

Wage returns to education in the four largest European economies

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Rationale

This article estimates the wage returns to different education levels in Germany, France, Italy and Spain by calculating the internal rates of return of tertiary education and upper secondary education and comparing them with lower secondary education.

Takeaways

- Employment income increases with education level. In the period 2010-2021 Germany was the country with the largest wage differential between individuals with a tertiary education and those with a lower secondary education, followed by France, Spain and Italy.
- In these four countries the returns to tertiary education were over 10% higher than the returns to lower secondary education. Germany and France have the highest returns (around 20%), while Italy and Spain have lower returns (11% and 12%, respectively).
- Regardless of field, the returns to long-cycle tertiary education are higher than the returns to higher vocational training. In addition, the returns to long-cycle tertiary education in the science, technology, engineering and mathematics fields are higher than in humanities. In all tertiary education specialisations, Germany stands out with the highest returns, followed by France, Spain and Italy.

Keywords

Returns to education, internal rate of return.

JEL classification

I24, I26.

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Introduction

Remaining in education for longer tends to be associated with higher salaries over a lifetime. However, continuing to study means giving up employment income for the duration of the training. Therefore, to estimate the wage returns to a certain education level it is necessary to compare the wage premium obtained for the extra years of education with the income lost during that period. In this respect, an individual's education level can be deemed an investment and, therefore, entails rates of return comparable to those of other economic investments.

Having estimations of these returns is key for different reasons. First, the returns are related to individual decisions to invest in human capital: higher returns incentivise households to invest in their children's education, as this leads to better jobs and more income (Organisation for Economic Co-operation and Development (OECD), 2021). Second, the existence of a wage differential among individuals with different education levels can affect a country's wage inequality.¹

Estimating the wage returns to education poses several methodological challenges as it requires information on individuals' employment income throughout their working life. In most countries, these longitudinal data on employment income are either unavailable or incomplete. For example, in Spain there are administrative data on the wages of graduates from some qualifications (basic, intermediate and higher vocational training and bachelor's and master's degrees), but they only incorporate information on the longest full-time employment relationship and only follow the graduate for the first four years after graduation. In addition, this information is not available for other countries, which therefore rules out the possibility of an international comparison of these returns.

This article aims to estimate the wage returns to education in the four largest European economies (Germany, France, Italy and Spain) using homogeneous information at the international level from the Eurosystem's Household Finance and Consumption Survey (HFCS). Four editions of the HFCS are currently available (2010, 2014, 2017 and 2021) and provide information on individuals' wage income and their highest level of education.

In this article income refers to gross annual employment income, including payments in kind, for all wage and salaried workers,² adjusted for each country's harmonised index of consumer prices according to Eurostat. Due to the lack of longitudinal data on an individual's employment income over their working life, the article proposes to estimate them as follows. First, we combine the four cross-sections of the HFCS for the period 2010-2021 for each country and we estimate employment

1 Katz and Murphy (1992) show how a sizeable portion of the increase in inequality in the United States between 1963 and 1987 was due to changes in the wage returns of university graduates.

2 Non-employment income and the income of the self-employed are excluded. Therefore, the cross-country differences in these returns by education level will not be captured in the rate of return.

income as a squared function of experience. The coefficients obtained from this regression are then used to calculate an individual's employment income for each year of experience, from 0 to 50 years. Lastly, with this income we estimate the wage returns to education, by calculating the internal rate of return (IRR) associated with different education levels.

Levels of education in the HFCS are defined consistently according to the United Nations Educational, Scientific and Cultural Organization's International Standard Classification of Education (ISCED). In this article they are grouped into three categories:

- Lower secondary schooling (ISCED 2). ISCED 2 is used as a benchmark to calculate the returns to higher education levels. ISCED 2 is the minimum compulsory level of education in the four countries under review. This avoids problems stemming from the inclusion of people who fail to complete compulsory secondary education. It provides individuals with key skills (reading, writing and mathematics), laying the foundations for higher levels of education. It tends to last ten years and students complete ISCED 2 at around 16.
- Upper secondary education (ISCED 3-4). This level prepares students for tertiary education and also provides skills relevant to employment for those that immediately join the labour market. Students typically start this level aged 14-16. It offers a wider array of options and streams. Teachers are often highly qualified in the subjects or fields of specialisation they teach. It lasts 2-4 years and students tend to complete it at 18.
- Tertiary education (ISCED 5-8). This level provides learning activities in specialised fields of education at a high level of complexity. A hierarchy exists among the qualifications obtained through tertiary education: short-cycle tertiary education lasting around two years (ISCED 5); bachelor's or equivalent level (ISCED 6); master's or equivalent level (ISCED 7); and doctoral or equivalent level (ISCED 8).

While this classification is consistent, there are subtle cross-country differences that should be considered when interpreting some of the findings by education level. For example, in Germany, specialisation for long-cycle tertiary education or vocational training begins from the sixth grade (i.e. at the start of ISCED 2),³ while in France, Italy and Spain this does not begin until the beginning of ISCED 3. Similarly, the Spanish Baccalaureate (ISCED 3) starts later and is shorter (11th grade, two years) than the Italian Liceo (ninth grade, five years) and French Liceo (tenth grade, three years).

Calculating the internal rate of return of education

In this article returns to education are estimated as the IRR of an investment. Calculating the IRR of years of education involves assessing the costs and benefits associated with investing in

3 In Germany, there is a primary school level (four or six grades), followed by an early orientation system with three pathways: *Hauptschule* (leading to manual labour apprenticeships after the ninth grade), *Realschule* (leading to administrative labour apprenticeships after the tenth grade) and *Gymnasium* (continuing up to the 12th-13th grade to go on to university).

education. The benefits are the wage income (W) of an individual with s years of education, over the course of their years of experience x , which range from 0, when the individual enters the labour market, to $X(s)$, which is the retirement age less the age they entered the labour market. The costs include the opportunity costs (which represent the income lost and are equal to a number of years of education below s) and the monetary and non-monetary costs of education, $C(s)$.

The IRR of completing s years of education is defined as the discount rate ρ that equates the present value of the flow of wage income to the present value of the opportunity costs and the costs of education, $C(s)$. It can be expressed as the following mathematical formula:

$$\sum_{x=0}^{X(s)} \frac{W(s, x)}{(1 + \rho)^{x+s}} - \sum_{x=0}^{X(s')} \frac{W(s', x)}{(1 + \rho)^x} - C(s) = 0$$

where $W(s, x)$ represents the flow of income for the group with s years of education, while $W(s', x)$ corresponds to the flow of income for the group with a number of years of education s' lower than s and that is used as a reference. This article distinguishes between three groups on the basis of the number of years of education: lower secondary education (ISCED 2), upper secondary education (ISCED 3-4) and tertiary education (ISCED 5-8).

Individuals' income over their working life is estimated as follows. First, combining the four waves of the HFCS for the period 2010-2021 for each country, the following regression model is estimated separately for each level of education:

$$\ln(W(x)|h(s)) = \alpha_0^{h(s)} + \alpha_1^{h(s)} x + \alpha_2^{h(s)} x^2 + \varepsilon^{h(s)}$$

where $W(x)$ is annual employment income, $h(s)$ is the education level corresponding to s years of education and x is work experience, which is calculated as the individual's age less the estimated age at which they completed their studies. Specifically, we assume that the education levels considered (lower secondary education, upper secondary education and tertiary education) end at 16, 18 and 22, respectively.

Second, using the coefficients estimated by this model, we calculate the employment income for each year of experience, from 0 to 50 years, for the three education levels in each of the four countries. We thus obtain a lifetime earnings profile by education level.

There are certain advantages to estimating working-life earnings this way: it reduces the potential errors stemming from small sample sizes for some levels of experience in certain groups and we do not need to assume that the wage differential between groups remains constant over a lifetime.

However, it also poses some drawbacks that are important to highlight. One is that we are assuming a specific empirical model for the wage-experience relationship applied to each group.

Although the squared model used is very typical in the literature for this type of application, this does not necessarily mean that it is an accurate approximation of the actual relationship. Accordingly, we estimated the IRR with a model for employment income that incorporates a quartic function of experience. The results obtained show quantitatively and qualitatively similar returns for the four countries. Another drawback is the use of data that combine the four cross-sections of the HFCS. This involves using information on different generations with the same level of education and experience (or age), without the model accounting for possible changes in the quality of the education level of different cohorts over time⁴ that could also affect wage income. To better understand the possible bias stemming from this approach, we analysed the wage changes across the same generations observed over the different waves of the survey, finding no major changes in the wage profiles of the different cohorts.⁵

Estimating lifetime wage profiles

Chart 1 shows the wage profiles estimated using the above equation by country and education level. For ease of interpretation, the age corresponding to the individual's years of experience is shown on the horizontal axis, from 16 (0 years of experience) to 66 (50 years of experience).

Across all countries, employment income rises with higher levels of educational attainment. Comparing the wage profiles of the tertiary educated cohort and that with lower secondary education at most, Germany stands out with the largest differential: at age 35, individuals in the former group earn 177% more than those in the latter. France follows with a gap of 88%, while Spain (66%) and Italy (64%) have smaller differentials.

The distribution of these gaps among middle and upper levels of education varies from country to country. For instance, in Germany the income gap at age 35 between those with a tertiary education and those with an upper secondary education is 50%. A similar differential is observed in Spain (47%) and France (48%), while the gap in Italy is smaller (30%). As for the income gap between upper and lower secondary education, the differential at age 35 is lowest in Spain (13%), followed by France and Italy (27%), while in Germany it stands at 84%.

Chart 1 also shows that the differentials between cohorts widen over time across all countries. Specifically, groups with lower education levels exhibit a relatively flat age-wage profile, while cohorts with higher education levels show a steepening curve. For instance, in the case of Spain, at age 25 a tertiary education graduate would earn 33% more than an individual with lower secondary schooling, with this differential widening to 100% at age 45.

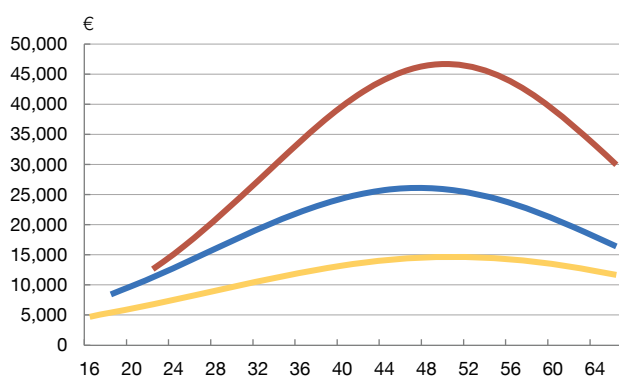
4 These changes over time in the quality of a country's education levels could be due to education reforms, changes in school curricula, in the resources available, in teacher quality, etc.

5 We used the four waves of the HFCS to construct a panel of synthetic cohorts, defined by year of birth and grouped into five-year intervals. We calculated average wage income for these cohorts. The resulting wage profile is fairly similar to that in Chart 1. However, for the groups with the most training, the wage curve during the early years of their working life is steeper, with a shallower drop in the years before they exit the labour market. Meanwhile, analysing the different generations at the ages at which they coincide, for Spain there is no clear pattern of improvement in education quality by cohort.

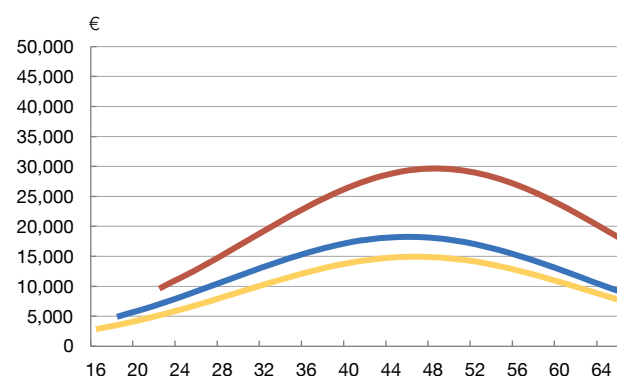
Chart 1

Lifetime earnings profile, by educational attainment level

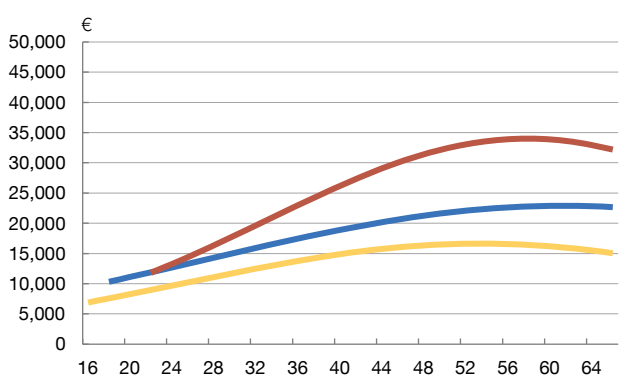
1.a Germany



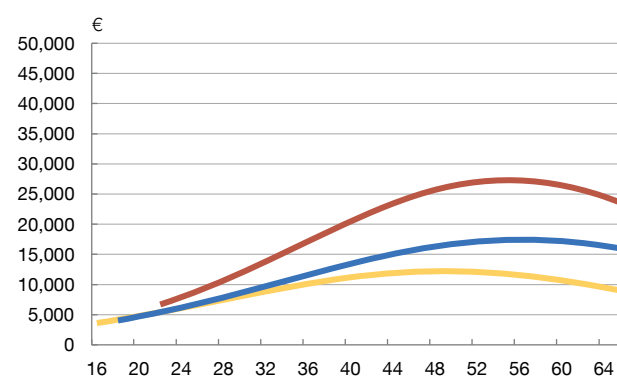
1.b France



1.c Italy



1.d Spain



■ Tertiary education (ISCED 5-8) ■ Upper secondary education (ISCED 3-4) ■ Lower secondary education (ISCED 2)

SOURCE: Banco de España, drawing on HFCS data (2010, 2014, 2017 and 2021 waves) compiled by the ECB.



Estimating internal rates of return

The IRR of each education level is calculated using the employment income flows discussed above. Moreover, to simplify the analysis, it is assumed that the monetary and non-monetary costs of education are equal to zero.⁶

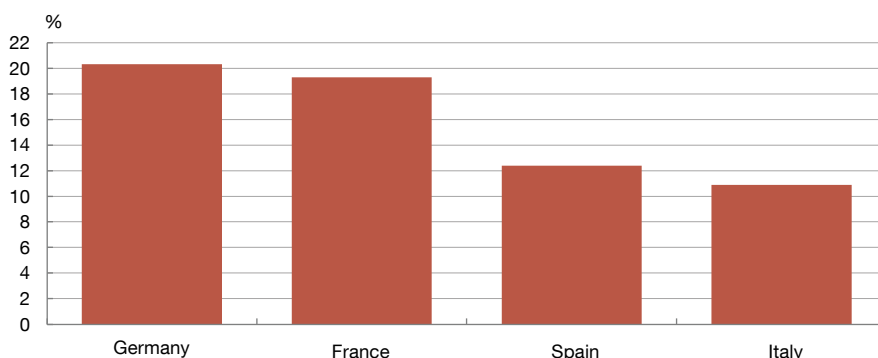
Chart 2.a presents the estimated IRRs comparing the income flow of an average tertiary education graduate and that of an individual with lower secondary education. In keeping with other international evidence,⁷ the returns are very high (over 10%) across all countries. France and

⁶ According to Heckman, Lochner and Todd (2006), in the case of the United States, considering the monetary cost of education reduces the return to education by between 1 and 2 percentage points. Similar figures have been calculated for Spain (Jansen and Lacuesta, 2024).

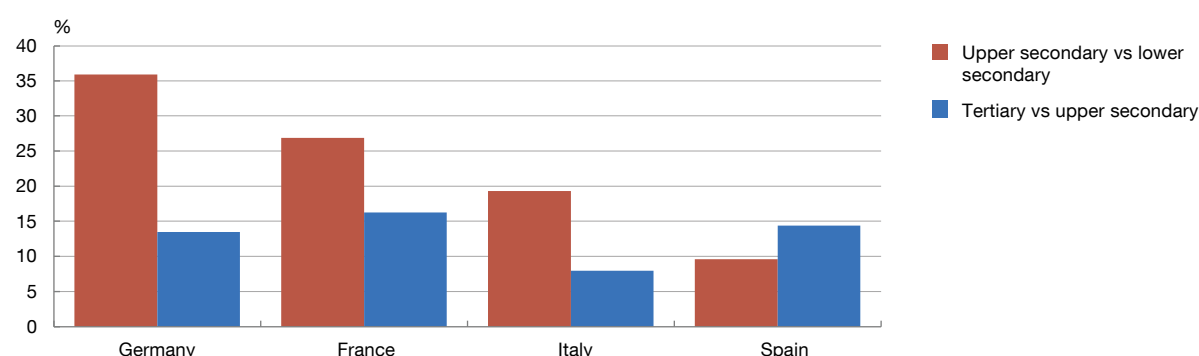
⁷ Card (2018).

Chart 2
IRR of education

2.a IRR of tertiary education relative to lower secondary education



2.b IRR of upper secondary education and tertiary education



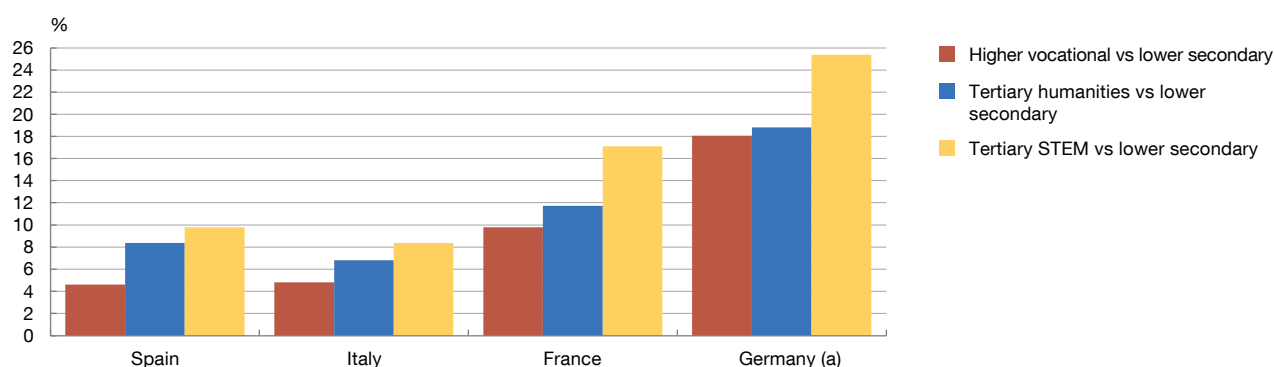
SOURCE: Banco de España, drawing on HFCS data (2010, 2014, 2017 and 2021 waves) compiled by the ECB.

Germany exhibit the highest returns, at about 20%, while the figures are lower for Italy (11%) and Spain (12%).⁸

Chart 2.b shows the estimated IRRs comparing (i) the income flow of an average individual with an upper secondary education against that of a person with a lower secondary education at most, and (ii) the income of an average tertiary education graduate and that of an individual with an upper secondary education. Again, the returns are very high across all four countries. The returns to upper secondary education compared to lower secondary education are particularly high in Germany (36%), followed by France (27%), Italy (19%) and Spain (10%). Meanwhile, the returns to tertiary education compared to upper secondary education are significantly lower in Germany, France and Italy, but higher in Spain. This is consistent with the international evidence, which typically shows that returns decline the further up the educational ladder one goes (OECD,

⁸ IRRs have also been estimated distinguishing between men and women, finding slightly higher wage returns to tertiary education compared to lower secondary education for women than for men, except in Germany. The estimated IRRs are as follows: Germany, 19% for women and 22% for men; Spain, 15% for women and 13% for men; France, 22% for women and 19% for men; Italy, 14% for women and 11% for men.

Chart 3
IRR of education, by tertiary education group (ISCED 5-8)



SOURCE: Banco de España, drawing on PIAAC 2021-2022 microdata compiled by the OECD.

a The figures for Germany pertain to the first wave of the PIAAC 2011-2012, since the second wave microdata do not include employment income data for the country.



2021). However, this is not the case in Spain, possibly indicating that in this country upper secondary education adds limited value beyond enabling access to higher qualifications. By contrast, in countries like Germany or France the return to upper secondary education (36% and 27%, respectively) is very high compared with that to tertiary education (13% and 16%, respectively).

The estimated return to tertiary education could be influenced by other factors, such as the distribution of students by field of specialisation. The tertiary education group (ISCED 5-8) encompasses a very broad range of education levels in terms of the knowledge and skills acquired. For instance, in most countries ISCED 5 includes higher vocational training, which prepares students for swift entry into the labour market. The other levels (ISCED 6-8) are bachelor's, master's or doctoral degrees in different fields of specialisation. Chart 3 shows the wage returns to tertiary education distinguishing between higher vocational training (ISCED 5) and ISCED 6-8 in (i) humanities, and (ii) science, technology, engineering and mathematics (STEM) fields. These calculations, unlike those presented so far, use data from the second wave of the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) 2021-2022, which allows these three categories to be distinguished within tertiary education.⁹

The results shown in Chart 3 indicate that the returns to tertiary education vary significantly when the different specialisations within this education level are considered. First, the IRRs of long-cycle tertiary education (ISCED 6-8), both in humanities and in STEM fields, are higher than those of ISCED 5, which includes higher vocational training. Second, Germany stands out with the highest IRR of higher vocational training (18%), followed by France (10%) and Spain (5%). Third,

⁹ The HFCS does not provide this information for the countries analysed. To check the robustness of the results, the IRRs are estimated using PIAAC 2021-2022 data, yielding very similar results. Specifically, based on the PIAAC data, the estimated IRRs of tertiary education compared to lower secondary education are 20% in Germany, 8% in Spain, 12% in France and 7% in Italy. These figures are comparable to those calculated using HFCS data (Chart 2).

the IRR of tertiary education is higher in STEM fields than humanities, except in Italy where they have similar returns. Again, Germany stands out with the highest IRR in STEM disciplines (25%), followed by France (17%), Spain (10%) and Italy (8%).

Estimating the returns to education is a complex task given the limited availability of public data to accurately estimate income differentials over the life cycle. This article uses data from different survey waves to bridge some significant gaps in the official administrative data. Improvements in this respect would help enhance the availability of more reliable information, enabling more robust analyses of these returns and their changes over time. Even if such data were available, estimating returns to education would not be without its difficulties given the endogeneity problems arising from unobservable factors, such as innate ability or motivation, which can influence both educational attainment and wages, thereby skewing the findings.

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