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The Role of Human Capital in Economic Growth: The Case of Spain

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Abstract

This study constructs an index of human capital for the Spanish labor force over the past two decades and projects it over the next decade on the basis of likely demographic developments. The methodology considers both educational attainment resulting from formal schooling and improvements in workers' productivity resulting from experience, or "learning by doing." Furthermore, it allows for the fact that people with higher education accumulate human capital through learning by doing at a faster pace than less educated workers or, in other words, that the full returns to formal schooling are realized with a lag of many years. Using this index, a growth accounting exercise is conducted to estimate the impact of human capital accumulation on economic growth over the past two decades. Finally, potential output growth is projected over the next few years, taking into account the impact of human capital accumulation.

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I. INTRODUCTION

Human capital accumulation is one of the key determinants of economic growth, for both developing and advanced countries. This is evident in the case of Spain, where it may be argued that convergence in schooling attainment toward the European Union (EU) average has been an important factor underlying convergence of per capita incomes over the past decades. In spite of past improvements, however, the average educational attainment of the Spanish labor force is still below the European Union. Therefore the scope exists for further educational catch-up and indeed this process has accelerated in recent years, following changes in the Spanish educational system that included increases in compulsory schooling age. These changes have already had a significant impact and will continue to do so in the next decades, with highly educated youth entering the labor force and older, less educated workers retiring.

This paper constructs an index of human capital for the Spanish labor force over 1977–97 and projects it over the next decade on the basis of likely demographic developments. The methodology by which the index is constructed considers both educational attainment resulting from formal schooling and improvements in workers' productivity resulting from experience, or "learning by doing." Furthermore, it allows for the fact that people with higher education accumulate human capital through learning by doing at a faster pace than less educated workers or, in other words, that the full returns to formal schooling are realized with a lag of many years. Using this index, a growth accounting exercise is conducted to estimate the impact of human capital accumulation on economic growth over 1978–97. Finally, potential output growth is projected for 1998–2003, taking into account the impact of human capital accumulation.

The **main result** is that the index of human capital has risen considerably, and at an increasingly rapid rate over the past two decades. The key factor underlying that increase in the growth rate of human capital is that the baby boom generation went through secondary schooling, and was therefore able to accumulate human capital through "learning by doing" at a comparatively rapid pace. As a result of institutional changes, demographic developments, and their interaction, over the next decade human capital is projected to grow at a slightly higher rate than that experienced in the last decade. Consistent with that result:

- in the growth accounting exercise, it is found that the contribution of human capital accumulation to economic growth has been considerable over the past two decades, and has risen within that period; and
- looking ahead, the contribution of human capital accumulation to economic growth in the next decade is estimated to remain very important, and slightly larger than that observed over the last decade.

More generally, the estimation of potential output and output gaps using a more refined technique that takes into account the role of human capital permits a more accurate

assessment of the potential for noninflationary output growth, as well as of the stance of policies, and of fiscal policy in particular. The latter objective has become even more important in light of Spain's commitments entailed by the Stability and Growth Pact under European Monetary Union. As always in the case of potential output growth projections, a number of caveats are in order, and this is even more so in the case of Spain, given the large uncertainty over developments in its nonaccelerating-inflation rate of unemployment. Under a set of assumptions that are described below, potential output growth over the next few years is projected at about 3.6 percent, slightly above that obtained by using standard methodologies.

The paper is organized as follows. Section II reports international comparisons of educational attainment. Sections III-V construct the index of human capital, review its evolution over the past decades, and project it over the next decade. Sections VII-VIII conduct a growth accounting exercise and present a scenario for potential output growth in 1998-2003 that takes into account the role of human capital. Section IX concludes.

II. INTERNATIONAL COMPARISONS OF EDUCATIONAL ATTAINMENT

Average educational attainment for the working age population (aged 25-59) in Spain is still one of the lowest in the EU, and substantially below the EU average: in 1995, the proportion of people who had completed at most lower secondary education (as defined by Eurostat) was 69 percent, compared with an average of 41 percent in the EU as a whole (Table 1, top panel). One of the factors underlying this result is simply that schooling was compulsory in Spain only up to 14 years of age until 1990, whereas at that time the compulsory schooling age had already been 16 for a long time in Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom.² At the same time, Spain fares much less unfavorably at the top end of the educational ladder: in 1995, the proportion of people who had completed college or advanced vocational degrees in Spain was almost the same as in the case of the EU average.

However, educational attainment for the population aged 25-29 in Spain is closer to the EU average than that for the whole working age population: in 1995, the proportion of

² OECD (1996) and Eurostat (1996) provide detailed international comparisons of educational systems and a broad range of statistical indicators on educational attainment.

Table 1. Spain: Educational Attainment in the European Union, 1995

(In percent)

Panel 1: Population Aged 25-59																
	EU15	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	UK
Low	41	29	43	19	30	38	17	54	51	62	55	20	76	69	24	47
Medium	40	62	33	53	48	43	60	31	29	30	28	58	12	14	47	31
High	19	8	25	28	22	19	23	16	21	8	16	22	12	17	29	22

Panel 2: Population Aged 25-29																
	EU15	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	UK
Low	31	20	27	10	15	24	13	32	33	49	53	14	63	48	10	43
Medium	49	72	41	65	65	49	70	46	38	44	33	64	24	23	63	34
High	20	8	32	24	21	27	17	21	30	7	15	22	14	29	27	23

Source: Eurostat (1996).

Notes: Low includes primary and lower secondary education; medium includes upper secondary education; and high includes college degrees and equivalent.

Spanish youth who had completed at most lower secondary education was 48 percent, compared with an EU average of 31 percent (Table 1, bottom panel). In addition, the proportion of youth who had earned college or advanced vocational degrees was 29 percent, compared with 20 percent in the EU as a whole.³ Given that a comparison of educational attainment between Spain and the rest of the EU yields much more favorable results for the young than for the entire working age population, future demographic developments should result in much greater educational gains in Spain than in the rest of the EU.

III. HUMAN CAPITAL IN SPAIN

A. Improvement in Educational Attainment

The improvement in average educational attainment over the past three decades has been impressive. The proportion of the population older than 16 years that had completed, at most, primary studies, declined from 93 percent in 1964 to 47 percent in 1998, and the proportion who completed college rose from 2½ percent to 11 percent over the same period (Table 2). (All data used in this paper and the exact definitions of educational categories are described in detail in Appendix I.) The improvement is even more marked when only labor force participants are considered, since those who have already retired have, on average, lower levels of education than the younger generations and, in general, participation rates are lower for the less educated.

Such improvement results mainly from a continued increase of enrollment rates in post-compulsory education, but also from increases in the compulsory schooling age. In 1970, education became compulsory up to the age of 14. In 1990, compulsory education was extended up to 16 years of age. In 1998, the effects of the reform of 1990 became complete: pupils that had enrolled in school at age 6 in 1990 reached age 14, and began the two years of school that the reform had made compulsory.

Improved educational attainment is a key factor underlying the evolution of human capital, but other factors such as “learning by doing” also play an important role; these are taken into consideration in constructing an index of human capital in the next section.

B. Methodology: The Index of Human Capital

This section describes the procedure used in this paper to construct an index of human capital that takes into account not only formal schooling, but also other crucial determinants of

³ On a more negative note, the comparatively high proportion of people aged 25–29 that have completed college or advanced vocational degrees might be partly related to massively higher youth unemployment in Spain than in other countries.

Table 2. Spain: Educational Attainment, 1964 and 1998
(In percent)

	Primary School		Secondary School		College	
	1964	1998	1964	1998	1964	1998
Population >16	92.9	47.4	4.6	41.9	2.5	10.7
Labor force	92.6	31.3	4.0	52.1	3.4	16.6
Employed	92.6	31.6	4.0	50.9	3.4	17.5

Sources: Mas et al. (1995) and second quarter EPA, *INE* (1998).

Note: See Appendix I for a definition of the educational categories.

workers' productivity, such as learning by doing and its interactions with formal educational attainment. The methodology is in the spirit of that applied to the United States by Jorgenson and others (1987): labor services are classified in different categories and weighted according to their average wage rate, the usual proxy for the marginal product of labor.

The economy is assumed to be characterized by a constant returns to scale production function F :

$$Y = A * F[K, L]$$

where Y is output, A is a parameter representing the level of technology or "total factor productivity" (TFP), K is the stock of physical capital, and L is labor input adjusted for quality (human capital). Specifically, L is defined as the weighted sum of the work hours provided by different types of workers, that is:

$$L = \sum_s w_s N_s$$

where w_s is the weight of workers of type s and N_s is the number of work hours provided by group s .

For simplicity of exposition, L can be rewritten as

$$L = N * h$$

where N is the total number of hours worked in the economy, and h is defined as average human capital

$$h = \sum_s w_s n_s$$

where n_s is the proportion of work hours provided by workers of type s (i.e., N_s/N). Under these assumptions, the marginal product of work hours by workers of type s is:

$$MP_s = A F_L w_s$$

where F_L indicates the derivative of the function F with respect to L . If factor markets are competitive, then MP_s will also equal the hourly wage for workers of type s . The ratio of the marginal products of workers of different types will thus equal the ratio of their respective wages. Therefore, the above assumptions imply that work hours undertaken by different groups of workers will be weighted according to their respective wages.

C. Empirical Implementation: Relative Wages by Educational Attainment, Age, and Gender

Turning to the empirical implementation of the above methodology, the index of human capital will be useful to the extent that workers are grouped according to characteristics that account for significant differences in wages. The characteristics considered in this paper are educational attainment, age, and gender, three variables that previous studies have found to be among the key determinants of wages in a variety of countries (see, for example, Willis, 1986).

Not surprisingly, earnings depend on educational attainment, age, and gender to a major extent also in the case of Spain.⁴ For example, among females aged 16–24, college educated workers earn 1.58 times what their primary-school educated counterparts do; among primary school educated females, those aged 55–64 earn 1.82 times as much as those aged 16–24; and among primary school educated workers aged 16–24, males earn 1.22 times as much as females. The differences become most pronounced when comparing college educated males aged 55–64 to females aged 16–24 with no more than primary education: in that case, the ratio of average earnings amounts to 8.36 (Table 3). (All earnings data refer to 1995.)

In determining wages, educational attainment, age, and gender also interact in interesting ways. For example, age-earnings profiles are steeper for males than for females.⁵ Also,

⁴ Data on hourly wages are not available at the required level of disaggregation (educational attainment, age, and gender). Earnings are therefore used as a proxy, assuming that average hours worked per worker are the same for all groups. Although there may be differences among the various groups in this respect, most of the differences in earnings are likely to reflect differences in hourly wages rather than in hours.

⁵ This might be partly due to the fact that women interrupt their careers more frequently than
(continued...)

returns to secondary education appear to be much higher for women than for men: considering an average for workers of all ages, secondary education yields 43 percent higher earnings than primary education for women, compared with a differential of only 23 percent for men.⁶ For the purposes of this paper, the most interesting interaction is that between educational attainment and learning by doing: while male college graduates earn 85 percent more than their counterparts with primary studies when they are at age 25–34, they earn 175 percent more when they reach age 55–64. This fact also reveals that the full returns to formal schooling come with a lag of many years.

Although the use of relative wages to proxy for relative productivity is standard, the results need to be treated with caution for a number of reasons. First, market distortions such as those that have bedeviled the Spanish labor market might imply that the assumption that labor inputs are paid their marginal product is not warranted. Second, education might simply act as a screening device, rather than contributing to workers' productivity. Education might serve merely as a signaling device to allow high quality workers to identify themselves to potential employers. In that extreme scenario, although individuals could obtain higher wages by improving their education, increases in average educational attainment would have no impact on productivity. Third, education might simply be a "normal" consumption good. In that case, the correlation between high wages and formal schooling would result from the following mechanism: children of families with high incomes would be more likely both to go through higher education and to have high wages (controlling for educational attainment) themselves.

⁵(...continued)

men do, for example for child rearing, and to the fact that they hold relatively more part-time jobs than men do.

⁶ This might explain why current enrollment rates in higher levels of education are higher for women.

Table 3. Spain: Earnings Ratios by Age, Educational Attainment, and Gender

(Female, up to primary education, age 16-24, normalized to 1)

Age group	16-24	25-34	35-44	45-54	55-64
Females					
Primary	1.00	1.49	1.95	1.98	1.82
Secondary	1.06	2.13	3.03	3.50	3.75
College	1.58	3.16	4.65	5.76	4.93
Males					
Primary	1.22	2.20	2.85	3.29	3.04
Secondary	1.29	2.71	3.94	4.82	4.94
College	1.90	4.08	6.72	8.23	8.36

Source: Own estimates based on Survey of Wage Structure, Instituto Nacional de Estadística (1995).

IV. MEASURES OF AVERAGE HUMAN CAPITAL OF THE LABOR FORCE

Average human capital at time t , $h(t)$, is computed as

$$h(t) = \sum_{g,i,j} w_{g,i,j} n_{g,i,j}(t)$$

where $n_{g,i,j}(t)$ is the proportion of individuals of gender g , with schooling I , and in age group j , at time t , and $w_{g,i,j}$ is the corresponding weight given by the 1995 earnings ratios in Table 3, using the proportions of the labor force represented by the 30 groups (five age bands, three educational attainment categories, and two genders) listed in Table 3, for the years 1977–97.

The composition of the labor force changed considerably during that period (Appendix II). In 1977 (and still in 1987), the representative member of the labor force was a fifty year old male with primary education. In 1997, the representative member was a thirty year old male with secondary education. Women increased their presence in the labor force from a proportion of 29 percent in 1977 to 39 percent in 1997. Also, while in 1977 and 1987 the

proportion of the labor force younger than 25 was close to 23 percent, in 1997 that proportion had fallen to 16 percent, as people increasingly enrolled in higher level education, thereby postponing their entry into the labor market. Among labor force participants aged 25–34, the proportion with secondary education became higher than that of those with primary education only in 1987. Among those aged 35–44, the same happened as recently as 1995.

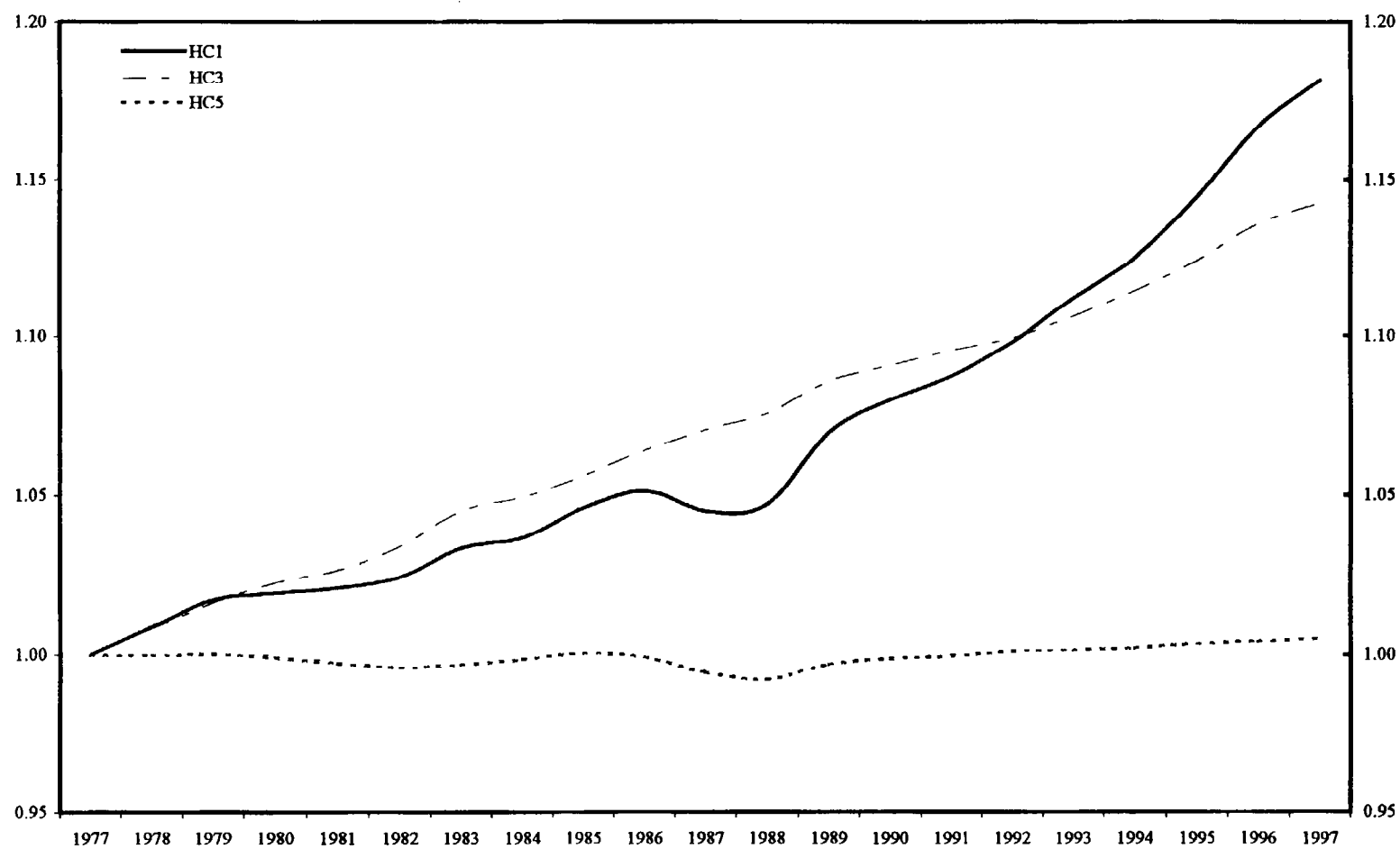
Not only did the human capital index (computed using the above procedure, solid line in Figure 1) grow considerably between 1977 and 1997, but it also did so at an increasingly rapid rate. The average annual growth rates were 0.90 percent in 1978–97, 0.45 percent in 1978–87, and 1.36 percent in 1988–97.⁷ This acceleration was not simply due to changes in educational attainment, or demographic factors, but rather to their interaction. This can be seen by considering two alternative indices of human capital constructed using the same methodology but taking into account only a subset of the factors listed above: one alternative index (dashed line in Figure 1) considers only educational attainment; another (dotted line in Figure 1) considers only age and gender. Neither alternative index displays the acceleration that characterizes the main index used in this paper. An important factor underlying that acceleration is the fact that the baby boom generation went through secondary schooling, so that its subsequent human capital gains from learning by doing have been comparatively large.

A wide range of simpler indices that have been used in other studies (often owing to the limited availability of data) was also constructed, to show the differences between their behavior and that of the main index used in this paper, which is based upon more solid theoretical foundations. (The growth rates for all indices and their cross-correlations are reported for 1977–97 in Appendix II.) These include, as mentioned above, (i) a measure based only on educational attainment (Barro and Lee, 1993), and (ii) a measure that weighs the labor force only according to age and gender (Hansen, 1985). Moreover, they include (iii) a measure based on educational attainment and gender only, (iv) the average number of years of schooling (Barro and Lee, 1993), and (v) the proportion of workers with secondary education (Serrano, 1997).

None of the alternative measures captures satisfactorily the behavior of the main index of human capital. The growth rate of the measures based on educational attainment only, educational attainment and gender only, and age and gender only are highly correlated with that of the main index of human capital. However, they do not capture its gradual

⁷ The same measure computed separately by gender shows that women's average human capital grew faster than men's (1.66 percent versus 0.87 percent over the whole period, though both show similar increases in the growth rate). This counteracted the downward pressure on growth rates induced by faster increases in female participation rates than in male participation rates.

Figure 1. Spain: Different Indices of Average Human Capital (in logs), 1977-97



Source: National Statistical Institute; Fund staff estimates.

acceleration during the period considered. The correlation coefficients between the growth rates of the indices based upon the average number of years of schooling or the percentage of the population with secondary education and that of the main index of human capital are even negative, suggesting that these alternative measures fail to capture crucial aspects of the process of human capital accumulation.

V. PROJECTIONS OF THE HUMAN CAPITAL INDEX, 1998–2007

The human capital index is projected over 1998–2007 using the following procedure. The starting point is the population proportions for 54 groups sorted by age (nine 5-year bands beginning at age 20), gender (two), and educational attainment (three levels as in Table 3) in 1997. Each of these groups will be five years older in 2002 and 10 years older in 2007—death rates (estimated by the National Statistical Institute for each age/gender group) are assumed to be independent of educational attainment. For groups aged 25 or older in 1997, transition rates from an education level to a superior one for each age/gender group are assumed to be the same as those observed over a typical five-year period in recent years. For groups aged 20–24 in 1997, enrollment rates are used. The projections are then compressed into 10-year age bands, and 1997 labor force participation rates for each age/gender/education group are applied to obtain the labor force structure in 2002 and 2007.⁸ Finally, average human capital is computed for 2002 and 2007.

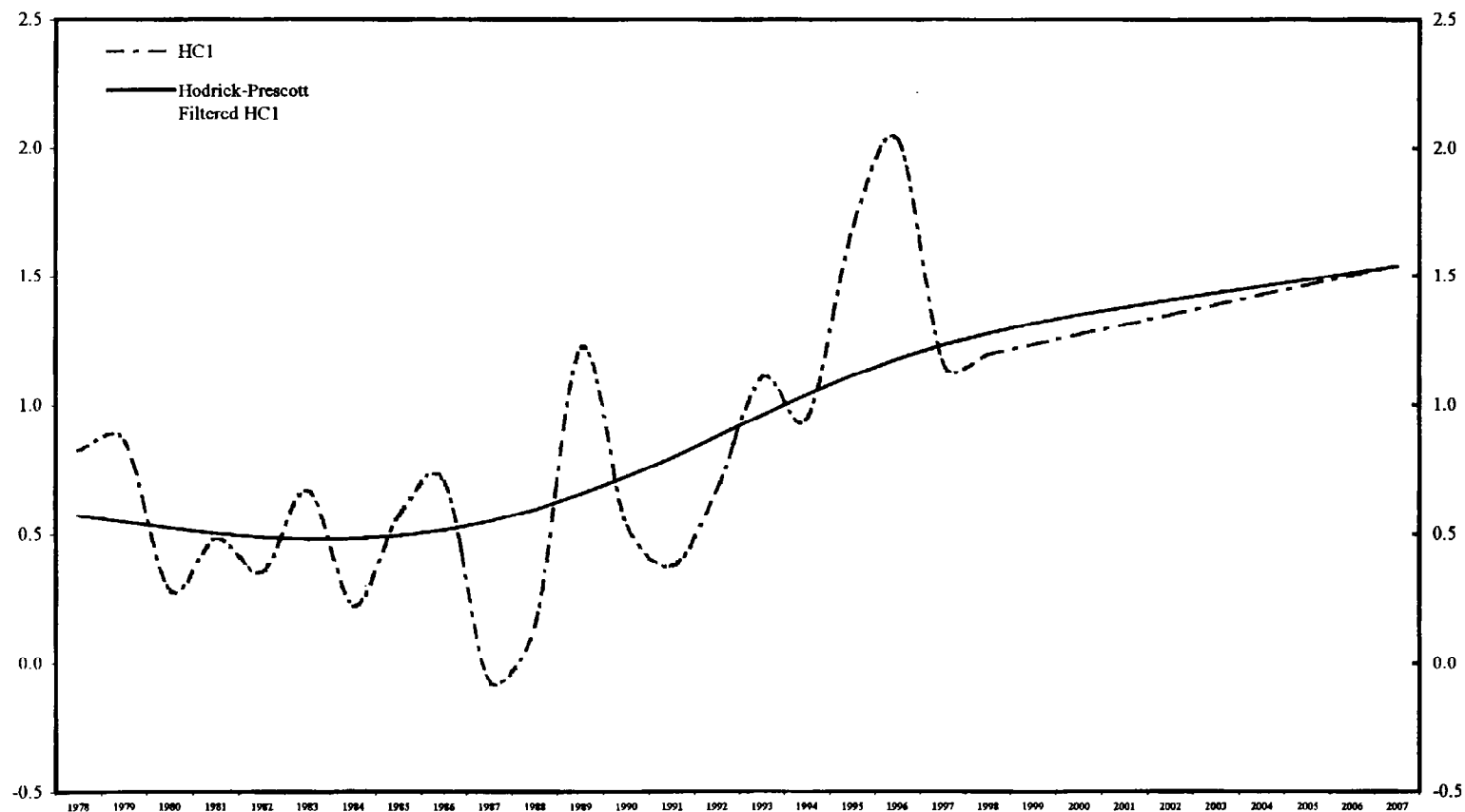
The growth rate of human capital over the next decade is projected to be slightly higher than in recent years. Specifically, average annual growth rates are 1.26 percent between 1997 and 2002, 1.25 percent between 1996 and 2002, and 1.36 percent between 1995 and 2002. (The results are reported for several base years as a sensitivity exercise). Projected average annual growth rates between 2002 and 2007 are 1.40 percent. By comparison, the average annual growth rate of the human capital index for the same portion of the labor force was 0.99 percent between 1987 and 1997. The fact that human capital is projected to rise faster than in recent years is also shown graphically, abstracting from cyclical developments, by applying the Hodrick-Prescott filter to the human capital index over 1977–2007 (Figure 2). The effects of the economic cycle on average human capital are explored in the next section.

VI. THE EFFECTS OF THE ECONOMIC CYCLE ON AVERAGE HUMAN CAPITAL

Although this paper focuses on medium-term developments in human capital and output, there are also interesting effects of the economic cycle on measures of average human capital. Concerning the average human capital of the labor force, it is well known that the most procyclical component of the labor force are the low skilled, who are the most likely to

⁸ As a result, the overall labor force participation rate is projected to rise, as expected.

Figure 2. Spain: Average Human Capital for the Labor Force aged 25-64,
Past and Projections, 1978-2007 (growth rates in percent)



Source: National Statistical Institute; Fund staff estimates.

become “discouraged workers” in a downturn and to re-enter the labor force in a recovery. Therefore, one would expect the average human capital of the labor force to be countercyclical. Concerning the average human capital of the employed, it is also well known that the low skilled are the first workers to be dismissed in a downturn (the “cleansing effect” of recessions) and hired again in a recovery. Therefore, again one would expect the average human capital of the employed to be countercyclical. In addition, since the effects of the economic cycle are stronger on employment than on the labor force, one would expect the human capital of the employed to be even more countercyclical than that of the labor force.

All of the predictions above are borne out by the data: years of negative employment growth and sharply increasing unemployment rates (such as the early 1980s) coincide with cyclical increases in the human capital index, whether measured on the basis of the labor force or employment (Figure 3). (A measure of average human capital for the whole population aged 16 to 64 is also reported to provide an idea of how human capital would evolve in the absence of cyclical developments.) Moreover, such increases are more pronounced for the average human capital index based upon the employed than for that based on the labor force as a whole. Conversely, years characterized by rapid employment creation and sharply declining unemployment (such as 1987) coincide with cyclical declines in the human capital index, which are more pronounced for the employment-based index than the labor-force-based index.⁹

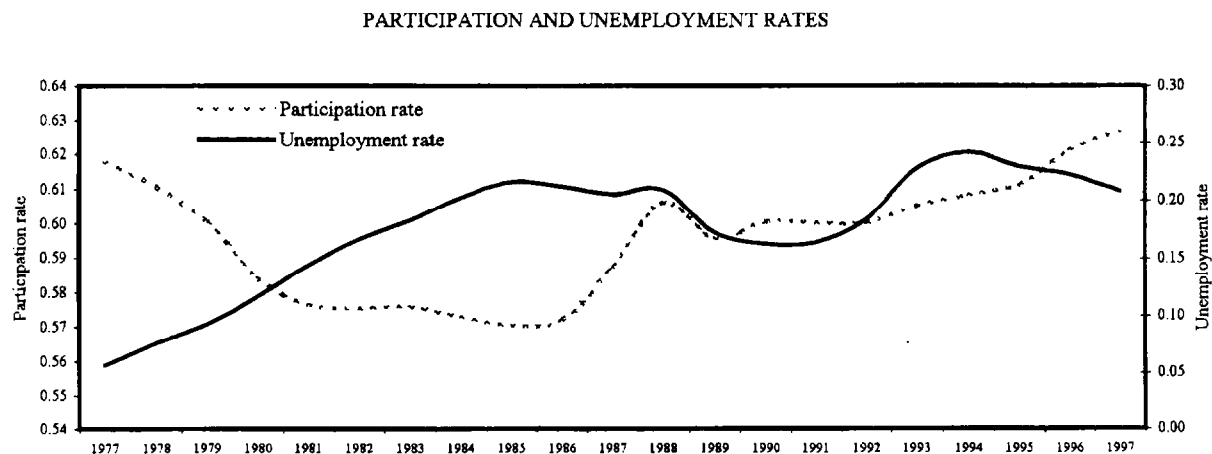
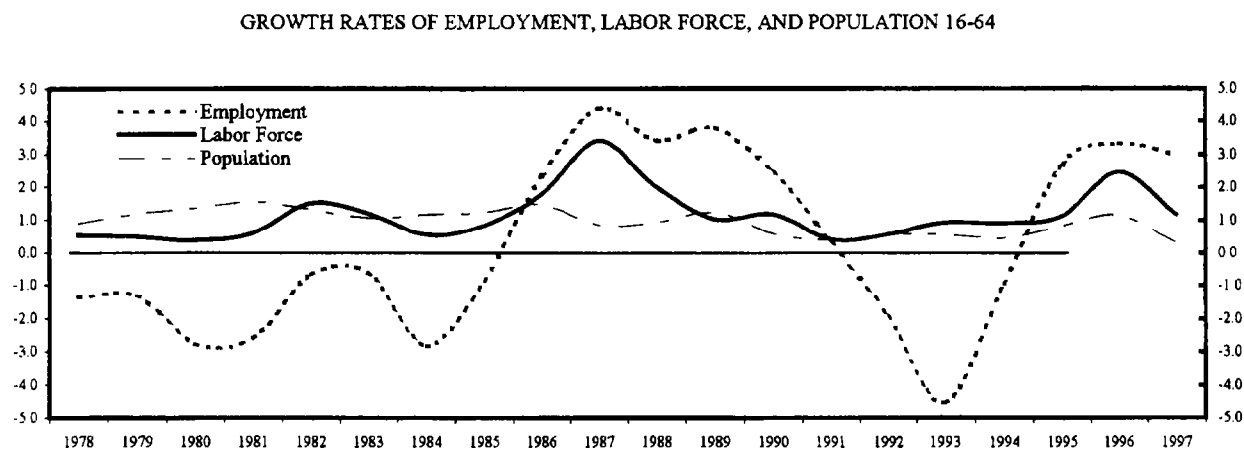
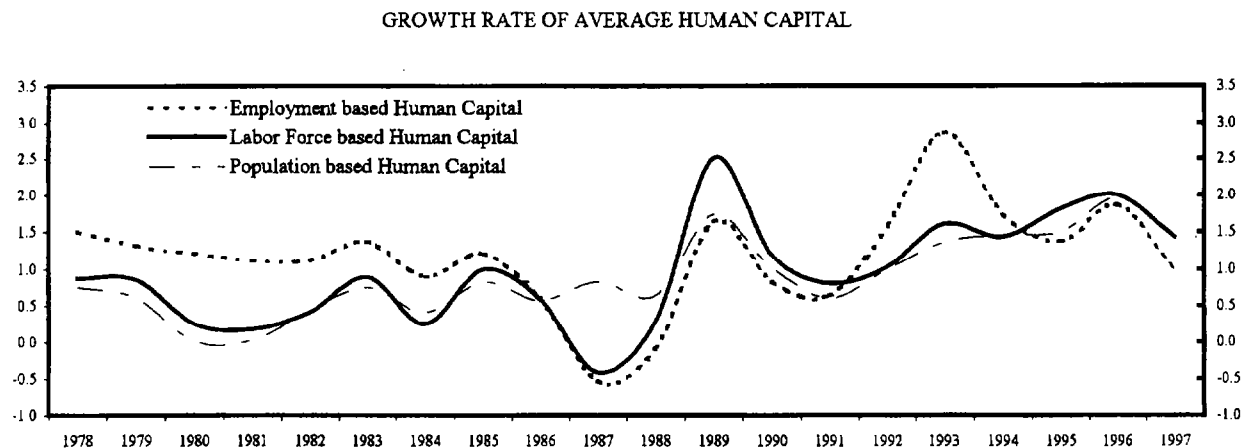
VII. GROWTH ACCOUNTING, 1978–97

Having constructed the index of human capital, it is now possible to estimate the contribution to economic growth resulting from human capital accumulation, in the context of a growth accounting exercise for Spain over 1978-97. The production function is assumed to be of the standard Solow form, $Y = A K^{1-\alpha} L^\alpha$, where Y is gross domestic product, K is physical capital, and L is labor, and the parameter α is, as usual, labor’s share in national income (approximately 0.7 in Spain). However, labor is adjusted for quality by weighing workers of different educational groups, age, and gender according to their relative wages, as explained in Section III. In other words, the human capital index is entered as a multiplicative factor directly in front of the total number of people employed, N :¹⁰

⁹ At the same time, these effects have apparently not operated in the last three years, when rapid employment growth has been accompanied by relatively high growth in the human capital index, suggesting that perhaps the jobs created over the past three years were of higher quality than those created in previous upturns.

¹⁰ This functional form is standard. Nevertheless, it is important to note that the choice of functional form can have important implications for the absolute size of the human capital contribution to economic growth. In fact, for example, the alternative functional form suggested by Mankiw, Romer, and Weil (1992), $Y = A K^{1-\alpha} h^\beta L^{1-\alpha-\beta}$, with β being typically assumed to equal 0.3, would result in a much lower contribution, because the growth rate of human capital would be multiplied by 0.3 instead of 0.7 as is the case with the form used in this paper. At the same time, changes over time in the contribution of human capital accumulation would follow the same patterns using either methodology.

Figure 3. Spain: Cyclical Effects and Human Capital, 1977-97



Source: National Statistical Institute; Fund staff estimates.

$$Y = A K^{1-\alpha} (hN)^\alpha$$

Output growth can therefore be accounted for in the usual manner, the only difference being that the contribution of labor can now be subdivided into the contribution of the total number of hours worked and that of average human capital:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + (1-\alpha)\frac{\dot{K}}{K} + \alpha\frac{\dot{N}}{N} + \alpha\frac{\dot{h}}{h}$$

where dots indicate derivatives with respect to time.

In the growth accounting exercise, the contribution of growth in the labor input is subdivided into that of three components: human capital, the number of hours worked per worker,¹¹ and the total number of people employed. The contribution of the growth of the number of people employed is further split into that of working age population growth, changes in the labor force participation, and changes in the employment rate (one minus the unemployment rate).

Considering the period 1978–97, about a third of overall GDP growth can be attributed to human capital accumulation, with another third accounted for by physical capital accumulation (Table 4). Indeed, had it not been for human capital accumulation, the contribution of growth in the input of labor would have been negative, given the decline in average hours worked per worker (resulting from both statutory reductions in weekly working hours and an increase in the share of part-time employment)¹² and zero growth in the number of people employed (as massive increases in the unemployment rate offset the growth of working age population). For easy comparison with the projection period, Table 4 reports the contribution of human capital accumulation using the labor-force-based index.¹³

Within the period 1978–97, abstracting from cyclical developments, there are interesting trends. Consistent with the increases in the growth rate of human capital shown in Section IV, the contribution of human capital accumulation increased over time. By contrast,

¹¹ Data limitations imply that the number of hours worked per worker needs to be assumed to be the same for all groups of workers.

¹² In 1980, the *Estatuto de los Trabajadores* reduced the work week from 48 hours to 40 hours. The share of part-time salaried employment increased from 5 percent in 1987 (the first year for which data are available) to 8 percent in 1997.

¹³ The contribution of human capital accumulation in 1978–1997 is somewhat higher (0.81 percentage point per year, on average) if the employment-based human capital index is used, because of the impact of massive job-shedding especially in the early 1980s, as noted in Section VI.

Table 4. Spain: Growth Accounting 1978-97 and Potential Output Growth 1998-2003
(In percent)

	1978-97	1998-03	Assumptions for potential growth
GDP growth	2.23	3.60	
Accounted for by:			
Physical capital	0.93	1.36	The investment/GDP ratio is assumed to rise gradually from 21.3 percent in 1998 to 23.0 percent in 2003
Labor input	0.43	2.24	
Human capital 1/	0.63	1.16	Average human capital is projected to grow at an average annual growth rate of 1.66 percent
Employment	0.06	1.32	
Working Age Population	0.62	0.02	Working age population is assumed to grow at an average annual growth rate of 0.03 percent
Participation Rate	0.05	0.41	The participation rate is assumed to increase from 62.7 percent in 1997 to 64.9 percent in 2003
Employment Rate	-0.61	0.89	Trend unemployment rate is assumed to decrease from 20.3 percent in 1997 to 14 percent in 2003
Hours	-0.44	-0.24	Average number of hours worked is assumed to decrease 0.34 percent annually
Total factor productivity	0.87	0.00	

Sources: Instituto Nacional de Estadística; Instituto Valenciano de Investigaciones Económicas; World Economic Outlook database; and own projections.

1/ Average human capital of the labor force as computed in the text.

the contribution from working age population growth declined somewhat. Finally, the growth of total factor productivity (or the Solow residual—the unexplained factor in economic growth) decreased considerably (in line with the findings of other studies on Spain—see, for example, Nicolini and Zilibotti, 1996—and other countries—see, for example, Englander and Mittelstadt, 1988), even turning negative in a few of the most recent years.

VIII. POTENTIAL OUTPUT GROWTH, 1998–2003

Having estimated the contribution of various production inputs on economic growth over the past decades, it is possible to project future developments in these inputs and the resulting potential output growth over the next few years. This section presents projections of potential economic growth in Spain during 1998–003. These must be treated with caution, since the margin of error is clearly very large. The approach taken here is to make explicit assumptions about the future growth rate of the various production inputs, and to highlight which of the assumptions are viewed as being based upon more solid foundations than others. The key assumptions are as follows.

- **The investment/GDP ratio** is assumed to rise gradually from 21.3 percent in 1998 to 23 percent in 2003. Such a rise is consistent with the rapid economic growth observed in recent years together with an “accelerator” view of investment, and possible increases in foreign direct investment into Spain as a result of European Monetary Union.
- **The human capital index** is assumed to rise at an average rate of 1.66 percent, using the projections presented in Section V. This is the main contribution of this paper and the margin of error in this assumption can be viewed as being lower than for most of the other assumptions.
- **Working-age population** is assumed to remain broadly stable over the next few years, in line with projections by Spain’s National Statistical Institute, which are very accurate over such a short time frame.
- **The labor force participation rate** is assumed to rise gradually from 62½ percent in 1997 to 65 percent in 2003. Such an increase is consistent with a trend observed over the past decades and would bring Spain’s participation rate only slightly below the EU average, which amounted to 68 percent in 1997.
- **The unemployment rate** is assumed to fall to 14 percent in 2003 (from 18½ percent in the second quarter of 1998), consistent with an assumed average employment growth of 2 percent a year over the period. These projections are subject to a large margin of uncertainty, but seem reasonable in light of developments in the labor market over the past few years.

- **The average number of hours** worked per worker is assumed to decline by 0.34 percent a year, roughly in line with past experience. Such a decline appears likely in light not only of the possibility of reductions in the work week, but also of the continued trend toward a higher share of part-time employment.
- **Total factor productivity** is assumed at zero. This is well below the average of the past two decades, but is consistent with a sharp downward trend observed not only in Spain (where total factor productivity growth was even negative in the most recent years), but also in other developed economies. Since total factor productivity is the unexplained portion of economic growth, by definition this is the assumption for which the least justification can be provided.

This set of assumptions implies an average growth rate of 3.6 percent for 1998–2003 (Table 4). There is a large margin of error in this figure and this should be taken as an illustrative scenario.

IX. CONCLUDING REMARKS

This paper constructs an index of human capital over the past two decades and projects it over the next decade. It finds that the human capital contribution to economic growth has been large and has gradually increased over the last two decades; over the next decade it is likely to be slightly higher than that experienced over the past decade. For a given set of assumptions about other determinants of economic growth, this leads to higher projections of economic growth in the next few years. This consideration should be taken into account in assessing the current stance of macroeconomic policies and in setting medium-term economic objectives.

More broadly, the results of this paper suggest that the gains from increases in formal schooling can be large, although they are translated into higher economic growth only gradually. Finally, the results suggest that the costs of youth unemployment in terms of foregone output are large, particularly for the better educated youth, because possible gains from learning by doing will be left unrealized. These costs might be overlooked because they will be felt more strongly only several years from now. These considerations provide an additional reason to pursue policies to solve that problem.

DATA DESCRIPTION

Educational categories:

The International Standard Classification of Education (ISCED) considers seven different categories. ISCED 0 is pre-primary education, ISCED 1 is primary education (usually lasting five years), ISCED 2 is lower secondary education (usually lasting three years), ISCED 3 is upper secondary education (four years), and ISCED 5, 6, and 7 are higher education.

In the text, the distinction is between primary, secondary, and college education. The equivalences are as follows:

Primary: Includes the illiterate, those without any formal education, and those with up to primary education (ISCED 1).

Secondary: Includes those with up to ISCED 2 or ISCED 3 (EGB, BUP, FP and COU in Spain).

College: Includes ISCED 5,6,7.

International organizations (including the OECD and Eurostat) group the educational levels differently. In the lower education level they include ISCED 2, which is lower secondary; in the middle group, they include ISCED 3; and in the higher education group they include ISCED >3. The Instituto Nacional de Estadística's (INE) Tempus Database follows a different classification: "estudios medios" includes lower and some upper secondary education groups (including vocational education).

Data for growth accounting:

Capital Stock: nonresidential private capital stock in billions of 1986 pesetas. For the years 1977 to 1992 data are from Table III.3.I in Vol. III of *El "Stock" de Capital en España y sus Comunidades Autonomas*, Fundacion BBV (1996) and the deflators from Table 10 in Vol. I of BBV (1996) are used to convert the data into 1986 pesetas; for the years 1993 to 2003 data are own estimates. (Private) gross formation of fixed capital is drawn from the IMF's World Economic Outlook data bank and the law of motion $K(t)=(1-\delta)K(t-1)+I(t-1)$ is applied. A value for δ is estimated to be 8 percent using the investment and capital stock data for past years.

Employment: Data are from the Survey of the Labor Force (Encuesta de Poblacion Activa, EPA) conducted by INE.

Output: GDP at market prices in billions of 1986 pesetas, from INE.

Working age population: population aged 15 to 64 from the OECD Analytical Database. From 1997 to 2003 the growth rates are drawn from INE's population statistics.

Labor Force: Data are from the EPA survey conducted by INE.

Unemployment Rate: implied by the labor force and employment series from above.

Hours Worked: Data from 1970 to 1988 are from Carbajo and Garcia-Perea (1987). For the period 1989 to 1997 they are drawn from INE. In both cases the data are quarterly averages.

The table on earnings is constructed based on the Survey of Wage Structure (*Encuesta de Estructura de Salarios*) conducted by INE in 1995 to compute the earning ratios for the different groups. Wage rates instead of earnings might be preferable, but data availability dictates the choice. Average earnings for different education, age and gender groups (normalizing to 1 the average for females aged 16 to 24 with at most primary education) are presented in Table 3. Although INE considers eight education levels and ten age groups (by gender) the dimensions of the table are simplified by considering three levels of schooling and five age groups (simple averages among the original data are used to obtain this simplified table).

Data from the Survey of the Labor Force used to compute the proportions of the labor force represented by each of the subgroups considered for the years for which data are available; that is, from 1977 to 1997. The data are averages of quarterly data for each year.

**LABOR FORCE STRUCTURE, HUMAN CAPITAL INDICES, AND PROJECTIONS
OF THE LABOR FORCE**

This appendix reports the labor force structure by age, gender, and educational attainment in Spain in 1977, 1987, and 1997 (Table 5); a comparison of the annual growth rates of average human capital in 1977–97, using a variety of indices (Table 6); and labor force projections by age, gender, and educational attainment, in 2002 and 2007 (Table 7).

Table 5. Spain: Labor Force Structure, 1977, 1987, and 1997

Age Group	16-24		25-34		35-44		45-54		55-64		All		
	F	M	F	M	F	M	F	M	F	M	F	M	All
1977													
Primary	6.2	9.1	3.5	11.4	4.1	13.0	4.7	15.0	3.3	9.2	21.8	57.7	79.5
Secondary	3.3	3.4	1.1	2.9	0.4	1.6	0.3	1.2	0.2	0.8	5.3	9.9	15.2
College	0.3	0.2	0.7	1.3	0.3	1.0	0.2	0.8	0.2	0.5	1.7	3.8	5.5
All	9.8	12.7	5.3	15.6	4.8	15.6	5.2	17.0	3.7	10.5	28.8	71.4	100.0
Both genders	22.5		20.9		20.4		22.2		14.2		100.0		
1987													
Primary	2.2	3.8	3.1	7.1	3.6	10.3	3.7	10.9	2.7	8.2	15.3	40.3	55.6
Secondary	7.4	8.6	4.0	6.9	1.3	3.2	0.4	1.7	0.2	0.9	13.3	21.3	34.6
College	0.7	0.3	2.2	2.2	0.9	1.6	0.4	0.9	0.2	0.7	4.4	5.7	10.1
All	10.3	12.7	9.3	16.2	5.8	15.1	4.5	13.5	3.1	9.8	33.0	67.3	100.0
Both genders	23.0		25.5		20.9		18.0		12.9		100.0		
1997													
Primary	0.7	1.4	1.3	2.6	3.0	5.4	3.6	7.6	2.1	5.1	10.7	22.1	32.8
Secondary	5.9	7.3	7.3	11.0	4.6	7.6	1.9	3.9	0.5	1.3	20.2	31.1	51.3
College	0.8	0.3	3.4	2.5	2.3	2.4	1.1	1.9	0.3	0.8	7.9	7.9	15.8
All	7.4	9.0	12.0	16.1	9.9	15.4	6.6	13.4	2.9	7.2	38.8	61.1	100.0
Both genders	16.4		28.1		25.3		20.0		10.1		100.0		

Source: INE's Tempus Database.

Table 6. Spain: Annual Growth Rates of Average Human Capital, 1977-97

	HC1	HC2	HC3	HC4	HC5	HC6		HC1	HC2	HC3	HC4	HC5	HC6
1978	0.87	2.58	0.81	0.78	-0.01	6.92							
1979	0.85	2.60	0.83	0.74	0.04	6.84	HC1	1.00	-0.10	0.59	0.63	0.77	-0.60
1980	0.23	2.66	0.64	0.64	-0.12	9.38	HC2		1.00	0.56	0.53	-0.09	0.72
1981	0.17	2.32	0.41	0.53	-0.17	9.39	HC3			1.00	0.76	0.24	-0.11
1982	0.33	3.28	0.75	0.64	-0.13	10.76	HC4				1.00	0.51	0.13
1983	0.92	3.73	1.08	0.94	0.09	9.51	HC5					1.00	-0.33
1984	0.32	2.30	0.42	0.46	0.16	7.86	HC6						1.00
1985	0.91	2.99	0.68	0.74	0.21	8.64							
1986	0.52	2.67	0.79	0.56	-0.14	6.06							
1987	-0.62	2.52	0.65	-0.08	-0.48	6.30							
1988	0.22	2.30	0.52	0.12	-0.22	6.14							
1989	2.25	2.77	1.00	0.91	0.46	4.81							
1990	1.01	1.80	0.50	0.31	0.20	4.08							
1991	0.75	1.50	0.48	0.32	0.08	3.00							
1992	1.06	1.76	0.39	0.19	0.15	4.44							
1993	1.42	2.50	0.70	0.57	0.03	5.43							
1994	1.29	2.33	0.81	0.50	0.07	4.10							
1995	1.98	2.11	0.98	0.70	0.14	2.46							
1996	2.20	2.59	1.17	1.10	0.08	3.23							
1997	1.47	1.62	0.65	0.54	0.07	2.44							
Av. 78-97	0.91	2.45	0.71	0.56	0.02	6.09							
Av. 78-87	0.45	2.76	0.71	0.59	-0.06	8.17							
Av. 88-97	1.36	2.13	0.72	0.53	0.11	4.01							

Source: own estimates as described in the text.

HC1 is based on educational attainment, gender and age.

HC2 is based on average years of schooling.

HC3 is based on educational attainment

HC4 is based on educational attainment and gender

HC5 is based on age and gender.

HC6 is based on the proportion with secondary education.

Table 7. Labor Force Projections, Ages 25-64, by Age and Educational Attainment,
2002 and 2007

(In percent)

Age Group	2002				Age group	2007			
	25-34	35-44	45-54	55-64		25-34	35-44	45-54	55-64
Females					Females				
Primary	0.82	1.94	2.79	1.77	Primary	0.51	0.96	1.87	1.51
Secondary	8.22	7.18	3.00	0.75	Secondary	6.58	7.63	4.10	1.14
College	6.08	3.68	1.92	0.54	College	6.64	4.57	3.01	0.89
All	15.12	12.80	7.70	3.06	All	13.72	13.16	8.97	3.55
Males					Males				
Primary	1.89	4.03	6.12	4.28	Primary	1.10	2.46	4.23	3.60
Secondary	14.21	12.16	5.75	1.91	Secondary	12.86	13.23	7.74	2.56
College	3.72	3.38	2.71	1.15	College	3.67	3.87	3.56	1.72
All	19.83	19.57	14.58	7.34	All	17.63	19.56	15.52	7.89

Source: Own estimates as described in the text.

REFERENCES

- Barro, Robert J. and Jong-Wha Lee, 1993, "International Comparisons of Educational Attainment," *Journal of Monetary Economics*, 32, 363-94, December.
- Englander, Steven and Axel Mittelstadt, 1988, "Total Factor Productivity: Macroeconomic and Structural Aspects of the Slowdown," *OECD Economic Studies*, 0 (10), Spring, 7-56.
- EUROSTAT, 1996, *Education Across the European Union: Statistics and Indicators*, (Brussels: EUROSTAT).
- Hansen, Gary D., 1985, "Indivisible Labor and the Business Cycle," *Journal of Monetary Economics*, 16 (3), 309-27, November.
- Jorgenson, Dale W., Frank M. Gollop, and Barbara M. Fraumeni, 1987, *Productivity and U.S. Economic Growth* (Cambridge, Massachusetts: Harvard University Press).
- Mankiw, N. Gregory, David Romer, and David N. Weil, 1992, "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics*, 107, 407-37, May.
- Nicolin, Juan Pablo and Fabrizio Zilibotti, 1996, "Fuentes de Crecimiento de la Economía Española," in *La Economía Española*, ed. by Ramon Marimon, (Barcelona: Antoni Bosch).
- OECD, 1996, *Education at a Glance: OECD Indicators*, (Paris: OECD).
- Roldós, Jorge E., 1997, "Potential Output Growth in Emerging Market Countries: The Case of Chile," IMF Working Paper 97/104 (Washington: International Monetary Fund).
- Martínez, Lorenzo Serrano, 1997, "Productividad del Trabajo y Capital Humano en la Economía Española," *Moneda y Crédito*, 205, 79-101.
- Willis, Robert J., 1986, "Wage Determinants: a Survey and Reinterpretation of Human Capital Earnings Functions," in *Handbook of labor economics*, ed. by Orley Ashenfelter and Richard Layard, Vol.1 (Amsterdam: North-Holland), 525-602.