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Changing Returns to Education During a Boom? The Case of Ireland

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Abstract: Ireland's "Celtic Tiger" years saw GDP per capita rise from 60% of the EU average to 120% of the average over the course of the 1990s, with a growth in employment of about 40% over the period 1994-2001. What were the consequences of the boom for returns to education and wage inequality? This paper uses data from the Living in Ireland Survey for 1994, 1997 and 2001 to examine wage inequality, the returns to education and the relative demand for labour for men and women.

Theories of skilled-biased technical change suggest that the rapid period of economic growth experienced in Ireland will have been accompanied by a rise in the relative demand for skilled labour that will, in turn, have led to rising wage inequality. However, this is not the case for this period. We find fairly stable returns to education and falling wage inequality for men throughout the period, partly explained by a rapid growth in demand for unskilled labour, which helped maintain low-skilled wages. For women we find some fall in the wage premium to a university degree and falling wage inequality in the period 1997-2001. We argue that for women, low-skilled wages were kept up by the introduction of the minimum wage in 2000, and high skilled wages fell due to a rapid rise in the supply of highly qualified women. The Irish example shows that skill-biased technical change theory needs to take account of both the specific changes in the nature of labour demand and the nature and extent of concomitant changes in labour supply.

JEL Codes: I2, J21, J23, J24, J30, J31.

Keywords: earnings inequality, returns to education, gender, Ireland.

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Changing Returns to Education During a Boom? The Case of Ireland

1. Introduction

Ireland's "Celtic Tiger" years saw GDP per capita rise from 60% of the EU average to 120% of the average over the course of the 1990s, with a growth in employment of about 40% over the period 1994–2001 (Nolan and Maitre, 2007). The period saw a remarkable transformation. Popular belief was certainly in rising wage - and income - inequality.

Economists writing about the impact of technology on the labour market in recent years have tended to emphasise the role played by skill-biased technical change, the idea that as an economy grows, technology is biased in favour of skilled workers and against unskilled workers. A large body of evidence documents a striking correlation between the adoption of computer-based technologies and the increased use of university-educated labour within detailed industries, firms and across plants within industries (see Katz and Autor 1999 for a survey of this literature). The idea of skill-biased technological change has primarily been used to explain rising wage inequality in, for example, the UK and the US (Goos and Manning, 2007). Certainly Harkness and Machin (1999) reported that the wage returns to education continued to rise considerably throughout the 1980s and 1990s in the UK, though returns have been more stable in recent years (Sianesi, 2003; Sloane and O'Leary, 2005). The pattern of rising returns is also found in the US (Katz and Autor, 1999). The implication of this theory is that, assuming that the rapid employment growth in Ireland was associated with a rapid growth in high-skilled jobs, this would lead to a rapid rise in wage inequality.

But a more recent paper by Autor, Levy and Murnane (2003) has argued for a more nuanced understanding the impact of technology on the labour market. They argue that technology can replace human labour in more routine tasks but cannot replace labour in non-routine tasks, a point echoed by Keep (2005). So, while computers can replace precise tasks in manufacturing, and even bookkeeping, tasks such as cleaning and waiting tables cannot be replaced. And in fact, a growth in high-skilled

employment may cause an increased demand for low-skilled service jobs. The result is rising relative demand in both high-skilled and low-skilled jobs, but a falling-off in relative demand for jobs in the 'middle', where technical skills have replace human labour. These demand changes will result in rising wages for the high skilled, but wages of the low skilled will be maintained. Given that many low-skilled service sector jobs are often carried out by women, this argument may be even more salient for women than for men.

The problem with demand-side explanations is that they tend to assume that the supply of labour is constant, and in many cases this is not the case. There may be changes in the absolute supply of labour, due to changes in participation, and also changes in the nature of labour supply, in terms of the qualifications of those employed. Thus changes in the returns to education and wage inequality are a complex interplay of changes in demand and changes in supply.

In addition, some industrialized countries have experienced much smaller increase in inequality than in the United Kingdom or in the US (OECD, 2006). This has focused attention on the role of institutional factors. Countries like Sweden, Germany and the Netherlands, which have seen little or no increase in earnings inequality, have some form of coordinated wage bargaining. This has led to the hypothesis that these wage-setting institutions were the primary factor limiting growth in inequality in these countries (e.g. Blau and Kahn, 1996). While the Irish labour market shares many characteristics with the UK and the US (e.g. low taxation, low redistribution) in one important respect it differs: centralized wage bargaining was introduced in 1987. This is discussed in more detail below, though note as the entire period of investigation is covered by centralized wage bargaining, it is not possible to directly test its effect on wage inequality.

In fact previous work on Ireland, examining the period 1987-1994, finds little support for the idea that wage bargaining reduces wage inequality, as wage inequality rose exceptionally fast in this period (Barrett et al., 1999). More recent analysis builds on this work, and finds that wage inequality stabilised in the mid-1990s, attributing this in part to a marked increase in high-skilled inward migration (Barrett et al., 2002).

In this paper we build on previous Irish work and international literature (see review in Harmon et al., 2000) to look at whether the idea of skill-biased technical change plays out in Ireland at a time of exceptional economic growth. Section 2 looks at developments in the Irish Labour Market as a background to the empirical analysis, reviewing changes in employment, and changes in the institutional context of employment. Following a brief discussion of the data used in Section 3, Section 4 examines wage inequality during the boom. Section 5 then documents the changing educational profile of the Irish workforce. In Section 6 we examine the returns to education for men and women in detail, and how they have changed over the period. We also consider the changing nature of women's labour market participation, given the rapid rise in participation. We consider both the linear specification of years but prefer the model that compares returns to different qualification levels, which we argue is more appropriate in this case. Section 7 looks at the relative demand for labour. We conclude in Section 8 by summarising the findings from the paper, reflecting on the implications of the findings for the international literature, and speculate on how the returns to education in Ireland might develop in the future.

2. The Irish Labour Market, 1994-2001

2.1 Principal Trends in the Labour Market

Table 1 shows summary data on some of the principal changes in the labour market since 1994, the year that the labour market impact of the economic boom began to unfold. This followed a period of sluggish growth, 1991-1993, with unemployment reaching almost 16% in 1993 (O'Connell, 2000). There are a number of important features. First, employment grew very rapidly, by almost 500,000 or 40% between 1994 and 2001. This is a very dramatic growth in employment in a very short period of time. The employment rate, expressed in proportion to the population aged 15–64, increased from 53% in 1994 to 65.7% in 2001. The Irish employment rate converged with the EU average in 1998, and exceeded it by about two percentage points in 2004.

Second, there was a sharp and sustained increase in women's employment. Total female employment increased by 60% between 1994 and 2001, almost twice the growth rate among men (32%). These differential growth rates resulted in a shift in

the balance of employment between men and women, and women's share of total employment increased from 37% in 1994 to over 42 per cent in 2001.

Table 1: Principle Changes in the Labour Market, 1994-2001

	1994	2001	Absolute Change	% Change
Total Employment (000)	1220.6	1721.9	501.3	41.1
Employment Rate (% population 15-64)	53.0	65.7	12.7	24.0
Male Employment (000)	766.3	1019.0	252.7	33.0
Male Employment Rate (%)	65.9	76.4	10.5	15.9
Female Employment (000)	454.3	702.8	248.5	54.7
Female Employment Rate (%)	40.1	55.0	14.9	37.2
Female Share (%)	37.2	40.8	3.6	9.7
Unemployment (000)	211.0	65.1	-145.9	-69.1
Unemployment Rate (% Labour Force 15+)	14.7	3.6	-11.1	-75.5
Long-term Unemployment (000)	125.4	20.8	-104.6	-83.4
Long-term Unemployment Rate (% Labour Force)	8.9	1.2	-7.7	-86.9

Sources: CSO: QNHS, Sept-Nov 1997 and QNHS 2002, Q2
Employment and Social Affairs *Employment in Europe, 2002* European Commission.

Third, unemployment fell from just under 15% in 1994 to less than 4% in 2001. Long-term unemployment fell precipitously: from 125,000 in 1994 to 20,000 in 2001 – a net decline of almost 105,000. This dramatic decline in long-term unemployment was facilitated by an increase in demand for low-skilled employment that complemented increased demand for high-skilled employment at the other end of the occupational structure (O'Connell and Russell, 2007).

Table 2 shows employment by sector. Among women, employment growth was most rapid in Transport and Communication, and Finance and Business, sectors largely characterised by medium to high skills. Among males, the most rapid growth occurred in Construction, where employment doubled, but which is largely characterised by low to medium skills. The other expanding sector was Finance and Business services, where higher skill levels are in demand. So employment expansion over the course of the decade entailed a polarisation process among men, with expansion at both extremes of the skill distribution (O'Connell and Russell, 2007). Among women,

employment expansion was more concentrated in sectors with demand for medium and higher skill.

Table 2: Employment by Economic Sector and Gender, 1994 and 2001

	1994 1,000s	%	2001 1,000s	%	% Change
Males					
Agriculture	132.5	17.3	109.2	10.7	82.4
Other Production	178.1	23.2	222.7	21.9	125.0
Construction	86.0	11.2	172.0	16.9	200.0
Distribution	99.6	13.0	131.0	12.9	131.5
Hotels & Restaurants	31.1	4.1	43.1	4.2	138.6
Transport & Communication	44.7	5.8	81.7	8.0	182.8
Finance & Business	61.7	8.1	110.5	10.8	179.1
Public Administration	42.8	5.6	46.0	4.5	107.5
Education & Health	53.7	7.0	60.4	5.9	112.5
Other	36.1	4.7	42.4	4.2	117.5
Total	766.3	100.0	1019.0	100.0	133.0
Females					
Agriculture	15.2	3.3	13.3	1.9	87.5
Other Production	74.0	16.3	95.4	13.6	128.9
Construction	5.6	1.2	7.9	1.1	141.1
Distribution	69.6	15.3	116.8	16.6	167.8
Hotels & Restaurants	37.3	8.2	60.7	8.6	162.7
Transport & Communication	11.2	2.5	29.4	4.2	262.5
Finance & Business	52.6	11.6	106.5	15.2	202.5
Public Administration	23.6	5.2	35.3	5.0	149.6
Education & Health	127.8	28.1	187.5	26.7	146.7
Other	37.5	8.3	50.1	7.1	133.6
Total	454.4	100.0	702.9	100.0	154.7

Source: CSO, *QNHS, Sept-Nov 1997* and *QNHS 2002, Q2*

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Part of the increase in employment, particularly during the latter half of the 1990s, coincided with increased inward migration. Barrett and Trace (1998) show that the educational profile of immigrants was greater than that of emigrants during the 1990s. Barrett et al. (2002) argue that the effect of immigration between 1996 and 1999 was to increase the supply of skilled labour by 3.2% and to reduce wages by 4.7 percentage points. Thus, they argue that immigration helped to restrain wage increases among the high skilled in the mid-1990s.

2.2 Irish Labour Market Institutions

Since 1987 a continuous series of centralised wage deals have been negotiated with support from the state. From its inception Social Partnership entailed a trade off between wage restraint on the part of trade unions in exchange for reduced income taxes. While Social Partnership expanded in scope over the subsequent two decades, covering a wide range of social and economic policy targets, and including an extensive range of collective actors, the core of the bargain has remained constant, with competitiveness and macro-economic stability as a core objective, at least until recent years (Ó Riain and O'Connell, 2000). Most analysts expect that the effect of centralised wage bargaining is to reduce wage dispersion, usually by constraining the wages of the higher skilled.

A national minimum wage was introduced in 2000. A minimum wage could lead to a significant improvement in the incentive to work for the unemployed and those engaged in home duties, while also enhancing rewards employment for current employees. These improved incentives would thus be expected to increase rates of participation in the labour force, particularly among women. Nolan et al (2002) found that at the time of its introduction, the majority of employees were already earning more than the hourly minimum: only about 5% of employees surveyed after the introduction of the minimum wage had received an increase in pay as a direct result of its introduction. Nevertheless, it remains possible that the minimum wage may have set a threshold that allowed for increased supply of labour, particularly among women.

In 2001 reforms were introduced to the income tax system to move towards tax individualisation, by which, over a period of three years, each individual whether single or married could set off an individual tax allowance against their own income, but which could not be transferred between spouses. One of the intentions was to stimulate labour supply, particularly of married women. By 2001 about two-thirds of the standard income tax allowance was dedicated exclusively to the individual earner, and just one-third could be transferred to the spouse. Callan et al (2004) in an econometric test to the impact of tax individualisation, show that the reform could have resulted in a one-off increase of about 2.5 percentage points in the labour market participation rate of married women. They note that "this can be compared with an

increase of about 30 percentage points in married women's labour force participation since 1980" (p.63).

Section 3: The Living in Ireland Survey, 1994-2001

The data for this study comes from the 1994, 1997 and 2001 waves of the Living in Ireland Survey (LIS). The LIS is a longitudinal household panel survey that formed the Irish component of the European Community Household Panel (ECHP). The first wave was 1994 and the final wave 2001. In the first wave 4,048 households were interviewed, a response rate of 57%.[1] Within these households, 9,904 individuals were interviewed. In this paper each wave is treated as a single cross-section of the Irish economy by applying cross-sectional weights. The advantages of using a single data source are obvious: data collection methods, survey instrument and measurement are identical, allowing easy comparisons across time.[2] There was a supplementary sample in 2000, and this is used in the analysis. Cross-checks with the slightly later National Employment Survey of 2003 (N of cases over 60,000) satisfy us that the re-weighted sample is a representative sample of Irish employees for 2001: earlier work confirms that this is also true of 1994 and 1997 (e.g. Russell and O'Connell, 2004).

When we restrict the sample to employees of working age (16-65) who were working more than 15 hours per week, this gives samples of 5,122, 3,738 and 3,594 for 1994, 1997 and 2001, respectively.

The dependent variable in the analysis of wages is the natural logarithm of gross average hourly wage, defined as total labour income divided by number of hours worked. For the wage analysis we exclude observations from the analysis missing on wages, hours worked or any of the control variables. Key control variables include the measure of education attained, which are divided into a number of levels corresponding to the Irish education system – this classification of qualifications is described in detail in the Appendix. Other controls include years worked (asked directly) and its square; years spent out of the labour market (asked directly); marital status; migrant status (those born outside Ireland and of non-Irish nationality are

[1] Detailed response rates are available in, e.g., Russell and O'Connell, 2004.
[2] Data is not pooled across years, as in other studies, because our interest is in examining changes at particular points in the 7 year period.

distinguished between EU and non-EU nationality). Sectors are defined following the NACE classification. With these exclusions, the wage analysis is based on 1,839 men and 1,355 women for 1994; 1,376 men and 1,096 women for 1997 and 1,193 men and 1,090 women for 2001.

Section 4: Wage Dispersion in Ireland during the boom

What happened to wage dispersion during this period of rapid economic growth? Using the Living in Ireland data, we examine two measures (a) the ratio of the highest to the lowest decile in the income distribution, and (b) the coefficient of variation. Note that wage inequality in Ireland at the beginning of the period (1994) was very high in comparative terms: OECD estimates show the ratio of the highest decile to the lowest ranging from just over 2 in Sweden to over 4 in Ireland, Canada and the US, the three countries with the highest wage inequality using this measure (see Barrett et al., 1999, Table 2).

Within the Irish labour market as a whole, the level of wage inequality fell markedly over the period but most particularly between 1997 and 2001. When the data was split according to gender some disparities again emerged (Table 3). While earnings inequality fell within the male distribution over both periods, inequality increased slightly in the female labour market from 1994 to 1997 before falling dramatically between 1997 and 2001. Furthermore, the coefficient of variation, which reflects dispersion across the entire wage distribution, remained constant for females while falling for males, suggesting that overall the male wage distribution tightened in a more consistent way over the period.

These findings are broadly consistent with Barrett et al. (2002) who find broadly stable wage inequality in the whole sample in the period 1994-1997 using the same data source.[3] What is striking is the contrast between the period 1987-1994 when wage inequality rose markedly (Barrett et al., 1999; Barrett et al., 2002), and 1994-2001 when it fell, particularly in the period 1997-2001.

[3] Their measure is based on hourly earnings as a proportion of the median and thus slightly different. Their sample also differs slightly, and the 1987 results are derived from a different survey than the Living in Ireland Survey used for all three years in the present study.

Table 3: Wage Dispersion in the Labour Market

	1994	1997	2001
Hourly earnings			
All employees?			
Highest to lowest decile	4.66	4.51	3.46
Coefficient Variation	0.65	0.63	0.59
Males			
Highest to lowest decile	4.44	4.19	3.32
Coefficient Variation	0.64	0.62	0.53
Females			
Highest to lowest decile	4.43	4.61	3.49
Coefficient Variation	0.63	0.63	0.65

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001, weighted by cross-sectional weights. Sample restrictions described in Section 3.

Table 4: Wages and Wage Growth by Education level: 1994 –2001 (Irish pounds)

Males	1994	1997	2001	Growth 97-01 (%)
No Quals	6.6	6.8	8.7	27.3
Lower Sec.	6.6	6.8	9.6	37.3
Upper Sec.	7.6	8.6	10.7	34.2
Sub-degree	8.9	10.3	11.7	27.7
Uni	13.9	16.0	16.8	19.0

Females	1994	1997	2001	Growth 97-01 (%)
No Quals	4.2	4.4	7.1	52.8
Lower Sec.	4.8	4.8	6.9	36.1
Upper Sec.	6.1	7.0	8.9	38.2
Sub-degree	6.7	7.5	10.5	45.1
Uni	12	13.3	15.2	23.4

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001, weighted by cross-sectional weights. Sample restrictions described in Section 3.

What was happening in the period to wages by educational level? Concentrating on the period 1997 to 2001, Table 4 indicates that wage growth was higher within the lower skilled groupings but most particularly for females with no qualifications, which in turn explains the radical fall in female wage inequality observed in Table 3. An obvious explanation for the rapid improvement in the relative position of low skilled females was the introduction of the minimum wage in 2000 which was let at

£IR 4.40 at the time.[4] More generally, the results from these descriptive tables indicate that wages grew at both extremes of the distribution, demonstrating that the growth experience in the Irish economy during the late 1990s relied on both high and low skilled labour.

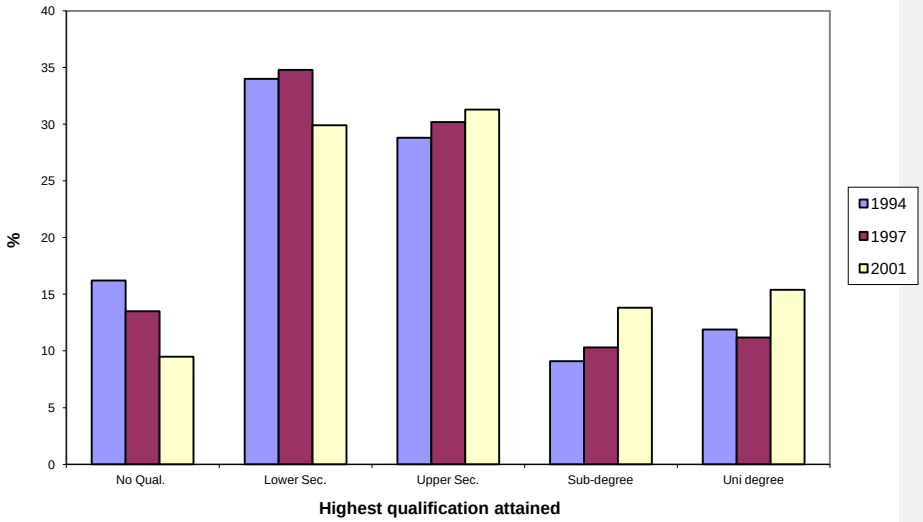
5. Labour Supply: The Educational Profile of Irish Employees

Before we examine wage returns, we consider changes in the nature of labour supply. It is immediately obvious from the data that substantial changes took place in the educational profile of Irish employees over the 1994 to 2001 period. The share of employees with a no qualifications fell back from 16% in 1994 to less than 10% in 2001 while the employment share of individuals holding post secondary 'sub-degrees' (certificates / diplomas) and university degrees increased substantially. The rate of change in the share of workers holding intermediate qualifications was moderate, there was some decline in the share of workers reaching the lowest level of educational qualification (lower secondary) and a marginal increase in the proportion of employees educated to upper secondary (leaving certificate) level.

It is unclear what has driven this rapid increase in the relative supply of educated labour although a number of factors present themselves as obvious candidates. Firstly, rising wage rates will have attracted more highly qualified individuals into the Irish labour market through a combination of non-national in-migration, returning Irish nationals and increased labour market participation, particularly among females (Barrett and Trace, 1998; Russell and O'Connell, 2004). In addition to this, the period will have seen a continuation of the trend of rising educational attainment among new labour market entrants from the educational sector. The nature of flows into the labour market are likely to have contrasted starkly with exits due to retirement which will have contained a disproportionate share of older workers with only few or no qualifications. The consequences of these effects are that the relative supply of poorly qualified labour within the Irish labour market fell off dramatically over the period.

[4] £IR4.4 was equivalent to about €5.60 at the time.

Figure 1: Educational Profile of Irish Employees, 1994, 1997, 2001



Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001, weighted by cross-sectional weights. Sample of employees working 15 hours or more.

While the pattern of rising educational attainment presented in figure 1 is quite dramatic, the rates, timing and nature of change in the composition of labour supply differed substantially across both male and female labour markets. Table 5 gives the employment share of workers with varying levels of educational attainment in 1994, 1997 and 2001. Separating the data out by gender, with the exception of upper second level, the growth in the employment shares of educated labour within the male labour market over the 1994 to 2001 period was just a fraction of that experienced within the female labour market. The relative importance of each male educational grouping above no qualifications increased by under 10% over the entire period, however, the vast bulk of this change took place during 1994 to 1997 with the data suggesting that the relative position of lower and upper second level qualifications fell back somewhat over the 1997 to 2001 period. Thus, there is little evidence that the nature of labour demand over the period has led to any radical skewing of composition of male labour market employment towards the more educated groupings.

Within the female labour market, the employment share of unqualified females fell back heavily relative to all other educational groupings during 1994 and 2001 from

18.3 to 10.5%. In contrast to the male labour market, the bulk of the expansion in educated labour supply occurred from 1997 to 2001. The employment share of sub-degree holders and university graduates increased dramatically over the period. However, despite increasing by over 40%, the female university graduate employment share was still below that of males in 2001. Moreover, the share of those with no qualifications fell to a similar extent. This suggests that, at least in respect of the educational composition of employment, 1994 to 2001 was a period of convergence with the male labour market. We suspect that increased female labour market participation driven by high wage growth, minimum wage legislation and perhaps, at least to some extent, the introduction of tax individualisation in 2001, represents the principal factor underlying the changing nature of female labour supply in Ireland over the period in question.

Table 5: Composition of Employment by Education Level, 1994 to 2001

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Males	1994 %	1997 %	2001 %	1994-2001
Primary	10.4	7.2	7.5	-27.9
Inter	33.9	35.3	34.5	1.8
Upper Sec.	27.3	31	28.6	4.8
Sub-degree	10.7	10.8	11.5	7.5
Uni. degree	17.7	15.8	17.9	1.1
Females				
Primary	18.3	15.8	10.5	-42.6
Inter	31.4	31.9	26.1	-16.9
Upper Sec.	31.7	32	34.2	7.9
Sub-degree	8.8	10.6	15	70.5
Uni. degree	9.8	9.7	14.1	43.9

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001, weighted by cross-sectional weights. Sample of employees working 15 hours or more.

Our preliminary assessment of the data suggests that the central predictions associated with any economic boom characterised by SBTC i.e. rising returns to education and increased wage inequality, did not hold in the Irish case. In the next section we examine the wage returns to education in more detail.

6. Returns to Education for Men and Women

Here we adopt a more formal multivariate framework to further examine trends over time in the economic returns to schooling in Ireland. We employ a standard wage equation framework and estimate the following two specifications:

$$LnW_{ij} = \sum_{j=1}^{J} S_{ij}\alpha_j + X_i\beta + \delta x_i + \gamma x_i^2 + \varepsilon_i \qquad (1)$$

$$LnW_{ij} = \sum_{j=1}^{J} Q_{ij}\alpha_j + X_i\beta + \delta x_i + \gamma x_i^2 + \varepsilon_i \qquad (2)$$

Where W is a measure of real earnings, X is a vector of personal characteristics and x_i is a measure of experience. Within the standard Mincer equations, S represents years of schooling whereas, in equation 2, Q represents a set of dummy variables that take the value 1 if an individual holds a certain highest qualification and 0 otherwise. In principal, provided that earnings increase linearly with schooling, both specifications should generate identical estimates. However, Heckman, Lochner and Todd (2003) demonstrate that the assumption of linearity may no longer be appropriate and that the Mincer regression estimated on cross sectional data can be misleading in times of economic transition. Given this and the rapid pace of economic growth in Ireland over the period in question, both specifications are estimated. The regressions include controls for time out of the labour market, migrant status, marital status and industrial sector described above. As is standard practice, the models are estimated separately for both males and females with the female equations augmented with a sample selection control.

Table 6 reports the male regression results for each wave. The coefficients on years of schooling from equation 1 are given in the upper section of the table; all other coefficients come from specification 2, which was estimated using primary education as the reference category. Regarding specification 1, the average payoff to males from one year of schooling remained stable at approximately 8% over the 1994 to 1997 period, however, by 2001 it had fallen back substantially to just 5.6%. On the grounds that the premium to an intermediate cert over no qualifications remained largely unchanged over the 1994 to 1997 period, the results suggest that the decline in the years schooling premium was non-linear and concentrated within the more qualified segments of the labour market. The situation becomes clearer in table 7,

which reports both the change in returns relative to the base over both periods and the change in incremental returns i.e. the premium to obtaining a qualification relative to the credential level immediately below it. Compared to the no qualifications base, the return to a diploma (sub-degree qualification) fell by 12.5 percentage points between 1997 and 2001 with the incremental premium to this qualification over the upper secondary qualification falling by over 10 percentage points from 1994 to 2001. The incremental return to the upper secondary qualification rose between 1994 and 1997 before falling back to its original level in the latter period. Therefore the decline in the return to schooling observed within the male distribution between 1997 and 2001 relates exclusively to a decline in the incremental returns of intermediate level qualifications. Generally speaking, despite the rapid growth of the economy, the entire period can be characterised as one of very minor change in the structure of male educational returns.

Table 6: Returns to Education, Males 1994, 1997 & 2001

Male	1994	1997	2001
Specification 1			
Years schooling	0.080*** (0.004)	0.084*** (0.005)	0.056*** (0.005)
Specification 2			
Lower Sec.	0.141*** (0.035)	0.124*** (0.047)	0.135*** (0.047)
Upper Sec.	0.354*** (0.039)	0.405*** (0.050)	0.336*** (0.050)
Sub-degree	0.515*** (0.044)	0.512*** (0.057)	0.387***(0.056)
Degree	0.831*** (0.042)	0.868*** (0.055)	0.774*** (0.053)
(Base no qualifications)			
Other Human Capital Controls			
Years worked	0.054*** (0.003)	0.037*** (0.003)	0.022*** (0.003)
Worked squared	-0.001***(0.000)	-0.001***(0.000)	-0.001***(0.000)
Time out	-0.035*** (0.009)	-0.039*** (0.009)	-0.065*** (0.010)
Time our squared	0.002*** (0.001)	0.001*** (0.000)	0.003*** (0.001)
Hours worked	-0.012*** (0.001	-0.008*** (0.001)	-0.008*** (0.001)
Married	0.170*** (0.024)	0.127*** (0.028)	0.179*** (0.030)
Migrant – EU	0.010 (0.088)	-0.245*** (0.085)	0.035 (0.083)
Migrant Non-EU	0.153 (0.247)	0.580** (0.248)	0.000 (0.000)
Constant	1.241*** (0.065)	1.419*** (0.081)	1.926*** (0.079)
R^2	0.579	0.537	0.404
F	139.28***	87.38***	46.86***
N	1839	1376	1193

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001. Sample restrictions described in Section 3. Includes sector controls – results available from the authors.

The movement in the returns to some of the control variables are also worthy of mention. Most noticeably, the average return to a year of labour market experience fell back from 6.5% in 1994 to just 2.9% in 2001 with the decline relatively evenly spread over both periods (Table 6). A potential explanation may lie in the increasing dominance of particular industries over the period within which labour market experience is not heavily rewarded. An indication of such structural adjustments was observed between 1997 to 2001 when the return to construction industry employment rose by 14% while the manufacturing industry premium declined by over 10% during the period[5].

Table 7: The Change in Male Educational Returns 1994-1997 & 1997 - 2001

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Specification 1	**94/97 total Δ**	**97 /01 total Δ**	**94 / 97 incremental Δ**	**97 / 01 incremental Δ**
Years schooling	0.005	-0.028***		
Specification 2				
Lower Sec.	-0.018	0.012		
Upper Sec.	0.051	-0.069	0.070**	-0.082**
Sub-degree	-0.003	-0.125*	-0.052	-0.052[6]
Degree	0.037	-0.094	0.049	0.022
(Baseno qualifications)				
Other Hum Capital Controls				
Years worked	-0.018***	-0.015***		
Worked squared	0.000***	0.000		
Time out	-0.003	-0.027**		
Time our squared	-0.000	0.002***		
Hours worked	0.004***	-0.000		
Married	-0.043	0.052		
Migrant – EU	-0.255**	0.279**		
Migrant Non-EU	0.426	0.000		

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001. Sample restrictions described in Section 3. Sectoral controls included but not presented.

[5] Results available from the authors

[6] The 1994 to 2001 10% drop in the incremental return to sub-degree over upper secondary was found to be significant at a 95% confidence level.

Table 8: Returns to Education, Females 1994, 1997 & 2001

	1994	1997	2001
Specification 1			
Years schooling	0.105***(0.006)	0.112*** (0.006)	0.075*** (0.006)
Specification 2			
Lower Sec.	0.163** (0.063)	0.097 (0.075)	-0.055 (0.061)
Upper Sec.	0.345*** (0.065)	0.352*** (0.078)	0.146** (0.063)
Sub-degree	0.493*** (0.070)	0.508*** (0.083)	0.267*** (0.070)
Degree	0.939*** (0.071)	0.894*** (0.086)	0.553*** (0.073)
(Base no qualifications)			
Other Human Capital Controls			
Years worked	0.065*** (0.004)	0.053*** (0.005)	0.029*** (0.004)
Worked squared	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Time out	-0.034***(0.006)	-0.041*** (0.007)	-0.030*** (0.006)
Time our squared	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Hours worked	-0.005*** (0.001)	-0.004*** (0.002)	-0.003** (0.001)
Married	0.020 (0.028)	0.033 (0.031)	0.047 (0.033)
Migrant – EU	-0.032 (0.084)	0.042 (0.111)	0.031 (0.129)
Migrant Non-EU	-0.507 (0.486)	0.201 (0.347)	-0.583* (0.306)
λ	0.092*(0.050)	-0.027 (0.061)	-0.042 (0.073)
Constant	1.151*** (0.136)	1.402*** (0.225)	1.934*** (0.176)
R^2	0.563	0.538	0.419
F	90.49***	65.96***	40.59
N	1355	1096	1090

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001. Sample restrictions described in Section 3. Includes sector controls, results available from the authors.

The results from the female models are reported in tables 8 and 9. As was the case for males, the return to a year of schooling fell back substantially from 10.5% in 1994 to 7.5% in 2001. However, unlike the male case, the results from Table 8 indicate that, relative to the base case of no qualifications, the return to the lowest level of educational attainment i.e. the lower secondary qualification has fallen markedly since 1994. This is confirmed in table 9, which shows that the premium of intermediate certificates over no qualifications fell by 22% between 1994 and 2001. There was some evidence of incremental effects with the return to a degree over post secondary diplomas \ certificates falling by 16% over the period. Thus, in contrast to the male labour market, the relative position of unqualified females improved somewhat over the period with the position of graduates simultaneously deteriorating suggesting that some reduction in wage dispersion might be expected to have taken place. Again, the

pattern of returns fit with our descriptive analysis of increased labour supply and run contrary to the predictions of SBTC.

In keeping with the male results, the return to female labour experience declined heavily over the period, however, unlike the male case, the rate of decline was more rapid over the 1997 to 2001 period. At a sectoral level the return to manufacturing employment also fell within the female labour market over the more recent period. In line with our supply-side explanation, the regression estimates suggest some shifts have taken place in the nature of female labour market participation. The selection term was positive and significant in the 1994 equation it was negative and insignificant in 1997 and 2001. Table 9 indicates that, in terms of the wage model, the nature of female labour market participation changed most substantially between 1994 and 1997.

Table 9: The Change in Female Educational Returns 1994-1997 & 1997 - 2001

Specification 1	**94/97 total Δ**	**97 /01 total Δ**	**94 / 97 incremental Δ**	**97 / 01 incremental Δ**
Years schooling	0.007	-0.038***		
Specification 2				
Lower Sec.	-0.066	-0.152*[7]		
Upper Sec.	0.007	-0.205**	0.073	-0.054
Sub-degree	0.015	-0.241**	0.008	-0.036
Degree	-0.045	-0.341***	-0.059	-0.101*[8]
(Base no qualifications)				
Other Hum Capital Controls				
Years worked	-0.012*	-0.024***		
Worked squared	0.000	0.000**		
Time out	-0.007	0.012		
Time our squared	0.001*	-0.001		
Hours worked	0.000	0.001		
Married	0.013	0.014		
Migrant – EU	0.074	-0.011		
Migrant Non-EU	0.708	-0.784*		
λ	-0.119*	-0.016		

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001. Sample restrictions described in Section 3. Sectoral controls included but not presented.

[7] The 1994 to 2001 22% fall in the return to lower secondary education over no qualifications was significant at 95%.
[8] The 1994 to 2001 16% fall in degrees over diplomas was significant at 99%.

While the change in the control term suggests that some alteration in the nature of participation may have taken place, the co-efficient is, in itself, uninformative as it may simply be a product of a changing female wage structure. To get a clearer indication of the dramatic change in the scale and nature of female participation over the period, we examine the stage one probits from the selection models estimated in each period with the results suggesting some important changes did indeed take place (Table 10).

Table 10: Female Labour Market Participation
Stage one probit models 1994, 1997 & 2001 (marginal effects)

	1994	1997	2001
married	-0.129***	-0.083	-0.119**
Years worked	0.043***	0.026***	0.0160***
Years worked sq.	-0.001***	-0.001***	-0.001***
Lower Sec.	0.181***	0.0679	-0.076
Upper Sec.	0.271***	0.195***	0.066
Sub-degree	0.256***	0.343***	0.126
degree	0.45***	0.405***	0.213***
Parents low educ.	-0.0147	-0.0163	-0.076
Kid 6 or under	-0.306***	-0.323***	-0.170***
Kid 7 - 16	-0.009***	-0.043***	-0.076***
Kid 17 or over	0.054***	0.0341	0.053***
Time out	-0.0824***	-0.061***	-0.030***
Time out sq.	0 .001***	0.001***	0.000***
Pseudo R^2	0.573	0.443	0.333

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001. 'Parents low educ' indicates that both parents had either no qualifications or lower secondary qualifications.

In 1994 the largest single barrier to female participation was having a child under the age of 6, with this attribute reducing the probability of labour market entry by over 30% in 1994 and 1997. However, between 1997 and 2001 the marginal effect had almost halved. Russell (2002) argues that the age and number of children has a much stronger effect on female participation in Ireland than in other EU countries, but the effect was certainly reduced in the period 1994-2001. In addition, the negative impact of a years absence from the labour market on the probability of entry declined steadily throughout the period from 8% in 1994 to just 3% in 2001, similarly, the importance of previous labour market experience on participation declined. Between 1997 and 2001 the relationship between educational attainment and participation altered

markedly as, by 2001, all qualifications below the graduate level were associated with similar likelihoods of labour market entry. Finally, it is worth noting that the predictive power of the model declined sharply between 1994 and 2001 indicating that unobservables played an increasingly important role in the labour market participation decision.

The implications of the model for the composition of female labour market supply are difficult to interpret as many of the changes could potentially be associated with changing participation rates at all education levels. However, given the pattern of female labour supply observed so far, we must conclude that the majority of the decline in the marginal effects of the principal attributes usually associated with lower participation i.e. having young children, previous work experience and years spent out of the labour market relate to a rise in educated female labour supply. Note also that there was a rapid increase in women returning to the labour market in this period: Russell and O'Connell (2004), using the Living in Ireland dataset, find that one quarter of those engaged in full-time in home duties in 1994 made a transition to paid work within the six-year period 1994-1999. This rapid increase in women returners may explain the fall in the return to female experience, particularly if the quality of labour market match declined on re-entry.

7. Relative demand for labour: 1997 to 2001

Given the rapid changes that have taken place in the educational makeup of the Irish workforce in recent years, the results from the wage equations do not provide an accurate picture of either the direction or strength of labour demand as they do not take account of the radically changing nature of Irish labour supply. To overcome this problem, we estimate the change in the demand for educated labour *relative* to the no qualifications base case. Essentially, we are measuring the extent to which the relative wages of more qualified workers have held up in the face of rapid increases in their supply as a means of assessing the overall direction of labour demand. We do this by estimating equation 3 for the 1997 to 2001 period. W represents the wage premiums to a particular credential over no qualifications and these are taken from Tables 6 and 8, S represents the relative labour market shares and σ is the assumed rate at which employers can substitute between the different types of workers. Following Autor,

Katz & Krueger (1997) and Harkness & Machin (1999), we assume that σ will take the value 1.4.[9] Essentially, this provides us with a framework of assessing the overall direction of demand in the economy.

$$\frac{\Delta D}{D} = \frac{\frac{\Delta W_{ij}}{W_{ij}} + \frac{1}{\sigma}\left(\frac{\Delta S}{S}\right)}{\frac{1}{\sigma}} \qquad (3)$$

Note that this model is intended to be illustrative and not definitive. We estimate, for example, separate models for men and women, as we argue it would be unrealistic to pool them, given the differences in labour market participation. However, it is possible that female supply will influence male demand and effect overall wages, not just female wages.

We find that the results are very different across the male and female labour markets. Within the male labour market we find that the demand for unqualified labour has been growing more quickly than that for more qualified workers (Table 8). This suggests that the expanding Irish economy required both high and low skilled labour over the period implying that SBTC was not a particularly dominant factor in the Irish context.

Within the female labour market demand was skewed towards educated labour, in particular, those with post secondary qualifications and graduates. However, in the face of such rapid supply change, demand was insufficient to ensure a rising premium for more skilled individuals. Nevertheless, it is important to note that a realistic interpretation of the results of Table 7 is that, rather than any fundamental gender based differences in the nature of labour demand, the growth of the Irish economy facilitated a period of rising female participation which, in turn, led to significant convergence in the structure of male and female employment.

[9] Macro models of the Irish economy suggest low substitutability between skilled and unskilled labour (e.g. Bergin and Kearney, 2007). However, these are long run models, which assume that all inputs are flexible and that firms behaved optimally. Our time horizon is much shorter – 4 years. Moreover, the macro models are based on a simple high-skilled/low-skilled distinction that does match with our more detailed educational categories.

Table 11: Annual Average Relative Demand- 1997 – 2001

Males

	Wage Change	Supply Change	Rel Demand pa
Degree \ No Qualification	-9.4	8.8	-1.1
Cert – Dip \ No Qualification	-12.5	2.2	-3.8
Upper Sec. \ No Qualification	-6.9	-11.4	-5.3
Lower Sec. \ No Qualification	1.1	-6.2	-1.2
Females			
Degree \ No Qualification	-34.1	118.7	17.75
Cert – Dip \ No Qualification	-24.1	112.9	19.80
Upper Sec. \ No Qualification	-20.6	60.3	7.87
Lower Sec. \ No Qualification	-15.2	23.1	0.46

Source: Own calculations based on the Living in Ireland Survey, 1994, 1997, 2001. Sample restrictions described in Section 3.

8. Conclusion

The purpose of this paper was to investigate wage inequality and the returns to education in the Irish labour market during a period of exceptional employment growth. For men we find largely stable returns to education throughout the period, partly explained by a rapid growth in demand for unskilled labour, which helped maintain low-skilled wages. Demand grew for both high and low-skilled males: the boom incorporated many previously unemployed men, many of whom had low skills. Wage inequality fell in the period. For women we find that, while relative demand was skewed towards educated labour, the scale of supply was such that the premium to a university degree fell. We argue that low-skilled wages were kept up, partly by the introduction of the minimum wage in 2000. Female labour force participation rates rose rapidly, and overall wage inequality fell in the period 1997-2001. Overall, the nature of demand has been such that it allowed women to catch up with men in terms of labour market participation, though the two groups have not yet converged.

In terms of wage inequality in Ireland, there are thus two distinct periods. In the first period, 1987-1994, we see sluggish employment growth and rapidly rising wage inequality (Barrett et al., 1999). In the second, 1994-2001, the rest of the booming 1990s, we find that wage inequality falls, most particularly between 1997 and 2001.

It remains to be seen how wage inequality has developed since 2001: preliminary estimates suggest that inequality may have risen since, as wages grew more quickly at the upper end of the wage distribution.

As the whole period was covered by centralized wage bargaining, we are not in a position to test the effect of wage bargaining on wage inequality in Ireland. However, preliminary evidence for 2003 suggests that, compared to individual level agreements, national and industry-level wage agreements tend to reduce wage dispersion (Kelly et al., 2007). This would suggest that the existence of centralized wage bargaining may have played a role in reducing wage inequality, though it is not possible to estimate the magnitude of this effect and it may have been small.

What are the implications of our findings? The Irish case suggests that skill-biased technical change does not apply in the male labour market in this period. Demand did not grow more for highly skilled labour, as predicted. Demand grew for both high and low-skilled male workers. Our analysis lends partial support for skill-biased technical change in the case of women. Demand for high skilled labour did grow more rapidly than for low skills, but because of rapid increases in supply, the premium for high skills did not rise as predicted. The Irish example shows that skill-biased technical change theory needs to take account of both the specific changes in the nature of labour demand and the nature and extent of concomitant changes in labour supply.

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Appendix

Education Categories in the Irish Education System

'No qualifications': This includes those who left school at the end of primary level, or did some second-level schooling but obtained no qualification.

'Lower Secondary' This include the Group and Intermediate Certificates, as well as their recent replacement, the Junior Certificate. These are exams taken after 3 years of second-level education.

'Upper Secondary' This is the qualification obtained by those successfully completing the senior cycle of second-level education, plus a small number with qualifications under the Post-Leaving Certificate and Vocational Preparation and Training Programmes.

'Sub-degree' This includes non-degree post-secondary qualifications from such institutions as regional technical colleges, often called 'diplomas' or 'certs'.

'University Degree' This includes both primary and higher university degrees.

Unless otherwise stated, 'no qualifications' is the omitted category in the regressions, and the wage returns are estimated relative to that group.

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