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Wage Inequality in Ireland's "Celtic Tiger" Boom*

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Abstract: Ireland offers a valuable case study of the evolution of wage inequality in a period of exceptional growth in output, employment and incomes from 1994 to 2007. We find that dispersion in hourly wages across all employees fell sharply to 2000, before increasing though much less sharply to 2007. Returns to both education and work experience declined considerably in the earlier period, while the increase in lower earnings relative to the median was associated with the introduction of the minimum wage in 2000, anchoring the bottom of the distribution subsequently. The more rapid increase in higher earnings in the latter part of the boom may be associated with the changing patterns of immigration and employment growth.

I INTRODUCTION

The distribution of earnings has been the topic of a very substantial research literature over the past two decades,[1] with interest fuelled by the rapid rise in dispersion seen in the USA. Having initially been interpreted primarily as reflecting a shift in demand towards more skilled labour due primarily to skill-biased technical change, a more nuanced picture has been emerging in more recent years. This is partly because of the fluctuating nature

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[1] Atkinson (2008) reports some 200 articles on the topic in leading economics journals since 1990.

of the observed trends: increasing US wage inequality has been concentrated at the top of the distribution since about 1988-90, unlike the 1980s (see for example, Autor, Katz and Kearney, 2008, Lemieux, 2008), and trends elsewhere in the OECD have varied considerably, although most often with some increase in dispersion (see for example, the OECD's *Growing Unequal,* 2008, Chapter 3). Furthermore, the complexities of the way technological change and the race between technology and education might operate have been increasingly recognised. Autor, Levy and Murnane (2003) and Goos and Manning (2007), for example, bring out that computerisation replacing "routine" (as opposed to unskilled) tasks could increase inequality towards the top but reduce it in the lower part of the distribution. Atkinson (2008) highlights that the dynamics of the "race" imply that a constantly rising demand for educated workers may lead not to a constantly rising wage premium, but to a stable differential, the size of which depends on the speed of the country's response to the shortage of skilled workers. This means that countries facing the same external shocks may have different outcomes in terms of wage dispersion. In addition, the role of wage-setting institutions, and the minimum wage in particular, have received a great deal of attention (see for example, DiNardo, Fortin and Lemieux, 1996; Lee, 1999, Card and DiNardo, 2002). The fact that shifts in demand occur in different supply and institutional settings over time and across countries has to be incorporated into the analysis and explanation of observed trends.[2]

As the survey by Lemieux (2008) concludes, a fruitful direction for research on the changing nature of wage inequality is to study the recent experience of countries other than the United States. Ireland is a particularly interesting case study in that respect because it experienced quite exceptional economic growth during the "Celtic Tiger" decade from the mid-1990s, fuelled at the outset by foreign direct investment and the expansion in high-value output and exports. Studies covering the first part of the boom by Barrett, FitzGerald and Nolan (2002) and McGuinness, McGinnity and O'Connell (2009) reported that wage inequality remained stable from 1994 to 1997, despite the rapid acceleration in economic growth, but was markedly lower by 2001. These studies highlight the strength and pattern of labour demand as economic growth surged, the very substantial numbers of highly-educated young people being produced by the education system at the time, the emergence of substantial in-migration of both skilled and less skilled labour,

[2] The role of institutional versus other factors in producing cross-country variation in the level and trends in earnings dispersion is discussed in for example, Freeman and Katz (1995); Blau and Kahn (1996) and DiNardo and Lemieux (1997).

and the role of centrally bargained wages and the introduction of the national minimum wage in 2000.

Here we extend these analyses in a number of important respects, both substantive and methodological. First, we include the second half of Ireland's economic boom, with new data up to 2007. This is particularly valuable in that the medium-term impact of the minimum wage can be examined; furthermore, there was a marked shift in the nature of economic growth around 2000-2001, with greater dependence on domestic demand and in particular construction affecting the pattern of labour demand. The latter period also saw the expansion of the European Union in 2004 to include the transition economies of Eastern Europe, with major implications for immigration into the "old" EU-15, and Ireland in particular. Secondly, unlike earlier studies we examine the evolution of wages year-by-year, which proves particularly useful in teasing out the impact of institutional innovations (such as the minimum wage) versus shifts in demand and supply of skills. Finally, we employ the decomposition technique using quantile regressions recently developed by Machado and Matta (2005) to distinguish the impact on dispersion of changes in returns versus changes in workforce composition.

We begin by outlining key features of the macroeconomic and institutional background over the very unusual period to be examined. Section III describes the micro-data to be employed in our analysis and the overall evolution of earnings dispersion over the period. To investigate what underpins these trends, Section IV looks at changes in the returns to education and skills. Section V presents the results of a decomposition analysis. Both immigration and the minimum wage appear to play an important role and these are the focus of Section VI. Finally conclusions are highlighted.

II IRELAND'S ECONOMIC BOOM

Key macroeconomic and labour market trends over the period to be studied are summarised in Table 1. Ireland saw remarkable economic growth from 1994 to 2000, with the average annual increase in real GNP at 7 per cent being among the highest in the OECD, giving rise to the "Celtic Tiger" label. Growth was lower in 2001-02 but then returned to 4-6 per cent per annum up to 2007, at which point Ireland's GNP per capita was among the highest in the European Union. That proved to be the high watermark of Ireland's economic boom, with the global financial crisis and the bursting of the domestic property bubble leading to an unprecedented contraction in GDP in 2008-2009. Here, however, our focus is on the boom years and how they impacted on the distribution of earnings.

This economic growth was accompanied by an increase in the total number in employment from 1.2 million in 1994 to 1.7 million by 2000. Although the annual increase then slowed somewhat, by 2007 there were 2.1 million in employment, a remarkable increase of 75 per cent since 1994. Unemployment declined from 15 per cent in 1994 to below 4 per cent by 2001, and was about 4.5 per cent each year from then up to 2007. The employment rate also rose very sharply as more married women in particular were drawn into the paid workforce: whereas about half of all working-age adults were in the workforce in 1994, by 2007 this had reached 69 per cent (with the rate for women going from 40 per cent to 60 per cent). Migration has also been extremely important in the expansion of the workforce, allowing growth to continue at a rapid pace as the domestic pool of unemployed and inactive shrank. While Ireland has traditionally been a country of outward migration, the scale of economic growth was such that significant net immigration emerged from 1997. It was substantial throughout the period to 2007, but was particularly large in 2005-2007 after the enlargement of the EU in 2004.

Table 1: *Trends in Key Macroeconomic and Labour Market Variables, Ireland 1994-2007*

	Growth in Real GNP %	*Numbers Employed* 000	*Unemployment Rate* %	*Employment Rate* %	*Net Migration* 000
1994	6.49	1,220.6	14.74	52.2	–4.7
1995	5.62	1,281.7	12.16	54.0	–1.9
1996	7.58	1,328.5	11.87	55.1	8.0
1997	10.07	1,379.9	10.33	56.1	19.2
1998	7.64	1,505.5	7.80	59.6	17.4
1999	8.46	1,605.9	5.75	62.5	17.3
2000	9.75	1,684.1	4.27	64.5	26.0
2001	3.78	1,738.0	3.64	65.2	32.8
2002	2.93	1,768.5	4.20	65.0	41.3
2003	5.74	1,800.0	4.41	64.9	30.7
2004	4.33	1.852.2	4.41	65.4	32.0
2005	5.59	1,944.6	4.29	67.1	55.1
2006	6.34	2,034.4	4.39	68.2	71.8
2007	4.35	2,113.9	4.56	69.0	67.3

Source: Central Statistics Office.

In the first phase of the Celtic Tiger exports were the key driver of growth, increasing rapidly from 1997 to 2000 in particular, and both total foreign direct investment flows internationally and the share coming to Ireland were particularly strong in these years. Export growth was significantly lower in

the later period, when consumption dominated and the construction sector grew to an unprecedented extent. This was reflected in a shift in the sectoral distribution of employment in the second half of the boom away from production and distribution (down from 39 per cent of employment in 2000 to 34 per cent in 2007) towards construction (up from 10 per cent in 2000 to 13 per cent in 2007) and public administration, health and education (up from 19 per cent to 22 per cent). Meanwhile, the importance of financial and other business services grew throughout the whole period, accounting for 14 per cent of employment at the end compared with about 9 per cent at the outset.

Turning to labour market institutions, wage bargaining in Ireland has been centralised at the national level since 1987 through a process known as social partnership, in which the government, employers and unions concluded agreements on wage levels in both private and public sectors, together with a wide range of economic and social policies. The contribution of these agreements to Ireland's rapid economic growth, and indeed the extent to which they represent successful social corporatism, is debated,[3] but wage restraint does seem to have contributed to enhanced competitiveness in the earlier part of the boom. The centrally bargained increases generally set a floor, with more profitable firms – particularly in the multinational sector – often giving greater increases. Public sector workers received substantial additional increases from 2002 as a consequence of a "benchmarking" process; Kelly, McGuinness and O'Connell's (2008) analysis suggests that the public sector premium over equivalent private sector workers grew substantially from 2003 to 2006 and was then greater in Ireland than in other industrialised countries. Finally, 2000 saw the introduction of a national minimum wage for the first time. As in the UK, for many years minimum wages had been set only for a limited number of occupations or sectors. The national minimum wage, by contrast, sets a minimum for all employees aged 18 or over, with reduced rates payable for younger/inexperienced workers. It was introduced at (the equivalent of) €5.59 per hour, corresponding to about half the median level of earnings at the time, and was up-rated irregularly but broadly in line with average earnings to reach €8.65 by mid-2007. Studies based on specially-designed surveys of firms aimed at assessing its impact suggest that about 4-5 per cent of workers in the private sector were earning at or about the minimum wage level in 2000-2002 and in 2005-2006.[4] Clearly the potential impact of this institutional innovation on the earnings distribution is of substantial interest.

[3] See for example Sexton and O'Connell (1996), Lane (1998), FitzGerald (1999), Allen (2000), O'Donnell and O'Riordan (2000), Baccaro and Simoni (2002), O'Donnell (2008).

[4] See Nolan, Williams and O'Neill (2002), Nolan, Williams and Blackwell (2006), O'Neill, Nolan and Williams (2006).

III DATA AND DESCRIPTIVE STATISTICS

The data enabling us to look at the evolution of wage inequality over Ireland's economic boom come from two sets of large-scale household surveys, the only sources that allow for year-by-year analysis of earnings dispersion over the period. The first is the *Living in Ireland Survey* (*LIIS*), a longitudinal household panel survey carried out by the Economic and Social Research Institute (ESRI) that formed the Irish component of the *European Community Household Panel* (*ECHP*) which ran from 1994 to 2001. In the first wave (fully described in Callan *et al.,* 1996), 4,048 households were interviewed with a response rate of 63 per cent of valid addresses contacted. The samples for analysis are reweighed to correct for non-response, on the basis of the number of adults in the household, urban/rural location, age and socio-economic group of household head, using external information. (Here we are not exploiting the panel nature of the survey so cross-sectional rather than longitudinal weights are used.) The overall representativeness of the original sample data was validated by comparison with a range of external information (see for example, Callan *et al.* 1996). The survey sought detailed information on the earnings, education, labour market experience and other characteristics of the employees in sample households. Over 3,000 employees responded fully to such questions, and they also appeared to represent employees well, in terms of age, sex, occupation and industry, when compared with available external data. By 2000 the overall sample size had declined substantially due to attrition, so 1,500 new households were added. Detailed checks suggested that the overall impact on the sample structure was slight, and the reweighing scheme sought to compensate for any biases to the extent that available external information allowed (for a detailed discussion see Whelan *et al.,* 2003, Appendix A.). Our sensitivity analysis suggests that the findings for 2000 reported in this paper are not dependent on the inclusion or exclusion of these additional observations.

Like the broader *ECHP* of which it was part, the *Living in Ireland Survey* was discontinued in 2001. At EU level the *ECHP* was replaced by *EU Statistics on Income and Living Conditions* (*EU-SILC*), which is an "output-co-ordinated" framework rather than an input-coordinated harmonised survey, and is now the reference source for common indicators on poverty and social inclusion in the European Community. In Ireland the information required under this framework is obtained via a new household survey, called *SILC*, conducted by the Central Statistics Office (CSO). This was initiated in 2003, with interviews carried out in the period June to December and a sample of 3,112 households obtained. The survey has been carried out annually since then with a total completed sample size of the order of 5,000 to 6,000

households and 13,000-14,000 adult individuals each year from 2004 (see for example CSO, 2005, 2008 on the 2004 and 2007 surveys respectively). The sampling frame and reweighing procedures differ from the *Living in Ireland Survey* (see for example CSO, 2005 for a detailed description), but these are similarly designed to ensure the sample is representative of the population using external controls. At a household level, the weights were adjusted on the basis of household composition and region, while at an individual level the age by sex distribution of the population was taken into account.

Prior to carrying out our analysis we invested significant effort into harmonising the variables and coverage across the *Living in Ireland* and *SILC* surveys; as we shall see, the similarity in the earnings distributions observed at the end of the *Living in Ireland Survey* and the beginning of *SILC* provides some reassurance in that respect.

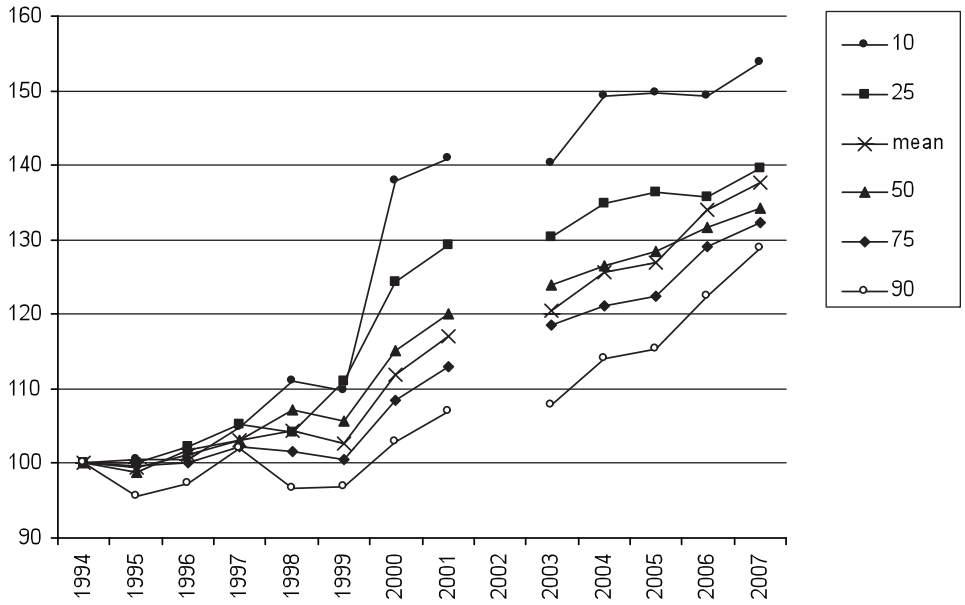
In analysing earnings inequality, a variety of alternative populations of earners and concepts of earnings are of substantive interest – notably the distribution among full-time employees versus all workers, and the dispersion of hourly, weekly and annual earnings. The number of hours worked in the week, and of weeks worked in the year, are clearly central to individual earnings and household income, but hourly wages more directly relate to differential rewards to skill and effort, and for that reason are the focus of most of the literature for other countries referred to earlier. The questions about earnings included in the two surveys are similar: employees were asked about the gross pay they received in their last pay period, how long this covered (a week, fortnight, month etc.), and the hours worked during that period. They were also asked whether this was the amount they usually receive, and if not what was their usual gross pay and hours usually worked. Here we focus on hourly earnings, derived for most employees as reported last gross pay received divided by hours worked in that pay period; for the small proportion of responding employees (generally about 5 per cent) who stated that their last pay was not usual, we use the usual amount received divided by hours usually worked. The currency in use switched from the Irish pound to the euro in 2000. We therefore converted earlier figures to euro at the conversion rate of IR£0.79 per euro employed at the changeover point.

We have also harmonised to the greatest extent possible across the surveys the employees who are included in the analysis. The sample on which our analysis is based comprises all employees aged 16-65, and excludes those in full-time education, employees reporting working less than an hour or more than 100 hours a week, or reporting an hourly wage at or below 1 euro (in 2007 prices).

Based on this data, Figure 1 shows how the level of earnings at the bottom decile, bottom quartile, top quartile and top decile evolved year by year,

together with the mean and median, each in constant price terms expressed as an index with base 1994=100. Mean and median hourly earnings rose rapidly in real terms throughout the period, with average hourly earnings increasing by 38 per cent and the median going up by 34 per cent. The lower part of the distribution saw above-average growth up to 1999, with the upper part lagging behind, but the really striking feature is the scale of the increase in the bottom decile and quartile from 1999 to 2000. In the period from 2000 to 2007, by contrast, the top quartile and decile rise faster than the median. Over the period as a whole, then, the bottom quartile and especially the bottom decile have risen more rapidly than the median, while the top quartile and decile lagged modestly behind it.

Figure 1: *Mean and Percentiles of Hourly Earnings, All Employees, 1994-2007 (Constant 2007 Prices)*



The implications for the overall shape of the earnings distribution are brought out in Table 2, showing the level of earnings at different percentiles as proportions of the median, together with the ratio of the top to the bottom decile, $P_{90}/P_{10,}$ a widely-used summary measure of earnings dispersion. The entire distribution was relatively stable from 1994 to 1997, with the bottom decile at about half the median and the top decile at 2¼ times the median or more. The top decile then fell relative to the median in 1998, followed by a very

marked increase in the bottom decile as a proportion of the median in 2000. The net result was that the P_{90}/P_{10} summary dispersion measure fell very sharply indeed from 1997 to 2000, from 4.8 to 3.6, a scale of change rarely seen internationally in this summary measure of earnings dispersion.

Table 2: *Distribution of Hourly Earnings, all Employees, 1994-2007*

	As Proportion of Median				*Top Decile/*
	Bottom Decile	*Bottom Quartile*	*Top Quartile*	*Top Decile*	*Bottom Decile*
1994	0.49	0.69	1.53	2.35	4.77
1995	0.50	0.70	1.54	2.27	4.54
1996	0.49	0.69	1.50	2.24	4.62
1997	0.50	0.71	1.52	2.33	4.64
1998	0.51	0.67	1.45	2.12	4.16
1999	0.51	0.73	1.45	2.15	4.21
2000	0.59	0.75	1.44	2.10	3.56
2001	0.58	0.74	1.44	2.09	3.62
2002			*No data available*		
2003	0.56	0.73	1.46	2.04	3.67
2004	0.58	0.74	1.46	2.12	3.65
2005	0.57	0.73	1.46	2.11	3.67
2006	0.56	0.71	1.50	2.18	3.92
2007	0.56	0.72	1.50	2.26	4.00

Source: Authors' calculations from *LIIS* and *SILC* data.

After 2000 the bottom decile and quartile both fell back slightly relative to the median, but the bottom decile in particular remained well above the level seen before 2000. However, the top quartile and especially the top decile now pulled away from the median, coming close to reversing the falls seen in the late 1990s. The net impact was that by 2007 the P_{90}/P_{10} ratio had risen from 3.6 back up to 4, a substantial increase but still leaving it well below the level of 4.8 seen in 1994. It is also worth noting that while the sample in the *Living in Ireland Survey* was substantially supplemented in 2000, the increase in P_{10} relative to the median in the overall sample was also seen in the continuing sample alone, and so is not simply a product of sampling factors.

The returns to different levels of educational attainment in the workforce and how they have changed over time are of central interest in this study. The educational categories we consider in this study, once harmonised, distinguish those whose highest level of attainment is:

- Primary: left school at the end of primary level, or did some second-level schooling but obtained no qualification.

- Lower secondary: Group, Intermediate or Junior Certificate obtained at the midway stage of second level education.
- Upper secondary: Leaving Certificate qualification obtained on completing second-level education, usually at about age 18.[5]
- Non-degree third-level: Diplomas and other non-degree qualifications from such institutions as regional technical colleges.
- University primary degree.
- University higher degree.

The distribution of employees across educational groups in *LIIS* and *SILC* surveys are reported in Table 3.

Table 3: *Distribution of Education in the Employee Population, 1994-2007*

	Primary	*Lower Secondary*	*Higher Secondary*	*Diploma*	*Primary Degree*	*Higher Degree*
1994	14.93	22.88	35.41	9.01	10.95	6.82
1995	14.37	22.89	37.50	8.99	10.02	6.22
1996	12.84	24.00	38.12	9.51	9.73	5.81
1997	12.24	22.68	39.33	10.34	9.63	5.77
1998	10.88	22.59	38.36	9.63	13.31	5.22
1999	10.95	23.14	37.88	11.67	10.12	6.25
2000	10.82	24.28	35.57	11.44	10.70	7.20
2001	10.91	22.77	37.66	10.71	11.32	6.65
2002			*No data available*			
2003	11.19	21.41	37.16	11.16	11.32	7.76
2004	11.00	20.70	36.61	11.32	11.70	8.68
2005	11.62	20.56	34.69	11.16	12.22	9.75
2006	9.72	18.83	36.48	11.28	13.66	10.03
2007	9.16	18.01	35.69	12.30	14.09	10.75

Source: Authors' calculations from *LIIS* and *SILC* datasets.

Other labour market controls considered include the individual's actual number of years of experience in the labour market, the actual number of years of experience squared, and the actual number of years spent in unemployment. Controls such as tenure, public/private sector or the size of the

[5] Also included in this category are a small number of individuals who obtained qualifications under the PLC (Post Leaving Certificate) and VPTP (Vocational Preparation and Training Programmes).

company would have provided useful additional information on an individual's labour market situation but are unfortunately not available in all the years. Due to differences in the coding used between the surveys it was not possible to identify comparable occupation categories across the entire period. A consistent series of sectoral dummies could however be reconstructed, and is included in our extended set of explanatory variables, as discussed below.

The existing literature on immigrants in the Irish labour market suggests that immigrants from English-speaking countries do not experience a wage penalty, whereas immigrants from non-English speaking countries do (see e.g., Barrett, McGuiness and O'Brien, 2011). Given the role played by immigrants from non-English speaking countries in the second part of the boom, it is of interest to examine their contribution to the evolution of the wage distribution in some detail. Both surveys, however, underestimate their share in the employee population.[6] Moreover, as discussed in Voitchovsky (2011), *SILC* underestimates the number of immigrants from the New Member States in particular in low (paid) occupations and hence their pay gap. We none the less include a dummy variable for individuals born in non-English speaking countries in our extended set of explanatory variables. Other explanatory variables included are gender, age, age squared and marital status.

Our main set of explanatory variables includes five education dummy variables (the default category being primary education), the actual number of years of labour market experience, the actual number of years of experience squared and a gender dummy. The extended set of variables used in the sensitivity analysis also comprises the number of years spent in unemployment, a dummy for immigrants from non-English speaking countries, age, age squared, a dummy for married, and a set of industry dummy variables. These are common explanatory variables, which could be re-constructed across surveys. As will be discussed, the additional controls turn out to have very little added explanatory power in explaining the evolution of wages or effects on the estimated returns to education or experience.

IV RETURNS TO EDUCATION AND EXPERIENCE

With the decomposition results highlighting the role of changing returns to characteristics rather than changes in workforce composition, we now focus on those returns. We first look at standard human capital earnings equations estimated via Ordinary Least Squares, where (log) hourly earnings is the dependent variable and education and experience are the key explanatory

[6] The number of immigrants in the Census of Population was 1.6 per cent in 1996 and 12.6 per cent in 2006, compared with 0.6 per cent and 7.4 per cent in *LIIS* and *SILC* respectively.

variables, with gender also included as a control. Table 4 shows the results of estimating such equations for all employees for 1994, 1997, 2000 (with and without the supplemented observations), 2004 and 2007.

Primary education is the omitted education reference category in these regressions, and relative to that base, higher levels of educational attainment consistently predict (statistically significant) higher levels of hourly earnings throughout. Looking across the period, though, the additional return to completing second level is a good deal higher in the early part of the period than from 2000 onwards – vis-à-vis primary education only, or in terms of the gap between completing lower versus upper secondary education. While a university primary degree consistently predicts a substantial further addition to earnings, the increment over school-leaving is also rather lower from 2000 onwards than before. The returns to a higher degree also declined from then on, but by less than the basic degree, while the increment attached to a post-school diploma seems to have held up.

Estimates of the education coefficients for each of the years from 1994 to 2007 (except 2002 for which no data are available) are graphed in Figure 2, and these show that the decline in average relative returns to completed schooling and to basic degrees occurred over the period from 1998-2001. The estimated coefficients on experience also show a marked downward trend in returns over the period, mostly concentrated from 1994 to 2000. Results for selected years are reported in Table 4. This pattern of results for education and experience is very similar when the extended set of explanatory variables is included (with a graph depicting estimated returns to education in that case reported in Figure A1 in the Appendix). Furthermore, findings for 2000 do not appear very sensitive to the exclusion of the supplemented observations (see column 2000 (b) in Table 4).

The proportion of women in our sample grows steadily from 42 per cent in 1994 to 50 per cent in 2007, with a significant average pay gap and no clear year by year trend in that gap. Our specification assumes similar returns for men and women and the declines reported could therefore reflect changing returns for women. Focusing on the sub-sample of men only reveals that the most striking features are, once again, a decline in the additional returns from completing secondary school or obtaining a third-level qualification from 1997 to 2000, and a declining returns to experience over the period; see Figure 3. This similarity in patterns of estimated returns to education and experience across samples suggests that the decline in returns observed in the whole sample reflects more than a change in the structure of the sample. The increased participation of women is also likely to have contributed to wider macro-economic shifts (see Table 1). These issues are discussed further in Section V.

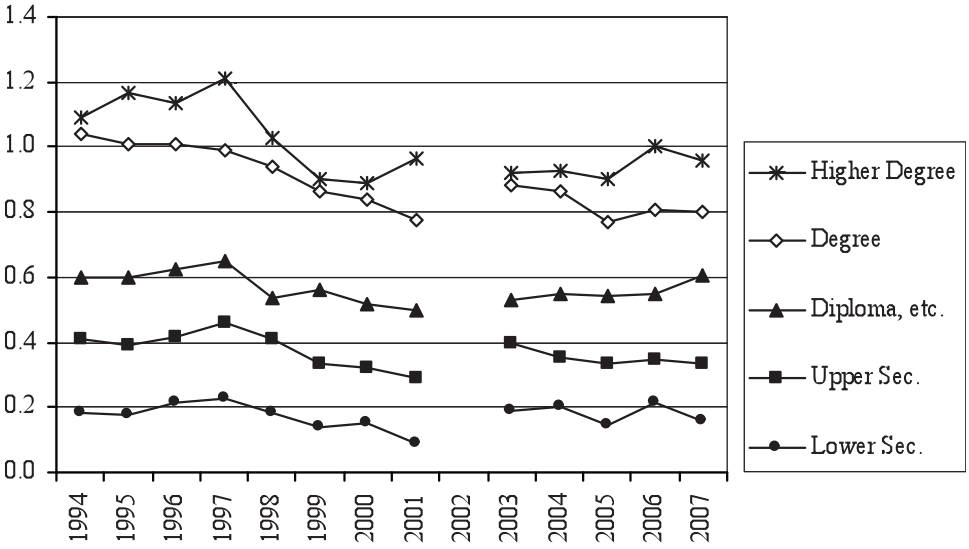
Table 4: *Estimated Earnings Equations, All Employees, Selected Years 1994 to 2007*

All Employees	*1994*	*1997*	*2000*	*2000 (b)*	*2004*	*2007*
Constant	1.460**	1.577**	1.978**	2.486**	2.005**	2.018**
	(0.0342)	(0.0431)	(0.0384)	(0.0548)	(0.0349)	(0.0453)
Lower secondary	0.182**	0.229**	0.154**	0.190**	0.200**	0.156**
	(0.0293)	(0.0381)	(0.0325)	(0.0468)	(0.0297)	(0.0392)
Upper secondary	0.411**	0.461**	0.324**	0.333**	0.351**	0.337**
	(0.0271)	(0.0377)	(0.0315)	(0.0459)	(0.0278)	(0.0374)
Diploma etc.	0.599**	0.652**	0.516**	0.505**	0.547**	0.606**
	(0.0388)	(0.0523)	(0.0414)	(0.0610)	(0.0352)	(0.0451)
Degree	1.040**	0.992**	0.839**	0.875**	0.863**	0.804**
	(0.0391)	(0.0589)	(0.0479)	(0.0615)	(0.0364)	(0.0509)
Higher degree	1.092**	1.213**	0.888**	0.882**	0.924**	0.958**
	(0.0416)	(0.0655)	(0.0591)	(0.0879)	(0.0435)	(0.0484)
Years work	0.0580**	0.0451**	0.0317**	0.0299**	0.0258**	0.0275**
	(0.00266)	(0.00332)	(0.00264)	(0.00369)	(0.00135)	(0.00160)
Years work^2*100	–0.0859**	–0.0540**	–0.0401**	–0.0352**	–0.0240**	–0.0232**
	(0.006)	(0.008)	(0.006)	(0.008)	(0.002)	(0.002)
Female	–0.103**	–0.0983**	–0.143**	–0.152**	–0.113**	–0.109**
	(0.0199)	(0.0256)	(0.0215)	(0.0313)	(0.0171)	(0.0216)
Observations	3374	2682	3366	1842	3652	3503
Adjusted R^2	0.497	0.508	0.395	0.420	0.355	0.357

Results in column 2000(b) based on the continuing sample excluding the supplemented observations which were added to increase the panel size in that year; Standard errors in parentheses; ** p<0.01, * p<0.05.

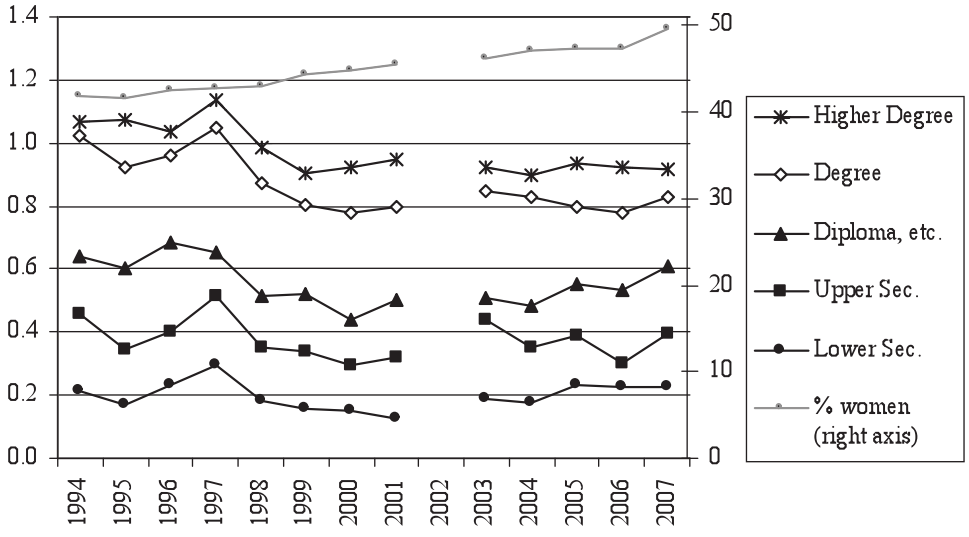
As well as examining returns to education and experience at the mean, we are interested in variation across the distribution. This can be explored via the estimation of quantile regressions, whereby quantiles of the conditional distribution are expressed as functions of observed covariates (see Koenker and Hallock, 2001), allowing for a full characterisation of the conditional distribution of the dependent variable, here (log) hourly wages. Table 5 shows the results of such regressions for 1994, 2000 and 2007, with the main set of explanatory variables, for P_{10}, P_{25}, P_{50}, P_{75} and P_{90}. Looking across the percentiles in each of the years, we see that the returns to higher levels of education are generally higher at P_{75} and P_{90} than at P_{10} and P_{25}, which is the standard pattern found elsewhere and open to a number of interpretations (see for example Martins and Pereira, 2004; though see also Denny and

Figure 2: *Estimated Returns to Education, All Employees, 1994-2007*



Note: All points plotted are significant at 5 per cent or less.

Figure 3: *Estimated Returns to Education, Men, 1994-2007*



Note: All points plotted are significant at 5 per cent or less.

O'Sullivan, 2007). Here our main concern is with change across the years, where we see that, controlling for experience and gender, the decline in the return to completing secondary education from 1994 to 2000 is most pronounced at P_{90}, and is not seen at P_{10}. The decline in returns to third level education, on the other hand, seen across the percentiles is fastest at lower percentiles between 1994 and 2000. While more pronounced from 1994 to 2000, the return to a basic degree continued to decline in the later period, and the return to higher degree started increasing slightly at all percentiles. The return to work experience declined substantially from 1994 to 2000 across the distribution, but the fall was greatest at P_{10} and P_{25}. As a result, returns to experience was higher at higher percentiles in 2000, while the reverse was true in 1994. From 2000 to 2007 returns to experience continued falling, though less rapidly.[7]

Table 5: *Results of Quantile Wage Regressions, All Employees, 1994, 2000, 2007*

A/ 1994	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}
Constant	0.941**	1.199**	1.550**	1.675**	1.911**
	(0.0771)	(0.0360)	(0.0372)	(0.0408)	(0.0479)
Lower secondary	0.0895	0.143**	0.145**	0.249**	0.343**
	(0.0656)	(0.0306)	(0.0318)	(0.0355)	(0.0446)
Upper secondary	0.346**	0.376**	0.402**	0.460**	0.523**
	(0.0629)	(0.0299)	(0.0308)	(0.0341)	(0.0411)
Diploma etc.	0.491**	0.502**	0.561**	0.729**	0.723**
	(0.0762)	(0.0406)	(0.0424)	(0.0477)	(0.0545)
Degree	0.910**	1.083**	1.031**	1.086**	1.116**
	(0.0973)	(0.0406)	(0.0410)	(0.0434)	(0.0530)
Higher degree	1.091**	1.078**	1.027**	1.150**	1.225**
	(0.0911)	(0.0430)	(0.0461)	(0.0495)	(0.0611)
Years work	0.0713**	0.0650**	0.0546**	0.0571**	0.0470**
	(0.00527)	(0.00268)	(0.00279)	(0.00318)	(0.00372)
Years work^2*100	–0.124**	–0.103**	–0.0806**	–0.0818**	–0.0557**
	(0.0133)	(0.006)	(0.007)	(0.008)	(0.009)
Female	–0.150**	–0.120**	–0.110**	–0.0813**	–0.0910**
	(0.0440)	(0.0204)	(0.0209)	(0.0232)	(0.0282)
Observations	3,374	3,374	3,374	3,374	3,374

[7] No major change to these trends can be reported when using the extended set of controls instead, although experience sometimes becomes insignificant while age is strongly significant.

Table 5: *Results of Quantile Wage Regressions, All Employees, 1994, 2000, 2007 (contd.)*

B/ 2000	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}
Constant	1.619**	1.768**	1.975**	2.178**	2.390**
	(0.0918)	(0.0544)	(0.0439)	(0.0396)	(0.0653)
Lower secondary	0.102	0.114*	0.172**	0.186**	0.141**
	(0.0832)	(0.0499)	(0.0403)	(0.0349)	(0.0522)
Upper secondary	0.288**	0.317**	0.327**	0.375**	0.322**
	(0.0823)	(0.0477)	(0.0385)	(0.0334)	(0.0509)
Diploma etc.	0.414**	0.511**	0.529**	0.608**	0.616**
	(0.102)	(0.0583)	(0.0486)	(0.0410)	(0.0599)
Degree	0.613**	0.840**	0.877**	0.972**	0.904**
	(0.113)	(0.0633)	(0.0491)	(0.0412)	(0.0601)
Higher degree	0.595**	0.826**	0.959**	0.996**	0.951**
	(0.133)	(0.0757)	(0.0594)	(0.0510)	(0.0740)
Years work	0.0258**	0.0339**	0.0308**	0.0319**	0.0386**
	(0.00604)	(0.00394)	(0.00325)	(0.00277)	(0.00347)
Years work^2*100	–0.0316*	–0.0461**	–0.0364**	–0.0397**	–0.0569**
	(0.0141)	(0.009)	(0.008)	(0.007)	(0.008)
Female	–0.0972*	–0.147**	–0.162**	–0.159**	–0.172**
	(0.0467)	(0.0300)	(0.0243)	(0.0210)	(0.0310)
Observations	3,366	3,366	3,366	3,366	3,366
C/ 2007	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}
Constant	1.775**	1.825**	1.947**	2.196**	2.528**
	(0.0636)	(0.0678)	(0.0462)	(0.0576)	(0.0618)
Lower secondary	0.0778	0.126*	0.174**	0.207**	0.163**
	(0.0518)	(0.0624)	(0.0417)	(0.0509)	(0.0534)
Upper secondary	0.252**	0.335**	0.378**	0.379**	0.274**
	(0.0494)	(0.0584)	(0.0395)	(0.0479)	(0.0521)
Diploma etc.	0.411**	0.536**	0.620**	0.626**	0.530**
	(0.0564)	(0.0655)	(0.0462)	(0.0568)	(0.0590)
Degree	0.441**	0.694**	0.865**	0.933**	0.898**
	(0.0700)	(0.0693)	(0.0460)	(0.0564)	(0.0575)
Higher degree	0.611**	0.861**	1.080**	1.017**	1.006**
	(0.0588)	(0.0696)	(0.0503)	(0.0627)	(0.0718)
Years work	0.0158**	0.0238**	0.0301**	0.0307**	0.0299**
	(0.00239)	(0.00221)	(0.00156)	(0.00210)	(0.00212)
Years work^2*100	–0.0119**	–0.0196**	–0.0251**	–0.0260**	–0.0259**
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Female	–0.0801**	–0.107**	–0.127**	–0.101**	–0.122**
	(0.0309)	(0.0300)	(0.0220)	(0.0277)	(0.0294)
Observations	3,503	3,503	3,503	3,503	3,503

Standard errors in parentheses: ** p<0.01, * p<0.05.

V DECOMPOSITION ANALYSIS

Shifts in labour force composition, such as increases in the proportion with experience or with higher education, can produce changes in overall earnings dispersion because earnings dispersion is typically higher among the more experienced and educated than among less-experienced or educated workers. We employ up-to-date decomposition methods based on simulation to explore this issue, namely whether the observed changes in the earnings distribution can be attributed to changes in the composition of the workforce (in terms of education and experience) or to changes in returns to those characteristics.

Several distinct decomposition approaches have been developed and applied to the distribution of earnings since the initial procedure employed by Juhn, Murphy and Pierce (1992), which relied on parametric regressions.[8] DiNardo, Fortin and Lemieux (1996) applied a method based on reweighting, extended by Leibbrandt *et al.* (2005). Machado and Mata (2005) employ quantile regressions, while Firpo, Fortin and Lemieux, (2009) have developed an approach based on unconditional quantile regressions. Fortin, Lemieux and Firpo (2010) provide a comprehensive overview of these decomposition methods. Like the original Oaxaca-Blinder decomposition of differences at the mean, all focus on the impacts that changes in composition or in returns would have on the distribution of wages in a partial equilibrium setting, rather than on the general equilibrium effects of quantities on prices. That is, prices (returns) and quantities are assumed to be unrelated.

Here we implement the decomposition approach developed by Machado and Mata (2005), which employs quantile regressions to partition the observed distribution of earnings into "price"/wage coefficients and "quantity"/ characteristics components. This allows a set of counterfactual earnings distributions to be derived, holding constant the characteristics of the workforce (e.g. education, experience and gender) observed in a base year but applying the returns to education and experience seen in a different year, and vice versa. This is analogous to the standard Oaxaca-Blinder technique using OLS regression coefficients, but whereas that is only able to characterise average differences, the Machado-Mata method can characterise differences at every point in the distribution using conditional quantile regression techniques and then integrating it over the dependent variables to obtain the entire unconditional distribution. Observed differences in hourly earnings, at each percentile, can then be decomposed in a part which is attributable to differences in characteristics and a part explained by differences in

[8] Earlier Irish studies by Barrett, FitzGerald and Nolan (2002) and McGuinness, McGinnity and O'Connell (2009) employed this decomposition method.

coefficients; see Melly (2006) for more discussion. This method addresses some limitations of earlier decomposition procedures, in particular in allowing heteroskedacticity to be taken into account, with the price and quantity terms "adding up" to the observed change. Autor, Katz and Kearney (2005) demonstrate that the Machado-Mata technique nests the other decomposition approaches in use in this literature.[9]

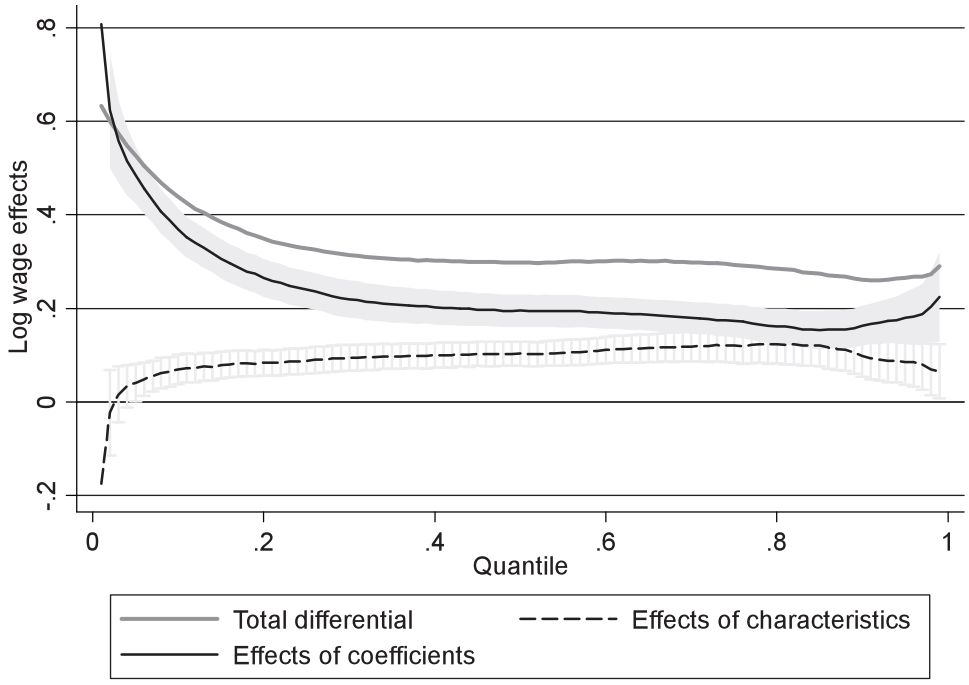
Using the STATA code developed in Melly (2006), we apply the procedure first to the entire period comparing 2007 with 1994, and then focus on 2 sub-periods to help bring out what underpins those results. In Figure 4 the bold unbroken line shows the total observed increase over the whole period in (log) hourly earnings at each percentile of the earnings distribution; as described earlier, earnings increased most rapidly for those towards the bottom. The light unbroken line then shows what the pattern of earnings changes would have been if returns to endowments (education, experience and gender) had evolved as they did, but holding the composition of the workforce in those terms fixed at its 1994 profile. Conversely, the broken line shows the pattern that would have been produced if only the endowment profile of the workforce had changed with returns to those characteristics held fixed. The shading around the "returns" and "characteristics" lines represents the 95 per cent confidence interval. The results suggest that towards the bottom of the earnings distribution, where earnings growth was most pronounced, it is changes in the return to characteristics that account for most of the observed changes in earnings. Changes in the composition of the workforce in terms of those characteristics (with returns unchanged) had a positive impact (except at the very bottom) but played a much smaller role. As we move up the distribution the impact of changes in returns falls but these remain more important than changes in composition for most of the distribution.

Including the additional controls in the decomposition suggests, if anything, that a larger part of the observed gap is explained by increased returns to characteristics rather than an increase in these characteristics.

To tease out what is happening, we look in greater details at the two sub-periods 1994-2000 and 2000-2007, first with a decomposition between shift in the composition and returns to all characteristics together (education, experience and gender) and then looking at these variables separately to see whether a variable in particular might be driving the results. Figure 5a shows the decomposition results for the earlier period based on the main set of explanatory variables. The observed increase in earnings now declines steadily as we move up the earnings distribution, and it is this pattern the

[9] A detailed description of the basic procedure is in the original paper by Machado and Mata (2005), and useful discussions are in studies applying and extending it such as Autor *et al.* (2005); Melly (2005); Azam (2009) and Albrecht, Bjorklund and Vroman (2009).

Figure 4: *Decomposition of Earnings Change, All Employees, 1994-2007*



decomposition seeks to explain or at least account for. We see that it is changes in the return to characteristics that account for almost all of the observed changes in earnings, while changes in the composition of the workforce in terms of those characteristics (with returns unchanged) would have had little impact.

Implicit in these decompositions is the assumption that individual characteristics or endowments are comparable through time. This may be a strong conjecture when a growing pool of workers has been trained (via education and experience) abroad. The small number of immigrants in our sample, even in 2007, should give us some reassurance on that matter. The addition of a dummy for immigrant workers also has no substantial impact on the results. Nevertheless, to allow for potential discontinuities in the domestic educational system we have also looked at the age at which a person has left education as an additional proxy for the level of education. Figure 5b reports the returns to several characteristics.

The black line shows as earlier the actual differences in log wages at each percentile, between 1994 and 2000. The other curves show the difference between the 1994 and "counterfactuals" for the distribution in 2000, had the employees displayed endowments as in 1994 but at 2000 prices. With larger

Figure 5a: *Decomposition of Earnings Changes, All Employees, 1994-2000 (1994 as Base Year)*

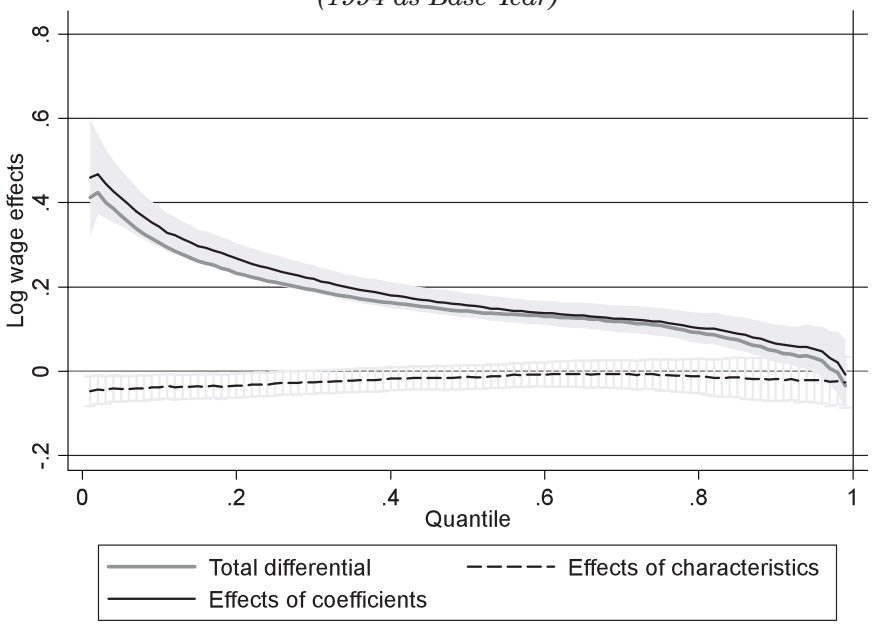
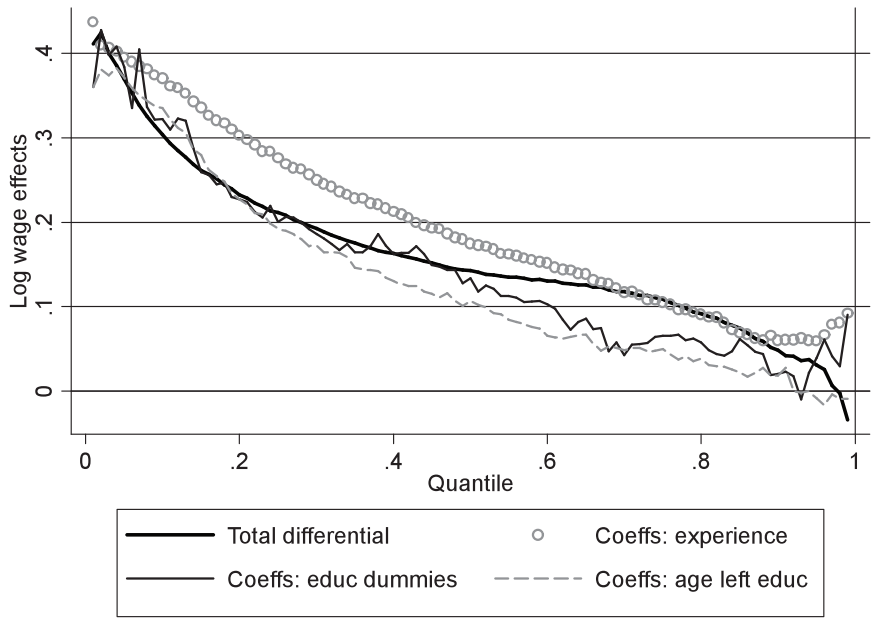


Figure 5b: *Decomposition of Earnings Changes, All Employees 1994-2000 (1994 as Base Year)*



differences in hourly wages in the lower half of the distribution, the experience curve suggests that these employees typically displayed lower levels of experience in 2000 than in 1994. In contrast, the education curves suggest that employees in the upper part of the distribution tended to have higher level of education at the end of the period. This trend is particularly marked when education is measured by the age at which a person has left education.[10] Differences in the gender composition of the sample, however, does not appear to be significant in any part of the distribution (not plotted for readability).

Recall, returns to both of education and to work experience fell markedly over this period. Employees at the bottom of the distribution, who also experienced the fastest wage increase, had less experience on average at the end of the period. This is consistent with a decline in returns to experience that is fastest at low percentiles, see Table 5. Figure 5b also suggests that employees in the upper part of the distribution tended to have higher levels of education at the end of the period. This meant that those with higher levels of education and more experience saw their earnings grow less rapidly than would have been the case if those returns had remained unchanged. The question now is why, in the first part of the boom, wages grew faster at lower percentiles, in spite of a tendency for reduced experience at the bottom of the distribution and increased education towards the top. We return to this in the next section.

Focusing on 2000-2007, Figure 6a shows the decomposition results for the main set of characteristics (education, experience and gender). The pattern of earnings change to be accounted for over this sub-period is very different, with the increase in earnings not varying much across the distribution although highest at the very top and bottom. Changes in returns and in characteristics are now equally important across the bulk of the distribution, though changing returns are the driving force at the very top and bottom.

Looking at the different counterfactual distributions for the period from 2000 to 2007 reveals that education continued to increase in the upper part of the distribution (except a the very top), and this time the increase is also seen further down the distribution, when captured by the set of dummies. Levels of experience have increased over that period, except again at the very top and very bottom, although these experience differences are rarely significant they are jointly significant with education. Gender differences do not appear to be significant at any point in the distribution (curve not plotted for readability).

[10] Taking into account a 90 per cent confidence interval (not plotted for readability), the experience curve is (significantly) above the "total differential" line from about the 10th to 50th percentile. The education dummies curve is significantly below the "total" line around the 70th percentile and the curve where education is proxied by age at which a person has left education is significantly below the total line from about the median to the 90th percentile.

Figure 6a: *Decomposition of Earnings Changes, All Employees, 2000-2007 (2000 as Base Year)*

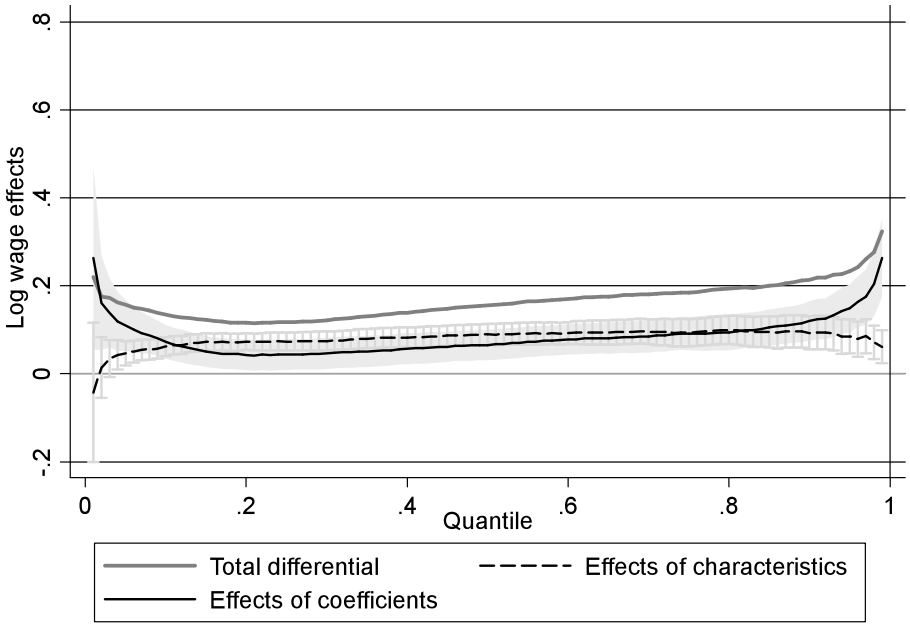
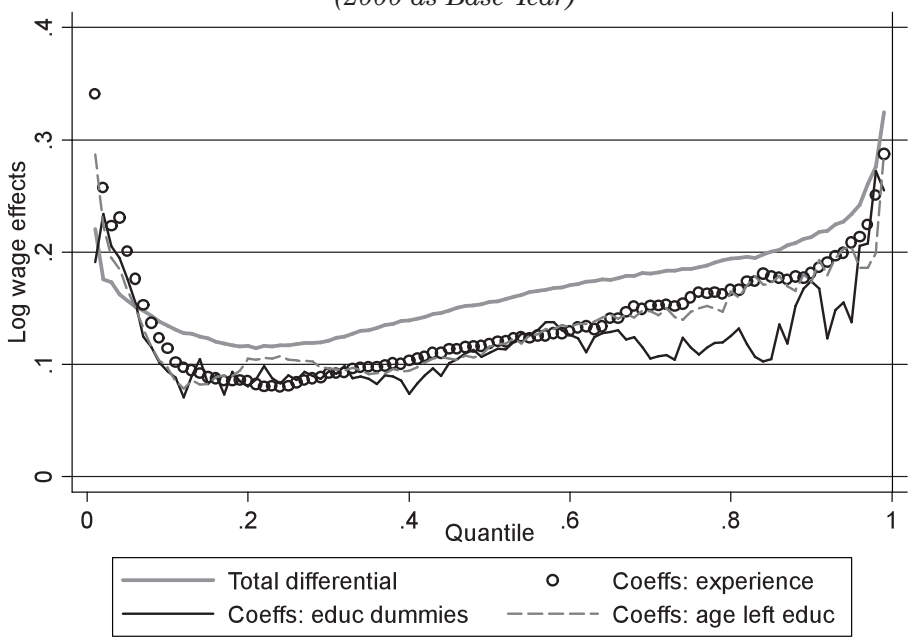


Figure 6b: *Decomposition of Earnings Changes, All Employees, 2000-2007 (2000 as Base Year)*



It appears, therefore, that although the proportion of women increased steadily between 1994 and 2007, this shift was not concentrated in a specific part of the distribution. A decomposition for 2000-2007 based on the extended set of controls – not shown – reveals a contribution of endowments that is positive and significant above the median only, implying that there was less of a change in these other characteristics between 2000 and 2007.

Recall that returns to a degree showed a slight decline over that period. This is compatible with seeing employees with "more education" further down the distribution, most likely in lower occupations. Unfortunately, occupation categories could not be made comparable across surveys but data from the Census over the boom confirms this trend, see Table 6. Workers with third levels education increasingly take up employment in lower paid occupations – they are no longer concentrated in managerial and professional occupations. This may contribute to a decline in estimated returns to a degree over the boom period. Nevertheless, estimated returns to a higher degree showed a slight increase from the P_{25} up between 2000 and 2007. This increase in average returns over that period is therefore driven by employees in the upper part of the distribution, most likely in top occupations. In *SILC* (though not the *LIIS*), it is possible to categorise occupations as in the Census Indeed, an interaction terms between higher degrees and the top two occupations – managers and higher professional – in *SILC* years is significant in the last 3 years and implies a slight decline in average return to higher degrees for employees in lower occupations and an increase for employees in the top two occupations.

Table 6: *Distribution of Employees (15-64) with Third Level Education, by Occupational Group, Census of Population Data*

	1996	*2002*	*2006*
Employers and managers	17.6	19.7	17.5
Higher professional	29.0	24.2	20.8
Lower professional	37.1	34.4	31.5
Non-manual	12.6	13.5	18.1
Manual skilled	1.3	2.1	2.9
Semi-skilled	1.3	2.2	4.2
Unskilled workers	0.7	0.7	1.2
All others unknown	0.5	3.2	3.9
Total	100	100	100
% in top 3 groups	83.6	78.3	69.7

We can then use these "counterfactual" distributions that would have been produced by a change in returns or in characteristics alone to quantify their impact of the gap between different percentiles in the earnings distribution – for example on the relationship between P_{90}, P_{50} and P_{10}, which underpin the summary dispersion measures employed earlier. Table 7 shows first the actual values observed for the relevant percentiles and summary measures at the beginning and end of the entire period 1994-2007 and the two sub-periods we have distinguished, and how they changed from the start to the end. It then shows how much they would have changed if only coefficients/returns on education, experience or gender had changed, and the corresponding changes if only the distribution of these characteristics had changed.

Over the whole period from 1994 to 2007, the change in coefficients/returns which occurred would have produced a very substantial reduction in the gap between P_{10} and P_{90}, with the change in characteristics having a modest offsetting impact. It is the estimated impact of changing returns that accounts for most of the narrowing both in the gap between P_{10} and P_{50} and between $P5_0$ and $P9_0$. Comparing 2000 with 1994, the middle panel of the table shows a more pronounced version of the same pattern. The change in returns in itself now produces an even larger narrowing of the gap between P_{10} and P_{90} – and between P_{10} and P_{50} – than over the whole period. The changing distribution of characteristics has an even more modest impact in the opposite direction than over the entire period. Looking at the later sub-period, from 2000 to 2007, we see that the change in returns had a very different impact: in itself it would now have produced some increase in the gap between P_{10} and P_{90}. The impact of changing characteristics was now similar in direction to that of returns, but the widening gap between top and middle predominantly reflecting the effects of changing returns.

It is of course the case that the observed changes in wages could also reflect changes in composition in relation to characteristics that are not observed and, therefore, not taken into account in our analysis. Differences in productive capacity due to unobserved ability are an example of such unobserved heterogeneity most commonly cited in the literature. It is possible in this particular instance that over the time period in question unobservable characteristics became more negative as participation rates grew and previously unemployed or inactive persons were drawn into employment. However, it is difficult to see how this could help account for the observed differences between the two sub-periods, and if such persons are more heavily concentrated towards the bottom than elsewhere in the distribution that would imply a downward pressure on earnings there whereas a relatively rapid increase was observed.

Table 7: *Decomposition of Wage Inequality Changes into Price and Quantity Components, 1994-2007*

Variation Between 1994 and 2007

	Observed Levels (in Logs)				
Percentiles	*1994*	*2007*	*Observed Difference*	*Coefficient Effects (% of Total Difference)*	*Covariate Effects (% of Total Difference)*
10	1.717	2.148	0.431	0.369 ()	0.070 ()
50	2.426	2.720	0.294	0.195 ()	0.103 ()
90	3.280	3.534	0.254	0.163 ()	0.099 ()
90-10	1.563	1.386	–0.177	–0.206 ()	0.029 ()
90-50	0.854	0.814	–0.040	–0.032 ()	–0.004 ()
50-10	0.709	0.572	–0.137	–0.174 ()	0.033 ()

Variation Between 1994 and 2000

	Observed Levels (in Logs)		*Observed*	*Coefficient*	*Covariate*
Percentiles	*1994*	*2000*	*Difference*	*Effects*	*Effects*
10	1.717	2.039	0.322	0.342	–0.038
50	2.426	2.568	0.142	0.156	–0.014
90	3.280	3.308	0.028	0.066	–0.018
90-10	1.563	1.269	–0.294	–0.276	0.020
90-50	0.854	0.740	–0.114	–0.090	–0.004
50-10	0.709	0.529	–0.180	–0.186	0.024

Variation Between 2000 and 2007

	Observed Levels (in Logs)		*Observed*	*Coefficient*	*Covariate*
Percentiles	*2000*	*2000*	*Difference*	*Effects*	*Effects*
10	2.039	2.148	0.109	0.073	0.062
50	2.568	2.720	0.152	0.065	0.090
90	3.308	3.534	0.226	0.120	0.093
90-10	1.269	1.386	0.117	0.048	0.031
90-50	0.740	0.814	0.074	0.055	0.003
50-10	0.529	0.572	0.043	–0.007	0.028

VI THE ROLE OF IMMIGRATION AND THE MINIMUM WAGE

The evolution of wage dispersion over Ireland's boom period brings out that, in studying wage inequality, distinguishing trends toward the bottom versus towards the top (as highlighted by Atkinson, 2008) is indeed crucial.

The key distributional changes identified in the first part of the boom, from 1994 to 2000, are that the bottom decile jumped from 0.51 to 0.59 of the median while the top decile fell from 2.35 to 2.10 times the median. Over the second half, from 2000 to 2007, the top decile rose to 2.26 while the bottom decile lagged the median modestly. We now focus on factors that may have underpinned these changes, in the light of the results of the decomposition analysis and trends in returns to education and experience documented in previous sections.

As well as rapid economic growth and increases in both the numbers employed and average earnings, a significant feature of the period being examined was the changing education profile of the workforce. In the surveys on which our analysis is based, the percentage of employees not having completed upper secondary education fell from over one-third in 1994 to close to one-quarter by 2007, while the percentage having some third level education rose from about one-quarter to over one-third. This reflected both rising levels of educational attainment for those educated in Ireland and the impact of in-migration. Ireland has seen a sustained rise in the numbers completing higher second-level education, from about one-third of the cohort in 1970 to 90 per cent by 2007, while the proportion going on to third-level education has risen from under 20 per cent to over 60 per cent. Much more recently, significant in-migration for the first time in Ireland's history has had a significant impact on the supply of skills. Net out-migration, substantial in the 1980s and into the 1990s, fell away from 1994-96, and as we saw from Table 1 a net inflow of people from abroad to work in Ireland then became substantial for the first time. Table 8 shows that up until 2004 these came mostly from the UK, USA or EU-15, but from then onwards the majority were from the eastern European countries joining the EU at that point.

The educational profile of the immigrant flow in the second half of the 1990s – including returning Irish migrants – and up to 2004 was considerably higher than that of the Irish workforce (see for example Barrett and Trace, 1998, Barrett, Bergin and Duffy, 2006). Previous Irish studies (such as Barrett, FitzGerald and Nolan, 2002, and McGuinness, McGinnity and O'Connell, 2009) have suggested this (together with the increase in educated domestic population) may help to explain the stability and then decline in the returns to education during these years. Our decomposition analysis shows that it was the decline in returns to higher education and experience from 1997 to 2000 that accounted fully for the fall in the P_{90}/median ratio over those years rather than any effect of changing workforce composition, consistent with this line of argument. The increased supply of educated/skilled workers seems to have sufficed to restrain returns to higher levels of education in this period of very rapid economic growth. The post-2004 inflow of immigrants

Table 8: *Trends in Migration, Ireland, 1994-2007*

	Net Immigration 000	*Gross Immigration 000*	*Immigration From*				
			UK	*EU-15*	*EU-12*	*USA*	*Other*
1994	–4.7	30.1	15.2	5.8		4.3	–4.8
1995	–1.9	31.2	15.6	6.3		3.8	–5.5
1996	8.0	39.2	17.6	7.2		6.4	8.0
1997	19.2	44.5	20.3	8.1		6.7	9.4
1998	17.4	46.0	22.1	9.1		5.1	9.7
1999	17.3	48.9	22.3	10.2		5.9	10.5
2000	26.0	52.6	20.8	11.7		5.5	14.5
2001	32.8	59.0	20.6	10.3		6.7	21.5
2002	41.3	66.9	19.1	11.3		6.6	29.9
2003	30.7	60.0	15.8	11.8		5.3	27.2
2004	32.0	58.5	14.6	15.2		5.3	23.3
2005	55.1	84.6	15.6	11.1	33.7	4.8	19.4
2006	71.8	107.8	17.7	13.5	49.3	4	23.3
2007	67.3	109.5	13.4	14.1	52.1	4.2	25.7

Source: Central Statistics Office.

from the new EU member states had a lower level of educational attainment than earlier immigrants (though not than natives), as shown in Barrett and Duffy, (2008), who also report that these immigrants are less likely than others to be in higher-level occupations. Barrett, McGuinness and O'Brien (2011) report a significant earnings penalty for those immigrants which is most pronounced for those at the upper end of the skills and earnings distributions. In our results the return to school completion and primary degrees are not seen to decline much more rapidly in the latter part of the boom, but we have emphasised earlier the limitations of the sample in terms of number of immigrants and their overall impact may thus be understated.

The shift noted earlier in the structure of employment in the second half of the boom may also be important, with construction, health and education and public administration becoming more important: when sectoral dummies are included in the estimated P_{90} earnings function, the coefficients on education and experience are more stable and the intercept no longer increases. Occupation also seems to play a more important role by the end of the period, with the estimated return to being an employer or manager or a professional (controlling for education and experience) increasing, though as noted earlier we are not able to include a consistent measure of occupation across the two datasets covering the entire period. The extra wage increases

awarded to the public sector during this period as a consequence of benchmarking could also have played a part.[11]

The factors that reduced pressure on returns to higher education/skills would also have kept downward pressure on the cost of producing in Ireland, fuelling economic growth. The rapidly expanding Irish economy then required both high and low-skilled labour, with low-skilled wages kept up by the scale of demand as employment increased rapidly across all skill levels, even with significant in-migration.[12] In addition, McGuinness *et al.* (2009) have suggested that the introduction of the minimum wage in 2000 could also have contributed, especially for women. Our results show that the sharp rise in the bottom decile as a proportion of the median over the 1994-2000 period was in fact almost entirely concentrated in the transition from 1999 to 2000. This is suggestive that the introduction of the national minimum wage played a role. A number of studies based on surveys of private sector firms have sought to assess the number of workers at or below the minimum wage and its impact on employment, if any (see for example Nolan, Williams and O'Neill (2002); O'Neill, Nolan and Williams (2006); Nolan, Williams and Blackwell, (2006)). These suggest first that the number directly affected by the minimum wage on introduction was relatively modest (with no more than about 5 per cent of private sector employees at or below the relevant earnings level), and secondly, that this continued to be the case as the minimum wage was increased over time broadly in line with average earnings. The strength of demand for labour in a booming economy, including towards the bottom, was seen as the key driver of wage developments rather than the minimum wage itself, though it may clearly have supported the very bottom of the distribution.

The minimum wage was introduced in April of 2000 at (the IR£ equivalent of) €5.59 per hour. In the *Living in Ireland Surveys* the level of hourly earnings cutting off the bottom decile – P_{10} – was €4.46 in 1999, whereas in the 2000 sample it had risen to €5.93, an increase of 33 per cent. On the face of it, the introduction of the minimum wage at a relatively high level could thus have played a major role in moving the bottom decile closer to the median at that point. However, earnings also increased relatively rapidly above that level – the increase in nominal hourly earnings from 1999 to 2000 at P_{20} was 20 per cent, 18 per cent at P_{30}, and 15 per cent at the median. This suggests there was strong demand for low-skilled workers, consistent with rising employment levels, although the most rapid increase in wages was certainly

[11] Unfortunately, public versus private sector employees are not readily distinguished in the *SILC* dataset for these years, so the impact of public versus private sector increases cannot be pursued with this dataset.

[12] Barrett *et al.* (2002) and McGuiness *et al.* (2009) show this to be consistent with simulation of a simple model distinguishing skilled and unskilled labour but treating them as complements, and comparing outcomes with and without significant immigration.

in the region of the minimum wage (with some potential "spill-over" from the minimum wage itself). It is also significant that a decomposition analysis distinguishing 1994-1999 and 19999-2000 reveals that the rate of increase in wages towards the bottom was actually quite rapid in the period 1994-1999 given the changing profile of employees at that point in the distribution in terms of endowments; the increase in returns (as opposed to average earnings) vis-à-vis endowments from 1999 to 2000 is not particularly pronounced.

In focusing on the impact of the minimum wage it must also be noted, though, that the proportion of employees in the 2000 sample below €5.59, at almost 9 per cent, is a good deal higher that the 5 per cent of private sector employees that the firm-based survey reported in O'Neill, Nolan and Williams, (2006) found to be at or below the level of the minimum wage on its introduction. (The *LIIS* sampling took place throughout the year whereas the firm survey was carried out in the latter part of 2000, but that would not suffice to explain the difference, nor would the fact that the *LIIS* included public sector employees since the proportion of those workers at or below the minimum wage is lower there.) One possible source of concern from a data perspective is that the sample in the *Living in Ireland Survey* was substantially supplemented in 2000, as already noted; however, we have verified that the substantial increase in P_{10} relative to the median was also seen in the continuing sample alone, and so was not simply a product of that sample enhancement. A household survey may well be less reliable than a firm-based one in obtaining the very precise information about wages and hours worked required to tease out the impact of a policy innovation such as the minimum wage at a point in time, while sufficing to capture trends in overall dispersion over a period.

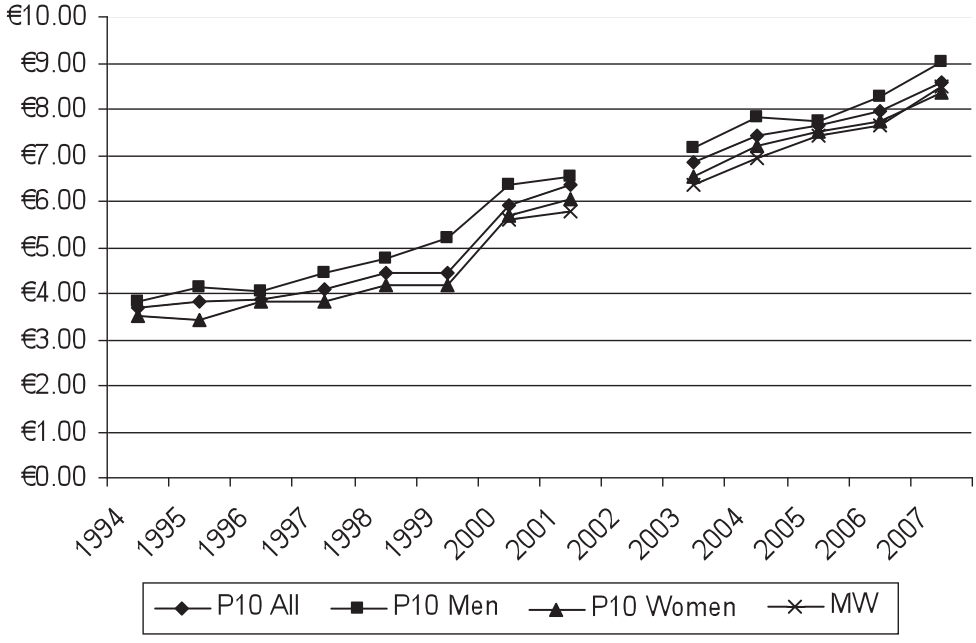
From 2000 to 2007, the P_{10}/median ratio was stable and then declined marginally. The minimum wage was increased over time broadly in line with median earnings, and as Table 9 shows this meant that P_{10} and the minimum wage evolved in a very similar fashion up to 2007.

Indeed, if we focus on P_{10} for women, this moved even more closely in line with the minimum wage, as brought out in Figure 7. So the minimum wage may have effectively anchored the bottom of the distribution relative to the median over these years, and may have been significant for the gender pay gap. The importance of the timing of the introduction of the minimum wage in the middle of a boom has to be emphasised: sustained demand for low-skilled workers allowed this anchoring to be combined with very low levels of unemployment. In the period from 2004, when many of the immigrants coming from the new EU member states worked in unskilled and semi-skilled jobs and increased the supply of labour available for those jobs, only a modest decline in the bottom decile relative to the median was seen.

Table 9: *Low Earnings and the Minimum Wage*

Private	*Bottom Decile Cut-off, €*			*Minimum Wage*
	P_{10} *All*	P_{10} *Men*	P_{10} *Women*	
1994	3.69	3.84	3.49	
1995	3.81	4.15	3.41	
1996	3.87	4.06	3.81	
1997	4.10	4.43	3.81	
1998	4.44	4.76	4.18	
1999	4.46	5.19	4.16	
2000	5.93	6.35	5.67	5.59
2001	6.35	6.52	6.06	5.79
2002				
2003	6.85	7.14	6.55	6.35
2004	7.44	7.82	7.18	6.95
2005	7.65	7.75	7.50	7.43
2006	7.98	8.25	7.75	7.65
2007	8.57	9.00	8.34	8.48

Figure 7: *Earnings at the Bottom Decile and Level of the Minimum Wage*



VII CONCLUSIONS

Ireland offers a valuable case study of the evolution of wage inequality in a period of exceptional growth in output, employment and incomes from 1994 to 2007. The key finding was that dispersion in hourly earnings across all employees fell very sharply indeed to 2000, before bouncing back somewhat by 2007. The bottom decile was stable 1994-99, rose from 0.51 to 0.59 of the median from 1999 to 2000, and by 2007 was 0.56; the top decile fell from 2.33 to 2.10 times the median from 1997 to 2000, then rose to 2.26 by 2007. Over the entire period declining returns to both education and work experience meant that those with higher levels of education and more experience, who tend to be higher up the distribution, saw their earnings grow less rapidly than others. These declining returns may be associated with the substantial immigration of relatively highly skilled workers attracted by the availability of jobs in a very rapidly expanding economy. The increase in the bottom decile relative to the median was also seen to be related to the introduction of the minimum wage in 2000, anchoring the bottom of the distribution at a higher proportion of the median from then onwards. For 2000-2007 the increase in higher earnings may be associated with the changing pattern of immigration and the changing nature of employment growth in that part of the boom.

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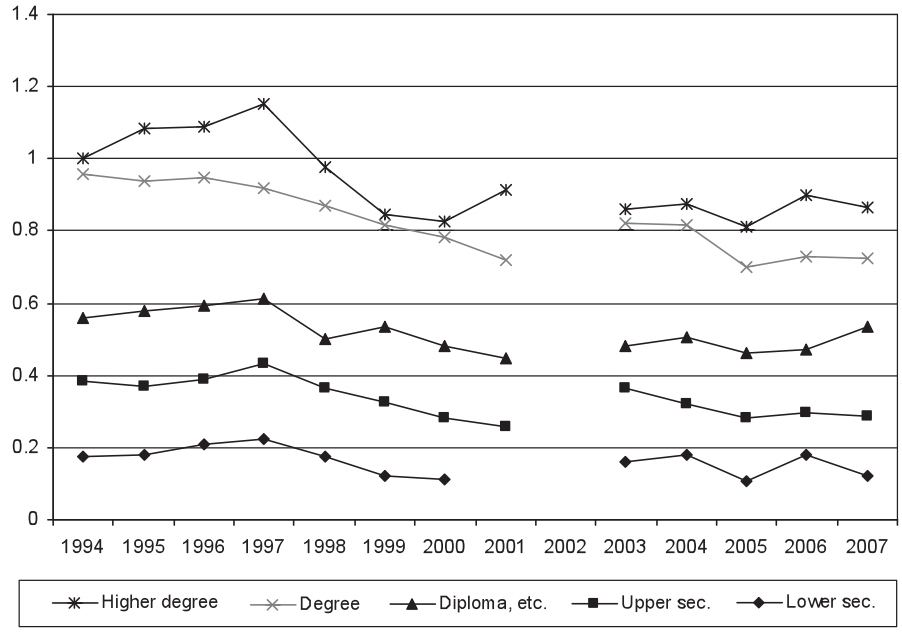
APPENDIX

Figure A1: *Estimated Returns to Education, 1994-2007, With Extended Set of Controls*



Note: dependent variable is the log of hourly earnings. Default category is primary education. Other explanatory variables include: the actual number of years of experience, the number of years of experience squared, a female dummy, a dummy for immigrants born in non-English-speaking countries, age, age squared, the number of years spent in unemployment, a married dummy and a set of industry dummies. All points significant at 5 per cent or less.