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Earnings Overlife: Are We Building a New Glass Ceiling?

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Abstract: The recent economic crisis has highlighted and enhanced the long-term value of earnings over life. This paper is focused on the relationship between income and age in Spain. We have considered cohort data using the information contained in the European Union Statistics on Income and Living Conditions (EU-SILC). The variation of earnings with age follows a quadratic function, reaches a maximum at age 48 years old and declines thereafter. The evidence found has important effects on retirement decisions and also confirms the existence of a significant gender gap. Also, we can accept the existence of a new glass ceiling.

Keywords: Earnings Overlife, EUSILC, Income Inequality, Glass Ceiling

JEL Classification Number: D31, C23.

1. Introduction

For the last decades, lifetime-earnings have become one of the most important topics in economic inequality literature. In particular, this issue is especially relevant in those studies analyzing factors affecting income distribution. As a consequence, many methodological advances have been made using different econometric and statistical techniques and diverse sources of data. In fact, there exist two different but complementary approaches to the issue of the distribution of income over life. The first one is focused on the relationship between age and earnings whereas the second one analyses social security benefits and pension reforms.

In relation to the first approach, in a seminal paper, Creedy (1977) studied the pattern of lifetime earnings and criticized the use of 'average lifetime earnings' to compare earnings in different occupations, regions, or from different qualifications. His estimates based on alternative measures provided a more detailed description of prospects within an occupation. Also, Creedy and Hart (1979) described how the distribution of the earnings of adult males in Great Britain changes with their ages and discussed the alternative econometric models which might generate the relationships between age and earnings. They also studied the short-term relationship between consecutive changes in earnings and age. They concluded that the variation of median real earnings with age was quadratic in form, reaching its peak at the age of 54 years. Furthermore, Nelissen (1989) proposed a

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model to obtain the distribution of lifetime income of a cohort or the distribution of income in a particular year in the future. He estimated the mean and the variance of the distribution of earnings using a database which covered an unusually long period. On the other hand, Leigh and Hunter (1992) presented a simple method for calculating the distribution of lifetime income for women and men. They showed that mortality differences across gender and race cause the distribution of lifetime income to differ from the distribution of current income. Also, other authors as Imbens and Lynch (2006) have focused their attention on the determinants of re-employment probabilities obtaining considerable changes in the chances of young workers finding jobs over the business cycle despite the fact that personal characteristics of those starting jobless spells do not vary much over time.

The second approach, as mentioned previously, refers to social security distributional analysis. Haider and Solon (2006) made an analysis of Social Security records containing nearly career-long earnings histories for the Health and Retirement Study sample; they found that the relationship between current and lifetime earnings departs substantially from the textbook model in ways that vary systematically over the life cycle. Moreover, Kitao (2010) studied the effects of tax-deferred saving and alternative retirement saving policies on life-cycle saving and labor supply of households and on aggregate economy. He concluded that a particular policy can increase the effective after-tax return of savings and can have a significant impact on aggregate capital. Pereira and Andraz (2012) estimate the impact of the Portuguese social security system on economic performance over the period from 1970 to 2007, suggesting the existence of negative effects on both labor markets and financial markets, as social security spending leads to higher unit labor costs and higher unemployment rates. In contrast, Chau (2012) estimated the intergenerational elasticity using an income dynamic model with intergenerational linkages. His model can explicitly account for sources of biases such as heterogeneous age profile and transitory shocks of changing variance over the lifecycle. He used the Panel Study of Income Dynamics (PSID) data from the United States and the German of Socio-Economic Panel (GSOEP) data from Germany to estimate intergenerational elasticity of fathers and sons.

Thus, much of the debate on the relationship between age and earnings can be summarized by two important related topics: financial sustainability of the pension system and population ageing. Both topics are linked with earnings over life. In this sense, policy makers are very worried about living standards, demographic conditions and long term fiscal sustainability. Spain is suffering the deepest recession in decades and it has to respond and adapt to changing demographic conditions as well as its impact on public finances and population welfare. In fact, low-wage employment has become a

matter of concern in many countries (Cabral 2005) confirming there are significant differences by gender and suggesting that low pay lasts longer for females.

Setting aside the political and economic debate about the distribution of future social security benefits and retirement income, the study of the general movement of earnings of individuals with their age continues being a very important target for developed countries. New data on income distribution are now available for the European Union (EU) countries and allow us to test different hypothesis. In particular this paper is focused on the distribution of income over life. The data used in this study have been obtained from the European Union Statistics on Income and Living Conditions (EU-SILC). Thus, we can deep on the general movement of earnings of individuals with their age using different econometric models which could explain the evolution and relationship between age and earnings.

2. Data

The data used in this study have been obtained from the European Union Statistics on Income and Living Conditions (EU-SILC) over the period 2004 to 2011. This survey contains timely and comparable cross-sectional and longitudinal microdata on income, poverty, social exclusion and living conditions for EU countries. It provides data which verify the requirements to be considered high quality statistics: relevance, accuracy and reliability, timeliness and punctuality, coherence and comparability, accessibility and clarity. Globally, the actual minimum EU sample size is about 150.000 households and in the case of Spain, the actual size required for persons aged 16 and over is 22.880. This survey belongs to the set of statistical operations that are harmonized for EU countries. Besides, it contains rich information about income, education, employment, etc. The EU-SILC substitutes the European Community Household Panel (ECHP) which was a pioneering data collection instrument launched in 1994 and expired in 2001. EU-SILC is organized under a framework regulation and provides two types of annual data. Firstly, cross-sectional data pertaining to a given time or a certain time period with variables on income, poverty, social exclusion and other living conditions. And secondly, a longitudinal data pertaining to individual-level changes over time, observed periodically over a four year period. At the personal level, there are five points of interest: basic demographic data, income, education, labour information and health. It includes basic personal data and detailed labor information including personal income. Besides, the reference population includes all private households and their currents members who reside in the corresponding country at the time of data collection although only those aged 16 or more are interviewed.

In EU-SILC, income details are collected at both household and individual level. The income measure we have used in our empirical analysis is disposable (after tax)

individual income and the reference period of income is the year prior to interview. As a consequence, although the interviews corresponding to the first eight waves of the EU-SILC where performed from 2004 to 2011, the corresponding incomes refer, respectively, from 2003 to 2010.

3. Theoretical Framework and Empirical Evidence

As already mentioned, we begin our analysis by examining the age-earnings profile generated by the EU-SILC data. In particular, how the mean and variance of the logarithms of earnings (denoted by μ_t and σ_t^2 respectively) vary with age. In order to do that, we analyze the pattern of annual earned income in Spain. In fact, we have considered five constant samples of individuals born in 1944, 1954, 1964, 1974 and 1984, which are referred to as cohorts. Table 1 includes values of μ_t and σ_t^2 for these cohorts at 2006 constant prices. The results obtained (Graph 1) confirm the general pattern. That is, when population average earnings are treated as a function of workers' ages, we can confirm it has a characteristic hump-shaped pattern (see, Creedy 1977; Bosworth et al. 2000). In fact, average earnings rise with age although fall after age 48. This visual conclusion is even stronger if we consider age-earnings profile from 2003 to 2010 (see, Graph 2).

On the basis of lifetime earnings models (Creedy and Hart 1979), we can express the logarithm of annual earnings as follows:

$$\hat{\mu}_t = \hat{\mu}_0 + \hat{\theta}\, t - \hat{\delta}\, t^2 + \hat{\alpha}_1 d_1 + \hat{\alpha}_2 d_2 + \hat{\alpha}_3 d_3 + \hat{\alpha}_4 d_4$$

where μ_t is the mean the logarithms of earnings, *d1, d2, d3* and *d4* are dummy variables for cohort 1974, 1964, 1954, 1944 and 1934 respectively, *t* denotes time and it is measured from age 20 when *t*=0. Results from applying the above model are the following ones (standard errors in parenthesis).

$$\hat{\mu}_t = \underset{(0.0226)}{6.1042} + \underset{(0.0002)}{0.1518}\, t - \underset{(0.2845)}{0.0016}\, t^2 - \underset{(0.2284)}{0.0579} d_1 - \underset{(0.1787)}{0.0517} d_2 - \underset{(0.1138)}{0.2696} d_3 - 0.1252 d_4$$

Also, from these results, μ_t reaches its maximum at 48 years old. Furthermore, if we compare these results with the ones obtained by Pascual (2006) over the period 1993 to 2000 and based on the microdata contained in the European Community Household Panel (ECHP), we can conclude that the relationship between earnings and age continues being very strong and quadratic in form although its maximum has shifted from 52 years to 48 years. Similar results are obtained when we use the standard panel data techniques (Greene, 2003). In this way, we get great flexibility in modeling differences across individuals. Thus, the basic framework is a regression model of the form:

$$log\ y_{it} = \alpha_i + \beta_1 A_{it} + \beta_2 A_{it}^2 + \varepsilon_{it}$$

where *i* refers to the individual, *t* is the year (*t*=2003,...,2010), y denotes individuals earnings and A denotes the age of each individual. Also, we have used Hausman's specification test for the random effects model. Finally, a Wald test is included to evaluate the joint significances of the variables. The results of the estimation using STATA 11.0 are given in Table 2. Variables are significant and signs of variables are those to be expected. Also, the Hausman (1978) test value shows that the fixed-effects approach should be used.

Again, the evidence obtained suggests that the variation of earnings with age is quadratic in form. Moreover, low-pay employment has become an important point of concern In developed countries. Therefore, policy makers and many researchers are worried about if employment (and unemployment) rates are permanent or transitory (Cabral, 2005). In fact, in Spain, we can suppose the existence of a "glass ceiling" as a consequence of the process of restructuring labor market. Although, this concept frequently refers to barriers faced by women, demographic groups and racial or ethnic minorities, we can apply it to earnings for men and women as a consequence of the economic crisis which Spain is suffering. The term "glass ceiling" has often been used to describe invisible but real barriers which prevent someone from achieving further success. The origin of this term can be situated in the 80s. In a pioneer article (Frenkel, 1984), it was used to explain the reasoning behind a decision to change jobs from one to another based on gender and earnings differences which cannot be explained by job-relevant characteristics of the employee. Subsequently, in 1986, an article titled "The Glass Ceiling: Why Women Can't Seem to Break The Invisible Barrier That Blocks Them From the Top Jobs", by Hymowitz and Schellhardt (1986), looked at the persistent failure of women to climb as far up the corporate ladder as might be expected from their representation in the working population as a whole. This concept could be applied to average earnings in Spain.

Also, it is important to take into account that Spain spends more than 10 percent of its Gross Domestic Product (GDP) on public pensions slightly more than the Organization for Economic Cooperation and Development (OECD) average (OECD 2013). The Spanish public pension system, which is part of the Social Security System, consists of a single, earnings-related benefit in the contribution level, with a means-tested minimum pension, and there exists also a non-contribution means-tested level covering special social assistance situations. Therefore, pensions in Spain are linked to the working life of individuals and depend on the number of years contributed by each pensioner to the personal regulatory base. However and according to the "European Commission Ageing Report (2012)" due to the expected dynamics of fertility, life expectancy and migration rates, the age structure of the European Union (EU) population is projected to dramatically change in coming decades. The overall size of the population is projected to be slightly larger in 50 years' time, but much older than it is now. The EU population is

Table 1: Measures of logarithms of annual earnings in Spain by sex at 2006 constant prices

Cohort	Year	Age	Total		Men		Women	
			Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Cohort 1984	2003	20	8.2017	1.0081	8.3197	1.0842	8.0209	0.8558
	2004	21	8.6362	0.8891	8.8557	0.7940	8.3742	0.9290
	2005	22	8.597	0.9123	8.7882	0.8511	8.3727	0.9346
	2006	23	8.7128	0.8888	8.8675	0.8309	8.5201	0.9240
	2007	24	8.8798	0.9001	9.0465	0.8295	8.6658	0.9441
	2008	25	8.9356	0.8672	9.0193	0.8259	8.8303	0.9089
	2009	26	8.9014	0.9183	8.9462	0.8760	8.8536	0.9622
	2010	27	8.9634	0.9246	9.0081	0.8229	8.9106	1.0335
Cohort 1974	2003	30	9.1917	0.7412	9.3915	0.6062	8.9800	0.8108
	2004	31	9.3237	0.6414	9.4720	0.5071	9.1472	0.7347
	2005	32	9.3291	0.657	9.4930	0.5128	9.1261	0.7543
	2006	33	9.3625	0.6308	9.5044	0.5279	9.2037	0.6971
	2007	34	9.4148	0.6046	9.5289	0.5602	9.2913	0.6279
	2008	35	9.4103	0.7404	9.5784	0.5926	9.2386	0.8329
	2009	36	9.3859	0.7586	9.5036	0.6987	9.2728	0.7978
	2010	37	9.3681	0.7396	9.4864	0.7382	9.2555	0.7252
Cohort 1964	2003	40	9.4208	0.7686	9.6766	0.5362	9.1029	0.8876
	2004	41	9.4314	0.7616	9.6117	0.6106	9.1655	0.8778
	2005	42	9.4319	0.7858	9.6493	0.5659	9.1359	0.9349
	2006	43	9.3708	0.894	9.6049	0.7121	9.1150	0.9987
	2007	44	9.388	0.7988	9.6189	0.6116	9.1347	0.8989
	2008	45	9.4319	0.7623	9.6774	0.5878	9.1738	0.8372
	2009	46	9.4613	0.8163	9.6710	0.7293	9.2245	0.8461
	2010	47	9.4787	0.674	9.6571	0.5961	9.3012	0.7012
Cohort 1954	2003	50	9.4619	0.8261	9.7305	0.6414	9.0853	0.9079
	2004	51	9.5675	0.7123	9.7864	0.5667	9.2674	0.7814
	2005	52	9.5964	0.6102	9.6843	0.5481	9.4696	0.6730
	2006	53	9.5534	0.7466	9.6943	0.6473	9.3282	0.8376
	2007	54	9.6283	0.6843	9.7930	0.5522	9.4039	0.7791
	2008	55	9.5667	0.8072	9.7549	0.6592	9.2954	0.9195
	2009	56	9.5891	0.7311	9.6835	0.7164	9.4430	0.7331
	2010	57	9.441	0.9869	9.5965	0.8238	9.1952	1.1642
Cohort 1944	2003	60	9.5527	0.7895	9.7723	0.6123	9.1478	0.9164
	2004	61	9.4641	0.8215	9.6681	0.6074	9.0166	1.0374
	2005	62	9.44	0.8084	9.6485	0.6404	9.0358	0.9474
	2006	63	9.4234	0.8228	9.5234	0.7661	9.2102	0.9093
	2007	64	9.1882	1.0586	9.3498	0.9710	8.9433	1.1522
	2008	65	9.3128	1.0608	9.5398	0.7695	8.8195	1.4116
	2009	66	8.9266	1.2298	9.0868	1.1653	8.6862	1.3174
	2010	67	9.3944	1.2923	9.5680	1.6339	9.2207	1.0064

Source: Authors' elaboration from EU-SILC.

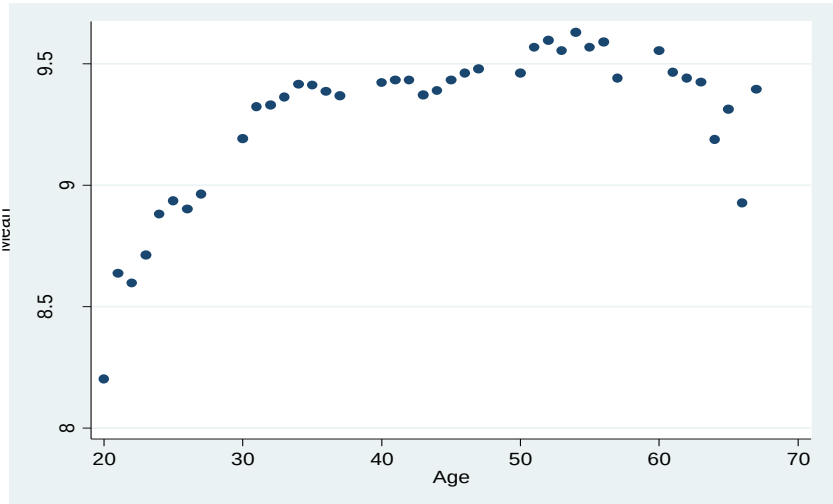
projected to increase (from 502 million in 2010) up to 2040 by almost 5%, when it will peak (at 526 million). Thereafter, a steady decline occurs and the population shrinks by nearly 2% by 2060. Nonetheless, according to the projections, the population in 2060 will be slightly higher than in 2010, at 517 million. So, earnings over life have become a key aspect to explain income inequalities and even living standards.

Table 2: Results of panel data approach by sex (Dependent variable: Logarithm of earnings)

	TOTAL		Men		Women	
Name	**Random Effects**	**Fixed Effects**	**Random Effects**	**Fixed Effects**	**Random Effects**	**Fixed Effects**
AGE	0.1244	0.1056	0.1310	0.1076	0.1305	0.1164
P-value	0.0000	0.000	0.0000	0.0000	0.0000	0.0000
AGE²	-0.0013	-0.0011	-0.0013	-0.0011	-0.0014	-0.0012
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Wald statistic and prob (Wald)	12642.95 (0.0000)		9391.44 (0.0000)		3511.66 (0.0000)	
Hausman statistic and prob (Hausman)	147.54 (0.0000)		65.16 (0.0000)		6.75 (0.0342)	
F-statistic and prob		1268.83 (0.0000)		472.34 (0.0000)		233.56 (0.0000)

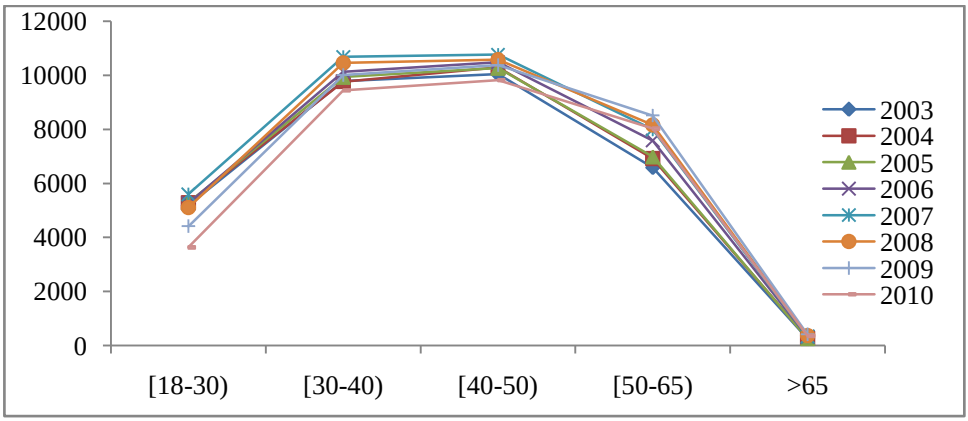
Source: Authors' elaboration from EU-SILC.

Graph 1: Variation in μ_t with age in Spain: Mean of logarithms of earnings at 2006 constant prices



Source: Authors elaboration from EU-SILC.

Graph 2: Mean of earnings by age at 2006 constant prices from 2003 to 2010



Source: Authors' elaboration from EU-SILC.

4. Conclusions and Policy Implications

In this paper, we have analyzed the relationship between earnings and age. The results are very important not only from a political point of view but also because of their effects on Spanish pension system. In fact, the sustainability of the pension system has become one of the main concerns of institutions across Europe, as well as for the Spanish government, since the financial crisis began. Nowadays, Spain has two main problems: unemployment rates and population ageing. Pension systems, as defined by European Commission, allow people to enjoy a well-deserved retirement after their working life. In Spain, the normal retirement age has been extended to 67 years. Also, in general, the amount of money workers get is calculated on the last 15 years. However, because of the Spanish economic problems, calculation period has been increased from 15 to 25 years at a uniform pace between 2013 and 2022. On the other hand, individuals obtain maximum ages around 48 years old (48.45 years old for men and 47.44 for women) when a few years ago it was 52. This is an important result because there will be an increase from 15 to 25 years of social security contributions taken to determine the regulatory base of pension which obviously has important economic consequences. Furthermore, there exist important differences by gender. Also, and using longitudinal data from the EU-SILC, it seems to exist a glass ceiling effect in earnings not only for women but also for the whole Spanish professionals.

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