; for example, Shannon has 99% built since 1961 and 100% of the houses have a bath, but Kilrush has only 6% of its houses built since 1961 and only 46% have baths.

We had data available on another social amenity—*the percentage of houses with electricity*, but as this was uniformly very high and so could not discriminate between towns we excluded it from our study. It does, however, show that most houses in all Irish towns are supplied with this basic necessity.

Other Features

We find a considerable degree of consistency between all our amenity statistics, *telephones, TV sets* and *cars* (58, 59, 60). All three probably give some indication of the wealth of a town. Attention is especially directed to the low coefficient of variation for cars—only ·25—indicating little variation in number per 1,000 population between towns. The general average (in 1971) was 125, a number which includes cars used for business purposes. Cars (and indeed other amenities) have become conventional necessities to a wide extent in Irish towns.

We call attention to the *Industrial Development Authority* (*IDA*) data (50, 51, 52) compiled by ourselves from the Authority Reports. (These data are in current prices. Admittedly a more valid comparison could be made if the data had been adjusted for inflation, but this would have involved very lengthy and tedious calculations of doubtful significance.)

There is obviously enormous variation between towns in the allocation of IDA funds. Subsequent analysis shows no discernible relationship between these IDA variables and others in Table A1, fairly intimately related amongst themselves. This lack of relationship is commented upon in the next chapter.

The other variables included in the appendix tables and indeed in our analysis are mainly descriptive variables and tell their own story. It was hoped that these variables would help to discriminate between towns in the analytical stage. One interesting point, however, emerges from the series for *gross sales per head of population* (56) which is that all but one (Shannon) of the twelve Special Towns which we have isolated are below average for this series—further evidence that these towns are basically appendages to larger cities.

Chapter 3

A Correlation Approach

THERE is no point in sophisticated analysis of data unless there are significant correlations between the variables i.e., unless each variable in the system has a significant relationship with at least one other variable. We hope, at this elementary stage, to identify the leading variables (i.e., those most highly intercorrelated) which would be the most useful to use in our latter analysis and to isolate the most interesting relationships between the more important characteristics of our towns.

From the many variables available to us we made an initial selection of 57 of what we considered would be the more important variables. On these we obtained a 57 × 57 correlation matrix (symmetrical, of course, with units along the principal diagonal). All 97 towns were included at this stage, but as data were available for fewer than 97 towns on some variables, each correlation included only those towns for which data were available for both variables. At a later stage data on a few more variables became available so we made out a second list of 59 variables, including these new variables and omitting some from the original list which we were duplicating or which had failed to show significant relationship to other variables. Both lists are indicated in Table 3.1. We obtained a correlation matrix for this second list also but this time we decided to exclude those 12 Special Towns—see Chapter 2—so that only 85 towns were included in this computation. In what follows we deal first with the significant relationship from the 97 towns, 57 × 57 correlation matrix and then with the 85 towns 59 × 59 matrix. Finally we show where the results from the two approaches differ. In this chapter for convenience we shall continue to refer to the respective matrices as the 57 × 57 and the 59 × 59.

Throughout this paper we constantly refer back to Table 3.1, for it contains a full description of the variables used in the various analyses of this paper. The numbers on the variables in this table are maintained throughout the paper and Appendix Tables A1 and A2.

For our statistical analysis we had therefore 71 variables. Four, however, were eliminated for reasons explained in the notes, leaving the 67 variables described in Table 3.1.

The few correlation coefficients (cc) that created some difficulty fall into three categories:—

(1) correlation coefficients between percentages in the same array (e.g., between per cent dwellings built before 1900 and per cent dwellings built in 1961 or after*) were found to be misleading. The reasons for this and a suggested solution to the problem are discussed in detail in the Technical Appendix at the end of this chapter. There were ten such correlations in the 57 × 57 matrix and they have been eliminated from Table 3.1 and Appendix Tables A2.

(2) High and significant values for some correlations are to be expected because the two variables concerned cover much the same ground e.g. the percentages of professional people classified by industry and by social group.† There are not many cases so obvious.

(3) There are also a few instances of correlation coefficients between the same variable for different periods. High coefficients for such cases as variables (3) and (4) are not trivial results since they indicate that, at least, confidence is to be reposed in the statistics and, more importantly, that growth persists.

*Variables nos. 43 and 44.

†Variables nos. 31 and 33.

TABLE 3.1: *Description of variables included in correlation matrices; means of absolute values of correlation coefficients with all other variables; number of ccs formally significant at ·001 null-hypothesis probability points on basis of 97 and 85 towns*

Variable no.	*Description of variable*	*Mean* | *cc* |	*No. ccs significant at P<·001*	
			97 *towns*	85 *towns*
1	Population	·13	4	6
2	Percentage of population in institutions	·22	15	8
3	Percentage population increase 1926–61	·22	16	11
4	Percentage population increase 1961–71 (varying town boundaries)	·25	18	17
6	Female–male ratio	·21	15	12
7	Percentage aged 0–14	·27	25	16
8	Percentage aged 65 and over	·30	23	16
9	Dependency ratio, 1961	·22	15	14
10	Dependency ratio	·18	7	5
11	Percentage aged 15–44 married or widowed	·33	27	9
12	Percentage increase in variable 11, 1961–71	·18	10	3
13	Fertility of marriages	·21	14	2
†14	Male migration rate for ages 10–44, 1966–71	·30	23	

continued on next page.

Table 3.1 *: continued*

†15	Female migration rate for ages 10–44, 1966–71	·30	21	
*16	Total migration rate for ages 10–44, 1966–71	·16		6
*17	Percentage born outside the county	·17		9
18	Percentage in labouring, transport and communication occupations	·19	12	4
19	Percentage in administrative and professional occupations	·25	17	13
20	Female–male ratio among the gainfully occupied	·25	18	12
21	Percentage aged 14–19 in schools, 1966	·19	11	12
22	Percentage aged 14–19 in schools	·17	9	11
*23	Number of boys in vocational school per 1,000 population	·18		8
*24	Number of girls aged 14–19 in vocational school per 1,000 population	·15		4
25	Percentage of population gainfully occupied	·18	8	2
26	Unemployment rate, 1966	·25	16	8
27	Unemployment rate	·25	18	7
28	Percentage in agriculture, mining and manufacturing industries	·24	14	14
29	Percentage in building, electricity, gas and water industries	·15	3	0
30	Percentage in commerce and transport industries	·19	12	11
†31	Percentage in public administration and profession industries	·23	15	
†32	Percentage in public administration and professions (males only)	·18	10	
†33	Percentage in professional groups	·25	14	
†34	Percentage in semi and unskilled manual groups	·24	14	
35	Percentage in non-agricultural, non-manual groups	·27	17	18
36	Percentage in non-agricultural, non-manual groups 1966	·26	17	19
37	Percentage of dwellings with 1–3 rooms	·23	13	1
38	Percentage of dwellings with 5 or more rooms	·32	26	13
39	Percentage of population in 1–3 person households	·18	10	18
40	Percentage of population in 7 or more person households	·24	17	12
41	Rooms per dwelling	·29	22	12
42	Rooms per person	·25	15	19
43	Percentage of dwellings built before 1900	·24	17	11
44	Percentage of dwellings built in 1961 or after	·32	24	10

Table 3.1 : *continued*

45	Percentage of dwellings rented	·16	3	1
46	Percentage of dwellings with bath or shower, 1946	·18	6	4
47	Percentage of dwellings with bath or shower	·31	27	13
50	Total IDA grants per head	·12	1	2
51	Total IDA grants per firm	·10	1	2
*52	Total new industry grants (IDA) per head	·11		2
53	Hotel and guest house rooms per thousand population, 1973	·14	4	6
54	Available land for industry	·17	4	6
55	Population density of hinterland	·15	0	0
56	Gross retail sales per head, 1966	·16	4	7
*57	Average wage in retailing, 1966	·13		3
58	Telephone stations per thousand population	·25	19	11
59	Television licences per thousand population, 1973	·27	27	1
60	Cars per thousand population	·34	31	3
*61	Swimming pool, dummy variable	·11		1
†62	Hospital, dummy variable	·19	14	
*63	Participation in Tidy Towns competition, dummy variable, 1973	·09		0
*64	Adult library readership as percentage of population 1973	·09		0
*65	Public houses per thousand population	·23		17
66	Distance from Dublin	·22	20	20
67	Distance from nearest large town	·20	13	0
69	Number of trunk roads	·17	2	2
†70	Main trunk road, dummy variable	·10	2	
71	Railway station, dummy variable	·09	0	0

Notes

Data relate to 1971 unless otherwise stated. Mean cc is the average absolute correlation coefficient.

All variables except those with * included in the first matrix (57×57) extended to all 97 towns.

All variables except those with † included in the second matrix (59×59) extended to 85 towns (i.e., Special Town data omitted).

Omitted variables are those numbered 5, 48, 49, and 68. No. 5 was percentage population increase 1961–71 but conceptually was different from No. 4 in that the increase for No. 5 related to the 1971 area of town while No. 4 related to town areas as at the respective Censuses. Ccs using No. 5 were nearly identical with those using No. 4, so No. 5 was omitted. Var. Nos. 48 and 49 were uncorrected versions of Nos. 50, 51. Corrections were small and few and did not effect cc values. Var. No. 68 was an attempt to construct a gravity model with which we did not proceed because of the multitude of calculations involved. Ccs for percentages in same arrays are omitted from data in last three columns, and generally in this paper.

See notes to Appendix Tables A.2 on basic sources of town data and definitions of certain variables.

Mean cc for * variables are based on 85 town data, all the rest of 97 towns.

Net number of variables included is 67.

The last three columns of Table 3.1 give some indication of which variables are highly interrelated in the system. The data for these columns are from Appendix Tables A2.1 and A2.2 where we summarise the significant relationships of the 57 × 57 and 59 × 59 correlation matrices respectively. We felt it was much more meaningful only to denote the level of significance of the relationships rather than print two large correlation matrices giving the exact coefficients, containing many insignificant results. In discussing relationships between variables the level of significance is more important than the actual size of the correlation coefficient. These two appendices supply information on many more relationships than we examine in this paper. We hope that the information is presented in such a form as will enable interested people to explore the relationships between any variable they deem important and others in the system. Variable numbers not listed in these tables opposite any variable indicates that the correlation coefficient between these variables was insignificant.

Two facts will be immediately evident from Table 3.1: (1) that the actual values of the ccs generally are not large, although, as will be seen later, the system is a highly correlated one; (2) that the 97 town set are more strongly correlated than are the 85 set.

As to (1), we find that even when the relationships are highly significant there is usually a good deal of residual unexplained variance, i.e., many towns do not fit into the pattern shown by the relationship. However, as we shall see, variables *collectively* do a much better job in explaining differences between towns than do the individual correlation coefficients.

As to (2), we would seem justified in devoting more attention to the relationships estimated on the 97 town basis than those estimated from the 85 towns. Comparison of the last two columns of Table 3.1 indicates that the omission of the 12 Special Towns had quite a substantial effect. The reason for this is that, for many variables, these towns not only have comparatively large deviations from their respective means but these deviations tend to be consistent in direction. It could be argued that these consistently extreme values would bias the correlation coefficient in the direction of these Special Towns, but as will be seen later, these towns only exhibit characteristics which can be taken as indicators of "goodness" and it is with such relationships we are primarily interested. The Special Towns can be looked on as achieving standards of housing, employment and amenities which all other towns should emulate, if not necessarily aesthetically.

In a few instances, one of these towns (usually Shannon) has a very extreme value in the "wrong" direction and dominates the resultant correlation coefficient. This distorts the true relationship existing between towns. The cases where this occurs are discussed in a later section of this chapter.

Significance of Correlation Matrices

The number of correlation coefficients in the full 57 × 57 matrix (97 town basis) is 1596 (= 57 × 56/2). Taking account of the exclusions indicated above due to the problem of correlations between percentage in the same array there remain 1,586. With such a large number of correlation coefficients each calculated from 97 pairs we would expect a certain number to be found "significant" even if all series were selected randomly. Numbers "significant" at the ·001, ·01 and ·05 probability levels would be about 2, 16 and 79 respectively. In consequence we must be careful in attributing significance to relationships in this chapter. It is for this reason that we have selected, in Table 3.1 the very low probability of ·001, which would be regarded as highly significant by any reasonable standard. When dealing with significance at higher probability levels we will treat the relationship as meaningful if it is consistent with other relationships.

In contrast to the numbers given above in the case of random pairs, a count of entries in Appendix Table A2.1 (and allowing for each entry counted twice therein) show that the number of ccs significant at ·001, ·01 and ·05 are respectively 392, 524 and 698. The contrast between these numbers and the 2, 16, 79 cited above is enough to make the point that the actual matrix is an overwhelmingly significant one, which (to repeat) is not to say that the individual ccs are high.

Repeating this counting of significance procedure for the 59 × 59 (85 town) correlation matrix the numbers that could be expected to be significant from 59 random series are 2, 17 and 86 at the ·001, ·01 and ·05 probability levels respectively. The actual number of significant relationships found were 236, 354 and 532. Again this indicates that the correlation matrix is significant; these numbers are much lower than those of the 57 × 57 correlation matrix and adequately illustrate the point that the variables for the 97 towns are more strongly interrelated than those of the 85 towns.

Examination of 57 × 57 Correlation Matrix (97 Town Basis)

In Table 3.2 the leading variables are listed in descending order of their mean correlation coefficient with all other variables. The last column is derived from a simple count of the significant relationship of each variable in Appendix Table A2.1. A comparison of the last two columns shows that ordering according to the last column (which some people might prefer) would not greatly affect the selection of leading variables, though it would affect their order. We might remark, however, that if we had selected 14 significant relationships at the probability level of ·001 as our cut-off point, Table 3.1 shows that in addition to the variables in Table 3.2 the following eleven variables would also qualify for inclusion:—

Var. no.	*Variable*	*Mean* | *cc* |	*No. significant* ($P<\cdot001$)
40	Percentage of population in 7 + person households	·24	17
43	Percentage of dwellings built before 1900	·24	17
34	Percentage in semi and unskilled manual groups	·24	14
31	Percentage in public administration and professions	·23	15
66	Distance from Dublin	·22	20
3	Percentage population increase 1926–61	·22	16
2	Percentage of population in institutions	·22	15
9	Dependency ratio 1961	·22	15
6	Female–male ratio	·21	15
13	Fertility of marriages	·21	14
62	Hospital dummy variable	·19	14

Table 3.2 and this list of eleven variables gives the variables most highly intercorrelated with all variables in the system. In the analyses that follow our selection of variables has been considerably influenced by these results.

TABLE 3·2: *Leading series by reference to mean absolute correlation with other series,* 97 *towns.*

Var. No.	*Variable*	*Mean* | *cc* |	*No. significant* ($P < \cdot001$)
60	Cars per 1,000 population	·34	31
11	Percentage married aged 15–44	·33	27
38	Percentage dwellings with 5 or more rooms	·32	26
44	Percentage dwellings built 1961 or later	·32	25
47	Percentage dwellings with bath or shower	·31	26
14	Immigration rate 1966–71, male	·30	24
8	Percentage population aged 65 +	·30	22
15	Immigration rate 1966–71, female	·30	21
9	Dependency ratios 1961	·29	22
59	Television licenses per 1,000 population, 1973	·27	26
7	Percentage population aged 0–14	·27	24
12	Percentage increase in var. No. 11, 1961–71	·27	17
36	Percentage non-manual social groups, 1966	·26	17
27	Unemployment rate	·25	19
58	Telephone stations per 1,000 population	·25	19

TABLE 3.2 (*continued*)

4	Percentage increase in population 1961–71	·25	18
20	Female/male ratio, gainfully occupied	·25	17
19	Percentage of G.O. in professions	·25	17
26	Unemployment rate 1966	·25	16
42	Rooms per person	·25	15
33	Percentage in social group professional	·25	14

Notes

See Table 3.1 for full description of variables. Variables arranged in descending order of mean | cc | and for ccs with same value order is according to number significant ($P <$ ·001). All calculations based on 97 town data.

It may be observed that most of the variables in Table 3.2 are consistent with each other, some for obvious reasons, e.g. that towns with a high proportion of new houses (44)* should have a high proportion of baths (47) and a high proportion of larger dwellings (38). We are scarcely surprised that towns with high proportion of cars (60) are also high in television licences (59). These relationships are interesting, although it could be said that they are self-evident. Their satisfactory statistical behaviour shows that the variables do measure something and their consistency shows that the relationships are not spurious. These relationships are not universal e.g., while we expect immigration rates (14 and 15) to be closely related to population growth (4), towns can grow without immigration. Towns attracting immigrants are of interest in their own right apart from their population growth behaviour.

Largest Correlation Coefficients

Table 3.3 shows many of the correlation coefficients which are higher than ·5 (an arbitrary value) in absolute terms. We have illustrated only the relationships which we deem to be the most interesting. Many pairs with high correlation coefficients have been omitted because their relationship is self-evident, for example, the correlation between percentage of population in institutions (2) and the percentage of population gainfully occupied (25) has a negative coefficient of ·52 as might be expected because the institutional population is mostly not gainfully occupied. The coefficients in Table 3.3 are mainly in the expected direction and show a high degree of consistency.

Over half the 57 variables used in the correlation matrix do not appear in Table 3.3, notably town size (1) and dependency ratio 1971 (10). This does not imply that these omitted variables are not significantly related to the system generally (most of the 57 are, often in an interesting way), because our selection of a coefficient of ·5 implies a very high significance level. With 97 cases a coefficient of ·33 is significant at the ·001 probability level.

*Numbers in parentheses refer to variable number in Table 3.1 and Appendix Tables A2.

TABLE 3.3: *Largest simple correlation coefficients between specified pairs of variables*

	cc		cc		cc
4 (pop. inc. '61–71) with—		12 (% change married) with—		38 (large dwellings) with—	
9 (dep. ratio '61)	—.63	14 (immigration—male)	.61	40 (large families)	—.53
12 (% change married)	.52	14 (immigration rate—male) with—		44 (% new dwellings)	.78
44 (% new dwellings)	.68	15 (immigration rate—female)	.98	47 (% with bath)	.76
6 (sex ratio '71) with—		38 (large dwellings)	.67	58 (telephones)	.54
8 (% aged)	.55	44 (% new dwellings)	.88	59 (% with TV)	.58
31 (% pub. adm.+prof.—ind.)	—.60	47 (% with bath)	.67	60 (cars)	.76
7 (% children) with—		58 (telephones)	.53	39 (small families) with—	
8 (% aged)	—.80	59 (% with TV)	.55	42 (rooms per person)	.82
11 (% married)	.72	60 (cars)	.54	40 (large families) with—	
19 (% prof.—occup.)	—.51	*20 (sex ratio—GO) with—*		*42 (rooms per person)*	—.74
20 (sex ratio—GO)	—.76	31 (% pub. adm.+prof.—ind.)	.51	60 (cars)	—.68
28 (% manuf.—ind.)	.54	21 (post-prim. ed. '66) with—		41 (rooms per dwelling) with—	
33 (% prof.—social)	—.58	22 (post-primary ed. '71)	.77	46 (% with bath, '46)	.56
44 (% new dwellings)	.53	28 (% manuf.—ind.)	—.51	47 (% with bath, '71)	.58
8 (% aged) with—		30 (% commerce—industry)	.51	58 (telephones)	.53
11 (% married)	—.69	26 (unemployment '66) with—		60 (cars)	.69
14 (immigration—male)	—.52	27 (unemployment '71)	.72	42 (rooms per person) with—	
20 (sex ratio—GO)	.60	38 (large dwellings)	—.64	60 (cars)	.61
28 (% manuf.—ind.)	—.53	47 (% with bath)	—.56	43 (% old dwellings) with—	
44 (% new dwellings)	—.67	60 (cars)	—.50	47 (% with bath)	—.74
47 (% with bath)	—.57	27 (unemployment '71) with—		66 (dist. from Dublin)	.56
59 (% with TV)	—.59	44 (% new dwellings)	—.51	44 (% new dwellings) with—	
9 (dep. ratio '61) with—		28 (% manuf.—ind.) with—		47 (% with bath)	.81
19 (% prof:- occup.)	—.55	35 (non-manual—social '71)	—.77	59 (% with TV)	.68
11 (% married) with—		36 (non-manual—social '66)	—.76	60 (cars)	.67
14 (immigration—male)	.83	31 (% pub. adm. & prof.—ind.) with—		46 (% with bath '46) with—	
20 (sex ratio—GO)	—.64	36 (non-manual—social '66)	.57	47 (% with bath '71)	.56
40 (large fams.)	—.51	35 (non-manual—social '71) with—		47 (% with bath) with—	
41 (rooms per dwelling)	.51	36 (non-manual—social '66)	.93	59 (% with TV)	.54
44 (% new dwellings)	.86	37 (small dwellings) with—		60 (cars)	.58
47 (% with bath)	.64	44(% new dwellings)	—.52	60 (cars) with—	
59 (% with TV)	.73	60 (cars)	—.51	58 (telephones)	.61
60 (cars)	.74			59 (% with TV)	.56

Notes (Particulars relate to 1971 (97 towns) unless otherwise indicated). See Table 3.1 for full description of variables. Correlation coefficients *r_{ij} ($=r_{ji}$) is given once only, i.e., for $j>i$. For full relationship of second variable j, whole table should be examined, e.g. $j=44$*: as well as being highly correlated with variable 47, 60, 59, it is also related to variables 4, 7, 8, 11, 14, 27, 37, 38.

Table 3.3 largely speaks for itself. Here we do not intend going into detail about the many relationships shown as we later describe in depth the relationships with the variables in which we are most interested. But some interesting questions are raised by the coefficients in this table. The first figure of a negative coefficient of ·63 between our prime variable, population increase (4), and dependency ratio, 1961 (9)—i.e., high increase is associated with low dependency in the starting year—is of great interest as it suggests that high dependency is a hindrance to growth.* This suggestion is backed by the very highly significant ($P < \cdot 001$) negative correlation coefficient between dependency ratio 1961 (9) and immigration (16) in Appendix Table A2.2—immigrants tend to come from high dependency towns. Some doubt is cast on this relationship in a later section, as evidence is available that its significance can be attributed to the influence of one town, Shannon.

The high positive correlation coefficient (·72) between children (7) and married (11) is to be expected but what is the reason for the equally high negative coefficient ($-\cdot 76$) between children (7) and the female-male ratio among the gainfully occupied (20)? Possibly that towns in which a high proportion of women (married as well as single) go to work have a small proportion of children, which seems reasonable.

We suggest that the highest figure in Table 3.3, namely, ·98 between male and female immigration (variables 14 and 15) should not be taken for granted. In their relationship with other variables in the system these immigration rates are almost identical, so much so that we have not included female immigration (15) as a first variable in Table 3.3 since its showing would be nearly identical with male immigration (14), for instance the correlation between male immigration (14) and percentage dwellings with 5 or more rooms (38) is shown as ·67 while the correlation between this and female immigration (15) is also ·67. Why should these two migration variables perform so similarly? One explanation could be that in "emigration" towns there is an equal lack of opportunities for both men and women and that "immigration" towns provide the opportunities to both.

We notice that the complex of new dwellings (44), cars (60), TV sets (59) and telephones (58) are all closely interrelated; this set of "amenity" variables may be regarded as a loose proxy for income. Also in several respects the results for 1971 are confirmed by those for 1966. This is particularly noticeable for the two unemployment variables, 1966 (20) and 1971 (27). We find the correlation between them is as high as ·72, an extremely satisfactory relationship, statistically speaking, between fundamentally important but elusive variables: the inference is, of course, that over the five-year period, the level of unemployment tended to persist at the given level.

There is scarcely a figure in Table 3.3 that does not provoke reflections of this kind. We commend this exercise to persons interested in particular aspects.

*cf. "An empirical Study of the Age Structure of the Irish Population" by Brendan Walsh. *The Economic and Social Review*. Vol. 1 No. 2 1970.

In the following paragraphs we confine our attention to the relationships affecting the increase in population (4), and other important characteristics of towns.

Population Increase 1961–71

In Table 3.4 we set out the correlation coefficients in three null-hypothesis probability (P) classes for variables "significantly" related to population increase 1961–71 (4). For reasons already mentioned, we must attach doubt to conventional probability levels in so large a correlation system. True null-hypothesis probability levels would certainly be less than those shown. We may wonder if each item in the third group $\cdot 01 < P < \cdot 05$, considered by itself, could be regarded as significant at all. On the other hand, there can be little doubt that the 18 variables in the $P < \cdot 001$ class are significant by any standard. So, in what follows, we use the term "significant" without mention of probability. We shall regard even the $\cdot 01 < P < \cdot 05$ variables as significant if their showing is consistent with that of other variables.

Certainly the picture of growth in Table 3.4 is a highly consistent one. A growth town* (large population increase 1961–71) has the following characteristics:—

(i) It also grew in period 1926–61 (3).

(ii) It has a low percentage of elderly (8), confirmed by high percentage of children (7).

(iii) It has a low dependency ratio 1961 (9), confirmed in 1971 (10).

(iv) It has a high percentage of young married persons (11) and has markedly increased in this percentage 1961–71 (12).

(v) It has attracted both male and female immigrants (14 and 15).

(vi) It has a low percentage in lowly-paid occupations (18) and a high percentage in professions (19).

(vii) Percentage unemployment was low in both 1966 and 1971 (26, 27).

(viii) It is high in manufacturing (28) and low in commerce (30).

(ix) It has a high proportion of large dwellings (38) and a low proportion of large families (40).

(x) A high proportion of dwellings were built since 1961 (44) and a low proportion were built before 1900 (43).

(xi) It is high in dwellings rented (45).

*The term 'growth town' as it is derived from correlation relationships cannot be defined in terms of a given rate of growth. This also applies to other terms we use based on correlation relationships.

TABLE 3.4: *Variables significantly related to percentage increase in population* 1961–1971 (*variable* 4) *showing correlation coefficients and conventional degree of significance.* 57 *variables,* 97 *towns.*

	Null-hypothesis probability (P) level and variable	*cc*
$P < \cdot 001$		
3	Percentage population increase 1926–61	·41
8	Percentage population 65 +	−·41
9	Dependency ratio 1961	−·63
11	Percentage married aged 15–44	·45
12	Increase in variable 11, 1961–71	·52
14	Immigration 1966–71, male	·55
15	Immigration 1966–71, female	·55
18	Percentage of GO in group transport, labourers	−·35
19	Percentage of GO in group professions	·38
27	Unemployment	−·33
30	Percentage in industrial group commerce, transport	−·38
38	Percentage dwellings of 5 + rooms	·46
40	Percentage population in 7 + person families	−·44
43	Percentage dwellings built before 1900	−·45
44	Percentage dwellings built 1961 or later	·68
47	Percentage dwellings with bath	·50
58	Telephone stations for 1,000 population	·43
60	Cars per 100 population	·36
$\cdot 001 < P < \cdot 01$		
21	Percentage aged 14–19 at school 1966	−·28
26	Unemployment 1966	−·29
28	Percentage in manufacturing etc. industry	·27
33	Percentage in professional social group	·30
37	Percentage dwellings 1–3 rooms	−·30
45	Percentage dwellings rented	·32
59	Television licences per 1,000 population, 1973	·26
$\cdot 01 < P < \cdot 05$		
6	Sex ratio	−·24
7	Percentage population aged 0–14	·22
10	Dependency/ratio	−·25
13	Fertility of marriages	−·22
22	Percentage aged 14–19 at school	−·21
54	Availability land for industry	·26
67	Distance from nearest large town	−·25
68	Weighted distance index	−·23

(xii) Proportions of households with baths (47), telephones (58), television (59) and cars (60) is high; in other words, these towns score high on modern amenities.

(xiii) Probably there is more land for industry (54).

(xiv) It is probably near a large town or city (67).

This list of 14 variables related to population increase 1961–71 does not exhaust the relationships shown in Table 3.4, but they are the relationships in which we can have most confidence because of their consistency, if such consistency is not absolute, e.g., having regard to (vi) and (viii) above. The list makes no mention of the curious result that population increase in these towns may be associated with low marriage fertility (13). This phenomenon attains only the last probability class and so we cannot place too much confidence in it. However, Appendix Table A2.1 shows that many of marriage fertility's own strong associations coincide with opposite sign to those we found for population increase*. It is likely therefore that this negative relationship between population increase (4) and low fertility (13) is not a statistical illusion. This association is probably due to the effect of the well-documented negative association between fertility (13) and the marriage rate† (11). We found a negative coefficient of ·38 between these**. Strength is added to this conclusion by the positive correlation coefficient of ·45 between population increase (4) and the percentage married (11).

Since it is merely in the lowest probability class we cannot be quite confident of the significance of the negative correlation between growth and percentage of children at school at ages 14–19 (22). It might mean that children in growth towns, on leaving primary school, can find employment easier than in other towns and so they are less inclined to continue schooling. Table A2.1 shows that the percentage of the population in post-primary schools (22) is strongly related to its level in 1966 (21)—lending credibility to the variable—also to industrial percentage in commerce and transport (30) but negatively to the percentage in manufacturing (28). There is no direct association between these variables or any of the variables strongly related to the percentage of children at school and population increase, leading us to doubt whether the association we found between them is real. Rather the percentage at school seems to be more associated with the social group structure of the population†† as it is strongly related positively to the percentage in non-agricultural non-manual groups in both 1966 and 1971 and negatively to the percentage in semi- and unskilled manual groups.

*There are 8 variables with highly significant associations with both marriage fertility (13) and population increase (4). They are variables numbers 11, 14, 27, 38, 40, 44, 47, and 60. In all cases the relationships of these with (13) and (4) have opposite signs; e.g. Table A2.1 shows that ccs (13, 11) and (4, 11) have opposite signs.

†cf: B. M. Walsh, 1968. *Some Irish Population Problems Reconsidered.* Dublin: Paper No 42, The Economic and Social Research Institute.

**This coefficient cannot be viewed too optimistically because the numbers married was used as a denominator in constructing the fertility rate.

††Variables nos. 34, 35 and 36.

In succinct terms, towns with large percentage increases in population between 1961 and 1971 are "good" towns by reference to associated phenomena, by "good"* being meant low in poorly paid (and high in the better paid) occupations, comparatively low in unemployment, high in substantial houses, high in proportion married and high in amenities. The *vice versa* proposition about towns with little or no increase in population 1961–71 would also hold. Autonomous growth of population of middle-sized towns in Ireland 1961–71 is to be interpreted as healthy growth.

This, we suggest, is by no means an obvious conclusion. There is no *a priori* reason why these associations should hold. Population growth could be associated with a flooding of a small local labour market, creating an excessive labour pool, high unemployment and bad housing, in fact the shanty town situation of some foreign cities. This is not happening in Ireland. The opposite result that towns with little or no population growth are worse housed, have fewer amenities and have higher unemployment rates than faster growing towns is equally important.

Consistent Group of Variables

Table 3.5 shows no fewer than 15 variables (of our original 58), one of which is population growth, which have the property that each pair of them are relatively highly correlated (formally $P < \cdot 01$ in all cases). The consistency is absolute: e.g., if x is significantly correlated to y and z, y will be correlated with z. Of great interest also is the strength of relationship. In most cases the coefficient is much higher than ·26 which would suffice to make the relationship significant at the ·01 probability level when 97 observations are used.
This is most pronounced perhaps in the case of percentage dwellings built since 1961 (44). We have been most careful in this section not to attribute *causation*: we always use the term association, but however the extremely strong association between new dwellings and all other growth-related factors raises the question as to which way the causation works. Would we be entirely wrong in suggesting that new dwellings come before the new population? This is certainly true of towns around Dublin but whether houses are being built speculatively in other medium-sized towns and attracting new population to them is a debatable point, although the strong association between population growth and new dwellings is maintained in the 85 town correlation matrix; this is not trivial since there may have been prior unoccupied dwelling space in growth towns.

Every selection of any number of variables from the 15 in Table 3.5 has the property of being closely intercorrelated. In particular we note the presence

*Having ourselves evolved the epithet "good" in relation to our towns we find it had been used by D. Donnison, Director of the Centre of Environmental Studies ("What is a 'good city'"?, *New Society*, CES, Reprint No. 16, December 1973). Donnison's "good city" might be described as a city of opportunity for schooling, jobs, housing etc. (metaphorically a city of "ladders"). The concept was very much criticised. Ours, as a purely statistical construct, is entirely different.

TABLE 3.5: *Correlation coefficients between pairs of variables most closely associated as a group—97 towns*

Variable	3	4	8	11	14	15	26	27	37	38	43	44	47	60	59
3. % population inc. 1926–61	1·00														
4. % population inc. 1961–71	·41	1·00													
8. % 65+	—·44	—·41	1.00												
11. % married	·47	·45	—·69	1.00											
14. Immigration 1966–71, male	·41	·55	—·52	·83	1.00										
15. Immigration 1966–71, female	·42	·55	—·53	·82	·98	1·00									
26. Unemployment rate 1966	—·33	—·29	·39	—·36	—·38	—·36	1·00								
27. Unemployment rate 1971	—·29	—·33	·31	—·42	—·44	—·42	·72	1·00							
37. % dwellings 1–3 rooms	—·30	—·30	·39	—·53	—·45	—·46	·32	·30	1·00						
38. % dwellings 5+ rooms	·49	·46	·47	·71	·67	·67	—·64	—·65	*a*	1·00					
43. % dwellings built before 1900	—·49	—·45	·54	—·49	—·53	—·54	·36	·26	·44	—·50	1·00				
44. % dwellings built 1961 or after	·58	·68	—·67	·86	·88	·88	—·49	—·51	—·52	·78	*a*	1·00			
47. % dwellings with bath	·54	·50	—·57	·64	·67	·66	—·56	—·52	—·50	·76	—·74	·81	1·00		
60. Cars per '000 population	·43	·36	—·46	·74	·57	·54	—·50	—·54	—·51	·76	—·33	·67	·58	1·00	
59. TV per '000 population	·36	·26	—·59	·73	·67	·69	—·35	—·38	—·45	·58	—·42	·68	·54	·56	1·00

a: invalid as within the same percentage array; see text and appendix.

Note

For full descriptions of variables see Table 3.1. As the table is symmetrical only figures below diagonal are given.

of the amenity variables percentage dwellings with bath (47), TVs (59) and cars (60). One amenity, telephones (58) is missing, although it is very strongly related to the other three amenity variables and to growth. The high positive correlation coefficient between the three amenity variables; baths, TVs and cars are given at the bottom right of Table 3.5. One has only to add the correlation coefficients for telephones with the three named: 44, ·33 and ·61 respectively, all significant at the ·001 probability level, to see that these variables form a very closely interrelated group. It is hoped that this group of variables will act as a proxy variable for income in the analysis and, as they are closely related to growth and the other "good" characteristics of towns, this hope would seem justifiable.

Partial Correlation

This technique may be used to deepen our understanding of the closely inter-related phenomena described in Table 3.5 and indeed elsewhere in the system. In many cases the simple correlation coefficient between two variables can be misleading as any relationship ascertained may be due entirely to the influence of one or more other variables, e.g., we have mentioned earlier the negative relationship we found between growth (4) and fertility (13) and how we expected that this relationship may be due to the influence of the negative relationship between fertility (13) and the marriage rate (11) on both variables. Partial correlation is a technique which allows us to test for this. It is the residual correlation between the two when we have allowed for the influence of some third variable on both.* Of course one can allow for the influence of more than one variable though in the few illustrations that follow we confine our attention to one.

In the case cited above, the simple correlation coefficients between growth (4) and fertility (13) was −·22. The partial correlation between the two, allowing for the influence of the marriage rate (11) on both is −·07, which is not at all significant, showing that the marriage rate has a substantial affect on the relationship between growth and fertility.

One of the most interesting results has been the persistence of growth, evidenced in the highly significant correlation between percentage growth in the intervals 1926–61 and 1961–71 (variables 3 and 4). Does this still hold when allowance is made for the percentage of new dwellings built since 1961 (44)? Using Table 3.5 and the formula in the footnote we find in this case a partial correlation coefficient of ·03, a quite insignificant value. Towns without new dwellings built since 1961 did not experience continued growth, a less obvious point than might at first appear.

*Partial correlation coefficients can be derived from the simple correlation coefficients by application of the formula:—

$$r_{xy.z} = (r_{xy} - r_{xz}\, r_{yz}) / \sqrt{[(1 - r^2_{xz})\,(1 - r^2_{yz})]}$$

Also highly significant is the negative relationship between growth 1961–71 (4) and the unemployment rate 1971 (27). But we know that unemployment afflicts the unskilled (represented by variable 18) most severely; so we compute the partial correlations between growth and unemployment allowing for the percentage in transport and labouring occupations to find a value of −·20, barely, if at all, significant. In towns with the same percentage unskilled, the negative relationship between growth and unemployment becomes doubtful.

Other Prime Associations

So far our emphasis has been almost entirely on the growth variable (4). Other variables can be regarded as "prime" and analysed on similar lines, for instance percentage in manufacturing industry (28). What are the characteristics of towns with a relatively large manufacturing work force? We learn from Table 3.1 that (at the $P < \cdot 01$ level) such towns tend to have the following characteristics:—

(i) A low percentage of the population in institutions (2).
(ii) High in recent growth (4).
(iii) Low sex ratio (6) i.e., more men than women.
(iv) Low in percentage in post-primary education (21).
(v) High in new houses (44).
(vi) They tend to be located near Dublin (66).
(vii) They are low in retail sales (56).

This last characteristic is slightly curious. One possible explanation could be that as these manufacturing towns tend to be located near Dublin, most of the shopping takes place in Dublin. The partial correlation technique allows us to check if this is so. Allowing for the influence of distance from Dublin on these two variables reduces their correlation from −·31 to −·28 which shows, though not conclusively, that the location near Dublin does have some affect.

There is no significant relationship between manufacturing towns and the amenity variables (47, 58, 59 and 60). This fact in conjunction with the low retail sales would seem to suggest that there is little "high living" in the industrial town.

Another area of interest might be towns with a high number of hotel and guest house rooms per thousand population. This variable, reflecting the tourist resorts, has only a few significant relationships. Tourist towns tend to have high sex ratios (6), i.e., many females, a low percentage of children (7), a low dependency ratio (9, 10) and a low proportion of the unskilled manual social groups (34). These relationships are again drawn from Appendix Table A2.1.

As another example, consider fertility of marriages (13). We find it associated with a high dependency ratio (10), a low percentage married (11), low immigration (14, 15), high unemployment (26, 27), small houses (37, confirmed by 38) and overcrowding (39, 40, 41, 42). High fertility towns are low in new dwellings (44) and in amenities (46, 47, 58, 59, 60). While we must not exaggerate, the conclusions must be that high fertility is not associated with what we have termed "good towns".

These kind of inferences could be drawn from *all* 57 variables on the foregoing lines. Of course these would vary greatly in interest and significance. All the information required for this exercise is contained in Appendix Table A2.1.

We must stress again the dangers of drawing too flat-footed inferences from data of this kind. Correlations, though significant, are generally low (i.e. much less than unity) in absolute value, so that there may be many towns exceptions to any generality and as we pointed out earlier, there can be many high correlations (of no meaningful significance) in so large a correlation matrix. Golden rules for drawing conclusions from material of this kind are

(i) they must make sense, or
(ii) they must be confirmed by cognate relationships.

Effect of Exclusion of Twelve Special Towns

As explained above, twelve Census towns are obviously in an exceptional category in many respects but particularly in respect of growth, our main interest. We surmise that different considerations (including formulae) may apply to forecasting future growth in the case of these twelve towns than apply to forecasts for the remaining 85. Table 3.4A relates to these remaining 85 towns.

The exclusion of these twelve towns is less arbitrary than might be supposed at first sight. It seemed to us obvious that these towns differed significantly from the remaining eighty-five; we felt that they were qualitatively different. We were pleased to discover that cluster analysis confirmed our opinions (see Chapter 4) that these twelve towns do in fact comprise a distinct subset.

Reconsideration of our material in the light of experience with the 57 × 57 correlation table and study of the original version of the basic Appendix Tables A1 impelled us to make some changes in our list of 57 variables. The nature of these changes will be clear from Table 3.1. They consist in the addition of 10 new variables, omission of 4 variables (largely tautologous), adaptation of others (e.g., one variable for immigration instead of two—very similar—in the original 57). There are 59 variables in the revised version, so that Table 3.4A is derived from a 59 × 59 correlation matrix based on particulars for 85 towns.

The omission of the twelve towns had an unexpectedly large effect on the actual values of the correlation coefficients, a fact that goes some way to further justify their exclusion. This will be clear from a comparison of the cc values in Tables 3.4 and 3.4A. While it is true that generally the 59 × 59 table has fewer "significances" than has the 57 × 57, some of the more important become more significant (by reference to cc value).

TABLE 3.4A: *Variables significantly related to percentage increase in population* 1961–1971 *(variable* 4*) showing correlation coefficients and conventional degree of significance.* 59 *variables,* 85 *towns*

Null-hypothesis probability (P) level and variable		*cc*
$P < \cdot 001$		
3	Percentage population increase 1926–61	·46
7	Percentage population aged 0–14	·38
8	Percentage population aged 65 +	−·40
11	Percentage married aged 15–44	·51
16	Immigration 1966–71, persons	·69
17	Percentage born outside county	·40
23	Percentage boys aged 14–19 in vocational school	−·37
27	Unemployment	−·39
38	Percentage dwellings 5 + rooms	·50
39	Percentage population 1–3 person households	−·42
44	Percentage dwellings built 1961 or later	·75
47	Percentage dwellings with bath	·47
54	Available land for industry	·38
57	Average wage in retailing, 1966	·39
65	Public houses per '000 population	−·42
$\cdot 001 < P < 01$		
12	Increase in variable 11, 1961–71	·25
26	Unemployment 1966	−·34
43	Percentage dwellings built before 1900	−·36
62	Hospital	−·34
71	Railway station	·31
$\cdot 01 < P < \cdot 05$		
18	Percentage of GO in occ. group labourers/transport	−·22
20	Female/male ratio amongst GO	−·23
21	Percentage aged 14–19 at school 1966	−·23
30	Percentage in ind. group commerce/transport	−·23
37	Percentage dwellings 1–3 rooms	−·26
41	Rooms per dwelling	·27

The physiognomy of the growth town emerges in the main the same from the two tables. It will be borne in mind that the following comments relating to associations with growth imply absence of these associations in relation to non-growth or decline.

The growth town 1961–71 was also a growth town in the period 1926–61, high in proportion married, low in unemployment, high in percentage of children and in dwellings built since 1961, generally with more emphatic showing than in Table 3.4. Of the variables which appear in Table 3.4 but not in Table 3.4A, the most notable absentees are the dependency ratio in 1961 and the dependency ratio in 1971 (variables 9 and 10); the 1961 dependency ratio, in particular, was highly significant in a 97 town context but quite insignificant in an 85 town setting. Noting that the fertility of marriages (variable 13) was negatively related to growth in the 97 town case, but statistically insignificant for the 85 towns, one may reasonably surmise that demographic variables which have been shown to be positively related to growth in the case of 85 towns may be unrelated, or negatively related, to growth in Special Towns. Other absentees include the percentage engaged in manufacturing industry (28)—a strange result, since many might expect such growth as has occurred to be due to increased manufacturing employment—and the amenities telephones (58) and television (59).

Of the variables not included in the 57 × 57 analysis, but included for the first time in the 59 × 59 matrix, we note the percentage born outside the county (17) highly significant positive, as we might expect, and the negative association for boys at vocational school, (23) confirmed by variable 21. The growth town is definitely low in public houses (65) and, no doubt the *vice versa* proposition also holds. Average wage in retail trading (57) is highly significant.

We shall mention one new variable only, public houses* per 1,000 population (negatively related to growth towns as we have already indicated), as an example of the use to which the 59 × 59 cc matrix could be put for many of the variables. Perhaps the most popular statistic relating to small towns and villages—far better known, than, say, population—is the number of public houses. Though our statistic, number of public houses per 1,000 population, might be thought to be of poor statistical quality, it is found to have a fairly large number of highly significant relationships ($P < \cdot 001$), as follows:—

		cc
1	Size of town	−·55
3	Percentage population increase 1961–71	−·42
8	Percentage population aged 65+	·38
21	Percentage aged 14–19 at school, 1966	·58
22	Percentage aged 14–19 at school, 1971	·50
23	Percentage boys at vocational school	·51
24	Percentage girls at vocational school	·43

*Public houses was about the only "new" variable that showed marked relationships, as will appear from Appendix Table A4; hence our special attention to it.

28	Percentage in manufacturing etc. ind.	$-\cdot 46$
30	Percentage in commerce etc. ind.	$\cdot 60$
35	Percentage non-manual soc. group, 1971	$\cdot 46$
36	Percentage non-manual soc. group, 1966	$\cdot 40$
37	Percentage population in 1–3 person households	$\cdot 52$
42	Rooms per person	$\cdot 39$
43	Percentage dwellings built before 1900	$\cdot 36$
44	Percentage dwellings built after 1961	$-\cdot 41$
66	Distance from Dublin	$\cdot 53$

The typical "public house town" is small (1), of static or declining population(3), many old and few new dwellings (43, 44), low in industry and high in commerce and non-manual occupations generally (28, 30, 35, 36). Families are small (37) and well-housed (42)—no doubt a consequence. There are high proportions of boys and girls in post-primary schools, a concomitant, as Tables 3.4 and 3.4A have shown, of a low industrial establishment. There is no significant relationship with the amenity variables, baths, cars, telephones, TV. Most of these phenomena are associated with the non-growth towns. We might add that one of the infallible signs of what we have termed the "good" town, percentage married aged 15–44, is significantly negatively correlated with pub density ($cc = -\cdot 29$, $\cdot 001 < P < \cdot 01$).

Comparison between the Two Approaches

While the results obtained from the examination of the two matrices were quite similar, certain important differences arose. This was due mainly to the extreme values exhibited by the twelve Special Towns which we excluded in the 59×59 matrix.

By examining Appendix Tables A2.1 and A2.2 we can find examples of relationships highly significant for the 97 town case which became insignificant for the 85 town case and also of the reverse phenomenon of relationships insignificant for the 97 town case becoming significant for 85 towns.

Here we shall consider the relationships with the percentage population increase 1961–71 (variable 4) where either of these phenomena occur. There are two variables insignificant in the 97 town case which become significant at the $p = \cdot 001$ level for the 85 towns. These are the percentage of population in 1–3 person households (variable 39) and the distance from Dublin (variable 66). Distance from Dublin is probably the more interesting of these where the lack of significance in the 97 town case can be entirely attributed to the influence of Shannon, which had by far the highest population growth of any town but is located quite a distance from Dublin. In fact, Shannon was so extreme in this case that it counteracted the influence of ten of the twelve Special Towns located near Dublin which would tend to make the relationship significant.*

*The 97 town correlation coefficient was $-\cdot 14$ and the 85 town correlation coefficient was $-\cdot 52$. When Shannon alone is excluded, the 96 town correlation is $-\cdot 41$ which illustrates the dramatic influence of Shannon.

Even more noteworthy are the cases where there is significance in the 97 town matrix but not in the 85 town one. Such cases reflect the tendency of the twelve Special Towns to have consistent extreme values. There are five such cases:—*

(i) Dependency ratio 1961 (9) (negative)

(ii) Percentage in administration and professional occupations (19) (positive).

(iii) Percentage of population in 7+person households (40) (negative).

(iv) Telephone stations per 1,000 people (58) (positive).

(v) Cars per 1,000 population (60) (positive).

The clearest case of the influence that can be effected by these Special Towns on the correlation relationship is again given by Shannon in no. (i) above. The 1961 dependency ratio in Shannon was 164, suggesting that those enumerated as living there in 1961 were predominantly workers living away from home. The effect of excluding Shannon from the calculation of the correlation coefficient is to make the relationship between dependency 1961 and growth insignificant.†

These illustrations mean that we must be cautious about the interpretation of those cases where these are discrepancies between the two correlation matrices and show that the relationship between growth (4) and dependency 1961 (9) we discussed earlier was illusory. The two cases we have discussed are the extreme cases, for no other variables have as large deviations from the mean for any town as Shannon had in these two cases. The other cases where we have said that discrepancies exist between two correlation matrices are probably cases where real differences occur between the twelve Special Towns and the other 85 towns. The fact that such discrepancies do exist is an important result in itself as we shall show later that these twelve towns are the best in the sense of being highest in all the indicators of "goodness" as we have defined it.

Negative Results

In many respects negative results (lack of relationship) can be equally important and as illuminating as the significant relationships. This case is no exception. By referring back to Table 3.1 we can find those variables which are on average least related to the system. We list them below.

It is not very surprising that many of variables listed here performed poorly as they were dummy variables measuring aspects probably not related to town growth, but some variables are worthy of special mention namely, (i) the IDA grant variables 50, 51, 52, and (ii) population size (1).

*Direction of the significant relationship in the 97 town matrix is indicated in parentheses ( ).

†Correlation coefficients between population growth 1961–71 and dependency 1961 are as follows —·97 towns: —·63; 85 towns: —·20; 96 towns: —·16.

Variable Number	Variable	mean | cc |	Number of significant relationships (P = ·001)
71	Railway station (dummy variable)	·09	0
63*	Participation in Tidy Towns competition	·09	0
64*	Library readership	·09	0
70	Main trunk road (dummy variable)	·10	2
51	Total IDA grants per firm	·10	3
61	Swimming Pool (dummy variable)	·11	1
52*	New Industry IDA grants per head	·11	3
50	Total IDA grants per head	·12	3
57*	Average wage in retailing 1966	·13	3
1	Population size	·13	4

*These variables included in 85 town matrix only.

The poor performance of the IDA grant variables was certainly a surprise as we had expected that a high level of grants would be reflected in a large population growth. That this was not so could be explained by a number of factors. The grant data used were not adjusted for inflation. The total level of grants allocated over the ten years was quite small—totalling about £15m or £1·5m p.a between 97 towns. It could also be true that IDA policy was directed towards preventing decline in these towns rather than inducing any autonomous growth—this could also account for the lack of relationship. Perhaps the most heartening inference is that any town can qualify for IDA help—after, no doubt, a rigorous test of industrial viability.

Town size is related to only four other variables at the P = ·001 level and to only two more at the P = ·01 level. These are:—

		cc
39	Percentage population in 1–3 person households	−·40
43	Percentage dwellings built before 1900	−·27
54	Available land for industry	·40
69	Number of trunk roads	·39
70	Main trunk road	·32
71	Railway station	·27

The first two variables (39 and 43) indicate mildly that as town size increases, small families and old dwellings proportionately decline slightly; variable 54 is an absolute figure (not a rate) so naturally it is related to town size; the showing of the other three variables is obvious.

It is the absence of relationship that is far more significant. Town size is in no way related to growth in the recent period 1961–71 (4) or in the past 1926–61 (3). There is not the faintest indication that greater size is associated with "betterment" in the context of what we have termed the "good" town, within the size range of town used in this study.

We must be careful at this stage not to draw the devastating inference that for population and economic growth town size is irrelevant. Too large an extrapolation is implied in assuming that if we brought towns, actual or hypothetical, with populations of 100,000 or 500,000 into our calculation, the same lack of relationship between town size and growth would transpire.

This lack of relationship does indicate, however, that the towns in the 1,500–10,000 size range constitute a homogeneous group in that their structure does not seem to vary with size. This independence of growth rate and size suggests that no town in the group is precluded from high growth on account of its size.

In a technical Appendix 2 to this chapter we give some multivariate regression results.

Technical Appendix to Chapter 3

1. *Significance of Percentages in the Same Array*

ORIGINALLY a number of the correlation coefficients in our correlation matrices were based on percentages within the same array, (an array being defined as a set of percentages which sum to 100 per cent), for example, the cc between percentages of (i) dwellings of three rooms or under and (ii) dwellings of five or more rooms. Assessment of significance in such cases is a special problem. We have not been able to find any treatment of it in the literature (though it must be a common problem), so we give our own solution (which is algebraically simple) and use it to test the significance of all ccs within percentage arrays in our 57×57 matrix.

In significance testing of correlation coefficients in general (as in the case of other types of ccs in our matrix), a population value of zero may be assumed, the question posed being: if there be no relationship, what is the probability that the actual value found would differ from zero? The value zero cannot be hypothesised in this within-array case. If in the array there were *two* classes only, the cc between *percentages* would be exactly *minus* one in all cases, whether the two sets of original data were related or not. If we made our percentages out of *three* independent series, having arranged that all have the same variance, the three ccs between pairs of percentages would be about *minus* 1/2. The point is that, in the case postulated, the null-hypothesis value is not zero, but some ascertainable negative quantity.

It does not appear possible to deal with the within-array problem of significance using percentage data alone. We must have recourse to the original values of the basic data. The null-hypothesis is that the numbers in each category are uncorrelated with one another. In general, it will suffice to consider three categories, the two we are concerned with and the third, with measures X_1, X_2 and X_3 respectively with population variances—

$$\sigma_1^2, \sigma_2^2, \sigma_3^2, \text{ i.e. } E(X_i - \bar{X}_i)^2 = Ex_i^2 = \sigma_i^2, EX_i = \bar{X}_i, x_i = X_i - \bar{X}_i, i = 1, 2, 3.$$

We propose to assess significance by comparing the actual partial cc, $r_{12.X}$ with $X = X_1 + X_2 + X_3$, with the population value $\rho_{12.X}$ for the null-hypothesis case, i.e. of X_1, X_2, X_3 being mutually uncorrelated.

$\rho_{12.X}$ is found as follows. We have—

$$x = x_1 + x_2 + x_3 \tag{3.1}$$

for the variables measured from their respective means. Then—

$$Ex^2 = \sigma_1^2 + \sigma_2^2 + \sigma_3^2 = \sigma^2; \tag{3.2}$$
$$Ex_1x_2 = 0;\ Ex_1x = \sigma_1^2;\ Ex_2x = \sigma_2^2.$$

It follows that the simple null-hypothesis correlation coefficients required are—

$$\rho_{12}=0;\ \rho_{1X}=\sigma_1{}^2/\sigma_1\sigma=\sigma_1/\sigma;\ \rho_{2X}=\sigma_2/\sigma. \tag{3.3}$$

Then—

$$\begin{aligned}\rho_{12}.X&=(\rho_{12}-\rho_{1X}\rho_{2X})/\sqrt{(1-\rho^2{}_{1X})\ (1-\rho^2{}_{2X})}\\&=-\sigma_1\sigma_2/\sqrt{(\sigma_3{}^2+\sigma_1{}^2)\ (\sigma_3{}^2+\sigma_2{}^2)}\end{aligned} \tag{3.4}$$

using (3.3). When $\sigma_1=\sigma_2=\sigma_3$, (3.4) shows that $\rho_{12.X}=-1/2$, as stated above. A simpler analysis on the same lines for two categories gives $\rho_{12.X}=-1$, as we feel it should. $r_{12.X}$ is calculated from r_{12}, r_{1X} and r_{2X}, these ccs being based on actual numbers, *not* percentages.

When n = number of sets ($=97$ here) the test of significance will be—

$$z=(r_{12.X}-\rho_{12.X})/\sigma \tag{3.5}$$

with σ estimated (n not being small) by—

$$\sigma=(1-\rho^2{}_{12.X})/\sqrt{(n-1)}. \tag{3.6}$$

In the null-hypothesis case z, as estimated, will be distributed approximately as N (0, 1).

Within the large matrix of correlation coefficients between percentages, there were originally 10 of the within-array type. These are specified in Table 3.6. Column 7 shows that all correlation coefficients, except that for case 2, are highly significant (null-hypothesis normal ·01 probability point is 2·58). Case 1 means that, with town population given, there is a negative relationship between number aged 0–14 and number aged 65+. Otherwise: a town with a high population of children is likely to have a low proportion of old persons. On the other hand, case 2 shows that, with total labour force given, there is no significant relationship between number in labour and transport occupations and number in professional occupations.

Apart from case 1, only case 6 has a significant negative partial cc, i.e. pertaining to the professional and the semi- and unskilled manual social groups; towns high in the one will be low in the other. All the other z's are positive, mostly highly so. It is perhaps natural that the industrial group (cases 3, 4, 5) should "hang together"; the case 10 result can be rationalised by the consideration that towns with a large number of dwellings built before 1900 are also likely to have a large number built since 1961, the latter perhaps in substitution for a proportion of the former which have become dilapidated.

Perhaps the major point in this analysis by partial correlation is the quasi-theoretical one that the simple correlation coefficients based on the tabled percentages, within the same arrays, are quite invalid. They are given in column 3. They are about as different as they could be from the figures in column 4. All coefficients in column 3 are negative, more than half in column 4 are positive.

As a result of this aspect of our research, of which we became aware only towards its end, we have decided to omit all references to intra-array correlation coefficients based on percentages, from this chapter and from the associated Appendix Tables A3 and A4.

TABLE 3.6: *Significance of relationship between pairs of variables within the same arrays*

Short description of pairs (1, 2) of variables	*Variable numbers*	*ccs between percents*	*Partial ccs between actual numbers* $r_{12.x}$	$\rho_{12.x}$	σ	*z = cols.* $(4-5) \div 6$
1	2	3	4	5	6	7
1. Ages: 1 0–14, 2 65+	7, 8	−·80	−·65	−·11	·1008	−5·4
2. Occupations: 1 lab. 2 prof.	18, 19	−·47	−·13	−·07	·1015	−0·6
Industries:						
3. 1 manuf. 2 commerce	28, 30	−·57	·30	−·35	·0895	7·2
4. 1 manuf. 2 PA, professions	28, 31	−·66	−·06	−·37	·0883	3·5
5. 1 commerce, 2 PA, professions	30, 31	−·11	·64	−·20	·0979	8·6
Social Groups:						
6. 1 professional, 2 s. and u. manual	33, 34	−·47	−·34	−·06	·1017	−2·7
7. 1 s. and u. manual, 2 non-manual	34, 35	−·70	·31	−·49	·0777	10·3
8. Dwellings: 1 rooms 1-3, 2 rooms 5+	37, 38	−·66	·20	−·38	·0875	6·7
9. Family size: 1 persons 1–3, 2 persons 7+	39, 40	−·65	·63	−·27	·0948	9·5
10. Dwellings: 1 old, 2 new	43, 44	−·68	·51	−·34	·0903	9·5

Notes

Cols. 1 and 2: For full description see Table 3.1

Col. 3: Calculated from percentages within arrays. These are invalid—see text.

Col. 5: See formula (3.4).

Col. 6: See formula (3.6).

2. *Multivariate Regression*

As a natural sequence to correlation we now essay single equation multivariate analysis, a main object of which is forecasting. So, this method might tell something about the prospect and potential of each town.

Regressions for Population Growth

Our main variable has been percentage growth in population in the intercensal period 1961–71. Regarding this a dependent variable (or "depvar"), Table 3·7 shows four regressions using the various sets of independent variables ("indvars") specified. As we have in mind forecasting the percentage increase in the period 1971–81 we must rely on Census data available in 1971 for the four regressors; similarly, for our 1971 forecasts we must use as indvars data available in 1961.

These four regressions are the "best" we have been able to derive, in the following sense. We prepared 1961 data for 17 indvars, selected from our correlation matrix as most likely to be useful. A regression on the whole 17 yielded a $\bar{R}^2$ of only ·78 which gave an idea of the level of $\bar{R}^2$ to be expected, using a more reasonable number of indvars. Many combinations of indvars from the original 17 were tried; it will be seen that in the case of the four regressions all values of $\bar{R}^2$ are of the same order of magnitude as the ·78 cited above: we cannot hope to do much better. However, no claim can be made that the four are optimal in any absolute sense. It is merely stated that, for each of the four, given the selection of indvars, no additional variable (of the 17) added significantly to the explained sum of squares. The F-test in all cases indicates overwhelming regression significance.

The Tau-Test for Residuals

The tau-test in the last column of Table 3.7 was devised by one of us* as a simple substitute for the familiar von Neumann/Durbin-Watson (DW) test of residual autoregression. It involves merely a count of sign changes in the residual vector. In the case of absence of autocorrelation DW tends asymptotically to 2, tau to N/2. Research has shown that, while possibly DW is more efficient (for detection of residual autoregression) than tau, tau is far more powerful than its simplicity would lead one to expect. Absence of residual autoregression is a desirable feature in ordinary least squares regression.

There may be some general interest in the tau methodology used for Table 3.7. DW and tau were originally designed for application to time series; the methodology here shows how they can be used with *all* kinds of multivariate regression. In using either statistic it is implied that the depvar series, and the set of indvars collectively, are so ordered at the outset as to be significantly autocorrelated for, if not (i.e., if the variables were randomly ordered), the

*R. C. Geary: 'Relative efficiency of count of sign changes for assessing residual autoregression in least squares regression "*Biometrika*" 57, No. 1, p. 123, 1970.

residuals also would be prone to non-autoregression, so that the test would be ineffective as an indicator of adequate (sometime called *complete*) relationship.

TABLE 3.7: *OLS regressions of percentage increase in population* 1961–71 *(depvar) on four sets of* 1961 *values of indvars.*

No.	*Intercept*	*Indvars* 2	4	5	7	8	9	20	21	$\bar{R}^2$	*F*	*Tau*
1	313·7	−·3			−·8	4·8			6·0	·68	52·3	34
	(3·6)	(2·8)			(7·2)	(2·2)			(4·8)			
2	279·8	−·1	−·3	−10·7	−·6	8·2	·2	1·9	5·1	·79	44·8	34
	(1·8)	(0·7)	(4·5)	(2·8)	(4·5)	(3·4)	(3·1)	(2·1)	(4·0)			
3	359·2		−·3	−22·0		8·7	·2	1·1	5·7	·74	46·9	44
	(2·2)		(5·2)	(7·1)		(3·4)	(2·0)	(1·1)	(5·0)			
4	25·2			−15·2	−·7	12·2	·3		4·0	·73	51·6	38
	(·2)			(4·2)	(4·5)	(5·1)	(3·7)		(4·1)			

Notes.

For key to indvar numeration see Table 3.8 and Note thereto. Figures in brackets under coefficient values are Student-Fisher *t*-values. Most are significant at the ·05 null-hypothesis probability level.

Note that while improvement in $\bar{R}^2$ is regular as indvars increase in number from 4 to 8, it is not considerable.

It is *not* the 8-indvar case (No. 2) that yields the non-autoregressive equation, but the 5-indvar (No. 3). In fact one-sided null-hypothesis probability for $\tau = 34$ is approximately ·002, 38 about ·025, but 46 about ·15, the latter being not significant, i.e., autoregression probably absent.

So it was in the case of Table 3.7. Originally the towns were ordered according to population in 1971 and residual autoregressive values of DW near 2 and of tau near N/2 were produced for all four equations, indicating no significant autoregression. But this was because the ordering was ineffective: as indicated frequently throughout this study, town size is very insignificantly related to all other variables.

Now for the point of methodology which we recommend for application in all cases of time series or other regression: re-order the observations according to the magnitude of the principal component of the indvars when these number more than one; if one only re-order according to its magnitude. In the case of two indvars, the observations should be ordered according to the sum of the indvars, which is proportional to the first component. It is assumed that all variables have been normalised to zero mean and standard deviation of unity. So, DW and tau are, so to speak, sensitised; all other regression statistics (coefficient values, $\bar{R}^2$ etc.) are invariant to order.

For the tau in Table 3.7 (as the Note shows) three of the regressions indicate residual autoregression, only number 3 being non-autoregressed. In simple terms, only for number 3 can the regression be regarded as satisfactory, as regards non-autoregression of residuals.

Quasi-forecasts of Growth Using 1971 *Data as Indvars*

For each town the estimated percentage growth rates for 1971–81 were first found by substituting the 1971 values of the indvars into each of the four regressions in Table 3.7. We hasten to add that we did not seriously regard these figures as "forecasts", first because the error of extrapolated estimate is too large in all cases (i.e., $\bar{R}^2$ is too small), secondly (and less important) because such "forecasts" would be autonomous, i.e., they assume that conditions affecting the growth of each town would be the same in 1971–81 as in 1961–71. We refrain from presenting the actual figures. Instead we averaged the four for each town and arrayed them ordinarily, with the highest value, for Rathcoole as 1. The result is shown in column 2 of Appendix Table A3, with four other orderings.

Regression for Seventeen Variables

In Table 3.8 we show 17 regressions for some leading variables. As in Table 3.7, depvars relate to 1971 and all indvars relate to 1961 except migration (which refers to 1961–66). Regression (3) is the same as number 1 in Table 3.7. In Table 3·8 "(x)" mean variable x. A key to the variables is appended; the numbering of variables is *not* that of Table 3.1. Wherever possible, a lagged value of the depvar is included amongst the indvars; sometimes this was not possible, e.g., (28), cars per 1,000 population, for which no value was available prior to 1971. All regressions (by (F-test) are conventionally significant though some are only mildly so. Disturbance values are omitted.

While some of the F-values are small all are highly significant of regression reality. Many of the $\bar{R}^2$ are satisfactorily high. It can be seen from Table 3.8 that the equations with the highest degrees of predictive power, as adjudged by the value of the adjusted correlation coefficient, are those relating to the percentage of dwellings built 1961–71 (31), the percentage of dwellings with bath or showers (32), the proportions of persons aged 65 or over (34), the percentage of the gainfully occupied in professional occupations (40), and the percentage at work in agriculture, mining and manufacturing (47). By far the greatest part of the variance of these variables was accounted for by the lagged value of the depvar itself: from the bracketed $\bar{R}^2$ values we note that in several cases the simple regression on the lagged value of the depvar yielded nearly as high an $\bar{R}^2$ as the full regression. The variables which proved most difficult to predict were the percentage of the gainfully occupied in labouring and transport (39), and the fertility rate (38); the latter result is not surprising, as some demographic variables are known not to respond to economic factors.

TABLE 3.8: *Seventeen OLS regressions, depvars relating to* 1971 *and indvars to years previous*

	$\bar{R}^2$
(3) = 313·7 − ·3 (2) − ·8 (7) + 4·8 (8) + 6·0 (21)	·68
(3·6) (2·8) (7·2) (2·2) (4·8)	
(28) = 548·1 + 12·6 (8) + 4·6 (22) + 12·1 (25,)	·51
(2·5) (2·9) (1·8) (4·5)	
(29) = − 11·7 + 1·0 (21) + ·8 (25)	·54 (·47)
(1·7) (3·9) (2·6)	
(30) = 53·8 − 33·9 (18) + ·5 (21) + ·4 (22)	·57
(6·1) (3·6) (5·5) (3·3)	
(31) = − 33·0 + 35·7 (18) + ·2 (20) + ·7 (21) + ·7 (25)	·83 (·76)
(3·3) (3·9) (2·4) (5·3) (5·4)	
(32) = 29·0 + 10·3 (18) + ·1 (21) + ·7 (22) − ·6 (23) + ·2 (25)	·89 (·80)
(6·0) (2·1) (1·4) (12·5) (2·7) (2·6)	
(33) = 8·4 + ·2 (5) + ·4 (8) + ·01 (9) − ·1 (11)	·64 (·37)
(2·5) (2·4) (6·5) (2·5) (3.3)	
(34) = 2·2 + 1·0 (6) − ·02 (17) − ·1 (25)	·90 (·86)
(1·5) (20·9) (1·9) (6·9)	
(35) = 741·9 − 20·0 (5) − 14·9 (6) + ·9 (7) + ·1 (9)	·48 (·27)
(8·6) (5·4) (3·9) (7·0) (2.2)	
(36) = 32·6 + ·5 (8) − ·02 (13) + ·1 (21) − ·3 (24) + ·3 (25)	·74 (·59)
(5·2) (4·1) (1·9) (1·8) (3·3)	
(38) = 777·7 + ·3 (9) + 4·1 (12) − 2·9 (25)	·29 (·18)
(9·2) (3·7) (2·2) (3·8)	
(39) = 8·1 + ·01 (7) + ·02 (10) − ·04 (14) − ·1 (25)	·25
(3.5) (3·6) (10·6) (1·4) (2·9)	
(40) = 17·0 − ·02 (7) + ·1 (22) + ·5 (24) + ·1 (26)	·81 (·63)
(5·9) (7·5) (3·2) (11·6) (2·8)	
(41) = 163·3 − ·5 (12) + ·3 (13) + ·1 (4) + 7·6 (24)	·51
(2·9) (0·3) (3·2) (2·1) (6·4)	
(43) = 34·3 + ·03 (13) − ·8 (23) + ·6 (26)	·45 (·40)
(9·4) (2·3) (2·8) (7·3)	
(46) = ·3 + ·004 (8) + ·4 (23) − ·1 (25)	·45 (·38)
(·2) (2·1) (4·6) (2·7)	
(47) = 6·5 − ·4 (5) + ·4 (8) + ·8 (10)	·80 (·77)
(1·7) (3·4) (3·6) (16·9)	

Notes

It was regrettably necessary to change variable number code (in parentheses) for this table from that of Table 3.1. See key on page 55.

Figures in parentheses under coefficient values Student-Fisher *t*-values. Most are significant at ·05 null-hypothesis probability level.

Figures in parentheses after some of the $\bar{R}^2$ are simple OLS regression values, the single indvar being a lagged value of the depvar, such indvar being also included in the multivariate regression.

Disturbance values are ignored.

Key to Table 3.8

Depvars (figures relate to 1971 unless otherwise indicated).

(3) Per cent population change 1961–71.
(28) Cars per 1,000 population.
(29) Migration 1966–71.
(30) Per cent dwellings built with 5 + rooms.
(31) Per cent dwellings built 1961–71.
(32) Per cent dwellings with bath or shower.
(33) Per cent persons aged 0–14.
(34) Per cent persons aged 65 +.
(35) Dependency ratio.
(36) Per cent married or widowed aged 15–44.
(38) Fertility rate.
(39) Per cent gainfully occupied in labour/transport
(40) Per cent gainfully occupied in professions.
(41) Female-male ratio amongst gainfully occupied.
(43) Per cent aged 14–19 at school.
(46) Unemployment rate.
(47) Per cent at work in ag., min., man.

Indvars (figures relate to 1961 unless otherwise indicated).

(2) Per cent population change 1926–61.
(4) Sex ratio (ages 15–44).
(5) Per cent persons aged 0–14.
(6) Per cent persons aged 65 +.
(7) Dependency ratio.
(8) Per cent married or widowed aged 15–44.
(9) Fertility rate.
(10) Per cent at work in ag., min., man.
(11) Per cent in commerce and transport.
(12) Per cent in public administration and professions.
(13) Distance from Dublin.
(14) Distance from large towns.
(18) Per cent persons in private households.
(20) Per cent dwellings built before 1918.
(21) Per cent dwellings built 1946–61.
(22) Per cent dwellings with bath or shower.
(23) Unemployment rate.
(24) Per cent at work in professions.
(25) Migration 1961–66.
(26) Per cent aged 14–19 at school.

We have produced Table 3.8 as a natural extension of the *cc* treatment; it is in no way intended to be a complete system of simultaneous equations, nor is it theoretically "pure" in that a significant amount of *a priori* theorising preceded the specification of the equations. At the very least, however, Table 3.8 indicates which variables are easiest to forecast. We do not use this table in our final assessment; we shall be gratified, however, if other researchers find it interesting or useful, or if it starts them on their way.

Chapter 4

Component and Cluster Analysis

In the preceding chapter the relationships between a relatively large set of variables were explored by calculating the coefficient of correlation between every pair of variables. The magnitude of the correlation coefficient indicated how closely related the pair of variables were, and the sign of the coefficient told whether the two variables tended to move in the same or opposite directions. Furthermore, a statistical test of significance showed how likely or unlikely it was that an observed relationship between two variables was a regular, systematic relationship, and not a purely random or accidental observation.

In this chapter, certain of these correlation coefficients are used as the basic data for a principal component analysis,* the main features of which are explained below, together with an explanation of why those particular correlations were chosen as input for the procedure. Succeeding sections present the detailed results of the component analysis; the first component, which can be clearly identified as an indicator of "goodness", is then used to rank the 97 towns in order of "goodness". Subsequently, the technique of cluster analysis is used, to group towns into groups or clusters, the towns in each cluster sharing a set of common characteristics. Two sets of clusters are identified: one splits up the whole 97 towns, using four components as the basis of discrimination; the other groups 85 towns (all the towns except the 12 Special Towns) on the basis of ten variables. In short, this chapter attempts to answer two questions: *what towns have benefited most from growth, and what towns are most alike?*

Component Analysis (an Explanation)

Component analysis† is designed to exhibit the inherent structure of a set of original variables which, for reasons given later, we have taken at 32. Components are linear expressions of the original variables, which they equal in number, i.e., in our case 32. The meaning of the first, or principal, component is unambiguous: it best expresses in linear form all that the original variables (usually highly correlated) have in common. This principal component itself "explains" a certain amount of the variation between the original variables. The second component "explains" the amount of the variation between the original variables when allowance has been made for the effect of the first

*The terms 'principal component analysis' and 'component analysis' are completely interchangeable; for convenience, the largely redundant 'principal' is omitted in the remainder of the text.

†An excellent treatment of component analysis and its closely associated discipline, factor analysis, will be found in *Factor Analysis as a Statistical Method* by D. N. Lawley and A. E. Maxwell (London, Butterworth, 2nd ed., 1971). By the way, our principal reason for adopting component in preference to factor analysis was, as these authors point out "when [component analysis] is employed no hypothesis need be made about the [original variables]". This no-hypothesis attitude is in keeping with ours (see Chapter 1). We hope others will form hypotheses and use factor analysis on our data.

component; and so on. Following are the principal properties of components, other than those cited:—

(i) Each original variable in the analysis has the same weight, i.e., importance. When the variance of each is deemed unity the sum squares (SS) of the system therefore equals the number of original variables (k).

(ii) The latent roots, or eigen values of the correlation matrix, all positive, in descending order of magnitude yield the variances of the components, the sum of which is therefore k. The eigen vectors are the coefficients of the original variables in the expressions for the components.

(iii) Different from the original variables, each pair of components are exactly uncorrelated, i.e., each cc = 0. This is the most remarkable and most convenient property of component analysis.

The principal object of component analysis is to summarise, the usually large number of original variables (as in our case) by a more manageable number (perhaps 4 or 5), thus rendering the system amenable to analysis. Unfortunately the derivation of such number unambiguously in all cases is not possible. We discuss this topic in the appendix to this chapter, giving our own empirical solution applicable to the present data.

The Choice of Variables

Of the 67 variables whose inter-relationships were examined in Chapter 3, 32 were selected for inclusion in the component analysis. This selection was based on two principles. First, the variables were members of a reasonably closely-related set; if the variables are not correlated with each other, component analysis breaks down. Secondly, largely tautologous variables among the roughly 70 candidates for inclusion were excluded—for example, the percentage of the population employed in administrative and professional *occupations* (19) is included, but the percentage in public administration and professions, classified on an *industrial* basis (31), is excluded. This pruning of tautologous variables was necessitated by the fact that, as already stated, components are linear combinations of the variables included: in other words, if a block of near-identical variables are included, artificial components are automatically created as a result. It is essential to include in the analysis only those variables that are thought to be, in some sense, significant or relevant.

Successful reduction of the number of original variables to a small number of components depends on the amount of the total variance of the system absorbed by a few of the largest latent roots. In general, the percentage of variance accounted for by a small number of components is determined by the overall degree of correlation in the system. As a result of the way we reduced the set of 71 variables to 32, the average correlation of the set increased, so that it was found that the 32 variables synthesise into far fewer components than could the original 71, a potent argument for the 32 selection.

For what follows each original variable has been standardised, i.e., adjusted to have a mean equal to zero and variance of unity; this makes no difference to any of the results.

Present Application

The 32 latent roots are shown in Table 4.1.

TABLE 4.1: *Latent roots and percentages of total variance*

Component No.	*Latent Root*	*Percentage of variance*	*Cumulative percentage*
1	10·53	32·9	32·9
2	5.65	17·7	50·6
3	3·54	11·1	61·6
4	1·94	6·1	67·7
5	1·35	4·2	71·9
6	1·16	3·6	75·5
7	·91	2·8	78·4
8	·83	2·6	81·0
9	·78	2·4	83·4
10	·68	2·1	85·5
11	·63	2·0	87·5
12	·48	1·5	89·0
13	·47	1·5	90·5
14	·40	1·2	91·7
15	·39	1·2	92·9
16	·32	1·0	93·9
17	·29	·9	94·8
18	·26	·8	95·6
19	·22	·7	96·3
20	·21	·6	97·0
21	·17	·5	97·5
22	·13	·4	97·9
23	·12	·4	98·3
24	·11	·4	98·7
25	·09	·3	98·9
26	·08	·2	99·2
27	·07	·2	99·4
28	·06	·2	99·6
29	·05	·2	99·8
30	·04	·1	99·9
31	·02	·1	99·9
32	·02	·1	100·0
Total	32·00	100·0	100·0

The third column illustrates the theoretical point that the sum of the latent roots equals the number of variables, which, in turn, due to the standardisation of the variables, equals the total variance of the system. It is reasonably satisfactory that the first component accounts for one-third of this total variance, and—see last column—that the first four account for two-thirds.

Table 4.2 shows the first 10 latent vectors, i.e. the coefficients (or *weights*) which are to be applied to the values of the standardised variables shown at the left of the table in order to produce the values of the components. For example:—

Component 2 = $-\cdot098$ var. 2 + $\cdot017$ var. 3 + = ... $-\cdot105$ var. 67.

Conversely, the table also shows how to express a particular variable in terms of components. For example:—

Variable 4 = $-\cdot183$ comp. 1 $-\cdot019$ comp. 2 + ... $-\cdot200$ comp. 10
+ effects of the other 22 components.

Principal Results of the Analysis

Table 4.1 shows that the first component accounted for almost one-third of total variance, and that the first four components together accounted for over two-thirds of the total variance. This may be compared with the findings of Moser and Scott, in their classic pioneering study of British towns*: their first component, derived from a 57 variable analysis, accounted for just over 30 per cent of variance, and the first four components accounted for just over 60 per cent.

Our objective in using component analysis is to obtain a small number of components which effectively synthesise the bulk of the information provided by the much larger set of 32 variables. Formal statistical theory, however, does not provide a satisfactory objective test for deciding how many components shall be considered to have effectively summarised the original data. Various rules of thumb exist: among these are rejection of any component corresponding to a latent root of less than unity (which implies, in this situation, that the component adds less to the variance than a single variable), and rejection of components beyond the first sharp discontinuity in the column of latent roots. The first of these methods would retain six of the present set of components; the second method does not give a clear-cut answer.

A statistical appendix to this chapter indicates why an existing statistical test failed to give a satisfactory answer to the problem. As a result, we devised a test of our own; details of its derivation and application may also be found in the statistical appendix. This test, in which we have considerable confidence, indicated that there were only four effective significant components; only these four components are retained below.

*C. A. Moser and W. Scott, *British Towns—a statistical study of their economic and social differences* (Oliver and Boyd, 1961).

Table 4.2: *Unitised latent coefficient vectors, 1–10*

Original variable	Component no.–									
	1	2	3	4	5	6	7	8	9	10
2 Population in institutions	·070	−·098	·457	·074	·011	·140	−·052	·114	−·104	−·160
3 Population change 1926–61	−·198	·017	·074	·163	−·026	·121	·316	·507	·072	−·220
4 Population change 1961–71	−·183	−·019	·182	−·179	−·426	−·013	·185	−·051	·063	−·200
6 Female-male ratio	·122	−·218	−·100	−·153	·019	−·445	−·080	·340	·058	−·081
7 Aged 0–14	−·184	·221	−·223	·181	−·092	−·141	·121	−·012	·109	−·025
8 Aged 65+	·228	−·190	·068	−·080	·045	−·030	−·121	−·030	−·004	−·191
11 Married aged 15–44	−·275	·042	−·157	−·064	−·075	−·020	−·132	−·008	−·008	−·062
12 Change in 11, 1961–71	−·149	−·111	·153	−·135	−·295	−·305	−·145	−·317	·258	−·093
13 Fertility	·149	·089	−·081	·325	−·439	−·153	·117	−·191	·076	−·094
16 Migration	−·264	−·022	−·008	−·073	−·182	·013	−·262	·036	−·074	·065
19 Adm.+Prof. occupations	−·013	−·236	·372	·075	−·178	·152	−·013	−·073	·058	−·057
20 Female-male ratio GO	·156	−·183	·273	−·113	·040	−·222	−·049	·221	−·067	·090
21 Schooling 14–19	·029	−·241	−·214	·228	·160	·175	·072	−·081	−·217	−·333
27 Unemployment	·186	·109	−·107	·095	−·187	−·035	−·299	·415	·178	−·240
28 Manufacturing and industry	−·103	·307	−·025	−·262	·040	−·083	·251	·021	−·181	−·175
30 Commerce and industry	·066	−·192	−·342	·229	−·132	·018	−·176	·132	·228	·167
34 Semi and unskilled soc.	·049	·310	−·046	−·195	−·052	−·043	−·236	·250	−·082	−·075
36 Non-manual soc. 1966	−·023	−·355	·078	·288	−·076	·082	−·047	·047	·099	·174
37 Dwellings 1–3 rooms	·198	·068	·023	−·192	−·194	·266	·224	·097	−·049	·467
38 Dwellings 5 or more rooms	−·264	−·132	·015	·049	·097	−·180	·053	−·062	−·136	−·052
39 Pop. 1–3 person households	−·005	−·262	−·216	−·358	−·007	·175	−·157	−·010	−·093	−·046
40 Pop. 7+ person households	·165	·228	·065	·333	·059	−·211	·086	−·037	−·008	·071
41 Rooms per dwelling	−·199	−·188	−·050	·085	·311	−·289	·963	−·016	−·008	−·165
43 Dwellings before 1900	·203	−·060	−·187	−·263	·123	−·010	·188	−·171	·202	−·104
44 Dwellings 1961 or later	−·287	·006	·043	−·037	−·206	−·005	−·063	·087	−·068	−·008
47 Bath or shower	−·256	·030	·116	·136	−·035	−·037	·019	·112	−·182	·123
58 Telephone	−·173	−·165	−·025	−·087	·054	−·181	·321	·259	·304	·360
59 Television	−·226	·012	−·149	−·030	−·010	·148	−·285	·045	−·219	·147
60 Car	−·245	−·143	−·144	−·036	·105	·088	·120	−·049	·140	·050
65 Public houses	·045	−·224	−·261	·089	−·311	·136	·123	·006	−·222	−·072
66 Distance from Dublin	·157	−·175	−·138	−·189	−·220	·010	·341	·155	−·102	−·189
67 Distance from large town	·147	−·105	−·058	·024	−·139	−·407	·012	−·091	−·610	·257

Note
For full description of original variable see Table 3.1

The Interpretation of the Components

Component 1—Reading from Table 4.2, it can readily be seen that the first component assigns high negative scores to those variables which are associated with the benefits of growth, and assigns high positive scores to those variables which represent the disadvantages of stagnation.* For example, the coefficients relating to the percentage of new houses, the percentage of people married, the percentage of houses with five or more rooms, the percentage with baths, the migration rate, and the ownership of cars and televisions are all high and negative. Conversely, the percentage of old houses, the percentage of old people, and the percentage of small houses have coefficients which are large and positive. It is clear that the first component is a highly discriminating measure of the welfare and amenities to be derived from growth, and the pattern of coefficients confirms the important finding of Chapter 3, that growth in Ireland has, as far as we have measured it, been an unambiguously beneficial process. In the following section, the value of the first component has been calculated for each town, and the towns ranked in decreasing order of "goodness".

Component 2—Inspection of the two largest coefficients, a high negative coefficient on the percentage in non-manual occupations and a high positive coefficient on the percentage in semi- and unskilled manual occupations, immediately suggests that the second component is in some measure related to social class. This is, in fact, borne out by examination of other large coefficients: negative coefficients attach to such variables as the percentage in professional occupations, the percentage of children in school in 1966, the number of public houses and the percentage of small families. Positive coefficients distinguish the percentage working in production,† the percentage of young people and the percentage of large families. The value of the second component for a particular town indicates, therefore, whether the characteristics of the town are those of a largely upper-class population or those of a largely lower-class population.

Component 3—By far the largest coefficient is a positive one relating to the percentage in institutions. The third component tends to distinguish those towns which possess a large institution, such as a regional hospital; this is confirmed by positive coefficients on the percentage in professional occupations (doctors, nurses, religious orders) and on the sex ratio among the gainfully occupied, again influenced by the relatively large numbers of nurses and nuns. Looking at the pattern of negative coefficients, those relating to the low percentage in commerce and transport industries and perhaps to the low number of pubs, are to be expected. Subsequent calculation of the scores for each town on the third component demonstrated in a remarkable manner the consistency with which the third component identified towns possessing

*It is immaterial that the "good" characteristic coefficients were negative; in each component, all coefficients can be changed in sign, if desired.

†The percentage engaged in agriculture, mining and manufacturing, variable No. 28 in Table 3.1.

a large institution; far and away the greatest score was that for Portrane, where a large mental hospital is situated.

Component 4—The fourth component groups together, with positive coefficients, a set of demographic variables, such as large families and high fertility, with a set of economic variables typical of towns dependent on service type activities. Those characteristics were shown to be related by the correlation approach. The negative coefficients conversely relate to manufacturing towns. It is difficult to interpret this component which, in terms of the size of the coefficients, is dominated by three demographic variables but it is tempting to suggest that towns which score high on this component are service-type towns as distinct from manufacturing towns although the pattern of coefficients does not allow one to be definitive about this. Towns with large positive scores include Mullingar, Portlaoise, Tuam, Kildare, Castleisland, Castlerea and Claremorris. The largest negative score is that for Kinsale. Shannon, Leixlip and Rathcoole also have large negative scores.

In sum, then, it can be said that, underlying the variegated picture presented by the 32 variables analysed, four basic factors account for over two-thirds of the variance: a growth-related factor, a social class factor, an institution factor, and possibly a factor associated with the function of a town.

Classification by the First Component

Table 4.3 lists all 97 towns in descending order of the value of the first component. This classification according to a statistically derived index of "goodness" shows some very definite patterns, which are of importance in assessing the regional impact of economic growth in Ireland.

Those towns which have grown fastest and obtained all the benefits which we have demonstrated to be associated with growth are almost exclusively concentrated in the eastern half of the country. Even more significant, of the top twenty towns, only three can be regarded as growing autonomously: Shannon, Naas and Arklow, and even then it is questionable whether Naas falls into the sphere of influence of Dublin or not. Of the remaining seventeen, fourteen are satellites of Dublin, one is a suburb of Cork, one a satellite of Drogheda, and one a satellite of Waterford. At the other end of the scale, the towns which have shared least in the fruits of development are to be found, in general, in the western half of the country. Portrane should be regarded as an exception, as the presence of a very large institution tends to distort its statistics.

The sharp drop in the value of the component after about 11 or 12 towns bears out the point that autonomous growth in Ireland has been of very limited significance. After a further sudden decline, roughly after about 28 towns, the majority of the towns shade gradually without a break from moderate to extremely poor development, no groupings comparable to the first dozen or so being apparent—except, perhaps, for Kilrush and Cahirciveen, which could legitimately be regarded as especially underdeveloped. Attempting

TABLE 4.3: *Towns ordered according to value of first component*

Order		Town	Score
1	42	Shannon Airport	38.6
2	89	Rathcoole	32.9
3	15	Tallaght	32.1
4	44	Blanchardstown	25.5
5	90	Portmarnock	25.4
6	32	Lucan	24.6
7	67	Leixlip	23.9
8	33	Swords	22.8
9	6	Clondalkin	22.7
10	39	Malahide	20.8
11	78	Ballincollig-Carrig	16.7
12	85	Laytown	10.6
13	13	Droichead Nua	8.1
14	30	Greystones-Delgany	7.8
15	23	Naas	6.1
16	40	Tramore	6.0
17	50	Skerries	5.5
18	7	Arklow	3.8
19	94	Celbridge	3.4
20	41	Balbriggan	2.8
21	8	Navan	2.8
22	65	Carrickmacross	2.7
23	87	Castlerea	1.6
24	57	Passage West	1.6
25	46	Kildare	1.3
26	72	Trim	1.2
27	62	Rush	1.0
28	4	Cobh	.9
29	36	Wicklow	.4
30	92	Claremorris	.1
31	86	Carrick-on-Shannon	− .1
32	21	Nenagh	− .7
33	12	Portlaoise	− 1.2
34	10	Mallow	− 1.2
35	91	Donegal	− 1.4
36	47	Portarlington	− 1.7
37	88	Cahir	− 1.8
38	49	Loughrea	− 2.0
39	3	Tullamore	− 2.1
40	38	Roscrea	− 2.2
41	19	Monaghan	− 2.2
42	45	Ardee	− 2.2
43	70	Muinebeag	− 2.3
44	5	Thurles	− 2.6
45	48	Edenderry	− 2.8
46	20	Letterkenny	− 2.8
47	22	New Ross	− 2.9
48	55	Roscommon	− 3.1
49	28	Midleton	− 3.2
50	84	Castleisland	− 3.4
51	75	Templemore	− 3.4
52	26	Longford	− 3.5
53	61	Ceannanus Mor	− 3.5
54	25	Tuam	− 3.6
55	51	Gorey	− 3.7
56	1	Mullingar	− 3.9
57	17	Youghal	− 4.2
58	35	Fermoy	− 4.2
59	83	Boyle	− 4.3
60	2	Killarney	− 4.4
61	11	Castlebar	− 4.4
62	29	Athy	− 4.6
63	31	Cavan	− 4.7
64	37	Birr	− 4.7
65	56	Mitchelstown	− 4.7
66	82	Tullow	− 4.8
67	93	Monasterevan	− 5.5
68	31	Kinsale	− 5.6
69	73	Rathluirc	− 5.8
70	68	Castleblayney	− 5.9
71	76	Clones	− 6.0
72	18	Dungarvan	− 6.1
73	77	Clara	− 6.2
74	24	Carrick-on-Suir	− 6.2
75	34	Bandon	− 6.4
76	79	Skibbereen	− 6.4
77	9	Enniscorthy	− 6.5
78	97	Cootehill	− 6.7
79	14	Ballina	− 6.8
80	69	Ballyshannon	− 7.4
81	52	Westport	− 7.4
82	53	Listowel	− 7.7
83	27	Tipperary	− 7.9
84	54	Mountmellick	− 8.1
85	96	Rathkeale	− 8.1
86	63	Bantry	− 8.2
87	66	Clonakilty	− 8.3
88	43	Buncrana	− 8.9
89	71	Macroom	− 8.9
90	58	Cashel	− 9.1
91	74	Ballybofey-Stran.	− 9.5
92	16	Ballinasloe	− 9.6
93	80	Kanturk	− 9.7
94	59	Newcastle	−10.3
95	64	Portrane	−10.3
96	60	Kilrush	−11.1
97	95	Cahirciveen	−14.2

to observe groupings of towns is constrained, however, by using one measure alone, which gives only a partial picture of the manifold characteristics of towns. The section following utilises towns' scores on all four components in order to produce a more clear-cut and discriminating grouping.

Cluster Analysis

Cluster analysis is a technique which involves bringing similar items, in this case towns, together in a number of clusters. Many difficult procedures have been evolved for doing this, which, for a large number of items and variables, is impracticable without computer assistance. Our results* are presented below, and tabulated in Table 4.4. An approximate statistical test of significance indicated that two clusterings were statistically significant. One clustering divided the towns into two groups—the first eleven towns in Table 4.3 and the rest. The second clustering produced nine clusters; it is this finer disaggregation which is given in Table 4.4. The clusters have been ordered according to the average value of the first component of the towns in each cluster, number 1 being the lowest.

Description of Each Cluster

Cluster 1 contains only one town, Portrane, which is isolated because of the dominant influence of the large mental hospital. Most other characteristics accrue therefrom.

Cluster 2 seems to contain mainly service type towns with few industries and a high ratio of females employed—probably due to the service nature of its function. These towns have a relatively large number of old people in small families with a high proportion of females. They have few young people, few large families and a low marriage rate. Houses tend to be old, with few new houses being built and a low proportion of houses with baths. The towns tend to be isolated, not only in regard to distance from Dublin but also from the other large towns. Over the period 1926–61 these towns fared badly, in most cases having quite a substantial decline in population, averaging $-13{\cdot}7$ per cent for the group.

Cluster 3 is the largest of all, containing 25 towns. The function of these towns seem to be service-orientated and they have a high unemployment rate. Demographically they seem to be average on all criteria, except possibly as regards their fertility rate, which is slightly above average. While on average these towns grew in both periods, their growth performance relative to other clusters has been poor. Housing conditions are not good, with many old houses, few new ones and a low number of rooms per person contributed by many few-roomed and few many-roomed houses. These towns tend to be relatively distant from Dublin and are low in amenities.

*The method we adopted was that devised by E. M. L. Beale, see his "Euclidean Cluster Analysis", (1969), contributed paper to the 37th Session of the International Statistical Institute. We gratefully acknowledge the help of Martin Joyce, Scicon Computer Services, London (of which E. M. L. Beale is a director), who was responsible for the computer work and aided us with several suggestions.

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TABLE 4.4: *Nine town clusters, arranged according to magnitudes of first four components. 97 town basis.*

Cluster No.	*No. of towns*	*Towns*
1	1	Portrane.
2	11	Fermoy, Westport, Listowel, Cashel, Bantry, Clonakilty, Macroom, Skibbereen, Kinsale, Cahir, Cahirciveen.
3	25	Enniscorthy, Mallow, Ballina, Dungarvan, New Ross, Tuam, Longford, Tipperary, Bandon, Birr, Mitchelstown, Newcastle, Kilrush, Kells, Ballyshannon, Rathluirc, Ballybofey-Stranorlar, Templemore, Clones, Kanturk, Tullow, Boyle, Castleisland, Rathkeale, Cootehill.
4	11	Mullingar, Killarney, Thurles, Castlebar, Ballinasloe, Monaghan, Letterkenny, Cavan, Loughrea, Roscommon, Castleblayney.
5	16	Tullamore, Youghal, Carrick - on - Suir, Midleton, Athy, Roscrea, Buncrana, Ardee, Portarlington, Edenderry, Gorey, Mountmellick, Rush, Muinebeag, Clara, Monasterevan.
6	14	Cobh, Arklow, Navan, Portlaoise, Droichead Nua, Nenagh, Naas, Wicklow, Balbriggan, Kildare, Passage West, Carrickmacross, Trim, Celbridge.
7	8	Greystones-Delgany, Tramore, Skerries, Laytown, Carrick-on Shannon, Castlerea, Donegal, Claremorris.
8	8	Clondalkin, Lucan, Swords, Malahide, Blanchardstown, Leixlip, Ballincollig-Carrigrohane, Portmarnock.
9	3	Tallaght, Shannon, Rathcoole.

The feature which *Cluster* 4 towns have in common is hospitalisation—a large hospital is situated in each town, resulting in a high proportion of the population in institutions, a high percentage of people in professional occupations, and a high sex ratio among the gainfully occupied. These towns tend to have few industries, relatively many old people, few young people and a low marriage rate. These towns are low in amenities, especially cars and television, and are below average in both old and new houses, but not in baths. Their growth has been slightly below average in both periods 1926–61 and 1961–71.

Cluster 5 towns seem to be mainly industrial, high in manual occupations and hence with a high level of unemployment. They have no unusual demographic characteristics and have not fared too badly in the growth context in either of the two periods. There is evidence of overcrowded accommodation as they tend to have small houses with big families and as such are low in rooms per person. They also seem to be low in amenities, particularly cars and 'phones.

Cluster 6 towns are mainly engaged in productive activities and, as such, are low in percentage children (14–19) at school, low in commerce and transport industries, and low in non-manual social groups and professional occupations. These towns, exceptionally, have a low unemployment rate. These fourteen towns are mostly within fifty miles of Dublin, although there are three exceptions, Cobh and Passage West which are situated near Cork, and Nenagh which is 25 miles from Limerick. Demographically they are high in the percentage of children and of big families, low in the percentage of old people and of small families, and have a low sex ratio. Their growth has only been slightly below average in both periods. They have an average proportion of new and old houses but with a slightly higher than average proportion of houses with five or more rooms.

Cluster 7 seems to contain two types of towns: four resort towns, situated within commuting distance of cities, and four towns in the North and West which might be characterised as "good". The towns are high in professional occupations, commerce and transport, non-manual social groups and the proportion of young persons attending post primary school. They are low in manufacture, manual social groups and unemployment. Demographically their only distinguishing feature is a high sex ratio. Their growth was slightly above average in 1926–61 and while they continued to grow over 1961–71, growth was below average. Housing conditions seem to be good with a large proportion of many-roomed houses and a high rooms per person ratio. These towns tend also to be high in amenities.

Cluster 8 contains eight of what we considered to be the Special Towns. They are basically dormitory towns for Dublin except for Ballincollig-Carrigrohane, which fills the same role for Cork. As such they are what we would consider "good" towns by reference to their demographic features, namely, a high marriage rate, mainly young people, few old people, low fertility and few big families, and also by reference to their housing, as they have many new houses with a high proportion with many rooms. No activities stand out as predominant among the inhabitants; they have a low unemployment rate. Their growth has been rapid in both periods and they score high in all the amenity variables.

The feature common to the three towns contained in *Cluster* 9 is that they are newly planned. They have recently grown enormously from a very small base, and they score high by criteria associated with "goodness". The inhabitants of these rapidly growing towns are mainly engaged in productive activity; they have associated with this a low unemployment rate and a low sex ratio among the gainfully occupied. Demographically their most prominent features are a high marriage rate and many young people, with few big families and few old people. Living conditions are good, with mainly new houses and plenty of room. Also they are well provided with all amenities.

Clustering Using Original Variables

The foregoing results seem sufficiently interesting to justify another approach to clustering. In the first place the 9-cluster solution, based on the four leading components, is not very decisive, going by the level of significance indicated by the statistical test used.* In the second place, the formal zero correlation between each pair of the four components must have militated against definitive clustering. Thirdly, some residual suspicion must always attach to constructed indices, such as components, where it is not always possible to be quite definitive about what they represent.

For a new experiment then, we changed these conditions, by clustering using the ten leading variables specified in Table 4.6. Unlike the components, they are highly intercorrelated and they are, by definition, specific: we know what they represent. Analysis was confined to the 85 towns, i.e., Special Towns were excluded. Our results are given in Tables 4.5 and 4.6. Table 4.5 lists the towns in each cluster, and Table 4.6 indicates the characteristics of each cluster.

Clustering on an original variables basis turned out to be statistically significant almost to an embarrassing degree. In trials ranging from 20 to 2 clusters, i.e. 19 in all, no fewer than 9 were found to be significant F-test ($P = \cdot 05$), namely, clusterings of 15, 13, 12, 11, 9, 8, 6, 4, and 2 towns. It seemed to us that the significant solution with the most clusters was likely to be the most satisfactory, being most discriminatory. It should be added that each of the 10 variables was standardised (i.e., brought to mean zero, and variance of unity) before being used in the analysis, implying that each of the 10 had the same weight throughout.

Table 4.6 attempts to describe each cluster in terms of the variables on which it scores relatively high or relatively low, "relatively" taking into account the numbers of towns in each cluster.

*Significant at a 10 percent null-hypothesis probability level, F-test. Details of the F-test may be found in Beale's paper, *op. cit.*, or in Scicon Computer Services' manual for the cluster analysis computer program 'Scipac * Clust.'

TABLE 4.5: *Towns in each of fifteen clusters, based on ten leading original variables. 85 town basis*

Cluster no.	No. of towns	Towns
1	2	Skibbereen, Cahirciveen
2	12	Tipperary, Bandon, Fermoy, Westport, Newcastle, Kilrush, Ballyshannon, Macroom, Clones, Kanturk, Boyle, Cahir
3	3	Roscommon, Cashel, Clonakilty
4	3	Killarney, Bantry, Kinsale
5	3	Castlebar, Ballinasloe, Monaghan
6	6	Ballina, Tuam, Templemore, Castleisland, Rathkeale, Cootehill
7	7	Thurles, Dungarvan, Cavan, Loughrea, Castleblayney, Trim, Ballybofey-Stranorlar
8	8	Tullamore, Carrick-on-Suir, Athy, Ardee, Portarlington, Gorey, Mountmellick, Muinebeag
9	8	Cobh, Mallow, Youghal, Midleton, Buncrana, Mitchelstown, Passage West, Rathluirc
10	3	Listowel, Clara, Claremorris
11	11	Enniscorthy, Nenagh, New Ross, Longford, Wicklow, Birr, Tramore, Skerries, Ceannanus Mor, Carrickmacross, Tullow
12	2	Carrick-on-Shannon, Donegal
13	8	Arklow, Roscrea, Balbriggan, Edenderry, Rush, Clara, Monasterevan, Celbridge
14	3	Mullingar, Letterkenny, Greystones-Delgany
15	6	Navan, Portlaoise, Droichead Nua, Naas, Kildare, Laytown-Bettystown-Mornington

Note: For description of variables used in clustering, see Notes to Table 4.6.

TABLE 4.6: *Characteristics of fifteen clusters, based on ten leading original variables*

Cluster number	*Variable number* 1	2	3	4	5	6	7	8	9	10
1	L	H					H		H	H
2							H	L	H	
3	L	H	H	H			H			
4	L			H			H		H	
5	L		H	H						
6										H
7		H								
8	H			L	H	L	L		L	
9					H				H	
10			H		L	H				H
11										
12				H		H				
13	H	L	L		H	L	L		L	
14			H		L	H				
15	H	L		L			L	H	L	

Notes

The ten variables used were as follows:

1. Percent population aged 0–14 years.
2. Percent population aged 65 + years.
3. Percent of gainfully occupied in professions.
4. Female-Male ratio among gainfully occupied.
5. Percent of population at work in production (agricultural, mining and manufacturing industrial groups).
6. Per cent of population in non-agricultural non-manual social groups.
7. Per cent of population in 1–3 person households.
8. Per cent houses built 1961 and after.
9. Distance from Dublin.
10. Public houses per 1,000 population.

"H" indicates that the cluster towns tended to take on the relatively *higher* values of a particular variable, "L" that they took on relatively *lower* values.

It should be understood that the cluster characteristics are determined by reference to *average* values; it does not follow that each town in a cluster possessed identically all the characteristics of the cluster. One can only say that, having regard to 10-dimensional distance, all towns in a cluster are nearer to one another than they are to towns in other clusters. We are content to let Table 4.6 speak for itwelf; interpretation of the results follows the simple lines employed earlier in this chapter when examining the 4-component clustering. We surmise that it will be of interest to town A that it is similar (in an obvious sense) to town B. One can envisage arguments for grants etc. based on this table. At the very least, towns may like to know the company they keep.

Cross-classification of Clusterings

There may be a certain interest in cross-classifying the two clusterings for 85 towns. In Table 4.7 we omit clusters 1, 8 and 9 since these, remarkably, exactly encompass the 12 Special Towns, which are not included in Table 4.5.

It is statistically satisfactory to note that the two clusterings are consistent. No chi-squared test is necessary to show the marked tendency towards "clumping" in the cells: no fewer than 46 of the 85 towns are in clumps of 4 or more. The 6 towns in cluster 6 and the 8 in cluster 8 of the 10-variable clustering, are in cluster 3 and cluster 5 respectively in the 4-component clustering. The exercise may be regarded as a way of breaking up the large numbers of towns in 3, 5 and 6 of the 4-component clustering. We would be inclined to think that the towns in clumps are more similar in statistical characteristics than are those in either of the clusterings separately. Readers will have no difficulty in identifying towns in any clump in Table 4.7 by using Tables 4.4 and 4.5.

TABLE 4.7: *Cross classification of clusterings in Tables 4.4 and 4.5; number of towns; mean value of first component*

Clustering based on 10 original variables	*Clustering based on 4 components*						*No. of towns*	*Mean first component*
	2	3	4	5	6	7		
1	2	.	.	.	.	.	2	−10·3
2	4	8	.	.	.	.	12	−7·1
3	2	.	1	.	.	.	3	−6·8
4	2	.	1	.	.	.	3	−6·1
5	.	.	3	.	.	.	3	−5·4
6	.	6	.	.	.	.	6	−4·8
7	.	2	4	.	1	.	7	−4·2
8	.	.	.	8	.	.	8	−3·9
9	.	3	.	3	2	.	8	−3·2
10	1	.	.	.	.	2	3	−2·0
11	.	6	.	.	3	2	11	−1·1
12	.	.	.	.	.	2	2	−·8
13	.	.	.	5	3	.	8	−·7
14	.	.	2	.	.	1	3	·4
15	.	.	.	.	5	1	6	4·6
Number of towns	11	25	11	16	14	8	85	—
Mean principal component	−7·4	−5·9	−4·1	−3·9	2·3	3·6	—	—

Source: Tables 4.4 and 4.5

Technical Appendix to Chapter 4

Effective Components

OUR objective in using component analysis is to obtain a small number of components which effectively synthesise the bulk of the information provided by the much larger set of 32 variables. Formal statistical theory, however, does not provide a satisfactory objective test for deciding how many components shall be considered to have effectively summarised the original data. Various rules of thumb exist: among these are rejection of any component corresponding to a latent root of less than unity (which implies that the component adds less to the variance than a single standardised variable), and rejections of components beyond the first sharp discontinuity in the vector of latent roots. The first of these methods would retain six of the present set of components; the second method does not give a clearcut answer.

The theoretical statistical criterion is derived by testing the hypothesis, where p is the number of variables (and also the number of components), that the p–k smallest latent roots of R, the correlation matrix, are equal; Lawley and Maxwell [op. cit., p. 20] state that "if this hypothesis is accepted, there is no point in finding more than k components from the data". With some reservations, these authors cite the Bartlett sampling test for equality of roots, given by, where n is the number of observations:

$$B = n\,[-\log_e d_{k+1}\, d_{k+2} \,..\, d_p + (p-k)\log_e d]$$

$$d = (p - d_1 - d_2 - \,..\, d_k)/(p-k).$$

B may be regarded as very approximately distributed as chi squared with $(p-k+2)(p-k-1)/2$ degrees of freedom.

We have no good reason to suppose that the Bartlett test will work with our data. And we are not disappointed—

k	*Degrees of freedom*	*Critical null-hyp. (1-sided) ·005 prob. point*	*Actual value of B*
4	405	482*	1,504
10	252	314*	848
20	77	112·7	217·8

*Approximate

By the Bartlett test even the last 12 roots show no tendency towards equality, although it is obvious, from inspection of the cumulative percentage of variance accounted for by the components (last column of Table 4.1), that the last dozen components, at least, should be found somehow to be "insignificant". This "equal root" approach is of little use with our material for identifying a few leading components. We must find some other way, more apt perhaps to our data, for reducing the number of components to a manageable few.

In psychological studies, component and factor analyses are much used; indeed, development in this branch of statistical science owes much to the needs of psychology. Psychologists are wont to "give a name", such as "intelligence", to each leading component by reference to the variables which have the largest absolute coefficient values.

We tried this approach with our components. In the case of the first component (i.e., No. 1 in Table 4.2), no fewer than 9 of the 32 variables had coefficients greater in absolute value than ·20. A few more had values slightly less than ·20 and all these (some 15) were nearly equal. A similar pattern held for the other leading components. It became obvious in the case of component 1 that the larger coefficient in sign and magnitude picked out the characteristics of what we have termed earlier the "good" town, for example.

This superficial examination revealed that the pattern of coefficients of a particular component was internally consistent, and led us to suspect that there might be a close relation between the set of these coefficients and the set of correlation coefficients between the variable and the largest component coefficient.

In the case of the first component, Table 4.2 shows that the highest coefficient, −·287, was that for variable 44, the percentage of dwellings built since 1961. There were available the ccs of this variable with the other 31 variables 2, 3, 4, . ., 66, 67. The coefficients of the 31 original variables (excluding 44) were ·070, −·198, −·183, ..., ·157, ·147. The cc between the latter two series has the satisfactorily high value of ·94.

This procedure was followed for all 32 components, and the results are shown in the table below. With each correlation coefficient is associated a probability, and the rejection procedure employed is to discard those components for which the correlation coefficient, as calculated above, exceeds some conventional level of null-hypothesis probability. The *rationale* behind the method is that those components which fail to pass the objective test of consistency, as described above, are not meaningful distillations of the original data, but are merely algebraic constructs attempting to mop up the residual unexplained variance. As the *degree* of consistency is all that matters the *sign* of the correlation coefficient is irrelevant; the table presents the absolute values of the correlation coefficients.

Significant values of $|cc|$ for the leading components are to be expected but so large a value as ·94 for the first component is highly encouraging for this new approach to assessment of component significance. Adopting this approach, and noting the high $|cc|$ values for components 2 and 3, we would certainly regard the first 3 components as significant; we would also be inclined to include no. 4, since its null-hypothesis probability is much lower than ·05.

Table of correlation coefficients between (i) coefficient and (ii) ccs for each leading variable for each component, showing conventional null-hypothesis significance.

Component No.	$\lvert cc \rvert$	Significance	Component No.	$\lvert cc \rvert$	Significance
1	·94	⩽·001	17	·20	>0·20
2	·83	·001	18	·22	,,
3	·78	·001	19	·04	,,
4	·42	·016	20	·21	,,
5	·31	·084	21	·03	,,
6	·26	·152	22	·05	,,
7	·33	·065	23	·04	,,
8	·24	·178	24	·14	,,
9	·30	·101	25	·06	,,
10	·24	·181	26	·04	,,
11	·03	>·20	27	·00	,,
12	·09	,,	28	·02	,,
13	·23	,,	29	·04	,,
14	·09	,,	30	·06	,,
15	·18	,,	31	·09	,,
16	·08	,,	32	·02	,,

Note: $\lvert cc \rvert$ means 'the absolute value of the correlation coefficient'.

Nos. 5–10 are in somewhat of a twilight zone. While none of their "probabilities" indicate significance, their *cc* values are so similar and, as a sequence, so different from those of nos. 1–3 on the one hand, and nos. 11–32, on the other, that we would not strongly counter an argument for their acceptance.

Chapter 5

Housing and IDA Grants

So far in this study we have confined our attention to attempts at discriminating between towns on the basis of growth or "goodness". In this chapter we drop these limits and discuss aspects of interest which emerged during the study which we did not discuss fully at the time. These are (i) the very important role that seems to be played by the construction of new dwellings and (ii) the pattern of IDA grants, the implication this has for regional development and how it compares with stated regional policy.

Growth and Housing

In the correlation treatment in Chapter 3, a coefficient of ·68 was obtained between growth 1961–71 and the percentage dwellings built between 1961 and 1971 for the 97 town case and ·47 for the 85 town case. These coefficients illustrate the strength of the relationship between the two variables but tell us nothing about causation. This poses the interesting questions as to whether it is population pressure that is giving the impetus to housing construction or whether the houses are built speculatively and then people move to the town to occupy them. The truth probably is a combination of both. Certainly in the towns around Dublin houses are built speculatively and there is little trouble in finding occupants but this could be attributed to the population pressure within Dublin. These houses would not have been built without this population pressure. But it is probably also true to say that in many areas, people who commute to work in the towns, move to those towns when adequate housing becomes available. The one thing that there can be little doubt about is that population growth and new housing go hand in hand, a propositon which is not as self-evident as might appear.

In the partial correlation section of Chapter 3 we obtained some evidence on this. We noticed that a persistence of growth of towns between the two periods 1926–61 and 1961–71, but when we made allowance for the percentage of new dwellings built since 1961, this relationship totally disappeared. The implication of this is that towns wishing to expand must be prepared to initiate new housing programmes.

The effect of new housing was quite substantial on the characteristics of towns. Towns with a large percentage of new houses were quite clearly "good" towns.* Not only did they have the obviously associated characteristics of many large dwellings and few small dwellings, a high rooms per person

*Our use of the term "good" is as defined in Chapter 3.

ratio and a large proportion of dwellings with bath, but they also had strong associations with many of the variables which we deemed to be characteristic of the "good" town in Chapter 3, namely:—

(i) Rapid population growth in 1926–61 and 1961–71
(ii) Many young people and few old people
(iii) A low dependency ratio
(iv) A high marriage rate and low fertility
(v) A high level of net immigration
(vi) Low unemployment
(vii) High in the amenity variables of cars, TVs and telephones, and
(viii) Located near to Dublin.

During the course of this study an attempt was made to forecast the likely future growth from estimates of future housing plans we obtained.* This was based on the very high association found between growth and new housing for previous years. The attempt was not successful and results are not reported here. However, as a byproduct, one interesting aspect of this attempt worthy of mention was an estimate of a housing "death" rate. The death rate was calculated as the total number of housing stock in 1961 plus new houses built 1961–1971 minus the housing stock in 1971 as a percentage of the stock in 1961. The death rate by county† is given in Column 5 of Table 5.1. This column shows that the percentage deaths varied a good deal between counties but a very evident pattern is visible—namely, that the western counties had figures nearly twice as high as the east. Column 6 shows houses built 1961–71 per thousand 1961 population. If we take the housing deaths figure as an (inverse) indicator of population pressure one would expect a high significant negative correlation between housing deaths (col. 5) and housing construction *per capita* (col. 6) but, in fact, the correlation is of the order of – ·328, which, although statistically significant, suggest that new construction is not completely related to population pressure. This would indicate that the west, with persistently declining population, is receiving a higher proportion of new dwellings than is warranted by population pressure alone. One reason may be that where there is population pressure, dwellings which are old and less fit for human habitation tend to remain occupied longer than they otherwise would and this is reflected in a lower death rate in the eastern counties. Of course, this discrepancy could be accounted for by the quality of housing in the west being poorer than in the east, in which case the lack of significance between the death rate and population pressure could indicate an equitable distribution of new housing. Another contributory cause could be the relocation of people from rural areas to adjacent towns, occupying new dwellings in the towns and leaving quite substantial houses derelict.

*These estimates were obtained from a survey of 75 of the 97 towns carried out by ourselves. The results obtained from this survey will be produced in a separate paper.

†Number of house built 1961–71 were not available for our towns, as we would have wished.

TABLE 5.1: *Calculation of number of dwelling units that disappeared ("deaths") 1961–71. Counties (incl. CBs)*

County (incl. CB)	*Dwellings built* 1961–71	*Housing units* 1961	*Housing units* 1971	*Deaths* 61–71	*Deaths as % of* 1961 *total*	*Dwellings built* 1961–1971 *per* 1000 1961 *population*
	1	2	3	4	5	6
Carlow	895	7,486	7,873	508	6·8	26·8
Cavan	1,177	14,935	14,088	2,024	13·5	20·8
Clare	2,845	18,195	18,869	2,171	11·9	38·6
Cork	10,918	78,402	84,383	4,937	6·3	33·0
Donegal	3,049	27,283	26,903	3,429	12·6	26·8
Dublin	44,089	158,462	190,929	11,622	7·3	61·4
Galway	4,832	32,654	33,842	3,644	11·2	32·2
Kerry	3,097	27,769	27,814	3,052	11·0	26·6
Kildare	2,572	14,111	15,890	793	5·6	39·9
Kilkenny	1,155	14,207	14,470	892	6·3	18·7
Laoighis	1,038	10,544	10,691	891	8·5	23·0
Leitrim	427	9,260	8,177	1,510	16·3	12·8
Limerick	5,817	29,374	33,093	2,098	7·1	43·6
Longford	657	7,791	7,411	1,037	13·3	21·4
Louth	2,963	15,425	17,436	952	6·2	44·0
Mayo	2,225	29,842	27,863	4,204	14·1	18·0
Meath	2,430	15,478	16,867	1,040	6·7	37·3
Monaghan	746	11,856	11,696	906	7·6	15·8
Offaly	1,396	11,957	12,231	1,122	9·4	27·1
Roscommon	1,365	15,643	14,426	2,582	16·5	23·1
Sligo	1,060	13,571	12,954	1,677	12·4	19·8
Tipp. (N.R.)	1,340	12,782	13,125	997	7·8	24·1
Tipp. (S.R.)	1,536	16,534	16,777	1,293	7·8	20·8
Waterford	2,474	16,986	18,488	972	5·7	34·6
Westmeath	1,739	12,290	12,699	1,330	10·8	32·9
Wexford	1,856	19,810	20,419	1,247	6·3	22·3
Wicklow	1,609	14,029	15,766	−128	−0·9	27·5
Ireland	105,307	656,676	705,180	56,803	8·7	37·4

Basic Sources: Census of Population 1961 Vol. 6, CSO town data sheets 1971; Dept. of Local Government Quarterly Bulletin of Housing Statistics

Note

Col. 4 = Cols (1 + 2 − 3).

Another interesting figure in column 5 is the death rate of Dublin which at 7·3 per cent is far from being the lowest despite the large construction rate there. This would be accounted for by the depopulation of its centre for commercial development and the relocation of people on the outskirts.

In discussing the death rate of housing in Ireland we have wandered slightly from the main theme of this paper, but we feel we are justified because of the very close link between growth and housing in that during the period 1961–71. Growth in Irish towns does not seem to have taken place without the provision of new housing.

Effect of the IDA Grants

We noted earlier the poor relationships we found between our IDA grant variables and our indicators of goodness of towns, including growth. This lack of relationship does not imply that IDA grants are ineffective in providing employment but they do not seem so far to have given sufficient impetus to towns to improve considerably their socio-economic structure. One cause of this could possibly be that up to the present, grant-aided firms have merely been taking up the slack in the existing labour force. There can be little doubt that IDA grant-aided firms are likely to affect significantly the future trend of population in Irish towns. The results we derived on the past performance of Irish towns are likely to be altered in so far as IDA grant-giving power can be used as a discriminating policy to influence the location of new employment and therefore of population.

At CP 1971, number at work in non-agriculture was 3·7 times the number in manufacture alone, a very stable multiplier in recent CP years. While we hesitate to imply that every 100 increase in employment in IDA-aided manufacture is likely to lead, under normal conditions, to an increase of 370 in total employment—an average figure where a marginal is needed—we can at least infer that the multiplier would be substantial. Incidentally, it would be very useful to have a reasonably accurate estimate of this magnitude.

We consider that authority should take active steps to ensure that ancillary employment measures up to autonomous employment, manufacturing or other, in any, especially a small, locality. Unaided "induction" alone may not be enough; and shortage of infrastructural and other services may be inimical to the success of the original investment.

Evidence of poor past performance could be reversed by the influence of IDA location policy, and that some of the towns which have performed badly under our tests are not necessarily doomed. While this may be so, we would still hold that our "good" towns will generally grow faster in the future because they have the inbuilt advantages that it will be easier to attract new industry to them and so that they will be likely to receive a better class of industry.

The figures in Table 5·2 represent the job potential of IDA grants for only three years; it is certain that in future years the distribution of new jobs will be different. Another point to be considered is that, while IDA policy is concerned with both the inter-regional and intra-regional distribution of new

TABLE 5.2: *Roughly estimated new employment potential in specified towns in manufacturing projects approved for grant by IDA in 1972–74.*

Town size 5,000–10,000		*Town size* 3,000–5,000		*Town size* 2,000–3,000		*Town size* 1,500–2,000	
Town	*No.*	*Town*	*No.*	*Town*	*No.*	*Town*	*No.*
1 Mullingar	295	25 Tuam	360	54 Mountmellick	35	81 Kinsale	50
2 Killarney	390	26 Longford	130	58 Cashel	35	82 Tullow	25
3 Tullamore	185	27 Tipperary	250	61 Kells	60	83 Boyle	35
4 Cobh	35	29 Athy	770	63 Bantry	70	86 Castleisland	45
6 Clondalkin	30	34 Bandon	55	65 Carrickmacross	50	87 Castlerea	70
7 Arklow	160	35 Fermoy	10	66 Clonakilty	45	92 Claremorris	70
8 Navan	25	37 Birr	15	68 Castleblayney	45	93 Monasterevan	95
9 Enniscorthy	330	41 Balbriggan	25	69 Ballyshannon	75	95 Cahirciveen	135
10 Mallow	185	42 Shannon	1352	70 Muinebeag	280	97 Cootehill	275
11 Castlebar	70	45 Ardee	70	71 Macroom	110		
12 Portlaoise	170	47 Portarlington	35	73 Rathluirc	70		
13 Newbridge	190	48 Edenderry	35	76 Clones	100		
14 Ballina	455	49 Loughrea	115	77 Clara	425		
15 Tallaght	500	53 Listowel	35	80 Kanturk	15		
16 Ballinasloe	35						
17 Youghal	150						
18 Dungarvan	315						
19 Monaghan	115						
20 Letterkenny	1885						
22 New Ross	100						
Total	5620		3257		1415		800

Basic source: IDA Reports: 1972–73; 1973–74.

Notes

These figures are not to be taken seriously as statistics. They are used in the text to make a single important point, for which only order of magnitude is required. The IDA report 1972–73 gives for each Development Region (i) estimated employment potential from all new manufacturing projects approved for IDA grants in the single year 1972–73, (ii) number of industries for each town in the Region in three employment potential classes (a) 10–50, (b) 50–100, (c) 100+. To (a) we attributed an average of 35, to (b) an average of 70, deriving (c) as a residual average. The 1973–74 report gave exact figures for each project by location. The numbers above were derived as the sum of these two components. We cannot associate a time factor with these figures, e.g., we cannot surmise if the Mullingar figure of 295 applies to 2 years, 5 years or infinite time!

employment, it may attain an equitable inter-regional distribution, but its intra-regional distribution could be biased in favour of the better towns of that region.

It would be a great help to analysts like ourselves if IDA were systematically to publish number of jobs actually created in each time span in relation to each project (with its *ex ante* job potential).

We are on more solid ground (than in Table 5·2) in Appendix Table A4, in giving for each town amounts of IDA grants approved and paid 1971–1974. Table 5·3 is a summary of Appendix Table A4.

TABLE 5.3: *Particulars of IDA grants approved 1971–74, in town population groups*

Population 1973	*New industries*				*Small industries*			
	Number		*Amount*	*Per head*	*Number*		*Amount*	*Per head*
	Towns	*Firms*	£000	£	*Towns*	*Firms*	£000	£
1 5,000–10,000	21	35	14,371·0	94·4	18	44	455·7	3·0
2 3,000– 5,000	11	20	3,407·1	30·9	16	26	264.5	2·4
3 2,000– 3,000	13	20	2,989·8	45·5	15	21	138·8	2.1
4 1,500– 2,000	3	3	332·8	11·2	11	21	145·6	4·9
Total 1,500–10,000	48	78	21,100·7	59·0	60	112	1,004·6	2·8

Basic Source: IDA Reports 1971–72, 1972–73 and 1973–74.

Note

For town detail, see Appendix Table A4.

It will be seen that, on the basis of the amount approved per head of total population within each size-group, the distribution was even-handed as regards towns with population 2,000 to 5,000, but for towns under 2,000 only three new industries were set up. The group of large towns seem to have received more and larger grants, possibly due to larger industries setting up there. The small towns did better than average as regards small industries.

Chapter 6

Conclusions

In the text of this study we have applied all the statistical techniques we deem suitable to the large volume of statistical material available principally from the Census of Population. We have also discussed some side issues raised by the analysis. There have been two main approaches: discernment of general relations between variables (Chapter 3) and classification of towns according to what were deemed the most important characteristics (Chapter 4).

Before outlining what we consider to be the most important results derived from this analysis we should like to draw attention to certain statistical problems which arose during the course of the analysis and the treatment we devised to surmount them:

1. Ascertainment and significance of true correlation between percentages in the same array (Technical Appendix to Chapter 3).
2. The fact of correlation between (i) coefficients of original variables in leading components and (ii) *ccs* between original variable with highest coefficient and other original variables, as a test of significance of components (Technical Appendix to Chapter 4).
3. In multivariate regression reordering data according to magnitude of principal component of indvars, to make the DW or tau test more sensitive. (Technical Appendix to Chapter 3).

We relegated discussion of these points to appendices to avoid interruption of the main flow of the text but we highlight them here as we feel statisticians may be interested in our treatment of them.

Rank of Towns

We had at first, been tempted to array the 97 towns in a definite hierarchy of "goodness" ranging from X "best" to Y "worst". We resisted this temptation not only because of individiousness but because of (1) the considerable degree of variation in the ranking of towns depending on the standard used, (2) while a fair measure of success has been obtained in "explaining" differences between towns, there remains a good deal of unexplained variation (perhaps particular to individual towns) and (3) the many variables used were mainly economic, such variables as the quality of life or the beauty of the environment, which many people would have regarded as more important, being left out of account.

However, in Table A3, we do rank the towns according to five different indicators. We make no attempt to construct one overall ranking for the reasons

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mentioned above. The five indicators include past performances, the results derived from clustering and also results derived from the attempts to forecast future population growth discussed in an appendix to Chapter 3.

In Table 6.1 we show that, having regard to the nature of the data, the *ccs* between pairs of rank variables are large, indicating a high degree of consistency.

TABLE 6.1: *Correlation coefficients between five rank variables in Appendix Table A3*

	1	2	3	4	5
1	1				
2	·726	1			
3	·670	·530	1		
4	·654	·431	·694	1	
5	·726	·632	·842	·677	1

Notes

Variables are numbered as columns of Table A3 which are as follows:–

1 Percentage population increase 1961–71
2 1981 regression estimate
  based on cluster
3 9 leading components
4 15 leading variables
5 Principal component.

All *ccs* are formally significant at null-hypothesis probability 0·001.

Only below-diagonal values are shown in this symmetrical matrix.

Much as one would expect, the indicator which is most highly related to all the others is the ranking according to the principal component, as it is the one which takes account of the greatest number of influences. Percentage population increase 1961–71 (variables in Table 6.1) comes next by this test.

The internal consistency of the indicators in Appendix Table A3 implies that these indicators should give a fairly good idea of which towns are likely to grow fastest. Indeed, the actual values of the indicators are reasonably close to one another.

Not-so-good Towns

In identifying poorer towns in a number of our tables (Appendix Table A3 in particular) we are not impelled by a censorious spirit—quite the contrary, in fact. Our approach is typical of that of social statisticians: we are more concerned about the less satisfactory aspects of things than the rest. In the present instance, we try to identify towns with poorer prospects so that something may be done about them. We publish the less flattering particulars about them to furnish their townsfolk with an idea of what needs to be done to improve their relative position. Anyway, our judgement, based mainly on past trends, may not be an infallible guide to the future, a point we have already made.

Use of Town Statistics for Individuals

We want our statistics to be useful in a mundane sense. We envisage a firm or an individual contemplating setting up in some provincial town. We would hope that much use would be made of this paper in general and of Appendix 1 in particular*. In Tables A1 we have provided for each characteristic a town size group mean and an overall mean and standard deviation. Arbitrarily, we have decided that a town's difference of more than one standard deviation is worthy of note, though not, of course, in a statistical sense.

We indicate that, possibly for the first time in Ireland as regards small and middle-sized towns, many such towns have a great future growth potential, i.e., growth in population and spending power. This should encourage a footlooseness on the part of, say professional persons, shops and other service establishments catering for consumers (as well, of course, as industries) and families attracted by amenities, perhaps over-inclined in the past to set up or reside in Dublin and other large towns. We have not provided all the information required for locational decisions e.g., environmental factors as such are by their nature not easily quantifiable. One figure we do give, is hinterland population densities (No. 55 in Tables A1) as a first indication of likely labour pool in and about each town.

Mention of hinterland prompts the reflection that as the research proceeded we began to wonder more and more if towns as at present defined for Census of Population purposes, within legally defined boundaries or other, with or without suburban additions, are the best area units for an inquiry such as this. We are aware that this is a much-discussed topic, to which we have little to add here. We do suggest, however, as worthy of examination, a project of supplying statistics of the type, at present available, for "town areas" (even if arbitrarily defined) so that to each town of say 1,000 population or more would be attributed its rural hinterland (including towns and villages of less than 1,000 population). The main argument in favour of such change is that the traditional distinction between town and country (including that celebrated "way of life" of the farmer) is breaking down in all kinds of ways, a cogent reason being, of course, the motor car. At the next Census we suggest that, at least, total populations classified by sex and rough age groups (but 15–24 in particular) should be provided for each town and hinterland, defined perhaps our way as within approximately five miles of town centre.** Such figures would be essentially useful for entrepreneurs contemplating setting up in or near the town.

*Here the Statistics are merely described in Appendix 1. They will be made available at £1 a copy.

**Townlands might be used as computation units. We used DED's which were too large and precluded our giving actual populations, but only population per square mile.

Another lack we found in the data available was information on commuting. We consider that the Census of Population should supply information as to work place when this is different from domicile, for each town and town area, as in many cases they are not the same and equating them can be misleading.

Two Important Questions

Two questions implicit in this study which we now attempt to answer are (1) has every town got a potential and (2) is industry necessary for the development of towns?

Has every town a potential? Correlation coefficients between percentage population increases in periods 1926–61 and 1961–71 were ·41 and ·46 on the 97 town and 85 town bases respectively. These values, while highly significant statistically speaking, are low in absolute value. We infer that while there is a tendency for growth to persist, there are many exceptional towns as comparison of growth rates for the two periods 1926–61 and 1961–71 (columns 3 and 4 in Table A1.1 will indicate.) On this evidence from the past one can hardly state that *any* town is doomed to stagnation, granted that it has someone to start the movement upwards.

Happenings since 1971 strongly confirm this impression. As mentioned earlier in this chapter, Ballina is an outstanding case of a town which all our statistical evidence showed to be one of the least favoured, yet, more recently, it has been experiencing something like industrial boom conditions. At the same time we think that future development will, and should, favour good towns, as we have discerned them in this study and that these good towns have inbuilt advantages which should ensure a continued growth.

Our finding of little relation between IDA grant policy and the "goodness" (or otherwise) of towns has a bearing on this problem. This means that IDA and other industrial experts, presumably after a thorough examination of prospects, and prepared to back their opinion by large investment, have in many instances opted for locations that we would regard as poor. While this policy continues any poor town may have a future, given local initiative.

Is industry necessary? In Ireland industry is overwhelmingly regarded as the main hope of salvation. Of course this view is reasonable: each industrial unit created endows the town with many more jobs than would the typical service unit, and the population effect is many times the job effect; nonetheless it is subject to qualification. We have found that while the industrial town has certain of the characteristics of the good town (for example, recent population growth, new dwellings, high percentage married, nearness to Dublin) it lacks others, tending to be low in professions, rooms per person and retail sales. There is virtually no relation with the amenity variables, perhaps the best indicators of good towns. There is no significant relationship between (i) percentage at work in manufacturing and (ii) the unemployment rate: perhaps we should be grateful that in this range of towns industry does not tend to create labour pools.

One of our most striking results is that industrial towns tend to be low in post-primary education. Earlier we postulated that this may be due to more job opportunities. Industry can only provide a minute number of jobs for those with formal education and it seems unlikely that industrial development will stem the flow of such people to service type jobs in Dublin and other large cities. Also, without much doubt, the towns in the group under study fall far short of the threshold level of population for the viability of many service type industries. There seems to be no realistic solution for the "brain" drain from small towns in the foreseeable future.

Of course, all this is not to decry the idea that, to develop, a town should have an industry. For many towns, industry is the only path open for development. However, only a few of this group of towns are likely to develop sufficiently to render viable the setting up of a full range of service-type industries.

Main Results

In this final section our aim is to outline what we consider to be the most important findings of this paper.

Basically our most important result is the very strong connection we have found between growth and what we have defined as "goodness", and the important role that new housing seems to play in this relationship. Its implications are that the provision of industry alone is not sufficient for development and that facilities and amenities to provide a good living environment are necessary for rapid growth. This obviously is the best kind of development.

In the cluster analysis of Chapter 4, we have provided two classifications of towns into groups, with a good degree of consistency between them. These classifications we feel provided a good picture of the positions of each town in relationship to all others. It also helps to highlight the different characteristics of towns fulfilling different functions.

Also in Chapter 4, we rank the towns according to the principal component (Table 4.4). This indicator probably gives the most comprehensive picture of the performance of towns.

In Chapter 5 we discuss two, what we consider to be, very important questions which were raised as side-issues of our earlier analysis. These questions were (i) the role of new housing and (ii) the effect of IDA grants.

In this final chapter we have considered the question of whether all towns have a potential for development and we emerge with the very heartening answer that no town is doomed to stagnation.

Appendix 1

Data on 67 *Variables for Towns*

This statistical supplement contains nine tables, A1.1 to A1.9, pertaining to 97 towns in descending order of 1971 population, in four main population classes. The sequence of numbers of columns is as in Table 3.1, which please see for full description of variables. The 12 Special Towns are indicated by (S). Variables number 67.

When years are not specified the data refer to Census Year 1971. Averages are supplied for each of the four population groups; such averages are unweighted. The object is to enable comparison to be made of the value for a particular town with more general averages. Figures which fall outside the (mean$\pm$standard deviation) are indicated by a †.

Missing data are indicated by an asterisk.

Notes at end of each table for definitions where this seems necessary.

Most data are in the form of percentages, rates etc. to enable comparisons to be made between towns of different sizes.

The supplement will be supplied on request at £1 a copy.

Appendix 2

Conventional Significance of Correlation Coefficients between Pairs of Variables

Table A2.1 relates to 57 variables and all 97 towns, Table A2.2 to 59 variables and 85 towns, i.e., with 12 Special Towns omitted.

Variables are arrayed in three conventional probability classes. According to mode of display, each pair of variables appears twice.

See notes at head of tables, and text.

TABLE A2.1: *Variables significantly related to each variable in system, classified by null-hypothesis conventional probability, 97 towns, 57 variables.*

(For key to number code see Table 3.1. A minus sign indicates that *cc* is negative, otherwise positive.)

Var. no.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
1	−39.54.69.70.	−43.71.	2.−30.−42.
2	−7.8.−11.19.20.−25. −28.−29.−30.31.32.33. −59.−60.62.	−10.−18.35.36.	1.3.−39.−42.54.69
3	4.7.−8.11.14.15.38.41. −43.44.−45.46.47.59. 60.−67.	−6.−20.−26. −27.−37.58.−66.	2.58.
4	3.−8.−9.11.12.14.15. 18.19.−27.−30.38.−40. −43.44.47.58.60.	−21.−26.28.33. −37.45.59.	−6.7.−10.−13.−22.54. −62.−67.
6	−7.8.20.−28.30.36.39. 42.43.−44.−47.53.62.66. 67.	−3.−11.22.35.−59.	−4.10.−14.−15.21. −27.−32.−55.56.69.
7	−2.3.−6.−10.11.14.15. −19.−20.28.−31.−32. −33.−35.−36.−37.38. −39.44.47.−53.59.60.−62. 66.	−21.−67.	4.34.41.
8	2.−3.−4.6.−11.−14. −15.20.21.26.−28.31.36. 37.−38.43.−44.−47.−59. −60.62.66.67.	10.−25.27.33.35.	13.19.22.30.39.−41.53. −55.−58.69.
9	−4.10.−14.−15.18.−19. 26.27.−33.−38.40.−44. −47.−58.−60.	−12.34.−35.−53.	−20.30.−36.−41.−42. 43.−46.−54.
10	7.9.13.−19.26.30.−33.	−2.8.18.−20.27. −32.40.−47.−58.	−4.6.−14.−25.−31. 43.−44.−53.56.
11	−2.3.4.7.−8.12.−13.14. 15.−20.−26.−27.28. −31.−37.38.−40.41. −43.44.47.58.59.60.62. −66.−67.	−6.25.−33.42. −45.	−19.−21.29.−53.−69.

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TABLE A2.1 (*continued*)

Var. no.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
12	4.11.14.15. −27.38. −40. 41.44.60.	−9.33. −37.42.47. 58.	19. −26.35.59.
13	10. −11. −14.27. −38.40. −41. −42. −44. −46. −47. −58. −59. −60.	−15.18.26.37. −39.	−4.8. −25.30.45.56.66.
14	3.4.7. −8. −9.11.12. −13. 15. −26. −27. −37.38.40. 41. −43.44.47.58.59.60. −66. −67.	−20.54.	−6. −10.28.46. −62.
15	3.4.7. −8. −9.11.12.14. −26. −27. −37.38. −40. 41. −43.44.47.54.58.59. 60.	−13. −67.	−6. −20. −62.
18	−4.9.26.27.30. −31. −32. −33.34. −35. −38. −47.	−2.10.13.29. −36. 43. −54. −58. −60.	−20.40. −41. −53.
19	2.4. −7. −9. −10.20.21. −25. −28. −29.31.32.33. −29.35.36.58.	−40.46.	8. −11.12. −26. −27. −43. −50.54
20	2.6. −7.8.11.19. −28.31. 33.35.36. −44.53. −59. −60.62.66.67.	−3. −10. −14. −29.37. −47.69.	−9. −15. −18. −38.43. 45.
21	8.19.22. −28.30. −34.35. 36.39.42.66.	−4. −7.31.33. −45.	6. −11. −40. −44. −55.
22	21.30. −34.35.36.39.41. 42.66.	6. −28. −40.46.60.	−4.8. −45. −55.
25	−2. −19. −31. −33.39.42. 59.60.	−8.11.58.	−10. −13. −26.28. −32. 38.41. −54. −62.
26	8.9.10. −11. −14. −15. 18.27. −38. −41.43. −44. −47. −58. −59. −60.	−3. −4.13.34.37.	−12. −19. −25.30.40. 45. −46.62.
27	−4.9. −11. −12.13. −14. −15.18.26.34. −38.40. −41. −44. −47. −58. −59. −60.	−3.8.10.30.37. −42.43.	6. −19. −32. −33. −35. −55.62.66.67

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TABLE A2.1 (*continued*)

Var. no.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
28	−2. −6.7. −8.11. −19. −20. −21. −32. −33.34. −35. −36. −62.	4. −22. −39. −42. 44. −56. −66. −67.	14.25.51. −53.55.59. −69.
29	−2. −19. −33.	18. −20. −31. −32. −56.	11. −35. −36. −51. −54. 59.60. −69. −71.
30	−2. −4.6.10.18.21.22.35. 36.39.56.66.	27. −34.42.43. −55.	−1.8.9.13.26. −44. −47. 67.
31	2. −7.8. −11. −18.19.20. −25.32.33. −34.35.36. −59.62.	21. −29.54. −60.	−10. −44.69.
32	2. −7. −18.19. −28.31. 33. −34.35.36.	−10. −29.54.	−6. −25. −27. −43.
33	2. −7. −9. −10. −18.19.20. −25. −28. −29.31.32.35. 36.	4.8. −11.12.21.46 58.	−27. −40.54.
34	18. −19. −21. −22.27.28. −31. −32. −36. −38. −41. −42. −58. −60.	9.26. −30.37. −39. 50. −53.	7. −47.51.
35	−7. −18.19.20.21.22. −28. 30.31.32.33.36.38. −40.41. 42.58.	2.6.8. −9.39.56.60.	12. −27. −29.47.53.
36	6. −7.8.19.20.21.22. −28. 30.31.32.33. −34.35.41. 42.56.	2. −18.39.53.58.69.	−9. −29.38. −40.67.70.
37	−7.8. −11. −14. −15. −41. −42.43. −44. −47. −59. −60.66.	−3. −4. −12.13. 20.26.27.34.40. −58.	50. −55.67.62.69.
38	3.4.7. −8. −9.11.12. −13. 14.15. −18. −26. −27. −34. 35. −40.41.42. −43.44.46. 47.58.59.60. −66.	−45. −62.	−20.25.36.55. −69. −67.

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TABLE A2.1 (*continued*)

Var. no.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
39	−1.6. −7.21.22.25.30.42. 43.66.	−13. −28. −34.35. 36.	−2.8.41.53. −54.
40	−4.9. −11. −12.13. −14. −15.27. −35. −38. −41. −42. −44. −47. −58. −59. −60.	10. −19. −22.34. 37.	18. −21.26. −33. −36. −46.71.
41	3.11.12. −13.14.15.22. −26. −27. −34.35.36. −37. 38. −40.42.44.46.47.58.59. 60.	−43.	7. −8. −9. −18.25.39.55. −56. −62. −69.
42	6.—13.21.22.25. −34.35. 36. −37.38.39. −40.41.58. 60.	11.12. −27. −28. 30.46.53.59.	−1. −2. −9.66. −69.
43	−3. −4.6. −7.8. −11. −14. −15.26.37. −38.39. −47. −54. −59. −60.66.	−1.18.27.30. −41.	9.10. −19.20. −32.45. −46. −58.67.
44	3.4. −6.7. −8. −9.11.12. −13.14.15. −20. −26. −27. −37.38. −40.41.47.58.59. 60. −66. −67.	28.54. −62.	−10. −18. −21. −30. −31.
45	−3. 59. −60.	4.11.21. −38. −41. −47.62.	13.20. −22.26.43.66.69.
46	−3. −13.38.41.47.60.	19.22.33.42.58.	−9.14. −26. −40. −43. 54.
47	3.4. −6.7. −8. −9.11. −13. 14.15. −18. −26. −27. −37. 38. −40.41. −43.44.46.54. 58.59.60. −62. −66. −67.	−10.12. −20. −45.	−30. −34.35.
50	51	34.	−19.37.
51	50.		28. −29.34.
53	6. −7.20.66.	−9. −34.36.42.	8. −10. −11. −18. −28. 35.39.58.

continued on next page

TABLE A2.1 (*continued*)

Var. no.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
54	1.15. −43.47.	14. −18.31.32.44.55.	2.4. −9.19. −25. −29. 33. −39.46.67.
55		−13. −30.54.	−6. −8. −21. −22. −27. 28. −37.38.41. −56. −69.
56	30.36. −59.67.	−28. −29.35.69.	6.10.13. −41. −55.66.
58	4. −9.11. −13.14.15.19. −26. −27. −34.35.38. −40.41.42.44.47.59.60.	3. −10.12. −18.25. 33.36. −37.46.	−8. −43.53. −62.
59	−2.3.7. −8.11. −13.14. 15. −20.25. −26. −27. −31. −37.38. −40.41. −43. 44. −45.47. −56.58.60. −62. −66. −67.	4. −6.42.	12.28.29. −69.
60	−2.3.4.7. −8. −9.11.12. −13.14.15. −20.25. −26. −27. −34. −37.38.39. −40.41.42. −43.44. −45.46. 47.58.59. −62. −67.	−18.22. −31.35. −69.	29. −66.
62	2.6. −7.8.11.20. −28.31. −47. −59. −60.66.67.69.	−38. −44.45.	−4. −14. −15. −25.26. 27.37. −41. −58.
66	6. −7.8. −11. −14. −15. 20.21.22.30.37. −38.39.43. −44. −47.53. −59.62.67.	−3. −28.36.	13.28.42.45.56. −60.
67	−3.6.8. −11. −14.20. −44.47.56. −59. −60.62.66.	−7.13. −15. −28.	−4.27.30.36.37. −38. 43.54. −55.
69	1.62.70.	20.36. −55.56. −60.	2.6.8. −11. −28. −29.31. 37. −38. −41. −42.45. −55. −59.
70	69.		36.71.
71			−29.40.70.

Note

See Table 3.1 for variable number code.

TABLE A2.2: *Variables significantly related to each variable in system, classified by null-hypothesis conventional-probability,* 85 *towns,* 59 *variables.*

(For key to number code see Table 3.1. A minus sign indicates that *cc* is negative, otherwise positive.)

Var. no.	$P < \cdot001$	$\cdot001 < P < \cdot01$	$\cdot01 < P < \cdot05$
1	−23. −43.54.61. −65.69.	2. −24. −30. −39. 44.57.71.	16. −21. −42.45.47.
2	−7.8. −9. −11.19.20. −59.69.	1.12. −18. −25. −28.35.36.54.	16. −29. −30.53.
3	4.17. −23. −39. −42. −43. 44. −45.46.47. −66.	7. −8.54. −65.	−6. −26. −30.40.
4	3.7. −8.11.16.17. −23. −27.38. −39. −43.44.47. 54.57. −65. −66.	−26.71.	12. −18. −20. −21. −30. −37.41.
6	−7.8.20. −28.30.35.36. 39. −40.42.53.66.	12.19.43.58.65.67.	−3. −17.21.22.41. −55.
7	−2.4. −6.9.11.17. −19. −20.28. −35. −36. −39. 40. −42. −53. −66.	3. −21. −43.44. −65.	10. −12.13.18. −22. −58.59. −67.
8	2. −4.6. −11. −17.19.20. 21. −28.35.36.39. −40.42. 65.66.	−3.10.12.43. −44. −59.	22. −25.26.30. −47. −55. −57.67.
9	−2.7.10. −12. −16. −19. −20.26.27. −35. −36. −38. −47. −58.	18.28. −44. −53. −54.	11. −22.40. −41.
10	9.11. −25.26. −53.	8. −20. −58.	7.13.27.30.
11	−2.4.7. −8.10.17. −20. 28. −66.	−19.44. −53. −65.	9.12. −35. −36.38. −39. 57.
12	−9.16.38.	2.6.8.19.20. −27. −40.42.44.58.	4. −7.11. −18. −28.35. 36.41.53.
13	40. −42.	27.30. −41. −46. −55. −58.	7.10.18.26. −39.65.
16	4. −9.12.44.54.57.	−18. −27.38.47.	1.2.19.36.58.63.
17	3.4.7. −8.11. −43.46.47. −66.	−20. −37.41. −65.	−6.38. −39.44.71.
18	26.27. −38. −47.	−2.9. −16. −20. −35. −36. −41. −54.	−4.7. −12.13.29.30.43. −44.

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TABLE A2.2 (*continued*)

Var. no.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
19	2. −7.8. −9. −20.21.22. −28.35.36.38.41.42.	6. −11.12. −25. −40.54.	16.24.39.46.47. −59.65. 69.
20	2.6. −7.8. −9. −11.19.35. 36.53.58.66.	−10.12. −17. −18. −28.39.42.	−4.67.69.
21	8.19.22. −28.30.35.36.39. −40.42.65.66.	−7.23.24.41.	−1. −4.6. −37. −44. −45. −55.58.
22	19.21. −28.30.35.36.39. −40. −42.65.66.	38.	6. −7.8. −9. −37. −45. 46. −55.
23	−1. −3. −4.24.30.56.65.66	21.36.39. −44.	35.43. −54.67. −71.
24	23.30.56.65.	−1.21.35.36.	19. −28. −45.67.
25	−10.58.	−2. −19.	−8. −26.39. −54.59. −64.
26	9.10.18.27. −38. −41. −44. −47.	−4. −58.	−3.8.13. −25.30.45.
27	−4.9.18.26. −38. −41. −58.	−12.13. −16. −44. −47.	10.30.40. −42. −55.
28	−6.7. −8.11. −19. −21. −22. −35. −36. −39. −42. −56. −65. −66.	−2.9. −20.40. −58.	−12. −24. −41.51. −53. 55. −64. −67.
29			−2.18. −36. −51. −54. −56. −60. −61.64. −69. −71.
30	6.21.22.23.24.35.36.39.56. 65.66.	−1.13. −40.42. −44. −55.	−2. −3. −4.8.10.18.26. 27.43. −47.58.67.
35	6. −7.8. −9.19.20.21.22. −28.30.36.38.39. −40.41. 42.58.65.	2. −18.24.53.56.66.	−11.12.23.64.67.69.
36	6. −7.8. −9.19.20.21. −28.30.35.38.39. −40.41. 42.56.58.65.	2. −18.23.24.53.66. 69.	−11.12.16. −29.64.67.
37	−41.	−17.	−4. −21. −22. −42.50. 52. −55.66. −71.
38	4. −9.12. −18.19. −26. −27.35.36.41.42.44.47.	16.22.46.58.	11.17.54.
39	−3. −4.6. −7.8.21.22. −28.30.35.36.42. −44. −47.58.65.66.	−1.20.23.53. −54.	−11. −13. −17.19.25. −55.67.

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TABLE A2.2 (*continued*)

Var. na.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
40	−6.7. −8.13. −21. −22. −35. −36. −42. −43. −58. −66.	−12. −19.28. −30. −65.	3.9.27. −41.
41	19.22. −26. −27.35.36. −37.38.42.46.47.58.	−13.17. −18.21.	4.6. −9.12. −28. −40. 53.55.
42	−3.6. −7.8. −13.19.21. 22. −28.35.36.38.39. −40. 41.43.58.65.66.	12.20.30. −44.46. 53.	−1. −27. −37. −54. −57.67.
43	−1. −3. −4. −17.39. −40. 42. −47. −54.65.66.	6. −7.8. −71.	18.23.30.45. −57. −61.
44	3.4.16. −26.38. −39.47. 54. −65. −66.	1.7. −8. −9.11.12. −23. −27. −30. −42.	17. −18. −21.57.71.
45	−3.		1. −21. −22. −24.26.43. −47.69.
46	3.17.41.47.	−13.38.42.	19.22.54.55.64. −65.
47	3.4. −9.17. −18. −26.38. −39.41. −43.44.46.54.	16. −27. −66.	1. −8.19. −30. −45.64. 71.
50	51.52.60.		37.
51	50.52.60		28. −29.
52	50.51.60.		37.53.66.
53	6. −7. −10.20.58.66.	−9. −11.35.36.39. 42.	2.12. −18. −28.41.52.
54	1.4.16. −43.44.47.	2.3. −9. −18.19. −39.55.	−23. −25. −29.38. −42.46.61.67.
55		−13. −30.54. −65.	−6. −8. −21. −22. −27. 28. −37. −39.41.46. −56. −67. −69.
56	23.24. −28.30.36.57.65.	35.	−29. −55.67.69.
57	4.16.56.	1. −65.	−8.11.42. −43.44
58	−9.20.25. −27.35.36.39. −40.41.42.53.	6. −10.12. −13. −26. −28.38.	−7.16. −18.21.30.
59	−2.	−8.	7. −19.25.
60.			28. −29.
61	1.	69.	−29. −43.54.
63			16.

continued on next page

TABLE A2.2 (*continued*)

Var. no.	$P < \cdot 001$	$\cdot 001 < P < \cdot 01$	$\cdot 01 < P < \cdot 05$
64			−25. −28.29.35.36.46. 47.65.
65	−1. −4.8.21.22.23.24. −28.30.35.36.39.42.43. −44.56.66.	−3.6. −7. −11. −17. −40. −55. −57.67.	13.19. −46.64.
66	−3. −4.6. −7.8. −11. −17.20.21.22.23. −28.30. 39. −40.42.43. −44.53.65.	35.36. −47.	37.52.67. −71.
67	68.	6.65.	−7.8.20.23.24. −28.30. 35.36.39.42.54. −55.56. 66.
69.	1.2.	36.61.	19.20. −29.35.45. −55. 56.
71		1.4. −43.	17. −23. −29. −37.44. 47. −66.

Note

See Table 3.1 for key to number coding of variables.

APPENDIX 3

TABLE A3: *Ranking of towns according to five indicators*

	Towns 5,000–10,000	*Percentage population increase* 1961–71	1981 *regression estimate*	*Cluster* 9	*Cluster* 15	*Principal component*
		1	2	3	4	5
1	Mullingar	25	40	55	8	56
2	Killarney	63	13	55	68	60
3	Tullamore	34	75	45·5	45·5	39
4	Cobh	43	58	26·5	37·5	28
5	Thurles	72	48	55	53	44
6	Clondalkin	10	9	7·5	*	9
7	Arklow	17	26·5	26·5	13·5	18
8	Navan	21	22	26·5	3·5	21
9	Enniscorthy	73	94	73	25	77
10	Mallow	46	15	73	37·5	34
11	Castlebar	38	26·5	55	65	61
12	Portlaoise	44	29	26·5	3·5	33
13	Droichead Nua	14	14	26·5	3·5	13
14	Ballina	78	88	73	60	79
15	Tallaght	4	3	2	*	3
16	Ballinasloe	84	51	55	65	92
17	Youghal	66	25	41·5	37·5	57
18	Dungarvan	70	13	73	53	72
19	Monaghan	61	44	55	65	41
20	Letterkenny	31	16	55	8	46
21	Nenagh	33	39	26·5	25	32
22	New Ross	47	35	73	25	47
23	Naas	22	18	26·5	3·5	15
24	Carrick-on-Suir	71	87	41·5	45·5	74

continued on next page

TABLE A3 (*continued*)

	Towns 3,000–5,000	Percentage population increase 1961–71	1981 regression estimate	Cluster 9	Cluster 15	Principal component
		1	2	3	4	5
25	Tuam	83	90	73	60	54
26	Longford	40	34	73	25	52
27	Tipperary	89	69	73	78	83
28	Midleton	36	17	41·5	37·5	49
29	Athy	29	53	41·5	45·5	62
30	Greystones-Delgany	19	62	15·5	8	14
31	Cavan	69	47	55	53	63
32	Lucan	7	7	7·5	*	6
33	Swords	9	8	7·5	*	8
34	Bandon	68	55	74	78	75
35	Fermoy	65	49	91	78	58
36	Wicklow	23	37	26·5	25	29
37	Birr	92	76	73	25	64
38	Roscrea	48	60	41·5	13·5	40
39	Malahide	13	11	7·5	*	10
40	Tramore	15	28	15·5	25	16
41	Balbriggan	20	20	26·5	13·5	20
42	Shannon Airport	1	2	2	*	1
43	Buncrana	79	81	41·5	37·5	88
44	Blanchardstown	8	4	7·5	*	4
45	Ardee	41	38	41·5	45·5	42
46	Kildare	27	32	26·5	3·5	25
47	Portarlington	67	92	41·5	45·5	36
48	Edenderry	60	50	41·5	13·5	45
49	Loughrea	62	42	55	53	38
50	Skerries	57	52	15·5	25	17
51	Gorey	50	67	41·5	45·5	55
52	Westport	81	70	91	78	81
53	Listowel	77	59	91	32	82

continued on next page

TABLE A3 (*continued*)

	Towns 2,000–3,000	*Percentage population increase* 1961–71	1981 *regression estimate*	*Cluster*		*Principal component*
				9	15	
		1	2	3	4	5
54	Mountmellick	64	95	41·5	45·5	84
55	Roscommon	76	68	55	71	48
56	Mitchelstown	82	54	73	37·5	65
57	Passage West	88	64	26·5	37·5	24
58	Cashel	91	95	91	71	90
59	Newcastle	74	61	73	78	94
60	Kilrush	95	93	73	78	96
61	Ceannanus Mor	30	74	73	25	53
62	Rush	24	82	41·5	13·5	27
63	Bantry	45	36	91	68	86
64	Portrane	2	23	97	*	95
65	Carrickmacross	42	31	26·5	25	22
66	Clonakilty	90	84	91	71	87
67	Leixlip	5	6	7·5	*	7
68	Castleblayney	54	83	55	53	70
69	Ballyshannon	93	86	73	78	80
70	Muinebeag	56	97	41·5	45·5	43
71	Macroom	94	73	91	78	89
72	Trim	16	24	26·5	53	26
73	Rathluirc	49	77	73	37·5	69
74	Ballybofey-Stranorlar	39	33	73	53	91
75	Templemore	28	72	73	60	51
76	Clones	87	91	73	78	71
77	Clara	97	63	41·5	13·5	73
78	Ballincollig-Carrigrohane	11	10	7·5	*	11
79	Skibbereen	86	57	91	84·5	76
80	Kanturk	85	80	73	78	93

continued on next page

TABLE A3 (*continued*)

	Towns 1,500–2,000	*Percentage population increase* 1961–71	1981 *regression estimate*	*Cluster*		*Principal component*
				9	15	
		1	2	3	4	5
81	Kinsale	53	30	91	68	68
82	Tullow	52	85	73	25	66
83	Boyle	59	89	73	78	59
84	Castleisland	55	46	73	60	50
85	Laytown-Bettystown-Mornington	12	12	15·5	3·5	12
86	Carrick-on-Shannon	26	41	15·5	18·5	31
87	Castlerea	58	56	15·5	32	23
88	Cahir	80	45	91	60	37
89	Rathcoole	3	1	2	*	2
90	Portmarnock	6	5	7·5	*	5
91	Donegal	37	66	15·5	18·5	35
92	Claremorris	51	71	15·5	32	30
93	Monasterevan	18	19	41·5	13·5	67
94	Celbridge	32	21	26·5	13·5	19
95	Cahirciveen	96	78	91	84·5	97
96	Rathkeale	75	79	73	60	85
97	Cootehill	35	65	73	60	78

Notes

These rankings are derived from the following:—

Col. 2: Table 3·7 (see text of appendix to Chapter 3)
Col. 3: Table 4·4
Col. 4: Table 4·5
Col. 5: Table 5·4

Where ties occur the rank of all towns obtaining the same score is given as the average of that group. This is particularly relevant to column 4 in which asterisks (*) indicate towns omitted in this clustering.

APPENDIX 4

TABLE A4. *New and small industry grants by IDA, paid and approved 1971–74. Number of firms and amount (£000).*

Towns	New industries					Small industries				
	No. of firms	*Paid* 1971–72	*Paid* 1972–73	*Paid* 1973–74	*Total approved*	*No. of firms*	*Paid* 1971–72	*Paid* 1972–73	*Paid* 1973–74	*Total approved*
Pop. 5,000–10,000										
1 Mullingar	1	—	6·8	7·3	20·0	3	10·2	3·5	16·3	46·4
2 Killarney	1	—	—	49·3	95·6	2	2·6	14·3	4·6	24·1
3 Tullamore	1	41·0	—	—	76·6	4	2·5	6·0	12·6	29·2
4 Cobh	2	—	120·3	111·8	361·8					
5 Thurles	1	12·5	—	—	67.2	1	—	—	2·3	2·5
7 Arklow	1	—	44·7	—	60·0	7				
8 Navan	1	—	25·0	—	25·0	7	26·3	16·0	31·4	88·3
9 Enniscorthy	1	15·8	7·8	1·8	29·1	3	5·8	—	14·2	22·0
10 Mallow	2	—	55·2	138·0	286·0	2	4·4	—	19·5	31·9
11 Castlebar	2	—	252·5	68·7	383·9	2	—	30·9	5·8	39·8
12 Portlaoise	4	26·4	99·5	330·5	1,898·4	2	—	2·9	0·9	5·0
13 Droichead Nua	2	292·2	58·9	151·4	1,174·1	1	1·6	—	—	2·6
14 Ballina	2	—	—	133·2	931·6	3	7·6	2·2	8·0	28·6
15 Tallaght	3	132·7	31·2	3·7	987·1	1	11·0	9·0	—	20·9
16 Ballinasloe	2	—	40·8	82·7	191·6	1	—	0·6	6·8	19·2
18 Dungarvan	2	803·2	197·6	450·3	3,596·5	1	—	—	29·0	33·9
19 Monaghan						1	—	4·2	0·3	6·0
20 Letterkenny	1	167·1	—	16·2	208·4	3	—	2·2	12·7	23·8
21 Nenagh	1	10·9	11·4	3·0	45·2	2	11·8	5·1		29·4
22 New Ross	1	131·9	139·0		278·5					
23 Naas	2	34·0	18·3	13·6	534·4					
24 Carrick-on-Suir	2	44·3	—	44·2	3,120·0	3	1·1	0·5		2·1
Group Total	35	1,712·0	1,109·0	1,605·7	14,371·0	44	84·9	97·4	164·4	455·7

continued on next page

TABLE A4 (*continued*)

Towns	*New industries*					*Small industries*				
	No. of firms	*Paid* 1971–72	*Paid* 1972–73	*Paid* 1973–74	*Total approved*	*No. of firms*	*Paid* 1971–72	*Paid* 1972–73	*Paid* 1973–74	*Total approved*
Pop. 3,000–5,000										
25 Tuam	1	111·8	3·7	—	115·5	2	1·5	22·9		26·2
26 Longford	1	634·6	198·0	44·2	960·3	4	3·5	7·9	28·2	70·4
27 Tipperary						2	4·8	—		10·4
28 Midleton	5	229·7	263·8	32·2	893·0					
29 Athy	2	—	—	89·8	334·6	1	—	—	2·2	6·3
30 Greystones–Delgany						2	2·0	—	6·9	10·2
31 Cavan						1	—	1·6		1·6
33 Swords	2	52·0	25·6		111·4					
34 Bandon	4	140·8	115·3	108·7	514·1					
35 Fermoy	1	8·4	—		25·3	1	—	14·7	3·8	18·5
36 Wicklow	1	7·0			7·0	1	20·4	0·4		22·1
37 Birr						2	1·1	2·0		4·6
43 Buncrana	1	10·0	4·2	1·5	30·3					
45 Ardee						1	—	3·6	2·3	8·3
47 Portarlington						2	—	1·0	1·6	2·6
48 Edenderry	1	1·6	4·5	15·3	70·6	2	—	20·5	10·0	41·2
49 Loughrea						1	—	12·4		13·8
53 Listowel	1	—	110·5		345·0	1	11·5	1·5		13·0
Group Total	20	1,195·9	725·6	291·7	3,407·1	18	44·8	88·5	61·6	264·5

continued on next page

TABLE A4 (*continued*)

Towns	*New industries*					*Small industries*				
	No. of firms	*Paid* 1971–72	1972–73	1973–74	*Total approved*	*No. of firms*	*Paid* 1971–72	1972–73	1973–74	*Total approved*
Pop. 2,000–3,000										
55 Roscommon	2	—	8·0	244·1	270·2	1	7·6	6·4		25·5
58 Cashel						1	1·9	—	0·2	2·2
60 Kilrush	1	48·5	72·9	19·6	280·0	1	—	—	3·5	7·8
61 Ceannanus Mor						1	1·2	—	0·1	1·4
65 Carrickmacross	1	10·5	7·5		19·0	2	3·0	—	3·6	6·7
66 Clonakilty	4	76·1	10·4	2·7	480·8	2	—	4·6	0·4	5·1
67 Leixlip	1	8·5	—	2·3	20·1	1	—	—	3·1	3·1
69 Ballyshannon	1	52·6	16·2	1·0	113·0	2	1·5	11·4	2·3	26·2
70 Muinebeag	1	—	—	43·4	228·0	1	6·2	0·6		9·7
71 Macroom	1	193·9	6·1	71·4	314·0	1	—	10·1		10·1
72 Trim						2	2·7	1·0		6·6
75 Templemore						1	—	0·2		0·3
76 Clones	2	31·4	15·0	105·3	275·5	2	4·2	1·8		20·9
77 Clara	3	59·7	119·0	59·9	469·6					
79 Skibbereen	1	—	8·4		405·7	2	0·9	2·5	1·6	10·0
80 Kanturk						1	—	3·2		3·2
Group Total	20	481·2	263·5	582·8	2,989·8	16	29·2	41·8	14·8	138·8
Pop. 1,500–2,000										
81 Kinsale						2	7·5	1·3		12·5
83 Boyle						2	3·7	—	6·6	12·1
86 Carrick-on-Shannon						3	3·2	2·4	0·6	13·2
87 Castlerea						1	0·7	—		1·4
91 Donegal						3	1·4	8·8	9·1	26·1
92 Claremorris	1	15·9	4·8	8·4	30·6	3	4·1	1·4		8·0
93 Monasterevan						2	5·8	0·9	5·4	23·1
96 Rathkeale						1	10·7	5·8		27·1
97 Cootehill	1			237·0	260·0	2	2·7	1·7		6·2
Group Total	3	15·9	4·8	250·3	332·8	18	39·8	23·2	33·3	145·6
Grand Total	78	3,405·0	2,102·9	2,730·5	1,100·7	84	198·7	250·9	274·1	1004·6

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