Education, Demographics and the Irish Economic Miracle

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ABSTRACT

This paper considers how changes in the educational and age composition of the Irish population between 1994 and 2003 have affected employment, unemployment and the supply potential of the economy. The impact of demographic change on the labour market is estimated to have been relatively small. In contrast, up to a quarter of the decline in the unemployment rate, and two thirds of the increase in the employment rate, could reflect the rise in educational attainment. This rise is also largely responsible for estimated labour quality increasing by 1.4 per cent per year. Together, labour quality and employment growth can account for 2.1 percentage points of the 4.7 per cent average annual growth of GNP per adult over the past decade — leaving relatively little room for an economic miracle.

1. Introduction

This paper considers how educational and demographic changes have affected employment, unemployment and the average quality of the workforce in Ireland. Interest in factors affecting employment and unemployment is self-evident, because of their implications for equality and wider macro-economic performance. Labour quality is also of vital importance, as it affects the potential output of the economy. And understanding recent changes in potential output may help in the forecast of future growth, and its likely trade-off with inflation.

Data considerations limit this paper to developments between 1994 and 2003. Although short, this period coincides with an almost miraculous upturn in Ireland's economic fortunes. On the official measure, unemployment fell from 14.7 per cent in 1994 to 4.4 per cent in 2003 (Figure 1). Over this period, the employment rate increased from 45.4 per cent to 56.9 per cent (Figure 2). This reflected annual employment growth of 4.2 per cent, almost three times the growth rate of the adult population. On the output side, GNP growth averaged 6.6 per cent per year, compared with its average rate of 4.1 per cent since 1980. But despite the fall in unemployment and the rapid economic expansion, inflation generally remained low and stable, averaging 3.1 per cent between 1994 and 2003 (Figure 3). In latter years, this may partly have reflected discipline associated with

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membership of the Euro. However, inflation was also in low in 1994 and 1995, before membership was confirmed, and despite the sharp pick-up in growth.

As discussed in more detail in Walsh (2004), the resurgence of fortunes in the labour market over the 1990s followed the gloom of the 1980s. Over that decade, employment fell by an average of 0.5 per cent per year. Data from the ESRI suggest that the unemployment rate rose from 7.0 per cent in 1979 to peak at 17.2 per cent in 1987. And the increasing share of long-term unemployment had led to a belief that this rise was mirrored in the natural rate: Layard et al (1991) estimated that this had increased from 9 per cent in the 1970s to 13 per cent over the 1980s. Inactivity had also risen, as had net outward migration.

Almost as remarkable as the pick-up over the 1990s has been the resilience of the labour market to the recent economic slowdown. Despite GNP growth slowing from over 10 per cent in 2000 to almost zero in 2002, unemployment remained steady at around 4 per cent. As noted by Walsh (2004), many observers had previously predicted that any downturn would be met with a sharp increase in unemployment. And, as recently as 1999, the NAIRU had been estimated to be 9 per cent (McMorrow and Roeger, 2000).

Barry (1999) and Fitzgerald (1999) provide a comprehensive discussion of many of the factors that are likely to have been behind Ireland's economic transformation. These include: the long-term benefits from the fiscal stabilisation of the late 1980s; European structural funds (which are estimated to have contributed about 0.5 percentage points to annual GDP growth over the 1990s); increased educational attainment improving the skill level of the workforce; favourable demographic shifts; continued Irish success in attracting Foreign Domestic Investment inflows; and peaceful labour relations leading to wage moderation.

This paper does not seek to contribute to the debate on the relative importance of all these factors. Instead, it focuses on the roles played by educational and demographic changes. In doing so, it builds on the results of Durkan et al (1999), who found that the increase in educational attainment raised labour quality (i.e. human capital) by about 0.9 per cent per year over the first half of the 1990s, but by only 0.5 percentage points over the 1970s and 1980s.

This paper extends the calculation of labour quality to 2003, and uses a different data source that enables a more flexible and accurate analysis, albeit at the expense of a shorter reference period. Durkan and co-authors used census data for 1981 and

1991, with the results extrapolated to 1996 using statistics on participation levels in education. In addition to removing the need for extrapolation, the labour force surveys used in this paper enable a joint evaluation of the effects of demographic and educational change on labour quality. They also allow labour quality growth to be decomposed into three factors: changes in the prevalence of different types of worker, changes in their employment rates, and changes in their average hours. More practical advantages are that up to five (rather than three) educational categories can be considered, while more recent wage data are also used. In addition to considering labour quality, this paper also estimates how changing demographics and educational attainment have affected the rates of unemployment, employment and potential output growth.

The remainder of this paper is organised as follows. Section 2 discusses the data sources used in the paper. Section 3 describes recent demographic and educational trends in Ireland. Section 4 estimates the effect of demographic change on the unemployment and employment rates. Section 5 considers the effects on these rates of educational changes. Section 6 evaluates how these trends have affected the skill composition of the workforce, and thus potential output while Section 7 calculates the effect on economic growth. Section 8 concludes.

2. Data

This paper uses both aggregate and micro level data. Aggregate National Accounts and labour market data were obtained from the Central Statistics Office (CSO), while the individual level data were sourced through the Irish Social Science Data Archive (ISSDA), although the surveys were originally conducted by the CSO.

Individual level labour market data were obtained from the Quarterly National Household Survey (QNHS) for 1998-2003, and the Labour Force Survey (LFS) for 1994-1997. The QNHS is a random nationwide survey and is used in the production of the official labour force statistics, including the measures of employment and unemployment. Each quarter, it surveys about 39,000 households, which equates to a sample of about 80,000 individuals aged 15 or over (which are hereafter referred to as adults). The QNHS replaced the annual LFS, which covered approximately 115,000 adults. This paper uses variables that are present in both surveys, with the results made representative of the general population by using the CSO's grossing factors.

Although the LFS and QNHS surveys are similar in design, two steps have been taken to ensure comparability of the results. As the LFS was conducted in April of each year, this paper only uses the second quarter QNHS waves to avoid seasonal distortions.

It also uses the PES (Principal Economic Status) classification of labour market activity, which is available from both surveys. This is a slightly different to the International Labour Organisation (ILO) definitions, which are now used in the official labour market statistics. However, these data were not collected in the LFS survey and the PES variable is used throughout to avoid any discontinuities. Differences between the two arise because the ILO classifies people on the basis of their experience in the week before the survey, while the PES asks respondents for their own assessment of their economic status. In practice, the differences between the two measures of the unemployment and employment rates are small (Figures 1 and 2), and the conclusions from using the PES survey are transferable to the official series. The small differences in the levels of unemployment arise because the PES measure includes people who describe themselves as unemployed, but who are not sufficiently active in the labour market to be categorised as unemployed on the ILO measure. The adoption of the ILO measure (with the introduction of the LFS) marginally increased the official measure of employment, which the CSO (1997) attribute to the higher number of individuals classified as either employed by relatives or in part-time work.

In addition to information on labour market status from the QNHS and the LFS surveys, this paper also uses wage data from the 1999/2000 and the 1994/1995 waves of the Household Budget Survey (HBS). These surveys each include details on a random sample of around 7,500 households. Although the HBS is conducted at the household level, this paper uses series that separately identify the wage, age and gender of the head of household and their spouse/partner.

Section 6 below uses the average wage for groups of workers defined on the basis of gender, age (categorised in 6 groups) and educational attainment (split in up to 5 levels). In practice, the HBS had few observations for some combinations, making their average wage subject to considerable measurement uncertainty. Thus, the wage data were smoothed by making the assumption that hourly wages are determined by age, education, gender and an idiosyncratic component according to the following expression:

$$\ln W_t^j = \sum_{a=1}^{6} \beta_t^a D_t^a + \sum_{e=1}^{5} \beta_t^e D_t^e + \sum_{g=1}^{2} \beta_t^g D_t^g + \varepsilon_t^j \qquad (\textit{equation 1})$$

Where superscript ^{a} refers to the age group, ^{e} the educational level and ^{g} the gender. The dummy variables (D_x) take the value 1 if the individual is in group x and are zero otherwise. ε^j is the idiosyncratic component, which is assumed to be randomly

distributed and independent of the other factors. Table A1 in the Appendix gives the results from this regression equation.

Comparison of Figures 4 and 5 reveals that the smoothed results are very similar to average actual wages, with the main difference being that there is no dip in the wage for those with primary/no education between the 15-19 and 20-24 age categories. Once smoothed wages by education, age and gender were calculated, these values were merged into the QNHS and LFS datasets. In practice, the results presented in Section 6 were virtually identical to using the unsmoothed data.

3. Trends in the Demographic and Educational Composition

Ireland has experienced significant demographic shifts between 1994 and 2003. Of particular importance for the purposes of this paper has been the 2.5 percentage points fall in the proportion of the population aged between fifteen and nineteen. This has been offset by an increase in the relative sizes of the 25-34 and the 55-64 age groups (Figure 6). However, especially by European standards, Ireland's population remains skewed towards the young, with over 20 per cent of the 15+ population aged 15-24: Ireland will continue to experience demographic change over the next few decades as this cohort ages.

Changes in the average educational attainment of the adult population over the past decade have been even more marked. In particular, the fraction whose highest qualification is at third level or above more than doubled to 31 per cent (Figure 7), which was mainly offset by a reduction in the proportion of those whose highest qualification is at lower secondary level or below.[1] In addition to the role played by migrants, these trends reflect two purely domestic factors. First, the decline in the 15-19 population reduced the proportion who are too young to have reached their highest educational level. And second, young cohorts, with relatively high educational levels, are replacing older ones, with relatively low ones (Figure 8). This cohort effect is evident in the school leaving statistics: the percentage of students who achieve a Leaving Certificate increased from 20 per cent in 1965 to 82 per cent in 2000, while the estimated rate of transfer to third level increased from 11 per cent to 57 per cent (Figure 9).

The increase in educational attainment at least partly reflects changes in government policy. The single most important contribution over the past thirty years was probably the introduction of free secondary level education in 1967 (Kearney,

1 The lower secondary level reflects the Junior Leaving Certificate (typically taken at age 15/16); the upper secondary level is the Leaving Certificate (age 17/18); and third level education is provided by Universities, Institutes of Technology and Colleges of Education.

1999). But an indication of the importance attached to educational policy over more recent years is that eleven pieces of primary and secondary legislation were passed between 1926 and 1988, but four times as many were passed between 1989 and 2003. Recent legislation included the 2000 educational welfare act, which raised the minimum school leaving age from 15 to 16 (or until students have completed three years of second level education). Another significant change was the introduction in 1989 of the Leaving Certificate Vocational Programme (LCVP), and its expansion in 1994. The, yet more practical, ''Leaving Certificate Applied Programme'' was introduced in 1995, which aims to prepare participants for adult and working life through general education, vocational training and vocational preparation. It was designed for those whose needs were not adequately catered for by the other courses, and thus was intended to raise the proportion remaining in education (Department of Education, 2004).

In addition to purely domestic changes, the composition of the population has also been influenced by migration. There have been net migratory inflows into Ireland since the mid 1990s, following net outflows over the 1980s (Figure 10). Between 1994 and 2003, average annual gross inflows were equivalent to 1.4 per cent of the resident population, while gross outflows averaged 0.7 per cent.

According to the QNHS and LFS surveys, the non-Irish born fraction of the population increased from 5.4 per cent in 1994 to 9.4 per cent in 2003. This implies that these immigrants have accounted for about a third of recent gross inward migration. These migrants have a greater propensity to be of prime working age range (25-44) than the domestic population (Figure 11). Their average educational attainment is also higher, being over fifty percent more likely to have a degree (Figure 12). However, their relatively low overall weight means that they account for only 1 percentage point of the 16 percentage points increase in the fraction educated to third level over the past decade, and for an even smaller amount of the demographic changes. Of course, the composition of immigrants has, to some extent, reflected the demand for highly skilled workers, so these changes are partly endogenous.

We only have limited information on the composition of the migratory flows of the Irish born, who account for around two thirds of gross inward migration over the period studied in this paper. This means that we are unable to quantify their influence on the aggregate changes in the levels of education attainment and demographics. Barrett and O'Connell (2001), using data for 1994-1996, found that the returning Irish were twice as likely to have a degree as the domestic population. However, Ireland

emigrants are also much better educated than average. The pick-up in the volume of educated returning Irish may therefore roughly offset the brain drain from educated Irish emigrants, which had previously suppressed average educational levels in Ireland.

More generally, outward and return migration are thought to have played a major role in shaping the Irish labour market since independence. As discussed in Walsh (2004), high labour mobility between Ireland and the UK ensured that the unemployment rates of the two countries tended to move in tandem. Honahan (1992) found that the equilibrium gap between the Irish and UK unemployment rates was around 5 per cent. However, this relationship has now broken down, with the unemployment rates in Ireland and the UK in 2003 comparable at slightly under 5 per cent.

4. Demographic Trends and Labour Market Outcomes

Unemployment and employment rates vary significantly by age in Ireland (Tables 1 and 2, and Figures 13 and 14). Employment rates are relatively low amongst the 15-19 and 20-24 age groups, many of whom remain in education. They pick-up sharply for the 25-34 age group, before gradually declining with age. For those who have left education, unemployment rates among the 15-19 and, to a lesser extent, the 20-24 age groups are relatively high.

Table 1: Unemployment rates, 1994 and 2003

	1994	2003
15-19	36.7	20.4
20-24	22.1	8.7
25-34	13.5	5.9
35-44	13.3	4.8
45-54	13.9	5.4
55-64	13.2	5.5
65+	5.2	2.4

Sources: QNHS, LFS and author's calculations. Derived from PES classification.

Table 2: Employment rates, 1994 and 2003

	1994	2003
15-19	12.0	13.6
20-24	57.5	58.4
25-34	69.3	79.2
35-44	59.8	75.8
45-54	53.5	68.9
55-64	37.2	48.0
65+	7.7	7.4

Sources: QNHS, LFS and author's calculations. Derived from PES classification.

By identity, the aggregate unemployment rate is the weighted average of the unemployment rates of all the separate age

groups. Thus, the reduction in the proportion of the young between 1994 and 2003 might have helped reduce (increase) the aggregate rates of unemployment (employment). Defining the share of each group as s^i and their unemployment rate as u^i:

$$U_t = \sum_i s_t^i u_t^i$$

So aggregate changes in the unemployment rate can be decomposed into movements in the rate of the different age-groups (shift) and changes in their relative size (share):

$$U_t - U_{t-1} = \frac{1}{2}\left(\sum_i (s_t^i + s_{t-1}^i)(u_t^i - u_{t-1}^i) + \sum_i (s_t^i - s_{t-1}^i)(u_t^i + u_{t-1}^i)\right)$$

In doing this, we follow previous authors including Perry (1970), Summers (1986), Shimer (1998) and Barwell (2000). Note that this analysis does not consider the details of how jobs are being formed, nor why others have been lost. Instead, it assumes that the demand for labour adjusts to variation in the supply. Implicit in such an analysis, and that used in section 5, is that there is some measure of the natural rate of unemployment that depends, amongst other things, on the age and educational composition of the population.

But, before undertaking this decomposition, it is necessary to consider why the young tend to have higher unemployment, and thus whether the downward ‘‘share’’ effect on aggregate unemployment caused by a reduction in the proportion of the young would be offset by a ‘‘shift’’ effect of higher group specific unemployment rates. Of course, there would be no such offset if the labour markets for different age groups are effectively segmented.

One factor behind the higher rate of unemployment amongst the young is that they are more likely to leave employment. Drawing upon the UK experience (Gregg and Wadsworth, 1995), this is likely to reflect their greater likelihood of being laid off, and their greater propensity to quit their jobs without alternative employment. As discussed in more detail in Barwell (2000), their greater rate of lay offs may be due in part to some firms operating on a ‘‘last-in, first-out’’ basis, which disproportionately affects young workers. Employers may also prefer to lay-off their youngest workers because they have less firm-specific human capital, or because they may expect them to be more likely to leave at some time in the future. Part of the explanation for young people being more likely to quit their jobs is that they are more concentrated in low-wage industries, which tend to have higher quit rates. In addition, they may ‘‘job-shop’’ until they find

a job that is suitable for them. Such a process naturally means that older workers have more job stability, because they have already undergone this sorting process.

A reduction in the proportion of young individuals might be expected to lower aggregate unemployment if the job shopping and/or firm-specific human capital factors are the most important explanations for the age-unemployment relationship. But if it instead reflects ‘‘first-in, last-out’’ policies other workers would instead be the first to be laid-off, with no change in aggregate unemployment. Total unemployment would also probably be unchanged if it reflects the concentration of the young in low-wage industries — unless the demand for such workers is modified alongside the change in the age structure of the population. Given that it is difficult to know the relative importance of the different factors, the results from an analysis of shifts in the share of different age groups provides an upper bound for the impact of demographic change. In addition to mirroring trends in unemployment, variation in employment rates by age group also reflects inactivity.

Shift-share analysis reveals that demographic trends can account for a maximum of only 0.2 percentage points of the 9.4 percentage points fall in the unemployment rate between 1994 and 2003 (Figure 15).[2] Instead, the vast majority of the change reflects the decline in the unemployment rate within each age group. The relatively small contribution from the reduction in the proportion of the high-unemployment 15-19 group is because their low activity rate means that they only have a small effect on aggregate unemployment. These results suggest a less important role for demographic trends in explaining the reduction in unemployment in Ireland than was found for the UK: Barwell (2000) found that demographics accounted for a tenth of the 5.7 percentage points fall in the UK unemployment rate between 1984 and 1998.

However, demographic shifts are estimated to have made a more substantial contribution to the increase in the employment rate in Ireland, accounting for up to 1.1 percentage points of the 9.6 percentage points increase (Figure 16). By identity, the bigger increase in employment than fall in unemployment is because of the downward effect on inactivity. This is unsurprising: the inactivity rate among the 15-19 group is high because many remain in education, so a reduction in the size of this group will tend to reduce aggregate inactivity. Thus, demographics may have an important effect on employment, even if the impact on unemployment is quite limited.

2 The effect of changes in the relative size of groups is given by: $\Sigma\ 0.5*\Delta S_a(U_{a,t} + U_{a,t-1})$. Where U_a is the unemployment rate of group a and S_a is it share. Age groups were: 15-19, 20-24, 25-34, 35-44, 45-54, 55-64 and 65+.

5. Educational Changes and Labour Market Outcomes

Unemployment rates are lower amongst the more educated groups in Ireland (Figure 17), while employment rates are higher (Figure 18). This is a trend common to 29 out of 30 OECD countries covered in OECD (2004).[3] But, as with demographic changes, it is important to understand the potential explanations for this relationship before concluding that the rise in educational standards discussed above has lowered aggregate unemployment.

A necessary — but not sufficient — condition for rising educational standards to reduce unemployment is that education provides skills that are valued in the labour market. Becker's (1964) seminal contribution argues that this is the case, as education facilitates the acquisition of new knowledge and skills that lead to an increase in human capital. However, a competing explanation for the positive relationship between education and earnings (shown in Figure 4) is that educational attainment merely enables individuals to provide a signal of their underlying ability. In this case, employers only care about the relative — rather than absolute — level of education of potential employees, as this enables them to detect high ability a percentage pointslicants. In this case, a shift towards a more educated workforce would be unlikely to have real effects on productivity, wages or aggregate unemployment.

As discussed in Card (2001), the methodological difficulties in distinguishing between the competing explanations are severe. This partly reflects identification problems, and the technical (and ethical) difficulties of conducting formal experiments. Amongst the most reliable studies include those conducted on twins (including Ashenfelter and Krueger, 1994) or using other natural experiments. Drawing on these results, Patrinos and Psacharopoulos's (2002) review concludes that the evidence from micro data studies has now ''established beyond any reasonable doubt that there are tangible and measurable returns to investment in education''. Pooling the results for 40 countries, they estimate that the average increase in wages associated with another year of schooling is about 10 percent. Unsurprisingly, they also find that as the supply of education increases, the return falls.

There is a less extensive literature on the relationship between education and unemployment or employment. One of the reasons given by Mincer (1991) for the lower rate of lay-offs among the more educated in the US is that they tend to undergo

3 The exception was Korea, where the unemployment rate for those with tertiary education was 3.0 per cent but was 2.1 per cent for those whose highest qualification was less than upper secondary.

more extensive ‘‘on-the-job’’ training and therefore tend to acquire more firm-specific human capital. So when it comes to a choice between laying-off a worker who has been invested in more heavily, or one less heavily, firms naturally choose the latter, who also has a lower level of education. If education and on-the-job training are complements (as proposed by Becker, 1964), a rise in educational standards would be expected to lead to an aggregate increase in training. As discussed in OECD (2004), this could lead to an overall reduction in unemployment.[4] Mincer also finds that the relatively high cost of hiring educated workers means that firms are more reluctant to fine-tune the number of such workers during cyclical fluctuations. In addition, education may improve the ability of individuals to ‘‘job-match’’. This may be because they have greater awareness of their own skills and/or because they tend to be more willing to migrate to find suitable employment. Within the language of a standard ‘‘matching model’’ of the labour market (Layard et al, 1991), greater ability to job match translates into an increase in the effectiveness of job-search and a decline in the equilibrium unemployment rate.

In addition to being less likely to be made unemployed, Mincer (1991) also found that the more educated tend to have shorter unemployment durations. This may be because the cost of becoming unemployed is greater, due to larger foregone earnings, so that they search harder for new work. Relatedly, unemployment amongst the more educated appears to have a larger subsequent negative effect on future earnings growth. A different explanation is that the better educated may be more efficient at accumulating information, and thus be more effective at finding a suitable new job. Greater flexibility in working hours and practices may also increase their ability for on-the-job-search, meaning that they do not have to quit before finding alternative work. The more educated may also have a larger range of career options available to them, which may effectively increase the supply of available labour for a given amount of unemployment. The standard matching model predicts that this would reduce aggregate unemployment.

Most of these explanations for the education-unemployment relationship suggest that an increase in educational attainment could lead to a reduction in the aggregate unemployment rate. However, there is little consensus in the literature on whether shift-share quantification of this effect is valid. Summers (1986) argues that although it may ‘‘overestimate the true effect . . . the overestimate may not be large’’. In contrast, Shimer (1998)

4 The OECD (2004) find that the incidence of training can explain up to 40 per cent of the cross-country variation in employment rates, even after controlling for education, GDP growth and institutional structure. Possible explanations for this are that expected wages are higher, that workers with more human capital are more adaptable to change, or that the relative attractiveness of unemployment falls if wages increases are not matched by increased unemployment benefits.

argues that such demographic adjustments are ‘‘extremely misleading’’. This was based upon his belief that employers mainly care about the relative (and not absolute) level of education of potential employees, as this provides a signal of their ability. However, Walsh (2004) and Lemieux and Card (2001) assume that changes in the share of different groups have no effect on the group unemployment rates.

We argue that there are a number of reasons for believing that the results from shift-share analysis are likely to be informative, particularly for Ireland. First, there is an increasing consensus in the literature that the significant returns to education do not solely reflect ability bias (Patrinos and Psacharopoulos, 2002): thus, education does provide skills that are valued in the labour market. Second, most of the explanations for the education-unemployment relationship discussed above suggest that a rise in educational standards could reduce aggregate unemployment. Third, Shimer’s skepticism was partly based upon his finding that the fall in the relative size of the lowest education group in the US had been accompanied by a significant increase in their relative unemployment rate: he attributed this to the average ability of the lowest educated group falling, as all but the least able increased their educational attainment. However, such an effect is not apparent in Ireland. Indeed, the fall in unemployment rates was remarkably consistent across the different educational groups in Ireland (Figure 17) while the relative employment rates remained very little changed (Figure 18). This remarkable pattern suggests that the demand for different worker types has adjusted in line with supply and/or that the characteristics of these educational groups have remained reasonably constant over time. Fourth, and relatedly, the relative wage of different educational groups remained extremely stable between 1992/3 and 1999/2000.[5] If workers are paid in proportion to their marginal product, this implies that their average relative productivity has remained constant. Fifth, and finally, the average educational attainment in the Irish population remains well below that in the US. For example, in 2001, 57.6 per cent of the Irish population aged 25-64 had at least upper secondary education, compared with 87.7 per cent for the US (OECD, 2004). This suggests there is less chance of the level of education in Ireland having reached the point where it no-longer provides a genuine boost to individuals’ human capital.

Shift-share analysis reveals that changes in the proportion of different educational groups has caused up to a 2.0 percentage points reduction in the unemployment rate between 1994 and 2003 (Figure 19). This has been driven by the fall in the number of those educated to lower secondary level or below, who tend

5 Although we have no data on the wage distribution in 2003, the shift in educational composition between 1992/3 and 1999/2000 was much more sizeable than between 1999/2000 and 2003.

to have relatively high unemployment rates.[6] An alternative calculation is to hold group specific unemployment rates at their 1994 values and evaluating the effect of the shares changing as they did. This boosts the effect to 2.5 percentage points.

The effect on employment is estimated to have been even more substantial, with the increase in educational attainment accounting for up to 6.1 percentage points of the 9.6 percentage points rise (Figure 20). The alternative calculation marginally increases this effect to 6.3 percentage points. The more important role in raising employment than reducing unemployment arises because of the downward effect on inactivity, which is more prevalent amongst the less educated.

A final issue is that, although the increase in educational attainment may have been necessary for the rise in employment, the driver for this change may have partly been an exogenous increase in the demand for skilled workers. This is because the level of education is, at least to some extent, endogenously determined and changing labour market conditions vary the incentives to remaining in education. However, it seems unlikely that changing labour market conditions can fully explain the change in the educational choices of domestic residents. In particular, while the modest increase in the wage premium associated with having a degree might have encouraged some to continue their studies, the decline in the unemployment rates of the less educated groups probably reduced the incentives to others in remaining in education. As discussed earlier, although labour market conditions also affect the level, and type, of immigration and emigration this only seems capable of accounting for part of the overall rise in standards.

6. The Effect of Educational and Demographic Changes on Labour Quality

This section estimates the impact of changes in the educational and age composition of the workforce on labour input. This is important because hours worked are not homogeneous. Instead, their quality depends on the characteristics of the job and the person — including innate ability, training, education, responsibility and experience.

Following Jorgenson et al (1987), the average skill level of the workforce can be summarised in a labour quality index. This weights together the number of hours worked by different types of individual who vary by observable characteristics that are likely to be related to their productivity. Following these authors, the characteristics used in this paper are age (which can be thought

6 Note that the increase in the size of the ‘‘third level’’ educational group means that their ‘‘share’’ effect gives a positive contribution to the unemployment rate. But this is more than offset by the effects from the decline in size of other groups.

of as proxying experience), educational attainment and gender.[7] The index does not measure the effect of labour augmenting technological progress. Therefore, an hour worked by a female worker, aged 25 with upper secondary education represents the same quality of labour input in 1994 as it does in 2003.

As the productivity of different types of workers cannot be observed directly, it is inferred in the construction of the index by assuming that it is proportional to their gross hourly wage. This would automatically be the case in a perfectly competitive labour market, as all workers would receive a wage equal to their marginal product. However, it also applies in the less restrictive setting where relative wages are proportional to relative productivity.

More formally, the effective labour input (*input*) of worker *j* at time *t* is assumed to be proportional to their hourly wage (*w*) scaled up by the hours that they work (*h*).

$$input_t^j = const \bullet w_t^j \bullet h_t^j$$

In practice, the labour quality index is constructed by summing over groups defined on the basis of age (*a*), education (*e*) and gender (*g*). Dividing by total labour input gives the share of labour input, which is equivalent to the wage bill share ($s^{a,e,g}$):

$$s_t^{a,e,g} = \frac{w_t^{a,e,g} \bullet h_t^{a,e,g}}{\sum_a \sum_e \sum_g w_t^{a,e,g} \bullet h_t^{a,e,g}}$$

The wage bill for each group is calculated by taking their average hourly wage from the HBS and multiplying up by the average usual number of hours worked by that type of worker from the LFS/QNHS surveys. Usual, rather than actual, hours were chosen because they are less volatile, although the results are robust to using actual hours.

Quality adjusted hours are defined as the sum of the hours worked by each group, weighted by their relative wage bill share:

$$QAH_t = const \bullet \sum_a \sum_e \sum_g s_t^{a,e,g} \bullet h_t^{a,e,g}$$

7 The inclusion of a gender variable is common to previous studies of labour quality. It does not try to measure innate skill differences between male and female workers, or sexual discrimination. Instead it is also likely to capture a range of other effects including different average job tenures of male and female workers, different occupational choices etc. etc.

Dividing by aggregate hours (H) gives average quality per hour (Qt):

$$Q_t = const \bullet \sum_a \sum_e \sum_g s_t^{a,e,g} \bullet \frac{h_t^{a,e,g}}{H_t}$$

In the absence of annual wage data, this paper uses relative wage data from the 1999/2000 HBS. Implicitly, it is assumed that this gives a good approximation to average relative wages between 1994 and 2003. In addition to, somewhat fortuitously, being almost in the middle of the sample period, the validity of this assumption is supported by relative wages having changed very little between 1994/5 and 1999/2000 (Figure 4). And, as discussed below, the results are virtually unchanged by the use of the earlier set of wage data, indicating that the results are robust to modest changes in wages.

After simplifying the notation so that superscript *i* represents each combination of age, education and gender, the log growth rate of labour quality is given by:

$$\Delta \ln Q_t = \sum_i s^i \bullet \ln\left(\frac{h_t^i}{h_{t-1}^i} \bullet \frac{H_{t-1}}{H_t}\right) \qquad (equation\ 2)$$

This equation reveals that labour quality increases if high wage groups increase their share of hours, with changes magnified by greater variation in wages.

Figure 4 shows how wages vary by educational level and age in Ireland. As discussed above, average wages rise with education. They also initially increase with age, before peaking with the 45-54 age group and declining slightly thereafter. The initial increase may reflect productivity gains due to increased experience. Explanations for the decline amongst the oldest workers include sample composition effects (higher rates of retirement amongst the more skilled) and older workers being less quick at adapting to new skills (Skirbeckk, 2003).

Movements in labour quality can also be decomposed into changes in the size of each skill group in the population (n^i), changes in their employment rates (e^i) and changes in the average hours per job of each type of worker (a^i):

$$\Delta \ln Q_t = \sum_i s^i \bullet \left\langle \ln\left(\frac{n_t^i}{n_{t-1}^i}\right) - \ln\left(\frac{N_t}{N_{t-1}}\right) \right\rangle + \sum_i s_i \bullet \left\langle \ln\left(\frac{e_t^i}{e_{t-1}^i}\right) - \ln\left(\frac{E_t}{E_{t-1}}\right) \right\rangle$$

$$(equation\ 3)$$

$$+ \sum_i s^i \bullet \left\langle \ln\left(\frac{a_t^i}{a_{t-1}^i}\right) - \ln\left(\frac{A_t}{A_{t-1}}\right) \right\rangle$$

Using this methodology, labour quality in Ireland is calculated to have increased by 13.6 per cent between 1994 and 2003, equivalent to an average annual rate of 1.4 per cent (Table 3). This mainly (12.6 percentage points) reflects the greater prevalence of relatively high skill groups in the population. Changes in their relative employment rates have made a very small negative contribution (–0.4 percentage points), as there has been a slightly larger increase in employment among the lower skill groups. This effect is unsurprising given the rapid economic expansion, as it is likely that firms increasingly had to hire less skilled workers. The final factor is that the average number of hours per job has declined by less among the more skilled, giving a small positive contribution to labour quality (0.9 percentage points).

Table 3: Contribution to increase in labour quality (1994-2003)

	Annual (percentage points)	Total from 1994 to 2003 (percentage points)
Change in relative size of different skill levels	1.4	13.2
Change in employment rate of different skill groups	0.0	–0.4
Change in hours worked by different skill groups	0.1	0.9
Total	1.4	13.6

Table 4 considers the separate effects on labour quality of increased educational attainment, demographic change and variation in the proportion of males and females working.[8] By far the main contribution (12.2 percentage points) to the change between 1994 and 2003 is the increase in the relative number of hours worked by the more highly educated groups. Further decomposition reveals that this has almost entirely reflected the increase in educational attainment amongst the population, rather than the more educated increasing their relative average hours worked or relative employment rates. Changes in the age composition have had a small positive effect (1.1 percentage points) on labour quality, reflecting the modest increase in the proportion of prime age workers and the decline in the number of hours worked by the, least productive, youngest age group. The change in the relative proportion of male and female workers has had no effect on quality.

These results are consistent with the earlier analysis which found that the influence of educational changes on the employment and unemployment rate have been much more important than demographic changes.

8 Although these partial indices inform us of the main drivers behind the increase in labour quality, they do not sum to the aggregate change, which also depends on interactions between the factors.

Table 4: Partial contributions to labour quality of changes in educational, demographic and gender composition of the population

	Annual	Total
Change in educational mix	1.3	12.2
Change in age composition	0.1	1.1
Change in male/female proportion of employment	0.0	–0.2

The calculations are robust to a number of alternative assumptions. Using the wage data from the 1994/5 rather than 1999/200 HBS survey marginally increases total labour quality growth between 1994 and 2003 to 14.3 per cent. If the number of educational groups is increased from four to five (by splitting the third level education group into those with and without a degree), then labour quality growth is reduced to 13.2 per cent. Given that the increase in labour quality was almost entirely driven by the rise in educational standards, the results are unchanged by varying the number of age categories, or by removing the gender classification.

Labour quality increases over this period have been much more rapid in Ireland than in either the US or the UK. The US Bureau of Labour Statistics report that quality increased by an average of 0.5 per cent between 1994 and 2002. Lau (2002) finds that it grew by an average of 0.8 per cent per year in the UK between 1994 and 2001. The greater increase in Ireland reflects the more rapid rate of increase in educational attainment.

7. The Contribution of Labour Quality to Economic Growth

This section considers how the increase in labour quality has affected the potential output of the economy. This is the maximum sustainable amount that can be produced given full utilisation of labour, capital and technology. Labour quality matters because any shift in the composition of the work force towards the more skilled is likely to boost the capacity of the economy, in the same way that it would be raised by an increase in the number of hours worked or the capital stock.

Following Solow (1957), and under the assumption of a CES production function, the standard decomposition of the contributors to output growth is:

$$\Delta \ln Y_t = \Delta \ln A_t + \alpha_k \Delta \ln K_t + \alpha_l \Delta \ln H_t \qquad (\textit{equation 4})$$

where Y is output; K the capital stock;[9] H hours worked; $\Delta \ln A$ the unobservable Solow residual, and α_k and α_l the income shares of capital and labour. In this paper, we make the assumption of

9 Calculated in this paper by aggregating real investment expenditure using the perpetual inventory method under the assumption that the depreciation rate is 4 per cent per year.

constant returns to scale so that $\alpha_k + \alpha_l = 1$ and set α_l to 0.71, the average GDP share of compensation to employees and the self employed over the period 1960 to 2000. The Solow residual captures the growth of output that cannot be explained in terms of the growth of inputs, and is a measure of Total Factor Productivity growth.

If the factor inputs only measure the quantity of capital and hours worked, then changes in their quality are, by default, absorbed in the Solow residual. Being able to take account of changes in labour quality enables us to make a more accurate decomposition of the determinants of economic growth, with the Solow residual modified to $\Delta \ln A^*$:

$$\Delta \ln Y_t = \Delta \ln A^*_t + \alpha_k \Delta \ln K_t + \alpha_L \Delta \ln H_t + \alpha_L \Delta \ln Q_t \qquad (\textit{equation 5})$$

Figure 21 and Table 5 report the results from using this methodology to decompose GNP growth between 1994 and 2003. Over this time, total growth averaged 6.4 per cent per year. The main contribution was from the increase in total hours worked (2.3 percentage points), while growth of the capital stock contributed 1.6 percentage points per year. Table 6 gives the contributions to growth of GNP per adult, which averaged 4.7 per cent over this time. Taking account of population growth reduces the contributions from both capital and labour to 1.1 percentage points. The increase in total hours per adult between 1994 and 2003 reflects the trends in the employment rate and in average hours per worker. Average hours fell from 41.7 to 37.9 hours per week, a reduction of 9 per cent. However, this was more than offset by the increase in the employment rate from 44.8 per cent to 54.4 per cent, an increase of 21 per cent. If average hours continue to fall, the employment rate must continue to rise if hours worked are to continue to make a positive contribution to growth.

Growth of TFP and labour quality are together estimated to have made a 2.5 percentage points contribution to GNP growth (and growth per adult). Of this, labour quality growth accounts for 1.0 percentage points, enabling us to reduce the unobservable TFP growth component to 1.5 percentage points. Thus, taking labour quality growth into account substantially reduces the uncertainty regarding the factors behind output growth.

This decomposition, together with the results presented earlier in the paper, suggests that the rise in educational standards has made a very significant contribution to the strength of GNP growth between 1994 and 2003. The 1.0 percentage points contribution from higher labour quality almost entirely reflects the increase in education. In addition, a maximum of two thirds of the increase in employment reflects the increase in educational standards, and this is sufficient to more than account

for the aggregate rise in total hours worked. Combining the two suggests that educational standards could have contributed up to 2.1 percentage points to the annual growth of GNP per adult over this period.

Table 5: Contributions to annual GNP growth (1995-2003)

	Average growth rate (per cent)	Average contribution to GNP growth (percentage points)
Capital stock	5.5	1.6
Total hours worked	3.3	2.3
Labour quality	1.4	1.0
TFP	1.5	1.5
Total = GNP growth	N/a	6.4

Table 6: Contributions to annual GNP per adult growth (1995-2003)

	Average growth rate (per cent)	Average contribution to GNP growth (percentage points)
Capital stock	3.8	1.1
Total hours worked	1.6	1.1
Labour quality	1.4	1.0
TFP		1.5
Total = GNP growth	N/a	4.7

8. Conclusions

This paper has investigated the impact of changes in the demographic and educational composition of the Irish population on unemployment, employment and potential supply. Under the principal economic status (PES) definition, the unemployment rate in Ireland has fallen from 15.6 per cent in 1994 to 6.2 per cent in 2003. On the ILO definitions, the decline is from 14.7 per cent to 4.4 per cent. This paper finds that up to a quarter of the decline using the PES measure reflects the rapid rise in educational standards, as the more educated tend to have lower unemployment rates. The effect on the employment rate has been even larger – at up to two thirds of its rise. Demographic changes are found to have been much less important – having a negligible effect on unemployment and only accounting for a tenth of the increase in the employment rate. Compared with the domestic population, non-Irish born migrants have tended to be more educated and more likely to be of prime working age. But their relatively small size means that they have only made a small contribution to these overall trends.

The increase in skills amongst the labour force, largely reflecting the increase in educational standards, is estimated to have

increased the growth of potential output by 1.0 percentage points per year. Adding the effect of the rise in hours worked associated with the increase in employment (which we argue may largely reflect the rise in educational standards) boosts the total contribution from higher labour input to 2.1 percentage points. The remaining contribution to average GNP growth per adult from capital and TFP growth is only 2.6 percentage points, with TFP contribution 1.5 percentage points. This compares favourably with the UK, where Burriel-Llombart and Jones (2005) estimate that TFP contributed about 0.5 percentage points per year to growth over this period once changes in labour quality were taken into account. But, although impressive, the Irish performance is by no means miraculous.

Quantifying the roles played by labour quality and employment growth may also help us more accurately forecast future GNP growth. It seems unlikely that the employment rate can continue increasing by 2 per cent per year. The ESRI (Sexton et al, 2004) predict an easing in the rate of increase in educational attainment, with the number of persons in employment with third level qualifications expected to rise by under a third between 2001 and 2010, compared with more than doubling between 1991 and 2001. This suggests that the rate of labour quality growth is likely to ease, also putting downward pressure on potential GNP growth.

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Appendix: Tables and Figures[10]

Table A1: Regression for log hourly wage

	Coef.	Std. Err.
_lage_2	0.02	0.18
_lage_3	0.33	0.18
_lage_4	0.47	0.18
_lage_5	0.50	0.18
_lage_6	0.49	0.18
_lage_7	0.26	0.20
_lsex_2	–0.33	0.02
_ledu_2	0.13	0.03
_ledu_3	0.36	0.03
_ledu_4	0.58	0.03
_ledu_5	0.93	0.03
_cons	2.40	0.18
Sample	5179	
Adj R^2	0.3	

Figure 1: PES and ILO measues of Unemployment

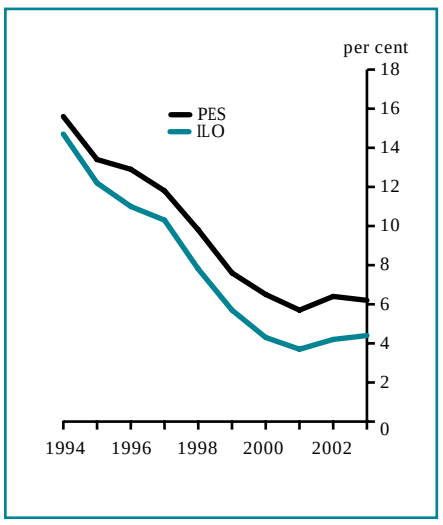
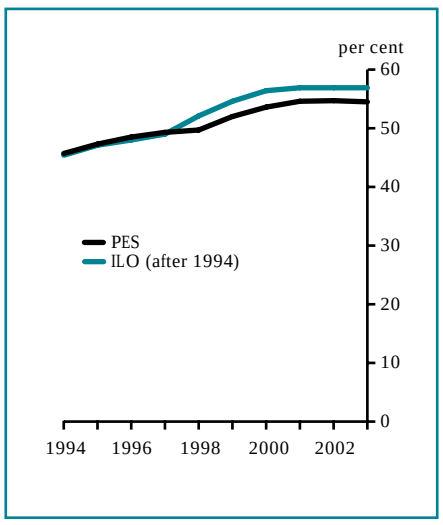


Figure 2: PES and ILO measues of Employment



10 The following Figures are based upon data from the LFS and QNHS surveys, together with the author's calculations. As described in section 2, they are derived using the PES classification of economic activity.

Figure 3: Annual GNP Growth and CPI Inflation

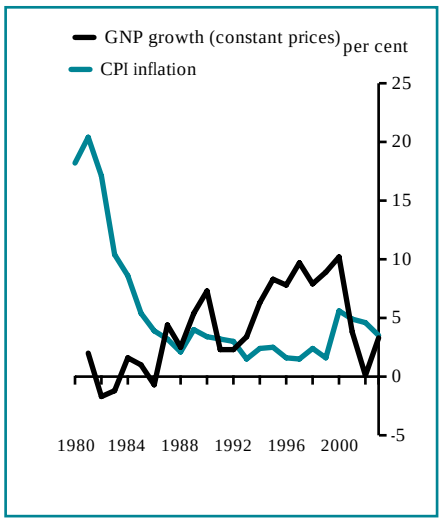


Figure 4: Actual Wage by Education and Age

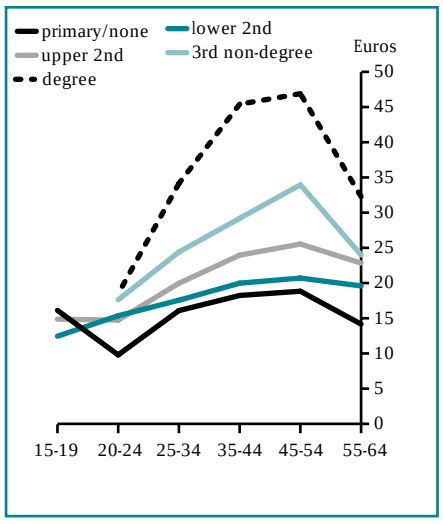


Figure 5: Estimated Wage by Education and Age

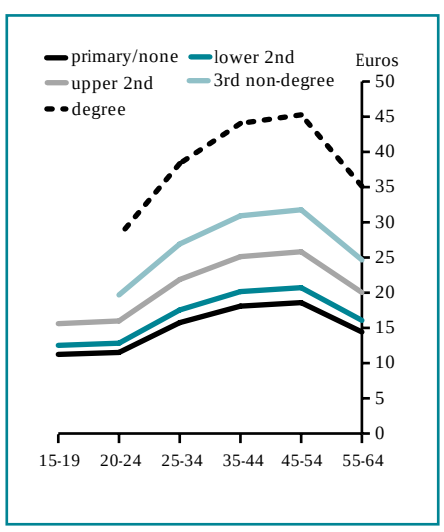


Figure 6: Age Composition (1994 and 2003)

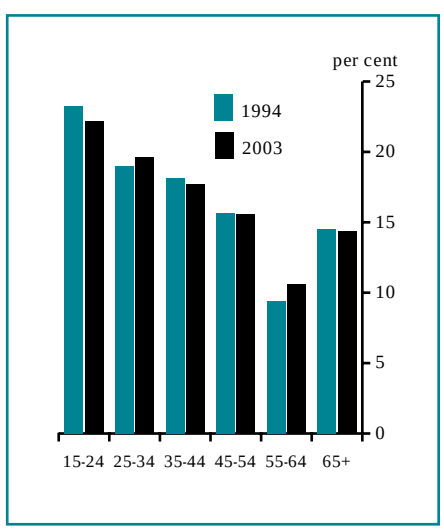


Figure 7: Highest Educational Qualification

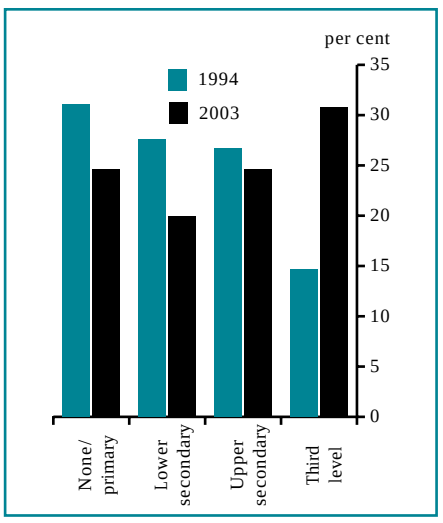


Figure 8: Age and Educational Level (2003)

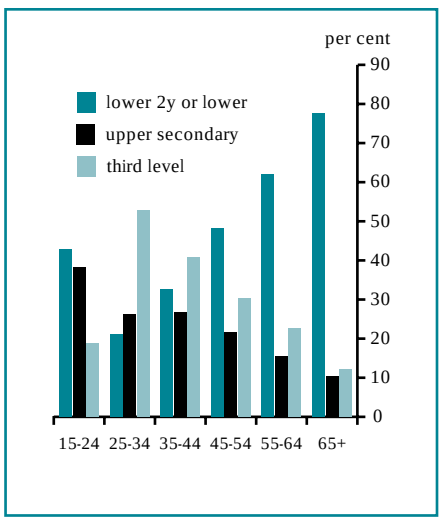


Figure 9: Cohort Educational Analysis

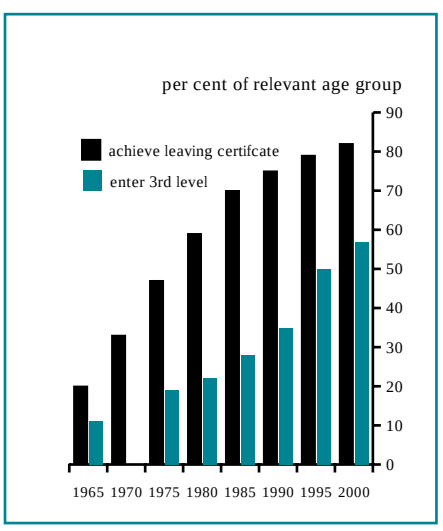
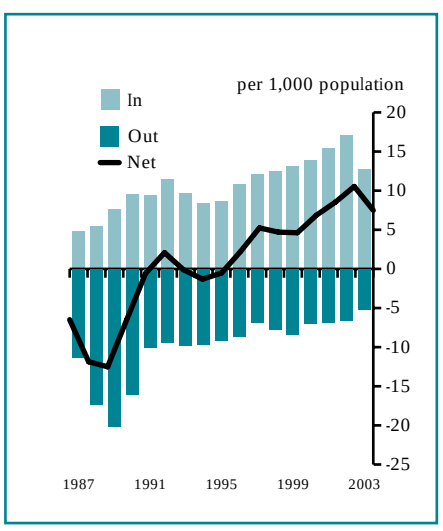


Figure 10: Migration



Note:
The rate of retention at second level corresponds to the estimated percentage of entrants to Junior Cycle in a given year who complete second level in a publicly aided school with a Leaving Certificate (including Leaving Certificate Applied).

Note:
The rate of transfer is estimated by taking the total annual intake to all full-time third-level colleges as a percentage of the estimated population at age 17. Some persons entering third level may have previously entered. Mature entrants and entrants from outside the State are also included.

Figure 11: Age Composition of those Resident in Ireland (2003)

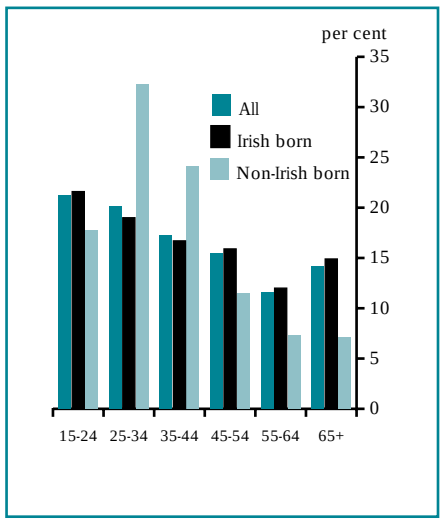


Figure 12: Educational Composition of Irish and non-Irish Born (2003)

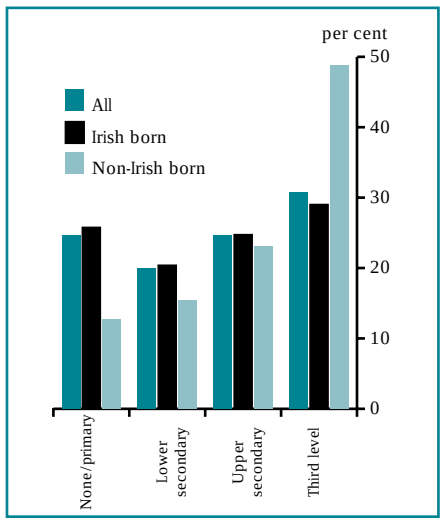


Figure 13: Age Unemployment Rates

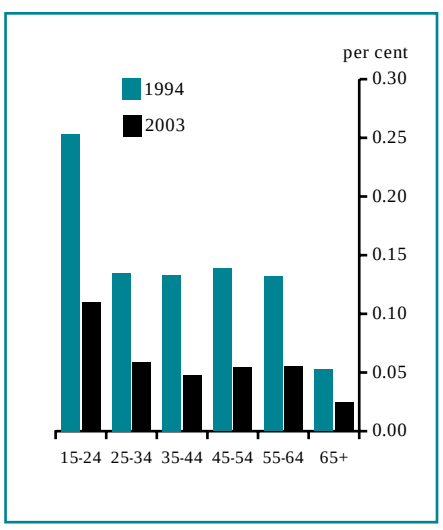


Figure 14: Age Employment Rates

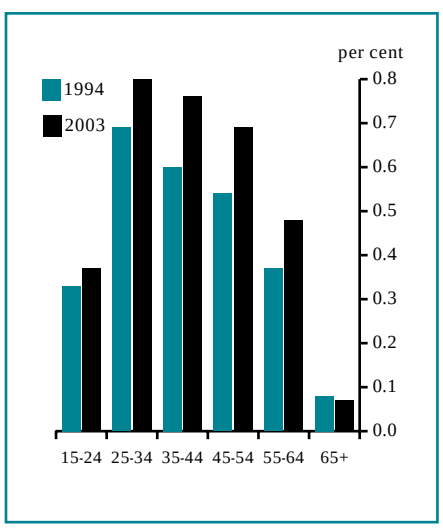


Figure 15: Contribution from Different Age Groups to Change in the Unemployment Rate

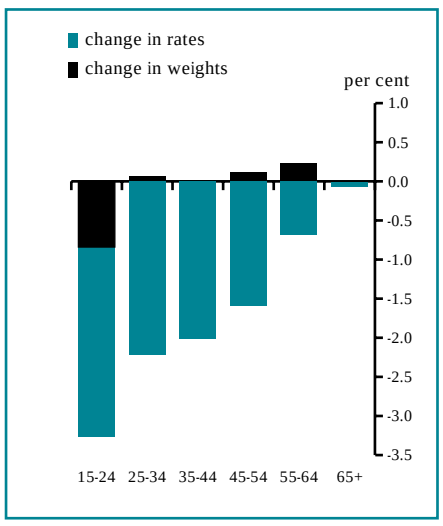


Figure 16: Contribution from Different Age Groups to Change in the Employment Rate

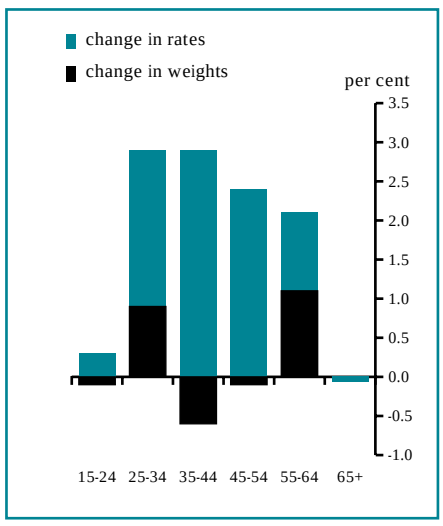


Figure 17: Unemployment Rate by Educational Group

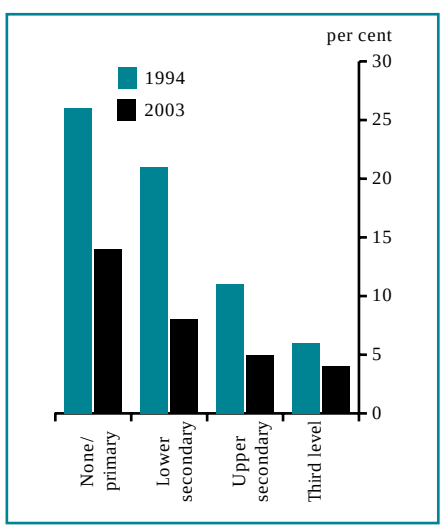


Figure 18: Employment Rate by Educational Group

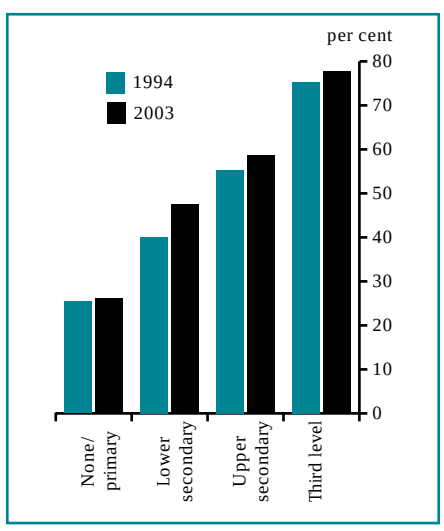


Figure 19: Contributions from Different Educational Groups to Change in the Unemployment Rate

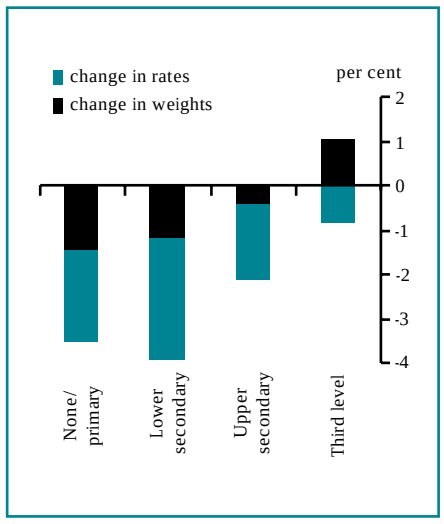


Figure 20: Contributions from Different Educational Groups to Change in the Employment Rate

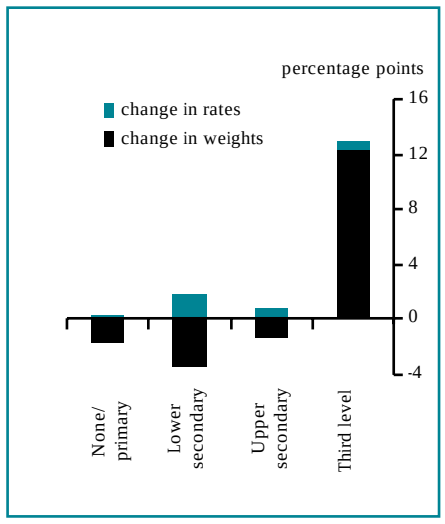


Figure 21: Decomposition of Output Growth