POPULATION, EMPLOYMENT AND LABOUR FORCE PROJECTIONS

The population of Scotland evolves over time under the combined influence of births, deaths and migration. Given appropriate assumptions about these three factors, population forecasts may be generated and analysed. Such forecasts are published annually in Scotland by the Office of the Registrar General. (1976a). These forecasts may be converted into an estimate of labour supply by scaling by the participation rates of the various age-sex groups. Such estimates are published from time to time in the Department of Employment Gazette (see for example pp 1258-63 December 1975). Occasionally an attempt is made to identify sectors in which the increased labour supply might be absorbed. (e.g. Department of Employment Gazette, July 1975) Heretofore, these three macro-aggregates have been forecast and analysed in isolation. However, it is the aim of this study to draw these forecasts together in order to present a possible outline of the Scottish labour market in mid 1981, and to explore the sensitivity of the resulting projections to alternative migration assumptions. The paper consists of three parts:-

1 Population projections
2 Labour force projections
3 Employment projections

and a summary which assesses the outlook for the Scottish labour market in 1981 on the basis of these projections.

Population Projections

The methodology of population projection is simple and well established. The number of persons aged x in any year t will be determined by those aged (x-1) in the previous year (t-1) who survive the full year plus or minus any net migration in the intervening year of those aged x. Algebraically,

$$P_x^t = (1-d_{x-1}^{t-1})\ P_{x-1}^{t-1} \pm M_x^t \qquad x = 1,2.... \qquad (1)$$

where

P_x^t Population aged x in mid year t

d_{x-1}^{t-1} Probability of death of a person aged (x-1) in year (t-1)

M_x^t Net migration during the period mid year (t-1) to mid year t of those aged x last birthday in mid year t

However, the method above cannot be used to predict births, i.e.

those aged o in mid year t. Such births are determined by the numbers of women in the child-bearing years, conventionally taken as 15-44, and by their propensity to bear children. Algebraically,

$$B^t = \sum_{x=15}^{44} p_x^{f(t)} \; f_x^t \qquad (2)$$

where

B^t Number of live births in the period mid year (t-1) to mid year t.

$p_x^{f(t)}$ Mid year population of females aged x last birthday in mid year t

f_x^t Age specific fertility rate of women aged x last birthday in mid year t

The base year figures for the 1976 Scottish population are taken from the Registrar General's Annual Estimate of the Population of Scotland (1976). The quarterly report of the same source presents population projections on the basis of specific fertility, mortality and migration assumptions. These assumptions are discussed below, as are the alternative assumptions used in the projections which we present here.

Fertility

The Registrar General assumes a gradual increase in fertility rates leading to an increase in the number of births from 65,000 in 1976-77 to approximately 72,500 in 1980-81. On the contrary, following recent trends we have assumed that over the period 1976-81, age specific fertility rates will decline slowly at most ages from their 1975 level with the steepest decline coming at ages 36-41. Rates in the mid-twenties to early thirties scarcely change, whilst those in the early to mid-twenties decline marginally. The effect on births is to produce a gradual fall from 68,000 in 1976-77 to 66,000 in 1980-81, under the assumption of net emigration of 10,000 a year over the period 1976-81.

Mortality

The imputed death rates in the Registrar General's projections are"based on recent experience", with an assumed decline over forty years to three quarters of their present levels. Over the period of this study 1976-81, the implied decline is of the order of 3½%. We have assumed mortality constant at 1974-6 levels, and imputed age-specific death rates from the classification of deaths by age produced by the Registrar General. Thus, our approach is likely to produce somewhat lower population figures

than those of the Registrar General.

Migration

The Registrar General assumes net outward migration of 8,000 in 1976-77, increasing to 10,000 per annum thereafter. However, the factors which induce migration are far from well defined, and 10,000 is rather a low figure in the light of Scottish experience. The decade of the sixties saw average net emigration of 30,000 a year, while the period 1970-75 saw an annual outflow of 16,000 people, a figure which would have been considerable higher but for an abnormally low outflow of 2,000 in 1974. We have therefore explored the alternative scenarios of annual net emigration of zero, 10,000, 20,000 and 30,000 and of net immigration of 5,000 annually between 1976 and 1981. The chosen overall figure must then be allocated amongst different age and sex groups. It appears from the 1971 Census of Population Migration Tables that the age structure of immigrants to Scotland, and emigrants from Scotland is broadly similar, accordingly we have distributed the total net outflow across age and sex groups in line with the age-sex distribution of one year migrants to and from Scotland enumerated in the 1971 Census. This results in a concentration of net emigration primarily amongst those aged under thirty.

Projections

The calculations set out in equations (1) and (2) above were carried out separately for males and females at single years of age from zero to ninety, and for the over nineties of each sex. The results under the varying emigration assumptions are presented below. For comparative purposes, we present the Registrar General's estimate of the 1976 Scottish population, and his projection for 1981 made under the assumptions noted above. Three aspects of the results are worthy of discussion, but before doing so it must be stressed that population projections are only as good as the fertility, mortality and migration assumptions which they embody. Different assumptions will obviously produce different results. This explains the discrepancy between our results (assuming net emigration of 10,000 annually) and those of the Registrar General. Bearing this caveat in mind, we draw the following inferences from Table 1.

(a) Total population

Positive levels of net emigration will cause the Scottish population to fall between 1976 and 1981. Under our extreme assumptions of a net annual outflow of 30,000, the fall is of

Table 1 Population Projections 1981

Age	Total Population* June 1976	Population Projections ('000s)					
		Annual Net Migration					Registrar General **
		+ 5,000	0	-10,000	-20,000	-30,000	-10,000
0-14 Both sexes	1,255	1,131	1,125	1,111	1,097	1,083	1,122
15-44 Male	1,042	1,137	1,128	1,112	1,096	1,080	1,113
15-44 Female	1,039	1,119	1,111	1,096	1,080	1,065	1,084
45-64 Male	552	537	536	533	531	529	542
45-59 Female	466	454	453	451	449	447	453
65 + Male	265	272	271	271	270	270	271
60 + Female	586	594	593	592	590	589	593
All ages Male	2,503	2,516	2,503	2,477	2,451	2,425	2,501
All ages Female	2,702	2,727	2,714	2,688	2,618	2,636	2,677
All ages Total	5,205	5,244	5,217	5,165	5,113	5,061	5,178

Sources: * *Registrar General Scotland; Annual Estimate of the Population of Scotland 1976.*

** *Registrar Scotland; Quarterly Return 1976.*

the order of 144,000 people. At the other extreme, where zero net emigration is assumed, the population appears to rise marginally.

(b) Dependent children

Regardless of the emigration assumption used, the numbers in the 0-14 age group fall substantially over the period. Even in the case of the Registrar General's projection where a rise in fertility rates is assumed, the decline is of the order of 130,000 children. As noted above, the trend in fertility rates in recent years has been downwards, and we assume that fertility will level out somewhat below 1975 levels as family planning techniques improve and more women enter the labour force. When coupled with somewhat higher levels of net emigration than the annual 10,000 assumed by the Registrar General, the contraction of the 0-14 age groups is all the more striking, being of the order of 170,000 under our most extreme emigration scenario. It would appear therefore that in the absence of substantial net immigration, or a sharp rise in fertility, there will be a sizeable contraction in the numbers of dependent children in Scotland in 1981, with consequent effects on school attendances, teacher demand, etc.

(c) Prime age population

The same is not true however, of those in the prime labour force age groups 15-44. In this case it would require net migration well in excess of 30,000 annually to prevent the numbers of prime age males and females from rising. Zero net emigration would lead to an increase of over 150,000 whilst the numbers would increase by 64,000 over the period 1976-81 even in the event of net emigration of 30,000 annually. This age group is of the utmost importance, as a high proportion are likely to be married, and hence in need of separate household accommodation. Furthermore, labour force participation rates tend to be close to their maximum levels in this age range, which has important implications for labour supply. This point is discussed in more detail below.

Finally, as a consequence of the changing age pattern of the Scottish population, the burden of dependency falls throughout the survey period regardless of the emigration assumption implemented. When measured as the proportion of the total population who are in the dependent age groups, (i.e. those 0-14 and 65 +), the ratio declines from over 40% in 1976 to close on 38% by 1981. In theory this should lead to a fall in the importance of social spending directed at those age groups coupled with an expanding tax base.

Table 2 Labour Force Projections 1981 ('000s)
1976 Participation Rates*

Age	Estimated Labour Force 1976	Net Annual Migration					Registrar General - 10,000
		+ 5,000	0	-10,000	-20,000	-30,000	
17-19 Both sexes	187	207	206	204	203	201	203
20-44 Male	786	861	854	840	826	812	841
20-44 Female	486	524	520	512	505	497	508
45-64 Male	520	506	505	503	501	498	511
45-59 Female	308	300	299	298	296	295	299
65 + Male	48	48	48	48	48	48	48
60 + Female	70	66	66	66	66	66	64
All ages Male	1,447	1,518	1,511	1,494	1,477	1,459	1,502
All ages Female	958	994	988	978	968	958	971
All ages Total	2,405	2,512	2,499	2,472	2,445	2,417	2,473

* See text

Labour Force Projections

From the population figures an estimate of the corresponding labour supply may be obtained by applying a participation rate to each age-sex group. This rate shows the proportion of that group who are economically active, i.e. those who are working or seeking work. However, such rates are not fixed, and vary under the influence of social, economic and legal factors. Thus there has been a secular increase in the participation rate of married women as educational standards have risen and average family size has fallen. The removal of the legal prohibition on the employment of women as night-shift workers might perhaps raise this rate still further. Similarly, the participation rate of those over sixty five, both male and female, has fallen as pension schemes have proliferated. Obviously, participation rates are far from constant, which causes problems when attempting to forecast labour supply. The participation rates which we have used initially are based on the results of the 1971 Census, but updated in the light of the 1973 Labour Force Survey conducted for the EEC (SOEC 1975). The projected labour supply in mid 1981 on the basis of these participation rates and under the varying emigration assumptions are shown below. For comparison, the labour supply implied by the Registrar General's 1981 projection is also shown, calculated on the basis of the same participation rates.

If participation rates were to remain static over the period 1976-81, we would expect the results set out in Table 2. The salient features of these projections are:

1. In the absence of net emigration of at least 30,000 a year, the labour force will grow between 1976-81.

2. There is little discrepancy between our projection based on assumed net emigration of 10,000 annually, and that of the Registrar General which embodies a similar migration assumption. Both sets of projections imply a growth of over 60,000 in the labour force during the period 1976-81, implying an annual increase of 13,000 in the numbers of those seeking employment in Scotland.

Increased net emigration obviously reduces these figures. At an annual net emigration level of 30,000 we would expect the labour force to fall by 2,000 a year. Conversely if net emigration were to cease entirely the supply of labour would increase by 19,000 annually under our mortality assumptions.

Table 3 Labour Force Projections 1981 ('000s)

1981 Projected Participation Rates*

Age	Estimated (1) Labour Force 1976	Net Annual Migration					Registrar General - 10,000
		+ 5,000	0	-10,000	-20,000	-30,000	
17-19 Both sexes	187	207	206	204	203	201	203
20-44 Male	786	861	854	840	826	812	840
20-44 Female	486	542	538	530	522	514	525
45-64 Male	520	504	503	501	499	497	509
45-59 Female	308	320	320	318	317	315	320
65 + Male	48	41	41	41	40	40	40
60 + Female	70	70	70	69	69	70	70
All Ages Male	1,447	1,510	1,501	1,484	1,467	1,450	1,490
All Ages Female	958	1,035	1,030	1,020	1,009	999	1,017
Total All Ages	2,405	2,545	2,531	2,504	2,476	2,448	2,507

* See text

(1) 1976 Particpation Rates

If we were to follow the Registrar General and assume declining mortality the growth in labour supply would be more rapid still.

Illuminating though the results of Table 2 may be, they suffer from a major defect in assuming that participation rates will not change over time. While this may be a plausible assumption in the case of prime age males, where such rates are probably at their maximum levels, the same is not true of females. The participation rates of women rose substantially in the inter-censal period 1966-71, whilst those of other women remained relatively stable. It can be expected that these trends will continue, given the low level of female participation in the 30-50 age range. Accordingly we have prepared an alternative, and in our view more plausible, series of labour supply projections which embody assumptions of changing participation rates over the period 1976-81. (Both sets of participation rates may be found in Appendix A.) The rates for 1981 have been calculated by applying to the base year participation rate in each age-sex group the percentage increase projected by the Department of Employment (1975) for that group. The consequences for the Scottish labour supply may be seen in Table 3.

Owing to the higher female participation rate, the growth in labour supply is obviously much greater in Table 3 than in Table 2. In the case of the Registrar General's population projection the implied labour force grows by 102,000 over the years 1976-81, and even in the case of our assumption of net emigration of 30,000 annually growth is of the order of 40,000 by 1981. Where our emigration assumption is comparable with that of the Registrar General, the labour force growth is broadly similar, in spite of our higher mortality assumptions, but still exceeds 95,000. The composition of this increase is of considerable interest, as it is heavily weighted towards the female labour force. Inspection of Table 3 reveals that women account for almost two thirds of the growth in labour supply over the period 1976-81. The rapid growth in the female labour force arises primarily on account of the higher projected participation rates for women, as a comparison of Tables 2 and 3 shows. Were female participation rates to remain at 1976 levels, and net emigration to average 10,000 annually, then the female labour force would grow by 20,000 over the period 1976-81. However, at projected 1981 participation rates, the growth is of the order of 60,000 under the same net emigration assumption.

At mid-June 1976 there were 105,000 men and 39,000 women registered as unemployed in Scotland. However, not all unemployed persons register and so it is of interest to derive an alternative measure of total unemployment, both registered and unregistered, by comparing the estimated labour force of Table 2 with the total gainfully employed and HM Forces. Such a reconciliation suggest

Appendix A

Participation Rates 1976, 1981

$$\left(= \frac{\text{Employed + Self-Employed + Unemployed}}{\text{Population}}\right)$$

	Male		Female	
Age	1976	1981	1976	1981
17-19*	.725	.725	.760	.760
20-24*	.898	.898	.712	.716
25-29	.966	.966	.462	.478
30-34	.979	.979	.487	.504
35-39	.982	.982	.603	.649
40-44	.981	.981	.675	.699
45-49	.977	.977	.649	.696
50-54	.967	.967	.741	.794
55-59	.948	.948	.590	.628
60-64	.865	.850	.318	.332
65-69	.308	.260	.110	.116
70-80	.114	.094	.026	.028

* Not including full time students

108,000 unemployed males and 70,000 females. When expressed as a proportion of the labour force, this represents an unemployment rate of 7.4%. In the next section, the job creation implications of reducing this unemployment rate to 5% by 1981, and of absorbing the growth in labour supply are explored. Table 4 sets out the annual net new job creation required to attain such an unemployment rate in 1981 under the various net migration assumptions.

Table 4 Annual Net New Job Creation 1976-81

Assumed Net migration	+ 5,000	0	- 10,000	- 20,000	Reg.Gen
Net New Job Creation	38,000	35,000	30,000	24,000	30,000

Source: *Table 3*

Employment Projections

The figures in Table 4 represent net new jobs, i.e. they are jobs which must be created over and above those required to compensate for job losses through redundancies and running down of existing industry. A broad outline of Scottish employment in 1975 as revealed by the Census of Employment can place these job creation targets in perspective. In that year women accounted for 41% of all employees, however, they were not spread evenly over all sectors of the economy, but were concentrated in the services sector, where almost three quarters of them were employed. The remaining 25% were practically all employed in the manufacturing sector, primarily in four industries; food and tobacco; textiles, paper and printing; and clothing and footwear. Male employment was considerably more diversified. In 1975, just over 40% of all Scottish male employees were employed in the services sector, 36% were employed in manufacturing industry, while the bulk of the remainder were in building and construction.

Having delineated the employment structure at the beginning of the period, the problems of absorbing the increased labour supply and attaining the job creation targets of Table 4 may be tackled. The task can be attempted from two broad angles, those of labour

supply and labour demand, respectively. It has been noted above that one of the prime reasons for the rapid labour force growth is the rising participation rates of women and particularly of married women. There can be little doubt that this component of labour supply could be restrained by manipulating the income tax system in such a way that a wife's income attracted a high marginal tax rate. However, on grounds of equity and for political reasons such a suggestion is likely to be totally unacceptable. Furthermore, it neglects the fact that for many couples, owner occupation is impossible unless the husband's income is supplemented by that of the wife. A more acceptable approach might lie in recognising the monetary value of work carried out by women in the home. Were a wage to be paid for domestic work, a more efficient allocation of labour between the home and the market might be expected under the postulates of neo-classical utility maximisation theory. However, whereas active discouragement of labour force participation may be politically unacceptable, domestic remuneration may be financially so.

A reduction in labour supply might however be effected by another route; that of mandatory retirement at the age of 60 for both sexes. Such a policy would effect a reduction of over 100,000 in the labour force by 1981. On paper this would appear to create considerable vacancies in employment,but it is possible that the policy would give rise to as many problems as it solved. Quite apart from the social problems of catering for a much increased body of economically inactive senior citizens, it is a moot point to what extent younger more active workers would be recruited to fill the posts vacated. In sum, it appears that little impact can be made on the job creation targets of Table 4 from the labour supply side. The solution, if one exists, must lie with the demand for labour.

Here too, there are problems, as two thirds of the jobs created must be suitable for women. As noted above, women employees in Scotland are concentrated in the services sector, and particularly heavily in the retail and distributive trades, public administration, and health and educational fields. Given a falling population, and reduced numbers of school going children, the prospects of increased employment in the latter sectors listed seem remote. The prospects in those manufacturing industries which currently employ large numbers of women seem equally poor in the opinion of the Department of Employment (1975). Furthermore, provision must also be made for the increase in the male labour supply. The required job creation totals remain daunting, but there can be little doubt that they are attainable provided economic growth is sufficiently rapid. The Scottish experience over the years 1972-75 (see Table 5) provides a useful pointer.

If the rate of employment increase could be maintained at the 1972-73 level of 61,000, then there would be little difficulty in absorbing increased labour supply between 1977 and 1981, even under the most optimistic migration assumptions.

Implications for the Scottish Economy

In order to create sufficient additional demand for labour there will clearly have to be an expansion of output. Using the method of Ball and St Cyr [1] we have made estimates of the likely effects on employment in manufacturing of differing rates of output growth. These are set out in Table 6 and assume that historic relationships continue to hold.

Given that Scotland's historic growth rate has been around 2% it is clear from the job creation targets in Table 4, and the likely rates of job creation in Table 6 that only if there is a considerable improvement on past growth performance can Scotland succeed in bringing unemployment down to 5% by 1981. The figures suggest that only if annual net emigration is around 20,000 can the average growth rate be allowed to fall below 3% in order to attain a 5% unemployment level. On the more optimistic migration assumptions the average growth rate should lie between 3% and 4%.

Such growth can come from any of three sources - consumption, investment or exports. The benefits of consumer led expansions tend to be quickly dissipated by import expansion and cannot generally be relied on to provide steady growth in the presence of a balance of payments constraint. However, let us consider what changes are likely in the pattern of consumer demand, both for goods and services, as a direct result of the demographic changes we have outlined.

The growing size of the labour force and changing age structure of the population are a potentially buoyant source of demand. One major effect will be on the demand for housing. Regardless of the net emigration assumption chosen, the size of the 15-44 age group will increase substantially between 1976 and 1981. At an annual net emigration rate of 10,000 the increase will be 127,000. If 90% of these marry there will be an increase of almost 60,000, or 12,000 a year in the number of household accommodation units required. By comparison, the fall in the numbers aged 44 and over is small and the resulting accommodation released unlikely to affect greatly the scale of new housing construction required. Added to this is the fact that the

Table 5 Net Change in Employment

		1972-73	1973-74	1974-75
Index of Production Industries	Male	+ 20,000	+ 5,000	-17,000
	Female	+ 8,000	+ 10,000	-20,000
Services	Male	+ 10,000	+ 1,000	+11,000
	Female	+ 25,000	+ 20,000	+19,000
Agriculture, Forestry, Fishing		- 2,000	- 2,000	- 1,000
	Total	+ 61,000	+ 34,000	- 8,000

Source: *Department of Employment*

Table 6 Output Growth and Employment

Industry	Annual Rate of Output Growth %	Employment (1981) (000's)	Annual Rate of Job Creation 1976-81
Manufacturing	0	582	- 7
	1	616	0
	2	652	+ 7
	3	689	+ 14
	4	728	+ 22
All Industries & Services (on the assumption of a 1:1 ratio between expansion of jobs in manufacturing and in other sectors)	0	2002	- 14
	1	2072	0
	2	2142	+ 14
	3	2212	+ 28
	4	2292	+ 44

current housing stock, though perhaps quantitatively adequate, is far from qualitatively so. Through imaginative improvement and financing schemes there is an opportunity for government to ensure that increased demand can be met and to resuscitate an industry currently experiencing its most acute post-war depression. Further, in contrast to other consumer durable goods, housing has a relatively high domestic multiplier effect given its high degree of labour intensity and low import content. Thus the benefits of a stimulus to consumer demand aimed particularly at housing rather than at all consumer goods are unlikely to be of a purely temporary nature.

In the service sector, which shares with construction a very low import content, increasing numbers of 15-44 year olds should stimulate demand for leisure and recreational services and for adult education. Indeed, coupled with substantial reductions in class size, the only means to offset the effects of a declining school-age population on employment in the educational sector may be through a substantial expansion of adult education.

A further consequence of declining birth rates will be evidenced in a reduction in the demand for maternity services. Although the Registrar General expects some rise in fertility, advanced methods of family planning coupled with the working of the Abortion Act (1967), generate a certain sceptimism as to the likelihood of this increase. The Abortion Act alone has had the effect of reducing the number of births by over 7,000 annually, so that the 1981 population in the 0-4 age group will be some 30,000 lower as a result. Given current class sizes, this implies a reduced demand for primary teachers of around 1,500 in later years, with similar effects in other educational sectors subsequently.

The effects of changing population structure on investment and export activities will be marginal. However, these are probably the key sectors in which expansion can take place in order that growth targets can be met and consequently that the level of job creation necessary to absorb increased labour supply can be attained. Discussion of the means whereby these sectors can be stimulated is outwith the scope of this article. Nevertheless, without strong and sustained stimulus to investment and exports it seems unlikely that unemployment can be brought below 5%.

Conclusions

This paper has detailed a model which forecasts population under a variety of assumptions regarding births, deaths and fertility.

Using estimated participation rates for 1981 job creation targets have been set which are calculated under different migration assumptions to bring the rate of unemployment down to 5% in 1981. Even if a sufficient number of jobs are created the unemployment rate may still exceed 5% if the new jobs do not match the skill/ sex composition of the 1981 labour force, which, as has been pointed out, will contain a larger proportion of females than currently.

If the required job creation is not forthcoming, the consequences may not manifest themselves in a higher unemployment rate, but rather in a smaller labour force. Paradoxically, the greater the employment expansion, the greater will be the supply of labour seeking that employment. A buoyant labour market encourages the growth of the secondary labour force. However, in depressed conditions, secondary workers tend to leave the labour force, and the effects are not seen in registered unemployment.

In conclusion, it may be emphasised that the Scottish labour force in 1981 will exceed that of 1976. To absorb this increased labour force will require a return to the growth rates of GDP which were seen in 1972-74. On present trends this appears somewhat unlikely. It is a sobering thought to reflect that an unemployment rate of 5% of the labour force implies actual unemployment of 125,000 people in 1981.

Bibliography

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