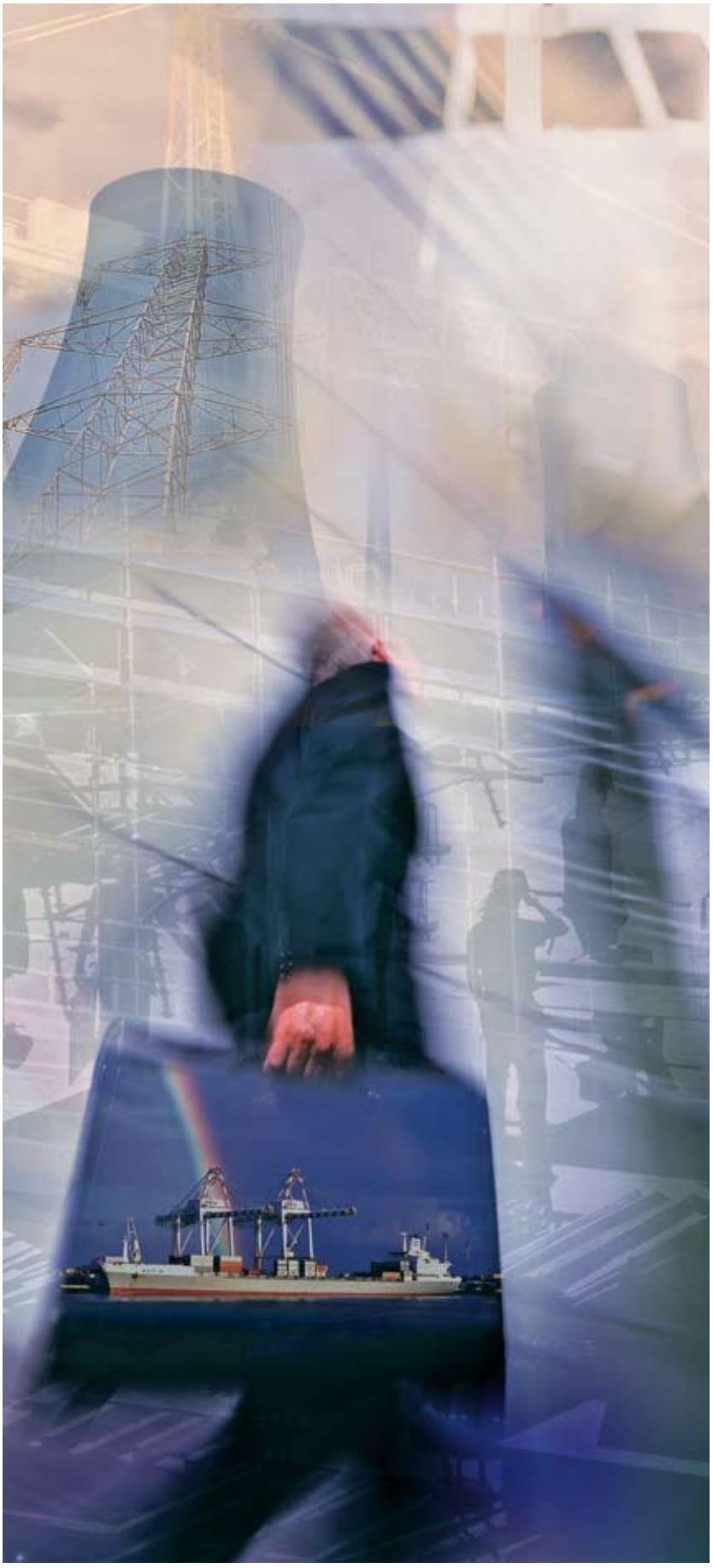

Queensland

The Economic Society of Australia Inc.

Proceedings of the 37th Australian Conference of Economists

Papers delivered at ACE 08

30th September to 4th October 2008

Gold Coast Queensland Australia

ISBN 978-0-9591806-4-0

Welcome

The Economic Society of Australia warmly welcomes you to the Gold Coast, Queensland, Australia for the 37th Australian Conference of Economists.

The Society was formed 83 years ago in 1925. At the time, the Society was opposed to declarations of policy and instead focused on open discussions and encouraging economic debate. Nothing has changed today, with the Society and the conference being at the forefront of encouraging debate.

This year we have a large number of papers dealing with Infrastructure, Central Banking and Trade.

Matters of the greatest global importance invariably boil down to be economic problems. Recent times have seen an explosion of infrastructure spending, after world-wide population growth has seen demand outpace aging supply. The world has become more globalised than at any time since World War I but the benefits of this (and the impact on our climate) has been questioned by some.

At the time of preparing for this conference we could not have known that it would have been held during the largest credit crisis since the Great Depression. The general public and politicians both look to central banks for the answers.

We are also very pleased to see a wide selection of papers ranging from applied economics to welfare economics. An A – Z of economics (well, almost).

Another feature of this conference is that we have gone out of our way to bring together economists from all walks of life, in particular from academia, government and the private sector. We are grateful to all of our sponsors, who are as diverse as the speakers.

The Organising Committee

James Dick
Khorshed Alam (Programme Chair)
Michael Knox
Greg Hall
Allan Layton
Rimu Nelson
Gudrun Meyer-Boehm
Jay Bandaralage
Paula Knight

Published November 2008

GPO Box 1170
Brisbane Queensland Australia
ecosocqld@optushome.com.au

Our Gold Sponsors

QIC

Queensland Treasury Corporation

Reserve Bank of Australia

Queensland Government
Department of Infrastructure and Planning

Keynote Sponsors

Australian Government
Productivity Commission

Australian Government
The Treasury

Queensland University of Technology
Faculty of Business
School of Economics and Finance

The University Of Queensland
AUSTRALIA

Goldman Sachs JBWere

The University Of Queensland
AUSTRALIA

NCER National Centre for Econometric Research

Central Council

Special Session Sponsors

Griffith UNIVERSITY

The Higher Education Academy Economics Network

Unless we have specifically been requested to do otherwise, all the papers presented at the conference are published in the proceedings in full. A small number of papers will have versions that have also been made available for special editions of Journals, Economic Analysis and Policy, and the Economic Record. Authors will retain the right to seek additional publication for papers presented at the conference so long as it differs in some meaningful way from those published here.

The opinions expressed in the papers included in the proceedings are those of the author(s) and no responsibility can be accepted by the Economic Society of Australia Inc, Economic Society of Australia (Queensland) Inc, the publisher for any damages resulting from usage or dissemination of this work.

The Paper following forms part of - *Proceedings of the 37th Australian Conference of Economists*
ISBN 978-0-9591806-4-0

The four E's : education, earnings, experience and externalities

Kerry Carne

kerry.carne@deta.qld.gov.au

Labour Market Research Unit,

Department of Education, Training and the Arts,

Level 7, 30 Mary Street, Brisbane, Queensland, Australia

Abstract

Externalities to differing levels of educational attainment are measured, at more levels of education than has previously occurred. Results are consistent with the literature in indicating that greatest externalities attach to highest levels of educational attainment and so greatest gains accrue to greatest shifts in the skills spectrum. However the expectation that productivity and thus earnings increase monotonically with experience is not confirmed for most educational-attainment groups.

Keywords: education; earnings; experience; vocational; externalities

1. Introduction

The literature detailing attempts to determine the existence and extent of externalities to education dates from Marshall (1890), who argued that learning spillovers among skilled workers in the same industry and location enhanced productivity. More recently, studies have differentiated between externalities to higher and lower levels of education, typified in the American or United Kingdom context as school and college-level attainment, and find greatest externalities attach to college-level attainment. However, such an approach overlooks vocational education.

This study adopts a finer degree of differentiation of educational attainment than previous studies, disaggregating educational attainment into five levels and so recognising a greater range of substitutability between skilled labour categories. It thus allows a focus on externalities in greater detail, enabling measurement of externalities to vocational education relative to other categories of education.

If the quantum of externalities to education is dependent on the type of knowledge and skill attained by the student, one might expect that externalities to vocational education would be exceeded by externalities to either schooling or university education. The rationale lies in the different levels of generic and specific skills conveyed by each. If greater externalities attach to generic than specific skills, and both schooling and university education imbue students with predominantly generic skills, educational attainment at the university and schooling levels should generate externalities in excess of those generated by vocational education.

A more nuanced approach recognises differences between levels of generic skills. It is unlikely that generic skills taught in schooling can be equated with generic skills taught in university, leading to a possible gradated approach along the lines of lower generic skills, specific skills, higher generic skills. This approach reduces to

that adopted in the more recent manpower planning literature, merely recognising factors underlying the designation of skills as low, medium or high.

The methodology adopted in this paper also enables determination in a simple manner of the role of experience in determining earnings at different educational levels. Standard Mincerian-style earnings functions typically include education, experience and experience squared as explanatory variables. A popular specification provides output which can be interpreted as the *mean* addition to earnings resulting from an additional time unit of experience. These functions therefore do not enable identification of the contribution of experience to earnings within education groups. While a disaggregated Mincerian earnings function is not undertaken in this study, the methodology adopted provides a measure of mean hourly earnings by education-experience groups, enabling identification of the broad impact of increments of five years of experience on earnings of workers of five different levels of educational attainment.

This study is structured as follows. Section 2 provides background including a fuller discussion of the rationale for an expectation that different levels of education create a different quantum of externalities. Section 3 explains the model, which is a derivation of a recent development in studies of this type, while Section 4 details the Household Income and Labour Dynamics in Australia (HILDA) Survey data used. Section 5 presents results, which accord with but provide additional detail to the current literature. Conclusions are provided in Section 6.

2. Background

Early studies of education externalities considered education without disaggregation into different levels and thus postulated perfect substitutability between workers of different educational levels. This may have lead to obscured

results wherein changes in average education yielded no evidence of significant externalities in US cities and states between 1970 and 1990 (Ciccone and Peri (2006)).

Later studies disaggregated education into schooling and college or university, recognising non-substitutability between these two broad categories. Moretti (1998, 2004) found that a greater share of college graduates in US cities lead to increases in all workers' wages. Similarly, Iranzo and Peri (2007) found that an increase in college education generated significant positive externalities in US states.

However, a shortcoming of this literature is that it designates college or university-educated workers as skilled workers while all workers with lesser educational attainment are designated as unskilled workers. The vocationally-educated are not separately identified in the skills groups. Such studies implicitly assume either that vocational education does not generate externalities or that externalities to vocational education are equal to externalities generated by the lower of the two educational levels considered. These assumptions are the focus of this study.

The justification for an expectation that externalities vary across levels of educational attainment lies in the different generic/specific skill content of different educational levels. It is likely that a mixture of generic and specific skills are provided at all levels of education however the proportions differ, with schooling and university education delivering a larger component of generic skills and vocational education providing mostly specific skills. This is supported by International Standard Classification of Education 1997 classification criteria which indicate that vocational education courses deliver mostly practical skills.

General education courses in contrast are more theoretical in nature. While some vocational education is delivered from the second basic stage of schooling education in Australia, schooling comprises mainly general education courses and thus presumably generates more generic than specific skills. This provides a potential rationale for the OECD (2007) finding that school students undertaking vocational education courses in partial substitution for general schooling courses scored lower in PISA numeracy tests.

Further, Callan (2003) surveyed Australian VET teachers and students with respect to their attitudes to generic and specific skills and found that VET teachers believe vocational education students are more focussed on acquisition of specific skills than generic skills. Callan concluded that certain generic skills (reading, spelling and writing, numeracy, inter-cultural communication, team work, conflict resolution, adaptability, dealing with incomplete information and challenging the status quo) are poorly taught in vocational education.

If greater external returns attach to generic skills than to specific skills, and schooling and higher education imbue mostly generic skills while vocational education imbues mostly specific skills, this suggests that externalities to schooling should exceed externalities to vocational education and both should be less than externalities to university education. This indicates that the ascending order of progression, in terms of tendency to generate externalities, may be vocational to schooling to higher education.

Alternately, if lower generic skills are gained during schooling than university, schooling may generate lesser externalities than vocational education and in turn higher education. Then the ascending order of externalities generation may be schooling, vocational and higher education. This corresponds with the innovation

literature in that higher generic skills, gained during university education, are required to generate technological change, while specific skills are required to implement it.

3. The model

The basis for the approach to measuring externalities, adopted in this paper, is described in Ciccone and Peri (2006) at page 382 as:

> *"... under general conditions, the strength of human-capital externalities equals the average weighted effect of human capital on wages, which in turn equals the effect of human capital on the average wage when holding the labour-force skill-composition constant."*

The methodology used in this paper is an alternative to the standard Mincerian approach. Ciccone and Peri (2006) state that the Mincerian approach calculates educational externalities as the employment-weighted average percentage change in wages resulting from an increase in the supply of educated workers. Accordingly, this amounts to applying larger weights to the earnings gains of less-educated workers and smaller weights to the earnings losses of more-educated workers. Thus they state that the standard Mincerian approach is likely to incorrectly yield positive externalities when there are none.

The alternative approach weights wages changes by earnings share, in comparison with the employment weights used in the standard Mincerian approach. The approach is based on the following identities:

$$Emp = 1 = S + U$$

where S = more educated workers

U = less educated workers and

Emp is total employment, which is held constant.

As labour is, by assumption, the only factor of production:

$$Y = w_U (1 - S) + w_S S \quad (1)$$

For a change in the relative proportions of worker categories, if more educated workers have a positive external effect:

$$\delta Y/\delta S = Ext + w_S - w_U \quad (2)$$

where $\delta Y/\delta S$ = the marginal product of S and

Ext = the externality.

From Equations 1 and 2, and differentiating with respect of an increase in the supply of more educated workers:

$$\delta Y/\delta S = (w_S - w_U) + (1 - S)(\delta w_U/\delta S) + S(\delta w_S/\delta S) \quad (3)$$

where $\delta w_i/\delta S$ reflects first order effects of labour supply changes on wages and

$$Ext = (1 - S)(\delta w_U/\delta S) + S(\delta w_S/\delta S) \quad (4)$$

From Equation 4, and expressing the externality as a proportion of output:

$$Ext/Y = (1 - \beta) ((\delta w_U/\delta S))/w_U) + \beta ((\delta w_S/\delta S)/w_S) \quad (5)$$

Where $\beta = Sw_S/Y$ = the ratio of educated workers' earnings to total earnings.

This identifies the externality as equal to the earnings-weighted average percentage change in wages. This can also be expressed as the change in the average wage holding the skill categories constant:

$$Ext/Y = \delta/\delta S (\ln((1 - S)\bar{w}_U + S\bar{w}_S))) \quad (6)$$

where upper bars denote values that are held constant. Ciccone and Peri (2006) refer to Equation 6 as the *constant-composition* approach to the identification of aggregate human-capital externalities.

The model used in this study follows Iranzo and Peri (2006) (which was in turn adopted from Ciccone and Peri (2006)), but includes a vocational education category and thus uses five educational groupings instead of two. The model uses educational attainment as a proxy for skills and recognises imperfect substitutability between

workers with schooling-level, vocational and higher education due to differences in skill mix between educational levels. The impact on total factor productivity of changes in the skills distribution is estimated.

The model relies on gradations in the mix of generic and specific skills within sectors rather than on segregation into a traditional and modern sector as in Iranzo and Peri (2006). That is, all sectors employ workers who have undertaken different kinds of education which has imbued those workers with a different generic-specific skill mix. An increase in high-level generic skills, mostly attained in university education, can be characterised as enabling greater generation of technological change while an increase in specific skills, mostly attained in vocational education, enables adoption of that technological change. Social and private returns to innovation differ as innovators are unable to capture all the benefits of their innovations.

The method is an extension of the dual accounting growth equation, wherein the growth rate of different qualities of labour types is multiplied by the associated income share and their sum is deducted from income growth to calculate total factor productivity growth as a residual. The basic model can be amended for increasing returns and spillovers, taxes and multiple factor types (Ciccone and Peri (2006)). Under certain restrictive assumptions, primarily that labour is the only factor of production, factor prices coincide with social marginal products, the production function exhibits constant returns to scale and markets are perfectly competitive, as well as the link posited above between skills mix and technological change, this approach to measuring total factor productivity is analogous to measuring externalities.

The following stochastic-form equation is estimated by ordinary least squares in the first stage, using White's correction for heteroskedasticity:

$$\ln w_{it} = \ln w(S,E)_t + \lambda_t X_{it} + \varepsilon_{it} \quad (7)$$

where $\ln w_{it}$ is the natural log of the hourly wage of individual i at time t

$\ln w(S,E)_t$ is the estimated wage of the group having schooling S and experience E

X_{it} are a set of dummy variables for feminine, unmarried and immigrant status and

ε_{it} are residuals having the usual desirable qualities.

Five schooling groups are used. These are Less than Year 12, Completed Year 12, Vocational, University graduate degree and University postgraduate. Ten experience groups are used, in five year ranges covering from zero to 49 years of experience.

The employment share of workers in each education-experience group for year *t* is designated $\varphi_t(S,E)$, where $S \in (S_1, \ldots S_5)$ and $E \in (E_1, \ldots E_{10})$. Then, expressing the percentage changes as logarithmic changes, the constant skill-composition percentage change in wages in each period is:

$$\ln w_t = \ln \Sigma (\varphi_t(S,E) * w(S,E)_{t+5}) - \ln \Sigma (\varphi_t(S,E) * w(S,E)_t)$$

This represents the change in total factor productivity over time. The measure can also be used to gauge the change in total factor productivity in response to changes in human capital, simulated by changing the size of two education groups in an offsetting manner such that total employment is unchanged but the labour force skill composition varies.

4. The data

Data from releases 1 and 6 of the HILDA Survey are used. The time period thus covers 2001 to 2006. Hourly labour income is measured as the ratio of current

weekly gross wages and salary from all jobs to combined number of hours usually worked per week in all jobs. Only employed persons are included.

Experience is determined as age less years of education less six. Years of education are obtained from highest educational level achieved, where attainment of a masters or doctoral degree equals 18 years, a graduate diploma or certificate equals 16 years, a bachelors degree equals 15 years, an advanced diploma or diploma equals 13 years, a Certificate III or IV or Year 12 equals 12 years, a Certificate I or II or Certificate not defined equals 10 years, Year 11 and below equals 11 years and undetermined educational attainment equals 10 years. Unmarried status is conferred on those not currently either married or in a defacto relationship. Immigrant status is conferred on all respondents not born in Australia.

Hourly wages for 2006 are deflated to 2001 terms using labour price indexes provided by *ABS Catalogue No. 6345.0 - Labour Price Index, Australia, December 2007*. Including dummy variables reflecting feminine, non-married and born overseas status as regressors controls for these qualitative characteristics. As the constant is suppressed, the regression coefficients for each experience-education group can be interpreted as the mean value of logged hourly wages earned by an Australian-born married male of each experience and education level.

5. Results

Tables 1 and 2 provide results of the analysis for 2001 and 2006. Table 2 also provides the result of the deduction of the weighted sum of coefficients for 2001 from the equivalent sum for 2006. As previously stated, this is analogous to total factor productivity gain during the intervening five years.

(insert Tables 1 – 2 here)

Under the assumptions of the model, the rise between 2001 and 2006 coefficients is indicative of total factor productivity gains of 0.168. This is much higher than Australian Bureau of Statistics (ABS) experimental measures of multi-factor productivity gains (based on quality-adjusted hours worked) over the equivalent period of 0.046. While differences exist between the bases of the two estimates (for example, the ABS measure relates to the market economy only whereas HILDA data cover the entire economy), it is acknowledged that the estimates are significantly different. This could be due to the allocation of education time expended to each qualification group, which was carried out arbitrarily in the absence of relevant data, and which was used with age to determine potential experience. Findings must therefore be qualified by awareness of this.

Figure 1 provides a diagrammatic depiction of the logged hourly wage coefficients for each year. Each experience group is bounded by vertical lines and educational attainment is shown sequentially in each.

(insert Figure 1 here)

The relative location of the coefficients, relating to different levels of education within experience groups, indicates that relative wages attaching to educational attainment have increased slightly over the intervening five years. Within experience groups, greater earnings of more educated and experienced workers can generally be seen, consistent with human capital theory. The exception is where Year 12 completers earn more than the vocationally educated, which occurs in three of the ten experience groups in 2001 and in four of the ten in 2006. Most of these occur in the greater experience groups i.e. mostly among older workers. This may be consistent with shorter effective earning lives attaching to the manual labour that is frequently associated with occupations requiring vocational education. This conflicts with the

standard Mincerian assumption that worker effectiveness and thus wages increase exponentially with education.

Figures 2 to 6 indicate how experience impacts earnings within education groups. With the exception of the curve depicting year 12 completion, the overall inverted-bowl shape of the curves is consistent with lifetime earnings curves. All educational groups experience increasing earnings in the first ten years. Experience leads to increased earnings during only the first ten years for workers with less than year 12 completion, after which earnings remain roughly constant in real terms. Year 12 completers experience increasing earnings as experience increases over most of the time frame, although the rate of increase is not constant. Vocationally educated workers achieve greatest earnings increases in the first 20 years of experience after which earnings remain constant or decrease slightly. Workers with undergraduate university education have earnings increasing with the first 15 years experience, after which earnings are roughly constant until 45 years of experience is attained when earnings begin to decrease sharply. The earnings of postgraduate university education completers rise during the first ten years of experience after which they remain roughly constant.

(insert Figures 2 - 6 here)

Employment weights are then manipulated in such a way as to simulate an alteration to the skills composition of the labour force, resulting from a change in educational attainment, while leaving its size constant. In each of five scenarios, ten per cent of the labour force is deducted from a chosen education group, proportionately distributed across the ten experience groups, and the amount distributed across another education group, again proportionately throughout the ten experience groups. The resulting amendment to the employment weights enables

identification of the educational attainment group to which attaches greatest externalities, by examining the change to total factor productivity growth resulting from each scenario. Numbers of workers involved are identical under each scenario. Table 3 provides results of this analysis, in ascending order of increase in total factor productivity growth.

(insert Table 3 here)

Scenario 1 shows that very small positive results are attained when ten per cent of workers are moved from less than 12 years to year 12 completion. Scenario 2 shows a larger but still small gain when ten per cent of the workforce move from year 12 completion to vocational education completion. A slightly larger positive result is attained by moving workers from less than 12 years to vocational education (Scenario 3). Thus, only small total factor productivity gains are made when moving workers from the lower end of the skills spectrum to another point at the lower end of the skills spectrum and the greatest gain is made when the increment to skills is greatest.

Much more significant gains are made when workers move to the higher end of the skills spectrum and again the greatest gains are made when the skills increment is greatest. Scenario 4 shows that a larger gain is made by moving workers from vocational to university education while Scenario 5 shows that an even larger increase results from moving workers from senior secondary schooling attainment into university education. Externalities, more than twice as great as those gained by increasing vocational education by the same number of individuals, are attained in this way. The results indicate that the ascending progression of externalities is schooling, vocational, university.

This should be considered in light of qualifications relating to shortcomings of the methodology used. Specifically, consistent with the externalities and returns to

education literature, only earnings of the employed are considered. Given the well-known negative impacts of unemployment on factors such as health and tendency to abide by the law, some of which would generate negative externalities in their own right, it is possible that externalities are understated by this widespread approach. The differential impact on categories of education is unknown and offers an avenue for further research.

6. Conclusions

Externalities are positively associated with shifts from lower to higher skills composition in the labour force. Greatest externalities attach to university education, followed by vocational education and schooling i.e. the ascending progression of externalities is schooling, vocational, university. Shortcomings of the methodology may contribute to the result, particularly with respect to vocational education.

The standard Mincerian assumption, that worker effectiveness and thus wages increase exponentially with education, is overturned for the surveyed group. The relative earnings positions of year 12 completers and the vocationally educated change frequently as experience increases. Experience impacts earnings for the shortest period for workers who have the least and most education (the less than year 12 completers and the postgraduates), followed by undergraduates, the vocationally educated and Year 12 completers. Only workers who complete senior secondary schooling experience earnings rising with experience, albeit unevenly, throughout their entire working life.

List of References

Acemoglu, D. (1996), "A Microfoundation for Social Increasing Returns in Human Capital Accumulation", *The Quarterly Journal of Economics,* MIT Press, Vol. 111, No. 3, pp 779-804

Acemoglu, D. (2002), "Technical Change, Inequality, and the Labor Market", *Journal of Economic Literature,* Vol. 40, pp 7-72

Autor, D.H., Katz, L.F. and Kearney, M.S. (2007), "Trends in U. S. Wage Inequality: Revising the Revisionists", *Journal of Population Economics, Vol. 21, No. 1, pp 1432-1475*

Barnett, A.H. and Yandle, B. (2007), "*The End of the Externality Revolution"*, accessed at http://www.mises.org/journals/scholar/barnett.pdf on 3 October 2007

Barro, R.J. (1999), "Notes on Growth Accounting", *Journal of Economic Growth*, Vol. 4, pp 119-137

Becker, G.S. (1962), "Investment in Human Capital: a Theoretical Analysis", *The Journal of Political Economy,* Vol. 70, No. 5, Part 2: Investment in Human Beings, October 1962, pp9-49

Bornemann, S. (2005), "Spillovers in Vocational Training: An Analysis of Incentive Schemes", *Department of Economics Discussion Paper 2005-15*, University of Munich

Callan, V.J. (2003), "Generic skills: Understanding vocational education and training teacher and student attitudes", *National Centre for Vocational Education Research*

Ciccone, A. and Peri, G. (2006), "Identifying Human-Capital Externalities: theory with Applications", *Review of Economic Studies,* Vol. 73, pp 381-412

Dockery, A.M. Norris, K. and Stromback, T. (2000), "The Social Return to Apprenticeship Training", *The Australian Economic Review,* Vol. 31, No. 1, pp 37-46

Dutta, J., Sefton, J, and Weale, M. (1999), Éducation and Public Policy", *Fiscal Studies,* Vol. 20, No. 4, pp 351-386

Goos, M. and Manning, A. (2003), "Lousy and Lovely Jobs: the Rising Polarization of Work in Britain", *Centre for Economic Performance Discussion Paper No. 604*

Holcombe, R.G. and Sobel, R. S. (2000), "Consumption Externalities and Economic Welfare", *Eastern Economic Journal, Volume 26, No. 2, pp 157-170*

Iranzo, S. and Peri, G. (2007), "Schooling Externalities, Technology and Productivity: Theory and Evidence from U. S. States", *NBER Working Paper No. W12440*

Kearns P. (2001), "Review of Research : Generic Skills for the New Economy", *National Centre for Vocational Education Research*

Lester, A. (2006), "Inequality and the Dual Economy: Technology Adoption with Specific and General Skills*", Centre for Applied Macroeconomic Analysis Working Paper 2006-01*, Australian National University

Lucas, R.E. Jr. (1988), "On the Mechanics of Economic Development", *Journal of Monetary Economics,* Vol. 22

Manning, A. (2004), "We can work it out: T he impact of technological change on the demand for low-skill workers", *Scottish Journal of Political Economy,* Vol. 51, No. 5, pp 581-608

Marshall, A. (1890), *Principles of Economics*, Macmillan

Moor, M.P. and Ranjan, P. (2005), "Globalisation vs Skill-Biased Technological Change: Implications for Unemployment and Wag Inequality", *The Economic Journal,* Vol. 115, pp 391-422

Moretti, E. (1998), "Social Returns to Education and Human Capital Externalities: Evidence from Cities", *NBER Working Paper W9641*

Moretti, E. (2004), "Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data", *Journal of Econometrics*, Vol. 121, pp 175-212

Organisation for Economic Co-operation and Development (OECD) (2007), *Education at a Glance*, OECD Education, Paris

Preston, A. (1997), "Where Are We Now With Human Capital Theory in Australia?", *Economic Record,* Vol. 73, No. 220, pp 51-78

Riddell, W.C. (2005), "The Impact of Education on Economic and Social Outcomes: An Overview of Recent Advances in Economics", *Paper written for the workshop on An Integrated Approach to Human Capital Development sponsored by Canadian Policy Research Networks, the School of Policy Studies at Queen's University and Statistics Canada*

Smith, C.S. and Ferrier, F. (2000), "CEET's Stocktake of the Economics of Vocational Education and Training", *Centre for the Economics of Education and Training Working Paper No. 28*

United Nations Educational, Scientific and Cultural Organisation (1997), *International Standard Classification of Education (ISCED) 1997,* Paris, November 1997

Vedder, R. (2004), "Private vs. Social Returns to Higher Education: Some New Cross-Sectional Evidence", *Journal of Labor Research,* Vol. 25, No. 4, pp677-686

Weale, M. (1990), "Externalities from Education", Hahn, F. (ed), *Proceedings of Section F (Economics) of the British Association for the Advancement of Science, Swansea,* Macmillan

Table 1 Regression results 2001

F	3781.54
Prob > F	0
R-squared	0.9304
Root MSE	0.75688

	Coef.	t	P>|t|		Employment numbers	Employment weights	Weighted coefficients
group1	1.928128	39.96		0	194	0.02	0.0468
group2	2.073333	59.23		0	405	0.05	0.1050
group3	2.162903	51.99		0	188	0.02	0.0508
group4	2.47216	49.06		0	175	0.02	0.0541
group5	2.657424	42.24		0	35	0.00	0.0116
group6	2.350027	45.09		0	122	0.02	0.0358
group7	2.444618	64.94		0	205	0.03	0.0627
group8	2.507511	70.17		0	262	0.03	0.0821
group9	2.780842	74.79		0	215	0.03	0.0748
group10	2.7763	43.48		0	84	0.01	0.0292
group11	2.528829	69.36		0	177	0.02	0.0560
group12	2.63647	58.62		0	148	0.02	0.0488
group13	2.660967	76.35		0	271	0.03	0.0902
group14	2.945823	60.18		0	151	0.02	0.0556
group15	3.082375	53.02		0	89	0.01	0.0343
group16	2.557561	80.05		0	276	0.03	0.0883
group17	2.69883	46.52		0	138	0.02	0.0466
group18	2.673232	84.1		0	365	0.05	0.1220
group19	2.919436	62.24		0	169	0.02	0.0617
group20	3.0901	71.57		0	142	0.02	dropped
group21	2.543709	85.54		0	325	0.04	0.1034
group22	2.580076	48.05		0	142	0.02	0.0458
group23	2.721172	86.4		0	433	0.05	0.1473
group24	2.96057	60.25		0	181	0.02	0.0670
group25	2.995806	55.22		0	120	0.02	0.0449
group26	2.499778	68.76		0	314	0.04	0.0981
group27	2.640459	42.56		0	121	0.02	0.0399
group28	2.668749	79.67		0	360	0.05	0.1201
group29	2.834913	43.75		0	134	0.02	0.0475
group30	3.024329	58.78		0	125	0.02	0.0473
group31	2.53209	61.08		0	295	0.04	0.0934
group32	2.615039	33.26		0	84	0.01	0.0275
group33	2.702583	65.27		0	258	0.03	0.0872
group34	2.980297	40.13		0	101	0.01	0.0376
group35	2.998751	42.42		0	71	0.01	0.0266
group36	2.570243	59.58		0	286	0.04	0.0919
group37	2.740906	34.7		0	64	0.01	0.0219
group38	2.686046	62.04		0	207	0.03	0.0695
group39	2.880658	24.8		0	40	0.01	0.0144
group40	2.915602	28.32		0	38	0.00	0.0139
group41	2.48659	46.13		0	173	0.02	0.0538
group42	2.631965	14.12		0	22	0.00	0.0072
group43	2.652182	35.81		0	117	0.01	0.0388
group44	2.849071	11.64		0	16	0.00	0.0057
group45	2.853131	13.33		0	20	0.00	0.0071
group46	2.563147	25.89		0	74	0.01	0.0237
group47	2.875552	17.95		0	9	0.00	0.0032

group48	2.677143	22.4	0	42	0.01	0.0141
group49	2.197599	4.87	0	8	0.00	0.0022
group50	3.182251	8.18	0	7	0.00	0.0028
gender	0.137625	7.34	0			
marital status	0.362254	14.79	0			
migrant status	0.136406	6.58	0			
			Total employment numbers	7998	Sum of weighted coefficients	2.5602

Table 2 Regression results 2006

F	4566.01
Prob > F	0
R-squared	0.947
Root MSE	0.66783

	Coef.	t	P>|t|	Employment numbers	Employment Weights	Weighted coefficients
group1	2.05332	55.35	0	284	0.04	0.073076
group2	2.207532	67.05	0	456	0.06	0.126145
group3	2.373508	69.89	0	213	0.03	0.063353
group4	2.582222	71.95	0	204	0.03	0.066012
group5	2.704867	38.73	0	45	0.01	0.015253
group6	2.500668	56.19	0	111	0.01	0.034784
group7	2.560634	82.86	0	198	0.02	0.063535
group8	2.610777	89.3	0	288	0.04	0.094224
group9	2.912772	80.91	0	209	0.03	0.076287
group10	2.996809	44.09	0	89	0.01	0.033423
group11	2.55486	43.96	0	94	0.01	0.030095
group12	2.664027	55.83	0	150	0.02	0.050076
group13	2.729498	85.89	0	285	0.04	0.097482
group14	3.053183	78.84	0	197	0.02	0.075373
group15	3.159221	60.52	0	124	0.02	0.049091
group16	2.562853	49.64	0	158	0.02	0.050743
group17	2.734812	59.23	0	142	0.02	0.048665
group18	2.8163	94.04	0	331	0.04	0.116816
group19	3.082175	65.09	0	163	0.02	0.062957
group20	3.169381	64.18	0	131	0.02	0.052029
group21	2.688103	82.15	0	237	0.03	0.079835
group22	2.808896	57.85	0	103	0.01	0.036255
group23	2.752525	90.24	0	351	0.04	0.12107
group24	2.985344	46.24	0	143	0.02	0.053497
group25	3.217431	80.87	0	147	0.02	0.059268
group26	2.642045	80.68	0	258	0.03	0.08542
group27	2.726938	52.35	0	107	0.01	0.036564
group28	2.823428	1.62	0	433	0.05	0.153201
group29	3.066441	58.78	0	157	0.02	0.06033
group30	3.13322	69.7	0	129	0.02	0.05065
group31	2.635578	72.65	0	222	0.03	0.073321
group32	2.716843	38.93	0	86	0.01	0.029279
group33	2.757188	84.03	0	335	0.04	0.115747
group34	2.999073	51.46	0	101	0.01	0.037958
group35	3.110271	59.47	0	97	0.01	0.037807
group36	2.613757	56.5	0	210	0.03	0.068783
group37	2.887829	31.24	0	59	0.01	0.021351
group38	2.790766	64.25	0	236	0.03	0.082534
group39	3.014564	33.31	0	76	0.01	0.02871
group40	3.10822	28.05	0	59	0.01	0.022981
group41	2.622225	43.88	0	172	0.02	0.056519
group42	2.870139	37.56	0	49	0.01	0.017624
group43	2.734976	49.85	0	155	0.02	0.053123
group44	3.05634	11.58	0	24	0.00	0.009192
group45	3.266018	25.66	0	27	0.00	0.01105
group46	2.623319	25.08	0	64	0.01	0.021039
group47	3.289012	5.76	0	9	0.00	0.003709

group48	2.709305	15.03	0	41	0.01	0.01392
group49	2.627873	2.54	0.011	9	0.00	0.002964
group50	3.157483	17.47	0	12	0.00	0.004748
gender	0.069077	4.04	0			
marital status	0.262819	11.68	0			
migrant status	0.073292	3.69	0			
		Total employment numbers		7980	Sum of weighted coefficients	2.727863
		Increase in total factor productivity				0.167663

Table 3 Comparison of total factor productivity growth under different skills compositions

	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
	10 % reduction of less than 12 years completion, 10% increase of 12 years completion	10 % reduction of 12 years completion, 10% increase of vocational completion	10 % reduction of less than 12 years completion, 10% increase of vocational completion	10 % reduction of Vocational, 10% increase of university undergraduate and postgraduate completion	10 % reduction of 12 years completion, 10% increase of university undergraduate and postgraduate completion
Increase in total factor productivity growth	0.001478	0.016608	0.019724	0.030591	0.048837
Ratio to 2006 actual	1.008815	1.099055	1.117640	1.182457	1.291282
Ratio to Scenario 1	1	11.23	13.35	20.7	33.04

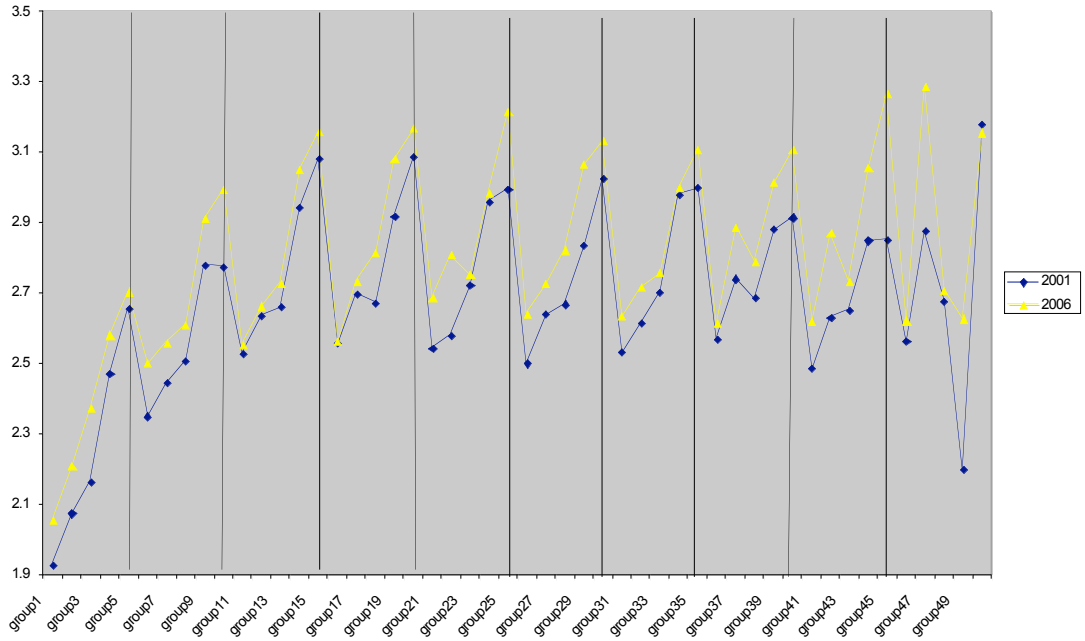

Figure 1 Education-experience logged wage coefficients
Note: Five-year experience groups are bounded by vertical lines. Order of educational attainment within experience groups is Less than year 12 completion, Year 12 Completion, Vocational education, Undergraduate University education and University Postgraduate education.

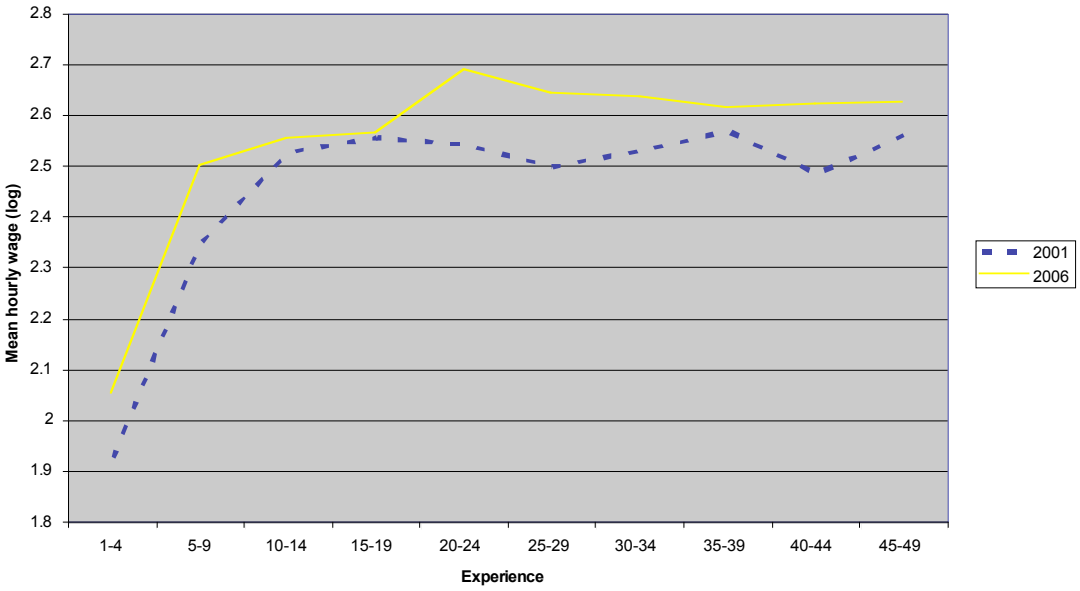

Figure 2 Average hourly wages by experience : Less than year 12 completion

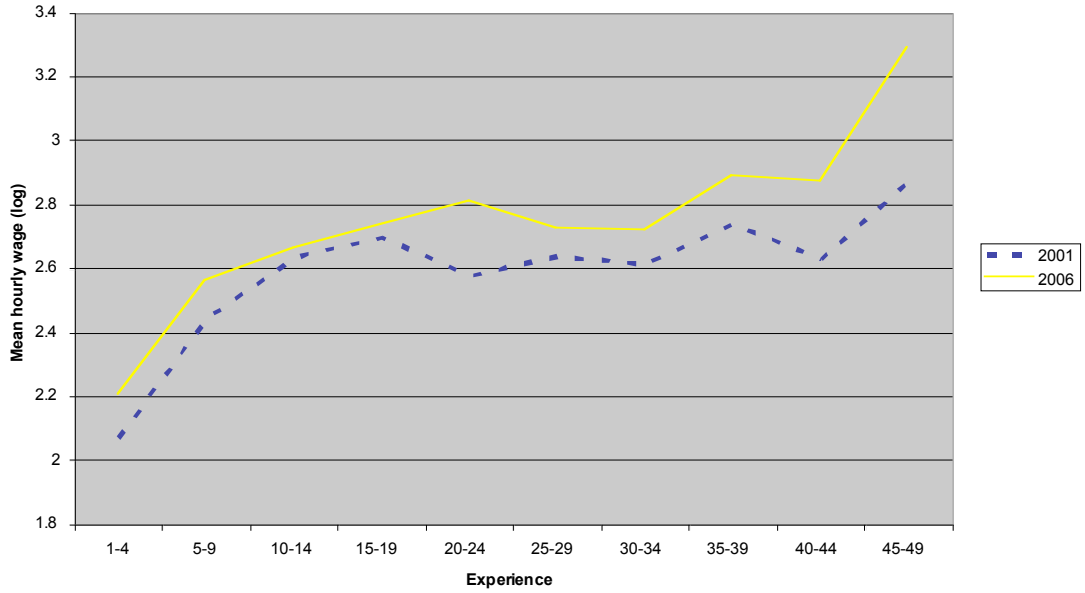

Figure 3 Average hourly wages by experience : Year 12 completion

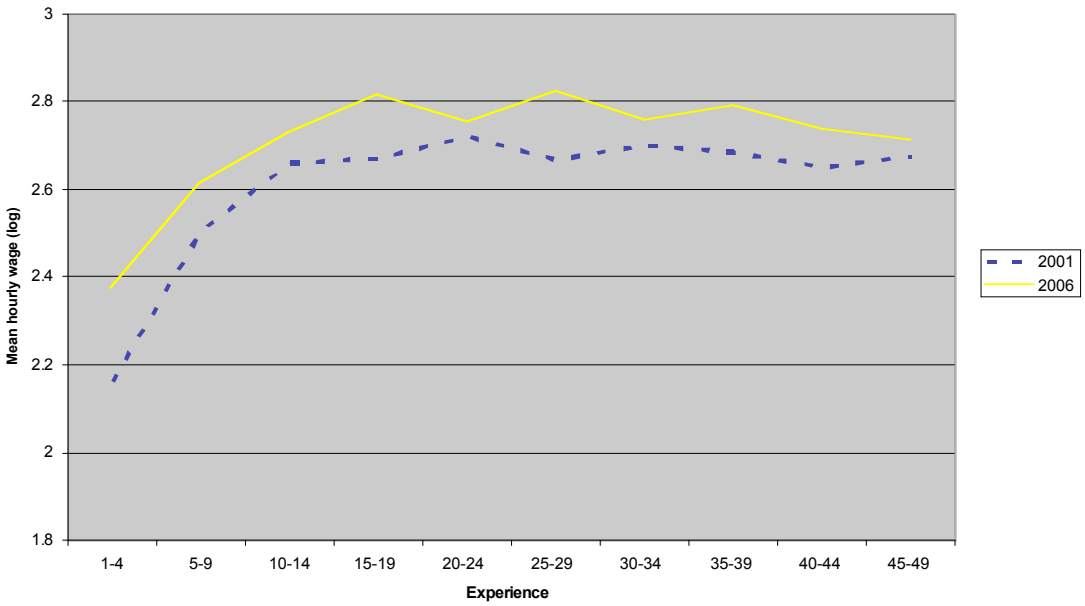

Figure 4 Average hourly wages by experience : Vocational education

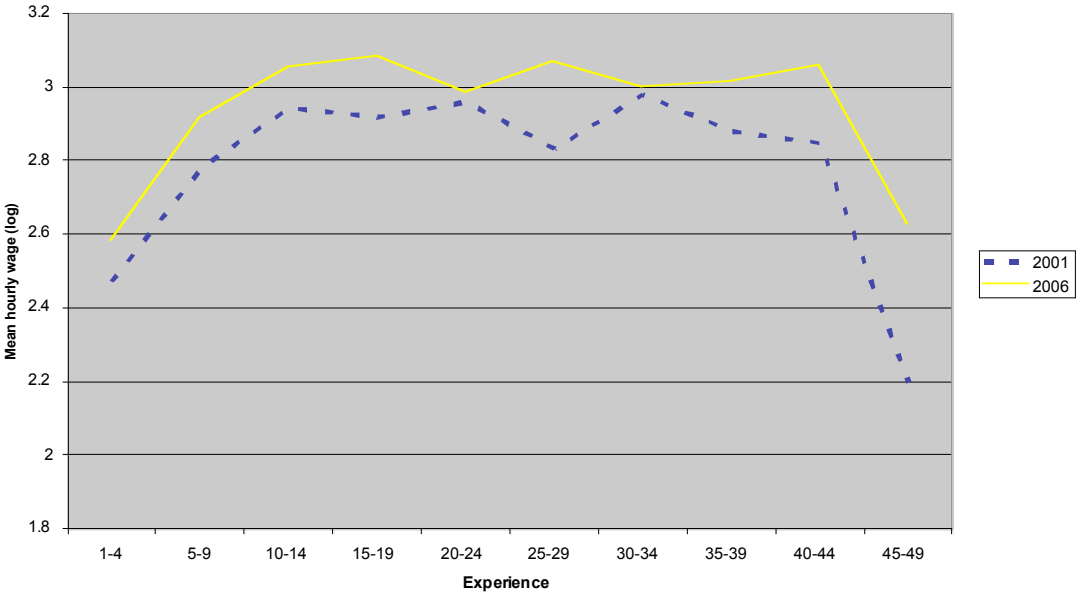

Figure 5 Average hourly wages by experience : Undergraduate university education

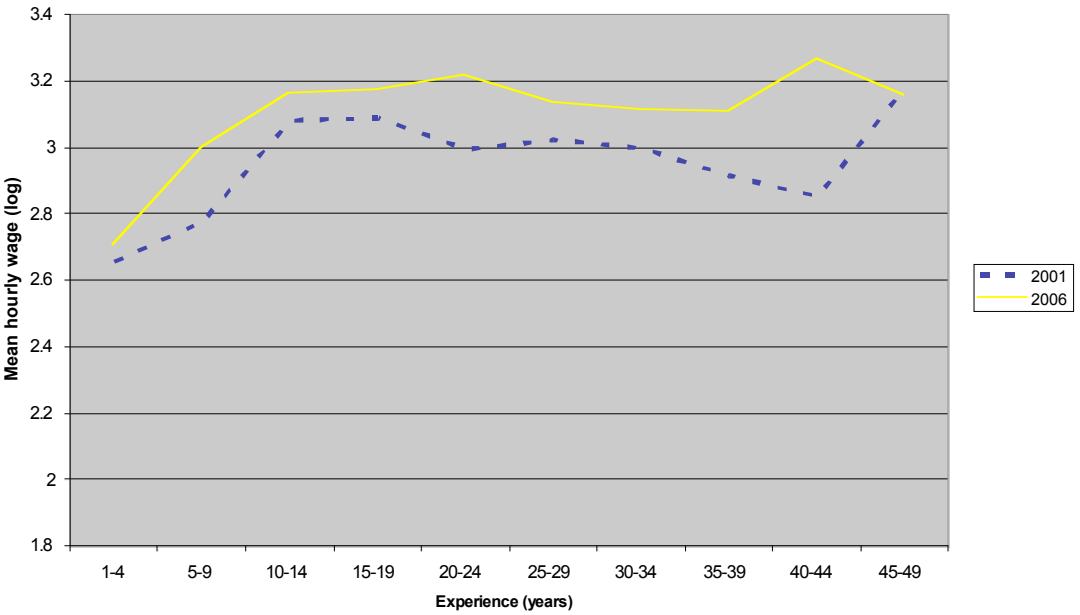

Figure 6 Average hourly wages by experience : University postgraduate education