Population Ageing and the Labour Market: Evidence from Italy

Irene Mosca

Abstract. Individual data from eight waves of the European Community Household Panel are used to investigate the impact of cohort size on age-earnings and employment profiles of Italian male workers. Evidence that over the life cycle cohort size depresses employment opportunities of men with low education and earnings and employment rates of men with intermediate and high qualifications born into large cohorts is found. These results are used to carry out a simple simulation where the average future wages of Italian male workers are projected for the next 4.5 decades. According to this simulation, the wages of Italian male workers will follow a hump-shaped pattern in the next three decades, before slightly increasing again.

1. Introduction

The current demographic situation in a number of industrialized countries, including Italy, is one of an ageing population. Population ageing is, in its simplest interpretation, the increase in the average or median age of a population. It is the process by which there is a redistribution of relative population shares away from the younger to the older age groups. Population ageing is caused by two main factors: a decrease in the rate at which births take place and an increase in the age at which people die. In the last half a century, the total fertility rate (TFR) in Europe dropped from 2.66 to 1.41 whereas life expectancy increased from 65.6 to 73.8 years (United Nations, 2006).

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Italy is one of the most rapidly ageing societies. The TFR peaked at 2.7 in 1964 and has been below the replacement level from 1977 onwards. The TFR was 1.34 in 2007, 56 per cent below the replacement level and around half of the peak it reached in 1964. In 1951, life expectancy at birth was 63.7 years for men and 67.2 for women, compared with 78.6 and 84.1, respectively, in 2007 (Istat, 2008a, 2008b).

Italy is also the 'oldest country in the world', for having the highest proportion of people aged 60 and over and the lowest share of people aged less than 15 (Golini, 2003, p. 16). Population ageing in Italy will induce a decrease in the size of the working age population and a decrease in the potential labour supply. According to the latest population projections of the Italian National Statistical Institute (Istat, 2008c), the labour force (including individuals aged 15–64) will decline from 38.0 million (66.0 per cent of total population) in 2007 to 33.4 million (54.1 per cent of total population) in 2050, a decrease of 11.9 percentage points. A decrease in the potential supply of labour will also be accompanied by a relative decrease in the potential supply of 'younger workers' and a relative increase in the potential supply of 'older workers'. If older (more experienced) and younger (less experienced) workers are not perfect substitutes in production and perform different tasks, this will pose specific problems, particularly in terms of age-earnings and age-employment profiles. This paper aims to investigate if changes in the supply of younger and older workers in the Italian labour market will affect their earnings and employment profiles. Although the phenomena of population and labour force ageing are particularly strong in Italy, no research has been carried out to investigate this particular issue in this country. In this paper, I find that measured over the complete life cycle, cohort size depresses the employment rates of Italian men with low education and the earnings and employment rates of men with intermediate and high qualifications born into large cohorts.

The literature on the effects of cohort size on age-earnings and employment profiles outside Italy is relatively vast, especially in the USA (Ahlburg, 1982; Alsalam, 1985; Berger, 1985, 1989; Falaris and Peters, 1985; Freeman, 1976; Levenson, 1980; Tan and Ward, 1985; Welch, 1979), but also outside the USA [see Dooley (1986) for Canada, Wright (1991) for the UK, Martin and Ogawa (1988) for Japan, Ben-Porath (1985) for Israel, Klevmarken (1993) and Dahlberg and Nahum (2003) for Sweden]. The evidence on the relationship between cohort size and age-employment profiles is somehow scarcer (Ahlburg, 1982; Ben-Porath, 1985; Bloom *et al.*, 1987; Fertig and Schmidt, 2003; Korenman and Neumark, 1997; Levenson, 1980; OECD, 1980; Russell, 1982; Schimer, 2001; Wachter, 1976).

Most of the studies of the cohort crowding literature investigate the labour market opportunities of the 1950s *baby boomers* (individuals belonging to unusually large cohorts) at the beginning of their career. The cohort crowding theory predicts that *large* cohorts suffer from lower earnings when entering the labour market. However, there is some uncertainty on the persistence of negative earnings effects for large cohorts later on in the career: some studies find evidence of more rapid earnings growth for large cohorts (e.g. Welch, 1979; Wright, 1991) whereas others find evidence of a slower earnings growth for large cohorts (e.g. Berger, 1985; Freeman, 1976). Bloom *et al*. (1987) investigate in detail whether the adverse economic effects of generational crowding should be taken as temporary or permanent. Earnings of larger cohorts would grow at a more slowly pace if larger cohorts experienced slower promotions and earnings growth during their career due to a fiercer competition for a relatively fixed number of higher level jobs in company hierarchies. Conversely, earnings of larger cohorts would grow at a faster pace if large cohorts made schooling and labour market decisions that would help to reverse the negative effects of their size. For example, members of large cohorts could decide to invest more in on-the-job training during their career due to depressed wages and hence lower opportunity costs of on-the-job training at labour market entry.

The evidence on the effects of cohort size on age-employment profiles is mixed: Ben-Porath (1985), Bloom *et al*. (1987), and OECD (1980) find evidence of a positive (negative) relationship between cohort size and unemployment (employment) profiles for Canada, Germany, Italy, Japan, the UK, and the USA. However, OECD (1980) finds no evidence for Australia, Finland, France, and Sweden. Finally, Fertig and Schmidt (2003) estimate a u-shaped relationship between the individual employment probability and the size of one's own cohort.

One can use a similar approach to investigate the impact of labour force ageing on individuals' age-earnings and employment profiles. The only difference is that, in the context of an ageing labour force, individuals entering the labour market belong to unusually small (rather than unusually large) cohorts. The basic theory underlying the cohort crowding literature is rather intuitive and is based on two main assumptions: (i) workers of different ages (i.e. workers belonging to different cohorts) are different factors of production, as compared with the more homogeneous factor capital; and (ii) workers of different ages are imperfect substitutes in production, especially in high-skilled occupations. In a labour market undergoing labour force ageing, the production factor *younger workers* becomes scarcer whereas the supply of the production factor *older workers* increases. As long as workers of different ages are imperfect substitutes in production, an increase in the supply of one factor of production will, by a simple supply–demand adjustment, have negative economic repercussions. Standard theories predict that in response to an increase in the supply of an input, its price and utilization rate will decline. This could mean either lower wages or higher unemployment rates (lower employment rates) for the factor of production, which is now more abundant, i.e. older workers. The exact extent to which wages and (un)employment opportunities change depends on the degree of substitutability between younger and older workers in the production process and the institutional framework of the labour market.

If the labour market were to work without significant frictions and the wage rates were free to move both upwards and downwards, the labour market would simply adjust through the wage mechanism: the relative wages of the scarcer factor of production (younger workers in the context of an ageing population) would rise. However, if the labour market were imperfectly competitive and to some extent rigid (as often is the case in industrialized countries due to labour unions, minimum wage laws, and other legislation aimed at making it complicated and costly to hire and fire workers), the wage structure would be prevented from adjusting completely to variations in relative factor scarcities. The consequences would arise in terms of employment and unemployment and we would expect a *negative* relationship between the individual probability of being employed and the size of her cohort. In this sense, the impact of changes in the age structure can be thought as a trade-off between wages and employment effects.

The remainder of the paper is structured as follows. Sections 2 and 3 describe the data and the empirical model used to investigate the effects of cohort size on age-earnings and employment profiles in the Italian labour market and summarize the results. Sections 4 and 5 present a simple simulation in which the results of the empirical model, the outcome of Italian population projections for the period 2005–50, and individual data from 'Income and living conditions' are used to project the average wage of Italian male workers for the next 4.5 decades. Section 6 concludes.

2. Data and empirical analysis

The Italian data used for the purpose of this paper are eight waves (1994–2001) of the European Community Household Panel (ECHP), a longitudinal survey of households and individuals living in private households within the European Union. In its first wave, the ECHP covered around 130,000 individuals living in Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and the UK. The ECHP is coordinated by Eurostat, which sets a common questionnaire for all countries. The questionnaire includes a household register, a household questionnaire submitted to the household head or spouse/partner of the head, and a personal questionnaire submitted to all eligible household members. The two major areas covered in the questionnaire concern the economic activity and personal income of the individuals concerned. However, a wider range of topics are investigated, including individuals' demographics, health, education, and training. In each country, the interviews are carried out by the National Data Collection Unit. National samples are selected through probability sampling.

A modified version of the model estimated by Berger (1985) and Welch (1979) is adopted, based also on Dooley (1986), Klevmarken (1993), and Wright (1991). Age-aggregated earnings and employment equations are estimated to investigate the effect of cohort size on the earnings and employment opportunities of Italian men. The following two simple models are estimated:

$$\ln(wage)_{it}^{s} = \alpha_0 + \alpha_1 age_i + \alpha_2 (age^2)_i + \alpha_3 \ln(cs)_{it} + \alpha_4 \ln(cs)_{it} \cdot age_i + \alpha_5 \bar{u}_t + \alpha_6 t + \varepsilon_{it} \quad [1]$$

$$\ln\left(\frac{e}{1-e}\right)_{it}^{s} = \alpha_0 + \alpha_1 age_i + \alpha_2 (age^2)_i + \alpha_3 \ln(cs)_{it} + \alpha_4 \ln(cs)_{it} \cdot age_i + \alpha_5 \bar{u}_t + \alpha_6 t + \varepsilon_{it}, \quad [2]$$

where:

$(wage)_{it}^{s}$ = age-aggregated mean of real gross hourly earnings (000s of Liras) of age group i with education level s ($s = 1$ = medium–high education; $s = 2$ = low education) in year t;

$(e)_{it}^{s}$ = age-aggregated employment rate of age group i with education level s in year t;

age_i = age of group i where $i = 0$ = age 20, 1 = age 21, 2 = age 22, . . . , 34 = age 54;[1]
cs_{it} = cohort size measure of age group i in year t;
$\overline{u}_t$ = aggregated unemployment rate in year t (per cent);
t = time trend where 0 = 1994, 1 = 1995, . . . , 7 = 2001.

Following Dooley (1986, p. 151) and Wright (1991, p. 300), age is substituted for experience. None of the papers of the cohort crowding literature review uses a measure of actual work experience. Welch (1979) uses a measure of potential experience where experience is imputed using data on age, year of birth, and years of schooling (see Welch, 1979, pp. 68–69). Age has the advantage of being directly measurable. Also, the age variable might capture differences in human capital at the time of graduation from school. Students do not graduate and join the labour force at the same age even if they have the same education level. Given that earnings tend to increase with age, but at a diminishing rate, both age and age squared are included as regressors.

The position in the demographic cycle is captured through the cohort size measure [i.e. ln(cs)]. Equation [3] shows that, following Welch (1979) and Wright (1991), cohort size is expressed as a moving average with inverted V weights of the age group i's share in the total labour force, given here by men aged 15–64:

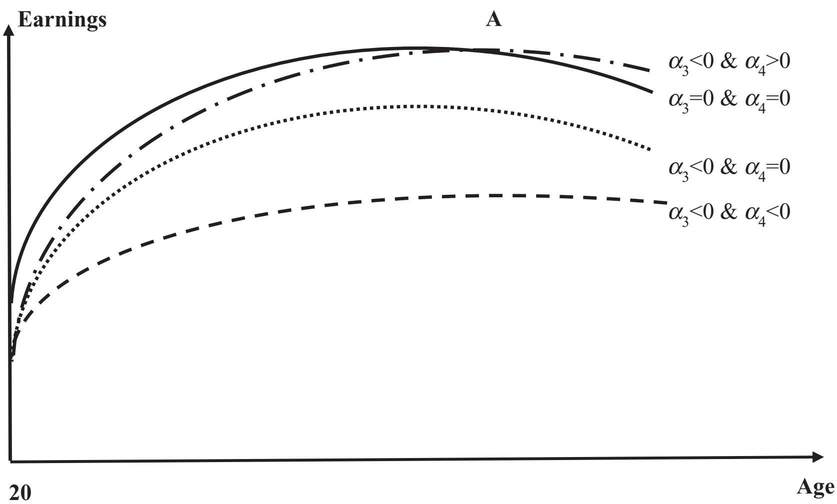
$$\ln(cs_{it}) = \ln\left[\frac{\sum_{k=-2}^{2}(w_k)(N_{i-k,t})}{\sum_{i=15}^{64} N_{it}}\right], \quad [3]$$

where N_{it} denotes the number of Italian men aged i in year t and w_k denotes the set of V weights, equal to 1/9, 2/9, 3/9, 2/9, and 1/9. In Berger (1985) and Welch (1979), the cohort size measure is education specific and therefore captures the share of men aged i with a specific education level in the labour force with the same education level. However, Wright (1991) claims this could lead to endogeneity problems if the education level attained by individuals depended on the size of their cohort. Following Wright (1991), the cohort size measure is demographically determined (not education specific).[2]

In equations [1] and [2] cohort size is also interacted with age. This interaction effect is introduced to investigate if the effect of cohort size on wages and employment profiles gets weaker or stronger as the individual gets older. If cohort size does not have any impact on earnings and employment profiles at labour market entry, α_3 will be equal to 0. Similarly, if cohort size does not have any impact on earnings (employment) growth during the individual's career, α_4 will be equal to 0. The cohort crowding literature predicts that α_3 is negative, meaning that earnings (employment) opportunities of members belonging to large cohorts are depressed at labour market entry. The evidence of the cohort crowding literature on the sign of α_4 is mixed: a negative α_4 means that the earnings (employment profiles) of large cohorts grow more slowly if compared with smaller cohorts; a positive α_4 indicates a faster earnings (employment) growth for larger cohorts. This can be seen graphically in Figure 1, where wages of 'normal cohorts' are given by the solid curve (i.e. $\alpha_3 = 0$ and $\alpha_4 = 0$). A negative α_3 implies lower wages at labour market entry (i.e. at age 20) for large cohorts. If α_4 is positive, the wages of large cohorts grow faster and overtake the wages of smaller cohorts in point A; if α_4 is negative, the wages of large cohorts grow more slowly than the wages of smaller cohorts (flatter curve).

Finally, demand influences are captured through the aggregate unemployment rate, a proxy variable used for business cycles that vary between but not within surveys. Also a time trend is included

Figure 1. Possible cohort size effect on earnings of large cohorts



to control for those factors that might impact on workers' wages and employment profiles.

Welch (1979) also includes the fraction of observations lost due to failure to report earnings for those who worked (i.e. exclusion rate due to income imputation).[3] In the ECHP dataset, imputation indexes are available only at household level and do not give enough information to distinguish between reported and imputed income at personal level (for more details, see European Commission, 2002). Accordingly, individuals belonging to households for which income is imputed are included in the sample. Welch (1979) finally includes the fraction of observations who did not work and therefore have no reported earnings (i.e. exclusion rate due to non-work) and a spline function. I follow Dooley (1986, p. 152) and Wright (1991, p. 300) and do not include these variables in the model.[4]

The effect of cohort size on earnings and employment is likely to differ by education level. The gap between experienced and inexperienced workers is likely to be more marked in occupations that require higher skills. Following Berger (1985), Dooley (1986), Welch (1979), and Wright (1991), the empirical analysis concentrates on earnings and employment within school-completion level. Individuals are split in two broad education categories: 'medium or high education' and 'low education'. The former is given by individuals who have completed secondary or tertiary education,[5] the latter by individuals with basic education.[6] Individuals with medium and high qualifications are merged due to a lack of data for the highly educated workers (i.e. insufficient number of observations).

The analysis is restricted to men given the intermittent career path of women. In the earnings model, men who are in self-employment or in unpaid family work are excluded. Also, data on gross real wages (1994 is taken as base year) are used. In the ECHP net wages are converted into gross wages through specific microsimulation models (for more details, see European Commission, 2004). The employment and earnings data extracted from the ECHP are weighted using the normalized base weight for interviewed sample persons (see European Commission, 2003a, 2003b).

Only individuals aged 20–54 are included in the model: individuals aged more than 54 are excluded due to potential selection bias resulting from the non-randomness of retirement decisions (see Berger 1985; Wright 1991). Following the cohort crowding literature (Berger, 1985, p. 314; Dooley, 1986, p. 152; Welch, 1979, p. 82;

Wright, 1991, p. 300), individuals' earnings and employment rates are aggregated into means on the base of age, year of observation, and educational level. For each education level there are 35 age groups (i.e. 0 = age 20, 1 = age 21, . . . , 34 = age 54) and eight years of data (i.e. from 1994 to 2001). Both the earnings and employment models are then estimated on 280 observations (i.e. 35 age groups times eight time periods). To correct for heteroskedasticity, which often accompanies grouped data, White-corrected standard errors are estimated. The earnings and employment models are thus estimated using ordinary least squares (OLS) with robust standard errors.

3. Results

Descriptive statistics of the dependent and independent variables are presented in Table A1 in the Appendix. Tables 1–4 report the estimates of equations [1] and [2] for the two education levels

Table 1. Parameter estimates of earnings equations, low-educated Italian men aged 20–54; time period 1994–2001

	Specification					
	1	**2**	**3**	**4**	**5**	**6**
Age	0.024	0.023	0.017	0.007	0.002	0.001
	[14.7]	[14.4]	[0.8]	[0.3]	[0.1]	[0.1]
Age^2	–0.0004	–0.0004	–0.0004	–0.0004	–0.0004	–0.0004
	[8.7]	[7.2]	[6.6]	[6.8]	[6.8]	[6.8]
$\ln(cs)$		0.034	0.053	0.079	0.087	0.090
		[0.5]	[0.5]	[0.8]	[0.9]	[0.9]
$\ln(cs) * age$			–0.002	–0.005	–0.006	–0.006
			[0.3]	[0.8]	[0.9]	[1.0]
$\bar{u}$				–0.007		–0.004
				[1.6]		[0.7]
t					0.003	0.002
					[1.7]	[0.9]
α_0	2.203	2.334	2.404	2.584	2.526	2.583
	[173.3]	[9.2]	[6.4]	[6.7]	[6.7]	[6.8]
R^2	0.766	0.767	0.767	0.769	0.769	0.769
N	280	280	280	280	280	280

Notes: Absolute value of *t*-statistics given in square brackets. The dependent variable is the natural logarithm of gross hourly real earnings. The estimation method is OLS with robust standard errors.

Table 2. Parameter estimates of employment equations, low-educated Italian men aged 20–54; time period 1994–2001

	Specification					
	1	**2**	**3**	**4**	**5**	**6**
Age	0.299	0.310	0.701	0.438	0.565	0.527
	[28.3]	[27.4]	[6.2]	[4.0]	[5.1]	[4.9]
Age^2	–0.008	–0.008	–0.007	–0.008	–0.008	–0.008
	[26.0]	[23.0]	[18.5]	[20.0]	[18.3]	[19.0]
$\ln(cs)$		–0.822	–1.922	–1.252	–1.602	–1.447
		[2.2]	[4.1]	[2.7]	[3.5]	[3.2]
$\ln(cs) * age$			0.105	0.034	0.068	0.058
			[3.5]	[1.2]	[2.3]	[2.0]
$\bar{u}$				–0.180		–0.235
				[4.9]		[5.4]
t					0.027	–0.033
					[2.0]	[2.3]
α_0	–0.570	–3.718	–7.902	–3.317	–6.782	–3.311
	[7.8]	[2.6]	[4.5]	[1.8]	[3.9]	[1.8]
R^2	0.756	0.759	0.767	0.791	0.770	0.794
N	280	280	280	280	280	280

Notes: Absolute value of *t*-statistics given in square brackets. The dependent variable is the natural logarithm of the employment rate divided by one minus the employment rate. The estimation method is OLS with robust standard errors.

identified (i.e. low education and medium–high education). Each table reports six specifications: specification 1 includes only age and age squared as regressors; specification 2 also includes $\ln(cs)$; specification 3 also includes the interaction between age and $\ln(cs)$; specification 4 also includes the aggregate unemployment rate; specification 5 drops the aggregated unemployment rate and includes the time trend instead; and specification 6 includes all the independent variables listed in equations [1] and [2]. The R^2 for each specification is added at the bottom of the table.

Turning first to the cohort size variables in the earnings equations for low-educated workers (Table 1), both the main effect [$\ln(cs)$] and the interaction between cohort size and age are *not* significant at conventional levels. However, the cohort size measure and its interaction with age seem to have an impact on the age-aggregated employment rate: Table 2 shows that the coefficient of $\ln(cs)$ is negative and significant in specifications 2–6 and the interaction of $\ln(cs)$ with age is significant and positive in specifications 3, 5, and 6. These results seem to show that in the Italian labour market, any

Table 3. Parameter estimates of earnings equations, medium–high-educated Italian men aged 20–54; time period 1994–2001

	Specification					
	1	**2**	**3**	**4**	**5**	**6**
Age	0.042	0.043	0.13	0.107	0.114	0.111
	[22.1]	[20.4]	[6.2]	[4.6]	[4.9]	[4.7]
Age^2	–0.0005	–0.0006	–0.0004	–0.0005	–0.0005	–0.0005
	[8.9]	[8.1]	[5.8]	[6.4]	[6.1]	[6.1]
ln(*cs*)		–0.113	–0.358	–0.300	–0.319	–0.307
		[1.8]	[4.4]	[3.4]	[3.7]	[3.4]
ln(*cs*) * *age*			0.023	0.017	0.019	0.018
			[4.2]	[2.8]	[3.1]	[2.9]
$\bar{u}$				–0.016		–0.018
				[2.6]		[2.2]
t					0.003	–0.001
					[1.4]	[0.4]
α_0	2.201	1.767	0.837	1.236	0.973	1.236
	[177.5]	[7.2]	[2.7]	[3.3]	[3.0]	[3.3]
R^2	0.909	0.909	0.914	0.917	0.915	0.917
N	280	280	280	280	280	280

Notes: Absolute value of *t*-statistics given in square brackets. The dependent variable is the natural logarithm of gross hourly real earnings. The estimation method is OLS with robust standard errors.

adjustment due to cohort size change of low-educated men is through the employment rate, rather than through the relative wage.

Turning then to the cohort size variables in the earnings equations for workers with medium and high qualifications, the main effect [ln(*cs*)] is negative and significant in specifications 2–6 and the interaction between cohort size and age is positive and significant at conventional levels in specifications 3–6 (Table 3). Similar conclusions apply to the employment equations (Table 4), in which both the main cohort size effect and its interaction with age are significant and negative and positive, respectively, in all the specifications. These results seem to show that in the Italian labour market, any adjustment due to cohort size change of medium and highly educated men is both through their relative wages and through their employment rates.

To capture the magnitude of the effects of cohort size on age-earnings and employment profiles, the *elasticities* of earnings and employment rates with respect to cohort size are computed and

Table 4. Parameter estimates of employment equations, medium–high-educated Italian men aged 20–54; time period 1994–2001

	Specification					
	1	**2**	**3**	**4**	**5**	**6**
Age	0.459	0.507	1.313	1.534	1.567	1.586
	[28.7]	[30.4]	[6.9]	[8.3]	[8.3]	[8.4]
Age^2	–0.010	–0.012	–0.011	–0.010	–0.010	–0.010
	[21.2]	[21.4]	[15.6]	[15.8]	[15.1]	[15.2]
ln(cs)		–3.45	–5.722	–6.285	–6.231	–6.399
		[6.7]	[7.7]	[8.4]	[8.4]	[8.6]
ln(cs) $*$ age			0.217	0.277	0.286	0.291
			[4.2]	[5.5]	[5.5]	[5.6]
$\bar{u}$				0.151		0.119
				[3.2]		[2.1]
t					–0.050	–0.020
					[3.5]	[1.1]
α_0	–1.900	–15.121	–23.758	–27.614	–25.854	–27.610
	[18.4]	[7.6]	[8.5]	[9.1]	[9.2]	[9.1]
R^2	0.842	0.862	0.872	0.878	0.876	0.878
N	280	280	280	280	280	280

Notes: Absolute value of t-statistics given in square brackets. The dependent variable is the natural logarithm of the employment rate divided by one minus the employment rate. The estimation method is OLS with robust standard errors.

summarized in Table 5 (specification 3 is used). Only employment results are presented for low-educated men given the insignificant results of the earnings equation. The results are presented at ages 20, 25, 30, 35, 40, 45, 50, and 54. Also the takeover point (e.g. point where the effect of cohort size turns from negative to positive) is calculated.

Turning first to the wages results for medium and highly educated men, the elasticity of cohort size with respect to wages at labour market entry (i.e. age 20 = 0) is equal to –0.36 (α_3).[7] This is in line with other studies of the cohort crowding literature — e.g. Wright (1991) computes an elasticity of –0.35 for high-skilled workers. The elasticity of cohort size with respect to earnings is the per cent change in wages following a 1 per cent increase in cohort size. This means that at labour market entry, wages decrease by 0.36 per cent following a 1 per cent increase in cohort size. The elasticity turns from negative to positive at age 36.

The elasticity of employment with respect to cohort size is calculated, using the Chain Rule, as the product of the derivative of ln(e)

Table 5. Earnings and employment elasticity calculations for medium–high- and low-educated workers

		Age								
		20	**25**	**30**	**35**	**40**	**45**	**50**	**54**	**Takeover point**
Medium–high-educated workers										
$\varepsilon(wage, cs)$		–0.36	–0.24	–0.12	–0.01	0.11	0.23	0.34	0.44	36
$\varepsilon(e, cs)$	Average cohort	–4.96	–2.01	–0.47	–0.12	–0.04	–0.01	0.04	0.19	46
$\varepsilon(e, cs)$	Large cohort	–5.39	–2.86	–0.76	–0.18	–0.05	–0.01	0.04	0.15	46
Low-educated workers										
$\varepsilon(e, cs)$	Average cohort	–1.22	–0.45	–0.14	–0.03	0.01	0.07	0.19	0.46	38
$\varepsilon(e, cs)$	Large cohort	–1.35	–0.52	–0.15	–0.03	0.01	0.06	0.16	0.38	38

Note: Fitted values of α_1, α_2, α_3, α_4, and e are used to compute the elasticity of employment with respect to cohort size.

with respect to e and the derivative of e with respect to $\ln(cs)$.[8] It is computed at different values of age and cohort size (i.e. for average and large cohorts). The elasticity of employment with respect to cohort size at labour market entry is –4.96 for average cohorts and –5.39 for large cohorts. This elasticity is the per cent change in employment rate following a 1 per cent increase in cohort size. At labour market entry, the employment rate decreases by 4.96 per cent for average cohorts and 5.39 per cent for large cohorts following a 1 per cent increase in cohort size. The impact of cohort size on employment at entry is hence negative and greater in magnitude for large cohorts. The elasticity turns from negative to positive at age 46.

Turning finally to the employment results for low-educated men, the elasticity of cohort size with respect to employment at labour market entry is −1.22 for average cohorts and −1.35 for large cohorts. Once again, the impact of cohort size on employment at entry is negative and greater in magnitude for larger cohorts. However, the effect of cohort size on employment turns positive at age 38.

4. Simulations in the baseline scenario

At the end of 2005, Istat carried out the second wave of an extensive survey — including around 50,000 individuals — called 'Income and living conditions' ('Reddito e condizioni di vita'). The survey is aimed to replace the ECHP and includes similar questions. It investigates, among other issues, respondents' labour market status and average gross monthly wages. The results of this survey are used to compute single-year-of-age employment rates and gross monthly wages of men aged 20–54 with low and medium–high education level in 2005.

The outcome of the survey 'Reddito e condizioni di vita', the results of the Italian baseline population projections for the period 2005–50, and the employment and earnings elasticities computed in the empirical analysis above are used to carry out a simple simulation in which average future wages of Italian men aged between 20 and 54 are projected for the next 4.5 decades. In the baseline projections, 'official' (Istat, 2005) fertility and mortality assumptions are used. The main fertility assumption is that the TFR increases slightly to 1.6 births per woman by the end of 2049. With respect to mortality, the main assumption is that male/female life expectancy at birth gradually increases to 83.6/88.8 years by the end of 2049. With respect to net migration, I begin with the assumption of zero net migration (natural change only). This projection provides a useful 'baseline' as it provides information on how the size and age structure of the population will be changed by fertility and mortality alone. However, this does not mean that I expect zero net migration in the future. The projection technique used is the 'cohort component' method, which is the same as used in the official population projections. The span of the projection is 4.5 decades. The base year of the projection is 2005 (end of calendar year), whereas the end year is 2049. That is, the first year of the population projection is 2006. The projections are run with the software Popgroup, developed at the Cathie Marsh Centre for Census and Survey Research, based in the University of Manchester [see Simpson (2005) for more details].

I start by computing four different simulations.

Scenario I — compositional (population) simulation: for each education level s and each year of the projection period t I compute (i) the average employment rate of men aged 20–54, given as the ratio of number of men in employment $\left[\sum_{i=20}^{54}\left(N_{i,s}^{t}\cdot e_{i,s}^{2005}\right)\right]$ to the number of men in the population $\left[\sum_{i=20}^{54} N_{i,s}^{t}\right]$. The number of men in the population is taken from the baseline population projections. For simplicity, I assume that the shares of low- and medium–high-educated men in the population remain constant at their 2005 level throughout the projection period, so that

$$N_{i,s}^{t} = N_{i}^{t}\cdot\left(\frac{N_{i,s}^{2005}}{N_{i}^{2005}}\right).$$

The number of men in employment is given as the summation, for all ages between 20 and 54, of the product of the number of men in the population and the 2005 employment rate. For each education level s and each year of the projection period t I then compute (ii) the average wage of men aged 20–54, given as the ratio of the total wage bill $\left[\sum_{i=20}^{54}\left(N_{i,s}^{t}\cdot e_{i,s}^{2005}\cdot w_{i,s}^{2005}\right)\right]$ to the number of men in employment as computed in (i). The total wage bill is given by the summation, for all ages between 20 and 54, of the product of the number of men in the population, the 2005 employment rate, and the 2005 wage rate. The average wage (not education specific) for each year of the projection period is finally computed as the weighted average of the wage of medium–high- and low-educated workers ($s = 1$ and $s = 2$):

$$av\_wage^t = \frac{\left[\frac{\sum_{i=20}^{54}\left(N_{i,1}^t \cdot e_{i,1}^{2005} \cdot w_{i,1}^{2005}\right)}{\sum_{i=20}^{54}\left(N_{i,1}^t \cdot e_{i,1}^{2005}\right)}\right] \cdot \left[\sum_{i=20}^{54}\left(N_{i,1}^t \cdot e_{i,1}^{2005}\right)\right] + \left[\frac{\sum_{i=20}^{54}\left(N_{i,2}^t \cdot e_{i,2}^{2005} \cdot w_{i,2}^{2005}\right)}{\sum_{i=20}^{54}\left(N_{i,2}^t \cdot e_{i,2}^{2005}\right)}\right] \cdot \left[\sum_{i=20}^{54}\left(N_{i,2}^t \cdot e_{i,2}^{2005}\right)\right]}{\sum_{i=20}^{54}\left(N_{i,1}^t \cdot e_{i,1}^{2005}\right) + \sum_{i=20}^{54}\left(N_{i,2}^t \cdot e_{i,2}^{2005}\right)}. \quad [4]$$

Scenario II — wage cohort size simulation: the second set of future average men's wages is computed taking into account future changes in population structure and wages. Future changes in wages are computed using the elasticity of earnings with respect to cohort size. I follow the same steps as in scenario I, but replace $w_{i,s}^{2005}$ with $w_{i,s}^t$, where $w_{i,s}^t$ is given by the age-specific wage in year $t - 1$ $\lfloor w_{i,s}^{t-1} \rfloor$ augmented by the wage change in year t, given as the product of the elasticity of earnings with respect to cohort size and the change in cohort size in year t (times 100):

$$w_{i,s}^t = w_{i,s}^{t-1} + \left(w_{i,s}^{t-1} \cdot \Delta w_{i,s}^t\right) = w_{i,s}^{t-1} + \left[w_{i,s}^{t-1} \cdot \left(\frac{\Delta cs_i^t \cdot \varepsilon(wage, cs)_s}{0.01}\right)\right] \quad [5]$$

$\varepsilon(wage, cs)_s$ is set to 0 for $s = 2$ because the empirical analysis of Sections 2 and 3 concluded that cohort size does not impact on wages of low-educated workers.

Scenario III — employment cohort size simulation: the third set of future average men's wages is computed taking into account future changes in population structure and employment rates. Future changes in employment are computed using the elasticity of employment with respect to cohort size. I follow the same steps as in scenario I, but replace $e_{i,s}^{2005}$ with $e_{i,s}^t$, where $e_{i,s}^t$ is given by the age-specific employment rate in year $t - 1$ $\lfloor e_{i,s}^{t-1} \rfloor$ augmented by the employment rate change in year t, given as the product of the elasticity of employment with respect to cohort size and the change in cohort size in year t (times 100).

Scenario IV — wage and employment cohort size simulation: the fourth set of future average men's wages is computed taking into account future changes in population structure, wages, and employment rates. Future changes in wages and employment are computed using the results of the elasticities of earnings and employment with respect to cohort size.

4.1 Baseline scenario results

I start by investigating what would happen to the average wages of Italian male workers in scenario I, as shown in Figure 2. A horizontal line reflecting what would happen if the average wage remained constant (2005 level) is also added. According to this simulation, the average wage of Italian men will increase in the first part of the projection period (i.e. 2006–18), decrease in the central part (i.e. 2019–33), and increase again in the final part, although to a lesser extent. Figure 3 shows that these results are in line with the outcome of the baseline population projections: in the first part of the projection period, the number of older workers is projected to

Figure 2. Average gross monthly wage of Italian men aged 20–54 in scenario I, baseline population projections; 2005–49

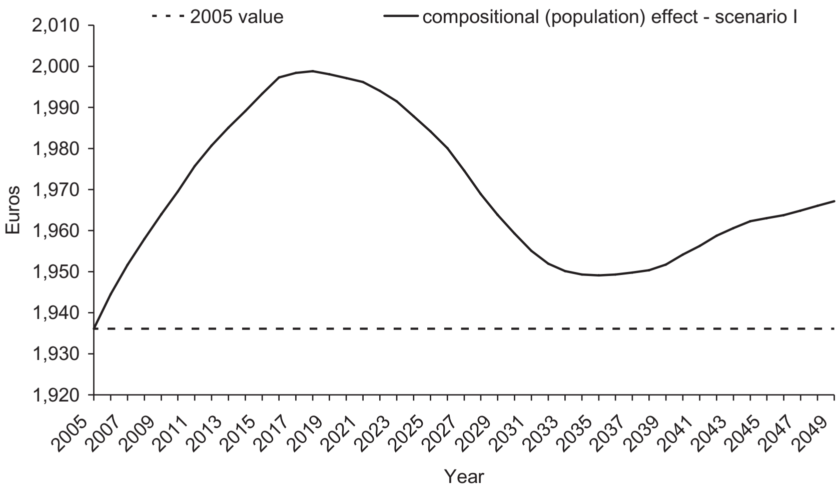
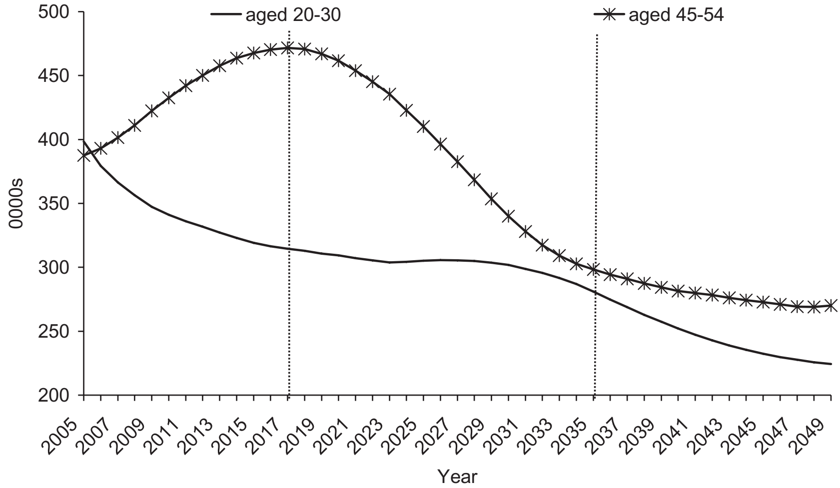


Figure 3. Projected number of younger (aged 20–30) and older (aged 45–54) male workers, baseline population projections; 2005–49



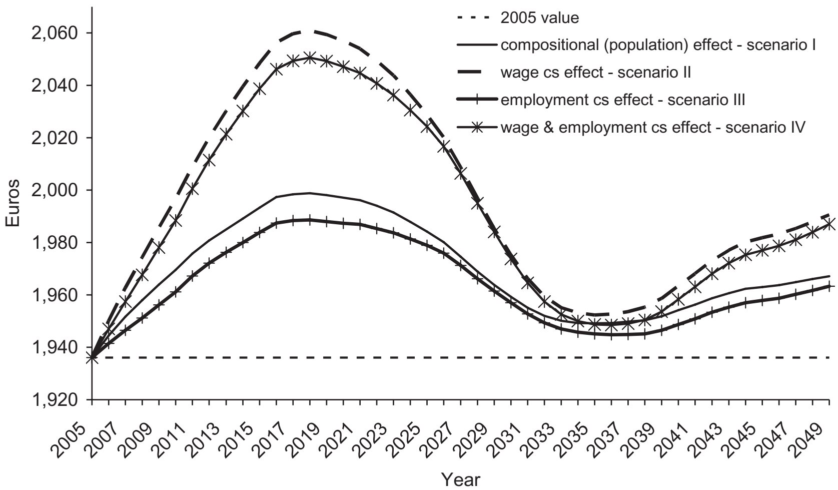
increase whereas the number of younger workers is projected to decrease. In the central part, both numbers of younger and older workers are projected to decrease. However, the number of older workers is projected to decrease to a greater extent. In the final part, both numbers of younger and older workers are projected to decrease. However, the number of younger workers is projected to decrease to a greater extent.

Figure 4 shows the results of the four different scenarios. The four average wage patterns are similar, but differ in magnitude. Wages seem to be the highest when the cohort size effect on wages is taken into account (scenario II), the lowest when the cohort size effect on employment is taken into account (scenario III).

5. Simulations when varying migration and fertility assumptions

In the baseline population projections, net migration was set to 0. Given that future levels of net migration is a big unknown, I now carry out a series of population projections incorporating a wide range of net migration assumptions. Specifically, I vary migration assumptions systematically upwards, assuming that 100,000; 200,000; 300,000; 400,000; and 500,000 net migrants will migrate to

Figure 4. Average gross monthly wage of Italian men aged 20–54 in scenarios I, II, III, and IV, baseline population projections; 2005–49

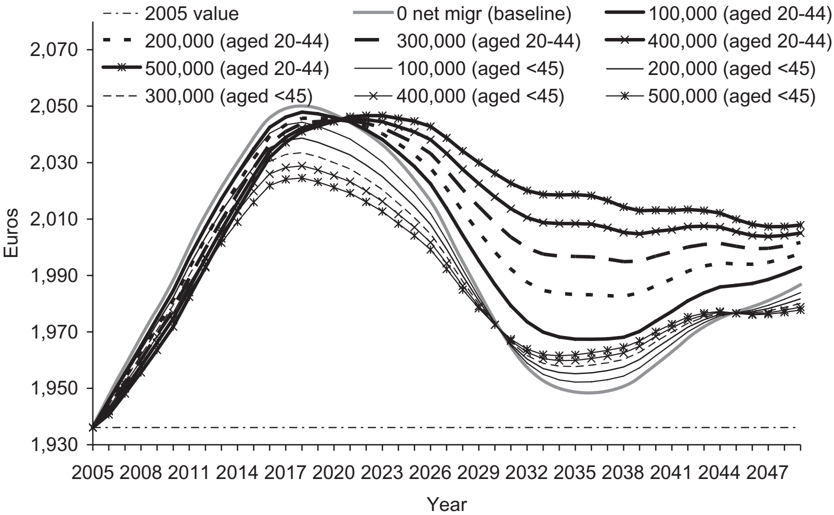


Italy in each year of the projection period. More precisely, I assume that: (i) all net migrants are aged less than 45 years and 20 per cent are aged less than 15; and (ii) all net migrants are aged between 20 and 44 years. In both cases, the sex ratio is assumed to be balanced at 50:50. These assumptions reflect the reality that most migrants are relatively young with the majority being of working age. These assumed age structures can be thought of as the outcome of having a successful immigration policy and system that targets and attracts 'young workers with children' (i) or 'young migrants without children' (ii). The assumptions relating to fertility and mortality are identical to those used in the baseline population projections.

Figure 5 summarizes the results of the wage and employment cohort size simulation (scenario IV) when migration assumptions are varied. The decrease in the average wage is significantly less marked in the second half of the projection period if a significant number of net migrants (i.e. 300,000; 400,000, or 500,000) aged 20–44 are to immigrate to Italy.

In the baseline population projection, it is assumed that TFR reaches 1.6 children per woman by the end of 2049. Given that below-replacement fertility is the principal cause of population ageing in Italy, I also explore alternative fertility scenarios,

Figure 5. Projected average monthly gross wage of Italian men aged 20–54 when varying migration assumptions — scenario IV; 2005–49



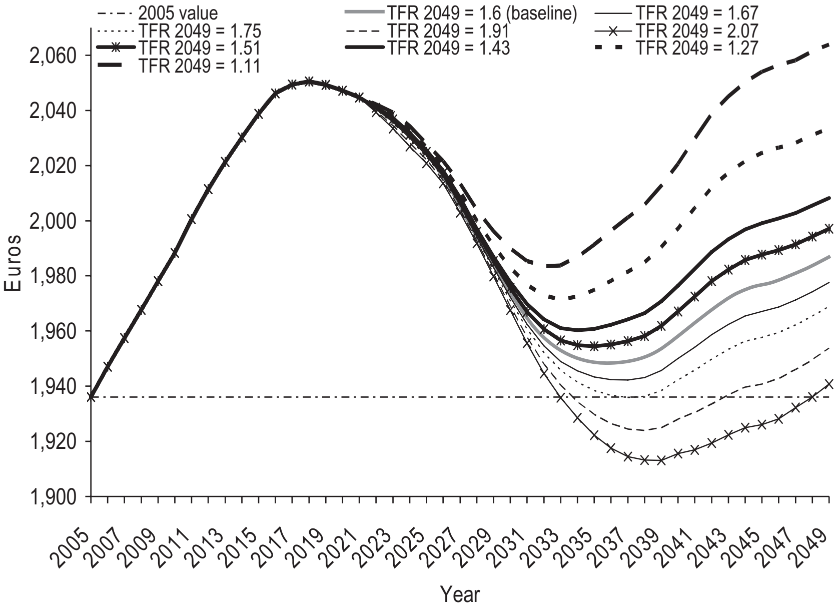
assuming that the TFR increases at a more rapid or less rapid rate than in the baseline scenario. In the new simulations, the TFR reaches 1.11, 1.27, 1.43, 1.51, 1.67, 1.75, 1.91, or 2.07 by the end of 2049, as compared with 1.60 in the baseline scenario. The assumptions relating to mortality and migration are identical to those used in the baseline population projections.

Figure 6 summarizes the results of the wage and employment cohort size simulation (scenario IV) when fertility assumptions are varied. As expected, the average wage of Italian male workers would increase to a significantly higher extent in the last part of the projection period if fertility was lower than in the baseline scenario.

6. Conclusions

The Italian labour force will decrease in size and age in the next 4.5 decades. In other terms, the relative supply of younger workers will decrease whereas the relative supply of older workers will increase in the Italian labour market. If older (more experienced) and younger (less experienced) workers are not perfect substitutes

Figure 6. Projected average monthly gross wage of Italian men aged 20–54 when varying fertility assumptions — scenario IV; 2005–49



in production and perform different tasks, this will pose particular problems, specifically in terms of age-earnings and age-employment profiles. There already exists a vast literature on the effects of cohort size on age-earnings and employment profiles. The existing cohort-crowding literature finds some evidence of an adverse effect of cohort size on large cohorts' employment and wages, across a number of countries. However, there is no evidence on Italy.

An empirical model aimed to investigate the effect of cohort size on age-earnings and employment profiles of Italian male workers was developed in Section 2. Evidence that over the life cycle cohort size depresses employment opportunities of individuals with low education and earnings and employment rates of men with intermediate and high qualifications born into large cohorts was found.

Individual data from the second wave of 'Income and living conditions', the outcome of the Italian population projections for the period 2005–50, and the results of the empirical model developed in Sections 2 and 3 were then used to carry out a simple simulation in which average future wages of Italian men aged between 20 and 54 are projected until 2049. According to the simulation results, the average wage of Italian male workers will increase until 2018, decrease between 2019 and 2033, and then increase again (although to a lesser extent) in the last part of the projection period. The average wage of Italian male workers would decrease to a lesser extent in the second part of the projection period if a substantial number of net migrants (e.g. 300,000; 400,000; or 500,000) aged between 20 and 44 were to immigrate to Italy in each year of the projection period. On the contrary, the average wage of Italian male workers would increase to a greater extent in the second part of the projection period if the TFR was lower than in the baseline scenario.

Appendix

Table A1. Descriptive statistics of aggregated variables in earnings and employment equations; time period 1994–2001

Variable	Mean	Standard deviation	Minimum	Maximum
Real hourly gross wage *w* (000s of Liras) — medium–high-educated workers	15.475	3.861	8.454	28.000
Real hourly gross wage *w* (000s of Liras) — low-educated workers	11.765	1.464	7.571	15.539
Employment rate *e* — medium–high-educated workers	0.794	0.230	0.092	0.998
Employment rate *e* — low-educated workers	0.789	0.150	0.207	0.985
Age	17	10.118	0	34
Age^2	391	355.903	0	1,156
Natural logarithm of *cs* ln(*cs*)	–3.824	0.105	–4.055	–3.663
Interaction between ln(*cs*) and age ln(*cs*) ∗ *age*	–65.628	40.240	–137.873	0
Aggregated unemployment rate $\overline{u}$ (per cent)	11.363	0.86	9.5	12.2
Time trend *t*	3.5	2.295	0	7

Notes: The employment and earnings data extracted from the ECHP are weighted using the normalized base weight for interviewed sample persons.
The ECHP provides data on current gross nominal monthly wages (000s of Liras) and number of hours worked per week (in main job). In this paper, weekly nominal gross wages are computed as the ratio of gross nominal monthly wages and number of weeks per month. Hourly gross nominal wages are computed as the ratio of weekly gross nominal wages and the total number of hours worked per week (in main job). Nominal gross hourly wages are finally converted into real gross hourly wages using consumer price index data (base year = 1994).

Notes

[1] This implies a rescaling exercise where age 0 is age at labour market entry.

[2] The data on the number of Italian men aged *i* in year *t* (N_{it}) are taken from Istat 'Ricostruzione intercensuaria della popolazione per eta' e sesso al 1 gennaio, Anni 1992–2001. The weighted moving average is used to incorporate the effects of the surrounding cohorts, based on the idea that the wages and employment profiles of a particular cohort (i.e. cohort 0) are affected by its own size, the size of the two preceding cohorts (i.e. cohorts –1 and –2), and the size of the two following cohorts (i.e. cohorts +1 and +2). The further away the cohorts, the less the degree of substitutability between workers belonging to different cohorts (the weights for cohorts ±2, ±1, and 0 are 1/9, 2/9, and 3/9, respectively).

[3] Welch (1979, p. 83) argues that if those not reporting have above-average earnings, then the higher the proportion of those not reporting, the lower will be the mean wage of those who do.

[4] In the literature, earnings are commonly specified as a quadratic function of age: earnings increase with age but at a diminishing rate. The use of a spline function would be equally arbitrary because the author would need to choose at what age groups to place the knots.

[5] 'Diploma o qualifica di scuola media superiore di 4 o 5 anni', 'diploma post-maturita' non universitario', 'diploma universitario, laurea breve o laurea', 'specializzazione post-laurea', or 'dottorato di ricerca' in the Italian education system.

[6] 'Licenza elementare', 'licenza di scuola media inferiore', or 'diploma o qualifica di scuola media superiore di 2 o 3 anni' in the Italian education system.

[7] $\varepsilon(w, cs) = \dfrac{\delta \ln(wage)}{\delta \ln(cs)} = \alpha_3 + \alpha_4 age$. At labour market entry age = 0 so $\varepsilon(w, cs) = \alpha_3$.

[8] $\varepsilon(e, cs) = \dfrac{\delta \ln(e)}{\delta \ln(cs)} = \dfrac{\delta \ln(e)}{\delta e} \cdot \dfrac{\delta e}{\delta \ln(cs)}$

where

$$\frac{\delta e}{\delta \ln(cs)} = \left[\frac{\delta \ln\left(\frac{e}{1-e}\right)}{\delta \ln(cs)} \right] \Bigg/ \left[\frac{\delta \ln\left(\frac{e}{1-e}\right)}{\delta e} \right].$$

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