# Human capital as a factor of growth and employment at the regional level. The case of Spain

**FINAL REPORT**


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**November 2003**


**Abstract**

We use statistical techniques to quantify the effects of school attainment on individual wages, participation rates and employment probabilities in Spain, and to measure the contribution of education to labour productivity at the regional level. These estimates are then combined with data on private and public expenditure on education and with information on taxes and social benefits to construct measures of the private and social returns to schooling, to explore the effects of public policies on private incentives to invest in human capital, and to analyse the long-term effects of schooling on public finances. The results are used, together with estimates of the returns to alternative assets, to draw some tentative conclusions regarding the adequacy of the aggregate investment patterns observed in the regions of Spain, and to identify changes in the design of national and EU cohesion and growth policies that may help enhance their effectiveness.



* We are grateful to Vittorio Campanelli, Antonio Ciccone, Eduardo de la Fuente and Francisco Alcalá for their useful comments and suggestions, and to Ana Belmonte, Juan Antonio Duro, Cristina Fernández, and Juan Ramón García for their competent assistance.




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## EXECUTIVE SUMMARY

This document is the final report on a study on the economic effects of schooling in the Spanish regions and on the potential role of investment in human capital as a tool for promoting regional growth and cohesion. It provides estimates of the economic returns to education in the regions of Spain, both from a private and from a social perspective, analyzes the impact of various government policies on private incentives to invest in human capital, and explores the long-term effects of educational expenditure on government finances. It also attempts to draw some tentative conclusions regarding the adequacy of observed aggregate investment patterns in the different territories, and to identify changes in the design of national and EU cohesion and growth policies that may help enhance their effectiveness.

*Methodology*

We use the methodology developed in de la Fuente (2003) to quantify the micro and macroeconomic effects of schooling. We calculate the private and social rates of return to education as the discount rates that equate the present value of the incremental cost and income streams generated by a marginal increase in the schooling of a representative individual for each region to whom we attribute the observed average levels of attainment and either wages or productivity. To construct these rates of return, we use econometric estimates of wage, employment and participation equations with individual-level data, and a simple model of growth that is estimated using a panel of regional data. As in de la Fuente (2003), we construct effective tax rates on human capital that measure the effects of public policies on private incentives to remain in schoool. In addition, we have extended the methodology used in the previous report to quantify the long-term impact of schooling on public finances.

*Educational expenditure, performance and attainment*

Expenditure on education varies significantly across the regions of Spain. Expenditure per student at the secondary and university levels in the Basque Country exceeds that in Andalucia by 66%. Differences in expenditure across territories seem to be driven by two main factors that work, respectively, through its private and public components: regional income per capita and the resources available to regional governments. These two factors explain two thirds of the observed variation in expenditure per student.

Educational attainment, measured by the average years of schooling of the adult population, also varies greatly across regions and is likely to continue to do so in the foreseeable future. The dispersion of schooling levels across territories drops by only one third when we consider the youngest adult cohorts rather than the entire population. This process of educational convergence across age groups, moreover, is mostly driven by the



universalization of (mandatory) lower secondary schooling. At higher educational levels, disparities across regions may actually be expected to increase in the future.

Relative educational performance, as measured by a composite index of access to non-compulsory schooling and academic success ratios, tends to increase with income per capita. All Objective 1 regions but two are below the national average in terms of this indicator, while non-Objective 1 territories are above the national mean with the only significative exception of Baleares. Expenditure per student and adult attainment seem to have a positive effect on aggregate educational performance.

*Private returns to schooling and the incentive to invest in education*

The private rate of return to schooling measures the financial returns to a marginal increase in attainment that are available to individuals, taking into account only the privately born costs of education and the expected increase in net income after personal taxes and social benefits. The estimated return to a one-year increase in average attainment cluster between 8% and 10% for most Spanish regions and tend to fall with the level of schooling. When separate returns are estimated for the different educational cycles, payoffs appear to be highest for advanced university studies and for initial vocational training.

Various public policies have a significant impact on the private return to schooling. On average, direct subsidies to education raise private returns by 21.5% while personal taxes and social benefits reduce them by 7.6% and 29.9% respectively. The combined effect of these policies is an effective tax rate on human capital of 16%. These figures suggest that while the tax system per se generates only modest disincentives to invest in education, those arising from unemployment insurance can be considerable. From the point of view of minimizing such distortions, it would be preferrable to uncap unemployment benefits while reducing replacement ratios. Efficiency gains, however, must be balanced against the equity considerations that rightly influence the design of the social protection system

As in previous studies, we find that schooling is an extremely attractive investment alternative from an individual point of view. Taking as a reference a balanced portfolio of corporate shares and government bonds, we find that the return to schooling comfortably doubles that on financial assets in all regions and all post-compulsory educational cycles. This suggests that the combination of market forces and existing subsidies already provides more than adequate financial incentives to invest in education.

*Education and public finances*

Public expenditure on education increases future tax revenues and reduces social insurance payments. Treating such expenditure as an investment, we have calculated a fiscal rate of return to schooling that summarizes the long-term impact of educational spending on government finances under assumptions that try to approximate the marginal return to education in general equilibrium. This rate of return can also be interpreted as the maximum real rate of interest at which the government can borrow to finance educational expenditure without increasing the present value of future deficits. In addition, we have also computed the net present fiscal value of a year of schooling, defined as the difference in present value terms between the incremental net fiscal revenues induced by an additional year of schooling and its direct costs to the public budget.

We find that public expenditure on post-compulsory education is self-financing over the long run and may actually help reduce future budget deficits. For the case of Spain as a whole, the fiscal rate of return exceeds 5%, implying a positive net present fiscal value of 3,000 euros per student (assuming a real discount rate of 3%). The estimated net fiscal value is positive for all post-compulsory levels and exceeds 12,000 euros for advanced university studies.

*Social returns to schooling and physical capital and the optimal investment pattern*

Our estimates of the contribution of schooling to aggregate productivity indicate that attainment differences explain around 40% of observed regional productivity differentials, making educational investment a potentially crucial tool of regional cohesion policy. These estimates also imply that the social returns to schooling are large (around 11.5% for Spain as a whole) and, by and large, compare favourably with those available from investment in physical capital. A mixed picture emerges, however, when we compare the expected returns to schooling with those on infrastructure investment. In general terms, the expected return on infrastructures exceeds that on human capital in the richer Spanish regions, but the reverse is true in most of the poorer territories.

*Implications for cohesion policy*

Infrastructure investment and training schemes have traditionally been the main instruments of regional policy and have played a key role in EU efforts to increase internal cohesion. Our results indicate that both schooling levels and infrastructure endowments are significant and quantitatively important determinants of income. One direct implication is that investment in both education and infrastructures can be effective in reducing internal disequilibria within Spain and in promoting the country's convergence toward average EU income levels.

Our results also suggest that there are important differences in the role that these two types of investment can and should play in achieving these two objectives. First, there seems to be more room for reducing internal inequality through investment in human capital than in infrastructures. Differences in schooling levels account for a significant fraction of productivity differentials across regions, while the distribution of infrastructure stocks contributes very little to such differences and actually reduces them marginally. Second, the pattern of returns across regions is very different for the two factors. While the expected



returns to infrastructure are generally higher in the richer regions, the return to education tends to be higher in the poorest territories. Hence, a conflict between the two goals of cohesion policy, national convergence to EU income levels and the reduction of internal disparities, arises in relation to infrastructures, but not with regard to education. These considerations suggest that it may be possible to increase the effectiveness of both national and EU cohesion and growth policies by devoting greater resources to investment in human capital in poorer regions and by redirecting part of EU financing for infrastructures towards richer areas.

Focusing on human capital, our analysis implies that raising attainment levels in the poorer regions can have a substantial payoff in the middle and long run both in terms of overall growth and of increased internal cohesion. Although we have not formally analyzed the effects of adult training in this report, we believe that EU-financed investment in human capital should be chanelled through the public school system to a considerably greater extent than in the past. The reason is that the public school system has two important advantages over the adult training schemes that have absorbed the bulk of EU expenditure on human capital in Spain. First, it provides a more efficient vehicle for reaching a broad segment of the population, and for doing so before skill shortages begin to build up. And second, working increasingly through this more consolidated and more closely monitored channel can be expected to increase the quality of training while improving the management and control of ESF resources. It would also be advisable to exploit any potential synergies and complementarities between the adult training and public school systems, particularly at the vocational and university levels. It seems likely that sharing facilities and personnel can reduce costs and increase the quality of both systems.

The resources required to finance additional investment in human capital should come from the Spanish national and regional governments as well as from the EU's Structural Funds. In our view, the central government's main responsibility in this regard is to gradually eliminate the important differences that we now find across territories in terms of the resources per capita available to regional governments, which are the administrations that are directly responsible for the provision of education. EU structural expenditure should co-finance the building and equipment of schools in needy areas and also subsidize in part their personnel costs. Such expenditure should be subject to strict additionality requirements so as to prevent the diversion of resources to other uses. Regional cofinancing rates for operating expenses should be higher than those for capital investment, and should gradually rise over time so that regional governments eventually assume the full cost of these programmes as increased attainment begins to translate into higher income and tax revenues.

## 1. Introduction

This document is the final report on a study on the economic effects of schooling in the Spanish regions and on the potential role of investment in human capital as a tool for promoting regional growth and cohesion. It provides estimates of the economic returns to education in the regions of Spain, both from a private and from a social perspective, analyzes the impact of various government policies on private incentives to invest in human capital, and explores the likely long-term effects of educational investment on government finances. It also attempts to draw some tentative conclusions regarding the adequacy of the aggregate investment patterns observed in different territories and to identify changes in the design of national and EU cohesion and growth policies that may help enhance their effectiveness.

The study is largely a replication at the regional level of a previous report that analyzed similar issues at the level of EU member states (de la Fuente, 2003), with some extensions that attempt to increase its policy relevance. In particular, we have constructed specific estimates of private returns for the different educational levels, explored the budgetary implications of educational expenditure, and compared the social returns to schooling to those on investment on infrastructures as well as on other physical capital.

An important change relative to de la Fuente (2003) is that all the parameters that measure the effects of schooling on individual wages and labour market outcomes have been estimated econometrically using homogeneous individual-level data. This is a significant improvement, for data availability problems and the time constraints on this earlier study forced us to set the values of some key coefficients using potentially heterogeneous estimates drawn from the literature or rough calculations made with rather coarse aggregate data. One important result of this methodological change is that our current estimates of the importance of the employment effects of schooling are considerably larger than those obtained in de la Fuente (2003) for the case of Spain. In turn, this finding modifies our conclusions regarding the effects of public policies on educational incentives. Since the distortionary effects of unemployment insurance rise with the responsiveness of the probability of employment to educational attainment, our estimate of the effective tax rate on human capital rises sharply relative to the previous study as a result of a sizable increase in the component of this tax rate that captures the disincentives generated by the unemployment insurance system.

Since we have been dealing with a single country, concerns about data quality and heterogeneity, while still significant, are considerably smaller in this study than in our previous report. Our data on school attainment and educational expenditure have been constructed using information from the national census and from various publications of the Spanish government that provide reasonably homogeneous information for all regions. On the



other hand, many of the other caveats emphasized in de la Fuente (2003) and de la Fuente and Ciccone (2002) remain applicable. In particular, given the considerable uncertainty that remains concerning estimates of the returns to schooling and to other assets, our results should be regarded as indicative of the order of magnitude of the relevant effects rather than as precise estimates of their values. The margin of error, moreover, increases considerably when we attempt to draw specific conclusions for different territories rather than for the country as a whole, as regional estimates of the social returns to schooling are more sensitive to assumptions concerning funcional forms and to other estimation issues than their counterparts for the entire sample.

With all the caution this requires, our findings reinforce the conclusions of our previous reports where we emphasized that schooling is a crucial determinant of labour market outcomes at the individual level and a strategic growth factor that should play an important role in growth policies in general and in regional development schemes in particular.

As in previous studies, we find that schooling is an extremely attractive investment alternative from an individual point of view, as its expected return greatly exceeds those on the financial assets available to households. Expected returns to schooling in Spain are particularly high for university and initial vocational training. We also find that the effects of schooling on employment constitute a significant fraction of its economic payoff, especially at the lower educational levels and in the poorer regions. As for the effects of public policies on private incentives to remain in school, we find that while the tax system per se generates only modest disincentives, those arising from unemployment insurance can be considerable. From the point of view of minimizing such distortions, it would be preferrable to uncap unemployment benefits while reducing replacement ratios. Efficiency gains, however, must be balanced against the equity considerations that rightly influence the design of the social protection system. We also find that educational expenditure at post-compulsory levels is self-financing over the long run, as increased tax revenues and savings on unemployment insurance payments more than offset, in present value terms, government expenditure on education.

Disparities in educational attainment across the regions of Spain are large and unlikely to disappear spontaneously in the foreseeable future. Educational differences across regions are lower for younger cohorts than for the adult population as a whole, but remain considerable even for this segment of the population. The reduction in regional educational inequality that we observe for the younger population is largely driven by homogeneization at the bottom, that is by the achievement of nearly universal lower secondary attainment in all regions. At the other end of the educational ladder, by contrast, there is no clear pattern of regional convergence when we focus on younger cohorts, and regional disparities in terms of university attainment can actually be expected to rise in the future.

Our estimates of the contribution of schooling to aggregate productivity suggest that attainment differences can explain a significant fraction of observed regional productivity differentials, making educational investment a potentially crucial tool of regional cohesion policy. These estimates also imply that the social returns to schooling are large and, on the whole, compare favourably with those available from investment in physical capital. A mixed picture emerges, however, when we compare the expected returns to schooling with those on infrastructure investment. In general terms, the expected return on infrastructures exceeds that on human capital in the richer Spanish regions, but the reverse is true in most of the poorer territories. European and national cohesion and growth policies should take into account this diversity of regional return patterns.

The rest of the report is organized as follows. Sections 2 and 3 contain preliminary material. Section 2 describes the construction of our estimates of educational expenditure and regional attainment levels. Section 3 then presents econometric estimates of the effects of schooling on individual wages, employment probabilities and participation rates and on aggregate productivity. Sections 4-6 contain the core of the analysis. Using the results of the previous sections, in section 4 we construct measures of the private returns to schooling and analyze the impact of public policies on private incentives to invest in education. Section 5 deals with the effects of educational investment on public budgets. In section 6 we present estimates of the social return to schooling and compare them with the expected returns to investment in alternative assets. Section 7 concludes with a summary of the main conclusions and some policy recommendations. The Appendix contains technical and data details as well as the complete results of the different calculations.

## 2. Educational expenditure and attainment in the Spanish regions

This section describes the construction of two variables that will play an important role in the analysis that follows: expenditure per student and educational attainment. In subsection a we estimate average private and public regional expenditure per student at the secondary and university levels and briefly explore the determinants of regional educational spending. In subsection b we use census data to construct regional series on educational attainment covering the period 1960-2001. We also use the last available census data on the attainment of the different age subgroups to explore the likely future evolution of regional schooling disparities, present some additional indicators of regional educational performance and explore the correlation between expenditure and performance.

### a. Regional expenditure on secondary and university education

The Spanish educational system has been gradually transferred to the regional governments over the twenty years following the promulgation of the Constitution of 1978, which introduced a quasi-federal system for the territorial organization of the state. The



central government, however, is still responsible for overall curriculum design, maintains other important supervisory and regulatory functions and finances most of the scholarhip and grant programmes. It also manages directly the public school system in the two autonomous North-African cities of Ceuta and Melilla as well as two national and rather atypical universities, one that provides education at a distance (through the mail and internet) and another one that specializes in short monographic courses that take place mostly over the summer vacation period. Public schools and universities are generally managed by the education departments of the regional governments but there are some exceptions, especially at the pre-primary level where both local administrations and the Ministry of Labour and Social Affairs play a relatively important role. In addition to the public school system, there is a large number of private centers, many of which are managed by the Catholic Church. The majority of these centers have "concertation agreements" with the regional administrations and are heavily subsidized. In principle, concerted schools are free, but they often raise significant revenues from fees for non-core academic activities and from voluntary contributions channeled through parents' associations.

We have estimated private and public expenditure per student in formal education at the secondary and university levels using data from different publications of the Ministries of Education and Finance and the National Statistical Institute. The details are in section 1 of the Appendix. Secondary schooling includes basic and advanced vocational training as well as general academic programmes and the schooling of students with special needs who have entered this educational level. We leave out the North-African territories of Ceuta and Melilla and the two national universities mentioned above. Public expenditure includes the operating costs of public educational institutions (net of research expenditure by universities), subsidies to concerted private centers, an estimate of the relevant indirect costs (general administration and support programmes) and two types of subsidies to households: tuition-related grants (which take almost exclusively the form of tuition waivers at the university level) and cash subsidies that help defray living expenses and other costs. Private expenditure is defined as the difference between academic fees paid by households and non-tuition subsidies received by them (and will be negative when subsidies exceed direct costs as in the case of Extremadura in Table 1 below). Hence, we do not take into account expenditure on books, school materials, lodging or transportation. Total expenditure is calculated as the sum of public and private expenditure. Notice that this definition means that non-tuition grants will cancel and drop out of the total.

Table 1 shows average expenditure per student at each level for the entire educational system, without distinguishing between students enrolled in private and public centers. These figures are normalized by average expenditure per student in the entire country (excluding Ceuta and Melilla). The last two columns (labeled *combined expenditure*) try to approximate the cost per student of a marginal incease in upper secondary attainment under the assumption that half of the new graduates will go on to university. They are weighted averages of expenditure per student at the secondary and tertiary levels with weights of 2/3 and 1/3 respectively.

**Table 1: Average expenditure per student, 2000**
**(weighted avge. of all regions = 100)**

| | *SECONDARY* | | *UNIVERSITY* | | *COMBINED* | | |
|---|---|---|---|---|---|---|---|
| | *private* | *total* | *private* | *total* | *private* | *public* | *total* |
| *País Vasco* | 194.3 | 154.6 | 109.0 | 89.8 | 132.7 | 132.9 | 132.9 |
| *Rioja* | 41.3 | 104.4 | 88.5 | 177.4 | 75.4 | 136.1 | 128.9 |
| *Navarra* | 60.6 | 147.1 | 142.4 | 80.2 | 119.7 | 125.3 | 124.7 |
| *Cantabria* | 32.2 | 101.4 | 112.0 | 137.8 | 89.9 | 116.8 | 113.6 |
| *Cataluña* | 221.8 | 112.8 | 167.8 | 111.9 | 182.8 | 103.0 | 112.5 |
| *Aragón* | 98.8 | 110.4 | 100.0 | 105.6 | 99.7 | 110.0 | 108.8 |
| *Canarias* | 58.8 | 112.2 | 29.8 | 94.6 | 37.8 | 115.5 | 106.3 |
| *Valencia* | 86.4 | 101.5 | 76.3 | 104.8 | 79.1 | 105.8 | 102.6 |
| *Cast. y León* | 46.1 | 103.5 | 67.2 | 98.3 | 61.3 | 107.3 | 101.8 |
| *Asturias* | 80.9 | 102.8 | 72.7 | 99.0 | 75.0 | 105.1 | 101.5 |
| *Galicia* | 56.9 | 108.9 | 54.0 | 86.0 | 54.8 | 107.5 | 101.3 |
| *Madrid* | 242.7 | 87.1 | 186.9 | 121.7 | 202.4 | 84.7 | 98.7 |
| *Baleares* | 104.5 | 103.2 | 88.4 | 72.7 | 92.9 | 93.0 | 93.0 |
| *Cast.-Mancha* | 5.7 | 92.0 | 27.3 | 93.1 | 21.3 | 102.0 | 92.4 |
| *Murcia* | 18.3 | 84.2 | 68.5 | 101.3 | 54.5 | 94.7 | 89.9 |
| *Extremadura* | -23.4 | 81.3 | -8.5 | 84.5 | -12.7 | 95.2 | 82.4 |
| *Andalucía* | 14.1 | 80.7 | 45.1 | 78.2 | 36.5 | 85.7 | 79.9 |
| *average* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| *average, euros* | *159* | *3,204* | *829* | *3,233* | *382* | *2,831* | *3,214* |
| *avge. Obj. 1* | 37.9 | 94.2 | 54.5 | 91.2 | 49.9 | 99.0 | 93.2 |
| *avge. rest* | 203.1 | 109.7 | 160.1 | 111.6 | 172.0 | 102.0 | 110.3 |

- *Note:* expenditure per student is always calculated by dividing the relevant total expenditure (private, public or both) by the total number of students, independently of whether they are enrolled in private or in public institutions. Average secondary and university expenditure in Objective 1 and non-Objective 1 regions are obtained by weighting regional expenditure levels in proportion to enrollments at each level. Combined expenditure is then obtained by averaging across levels with the same weights as elsewhere (2/3 and 1/3).

As may be expected, expenditure per student rises with income per capita and with the resources available to regional governments. A regression of combined total expenditure per student on these two variables, with all magnitudes measured in percentage deviations from the Spanish average, gives the following results:[1]

(1) *expenditure per student = 0.508*regional financing per capita + 0.367*income per capita*
*(t =) (3.61) (3.34)*

with an $R^2$ of 0.621. Income per capita is measured by GDP per capita in 1995 and the data on regional financing per capita, taken from de la Fuente (2000), refer to 1997 (which is the

[1] The ratio of the total number of secondary and university students to the population aged 25 and over was not significant in equation (1).



**Figure 1: Public expenditure per student vs. regional financing per capita**

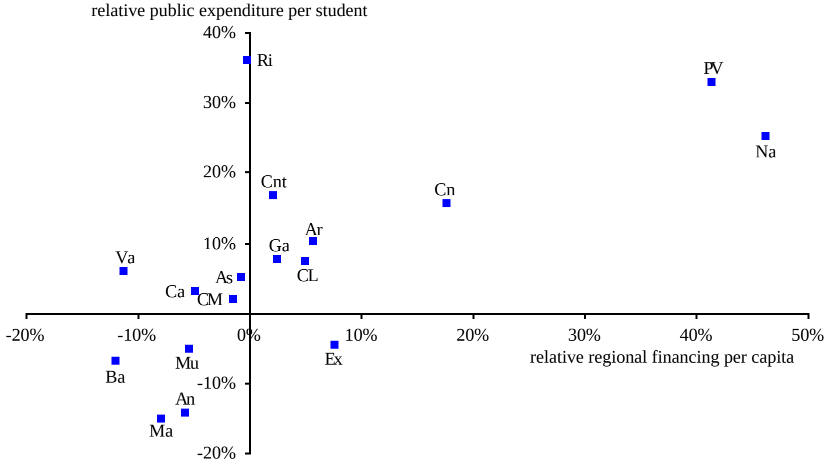
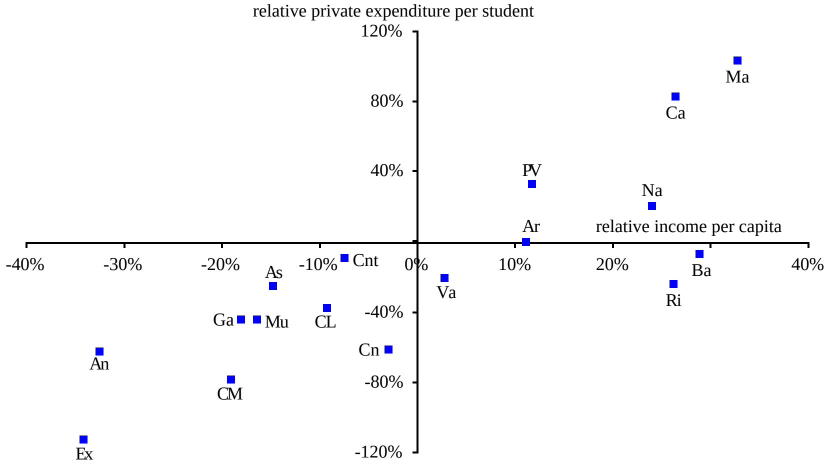



**Figure 2: Private expenditure per student vs. income per capita**




*Notes:*
- All variables measured in percentage deviations from their national means.
- Relative income per capita is GDP per capita in percentage deviations from the national average in 1995. The data used to calculate it are taken from Fundación BBV (2000).

- *Key: An* = Andalucia; *Ar* = Aragón; *As* = Asturias; *Ba* = Baleares; *Cn* = Canarias; *Cnt* = Cantabria; *CL* = Castilla y León; *CM* = Castilla la Mancha; *Cat* = Cataluña; *Va* = Valencia; *Ex* = Extremadura; *Ga* = Galicia; *Ma* = Madrid; *Mu* = Murcia; *Na* = Navarra; *PV* = País Vasco; *Ri* = Rioja.

latest year for which they are available) and have been homogenized to correct for differences across regions in the functions they had assumed in that date.[2]

Figures 1 and 2 plot the private and public components of expenditure per student against the two explanatory variables of equation (1), with all variables again measured in percentage deviations from national averages. The private component of expenditure per student rises with income per capita, and the public one appears to be quite sensitive to regional financing.

**b. School attainment and other educational indicators**

In this section we construct and analyze measures of school attainment by region and cohort and other educational indicators.

**i. The evolution of regional school attainment levels**

We have used data from the national census and the municipal registers to construct new regional series of educational attainment covering the period 1960-2000. (See section 2 of the Appendix for details). We provide estimates of the fraction of the population aged 25 and over that has started (but not necessarily completed) each of the following levels of education: illiterates *(L0)*, primary schooling (*L1*), lower and upper secondary schooling (*L2.1* and *L2.2*) and two levels of higher education (*L3.1* and *L3.2*).

**Table 2: Attainment levels and cumulative durations**

| *code* | *level* | *Spanish equivalent* | *duration* |
|---|---|---|---|
| *L0* | Illiterates | | 0 |
| *L1* | Primary | primaria, graduado escolar | 5 |
| *L2.1* | Lower secondary | EGB, bachiller elemental, ESO | 8 |
| *L2.2* | Upper secondary | bachillerato, COU, FP I and FP II | 12 |
| *L3.1* | Higher education, first level | diplomatura, peritaje | 14 |
| *L3.2* | Higher education, second level | licenciatura | 17 |

Table 2 lists the Spanish equivalents of the different attainment levels (which have changed over time) and their typical cumulative durations. Tables A.12-A.17 in section 2 of the Appendix contain detailed results on the composition of the adult population by educational level between 1960 and 2000. Using these data and the durations given in Table 2, we have estimated average years of attainment, which is shown in Table 3. The table shows normalized attainments, with the national average set to 100 in each period and the regions

[2] On the other hand, a dummy for Rioja is significant when added to equation (1). Notice that this region is a clear outlier in Figure 1 because of its very high public expenditure per student at the university level. This seems to be largely due to the fact that this region's university is of recent creation. As a result, expenditure includes large set up and investment components.
When a Rioja dummy is added, the coefficients of regional financing and income per capita in equation (1) become 0.522 (t = 4.27) and 0.293 (t = 2.94) respectively.



ordered by decreasing schooling in 2000. The last two rows show, respectively, average attainment in years for the country as a whole and the coefficient of variation across regions of relative attainment.

**Table 3: Normalized average years of schooling, Spain = 100**

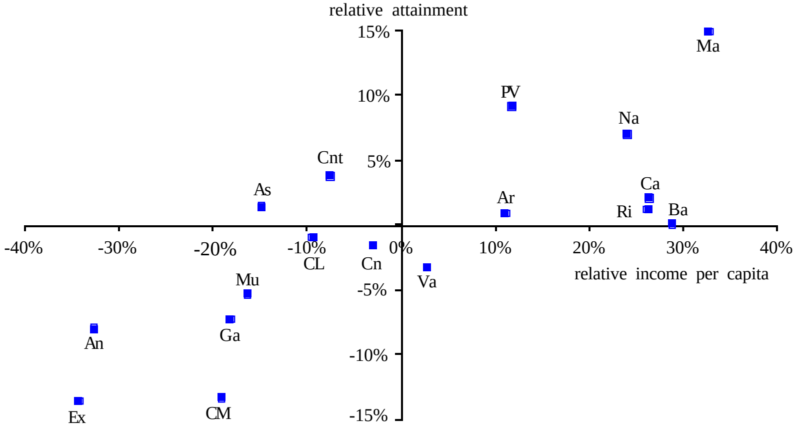
| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Madrid* | 120.9 | 120.2 | 119.6 | 120.2 | 120.7 | 118.5 | 116.8 | 114.9 | 114.2 |
| *P. Vasco* | 112.9 | 111.4 | 109.9 | 109.5 | 109.1 | 108.8 | 109.3 | 109.1 | 109.8 |
| *Navarra* | 108.3 | 108.6 | 108.8 | 108.0 | 107.3 | 106.7 | 106.9 | 106.9 | 108.0 |
| *Cantabria* | 112.1 | 110.0 | 108.0 | 107.0 | 106.1 | 104.8 | 104.3 | 103.8 | 104.2 |
| *Rioja* | 107.2 | 105.3 | 103.4 | 102.5 | 101.7 | 100.6 | 100.3 | 101.2 | 103.1 |
| *Cataluña* | 105.8 | 104.4 | 103.1 | 103.9 | 104.6 | 103.6 | 103.1 | 102.1 | 101.9 |
| *Aragón* | 102.1 | 102.0 | 101.8 | 101.0 | 100.3 | 100.1 | 100.7 | 100.9 | 101.9 |
| *Asturias* | 109.1 | 107.9 | 106.7 | 105.2 | 103.9 | 102.6 | 102.2 | 101.4 | 101.4 |
| *Baleares* | 98.0 | 98.4 | 98.8 | 99.0 | 99.1 | 99.5 | 100.6 | 100.1 | 100.3 |
| *Cast. y León* | 106.2 | 105.1 | 104.0 | 102.6 | 101.4 | 100.1 | 99.7 | 99.0 | 99.3 |
| *Canarias* | 91.9 | 94.4 | 96.8 | 97.1 | 97.4 | 98.1 | 99.5 | 98.4 | 97.9 |
| *Valencia* | 99.0 | 98.2 | 97.5 | 96.7 | 96.0 | 96.0 | 96.8 | 96.7 | 97.3 |
| *Murcia* | 93.2 | 92.6 | 92.0 | 90.8 | 89.7 | 91.5 | 94.3 | 94.7 | 95.4 |
| *Galicia* | 97.9 | 97.3 | 96.7 | 95.0 | 93.6 | 92.7 | 92.6 | 92.7 | 93.6 |
| *Andalucía* | 86.9 | 87.7 | 88.4 | 88.5 | 88.6 | 89.7 | 91.5 | 92.0 | 93.0 |
| *Cast.-Man.* | 86.7 | 87.0 | 87.2 | 85.8 | 84.4 | 84.9 | 86.2 | 86.7 | 87.6 |
| *Extremadura* | 85.6 | 86.1 | 86.5 | 85.3 | 84.3 | 84.9 | 86.3 | 86.4 | 87.0 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| *Spain, years* | *4.97* | *5.08* | *5.19* | *5.53* | *5.87* | *6.35* | *6.84* | *7.52* | *8.19* |
| *coef. of var.* | *9.8%* | *9.2%* | *8.6%* | *8.9%* | *9.2%* | *8.5%* | *7.7%* | *7.3%* | *7.1%* |

Average educational attainment in Spain rose by over 60% between 1960 and 2000 while the dispersion of attainment levels across regions fell by 28%. Progress on both fronts was considerably faster during the second half of the sample period. Following some oscillations in the first two decades of the sample, regional attainment disparities decrease steadily after 1980 and the growth rate of years of attainment roughly doubles relative to the first half of the sample.

Using data for 1995, Figure 3 shows that educational attainment is closely related to income per capita. The correlation between relative income per capita and relative attainment (both measured in percentage deviations from the national mean) is 0.773 and the majority of the regions concentrate on the north-eastern and southwestern quadrants of Figure 3, indicating that below-average income goes hand in hand with below-average attainment. In particular, all Objective 1 regions[3] but two (Asturias and Cantabria) have attainment levels below the national mean.

[3] Valencia (Va) and all the regions located to its left in Figure 3 were Objective 1 regions in 1995.

**Figure 3: Relative attainment vs. relative GDP per capita in 1995**




- *Note:* relative income per capita is GDP per capita in percentage deviations from the national average in 1995. The data used to calculate it are taken from Fundación BBV (2000).

- *Key: An* = Andalucia; *Ar* = Aragón; *As* = Asturias; *Ba* = Baleares; *Cn* = Canarias; *Cnt* = Cantabria; *CL* = Castilla y León; *CM* = Castilla la Mancha; *Cat* = Cataluña; *Va* = Valencia; *Ex* = Extremadura; *Ga* = Galicia; *Ma* = Madrid; *Mu* = Murcia; *Na* = Navarra; *PV* = País Vasco; *Ri* = Rioja.

**ii. Attainment by cohort and the likely evolution of educational disparities**

Using data from the 2001 Census, we have constructed measures of educational attainment by cohort for the different regions (see section 2 of the Appendix for details). This section explores the implications of these data for the likely future evolution of regional educational disparities. In particular, we construct indicators of educational convergence between regions as we move to younger and younger cohorts and interpret them as predictors of future trends in educational convergence. Although the dispersion of schooling levels across regions is significantly smaller for younger cohorts than for the overall population, we conclude that sizable disparities are likely to persist in the future. At higher attainment levels, differences across regions may actually be expected to increase over time.

Table 4 shows average attainment by cohort in each region in 2001. The body of the table shows values normalized by average Spanish attainment (shown in years in the penultimate row), and the last row of the table shows the dispersion across regions of relative attainment, measured by its coefficient of variation. The first column refers to the entire adult population (25+), and the remaining columns to different age subgroups.

As expected, attainment rises sharply and its dispersion across regions falls as we move from older to younger cohorts. A comparison between the first and second columns of the table (i.e. between the entire adult population and its youngest cohort) can be especially informative, as it tells us how the existing situation is likely to change in the future assuming



that current enrollment patterns remain unchanged and that there are no significant migration flows. Under these assumptions, regional disparities in attainment can be expected to fall by 26.3% in the future (i.e. the coefficient of variation of relative attainment would drop from 9.2% to 6.8%). This is a rather significant change, but it would still leave a substantial amount of regional inequality and a difference in relative attainment of over twenty points between the top and the bottom regions.

**Table 4: Average years of schooling by cohort, 2001 (Spain = 100)**

| | *25+* | *25-34* | *35-44* | *45-54* | *55-64* | *65+* |
|---|---|---|---|---|---|---|
| *Madrid* | 116.4 | 110.3 | 113.2 | 113.7 | 118.7 | 119.9 |
| *P. Vasco* | 113.0 | 111.9 | 112.6 | 110.9 | 114.3 | 122.6 |
| *Navarra* | 111.8 | 107.7 | 108.4 | 110.9 | 118.2 | 125.9 |
| *Cantabria* | 106.7 | 102.8 | 104.7 | 107.7 | 114.8 | 121.3 |
| *Rioja* | 105.7 | 103.9 | 104.6 | 106.9 | 111.2 | 117.0 |
| *Aragón* | 103.4 | 105.6 | 105.8 | 107.3 | 109.3 | 107.8 |
| *Cataluña* | 102.5 | 101.1 | 102.6 | 102.3 | 102.9 | 107.0 |
| *Asturias* | 102.4 | 105.5 | 105.7 | 105.1 | 106.2 | 110.2 |
| *Baleares* | 101.1 | 93.7 | 96.4 | 101.3 | 108.8 | 107.6 |
| *C.-León* | 100.7 | 105.2 | 103.4 | 103.3 | 104.6 | 109.3 |
| *Canarias* | 97.6 | 92.0 | 92.9 | 95.0 | 95.4 | 93.4 |
| *Valencia* | 97.3 | 96.6 | 96.2 | 97.6 | 97.7 | 98.4 |
| *Murcia* | 93.7 | 92.1 | 94.1 | 93.0 | 88.4 | 83.8 |
| *Galicia* | 91.8 | 100.4 | 96.4 | 92.7 | 91.5 | 90.4 |
| *Andalucía* | 90.7 | 92.6 | 90.6 | 89.1 | 85.5 | 80.8 |
| *C.-Mancha* | 83.5 | 91.6 | 89.9 | 87.0 | 77.1 | 69.6 |
| *Extremadura* | 83.1 | 92.0 | 88.2 | 84.4 | 77.6 | 71.2 |
| *Spain* | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| *Spain (years)* | *7.93* | *10.61* | *9.56* | *8.07* | *6.32* | *4.55* |
| *coeff. of var.* | 9.2% | 6.8% | 7.6% | 8.7% | 12.9% | 17.0% |

- *Note:* estimates for the 25+ population do not coincide exactly with those given in Table 3 for two reasons. First, they correspond to 2001 rather than to 2000, and second, in this table we are using a finer breakdown by educational level than in Table 3 (because such a breakdown was not available for earlier census data).

Figure 4 plots relative attainment of the 25-34 and 25+ age groups against relative income per capita in 1995. Focusing on the bottom of the income distribution, many of the poorer regions seem to be doing quite well in terms of raising the relative attainment levels of their younger citizens. The exceptions are Andalucía, Murcia and Canarias (*An*, *Mu* and *Cn*). In the first case the gains are rather small, and in the last two relative attainment levels actually drop when we consider the youngest cohort. At the other end of the income scale, the evolution of Baleares *(Ba)* is also worrisome, as this region is clearly heading towards below average attainment levels in the future.[4]

[4] It is worth noting that the two island regions (Baleares and Canarias) show rather marked declines in relative attainment for the younger population. It is possible that plentiful job opportunities in the booming touristic sector may be discouraging youngsters from staying in schoool beyond the compulsory age.

**Figure 4: Relative attainment in years vs. relative income per capita in 1995**

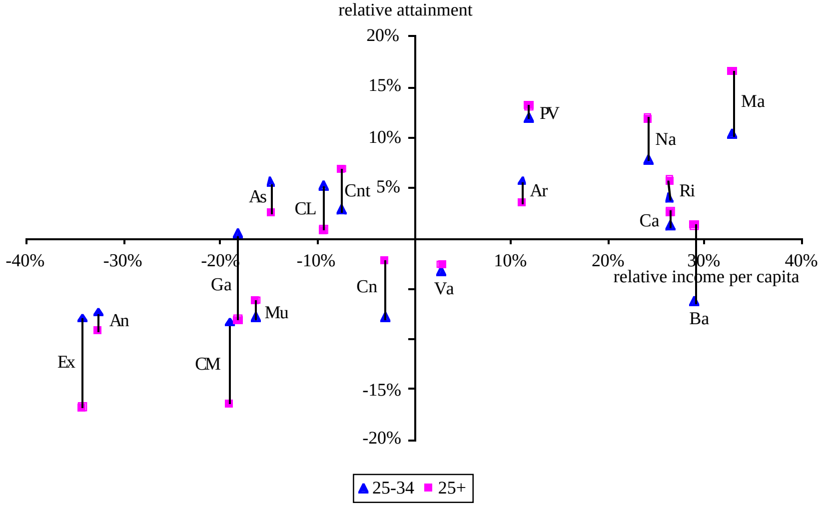
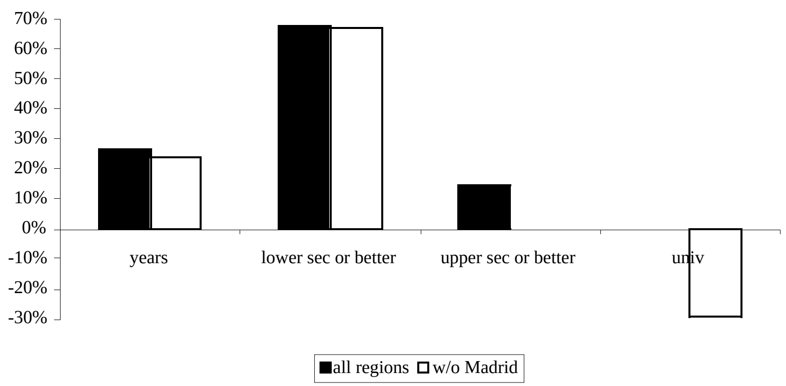



**Figure 5: Regional convergence of attainment levels across cohorts**




- *Note:* percentage decrease in the coefficient of variation across regions as we go from the entire adult population (25+) to the youngest cohort (20-24 for lower and upper secondary or better and 25-34 for university).

To see what is driving the process of regional convergence in years of schooling across cohorts, it is useful to examine how regional disparities vary across age groups for different educational levels. Figure 5 shows the degree of convergence across cohorts for four different educational indicators: the average number of years of schooling and the fraction of the population which has completed at least each of three successively higher educational levels (lower secondary, upper secondary including vocational training, and the first cycle of



university). Convergence is measured by the percentage reduction in the coefficient of variation across regions of the relevant attainment measure that we observe as we go from the entire population to the youngest relevant cohort. This indicator is computed for all regions together and for a restricted sample that excludes Madrid (which as we will see shortly displays rather atypical behaviour in some ways).[5]

The figure suggests that the process of convergence in years of schooling is driven mainly by the extension of compulsory schooling to the lower secondary level. Attainment rates at this level are uniformly very high across regions for younger cohorts. Things are rather different, however, for post-compulsory cycles. If we exclude Madrid from the sample, there is absolutely no convergence across cohorts in terms of upper secondary (or better) attainment, and regional disparities in terms of university attainment can actually be expected to increase by 30% in the future.

**Figure 6: Regional convergence in university attainment across cohorts**

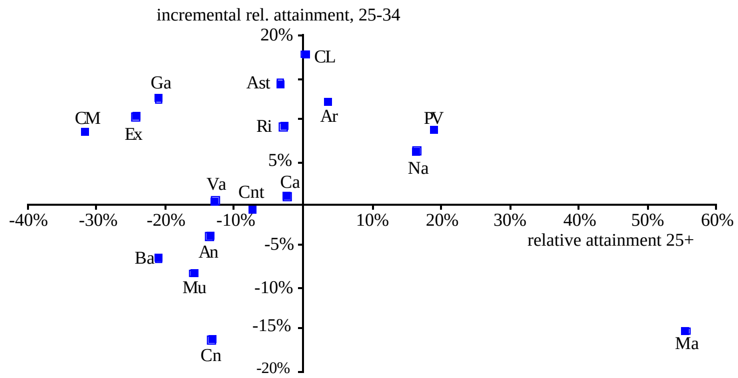


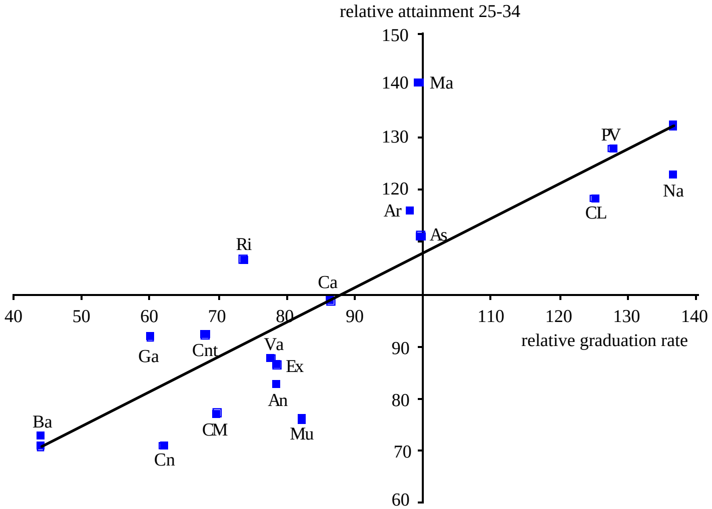

Figure 6 shows what is behind this last finding. It plots the increase in relative university attainment as we go from the 25+ to the 25-34 age groups against the relative attainment of the 25+ population. Notice that Madrid is an extreme outlier in this figure. If we keep it in the sample, there is a broadly negative relationship between the two variables that may be taken as an indication of convergence (i.e. that intially less educated regions are making faster progress). In the absence of Madrid, however, this is no longer the case. Moreover, more than half the regions display divergent behaviour, meaning that university attainment tends to rise further in regions that are already above the national average (Castilla and León,

5 Being the seat of the national government, and of most large company headquarters, Madrid has traditionally attracted large numbers of highly skilled people. Over the last twenty-five years, however, this factor has become increasingly less important as a result of the process of decentralization and the creation of the regional governments.

Aragón, Navarra and Pais Vasco), and to fall in regions that are below the Spanish mean (Baleares, Murcia, Andalucía, Canarias and Cantabria).

A region may fail to raise its university attainment level either because it does not succeed in giving enough of its residents a university education or because a large fraction of those who do achieve such qualifications migrate to other regions. To get some feeling for the contribution of migration flows to the evolution of university attainment, Figure 7 plots the relative attainment level of the 25-34 age group against the relative university graduation rate, together with the fitted regression line. The (gross) university graduation rate is originally defined as the ratio between the total number of graduates in the universities of a region during a given academic year and the total population of the same region with the theretical age of college graduation. I have corrected this variable so that it approximates the graduation rate by region of origin (rather than by location of the university).[6]

**Figure 7: Relative university attainment 25-34 vs. relative graduation rate by region of origin**




Large deviations from the fitted regression line in Figure 7 alert us to regions where migration flows are important determinants of university attainment rates for young cohorts. As expected, Madrid shows a large positive deviation that signals a large inflow of young university graduates from other regions (or an inflow of university students who remain in the region after graduation). At the other extreme, the migration of highly qualified young

[6] The data on gross graduation rates are taken from Ministerio de Educación (2002). Actually, this source provides two separate graduation rates for short and long univesity courses. I have added both rates to approximate the overall gross graduation rate. This figure is then multiplied by a correction factor that is constructed as the quotient between the number of university students whose family residence is in a given region, and the total number of students enrolled in universities located in the same region. Both the numerator and the denominator exclude graduate students.



people appears to be an important problem in Murcia, Castilla la Mancha, Canarias and Andalucía. In all these regions, however, gross graduation rates are well below the national average, indicating that migration is not the only cause of the problem.

**iii. Other indicators of educational performance**

In this section we construct a set of indicators that measure regional educational performance along two dimensions: access to non-compulsory schooling cycles, and academic success at different educational levels. Table 5 gives the relative values of the different indicators, normalized by the corresponding national averages, which are set to 100 in all cases. The raw values of the different variables are shown in Table A.25 in the Appendix and, for the case of Spain as a whole, in the last row of Table 5. The information is taken from Ministerio de Educación (2002) and Consejo de Universidades (2002) and refers to 1999-2000 or to some nearby year.

The first panel of Table 5 contains several indicators of academic success at different schooling levels. Success rates in mandatory cycles are measured by regional adequacy ratios at ages 12 and 15 (*adeq12* and *adeq15*), which are defined as the percentage of students of those ages that are enrolled in the level that corresponds to them according to their age. The third and fourth columns contain two variables that try to approximate the probability of completing upper secondary schooling *(uppsec)* and university training *(univ)*. *Uppsec* corresponds, roughly, to the probability of completing upper secondary schooling on time. Its raw value is obtained by multiplying the promotion rates for the two courses of this level, defined as the percentage of enrolled students that successfully complete each grade.[7] *Univ* is defined as the ratio of graduates from long university cycles in 1999-2000 to the number of students entering these cycles five years earlier and will therefore approximate the probability of obtaining a university degree but not necessarily within its theoretical duration. The last column of the table contains a combined indicator *(success)* which is constructed as an unweighted average of the partial indicators given in the previous columns of the table. Regions are ranked by this combined indicator.

Panel b of Table 5 contains indicators of access to non-compulsory educational levels. Access to pre-primary education is measured by the expected years of pre-primary schooling in each region *(pre-school)*, which is calculated using enrollment rates at different pre-primary levels. Access to post-compulsory schooling is measured by the net enrollment rate in any post-compulsory cycle at age 17 *(enr17pc)*, and by the net enrollment rate in university at age 20 *(enr20univ)*. Net enrollment rates are defined as the percentage of the population of a given age that are enrolled in the relevant course. Net enrollment rates for university peak at 20

[7] Since the old and new systems coexist at this level, completion rates are calculated first for the different systems and then averaged, using as weights the share of students enrolled in each system.

**Table 5: Selected educational indicators**

**a. Academic success at different educational levels**

| | *adeq12* | *adeq15* | *uppsec* | *univ* | *success* |
|---|---|---|---|---|---|
| *País Vasco* | 102.8 | 113.8 | 127.2 | 106.2 | *112.5* |
| *Navarra* | 104.1 | 113.0 | 134.4 | 98.1 | *112.4* |
| *Cataluña* | 103.9 | 129.7 | 98.0 | 110.3 | *110.5* |
| *Asturias* | 102.8 | 104.1 | 101.2 | 123.8 | *108.0* |
| *Madrid* | 101.3 | 99.7 | 100.5 | 115.6 | *104.3* |
| *Valencia* | 100.3 | 95.9 | 94.5 | 102.9 | *98.4* |
| *Aragón* | 102.0 | 101.9 | 112.5 | 75.8 | *98.0* |
| *C.-León* | 101.4 | 94.4 | 91.5 | 102.8 | *97.5* |
| *Andalucía* | 97.4 | 90.3 | 116.0 | 83.7 | *96.9* |
| *Rioja* | 102.7 | 102.2 | 105.5 | 75.8 | *96.5* |
| *Cantabria* | 102.3 | 96.2 | 89.6 | 84.9 | *93.3* |
| *C.-Mancha* | 99.4 | 89.2 | 97.7 | 79.0 | *91.3* |
| *Galicia* | 99.3 | 94.8 | 85.6 | 75.7 | *88.9* |
| *Murcia* | 98.8 | 90.1 | 88.9 | 76.7 | *88.6* |
| *Extremadura* | 100.6 | 89.7 | 92.4 | 65.5 | *87.0* |
| *Canarias* | 94.6 | 90.8 | 73.0 | 68.9 | *81.8* |
| *Baleares* | 94.6 | 85.8 | 92.4 | 53.2 | *81.5* |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| *Spain (level)* | 90.1% | 63.9% | 49.1% | 77.7% | |

**b. Access to non-compulsory schooling**

| | *pre-school* | *enr17pc* | *enr20univ* | *access* | *perf* |
|---|---|---|---|---|---|
| *País Vasco* | 117.12 | 127.48 | 118.46 | *121.02* | *117.8* |
| *Navarra* | 96.91 | 124.47 | 118.95 | *113.44* | *115.3* |
| *Cast. y León* | 98.99 | 108.00 | 116.78 | *107.93* | *101.8* |
| *Aragón* | 99.02 | 116.66 | 108.04 | *107.91* | *106.7* |
| *Asturias* | 96.78 | 111.22 | 114.73 | *107.58* | *105.1* |
| *Madrid* | 105.50 | 110.83 | 93.75 | *103.36* | *101.9* |
| *Cataluña* | 122.39 | 100.85 | 81.06 | *101.43* | *106.0* |
| *Rioja* | 99.22 | 110.53 | 70.58 | *93.45* | *98.4* |
| *Cast. Mancha* | 97.20 | 88.91 | 93.33 | *93.15* | *94.3* |
| *Cantabria* | 96.13 | 99.66 | 76.27 | *90.69* | *93.4* |
| *Valencia* | 94.24 | 90.47 | 86.79 | *90.50* | *93.7* |
| *Extremadura* | 95.96 | 87.43 | 82.37 | *88.59* | *91.4* |
| *Murcia* | 101.46 | 91.99 | 71.33 | *88.26* | *90.4* |
| *Andalucía* | 83.08 | 92.99 | 86.14 | *87.40* | *94.3* |
| *Galicia* | 93.26 | 100.17 | 65.67 | *86.37* | *89.8* |
| *Canarias* | 95.61 | 94.81 | 61.43 | *83.95* | *85.0* |
| *Baleares* | 99.77 | 81.96 | 63.85 | *81.86* | *86.4* |
| *Spain* | *100.00* | *100.00* | *100.00* | *100.00* | *100.0* |
| *Spain (level)* | 3.07 | 63.9% | 32.0% | | |



presumably because of late entry of some applicants. As in the previous section (see footnote 6), I have corrected the net university enrollment rate so that it reflects the region of origin of the student population, rather than the location of the center where they are enrolled. The last two columns of the table contain a combined indicator of access to non-compulsory schooling *(access)* and an overall peformance index *(perf)*. The access indicator is an unweighted average of the variables in the previous columns, and *perf* is a simple average of the success and access indicators. Figure 8 shows the ranking of regions according to the overall performance indicator.

**Figure 8: Relative educational performance *(perf)***

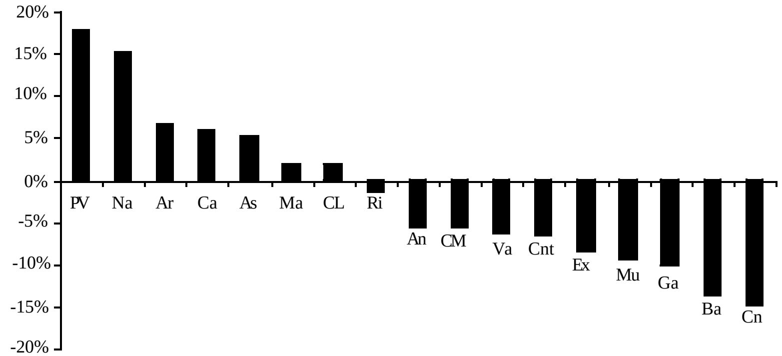



Figure 9 shows that there is no apparent trade-off between educational access and success, as the correlation between these two variables is positive and high. Figure 10 plots the combined educational peformance index against income per capita in 1995. With only three significant exceptions (Asturias, Castilla y León and Baleares), Objective 1 regions display below-average educational performance, and richer territories lie above the national mean in terms of this indicator.

Table 6 shows the results of regressing different performance indicators on two variables that can be reasonably expected to have an important effect on them, namely, expenditure per student and the average attainment of the adult population (which we interpret as a proxy for parental attainment).[8] The estimated coefficients of both variables are positive as expected, but not always significant (which is perhaps not surprising given the small number of observations and the coarseness of some of our indicators). Parental attainment seems to be especially important as a determinant of the decision to continue studying beyond the

[8] It is interesting to note that this second variable performs much better than average income per capita in regressions like the ones summarized in Table 6, suggesting that parental education is more important than income per se as a determinant of academic success.

compulsory level (equation [1]), and expenditure per student at the secondary level appears to



**Figure 9: Educational access vs. success**

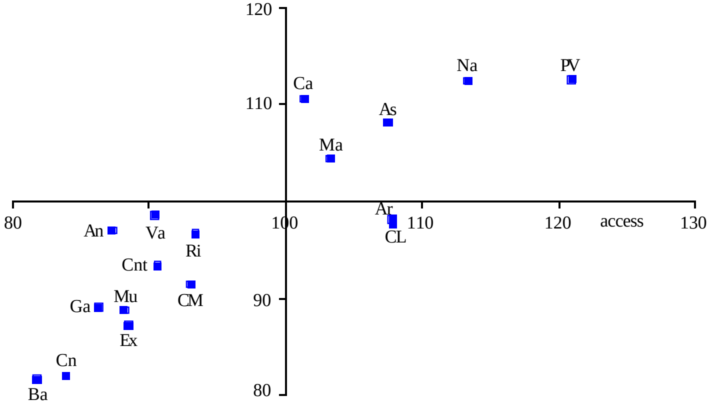
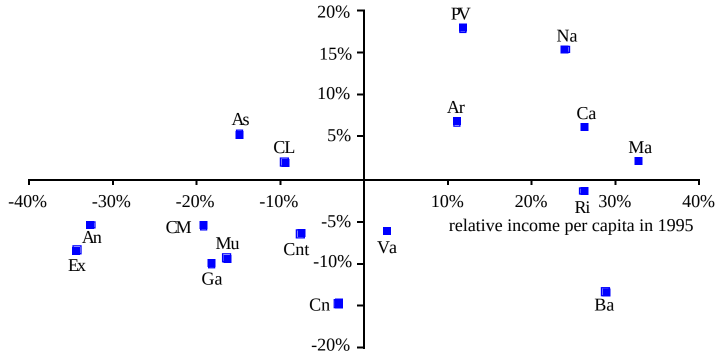



**Figure 10: Combined educational performance *(perf)* vs. relative income per capita**




be an important determinant of both access and success at pre-university levels (equations [1], [3] and [4]). Measures of university or combined spending, on the other hand, are not significant determinants of tertiary access or success (see equations [2] and [5]) even when we add a dummy to control for Rioja where, as noted above, university expenditure per student may be greatly overestimated. Both adult attainment and expenditure have positive effects on the overall performance indicator, although neither coefficient is significant at the 5% level (equation [6]).

**Table 6: Expenditure, attainment and educational performance**

| | [1] *enr17pc* | [2] *enr20univ* | [3] *adeq15* | [4] *uppsec* | [5] *univ* | [6] *perf* |
|---|---|---|---|---|---|---|
| *secondary expenditure* | 0.251 | | 0.243 | 0.347 | | |
| | (2.10) | | (1.88) | (1.81) | | |
| *university expenditure* | | | | | 0.263 | |
| | | | | | (0.92) | |
| *combined expenditure* | | 0.297 | | | | 0.306 |
| | | (0.64) | | | | (1.74) |
| *attainment 25+* | 0.762 | 0.620 | 0.403 | 0.339 | 0.984 | 0.359 |
| | (3.01) | (0.92) | (1.47) | (0.83) | (1.99) | (1.40) |
| *dummy Rioja* | | -0.239 | | | -0.310 | -0.078 |
| | | (1.38) | | | (1.41) | (1.19) |
| $R^2$ | 0.661 | 0.208 | 0.454 | 0.350 | 0.364 | 0.522 |

*Notes*
- *t* ratios in parentheses below each coefficient.
- All equations include a constant, whose value is not reported.

### 3. Econometric estimates of the effects of schooling

In this section we present some econometric estimates of the effects of schooling on individual wages and labour market outcomes and on aggregate productivity growth. These estimates will be a key input to the rate of return calculations reported below.

#### a. Schooling and wages

The 1995 Wage Structure Survey (WSS) is a large employer survey undertaken by the National Statistical Institute. It provides data on the wages, working hours and personal characteristics for a sample of 155,000 workers drawn from a population of around 3.6 million salaried employees working in private establishments of at least 10 workers in all sectors except for agriculture and fisheries. Using these data we have estimated two different wage regressions for each region.[9] The first one is a standard Mincerian wage equation of the form

$$(2)\ \ln W_i = c + \theta S_i + a{*}potexp_i + b{*}potexp_i^2 + d{*}Dsex_i + e{*}Dcoal + u_i$$

where $W_i$ is the gross hourly wage of worker *i* (before income tax and employee social security contributions are witheld), *c* a constant and $u_i$ a random disturbance. The explanatory variables are the number of years of schooling *(S)*, potential experience *(potexp*, defined as the time elapsed since the completion of education) and its square, and two dummy variables, one for the sex of the worker *(Dsex)* and the other for the coal mining sector *(Dcoal)*. The last variable is included because coal mining is a peculiar sector that mostly employs workers without qualifications but pays extremely high wages, in part because it is dominated by a

9 See de la Fuente and Jimeno (2003) for additional details on the estimates presented in this subsection and in the following one.



public enterprise with a highly unionized and militant labour force, and in part as compensation for the high occupational risks faced by miners.[10] The second specification is identical to equation (2) except that the years of schooling variable *(S)* is replaced by a set of dummy variables, one for each of the educational levels listed in Table 7.[11]

**Table 7: Attainment levels used in the WSS and cumulative durations**

| | *cumulative duration* |
|---|---|
| primary or no schooling | 5 |
| lower secondary (EGB) | 8 |
| basic vocational training (FP I) | 10 |
| upper secondary (bachillerato) | 12 |
| advanced vocational training (FP II) | 13 |
| university, 1st cycle (diplomatura) | 15 |
| university, 2nd cycle (licenciatura) | 17 |

It is important to note that the WSS is not a random sample comprised of independent observations drawn from a common distribution with equal probabilities. The probability that a worker will be included in the sample varies across sectors, establishment sizes and regions, and it is likely that wages will be highly correlated within a given firm. Since these features of the data can lead to inconsistent estimates of the relevant coefficients or of their standard errors when Ordinary Least Squares (OLS) is used, we have estimated both specifications using a Weighted Least Squares technique (WLS) that weights observations by the inverse of their inclusion probabilities (the survey's elevation factors) and we have allowed for the possible correlation of wages within firms when computing standard errors.[12]

The detailed results of the estimation are shown in Tables A.26 and A.27 of the Appendix. Table 8 shows the estimated values of the parameters that measure the effects of schooling on wages. The first column shows the coefficient of years of schooling in the Mincerian specification *(θ)*, which measures the percentage increase in wages associated with a one-year increase in attainment. The entries in the other columns ($\theta_i$ with *i* = *ls*, *us*, *lv*, *uv*, *lu* and *uu*) capture the marginal returns *per year* to each educational level relative to the immediately preceding school cycle and are constructed using the estimated coefficients of the educational dummies included in the second specification. Each entry is obtained by dividing

10 In the absence of this variable, the coefficients of the dummies for most non-university levels become insignificant or even negative in the second specification in those regions where coal mining is important. In the Mincerian specification, the value of *θ* for these regions becomes atypically low.

11 Notice that the breakdown by level given in the WSS is finer than the one we have used in the previous section (because the level of detail is smaller in earlier census reports). The years of schooling used in the first specification of the wage equation are calculated using the durations given in Table 7.

12 See Cochran (1977) and Binder (1983). DuMouchel and Duncan (1983) provide a test that can be used to determine whether the weighted estimator is preferable to OLS. This test suggests that this is indeed the case with our data.

the difference between the coefficients of the relevant dummies (those corresponding to the level of interest and to the one that immediately precedes it) by the difference in their cumulative durations measured in years.[13] Hence, they are directly comparable to the Mincerian returns parameter *($\theta$)*, which can be seen as a weighted average of all these coefficients.[14]

**Table 8: Estimated yearly effects of schooling in wage equations**

| | *all levels* $\theta$ | *lower sec* $\theta_{ls}$ | *upper sec* $\theta_{us}$ | *lower voc* $\theta_{lv}$ | *upper voc* $\theta_{uv}$ | *lower univ* $\theta_{lu}$ | *upper univ* $\theta_{uu}$ |
|---|---|---|---|---|---|---|---|
| *Madrid* | 9.02% | 1.45% | 9.94% | 9.40% | 8.55% | 11.34% | 15.41% |
| *Extremadura* | 8.52% | 6.01% | 11.10% | 11.28% | 1.97% | 6.58% | 16.18% |
| *Galicia* | 8.30% | 3.45% | 11.17% | 14.38% | 4.76% | 9.38% | 11.93% |
| *Baleares* | 8.30% | 1.85% | 12.66% | 21.68% | **0.00%** | 7.58% | 4.92% |
| *Cast.-Mancha* | 8.27% | 3.01% | 12.25% | 13.21% | 8.09% | 8.82% | 6.70% |
| *Canarias* | 7.99% | 2.75% | 10.71% | 9.05% | 5.13% | 9.89% | 15.23% |
| *Cataluña* | 7.93% | 2.01% | 10.33% | 12.24% | 5.53% | 9.55% | 12.84% |
| *Andalucía* | 7.91% | 1.47% | 11.76% | 11.52% | 7.47% | 7.03% | 13.86% |
| *Valencia* | 7.89% | 2.84% | 11.12% | 9.80% | 7.18% | 7.30% | 9.91% |
| *Murcia* | 7.86% | 7.14% | 9.59% | 8.97% | 1.94% | 5.01% | 13.60% |
| *Rioja* | 7.77% | 2.75% | 11.74% | 15.07% | 1.55% | 5.90% | 11.49% |
| *Cast- y León* | 7.52% | 3.04% | 10.01% | 10.63% | 6.47% | 7.53% | 14.78% |
| *Cantabria* | 7.04% | 4.22% | 8.87% | 11.27% | 1.93% | 5.39% | 20.04% |
| *P. Vasco* | 6.08% | 0.74% | 7.98% | 9.39% | 3.73% | 8.23% | 15.61% |
| *Aragón* | 5.99% | **0.00%** | **8.49%** | 9.05% | 5.71% | 7.25% | 14.23% |
| *Navarra* | 5.94% | 0.98% | 6.51% | 10.17% | 4.78% | 9.92% | 12.72% |
| *Asturias* | 5.89% | 0.20% | 7.95% | 11.22% | 1.89% | 10.72% | 6.44% |
| *Spain* | *8.38%* | *1.96%* | *10.98%* | *12.53%* | *6.24%* | *9.02%* | *15.32%* |

- *Note:* see footnote no. 14.

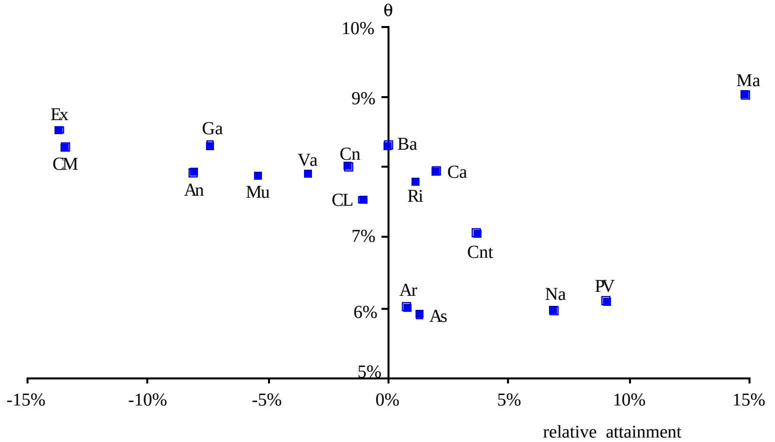
Inspection of the table reveals that there is considerable variation across educational levels and across regions in the estimated wage effects of schooling. Marginal payoffs appear to be quite low at the lower secondary level, with the exception of some of the poorer regions (in particular, Extremadura and Murcia). They rise very sharply for the lowest non-compulsory levels (*upper sec* and *lower voc*), fall significantly for the next two, and are highest for advanced university diplomas.

[13] Completion of lower secondary education is followed either by the two cycles of vocational training or by upper secondary education and university. The return to upper vocational training shown in the table, for instance, measures the percentage difference in wages between those who have completed this cycle and those whose final qualification is basic vocational training, divided by three, which is the duration in years of the second cycle of vocational training.

[14] The zero coefficients shown in bold in Table 8 have been imposed. The original point estimates were small negative numbers, but not statistically different from zero. When this is done, the estimated marginal return to the next higher level is also corrected so as to avoid overestating it and the relevant coefficient is also shown in bold in the table. In particular, the adjustment is carried out directly on the estimated coefficients of the educational level dummies in the wage equation (whose original values are shown in Table A.27 in the Appendix). When a given coefficient is smaller than the one corresponding to the immediately lower educational level, the original value of the former is replaced by the estimated value of the latter, and then the marginal returns shown in Table 8 are calculated as discussed in the text using the corrected coefficients.

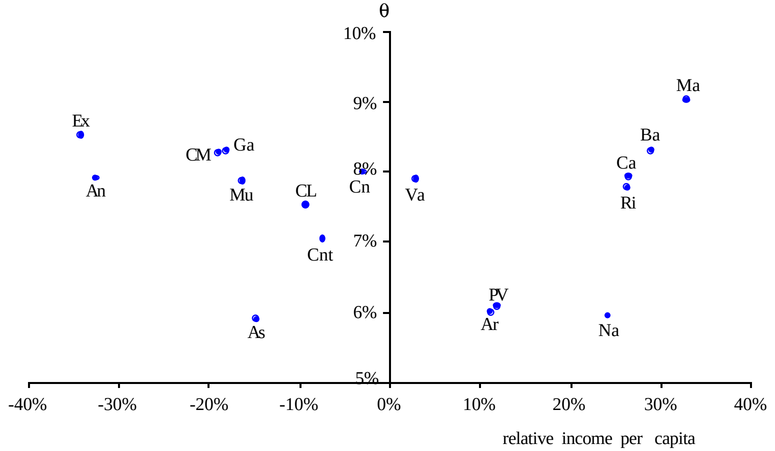


**Figure 11: Mincerian returns to schooling vs. relative attaiment in 1995**




- *Note:* relative attainment is average years of schooling in 1995 measured in percentage deviations from the national average.

**Figure 12: Mincerian returns to schooling vs. relative GDP per capita in 1995**




- *Note:* relative income per capita is GDP per capita in percentage deviations from the national average in 1995. The data used to calculate it are taken from Fundación BBV (2000).

Focusing on the Mincerian estimates given in the first column of Table 8, the differences across regions are considerable but not statistically significant for territories in the middle of the table. Estimated coefficients range from 5.9 % to 9%, with an average value (weighting the regions by their respective sample sizes) of 7.7%. Only the three regions at the top of

Table 8 and the four at the bottom are more than 1.5 standard errors away from this average value of $\theta$.

It is interesting to note that, while $\theta$ tends to fall across regions with average attainment, there is no clear correlation between income per capita and the return to schooling. Figures 11 and 12 plot the estimated value of $\theta$ agains relative attainment and relative income per capita in 1995 (with both variables measured in percentage deviations from their national means). The first scatter shows a clear tendency for returns to fall with average attainment, except in the case of Madrid, which combines the largest value of $\theta$ with the highest income level and appears as a clear outlier. The second scatter suggests a U-shaped relationship between $\theta$ and relative GDP per capita, with high returns to schooling at both ends of the income distribution, and relatively low returns in the middle.[15]

**b. Schooling, labour force participation and employment**

Following Heckmann (1979), we use a two-stage procedure to estimate the effect of schooling on labour force participation rates and employment probabilities. First we estimate a probit model that relates the probability that a given individual will be active *(q)* to his or her level of schooling and a series of personal characteristics and other variables that are listed in Table 9. Then, we estimate a second probit relating the probability of employment *(p)* to schooling and to a subset of the same explanatory variables, including as an additional regressor a variable that measures the propensity of the individual to participate in the

**Table 9: Non-schooling variables used in the participation and employment equations**

| | *particip.* | *employm.* |
|---|---|---|
| sex (male) | X | X |
| potential experience | X | X |
| potential experience squared | X | X |
| university student | X | X |
| non-university student | X | X |
| yearly dummies (1996-2000) | X | X |
| quarterly dummies (Q1-Q3) | X | X |
| married | X | |
| married*male | X | |
| children below six | X | |
| children below six * male | X | |

15 Raymond (2002) also estimates Mincerian wage equations by region using data from the 1990-91 Household Budget Survey. His results are qualitatively similar to ours in that the estimated value of the Mincerian parameter, θ, falls with regional school attainment. There are, however, some important differences. His estimates are generally higher than ours (the estimated Mincerian return for the country as a whole is 11.6%), and Madrid goes from the first place in the regional ranking according to our results to the last place using Raymond's.



**Table 10: Estimated contribution of a year of schooling to the probability of participation (%)**

| | *all levels* $q'$ | *lower sec* $q'_{ls}$ | *upper sec* $q'_{us}$ | *lower voc* $q'_{lv}$ | *upper voc* $q'_{uv}$ | *lower univ* $q'_{lu}$ | *upper univ* $q'_{uu}$ |
|---|---|---|---|---|---|---|---|
| *C.-Mancha* | 3.79 | 2.90 | 0.08 | 5.15 | 2.05 | 6.05 | 2.14 |
| *C.-León* | 3.70 | 2.41 | 1.01 | 4.60 | 2.71 | 5.18 | 2.04 |
| *Asturias* | 3.53 | 2.72 | 1.17 | 6.28 | 3.12 | 5.17 | 3.65 |
| *Canarias* | 3.44 | 3.36 | 0.19 | 3.62 | 3.40 | 5.55 | 1.91 |
| *Extremadura* | 3.35 | 2.69 | 0.19 | 4.25 | 3.03 | 6.14 | 0.95 |
| *Andalucía* | 3.26 | 2.12 | 0.18 | 4.34 | 3.46 | 6.88 | 1.82 |
| *Navarra* | 3.14 | 0.17 | 0.01 | 4.04 | 2.92 | 7.54 | 1.34 |
| *P. Vasco* | 3.12 | 0.38 | 0.41 | 4.92 | 3.27 | 5.97 | 3.88 |
| *Aragón* | 3.03 | 2.44 | 0.32 | 3.74 | 2.64 | 4.99 | 0.83 |
| *Galicia* | 2.98 | 2.47 | **0.00** | 3.05 | 3.25 | 5.49 | 2.67 |
| *Rioja* | 2.93 | 1.96 | 0.16 | 3.73 | 1.60 | 5.35 | 3.59 |
| *Murcia* | 2.79 | 1.78 | **0.00** | 3.40 | 2.94 | 5.62 | 3.81 |
| *Cataluña* | 2.78 | 2.63 | 0.38 | 1.80 | 2.62 | 3.55 | 1.15 |
| *Valencia* | 2.77 | 1.59 | **0.00** | 3.28 | 2.68 | 5.41 | 2.61 |
| *Cantabria* | 2.49 | 0.42 | 0.30 | 2.85 | 4.28 | 5.95 | 4.46 |
| *Madrid* | 2.47 | 2.41 | 0.55 | 4.79 | 1.01 | 2.87 | 3.64 |
| *Baleares* | 1.86 | 1.15 | 0.31 | 4.87 | 0.94 | 4.10 | 1.10 |
| *Spain* | *3.18* | *2.40* | *0.27* | *3.88* | *2.79* | *5.41* | *2.21* |

- *Note*: the zero coefficients shown in bold have been imposed. See footnote no. 14.

**Table 11: Estimated contribution of a year of schooling to the probability of being employed, conditional on labour force participation (%)**

| | *all levels* $p'$ | *lower sec* $p'_{ls}$ | *upper sec* $p'_{us}$ | *lower voc* $p'_{lv}$ | *upper voc* $p'_{uv}$ | *lower univ* $p'_{lu}$ | *upper univ* $p'_{uu}$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 2.64 | 2.67 | 2.36 | 0.86 | 1.65 | 1.44 | 0.32 |
| *Extremadura* | 2.52 | 2.66 | 2.12 | **0.00** | 2.76 | 0.67 | 1.39 |
| *Valencia* | 1.65 | 0.69 | 1.97 | 1.22 | 1.67 | 0.76 | 0.38 |
| *Canarias* | 1.60 | 0.95 | 1.52 | 0.41 | 1.46 | 1.36 | 0.22 |
| *P. Vasco* | 1.60 | **0.00** | 1.99 | 1.61 | 2.04 | 1.78 | **0.00** |
| *Galicia* | 1.58 | 0.85 | 1.38 | 0.06 | 2.20 | 1.89 | 0.33 |
| *Cantabria* | 1.56 | **0.00** | 1.22 | 0.29 | 3.10 | 2.53 | 0.39 |
| *Cataluña* | 1.53 | 0.95 | 1.48 | 1.47 | 0.79 | 0.81 | **0.00** |
| *Asturias* | 1.48 | 0.29 | 1.98 | 2.23 | 0.84 | 0.96 | 0.60 |
| *C.-Mancha* | 1.47 | 1.61 | 1.33 | 0.00 | 1.36 | 0.80 | **0.00** |
| *Murcia* | 1.37 | 1.36 | 1.37 | 0.00 | 1.56 | 0.76 | 0.20 |
| *C.-León* | 1.32 | 1.17 | 1.52 | 0.10 | 1.91 | 0.49 | **0.00** |
| *Madrid* | 1.30 | 0.62 | 2.04 | 2.55 | 0.48 | 0.24 | 0.13 |
| *Baleares* | 1.13 | 0.31 | 1.06 | 2.50 | 0.63 | 0.38 | 0.80 |
| *Rioja* | 0.83 | 0.09 | 1.28 | 2.20 | 0.63 | 1.17 | **0.00** |
| *Aragón* | 0.77 | 0.52 | 1.01 | 1.17 | 0.65 | 0.16 | 0.25 |
| *Navarra* | 0.55 | 0.16 | **0.00** | 0.64 | 0.80 | 1.53 | **0.00** |
| *Spain* | *1.83* | *1.69* | *1.72* | *1.10* | *1.42* | *0.83* | *0.11* |

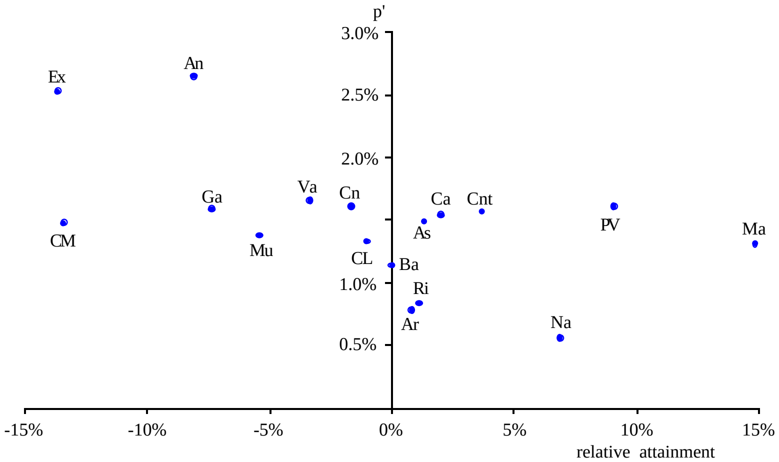
- *Note*: the zero coefficients shown in bold have been imposed. See footnote no. 14.

labour market.[16] This variable, known as the inverse Mill's ratio, is constructed using the results of the first-stage regression. Its inclusion in the second equation serves to correct the likely sample selection bias that would arise in its absence.

The data are taken from the Labour Force Survey for the years 1995-2000. As in the previous section, we estimate two alternative specifications. In the first one education enters only through the years of schooling of each individual, and in the second we include separate dummy variables for each educational level. Tables 10 and 11 show the estimated effects of an additional year of schooling on individual participation and employment probabilities. (The detailed results are in Tables A.28-A.31 in the Appendix). In all cases, the coefficients we report are not the direct estimates of the original parameters of the probit model, but the estimated marginal effects (calculated at the sample means of all the regressors) that measure the expected change in the relevant probability in response to a marginal increase in each of the explanatory variables.

The estimates that appear in the first column of Tables 10 and 11 (labelled *all levels*) come from the first (Mincerian) specification, where years of schooling is the only educational variable. The rest of the coefficients are constructed using the estimated coefficients of the educational dummies included in the second specification. As in the

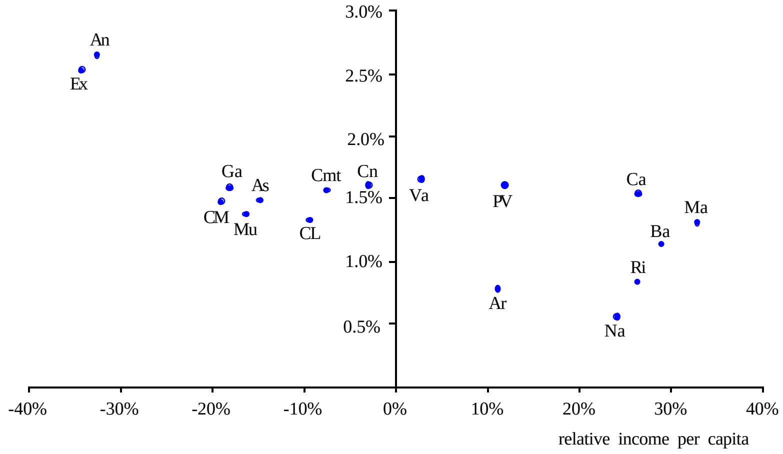
**Figure 13: Marginal employment effects (all levels) vs. relative attainment in 1995**




16 In order to avoid identification problems, the explanatory variables used in the second equation should be a subset of the set of regressors of the first-stage equation (see Wooldridge, 2002). In our case, we assume that marital status and the number of children under six years of age affect the participation decision but not the probability of employment conditional on participation.



**Figure 14: Marginal employment effects (all levels) vs. relative GDP per capita in 1995**




previous section, they should be interpreted as marginal effects per year of schooling at each level, that is, as the increase in the relevant probability over its expected value for an agent who has completed the immediately lower level of education, divided by the (incremental) duration of the relevant level.

Employment effects tend to become smaller as we move to the right in Table 11 to higher attainment levels. Figures 13 and 14 plot the marginal employment effect of an additional year of schooling (*p'* in the first column of Table 11) against relative attainment and relative income per cápita in 1995. The correlation between *p'* and each of these variables is clearly negative. Estimated employment effects are particularly strong in the poorest regions (Andalucía and Extremadura) and tend to fall with income, although there is considerable dispersion at the upper end of the income distribution.

### c. Schooling and aggregate productivity

In this section we investigate the contribution of investment in human capital to the growth of regional productivity using a simple growth model developed in de la Fuente (2002c) and de la Fuente and Doménech (2002a). The model is built around a regional production function and a technical progress relation that allows for the diffusion of technical know-how across regions. It is estimated with a panel of regional data covering the period 1965-95 at two-year intervals.

We will assume that the educational attainment of employed workers *(SE)* is one of the inputs in a constant-returns Cobb-Douglas aggregate production function which we will write in intensive form

(3) $q_{it} = a_{it} + \alpha_k k_{it} + \alpha_x x_{it} + b^* se_{it}$

where $q_{it}$ is the log of output per employed worker in region $i$ at time $t$, $k$ and $x$ the logs of the stocks of (non-infrastructure) physical capital and infrastructures per employed worker, $se$ the log of the average number of years of schooling of employed workes and $a_{it}$ the log of total factor productivity (TFP). One difficulty we face when trying to estimate (3) is that our human capital data *(S)* generally refer to the adult population rather than to employed workers. To get around this problem, we will hypothesize that *SE* increases with population attainment and decreases with the ratio of employment to the adult population *(E)*, i.e. that

(4) $se_{it} = c^* s_{it} - d^* e_{it}$

where all variables are measured in logarithms. Substituting (4) into (3) we obtain the reduced-form production function

(5) $q_{it} = a_{it} + \alpha_k k_{it} + \alpha_x x_{it} + \beta h_{it} - \varphi e_{it}$

where

(6) $\beta = bc$ and $\varphi = bd$.

We will estimate a growth equation based on (5) using different schooling series and a common set of other variables. Our specification is obtained by taking differences of (5) and assuming that the resulting TFP growth term, $\Delta a_{it}$, incorporates a technological catch-up effect that favours backward regions. The estimated equation is of the form[17]

(7) $\Delta q_{it} = \Gamma + \mu_i + \eta_t + \alpha_k \Delta k_{it} + \alpha_x \Delta x_{it} + \beta \Delta h_{it} - \varphi \Delta e_{it} + \lambda b_{it} + \varepsilon_{it}$

where $\Delta$ denotes annual growth rates (over the subperiod starting at time $t$) and $b_{it}$ is a technological gap measure that enters the equation as a determinant of the rate of technical progress in order to allow for a catch-up effect. This term is the Hicks-neutral TFP gap between each region and Madrid *(M)* at the beginning of each subperiod, given by

(8) $b_{it} = (q_{Mt} - \alpha_k k_{Mt} - \alpha_x x_{Mt} - \beta s_{Mt} + \varphi e_{Mt}) - (q_{it} - \alpha_k k_{it} - \alpha_x x_{it} - \beta s_{it} + \varphi e_{it})$.

To estimate this specification we substitute (8) into (7) and use non-linear least squares with data on both factor stocks and their growth rates. In this specification the parameter $\lambda$ measures the rate of (conditional) technological convergence. Notice that if this parameter is positive, relative TFP levels eventually stabilize, signalling a common asymptotic rate of technical progress for all territories, and the regional fixed effects $\mu_i$ capture permanent differences in relative total factor productivity that will presumably reflect differences in R&D investment and other omitted variables.

The data on regional employment (number of jobs) and output (gross value added, GVA, at factor cost) are taken from Fundación BBV (1999 and 2000). GVA is measured in pesetas of 1986 and excludes the value added of the building rental sector, which includes imputed rents on owner-occupied buildings. Employment in this sector, which is very small, is also deducted

[17] Equation (7) is obtained from equation (5) under the assumption that the rate of technological progress is given by $\Delta a_{it} = \lambda b_{it} + \mu_i + \eta_t$ The term $b_{it}$ is obtained by solving for TFP in the production function in log levels and taking differences with Madrid, which we take to be the technologically leading region.



from overall employment. The series of infrastructure and non-infrastructure capital stocks have been constructed by Mas, Pérez and Uriel (2002). The (net) stock of physical capital, which is also measured in 1986 pesetas, is broken down into two components. The infrastructure component *(x)* includes publicly financed transportation networks (roads and highways, ports, airports and railways), water works, sewage, urban structures and privately-financed toll highways. The stock of non-infrastructure capital *(k)* includes private capital, net of the stock of residential housing, and the stock of public capital associated with the provision of education, health and general administrative services. These last three items are aggregated with the capital stock of the private sector because our output measure includes government-provided services.[18] For shortness, we will often speak of *private* and *public* capital to refer to the infrastructure and non-infrastructure components of the stock of physical capital. It should be kept in mind, however, that this is not entirely accurate.

**Table 12: Growth estimates with alternative schooling series and specifications**

| | [1] | [2] | [3] | [4] |
|---|---|---|---|---|
| *S data from:* | *MPUSS* | *D&D* | *MPUSS* | *D&D* |
| $\alpha_k$ | 0.161 | 0.171 | 0.161 | 0.171 |
| | (3.05) | (3.27) | (3.24) | (3.50) |
| $\alpha_x$ | 0.062 | 0.0567 | 0.062 | 0.0560 |
| | (3.52) | (3.25) | (4.33) | (3.88) |
| $\beta$ | -0.013 | 0.835 | -0.013 | 0.835 |
| | (0.11) | (2.04) | (0.11) | (4.13) |
| $\lambda$ | 0.048 | 0.045 | 0.048 | 0.045 |
| | (3.27) | (3.30) | (7.96) | (6.36) |
| *adj.* $R^2$ | 0.749 | 0.753 | 0.757 | 0.763 |
| *std. error reg.* | 0.0097 | 0.0096 | 0.0095 | 0.0094 |
| *no. of observ.* | 255 | 255 | 255 | 255 |
| *regional effects* | all | all | signif. | signif. |

*Notes:*
- All equations include period dummies.
- White's heteroscedasticity-consistent *t* ratios in parentheses below each coefficient.
- The employment ratio has been dropped from the equation due to its lack of significance.

The employment ratio, $e$, that enters equations (7) and (8) has been approximated by the ratio of total employment to the overall population. This variable, however, is never significant with our specification and has been dropped from the equation. As a proxy for the stock of human capital, we use our own attainment series described in section 2.b.i and an

[18] The results are very similar when we exclude the output of the public sector from our productivity measure and the non-infrastructure component of public capital from *k*.

alternative estimate of average years of schooling constructed using Mas et al's (MPUSS, 2002) series on the composition of the working-age population by attainment level which is, in turn, based on Labor Force Survey data. Section 4 of the Appendix gives estimates of reliability ratios for these two schooling series. As discussed in de la Fuente and Ciccone (2002), this variable is a statistical indicator of the information content of a given data set that can be used to gauge the size of the downward bias caused by measurement error in the estimation of the growth effects of human capital.

The results obtained with both schooling series are reported in Table 12.[19] All equations contain period dummies. Equations [1] and [2] contain a full set of regional dummies, and equations [3] and [4] retain only those regional fixed effects that were significant in the first iteration.

Inspection of the table and a comparison with other studies reveals a number of interesting results. First, the coefficient of human capital *($\beta$)* goes from being non-significant when the MPUSS (2002) data are used to having a large and significant value with our attainment series. This result is consistent with our estimates of the information content of the two series, as the relevant reliability ratio is 0.900 for our data and only 0.035 for MPUSS's attainment series. Second, our estimate of $\beta$ in this paper (0.835) is higher than those obtained with cross-country data by de la Fuente and Doménech (D&D 2002a) using similar specifications (0.540 with a full set of country dummies and 0.394 when only the significant fixed effects are retained). Again, the explanation seems to lie at least partly in the information content of the different data sets (the relevant reliability ratio for the cross-country attainment series in D&D was 0.246). In fact, our estimate of $\beta$ in this report lies well within the range (and somewhat below the average value) of the meta-estimates obtained by D&D (2002) after correcting for measurement error.

Our estimate of $\beta$ implies that human capital accounts for a substantial fraction of cross-regional productivity disparities. Figure 15 shows the contribution of schooling to the relative productivity of the Spanish regions. Relative productivity is defined as log real output per job measured in deviations from the (unweighted) sample average of the same variable. Using regression weights to average the different regions (see Box 4 in de la Fuente and Ciccone (2002) for the details), we find that the share of schooling in average productivity was 39.86% in 1995 -- that is, that for the typical Spanish region schooling accounts for 4/10 of the productivity gap with the sample average.

Turning to the remaining coefficients of the model, we find that both the private capital stock and the stock of infrastructures enter the equation with positive and significant coefficients. On the other hand, both of these coefficients are smaller than those obtained in previous studies that have made use of similar regional data together with the MPUSS

[19] See de la Fuente and Doménech (2003) for additional results and some robustness checks.



**Figure 15: Contribution of schooling to relative productivity in 1995**

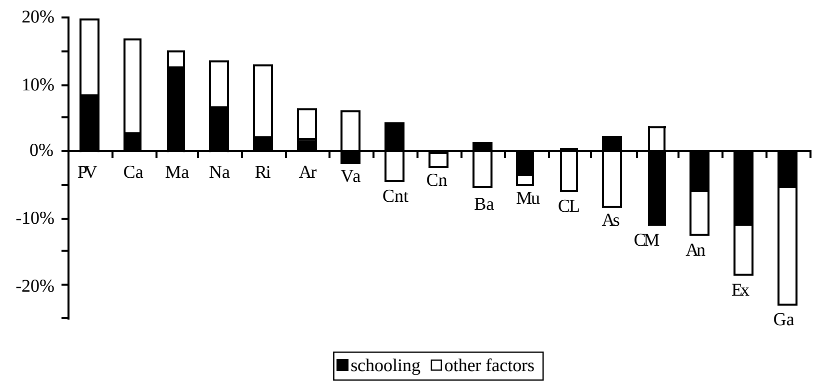
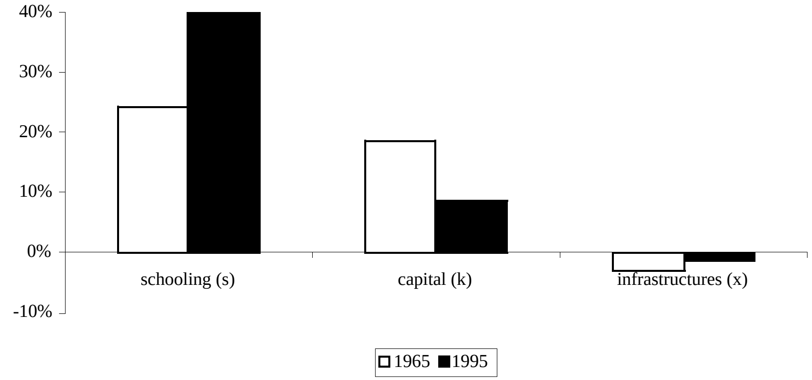



**Figure 16: Shares of different factors in relative productivity**




schooling series.[20] The sum of these two coefficients is about 25% below capital's share of national income, whose average value over the last decade in our sample was 31.4%.[21] To be on the safe side when comparing the social returns to different assets, for our calculations in section 6.d below we will scale up the coefficient of private capital *($\alpha_k$)* so that the sum $\alpha_k$ +

[20] See for instance Mas, Maudos, Pérez and Uriel (1995), de la Fuente and Vives (1995), González-Páramo and Argimon (1997), Dabán and Lamo (1999) and de la Fuente (2002c).

[21] The share of capital in output is measured as the ratio between gross operating surplus and GVA for Spain as a whole after excluding the building rental sector. For this calculation we use Fundación BBV data and estimate total labour costs by imputing to non-salaried employees the average compensation of salaried employees in the same sector, except for the fisheries sector where this would yield a negative operating surplus. For this sector, we impute to non-salaried employees 1/2 of the labour cost per salaried employee.

$\alpha_x$ is equal to the share of capital in national income. This ad-hoc correction yields a baseline value of $\alpha_k$ of 0.258.[22]

Using our corrected estimates of the parameters of the production function, Figure 16 shows the shares of schooling and private and public capital in the relative productivity of a typical Spanish region in 1965 and 1995. The figure shows that differences in schooling have become relatively more importance over time as a source of (shrinking) productivity disparities across regions, making this variable a potentially very powerful instrument of regional redistribution. By contrast, remaining differences in stocks of private capital account only for 10% of observed productivity disparities in the last year of our sample, and infrastructure stocks display a slightly negative correlation with relative productivity.

**4. The private return to schooling and the impact of public policies on private incentives**

In this section we will present estimates of the private return to post-compulsory schooling in the Spanish regions using the methodology developed in de la Fuente (2003). Subsection a discusses the procedure we have used to calculate the rate of return and to construct effective tax and subsidy rates that measure the effects of various public policies on private incentives to invest in education. Subsection b presents estimates of average returns across all educational levels based on the Mincerian specifications of the wage and employment equations, and subsection c gives estimates of returns for different educational levels.

In all cases, our estimates will be obtained under the assumption that our reference individual is active throughout his working life (i.e. that he is active while attending school at post-compulsory levels and remains a member of the labour force until the standard retirement age) and that he wants to work (but may not succeed in doing so) 20% of a standard work-year while enrolled in school. Hence, the employment probabilities and related parameters used in the calculation are conditional on labour force participation.

The calculations will allow for the taxes on labour income to which the representative individual would be subject in each region (including national and regional income taxes and employee social security contributions) and for the unemployment benefits for which he would be eligible, working under the assumptions that i) he is single and has no children (so as to abstract from family support policies), and ii) that any unemployment spells he suffers are relatively short-lived and do not exahust contributive benefits.

To properly interpret the results that will be presented below, it is important to keep in mind that the rates of return we will calculate measure the return to educational investment in a rather specific and restrictive sense. They capture, in particular, the average payoff to an additional year of schooling holding its cost and quality constant at the existing level.

22 We scale up $\alpha_k$ alone, rather than $\alpha_k$ and $\alpha_x$ together while respecting their ratio, because this yields a more plausible pattern of relative returns. The coefficient estimates shown in Table 12 imply rates of return of 5.09% and 14.46% for private and public capital respectively in Spain as a whole. With our correction, the return to private capital rises to 10.91%.



They do not, however, tell us anything about the returns to additional spending on quality-improving policies.[23] It should also be noted that the results presented in this section are estimates of the individual returns to schooling in partial equilibrium -- that is, they capture the financial rewards available to an individual acting alone, assuming that factor prices and average school attainment at the aggregate level remain constant.

**a. Methodology**

The private rate of return to schooling *($r_p$)* is defined as the discount rate that equates the present value of the expected stream of net-of-tax earnings generated by a marginal increase in school attendance to the present value of the incremental costs of schooling. As discussed in de la Fuente (2003), under certain assumptions $r_p$ is given by

$$(9)\quad r_p = R_p + g$$

where $g$ is the exogenous growth rate of productivity and $R_p$ is the value of $R$ that solves the following equation

$$(10)\quad \frac{R}{1-e^{-RH}} = \frac{\left(\frac{p_o+(1-p_o)a}{p_o+(1-p_o)(a+b)}\right)\left(\frac{1-T'}{1-\tau_o}\right)\theta + \left(\frac{(1-a-b)p_o}{p_o+(1-p_o)(a+b)}\right)\varepsilon}{\left(1-\frac{1-\tau_S}{1-\tau_o}\frac{(1-\phi)\eta p_o}{p_o+(1-p_o)(a+b)}\right)+\frac{\mu_s}{(1-\tau_o)\left[p_o+(1-p_o)(a+b)\right]}} \equiv \frac{\theta_{net}+\varepsilon_{net}}{OPPC+DIRC}$$

where $\theta$ is the parameter that measures the marginal contribution of education to gross wages, $p_o$ stands for the probability of employment of an adult with the relevant attainment level, $\varepsilon = p'/p_o$ captures the employment effects of schooling, $\phi$ is the fraction of time taken up by full-time school attendance, $\mu_s$ the direct costs of schooling measured as a fraction of full-time wages, and $H$ the duration in years of the post-school working life of the reference individual. The additional terms that appear in this expression are tax and benefit parameters: $\tau_o$ and $T'$ are the average and marginal tax rates applicable to the representative full-time worker, $\tau_s$ the average tax rate on income from part-time work and $a$ and $b$ the components of the net replacement ratio for unemployed workers that are, respectively, linked and not linked to previous earnings. All terms are defined more precisely in Table 14 below for the case of the calculation of average returns across all educational levels. The modifications required for the calculation of level-specific rates of return are discussed in subsection c.

To interpret equation (10), notice that its left-hand side is an increasing function of $R$ where the term $1-e^{-RH}$ that appears in the denominator serves to adjust for the fact that the "useful life" of the asset (the working life of the individual) is finite. The right-hand side is simply the ratio of the marginal benefits derived from an additional year of schooling

23 The problem here is empirical rather than conceptual. While it is straightforward to derive the appropriate rate of return formulas for investment in educational quality, we do not yet have reliable estimates of the impact of resource inputs on educational quality or of the effects of quality on wages and productivity that can be entered into these formulas. This is most unfortunate because this is without doubt the more relevant policy margin in the long run, and because we have reasons to suspect that the quality of education may be at least as important as its quantity. (See Appendix 3e in D&C, 2002).

(which we can interpret as the "dividend" paid by human capital) to its cost, with all the terms expressed as fractions of the expected net-of-tax earnings of an adult worker with average education. The first term in the numerator *($\theta_{net}$)* captures the expected increase in after-tax earnings and benefits holding the probability of employment constant, and the second one *($\varepsilon_{net}$)* the increase in expected net earnings that comes from an increase in the probability of employment. The denominator measures the total cost of an additional year of schooling as the sum of two terms. The first one *(OPPC)* is the opportunity cost of school attendance (foregone wages), and the second one *(DIRC)* the direct costs of schooling born by the student himself.

Public policies influence the private return to schooling in many ways. Educational subsidies or the direct public provision of educational services will raise the return to schooling by lowering its direct cost to the individual *(DIRC)*. The effect of taxation is more complicated. Notice that a flat-rate income tax (i.e. a tax system in which $\tau_o = T' = \tau_s$) would have absolutely no effect on the return to schooling whenever there are no direct costs (i.e. when *DIRC = 0*) because taxes would then reduce both the costs and the benefits of education in the same proportion.

Hence, the effects of the tax system will come from differences among the three tax rates that enter the formula and from their interaction with the direct cost term, *DIRC*. Notice that $\theta_{net}$ depends only on the progressivity of the tax schedule at the average income level: as the tax system becomes more progressive (i.e. as the ratio $(1-T')/(1-\tau_o)$ declines), the incentive to invest in education falls. If we fix the degree of progressivity, an increase in $\tau_o$ actually raises the return to schooling by lowering its opportunity cost, while an increase in the student tax rate, $\tau_s$, has the opposite effect. Finally, tax rates interact with the direct cost of schooling term, *DIRC*. If $\mu_s > 0$, an increase in the average tax rate, $\tau_o$, increases *DIRC* (by lowering its denominator) thus lowering the return to schooling. If students receive a net subsidy, so that $\mu_s < 0$, the effect of $\tau_o$ on $r_p$ is the opposite one: higher taxes now raise the return to schooling by increasing the size of the subsidy when measured as a fraction of net adult earnings.

Unemployment benefits reduce the return to schooling by raising the expected income of adult workers, thereby increasing the opportunity cost of not being in the (full-time) labour market, and by reducing the loss of earnings associated with unemployment (i.e. by lowering $\varepsilon_{net}$). Notice that the size of this second effect will be proportional to the value of $\varepsilon$, for if schooling has no effect on employment probabilities the difference in earnings between employed and unemployed workers is irrelevant for the calculation. When unemployment benefits are linked to previous earnings and therefore to education (i.e., when $a > 0$), these effects are partially offset by an increase in $\theta_{net}$ as additional schooling now translates into an increase in benefit levels. Notice that $\theta_{net}$ is independent of benefit parameters when



these do not have a fixed-rate component (i.e. when $b = 0$), and declines with $b$ once this component of the replacement ratio becomes positive.

**Measuring the effect of public policies on private returns**

To quantify the contribution of various forms of government intervention to the net private return to schooling, it will be useful to recalculate the rate of return under a set of different counterfactual assumptions or *scenarios*. In the *NO GOV'T* scenario [1] we assume there is no government intervention, i.e. that private agents pay the full costs of education and there are no taxes or social benefits. In scenario [2] we introduce *subsidies* to education respecting the remaining assumptions. In [3] we introduce *taxes* and in [4] social benefits to obtain an estimate *(OBS)* that includes the effects of all relevant public policies and mesures the observed returns to education from the point of view of private agents. Finally, scenario [5] tries to isolate the impact of differential student unemployment *(nodiffstU)*. This scenario deviates from *OBS* only in that it assumes that $\eta = 1$, i.e. that the probability of finding part-time work while in school is the same as the probability of finding full-time work after graduation. Table 13 summarizes these assumptions.[24] In what follows, we will refer to estimates of $r_p$ obtained under the assumptions of the *NO GOV'T* and *OBS* scenarios as *raw* and *all-in* returns.

**Table 13: Assumptions underlying the scenarios**

| | *raw return* *NO GOV'T* *[1]* | *subsidies* *[2]* | *taxes* *[3]* | *all-in return* *OBS* *[4]* | *nodiffstU* *[5]* |
|---|---|---|---|---|---|
| *direct costs* | total | private | private | private | private |
| *taxes* | none | none | observed | observed | observed |
| *benefits* | none | none | none | observed | observed |
| *diffstU correct.* | yes | yes | yes | yes | no |

The rate of return estimates estimates obtained under the different scenarios will be used to construct a set of effective tax and subsidy wedges and rates that measure the impact of public policies on private incentives to invest in education. We calculate the tax or subsidy wedge *($wedge_{gov@}$)* generated by public policies as the difference between the raw and all-in rates of return to schooling, and define the effective tax rate on human capital *($etr_{gov@}$)* as the

24 Notice that assumptions underlying these scenarios differ from those used in de la Fuente (2003) and in the interim version of this report, where $\eta = 1$ was assumed in the first four scenarios and the estimated probability of student employment was used only in the last scenario. The reason for the change is that the estimate of the correction factor for differential student unemployment used in this study has been obtained using individual-level data and should be more reliable than the rough approximation used in de la Fuente (2003) for the EU countries. Given this, it seems more reasonable to compute the rates of return to schooling and analyze their sensitivity to public policies using the estimated value of the adjustment parameter.

ratio between the tax wedge and the raw return. Letting $r_i$ denote the estimated private rate of return to schooling under scenario *i*, we have

$$(11)\quad wedge_{gov't} = r_{no\,gov't} - r_{obs} \quad \text{and} \quad etr_{gov't} = \frac{wedge_{gov't}}{r_{no\,gov't}}.$$

Notice that $wedge_{gov't}$ and $etr_{gov't}$ capture the joint effect of all the public policies we are considering. To isolate the impact of each individual policy, it will be useful to note that $wedge_{gov't}$ and $etr_{gov't}$ can be written as the sum of three factors that capture the effects of educational subsidies, personal taxes and social benefits as follows. First, we write $wedge_{gov't}$ in the form[25]

$$(12)\quad \begin{aligned} wedge_{gov't} &= r_{no\,gov't} - r_{obs} = (r_{no\,gov't} - r_{subsidies}) + (r_{subsidies} - r_{taxes}) + (r_{taxes} - r_{obs}) \\ &\equiv -wedge_{subs} + wedge_{tax} + wedge_{ben} \end{aligned}$$

Dividing through by $r_{no\,gov't}$, the corresponding partial tax and subsidy rates are given by

$$(13)\quad \begin{aligned} etr_{gov't} &= \frac{wedge_{gov't}}{r_{no\,gov't}} = \frac{-wedge_{subs} + wedge_{tax} + wedge_{ben}}{r_{no\,gov't}} \\ &\equiv -subs + etr_{tax} + etr_{ben} \end{aligned}$$

(Notice that the partial wedges and rates are defined so that their signs are positive under normal circumstances, that is, whenever taxes and unemployment benefits reduce the private returns to schooling and educational subsidies increase them).

An alternative approximate decomposition of the overall tax rate will turn out to be very useful for understanding how effective tax rates vary across regions and educational levels. Let us denote by $R'$ the right-hand side of the rate of return formula given in equation (10). The values of $R'$ corresponding to the *NO GOV'T* and *OBS* scenarios can be written in the form

$$(14)\quad R'_{no\,gov't} = \frac{\theta + \varepsilon}{C} \quad and \quad R'_{obs} = \frac{\theta_{net} + \varepsilon_{net}}{C_{net}} = \frac{(1-t_\theta)\theta + (1-t_\varepsilon)\varepsilon}{(1-s)C}$$

where we can think of $t_\theta$ and $t_\varepsilon$ as the marginal tax rates on the wage and employment benefits of schooling and of *s* as the overall subsidy rate on total schooling costs.

Let us now define a new measure of the overall tax rate, *t*, by working directly with these two terms as

$$(15)\quad t = \frac{R'_{no\,gov't} - R'_{obs}}{R'_{no\,gov't}}$$

and observe that

$$t = \frac{\dfrac{\theta+\varepsilon}{C} - \dfrac{(1-t_\theta)\theta + (1-t_\varepsilon)\varepsilon}{(1-s)C}}{\dfrac{\theta+\varepsilon}{C}} = 1 - \left[\left(\frac{1-t_\theta}{1-s}\right)\frac{\theta}{\theta+\varepsilon} + \left(\frac{1-t_\varepsilon}{1-s}\right)\frac{\varepsilon}{\theta+\varepsilon}\right]$$

or

[25] Notice that the definition of the components of the overall effective tax rate has changed relative to the preliminary version of this report. I now divide all of the tax wedges by $r_{nogov't}$ rather than by the estimated return in the previous scenario. This makes the tax rates more comparable with each other and less sensitive to the order in which the different policies are introduced in the analysis.



$$(16)\quad 1-t = \left(\frac{1-t_\theta}{1-s}\right)\frac{\theta}{\theta+\varepsilon} + \left(\frac{1-t_\varepsilon}{1-s}\right)\frac{\varepsilon}{\theta+\varepsilon}.$$

Hence, the overall tax factor, *1-t*, is a weighted average of the tax factors on the wage and employment components of the return to schooling, with weights that are proportional to their shares in the total return. It should be clear that *t* will not coincide with the effective tax rate defined above ($etr_{gov't}$) but the intuition will carry over since *r* is an increasing transformation of $R'$.

It is worth noting that the effects of taxes and benefits on the denominator of $R'_{obs}$ will generally be small (because $1-\phi$ and $\mu_S$ are themselves small). As a result, the bulk of the effects of tax and benefit policies will come through $t_\theta$ and $t_\varepsilon$ Now, these terms are given by

$$(17)\quad 1-t_\theta = \left(\frac{p_o + (1-p_o)a}{p_o + (1-p_o)(a+b)}\right)\left(\frac{1-T'}{1-\tau_o}\right)$$

and

$$(18)\quad 1-t_\varepsilon = \frac{(1-a-b)p_o}{p_o + (1-p_o)(a+b)}$$

Notice that $t_\varepsilon$ is a function of benefit parameters (and employment probabilities) only, whereas $t_\theta$ depends in principle on both tax and benefit parameters. When benefits are linked to previous income, however, (i.e. when $b = 0$), the first term of $t_\theta$ cancels and this factor depends only on tax parameters.

**b. Average returns across all educational levels**

In this section we will present estimates of the average return to schooling across all educational levels in each Spanish region. The calculations in this section make use of the results of the Mincerian specification of the wage and employment equations presented in sections 3.a and 3.b. The rate of return estimates will be constructed by applying equation (10) to a representative individual in each region endowed with average school attainment. We will assume that this representative agent's income, when employed, is equal to the gross earnings of the average salaried worker employed in manufacturing, construction or services (ASW).

**i. Data and sources**

Table 14 describes the different variables and parameters used in the computation of the private rate of return to schooling and gives the sources of these data. The details of the construction of the different variables are discussed in sections 2 and 3 and in section 5 of the Appendix.

The expected length of the working life of the representative individual for each region is calculated as the difference between the estimated average age of retirement and the age at which average attainment (measured in 2000) has been completed (provided this last figure is at least fourteen years). The retirement age refers to the entire country in 1995 and is calculated by averaging the estimates for males and females reported by Blöndal and Scarpetta (1999), weighting them by the share of each sex in total employment (using Eurostat data for 2000 referring to the age group 25-64).

Our estimates of average attainment and educational expenditure have already been discussed in previous sections. For purposes of calculating private returns, expenditure per student must be divided by the average gross earnings of full-time salaried workers. This variable is constructed as discussed in Section 5.a of the Appendix using data for 2000 taken from wage and hours surveys conducted by the National Statistical Institute.

For the probability of employment of adult workers $(p_o)$ we use the prediction of the second-stage employment equation estimated in section 3.b for the average values of the regressors (using the first specification of this equation where education is measured by average years of schooling). The employment probability of students is approximated by adding to this average prediction a weighted average of the coefficients of the dummies for non-university and university students (with weights 2/3 and 1/3) respectively. The marginal impact of education on the probability of employment, $p'(S_o)$, is given by the coefficient of years of schooling *(S)* in the same equation (or, more precisely, by the corresponding marginal effect as given in the first column of Table 11). Combining these two figures, we construct an estimate of the sensitivity of the probability of employment to educational attainment (captured by $\varepsilon = p'(S_o)/p(S_o)$).

The tax and benefit parameters are calculated using the tax and and benefit provisions in force in 2000 and refer to single individuals with no children.[26] The average and marginal tax rates on adult workers ($\tau_o$ and $T'$) are those applicable to an individual earning the same salary as the average full-time salaried worker employed in the manufacturing, construction or service sectors (ASW). The average tax rate on student income $(\tau_s)$ has been been calculated under the assumption that the income of an employed student is 20% of ASW earnings. All tax rates incorporate national and regional personal income taxes and employee (but not employer) social security contributions, so as to be consistent with the data on gross wages that have been used to estimate the wage equations.

Our estimates of the components of the net replacement ratio induced by unemployment benefits (*a* and *b*) have been constructed using the description of the unemployment protection scheme given in the country chapter for Spain of the OECD's *Benefit Systems and Work Incentives 1999*. We have worked under the assumptions that i) we are dealing with a single individual with no children whose wage prior to the loss of employment was equal to the average regional salary as defined above and ii) that any unemployment spells experienced

[26] For the majority of regions, personal income tax is shared by the national and regional governments. The latter have some power to set tax rates and deductions but differences across territories are minor. The exception are the two foral regions of Navarre and the Basque Country, where income taxes are set and collected exclusively by the regional governments. For these two regions we have used the regional tax codes (and in particular the updated versions of the Norma Foral 8/1998 of Guipuzcoa for the Basque Country and the Ley Foral 22/98 for Navarra).



by our representative worker are sufficiently brief that he does not exhaust the contributory benefits to which he is entitled. While benefit levels are in principle linked to previous wages, there is also a ceiling that is binding for a worker with average earnings in all but three regions, effectively turning the system into a fixed rate one. As a result, the component of the net replacement ratio linked to previous wages is equal to zero in fourteen of the seventeen regions.

**Table 14: Variables and parameters used in the calculation of the private rate of return on schooling and sources of the data**

*parameters*

$g$ = 1.5, rate of exogenous productivity growth. Source: Jones (2002).

$\phi$ = 0.8, fraction of time taken up by (full-time) school attendance; $1-\phi$ is the potential labour supply while in school.

$U$ = 60.5 = Average retirement age in 1995 in Spain, constructed by averaging separate estimates for men and women, weighted in proportion to their shares in total employment. Source: Blöndal and Scarpetta (1999).

*variables*

$S_o$ = average years of school attainment of the adult (over 25) population in 2000. Source: Section 2.b.i.

$H = U - Max(6+S_o, 14)$ = estimated length of the (post-school) working life of the representative individual.

$\theta$ = microeconomic Mincerian returns to schooling parameter. It measures the average (log) increase in gross wages (wages before income taxes and employee social security contributions are witheld) resulting from an additional year of schooling. Source: Section 3a.

$\mu_s$ = direct cost of schooling born by the individual, measured as a fraction of average gross earnings of full-time salaried workers (weighted average of secondary and tertiary levels with weights 2/3 and 1/3 respectively). Average costs are shown net of direct public subsidies to students for living costs and other non-tuition expenses and will be negative when these subsidies exceed tuition charges. Source: section 2.a and section 5.a of the Appendix.

$\mu$ = total (private + public) cost of schooling per student measured as a fraction of average gross earnings of full-time salaried workers (weighted average of secondary and tertiary levels with weights 2/3 and 1/3 respectively). It excludes an estimate of research expenditure by universities. Direct subsidies to students for living and non-tuition expenses are not considered a net cost from the point of view of society as a whole. (We consider them a transfer to the private sector). Source: section 2.a and section 5.a of the Appendix.

$p_o$ = probability of employment after leaving school, conditional on participation in the labour force. Estimated using the results in section 3.b.

**Table 14: Variables and parameters used in the calculation of the private rate of return on schooling and sources of the data -- continued**

$p_S$ = probability of employment while attending school, conditional on participation in the labour force. Estimated using the results in section 3.b.

$\eta$ = $p_S/p_O$, correction factor capturing the greater difficulty of finding part-time employment while attending school.

$\varepsilon = p'(S)/p(S)$ measures the responsiveness of the probability of employment of active workers to their level of schooling. Estimated using the results in section 3.b.

$\tau_O$ = average tax rate on labour income (including national and regional income taxes and employee social security contributions) applicable to the average full-time salaried worker in 2000.

$T'$ = marginal tax rate on labour income (including national and regional income taxes and employee social security contributions) applicable to the average full-time salaried worker in 2000. See section 5.b of the Appendix.

$\tau_S$ = average tax rate on labour income (including national and regional income taxes and employee social security contributions) applicable to a worker earning 20 of the salary of the average full-time worker.

$a$ = first component of the net replacement ratio (ratio of net after-tax earnings out of work to net after-tax earnings while employed) for a single individual with no children whose previous earnings were equal to the average production worker's salary. This parameter captures the effects of unemployment benefits that are linked to previous earnings.

$b$ = second component of the net replacement ratio, calculated under the same assumptions as $a$. It captures the effects of unemployment and housing benefits whose amount is not linked to previous earnings. .

Table 15 shows the actual data used in the rate of return calculations. As a reference, the last row of each block of the table shows the estimates of the different variables obtained in de la Fuente (2003). A comparison of these figures with our current estimates for the entire country reveals a number of significant differences. Discrepancies across studies in employment parameters arise from differences in the underlying data and in the estimation procedure. The most significant one is that our current estimate of the parameter that measures the employment effects of schooling ($\varepsilon$) is over three times larger than the previous one (which as we have already noted was constructed using aggregate rather than individual data and should therefore be less reliable). Most of the remaining discrepancies seem to be related to the rather significant difference that exists between our estimates of average salaries and those provided by the OECD (see footnote 14 in section 5.a of the Appendix). This factor, however, is insufficient to explain the large difference between the two estimates



**Table 15: Data used in the calculation of the private rate of return on schooling**

| | $S_O$ | $H$ | $\theta$ | $\mu_S$ | $\mu$ | $p_O$ | $p_S$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 7.62 | 46.5 | 7.91% | 0.92% | 16.92% | 72.25% | 58.84% |
| *Aragón* | 8.35 | 46.1 | 5.99% | 2.24% | 20.52% | 89.02% | 76.84% |
| *Asturias* | 8.31 | 46.2 | 5.89% | 1.59% | 18.05% | 79.81% | 54.30% |
| *Baleares* | 8.22 | 46.3 | 8.30% | 2.35% | 19.75% | 90.26% | 83.08% |
| *Canarias* | 8.02 | 46.5 | 7.99% | 1.00% | 23.65% | 82.89% | 77.39% |
| *Cantabria* | 8.54 | 46.0 | 7.04% | 2.09% | 22.21% | 78.11% | 54.50% |
| *Cast. y León* | 8.14 | 46.4 | 7.52% | 1.43% | 19.97% | 82.44% | 61.86% |
| *Cast.-Mancha* | 7.18 | 46.5 | 8.27% | 0.57% | 20.89% | 82.10% | 64.28% |
| *Cataluña* | 8.35 | 46.1 | 7.93% | 3.98% | 20.60% | 87.17% | 79.21% |
| *Valencia* | 7.98 | 46.5 | 7.89% | 1.99% | 21.72% | 82.77% | 68.07% |
| *Extremadura* | 7.13 | 46.5 | 8.52% | -0.35% | 18.95% | 74.61% | 57.55% |
| *Galicia* | 7.67 | 46.5 | 8.30% | 1.42% | 21.99% | 78.85% | 49.71% |
| *Madrid* | 9.36 | 45.1 | 9.02% | 3.94% | 16.15% | 83.67% | 69.04% |
| *Murcia* | 7.82 | 46.5 | 7.86% | 1.50% | 20.83% | 80.89% | 59.17% |
| *Navarra* | 8.85 | 45.7 | 5.94% | 2.52% | 22.03% | 90.88% | 85.86% |
| *P. Vasco* | 9.00 | 45.5 | 6.08% | 2.51% | 21.11% | 83.15% | 70.53% |
| *Rioja* | 8.44 | 46.1 | 7.77% | 1.83% | 26.34% | 84.23% | 57.02% |
| *Spain* | *8.19* | *46.3* | *8.38%* | *2.26%* | *18.99%* | *80.96%* | *65.65%* |
| *de la F. (2003)* | | 46.5 | 8.23% | 4.05% | 25.64% | 88.62% | 60.00% |

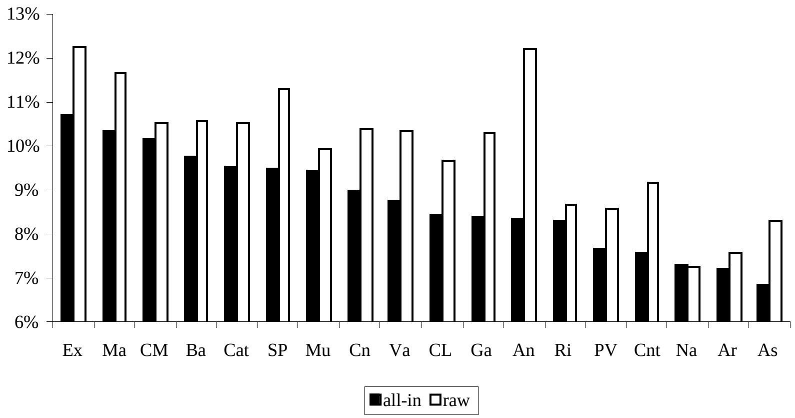
| | $\eta$ | $\varepsilon$ | $\tau_O$ | $T'$ | $\tau_S$ | $a$ | $b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.814 | 3.66% | 18.58% | 28.83% | 6.35% | 0.0% | 72.5% |
| *Aragón* | 0.863 | 0.86% | 19.70% | 28.83% | 6.35% | 0.0% | 65.1% |
| *Asturias* | 0.680 | 1.86% | 20.22% | 28.83% | 6.35% | 0.0% | 61.6% |
| *Baleares* | 0.921 | 1.25% | 18.55% | 28.83% | 6.35% | 0.0% | 72.7% |
| *Canarias* | 0.934 | 1.93% | 18.06% | 28.83% | 6.35% | 0.0% | 75.8% |
| *Cantabria* | 0.698 | 2.00% | 19.36% | 28.83% | 6.35% | 0.0% | 67.4% |
| *C.-León* | 0.750 | 1.60% | 19.33% | 28.83% | 6.35% | 0.0% | 67.5% |
| *C.-Mancha* | 0.783 | 1.79% | 17.89% | 28.83% | 6.35% | 75.9% | 0.0% |
| *Cataluña* | 0.909 | 1.76% | 19.97% | 28.83% | 6.35% | 0.0% | 63.3% |
| *Valencia* | 0.822 | 2.00% | 18.59% | 28.83% | 6.35% | 0.0% | 72.5% |
| *Extremadura* | 0.771 | 3.38% | 17.69% | 28.83% | 6.35% | 76.0% | 0.0% |
| *Galicia* | 0.630 | 2.00% | 18.32% | 28.83% | 6.35% | 0.0% | 74.2% |
| *Madrid* | 0.825 | 1.55% | 20.91% | 28.83% | 6.35% | 0.0% | 56.9% |
| *Murcia* | 0.731 | 1.70% | 17.62% | 28.83% | 6.35% | 76.0% | 0.0% |
| *Navarra* | 0.945 | 0.60% | 20.05% | 29.76% | 6.35% | 0.0% | 60.8% |
| *P. Vasco* | 0.848 | 1.92% | 21.10% | 29.76% | 6.35% | 0.0% | 56.8% |
| *Rioja* | 0.677 | 0.99% | 18.94% | 28.83% | 6.35% | 0.0% | 70.1% |
| *Spain* | *0.811* | *2.26%* | *19.64%* | *28.83%* | *6.35%* | *0.0%* | *65.5%* |
| *Spain (D2003)* | 0.677 | 0.66% | 18.5% | 28.8% | 6.35% | 74.45% | 0.00% |

of private expenditure on education. Part of this difference may be due to the fact that the OECD data on the weight of government in total educational expenditure used in de la Fuente (2003) grouped together all non-university levels whereas here we use more disaggregated information.[27]

### ii. Results

Figure 17 displays our estimates of the raw and all-in private rates of return to schooling in the Spanish regions (that is, before and after taking into account the effects of public policies).[28] The all-in rate of return, $r_{obs}$, ranges between 6.85% in Asturias and 10.73% in Extremadura with a value of 9.50% for the country as a whole. Baseline returns vary between 7.26% in Navarra and 12.25% in Extremadura. The total tax wedge given by the difference between these two rates of return is 1.8 percentage points for the entire country with a maximum of 3.86 points in Andalucía.

**Figure 17: Private rate of return to schooling in the Spanish regions**




- *Key: An* = Andalucia; *Ar* = Aragón; *As* = Asturias; *Ba* = Baleares; *Cn* = Canarias; *Cnt* = Cantabria; *CL* = Castilla y León; *CM* = Castilla la Mancha; *Cat* = Cataluña; *Va* = Valencia; *Ex* = Extremadura; *Ga* = Galicia; *Ma* = Madrid; *Mu* = Murcia; *Na* = Navarra; *PV* = País Vasco; *Ri* = Rioja; *SP* = Spain.

Figures 18 and 19 plot the raw return to schooling against relative attainment and relative GDP per capita. As in section 3.a, the relationship between the return to schooling and income per capita seems to be non-linear, with high rates of return at both ends of the income

[27] A second potential explanation for this discrepancy is that the OECD figures may include in private expenditure the fees paid by households to private centers for non-academic services, which we have excluded from our calculations.

[28] In this figure, and elsewhere in the report, the rates of return for Spain as a whole are obtained by entering the relevant parameter values for the entire country in the rate of return formula, and not by averaging the rates of return across regions.



distribution, and returns tend to fall with average attainmentmt, except in the case of Madrid which continues to be an exception. One possible explanation for this peculiarity of the capital region may be related to the finding in the literature (see de la Fuente and Ciccone, 2002) that the returns to schooling tend to be higher in territories characterized by greater technological dynamism.

**Figure 18: Raw rate of return to schooling vs. relative GDP per capita in 1995**

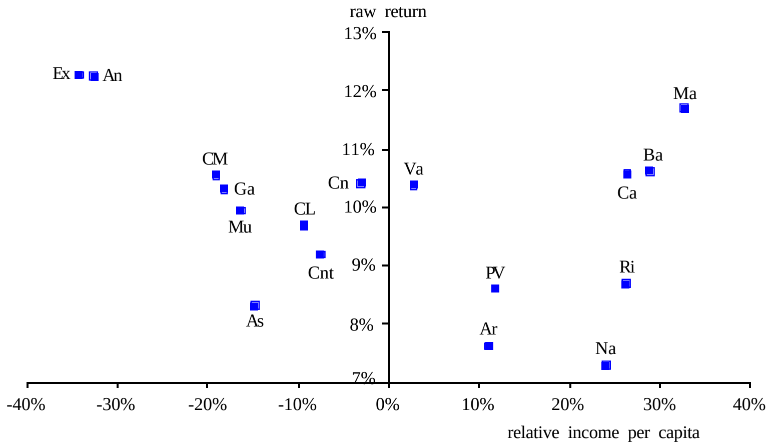
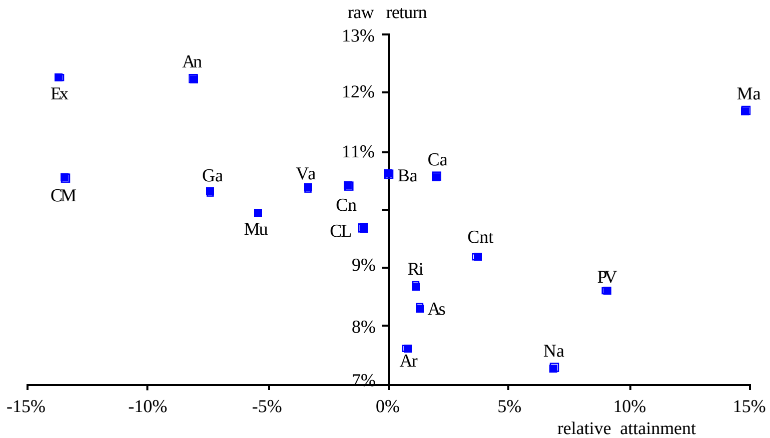


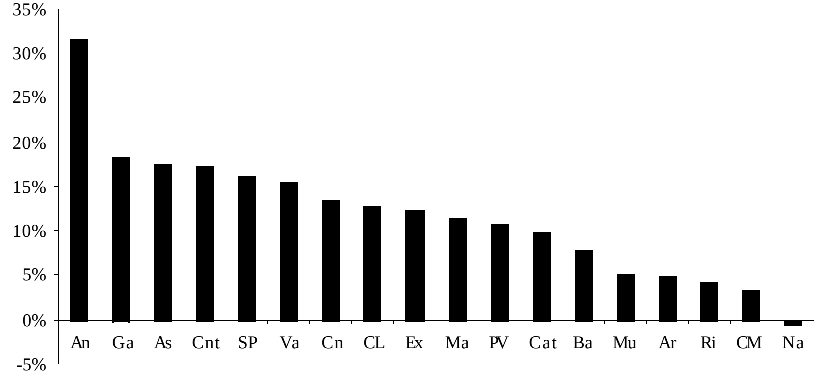

**Figure 19: Raw rate of return to schooling vs. relative attainment per capita in 1995**




### The effect of public policies

A comparison between the raw and all-in rates of return displayed in Figure 17 suggests that government policies have an often large and rather uneven impact on educational returns. Indeed, as shown in Figure 18, the effective tax rate on human capital ranges between -0.5% in Navarra and 31.6% in Andalucía.

**Figure 20: Effective tax rate on human capital ($etr_{gov@}$)**



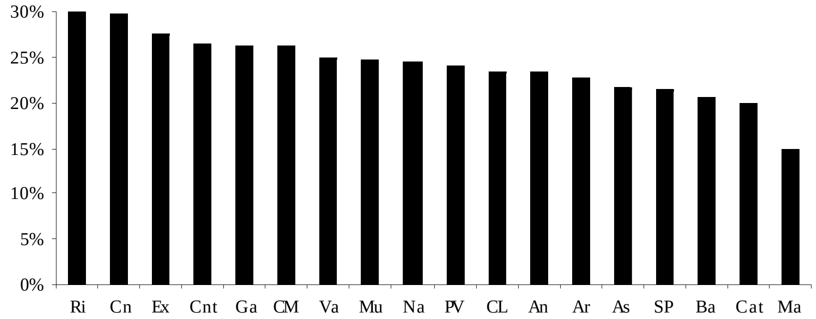

The detailed results of the wedge and tax rate calculations are shown in Tables A.36 and A.37 in section 5.c of the Appendix, and summarized in Figures 20 and 21. The average subsidy rate *(subs)* is substantial (21.5% for the country as a whole) when we consider only the effects of public educational finance (Figure 21.a). On the other hand, both personal taxes and social benefits reduce the net return to schooling and these two factors more than offset direct subsidies to education in all regions but one. The effect of the tax system per se is relatively small, and most of the disincentive effects are due to social benefits. On average, personal taxes reduce educational returns by 0.9 percentage points, while unemployment benefits generate a much larger wedge of 3.4 points. The corresponding effective tax rates are 9.9% and 28.7% respectively (Figures 21.b and 21.c).

These figures imply that public policies impose a positive tax of 16% on human capital. This result stands in sharp contrast with our previous finding of a negative tax rate of -6.4% for Spain (de la Fuente, 2003). This change is largely due to the fact that our current estimates of the parameter that measures the sensitivity of the probability of employment to educational attainment *(ε)* are considerably higher than those obtained in the previous study for reasons that have already been discussed. Since the net replacement ratio *(a+b)* interacts with *ε* in the rate of return formula (see section 6a), the higher values of this last parameter used here greatly increase our estimates of the disincentive effects of unemployment benefits. As can be seen by comparing the last two rows of Table A.37 in the Appendix, the observed increase in $etr_{gov@}$ relative to de la Fuente (2003) can be attributed almost entirely to its social

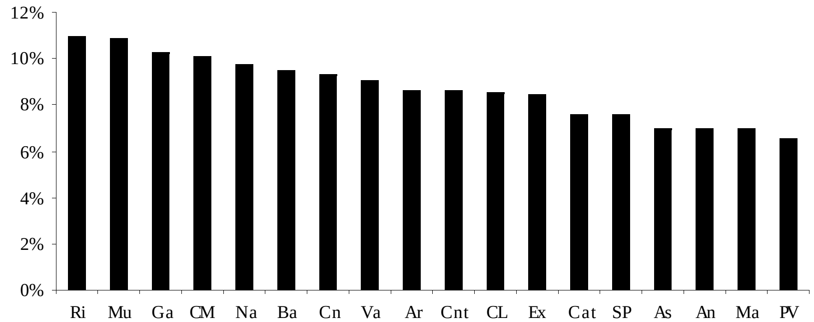


**Figure 21: Components of the effective tax rate on human capital**

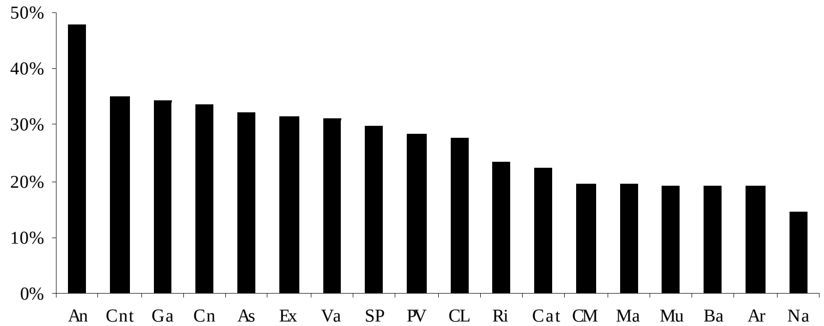
**a. Educational subsidies (*subs*)**




**b. Taxes ($etr_{tax}$)**




**c. Unemployment benefits ($etr_{ben}$)**



benefits component, which increases from 7.5% in the previous study to 29.9% in this one.[29]

In fact, our estimates of the overall effective tax rate on human capital ($etr_{gov©}$) are dominated by their social benefits component ($etr_{ben}$). For all Spanish regions, $etr_{ben}$ is by far the largest of the two non-subsidy components of $etr_{gov©}$. In addition, the correlation between the overall tax rate and $etr_{ben}$ is 0.934, whereas those between $etr_{gov©}$ and its other components are considerable smaller (-0.081 for the subsidy component and -0.524 for the component induced by personal taxes). Hence, we conclude that most of the disincentives for investment in education generated by public policies come from unemployment insurance rather than from the tax system per se. It should be noted, however, that our estimates will overstate the effects of unemployment insurance because we have assumed that contributory benefits never run out, which is certainly not the case. Even so, it seems unlikely that a correction for this factor will qualitatively affect our results. In recent years, the coverage ratio (the ratio of recipients of contributory benefits to the total number of unemployed) has stood around 70% for the industry, services and construction sectors, and it is likely to be considerably higher for the relatively skilled workers that we are focusing on. A quick correction for this factor, obtained by multiplying the average replacement ratio by 0.7, reduces the value of $etr_{ben}$ from 29.9% to 21.8%, which is still almost three times larger than the personal tax component of the effective tax rate on human capital.

A feature of our results that may be puzzling at first sight is the enormous variation of estimated effective tax rates across a set of territories that share a common tax and social protection system and where differences in average wage levels are relatively minor (below 30%). As it turns out, the large cross-regional differences in observed tax rates are driven mainly by two factors: differences across regions in the relative importance of wage and employment effects, and the ceiling on unemployment benefits, which is binding in some cases but not in others.

To illustrate this, we need to go back to the second (approximate) decomposition of the tax rate developed at the end of section 6.a. As noted there, the overall tax rate on human capital may be seen as a weighted average of the average tax rates on the marginal wage ($t_\theta$) and employment ($t_\varepsilon$) benefits of schooling, weighted by the shares of these two components in the total return. We have seen, in particular, that

$$(16)\quad 1-t=\left(\frac{1-t_\theta}{1-s}\right)\frac{\theta}{\theta+\varepsilon}+\left(\frac{1-t_\varepsilon}{1-s}\right)\frac{\varepsilon}{\theta+\varepsilon}$$

where $t$ is an increasing transformation of the effective tax rate ($etr_{gov©}$) and $s$ the overall subsidy rate to schooling measured as a fraction of its total (direct + opportunity) cost. It is also useful to recall that

[29] As noted above, the components of the overall effective tax rate have been computed in slightly different ways in the two studies and are therefore not stictly comparable. Using the same definition as in de la Fuente (2003), the effective tax rates induced by personal taxes and unemployment benefits found in the current study would be 6.25% and 26.3% respectively.



$$(17)\quad 1-t_\theta=\left(\frac{p_o+(1-p_o)a}{p_o+(1-p_o)(a+b)}\right)\left(\frac{1-T©}{1-\tau_o}\right)$$

and to note that this expression may be used to split $t_\theta$ into two components, one that depends only on personal tax parameters, and a second one which depends on the components of the replacement ratio ($a$ and $b$) and will be different from zero only when the ceiling on unemployment benefits becomes binding.

**Table 16: Effective tax rates by region and their main determinants**

| | [1] $etr_{gov©}$ | [2] $\frac{\varepsilon}{\theta+\varepsilon}$ | [3] $t_\varepsilon$ | [4] $t_\theta$, total | [5] $t_\theta$, tax induced | [6] $\frac{\mu_s}{\mu}$ | [7] $a+b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 31.62% | 0.316 | 78.51% | 31.63% | 12.59% | 5.44% | 72.5% |
| *Galicia* | 18.26% | 0.194 | 78.47% | 27.33% | 12.86% | 6.44% | 74.2% |
| *Asturias* | 17.44% | 0.240 | 66.78% | 22.81% | 10.78% | 8.79% | 61.6% |
| *Cantabria* | 17.22% | 0.221 | 72.54% | 25.75% | 11.73% | 9.41% | 67.4% |
| *Valencia* | 15.47% | 0.202 | 76.07% | 24.03% | 12.58% | 9.17% | 72.5% |
| *Canarias* | 13.37% | 0.194 | 79.12% | 24.90% | 13.14% | 4.23% | 75.8% |
| *C.-León* | 12.75% | 0.175 | 71.63% | 22.87% | 11.77% | 7.17% | 67.5% |
| *Extremadura* | 12.37% | 0.284 | 80.91% | 13.53% | 13.53% | -1.83% | **76.0%** |
| *Madrid* | 11.46% | 0.147 | 61.22% | 19.01% | 10.01% | 24.39% | 56.9% |
| *P. Vasco* | 10.77% | 0.240 | 61.23% | 20.16% | 10.98% | 11.88% | 56.8% |
| *Cataluña* | 9.84% | 0.181 | 66.44% | 18.64% | 11.07% | 19.32% | 63.3% |
| *Baleares* | 7.81% | 0.131 | 74.67% | 18.97% | 12.62% | 11.88% | 72.7% |
| *Murcia* | 5.12% | 0.178 | 79.65% | 13.61% | 13.61% | 7.22% | **76.0%** |
| *Aragón* | 4.79% | 0.126 | 67.73% | 17.96% | 11.37% | 10.90% | 65.1% |
| *Rioja* | 4.28% | 0.113 | 73.61% | 22.39% | 12.20% | 6.96% | 70.1% |
| *C.-Mancha* | 3.37% | 0.178 | 79.36% | 13.32% | 13.32% | 2.74% | **75.9%** |
| *Navarra* | -0.45% | 0.092 | 63.04% | 17.20% | 12.15% | 11.42% | 60.8% |
| *Spain* | *16.05%* | *0.212* | *70.14%* | *23.26%* | *11.43%* | *11.90%* | *65.5%* |
| *coeff. var.* | 0.609 | 0.296 | 0.089 | 0.231 | 0.082 | 0.613 | 0.093 |
| *corr w/* $etr_{gov©}$ | 1.000 | 0.799 | 0.238 | 0.798 | -0.066 | -0.124 | 0.110 |
| *corr w/wrel* | -0.085 | -0.164 | -0.978 | 0.024 | -0.915 | 0.739 | -0.993 |

- *Note:* bold figures in column [7] indicate that the ceiling on unemployment benefits is not binding, given the average wage in the region.

Table 16 shows the effective tax rate estimated for each region together with a number of the variables that enter equations (16) and (17). Column [5] shows the component of $t_\theta$ that reflects the operation of the personal tax system per se (which depends on its progressivity as measured by the last factor on the right-hand side of (17)), column [6] shows the fraction of the total direct costs of schooling that are paid by students, and column [7] the overall net replacement ratio ($a+b$), which is shown in bold type if the ceiling on unemployment benefits is not binding. The last three rows of the table show, respectively, the coefficient of variation of each variable and its correlation with $etr_{gov©}$ and with relative wages (average wages in percentage deviations from the national average, *wrel*), treating the whole of Spain as an additional regional observation.

As can be seen in column [3] the tax rate on the employment benefits of schooling $(t_\varepsilon)$ is very high but does not vary much across regions. As a result, the weight of this component in the overall tax rate ($\varepsilon/(\varepsilon+\theta)$) is extremely important in determining the value of $etr_{gov@}$. In fact, the correlation between these two variables is 0.8. The other crucial factor that helps explain cross-regional variations in $etr_{gov@}$ is the value of $t_\theta$, which also displays a correlation of 0.8 with this variable.[30] Notice that the average value of $t_\theta$ is much lower than that of $t_\varepsilon$ but varies considerably more across regions. Most of the variation, however, comes from the social insurance system and, in particular, from the substantial increase in $t_\theta$ that takes place once the ceiling on unemployment benefits becomes binding. By contrast, the tax-induced component of $t_\theta$ (given in column [5]) is both rather low and fairly uniform across regions and displays a small negative correlation with the overall tax rate.

The correlations of some of these variables with income levels (as measured by relative wages, *wrel*) is also of considerable interest. The tax-induced component of $t_\theta$, which captures the progressivity of the personal income tax system, falls with wages. As a result, the disincentive effects of personal taxes tend to be greater at low income levels. Similarly, $t_\varepsilon$ is strongly negatively correlated with wages because net replacement rates fall with income. These two factors, however, are partly offset by the behaviour of public educational subsidies (which account for a greater fraction of direct costs in low income regions) and by the effects of the unemployment benefit ceiling, which substantially increases $t_\theta$ in all but the lowest-wage regions. On the whole, the correlation between effective tax rates and average wages is negative but very small.

### c. Results by educational level

In this section we will present separate rate of return estimates for each of the different levels of schooling, distinguishing in particular between lower secondary education, general upper secondary schooling, the two cycles of vocational training and the two university cycles. The procedure is analogous to the one used above to calculate the average return to an additional year of schooling. As before, we apply equation (10) in section 4.a to a hypothetical representative worker for each attainment level whom we continue to assume active throughout his adult life, single and childless. The relevant tax and subsidy wedges and rates will also be computed following the procedure described above.

[30] These two variables alone explain 93% of the variation in the overall effective tax rate.



#### i. Methodology and data

The definitions of the variables that enter the rate of return formula given in Table 14 in the previous section continue to be valid with minor changes that will be discussed shortly. The values of these variables are shown in Tables A.40-A.45 in the Appendix.

The changes in the construction of the relevant variables are as follows. First, when calculating the marginal returns to schooling at level *n*, we will use as a reference the average earnings and employment probabilities of workers who have completed the immediately preceding educational level, *n-1*. That is, we will be assuming that the opportunity cost of a student enrolled in, say, upper secondary school is determined by the average wage and employment probability of full-time workers who have completed lower secondary schooling and by the tax and benefit parameters determined by these wage and employment levels. The value of $\varepsilon$ for educational level *n*, is obtained by dividing the estimated value of $p'()$ for level *n* by the average probability of employment in level *n-1*; that $\varepsilon_n = p_n'/p_{n-1}$.

An important complication is that we have had to estimate the average wage and employment probability of a representative individual for each attainment level and region, since we lack direct estimates of these magnitudes. This has been done by correcting the average wages and employment probabilities used for the entire population in the previous section using the results of the wage and employment equations following the procedure discussed in section 5.e.i of the Appendix. As in the previous section, student employment probabilities are obtained by adding to the corresponding adult employment probabilities the estimated coefficient of the relevant student dummy (university or non-university) in the second version of the employment equation.

A second key difference in the calculation is that we will now use level-specific estimates of the marginal wage and employment effects (per year) obtained with our second specification of the employment and wage equations (columns 2 through 7 of Tables 8 and 11) rather than the corresponding Mincerian estimates of the relevant parameters ($\theta$ and $p'(S)$) for all school cycles combined.

Third, the private and total direct costs of schooling are allowed to vary across levels as much as our data permit. Given the limitations of the expenditure data (see section 1 of the Appendix), we have had to assume that expenditure per student (measured in euros) does not vary across university cyles, and that this variable also remains constant across all secondary and vocational cycles. Expenditure for educational level *n* is then normalized by the average wage of workers of attainment *n-1* as estimated above. Finally, the length of post-school working lives will now be estimated as the difference between the mean retirement age (which is assumed to be the same for all skill levels for lack of better data) and the theoretical age of completion of each school cycle using the cumulative durations given in Table 7.

### ii. Results

The detailed results of the rate of return and tax and subsidy calculations for each region are given in Tables A.46 - A.55 in the Appendix. The discussion in this section will focus on average results for Spain as a whole.

**Figure 22: Marginal returns to schooling by level in Spain as a whole**

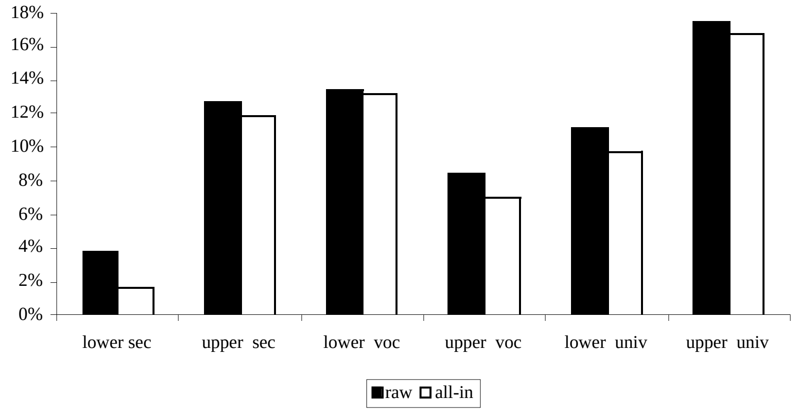



Figure 20 shows our raw *(NO GOV'T)* and all-in *(OBS)* estimates of the private rate of return to the different levels of schooling. The estimated return is rather low at the last compulsory schooling level (lower secondary) but rises sharply for early post-compulsory cycles (upper secondary and lower vocational training). It then drops somewhat for the next two levels and increases again for advanced university training. This last cycle displays the largest estimated return (17.5% before correcting for the effects of public policies), followed by lower vocational training (13.37%) and by upper secondary schooling (12.68%).

Table 17 shows how the relative returns to the different schooling cycles vary across regions. To construct this table we first average estimated all-in *(OBS)* returns across all educational cycles for each region. The table then shows the return to each educational level normalized by this average. Large deviations from the national pattern of relative returns are highlighted by showing in bold type those entries that exceed the corresponding national average (shown in the last row) by more than thirty points, and in bold italic those that lie over thirty points below this reference.

Inspection of the table shows considerable differences across regions in the pattern of relative returns. Returns at the lower secondary level, for instance, are exceptionally high in two of the poorest regions, Extremadura and Murcia, where the estimated raw returns exceed



8%, and are actually negative in five of the regions.[31] At the other end of the educational ladder, the return to long-cycle university studies is particularly high, in relative terms, in País Vasco, Cantabria and Aragón, and especially low in Castilla la Mancha, Baleares, Valencia, Galicia and Asturias.

**Table 17: Relative returns to the different educational levels**

| | *average* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 100.0 | **70.5** | 126.9 | 117.7 | ***20.1*** | 75.2 | 189.6 |
| *Madrid* | 100.0 | -1.5 | 107.2 | 107.9 | 90.5 | 123.4 | 172.6 |
| *Cast. la M.* | 100.0 | 38.3 | 90.7 | 158.7 | **103.8** | 117.4 | ***91.1*** |
| *Baleares* | 100.0 | 9.7 | **178.7** | **296.2** | ***-84.8*** | 119.2 | ***81.0*** |
| *Cataluña* | 100.0 | 14.7 | 120.0 | 142.5 | 65.1 | 104.3 | 153.4 |
| *Murcia* | 100.0 | **93.3** | 122.0 | 121.9 | 14.1 | 70.1 | 178.7 |
| *Canarias* | 100.0 | 27.0 | 117.1 | ***99.5*** | 55.8 | 121.2 | 179.4 |
| *Valencia* | 100.0 | 28.5 | 145.3 | 118.3 | 87.0 | 94.7 | ***126.1*** |
| *Cast. y León* | 100.0 | 32.2 | 123.2 | 121.1 | 76.7 | 83.5 | 163.4 |
| *Galicia* | 100.0 | 33.7 | 124.1 | 143.8 | 53.3 | 110.1 | ***135.0*** |
| *Andalucía* | 100.0 | 14.5 | 130.4 | 128.2 | 77.7 | 88.2 | 160.9 |
| *Rioja* | 100.0 | 25.3 | 139.1 | **200.2** | ***-0.7*** | 82.7 | 153.4 |
| *País Vasco* | 100.0 | ***-41.7*** | 130.2 | 116.7 | 58.9 | 116.2 | **219.7** |
| *Cantabria* | 100.0 | 42.4 | 114.9 | 126.8 | ***27.3*** | 70.6 | **218.0** |
| *Navarra* | 100.0 | ***-18.1*** | ***88.3*** | 139.3 | 73.5 | **139.6** | 177.5 |
| *Aragón* | 100.0 | ***-102.9*** | 118.2 | 142.6 | 94.9 | 119.6 | **227.5** |
| *Asturias* | 100.0 | ***-93.9*** | **204.9** | **168.6** | ***12.2*** | **179.1** | ***129.1*** |
| *Spain* | *100.0* | *16.5* | *118.8* | *131.7* | *69.3* | *96.9* | *166.8* |

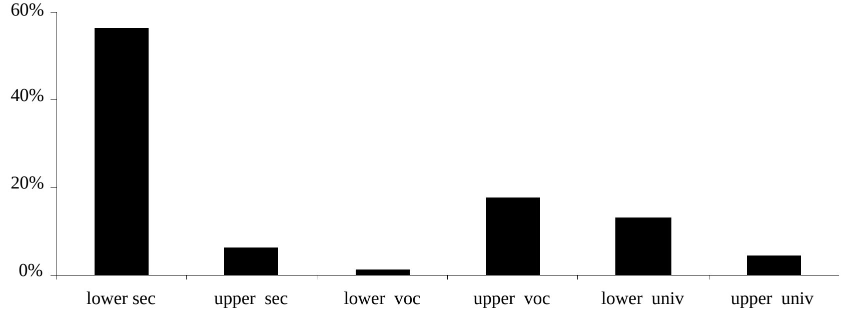
### The effect of public policies

Figures 23 and 24 display the average effective tax rate on each schooling cycle and its subsidy, personal tax and social benefit components. Figure 25 shows the relative weight of the employment benefits in the total benefits of schooling ($\varepsilon/(\varepsilon+\theta)$) and the tax rates on the two benefit components, $t_\varepsilon$ and $t_\theta$, distinguishing in the second case between the tax and benefit-induced components of this variable.

The effective tax rate is extremely high at the lower secondary level, where it exceeds 55%, and drops to values below 18% for all post-compulsory cycles. Tax rates are lowest for upper secondary and lower vocational training, increase sharply at the upper vocational level and decline thereafter as we move to the right in Figure 23. As in the previous section, effective tax rates are quite sensitive to the relative weight of employment benefits in the total benefits of schooling and to the ceiling on unemployment benefits.

31 As for all other levels, the rate of return to lower secondary schooling is calculated under the assumption that the opportunity cost to the agent is determined by the wages of the next lower attainment level. Since lower secondary schooling is mandatory, however, and school-age children are not allowed to work regularly, it may be argued that the relevant opportunity cost is in this case zero. Under this alternative assumption, all regions display positive rates of return.

**Figure 23: Effective tax rate on human capital ($etr_{gov@}$), entire Spain by level**




Subsidy rates *(subs)* drop markedly as we move to the right in Figure 24.a because direct costs are a greater fraction of wages at lower attainment levels and because raw subsidy rates (the fraction of total direct costs paid by the government) is lower for university studies than for secondary or vocational ones.

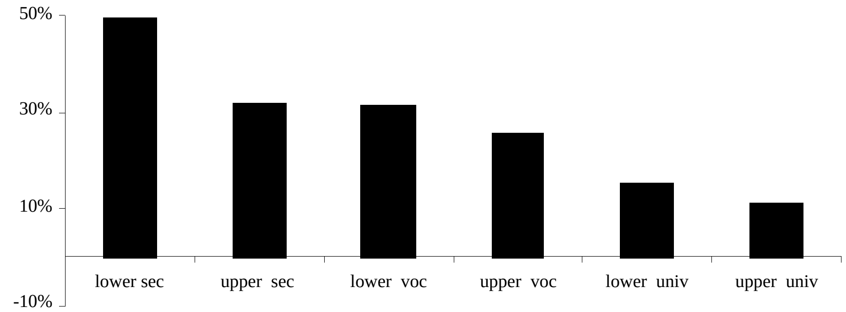
The tax induced by unemployment benefits ($etr_{ben}$) falls as we go from lower secondary scholing to lower vocational training in Figure 24.c in response to a decline in the relative weight of employment benefits (Figure 25.a). For these three levels, the net replacement ratio (which is the main determinant of $t_{\varepsilon}$ shown in Figure 25.c) is practically the same. The value of $etr_{ben}$ jumps up at the upper vocational level because the ceiling on unemployment benefits becomes binding, making the benefit induced component of $t_{\theta}$ positive as shown in Figure 25.b. As we move on to university schooling in Figure 24.c, $etr_{ben}$ declines because replacement ratios fall (as a fixed benefit becomes relatively less important relative to rising wages as shown in Figure 25.c).

Finally, the tax-induced component of the effective tax rate ($etr_{tax}$ in Figure 24.b) is driven by the tax component of $t_{\theta}$, which reflects the progressivity of the tax system at each income level, and by the relative importance of wages in the overall benefits of schooling. For the first three schooling levels the degree of progressivity is practically the same, but $etr_{tax}$ rises as a result of the increasing relative importance of wage benefits. For higher attainment levels, progressivity is lower, although with some oscillations, yielding generally lower values of $etr_{tax}$ that peak at the lower university level.

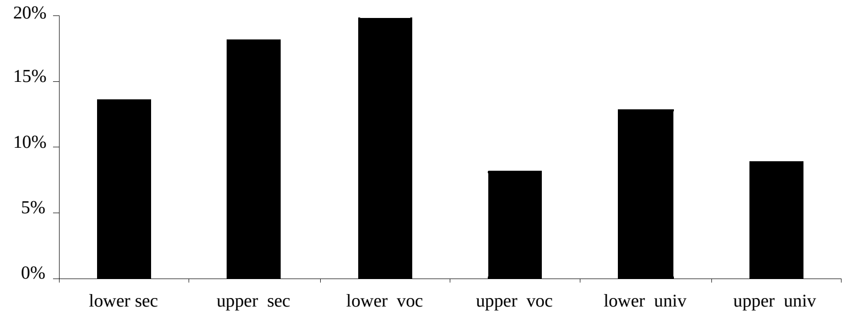


**Figure 24: Components of the effective tax rate on human capital, entire Spain by level**

**a. Educational subsidies (*subs*)**




**b. Taxes ($etr_{tax}$)**




**c. Unemployment benefits ($etr_{ben}$)**

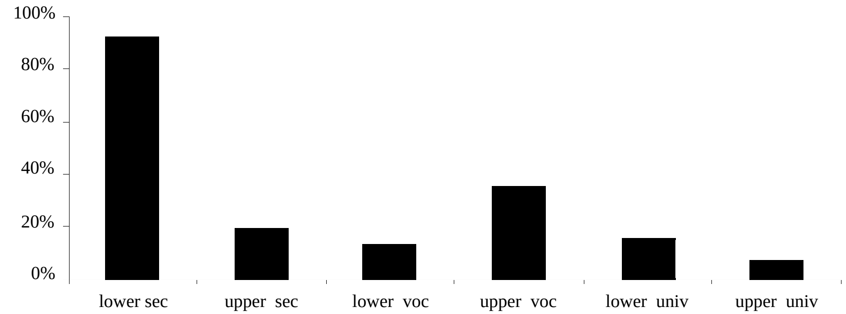
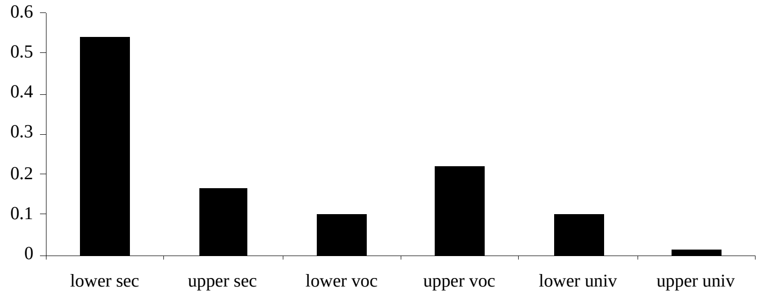
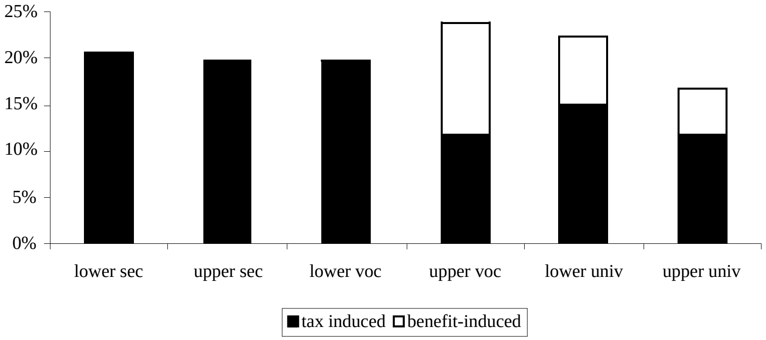


**Figure 25: Determinants of the effective tax rate on human capital**

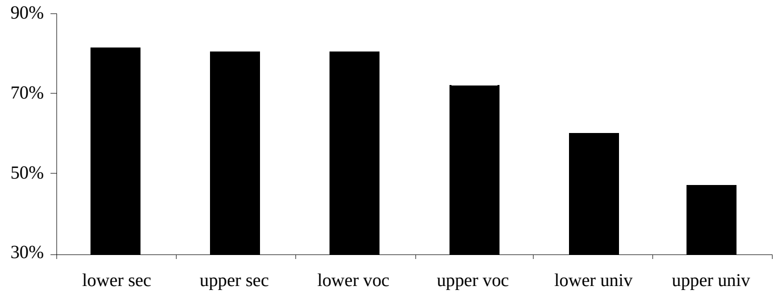
**a. relative weight of the employment benefits of schooling ($\varepsilon/(\varepsilon+\theta)$)**




**b. tax rate on the wage benefits of schooling ($t_\theta$)**




**c. tax rate on the employment benefits of schooling ($t_\varepsilon$)**






**d. How does the private return on schooling compare with that on alternative assets?**

In this section we will compare the returns to schooling estimated above to those available on alternative assets that households can invest in. Table 18 shows the before-tax real returns on bonds and stocks during the period 1950-99 and different subperiods. These data are taken from Dimson, Marsh and Staunton (2002). The last column of the table shows the average return on a portfolio where bonds and shares have the same weight.

**Table 18: Real before-tax returns to debt and equity in Spain**

| | *equity* | *bonds* | *avge. portfolio* |
|---|---|---|---|
| 1950-59 | 6.4% | -0.7% | 2.9% |
| 1960-69 | 11.3% | -1.0% | 5.2% |
| 1970-79 | -15.1% | -7.6% | -11.4% |
| 1980-89 | 18.4% | 6.2% | 12.3% |
| 1990-99 | 9.2% | 7.6% | 8.4% |
| 1950-89 | 4.5% | -0.9% | 1.8% |
| *1950-99* | *5.5%* | *0.9%* | *3.2%* |

Figure 26 shows what we will call the *private premium on human capital*. This variable is defined as the difference between the private *after-tax* rate of return on schooling (under the all-in scenario, *OBS*) and the average *before-tax* return on the equal-weight portfolio given in Table 18 for the entire period 1950-99. Panel a of the figure refers to the average (Mincerian) returns across all levels for each region, and panel b to the average marginal return to each educational level for Spain as a whole. In both cases the estimated private premia on human capital are generally positive and large, with the only exception of lower secondary schooling. Across regions, the largest premium corresponds to Extremadura (7.35%) and the lowest one to Asturias (3.65%) with a mean value of 6.30% for the entire country. Across levels, the premium lies above 4 percentage points for all post-compulsory levels and reaches 14% for advanced university courses.

These results reinforce our conclusion in de la Fuente and Ciccone (D&C, 2002) and de la Fuente (2003) that schooling is a rather attractive investment from an individual point of view.[32] Its expected return is at lest twice that on financial assets in all regions and all post-

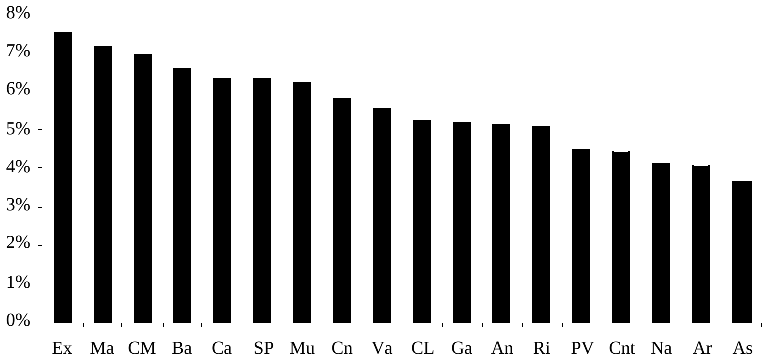
[32] As noted in D&C (2002), in order to draw unequivocal conclusions about the relative attractiveness of education as an investment, we would need to control for the riskiness of its returns. While the variation of earnings across workers with similar attainment levels is very high, much of this variation is not the result of random luck but of differences in individual abilities and career choices. I am not aware of any refined measures of earnings risk that can be used to draw valid comparisons with other assets.

On a different note, Padula and Pistaferri (2001) provide some evidence that introducing risk considerations may actually increase the attractiveness of investment in schooling. They find, in particular, that increases in attainment tend to lower wage risk and, as a result, increase the (risk-adjusted) rate of return on schooling. (Thanks to G. Brunello for providing this reference).

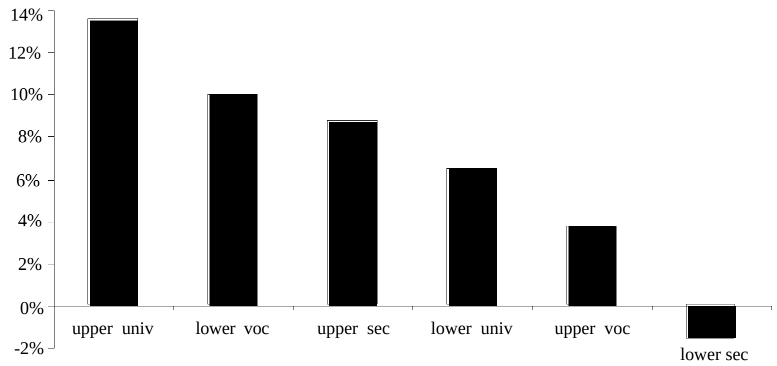
compulsory levels. When allowance is made for taxes on capital income, the premium on schooling will increase significantly.

**Figure 26: Private premium on human capital**

**a. Average across levels (Minцerian estimates) for each region**




**b. for each level in Spain as a whole**




## 5. The long-term impact of schooling expenditure on public finances

Public expenditure on education increases future tax revenues and reduces social insurance payments. Proceeding as in the previous section, we can treat such expenditure as an investment and compute a *fiscal rate of return to schooling* that will summarize the long-term impact of educational spending on government finances. This variable, which we will denote by $r_f$, will be defined as the discount rate that equates the present value of public schooling expenditure (which includes also an opportunity cost component as school attendance reduces wage income and hence current tax payments) with the present value of the induced



incremental flows of tax revenues and savings on social protection payments. This fiscal rate of return can also be interpreted as the maximum real rate of interest at which the government can borrow to finance educational expenditure without increasing the present value of future deficits. In addition, we will also compute the *net present fiscal value* of an additional year of schooling, defined as the difference in present value terms between incremental net fiscal revenues and educational expenditures. In all calculations, we will take into account the effects of education on labour force participation, and will try to approximate the marginal effects of schooling on tax revenues in general equilibrium, that is, when aggregate attainment levels are allowed to change and to affect factor prices.

### a. Methodology

Proceeding as sketched in de la Fuente (2003), but focusing only on public educational expenditure and on the tax and benefit flows induced by a one-year increase in attainment, it can be shown that the fiscal rate of return on schooling is given by

$$(19)\quad r_f = R_f + g$$

where $g$ is the exogenous growth rate of productivity and $R_f$ is the value of $R$ that solves the following equation

$$(20)\quad \frac{R}{1-e^{-RH}} = R' \equiv \frac{D\varepsilon_q + N_1\theta + N_2\varepsilon}{(D-N_3)+\frac{\mu_g}{q_o}} \equiv$$

$$= \frac{\left[p_o\tau_o-(1-p_o)(a+b)(1-\tau_o)\right]\varepsilon_q+\left[p_oT'-(1-p_o)a(1-T')\right]\theta+p_o\left[\tau_o+(a+b)(1-\tau_o)\right]\varepsilon}{\left[p_o\tau_o-(1-p_o)(a+b)(1-\tau_o)\right]-\eta_q\eta p_o\tau_s(1-\phi)+\frac{\mu_g}{q_o}}$$

where $\mu_g$ is public expenditure per student measured as a fraction of the gross wage of the reference worker and $q(S)$ denotes the probability that a worker will be active as a function of his school attainment. In particular, $q_o = q(S_o)$ is the participation rate of adult workers, $\varepsilon_q = q'(S_o)/q(S_o)$ measures the sensitivity of the participation rate to the level of schooling and $\eta_q = q_s/q_o$ the ratio between the participation rates of full-time workers and students of the relevant attainment level. The remaining variables have the same meaning as in section 4.

The net present fiscal value of a year of schooling at a given discount rate, $r_o$, can be approximated by

$$(21)\quad NPFV(r_o) = \left[R'\frac{1-e^{-(r_o-g)H}}{r_o-g}-1\right]\left[(D-N_3)+\frac{\mu_g}{q_o}\right]W_o$$

where $R'$ is the benefit to cost ratio that appears on right-hand side of equation (20) and $W_o$ the average gross salary of a full-time worker with the relevant level of schooling.

Equation (20) has essentially the same interpretation as the private returns formula given in section 4. That is, $r_f$ is the ratio of the marginal (budget) benefits of an additional year of schooling to its costs, adjusted for the finiteness of working lives. We have written $R'$ so that all its cost and benefit components are measured as fractions of an adult worker's gross wages.

Notice that the term $D$ that enters both the numerator and the denominator of $R'$ corresponds to the expected increase in tax revenues per worker (net of incremental social benefits) that is generated by an additional year of schooling. This variable, which can have either a positive or a negative sign, will vary across regions and educational cycles depending on employment probabilities and wages, which determine both average tax rates and unemployment benefit levels.

The numerator of $R'$ in equation (20) measures the expected net annual contribution to the public budget of an additional year of schooling. Its first term, $D\varepsilon_q$, captures the impact of an increase in the labour force participation rate. Since inactive workers pay no taxes on labour income and are not entitled to unemployment benefits, increasing the labour force participation rate will increase net tax revenues provided tax payments by newly active workers exceed the social benefits paid to them. The second term, $N_1\theta$, captures the net revenue effects of higher salaries, which increase tax payments by employed workers but also the insurance entitlements of the unemployed. The third term, $N_2\varepsilon$, reflects the impact of the increase in the probability of employment and is unambiguously positive since greater employment implies both higher tax revenues and lower social insurance payments.

The denominator of $R'$ is the sum of the opportunity and direct budget costs of schooling. The opportunity cost term, $D$-$N_3$, is the difference between expected net tax receipts from a full-time worker and net receipts from a part-time student worker. The direct cost component, finally, is equal to government expenditure per student divided by the labour force participation rate. This correction is required because expenditure is incurred for all students, but only those that enter the labour force pay taxes on labour income or are entitled to unemployment benefits.

We will use equations (20) and (21) to explore the fiscal consequences of increasing average attainment by one year in each region and to compute the fiscal rate of return to each post-compulsory educational level for Spain as a whole. Hence, our raw data are the same that have already been used to calculate the private returns to schooling in sections 4.b and 4.c. We will, however, introduce a number of deviations from our previous assumptions to try to obtain a more realistic estimate of the impact of schooling on public finances. First, we will now take into account the effects of schooling on labour force participation rates. Hence, our calculations in this section will apply to a representative individual who may or may not be active with probabilities based on observed labour force participation rates, rather than to an individual who remains active throughout his student and adult life, as was the case in the previous section. Equation (20) already incorporates participation effects, and the values of the relevant parameters will be set using the participation equations estimated in section 3.b following exactly the same procedure we used above to construct the analogous parameters



that capture the effects of education on the probability of employment conditional on labour force participation.[33]

Second, since trying to account for pension benefits would take us too far afield, we will abstract from pension financing in our analysis of the budget effects of schooling by eliminating from our calculations that part of social security contributions that goes to finance pension (and sick leave) benefits. This will be done by subtracting this contribution (which is levied at a flat rate of 4.7%) from our previous estimates of the average and marginal income tax rates.

Finally, we will try to approximate the general equilibrium effects of schooling on wages and employment probabilities. As has already been noted, the estimates of the wage $(\theta)$ and employment $(\varepsilon)$ benefits of schooling reported in sections 3.a and 3.b are partial equilibrium estimates that capture the returns that a single individual can expect when he increases his attainment level holding constant aggregate factor stocks and prices. It should be expected, however, that the realized marginal returns to schooling will be smaller when the government undertakes policies that raise average attainment at the aggregate level. As discussed in de la Fuente (2003)[34] the required correction to the wage benefits of schooling can be approximated by multiplying the estimated value of $\theta$ by one minus the share of capital in national income (which we have estimated at 0.314 in section 3.c). For the case of the employment and participation parameters ($\varepsilon$ and $\varepsilon_q$) we will introduce an ad-hoc correction that consists in reducing the original estimates of both coefficients by two thirds.

**b. Results**

Table 19 shows our estimates of the fiscal rate of return and the net present fiscal value per student (assuming a real discount rate of 3%) for the case of a one-year increase in average attainment in each region. These calculations are carried out under three alternative sets of assumptions concerning the unemployment coverage ratio (i.e. the fraction of unemployed workers drawing benefits) and the financing of the additional expenditure required to increase enrollments. Column [1] assumes a coverage ratio of 100% and that private expenditures increase in step with public expenditure so that their ratio remains constant. Column [2] maintains the second assumption but assumes a coverage ratio of 70% for all regions (which is the observed national average as of 2003) and column [3] assumes that all the required new expenditure comes from the public sector with a coverage ratio of 70%. Regions are ordered by the estimated fiscal rate of return given in column [3].

33 Thus, the value of $q_o$ for the Mincerian calculations by region is the prediction of the Mincerian participation equation estimated in section 3.b for the mean values of all regressors. We use this value and the results of the second specification of the participation equation (with dummies by educational level) to recover an estimate of the average participation rate at each attainment level, as discussed in section 5.e.i of the Appendix for the case of the analogous employment probabilities. The corrections required to estimate student participation rates and the calculation of $\varepsilon_q$ also follow the procedures discussed in sections 4b. and 4.c

34 See in particular section 8 of the Appendix.

**Table 19: Fiscal rate of return and net present fiscal value per student of an additional year of schooling by region**

| | *fiscal rate of return* | | | *net present fiscal value* | | |
|---|---|---|---|---|---|---|
| *financing =* | *priv+pub* | *priv+pub* | *only public* | *priv+pub* | *priv+pub* | *only public* |
| *coverage ratio =* | *100%* | *70%* | *70%* | *100%* | *70%* | *70%* |
| | *[1]* | *[2]* | *[3]* | *[1]* | *[2]* | *[3]* |
| *Andalucía* | 9.67% | 7.21% | 6.79% | 4,872 | 3,697 | 3,477 |
| *Madrid* | 8.05% | 7.16% | 5.81% | 5,733 | 5,050 | 3,954 |
| *Baleares* | 6.16% | 5.56% | 4.99% | 3,446 | 2,890 | 2,407 |
| *Cataluña* | 6.54% | 5.84% | 4.88% | 4,258 | 3,563 | 2,645 |
| *Valencia* | 6.29% | 5.35% | 4.85% | 3,403 | 2,600 | 2,179 |
| *Galicia* | 6.16% | 5.13% | 4.76% | 3,107 | 2,300 | 1,990 |
| *C.-León* | 5.52% | 4.84% | 4.48% | 2,799 | 2,185 | 1,842 |
| *Canarias* | 5.05% | 4.35% | 4.14% | 2,345 | 1,637 | 1,415 |
| *Extremadura* | 3.73% | 3.73% | 3.83% | 470 | 578 | 650 |
| *P. Vasco* | 4.49% | 3.92% | 3.40% | 2,120 | 1,367 | 642 |
| *Cantabria* | 4.67% | 3.86% | 3.38% | 1,881 | 1,042 | 498 |
| *C.-Mancha* | 3.29% | 3.44% | 3.31% | 245 | 428 | 309 |
| *Asturias* | 4.23% | 3.64% | 3.25% | 1,475 | 824 | 332 |
| *Aragón* | 3.85% | 3.49% | 3.06% | 1,015 | 610 | 75 |
| *Rioja* | 3.74% | 3.34% | 3.02% | 948 | 450 | 32 |
| *Murcia* | 2.99% | 3.13% | 2.79% | -8 | 115 | -195 |
| *Navarra* | 3.40% | 3.17% | 2.74% | 543 | 240 | -393 |
| *Spain* | *7.15%* | *6.13%* | *5.45%* | *4,528* | *3,692* | *3,133* |

For the country as a whole, the fiscal rate of return ranges between 5.45% and 7.15% depending on the scenario, and imply positive net fiscal values of between 3,000 and 4,500 euros per student. For scenario [3], which is arguably the more realistic one, the fiscal rate of return exceeds 3% in all regions but two, and the present value of net tax revenues exceeds 1,000 euros per student in half the regions.

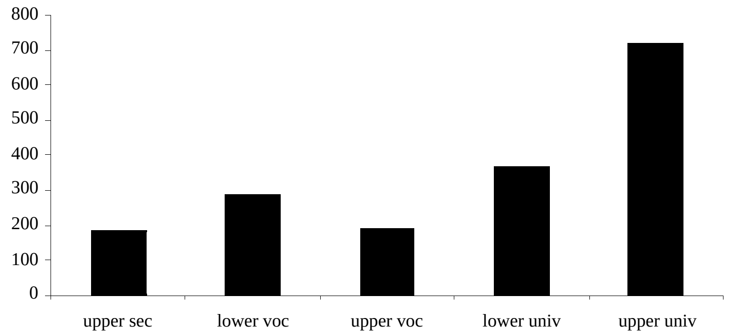
**Table 20: Fiscal rate of return and net present fiscal value per student of an additional year of schooling by level in Spain as a whole**

| | *fiscal rate of return* | | | *net present fiscal value* | | |
|---|---|---|---|---|---|---|
| *financing =* | *priv+pub* | *priv+pub* | *only public* | *priv+pub* | *priv+pub* | *only public* |
| *coverage ratio =* | *100%* | *70%* | *70%* | *100%* | *70%* | *70%* |
| | *[1]* | *[2]* | *[3]* | *[4]* | *[5]* | *[6]* |
| *upper sec* | 3.99% | 3.95% | 3.66% | 841 | 910 | 656 |
| *lower voc* | 3.59% | 4.26% | 3.98% | 780 | 1,946 | 1,560 |
| *upper voc* | 4.75% | 3.88% | 3.62% | 1,588 | 852 | 627 |
| *lower univ* | 9.29% | 8.56% | 6.97% | 6,374 | 6,015 | 4,967 |
| *upper univ* | 12.71% | 12.14% | 10.56% | 14,200 | 13,927 | 12,893 |



Table 20 shows the results of similar calculations for each post-compulsory educational cycles in the case of Spain as a whole. Focusing on scenario [3], the estimated fiscal rates of return lie between 3% and 4% for secondary and vocational training and are much higher at the university level, where the net present fiscal value per student of an additional year of training shoots up to around 5,000 for the first cycle and to over 12,000 for the second one.

**Figure 25: Incremental annual net tax revenue per student and year of schooling after graduation, in euros of 2000**




These results suggest that any increase in public educational expenditure required to marginally raise current attainement levels would more than pay for itself over the long run through higher tax revenues and lower social insurance payments.[35] The fiscal surplus per student is considerable for some cycles and regions and can potentially make a modest positive contribution to public budgets in the future.[36] Figure 25 shows the incremental annual net tax revenues per student generated by an additional year of schooling at each level.[37] To get some feeling for the macroeconomic implications of our results, we have calculated that increasing by 100.000 the number of graduates at each university cycle would increase net tax revenues by 325 million euros per year, or 0.05% of Spain's GDP in 2000.

[35] Barceinas et al (2000) reach the same conclusion for Spain as a whole using a more elaborate procedure. Their calculations are based on uncorrected partial equilibrium estimates of the relevant wage and employment effects, but they discount the entire expected profile of net tax revenues over the life-cycle using the "elaborate method" to allow for marriage, child benefits and tax deductions for home purchases. Our approach can be seen as an approximation to this procedure that considerably simplifies the required calculations, making it feasible to obtain region-specific results.

[36] One limitation of these calculations is that they do not take into account years of schooling that are "wasted" because of repeats and dropouts. A reasonable allowance for these factors should not, however, qualitatively change the results.

[37] These figures refer to the expected yearly increase in net tax revenues after the completion of schooling. They are obtained by multiplying the numerator of the benefit to cost ratio R' in equation (20) by the estimated average wage in 2000.

### 6. The social rate of return to schooling and the optimal investment pattern

In this section we will present estimates of the social return to schooling and to alternative assets in the Spanish regions. The procedure used to estimate the rate of return to schooling is similar to the one described in section 4 except for the fact that we will now be concerned with the social, rather than private, costs and benefits of an additional year of schooling. As a result, we need to consider the effects of education on aggregate output rather than on individual income, and its contribution to faster technological progress. On the other hand, taxes and social benefits are no longer relevant, as we are not interested in flows of resources between the public and private sectors.

Box 1 outlines a simple model of growth with human capital that specifies the connections between the educational attainment of the labour force and the level and growth rate of aggregate productivity. As in our previous reports, the model allows for two types of links between average schooling and aggregate output to which we will refer as "level" and "rate" effects. First, the *level* of output is assumed to be an increasing function of average attainment through a standard aggregate production function with human capital as an input.[38] And second, the model assumes that the rate of technical progress is also an increasing function of average schooling through an external effect that cannot be privately appropriated by individuals in the form of higher wages.

Box 1 also gives the formula for the calculation of the social rate of return under the assumptions of the model. The choice of values for the key parameters of this formula will be discussed below. It must be kept in mind that, as their private counterparts in section 4, the social rates of return reported in this section capture the marginal return to an increase in the quantity of schooling holding cost and quality constant at the existing level. An additional problem is that the social returns estimates in this section are less likely to capture differences in quality levels across regions than the private returns reported above. One of the key inputs for the social returns calculation is an econometric estimate of the contribution of school attainment to productivity which essentially measures the strength of this connection in the case of a hypothetical average region.[39] Hence, our social rate of return estimates

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[38] The functional form of the production function is very important in cross-regional comparisons. As shown in Box 1, the Cobb-Douglas function in years of schooling that underlies our calculations forces the aggregate Mincerian returns parameter *($\rho$)* for each territory to be inversely proportional to its average attainment. An alternative ("Mincerian") specification that has often been used in the recent literature, by contrast, imposes a common value of $\rho$ for the whole sample (see Box 2 in section 3b.ii of D&C (2002)). This makes little difference when we are interested in drawing conclusions for a hypothetical average region but becomes crucial when we want to compare rates of return across territories. While we find the Cobb-Douglas specification intuitively more appealing than the Mincerian functional form and have found that it fits the OECD data better, it may still be too restrictive. If this is the case, cross-regional results may be distorted in a way that will depend on the true sensitivity of $\rho$ to average attainment.

[39] This problem does not arise in the calculation of the private returns to schooling because the relevant parameter is estimated separately for each region using individual data and can therefore pick up cross-



**Box 1: A simple model of human capital and growth
and the social rate of return to schooling**

Our estimates of the social return to schooling will be based on a simple model of human capital and growth with two components: an aggregate production function and a technical progress function. The production function will be assumed to be of the Cobb-Douglas type:

(1) $Y_{it} = A_{it} K_{it}^{\alpha_k} S_{it}^{\alpha_S} L_{it}^{\alpha_l}$

where $Y_{it}$ denotes the aggregate output of region *i* at time *t*, $L_{it}$ is the level of employment, $K_{it}$ the stock of physical capital, $S_{it}$ the average stock of human capital per worker, measured by the average years of schooling of the adult population, and $A_{it}$ an index of technical efficiency or total factor productivity (TFP) which summarizes the current state of the technology and, possibly, omitted factors such as geographical location, climate, institutions and endowments of natural resources. The coefficients $\alpha_i$ (with *i = k, s, l*) measure the elasticity of output with respect to the stocks of the different factors. An increase of 1% in the stock of human capital per worker, for instance, would increase output by $\alpha_S$% holding constant the stocks of the other factors and the level of technical efficiency.

Under the standard assumption that (1) displays constant returns to scale in capital, labour and total human capital, *LS*, (i.e. that $\alpha_k + \alpha_l = 1$) we can define a per capita production function that will relate average productivity to average schooling and the stock of capital per worker. Letting *Q = Y/L* denote output per worker, *Z = K/L* the stock of capital per worker, and dividing both sides of (1) by total employment, *L*, we have:

(2) $Q = f(S) = AZ^{\alpha_k} S^{\alpha_S}$

The aggregate Mincerian returns parameter that appears in the rate of return formula shown below is given by

(3) $\rho = \dfrac{f'(S)}{f(S)} = \dfrac{AZ^{\alpha_k}\alpha_S S^{\alpha_S - 1}}{AZ^{\alpha_k} S^{\alpha_S}} = \dfrac{\alpha_S}{S}$

This parameter measures the percentage increase in output resulting from a one-year increase in average attainment.

The technical progress function describes the determinants of the growth rate of total factor productivity. We will assume that region *i*'s TFP level can be written in the form:

(4) $A_{it} = B_t X_{it}$

where $B_t$ denotes the national "technological frontier" (i.e. the maximum attainable level of efficiency in production given the current state of scientific and technological knowledge in the country) and $X_{it} = A_{it}/B_t$ the "technological gap" between territory *i* and the frontier. It will be assumed that $B_t$ grows at a constant and exogenous rate, *g*, and that the growth rate of $X_{it}$ is given by

(5) $\Delta x_{it} = \gamma_{io} - \lambda x_{it} + \gamma S_{it}$

where $x_{it}$ is the log of $X_{it}$ and $\gamma_{io}$ a fixed regional effect that helps control for omitted variables such as R&D investment. Notice that this specification incorporates a technological diffusion or catch-up effect. If $\lambda > 0$, regions that are closer to the technological frontier will experience lower rates of TFP growth. As a result, relative TFP levels will tend to stabilize and their steady-state values will be partly determined by the level of schooling.

Under these assumptions, it can be shown that the social rate of return to schooling, $r_s$, is given by

(6) $r_s = R_s + g$

where *g* is the rate of exogenous productivity growth at the frontier and $R_s$ the value of *R*

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regional differences in the quality of education. We cannot follow a similar strategy to estimate the aggregate parameter because there are not enough data, and not enough variation in the available aggregate data, to obtain precise region-specific estimates.

**Box 1 -- continued**

that solves the following equation:

$$(7)\quad \frac{R}{1-e^{-RH}} = \frac{\varepsilon+\rho+\dfrac{\gamma}{R+\lambda}}{(1-(1-\phi)\eta)+\dfrac{\mu}{p_o}} \equiv \frac{\rho+\varepsilon+EXT}{OPPC+DIRC}$$

where $\mu$ is the total direct cost of a year of schooling measured as a fraction of average output per worker, $\rho$ is the aggregate Mincerian returns coefficient, $\gamma$ the rate effects parameter that captures the contribution of schooling to technical progress and $\lambda$ the rate of technological diffusion. The remaining parameters have the same interpretation as in section 4. Notice that equation (7) has the same form as the private returns formula derived in section 4.a, except for the absence of tax and benefit parameters and for the inclusion of a new term *(EXT)* that captures the externality or rate effects of human capital. Aside from this, the interpretation of the formula remains unchanged: the rate of return to schooling is the ratio of its marginal benefits to its marginal costs, adjusted for the finite life of the asset.

implicitly assume that the quality of a year of schooling is the same everywhere, irrespective of its cost or indeed of any other factor. This implies that our calcuations will understate the aggregate return to schooling in regions with educational systems of above-average quality. If quality is positively correlated with resource input (an issue that remains controversial, as discussed in D&C (2002)), our results will also underestimate the returns to education in territories with high expenditure per student.

**a. Data and sources**

Table 21 defines the variables that enter the social rate of return formula and Table 22 shows the relevant data. The cost and employment parameters have been taken from the same sources as those used in the private return calculations.

An important difference with the calculations presented in section 4 is that we will now consider the total effect of education on employment, rather than just the increase in the probability of employment of active workers. That is, we will consider as part of the social benefits of education the induced increase in the rate of labour force participation. Hence, the values of $p_o$, $\varepsilon$ and $\eta$ used in this section are based on data on the absolute probability of employment (i.e. the fraction of the adult population that is employed) rather than on the probability of employment conditional on labour force participation, as was the case in section 4. A second difference is that the variable that measures the cost of education, $\mu$, now refers to total rather than private expenditure, and is normalized by average labour productivity rather than by the average earnings of full-time salaried workers.



**Table 21: Variables used in the calculation of the social rate of return on schooling and sources of the data**

$\rho$, $\rho_{min}$ = macroeconomic Mincerian returns to schooling parameter. It measures the average (log) increase in output per employed worker resulting from an additional year of schooling of the adult population. It is obtained by dividing the estimated elasticity of output with respect to the stock of human capital $(\alpha_S)$ by average attainment in each region, using the results in D&D (2002) and in section 3.c and this report's estimates of regional attainment. Our baseline estimates of $\rho$ are based on an estimate of $\alpha_S$ that is corrected for measurement error bias, but we also use an uncorrected estimate to obtain a lower bound on the value of $\rho$, which is denoted by $\rho_{min}$.

$U$ = 60.5, average retirement age in 1995.

$S_o$ = average years of school attainment of the adult (over 25) population in 1995. Source: Section 2.b.

$H = U - Max(6+S_o, 14)$ = estimated length of the (post-school) working life of the representative individual.

$\mu$ = total costs of schooling per student measured as a fraction of GDP per employed worker. Calculated as described in Table 14 except that the denominator is GDP per employed worker in 2000 (at market prices, taken from *Contabilidad Regional de España*, published by the National Statistical Institute).

$p_o$ = total probability of employment after leaving school, taking into account the probabilities of employment and labour force participation. Estimated using the results in section 3.b.

$\eta$ = correction factor capturing lower student labour force participation and employment rates. Estimated using the results in section 3.b.

$\varepsilon = p'(S)/p(S)$ = sensitivity of the total probability of employment to the level of schooling. Estimated using the results in section 3.b.

The probability of employment of adult workers and students are estimated using the predictions of the participation and employment equations estimated in section 3.b (using the first specification where education is measured by average years of schooling). The total probability of employment of adult workers $(p_o)$ is constructed as the product of the predictions of the participation and employment models for the the average values of the regressors. In the case of students, we adjust each of these probabilities by adding to them a weighted average of the coefficients of the dummies for non-university and university students in the corresponding equation (with weights 2/3 and 1/3) respectively, and then multiply the results to obtain $p_S$. The student correction factor $(\eta)$ is then calculated as $p_S/p_o$. Finally, for each of the (participation and employment) equations we calculate the ratio between the marginal effect of schooling *(p'(S))* and the model's average probability prediction and sum the results to obtain a raw estimate of $\varepsilon$ that now measures the sensitiviy of the total probability of employment to schooling. This figure is then divided by three to obtain the number shown in Table 22. As in the previous section, the reason for this adjustment is that the original result is obtained in conditions of partial equilibrium and measures the response of the relevant probabilities to additional schooling for the case of a single individual under the implicit assumption that the agent acts alone and, in particular, that economy-wide attainment levels remain constant. It can be expected, however, that the impact on employment of an increase in aggregate attainment will be substantially smaller.

**Table 22: Data used in the calculation of the social rate of return to schooling**

| | *So* | $\rho$ | $\rho_{min}$ | $\mu$ | $p_o$ | $\varepsilon$ | $\eta$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 6.91 | 8.49% | 5.70% | 7.50% | 45.87% | 2.93% | 0.149 |
| *Aragón* | 7.58 | 7.74% | 5.20% | 9.03% | 63.40% | 1.70% | 0.300 |
| *Asturias* | 7.62 | 7.70% | 5.17% | 8.72% | 46.48% | 2.64% | 0.030 |
| *Baleares* | 7.52 | 7.80% | 5.24% | 7.14% | 66.39% | 1.26% | 0.233 |
| *Canarias* | 7.40 | 7.93% | 5.33% | 9.38% | 54.11% | 2.40% | 0.294 |
| *Cantabria* | 7.80 | 7.53% | 5.05% | 9.25% | 49.27% | 1.98% | 0.024 |
| *Cast. y León* | 7.44 | 7.89% | 5.29% | 8.67% | 56.38% | 2.33% | 0.216 |
| *Cast.-Mancha* | 6.51 | 9.01% | 6.05% | 8.54% | 56.15% | 2.44% | 0.176 |
| *Cataluña* | 7.67 | 7.65% | 5.14% | 8.84% | 66.37% | 1.80% | 0.289 |
| *Valencia* | 7.27 | 8.07% | 5.42% | 9.47% | 59.45% | 1.95% | 0.267 |
| *Extremadura* | 6.50 | 9.04% | 6.07% | 8.79% | 50.26% | 2.79% | 0.109 |
| *Galicia* | 6.97 | 8.42% | 5.65% | 10.57% | 53.32% | 2.14% | 0.123 |
| *Madrid* | 8.64 | 6.80% | 4.56% | 6.94% | 59.06% | 1.69% | 0.103 |
| *Murcia* | 7.12 | 8.25% | 5.54% | 8.86% | 54.40% | 1.95% | 0.178 |
| *Navarra* | 8.04 | 7.30% | 4.90% | 9.37% | 65.75% | 1.65% | 0.242 |
| *P. Vasco* | 8.20 | 7.16% | 4.80% | 9.71% | 58.17% | 2.13% | 0.206 |
| *Rioja* | 7.61 | 7.72% | 5.18% | 10.47% | 58.10% | 1.75% | 0.036 |
| *Spain* | *7.52* | *7.81%* | *5.24%* | *8.40%* | *55.38%* | *2.30%* | *0.189* |
| *Spain (D2003)* | 7.10 | 8.27% | 5.55% | 8.16% | 70.61% | 1.36% | 0.154 |

For the calculation of the social rate of return, the microeconomic Mincerian returns parameter *($\theta$)* used in section 4 must be replaced by its macroeconomic or aggregate counterpart ($\rho$), which measures the contribution of an additional year of schooling to aggregate productivity rather than to labour earnings. This variable is constructed by dividing the estimated coefficient of human capital in the aggregate production function *($\alpha_S$)* by average attainment in each country, as indicated in Box 1. The estimate of $\alpha_S$ is based on the results of growth regressions that are estimataed with panel data by country or region rather than on those of wage equations estimated separately for each territory with individual-level wage data. The choice of baseline values for $\alpha_S$ will be discussed in greater detail in the following section.



The last row of Table 22 shows the estimates of the different variables obtained in de la Fuente (2003) for Spain as a whole. One difference between the two studies is that we now focus on attainment in 1995 rather than in 1990. The increase in average schooling over this period translates into lower estimates of the Mincerian return parameter *($\rho$)* in this report. A second and more important difference has to do with the employment parameters and, as in section 4, arises from differences in the underlying data and in the estimation procedure. Our current estimates of the average probability of employment *($p_o$)* is significantly lower because it refers to the entire working-age population rather than to prime-age cohorts as was the case in the previous study. As in section 4, our current estimate of $\varepsilon$ is considerably larger than the previous one (which as we have already noted was constructed using aggregate rather than individual data and should therefore be less reliable).

**b. Parameter values**

Table 23 lists the values or ranges of values of the parameters that will be used below to compute the social return to investment in human and physical capital, with our baseline estimates shown in italics. As in section 4, we assume an exogenous (steady-state) rate of productivity growth of 1.5% per annum and a value of $\phi$ equal to 0.8. The depreciation rates for infrastructures and for non-infrastructure physical capital have been recovered from the corresponding investment and capital stock series using the data from Mas et al (2002) discussed in section 3.c. The estimates of $\delta_k$ and $\delta_p$ given in the table are average values over the last 10 years in our sample of the depreciation rates for Spain as a whole .

**Table 23: Parameter values used in the calculations**

| | |
|---|---|
| *human capital:* | |
| level effects: $\alpha_S$ | 0.394-*0.587* |
| rate effects: $\gamma$ | 0-*0.15%* |
| *others:* | |
| physical capital: $\alpha_k$ | *0.258* |
| infrastructures: $\alpha_x$ | *0.056* |
| technological diffusion: $\lambda$ | *0.045* |
| rate of tech. progress: *g* | *0.015* |
| time used in school: $\phi$ | *0.80* |
| depreciation of ph. cap.: $\delta_k$ | *7.86%* |
| depreciation of infrast..: $\delta_k$ | *4.33%* |

The remaining coefficients shown in the table are the key parameters of the growth model outlined in Box 1 once the production function given there has been extended to include infrastructures as an additional input separate from other physical capital. Three of these parameters are the elasticities of aggregate output with respect to average educational attainment $(\alpha_S)$ and to the stocks of physical capital $(\alpha_k)$ and infrastructures $(\alpha_x)$. These parameters measure the percentage increase in output that would result from a 1% increase in the stocks of the different productive factors. The fourth coefficient $(\gamma)$ captures the intensity of rate effects, i.e. the contribution of one additional year of schooling to the growth rate of total factor productivity (TFP). The last parameter of interest $(\lambda)$ can be interpreted as the rate of technological diffusion across regions. Notice that the technological diffusion process assumed in the model implies that increases in schooling have only transitory effects on the growth rate of TFP and, in the long run, affect only the level of this variable. The percentage increase in steady-state TFP induced by a one-year increase in average attainment is given by $\gamma/\lambda$.

The range of values of the parameter that measures the level effects of human capital $(\alpha_S)$ shown in Table 23 are those used in de la Fuente (2003)[40] and were set drawing on the results of D&D (2002) for a sample of OECD countries. The rate effects parameter $(\gamma)$ has been set using the results obtained in section 3.c and the baseline value of $\alpha_S$. Proceeding as in de la Fuente (2003), we interpret the estimate of the human capital coefficient $(\beta)$ given in Table 12 in section 3.c as the sum of the level and rate effects in a steady state, and recover the implied value of $\gamma$ working under the assumption that $\alpha_S = 0.587$.[41] The reported values of $\lambda$ and $\alpha_x$ are taken from Table 12 in section 3.c. As noted in that section, the value given in the table for $\alpha_k$ has been obtained by scaling up the original estimate of this parameter so that the sum of the coefficients of public and private capital is equal to the observed share of capital in gross value added (which is 31.4%).

**c. Results**

Figure 28 shows two alternative estimates of the social rate of return to schooling $(r_S)$ in the Spanish regions. Both sets of figures are all-in estimates that take into account rate effects (using our baseline estimate of 0.15% for $\gamma$) and induced changes in employment and correct for differential student employment probabilities. The only difference between them has to do with the assumed value of the level effects parameter $(\alpha_S)$, which is corrected for measurement error bias in one case (labeled *baseline* in the figure) but not in the other *(min)*.

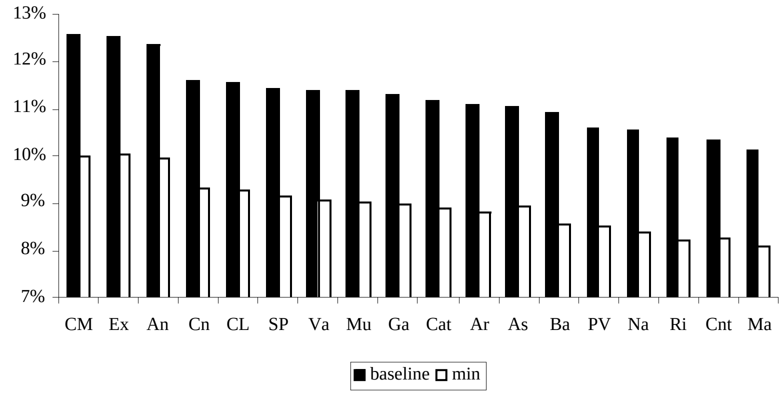
According to our baseline estimates, the social rate of return to schooling ranges from 10.10% in Madrid to 12.55% in Extremadura, with an average value of 11.41% for the entire country. Under the more pessimistic *(min)* assumption on the size of the level effects, the

[40] See section 4b of that report for a discussion of how these values were chosen.

[41] Hence, we are assuming that the parameters of interest satisfy the following relation, $\frac{\beta}{S} = \frac{0.587}{S} + \frac{\gamma}{\lambda}$, where $S$ is average attainment for Spain as a whole in 1995. Notice that the left-hand side is the total estimated effect of an additional year of schooling on steady-state output per worker and the right-hand side breaks down this total into its level and rate effect components. Since $S$ is known and $\beta$ and $\lambda$ have been estimated in section 3.c, the equation can be solved for the rate effects parameter, $\gamma$, which is the only unknown.



**Figure 28: Social rate of return to schooling in Spain**

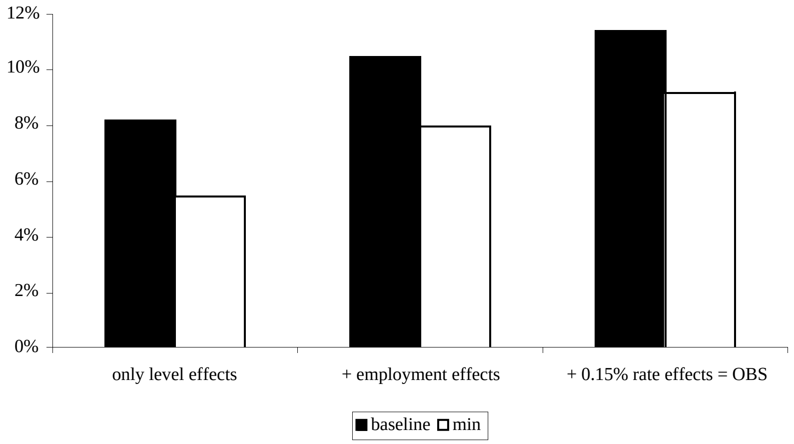



average return drops to 9.15% and the lowest value of $r_S$ to 8.07%. Under both assumptions, estimated returns to human capital are highest in the poorest regions (Castilla la Mancha, Extremadura and Andalucía) and lowest in Madrid, Cantabria and Rioja.

As in section 4, it will be convenient to recalculate the rate of return to schooling under a variety of scenarios in order to isolate the contribution of different factors to this return and to check the sensitivity of the results to various assumptions. Using the two alternative assumptions about the size of level effects discussed above, we will construct *baseline* and *min* estimates of the return to schooling under three different scenarios. The first one *(level)* considers only the direct level effects of human capital on average productivity. In the second one *(employment)*, we introduce employment effects and in the third one *(OBS)* we add rate effects under the assumption that $\gamma = 0.15\%$ to obtain the all-in estimates that correspond to Figure 28. In all cases, we use the estimated value of $\eta$ to correct for the low participation and employment rates of students in many regions.

Tables A.56 and A.57 in the Appendix show the detailed results of the calculations for all regions and Figure 29 summarizes the findings for Spain as a whole. The bulk of the return to human capital can be traced back to its direct (level) effects on productivity. Considering only this factor, the baseline estimate of $r_S$ goes from 7.23% in the Madrid to 9.36% in Castilla la Mancha with a national average of 8.19%. For the country as a whole, the sequential introduction of employment and rate effects adds 2.24 and 0.98 percentage points respectively to the baseline returns arising from level effects.

**Figure 29: Social returns to schooling under different scenarios in Spain as a whole**




### d. The relative returns to investment in schooling and in physical capital

In this section we will compare the social return to schooling (using the *baseline* and *min* estimates under the last, all-in scenario) with the returns to non-infrastructure physical capital and to infrastructures ($r_k$ and $r_x$). Our estimates of $r_k$ and $r_x$ are calculated as $r_i = MP_i - \delta_i + g$ where $MP_i$ is the marginal product of factor $i$, $\delta_i$ its rate of depreciation and $g$ the rate of technical progress (which is assumed to be 1.5% as in the previous sections).[42] For these calculations we use the data on regional output and factor stocks in 1995 discussed in section 3.c and our baseline estimates of the relevant output elasticities and depreciation rates given in Table 23.

The detailed results of the calculations are shown in Table A.58 in the Appendix. Figure 30 summarizes the results of this section and the previous one for the case of the entire country. If we exclude the lowest bound scenario (our *min* estimate when only level effects are considered), our calculations suggest that, at the national level, the economic returns on human capital are at least comparable to and probably slightly higher than those on non-infrastructure physical capital. On the other hand, the estimated return to infrastructure investment appears to be significantly higher than those on private and human capital.[43]

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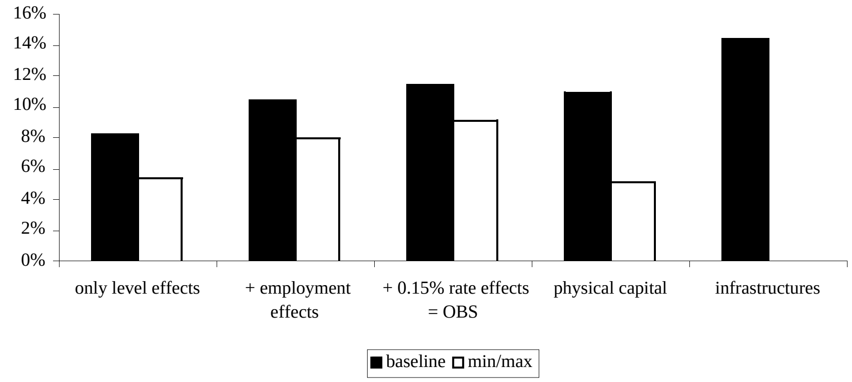
[42] This formula comes out of a calculation analogous to the one described in Box 1, which is much simpler in the case of physical capital because of the absence of delays and rate effects.

[43] The contribution of infrastructures to productivity has been an extremely controversial issue in the literature. Recent evidence for the US states suggests that the economic returns to infrastructure investment have been rather low or even negligible over the last three decades, but practically all the evidence available for Spain points to the opposite conclusion. One possible explanation for these contrasting results is that the payoff to infrastructures may fall sharply once the stock of this factor becomes large enough to adequately serve the needs of a given territory. If this is the case, existing results suggest that



**Figure 30: Social rate of return to schooling under different scenarios and returns on physical capital and infrastructures in Spain**




- *Note:* the "min" estimate of the return on physical capital makes use of the direct estimate of $\alpha_k$ given in Table 12 in section 3.c.

The situation, however, varies greatly across regions, particularly in terms of the relative returns to education and infrastructures. Figure 31 displays two estimates of the *social premium on human capital* relative to both private capital and to infrastructures. These social premia are defined as the difference between the social rate of return on schooling and the expected returns to the two (private and infrastructure) components of the stock of physical capital. For each of these two factors, we show two estimates of the human capital premium that are obtained by comparing, respectively, our *baseline* and *min* estimates of the return to human capital with the estimated (baseline) returns on the other assets.

For about two thirds of the regions, our baseline estimate of the human capital premium relative to private capital is positive, suggesting that education should be favoured over physical capital as an investment alternative. When we use as a reference the lower bound on $r_s$, the premium on human capital becomes zero or slightly negative for the intermediate range of regions shown in Figure 31.a.

When we turn to infrastructures, the situation is reversed: according to our baseline estimates, the return on public capital exceeds that on human capital in ten out seventeen regions. But education continues to yield the highest return in most of the poorer territories. This is illustrated in Figure 32, which plots the human capital premium relative to infrastructures against relative income per capita in 1995. For the richest Spanish regions (Madrid, Baleares and Cataluña) the expected returns on infrastructure investment are

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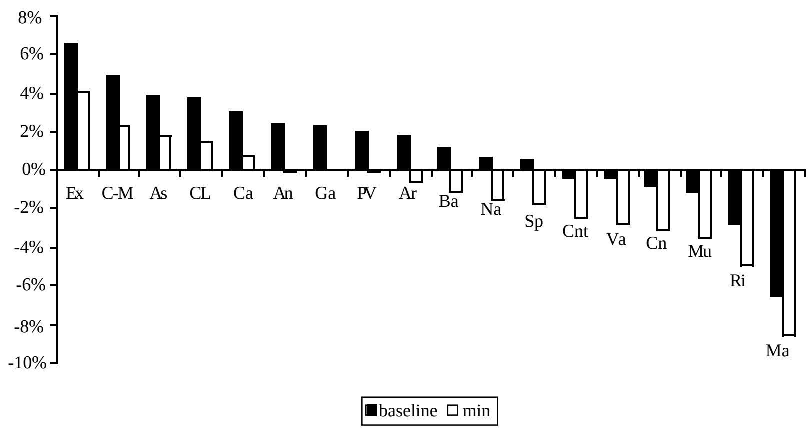
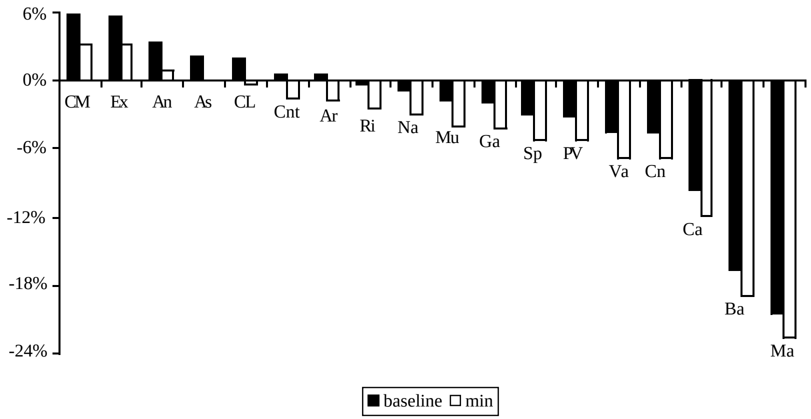
Spain has not yet reached this "saturation" point. See de la Fuente (2002b) for a survey of the relevant literature.

**Figure 31: Social premium on human capital**

**a. relative to non-infrastructure physical capital**



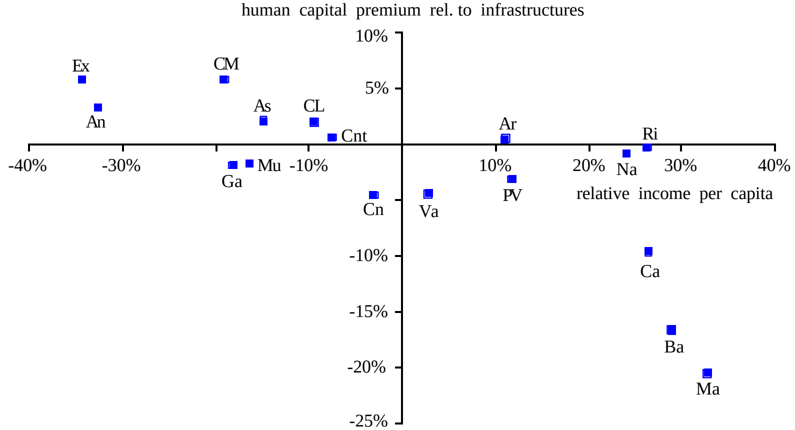

**b. relative to infrastructures**




extremely high and exceed those on education by over ten percentage points. For the rest of the regions the differences in estimated returns are much lower and the human capital premium is generally positive in the poorer regions and tends to decline with income per capita. This suggests that public investment strategies should differ across regions. Infrastructure stocks appear to be the critical bottleneck at the top of the income distribution, while increasing educational attainment seems to be crucial for low income-regions.



**Figure 32: Human capital premium relative to infrastructures vs. relative income per capita in 1995**




### e. A typology of regions

Drawing on previous results, in this section we will attempt to classify the regions of Spain into several groups according to the priority that should be accorded to education relative to infrastructures in the allocation of the available investment resources. Since such priority may be justifiable on either equity or efficiency grounds, we will construct a typology of regions by combining an index of relative educational needs with a measure of the returns to schooling relative to those on infrastructure investment.

The relative return indicator *(rreturn)* will be the ratio betwen our baseline estimate of the social return to schooling in each region and the expected return on infrastructure investment, as calculated in section 6.c (see Table A.58 in the Appendix). The (inverse) need indicator *(need)* will be constructed as an unweighted average of four variables, all of which will be measured in relative terms, i.e. as ratios to the corresponding national average. These four variables are the following:

1) Expenditure on education *(exp)*, measured by combined total expenditure per student at the secondary and university levels as defined in section 2.a.

2) and 3) The educational attainment of the adult (25+) population in 2001 *(att25+)* and of the 25-34 cohort in the same year *(att25-34)*, measured in average years of schooling. (See section 2.b.ii).

4) The performance of the regional school system *(perf)* as measured by the combined indicator constructed by averaging the access and success indices given in Table 5 of section 2.b.iii.

**Table 24: Regional indicators of relative educational needs and returns**

| | [1] exp | [2] att25+ | [3] att25-34 | [4] perf | [5] need | [6] rreturn |
|---|---|---|---|---|---|---|
| *Andalucia* | 79.9 | 90.7 | 92.6 | 94.3 | 89.4 | 134.8 |
| *Aragón* | 108.8 | 103.4 | 105.6 | 106.7 | 106.1 | 104.0 |
| *Asturias* | 101.5 | 102.4 | 105.5 | 105.1 | 103.6 | 122.8 |
| *Baleares* | 93.0 | 101.1 | 93.7 | 86.4 | 93.5 | 39.5 |
| *Canarias* | 106.3 | 97.6 | 92.0 | 85.0 | 95.2 | 71.3 |
| *Cantabria* | 113.6 | 106.7 | 102.8 | 93.4 | 104.1 | 104.8 |
| *C.-León* | 92.4 | 100.7 | 105.2 | 101.8 | 100.0 | 120.0 |
| *C.-Mancha* | 101.8 | 83.5 | 91.6 | 94.3 | 92.8 | 183.2 |
| *Cataluña* | 112.5 | 102.5 | 101.1 | 106.0 | 105.5 | 53.4 |
| *Valencia* | 102.6 | 97.3 | 96.6 | 93.7 | 97.5 | 71.3 |
| *Extremadura* | 82.4 | 83.1 | 92.0 | 91.4 | 87.2 | 182.6 |
| *Galicia* | 101.3 | 91.8 | 100.4 | 89.8 | 95.8 | 85.0 |
| *Madrid* | 98.7 | 116.4 | 110.3 | 101.9 | 106.8 | 32.9 |
| *Murcia* | 89.9 | 93.7 | 92.1 | 90.4 | 91.5 | 86.4 |
| *Navarra* | 124.7 | 111.8 | 107.7 | 115.3 | 114.8 | 91.9 |
| *P. Vasco* | 132.9 | 113.0 | 111.9 | 117.8 | 118.9 | 76.8 |
| *Rioja* | 128.9 | 105.7 | 103.9 | 98.4 | 109.2 | 96.1 |

**Figure 33: Relative need vs. relative return**

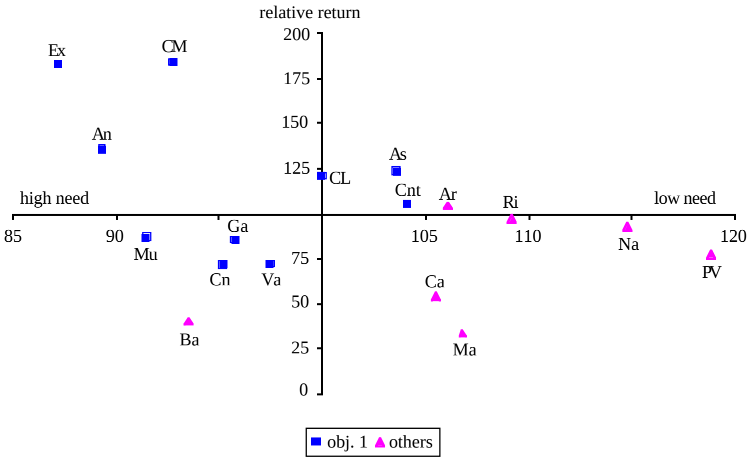



Table 24 shows the values of the relative need and return indicators and the information required to construct them. Figure 33 plots these two variables against each other, identifying those regions that are included in Objective 1 territory. The figure shows that, with the partial exception of Baleares (Ba), educational needs and relative returns are generally higher in Objective 1 regions than in the rest of Spain. Within the assisted territory, moreover, there is a group of regions (Extremadura, Andalucía and Castilla la Mancha) were



human capital should be given special priority since needs are high and the expected return to education clearly exceeds that on infrastructure. For the remaining Objective 1 regions there is a of trade-off between our two target variables, as expected returns are high in regions with low need indices (Castilla and León, Asturias and Cantabria) while the opposite is true in Murcia, Canarias, Valencia and Galicia.

**7. Conclusions and policy recommendations**

In this report we have constructed measures of school attainment and educational investment in the Spanish regions and analyzed the private and social returns to such investment and its implications for government finances. The main conclusions of the analysis contained in the previous sections can be summarized as follows.

1) Expenditure on education varies significantly across territories. Expenditure per student at the secondary and university levels in the Basque Country exceeds that in Andalucia by 66%. Differences in expenditure across regions seem to be driven by two main factors that work, respectively, through its private and public components: regional income per capita and the amount of resources available to regional governments. These two factors explain two thirds of the observed variation in expenditure per student.

2) Attainment levels, measured by the average years of schooling of the adult population, also vary greatly across regions and are likely to continue to do so in the foreseeable future. The dispersion of attainment levels across regions drops by only one third when we consider the youngest adult cohorts rather than the entire population. The decline in inequality that we observe across cohorts, moreover, is mostly driven by the universalization of (mandatory) lower secondary schooling. At higher educational levels, disparities across regions are likely to remain constant or even increase over time.

3) Relative educational performance, as measured by a composite index of access to non-compulsory schooling cycles and academic success ratios, tends to increase with income per capita. All Objective 1 regions but two (Asturias and Castilla y León) are below the national average in terms of this indicator, while non-Objective 1 territories are above the national mean with the only significative exception of Baleares. Expenditure per student and adult attainment seem to have a positive effect on at least some indicators of aggregate educational performance.

4) Educational attainment is a primary determinant of wage levels, employment probabilities and participation rates at the individual level. The wage effects of schooling tend to fall with average attainment (but not necessarily with income), and employment effects are particularly strong in the poorest regions, where unemployment rates are also especially high.

5) At the aggregate level, educational attainment is also a primary determinant of labour productivity. Disparities in schooling levels account for 40% of the observed productivity differentials across the Spanish regions.

6) The private return to schooling is considerable in all regions and for all post-compulsory educational levels and remains so after accounting for the effects of personal taxes and unemployment insurance. The return to schooling compares quite favourably to the expected returns to financial assets, suggesting that financial incentives to invest in education are quite adequate.

7) On the whole, public policies introduce modest disincentives to invest in human capital. Unemployment insurance seems to generate a greater distortion than personal taxes, particularly at low attainment levels.

8) Public expenditure on post-compulsory education seems to be self-financing over the long run and may actually help reduce future budget deficits by increasing tax revenues and reducing social insurance payments.

9) The social return to schooling is at last comparable to the return on investment in non-infrastructure physical capital. The return on infrastructure investment is higher than than on human capital for the country as a whole and for its richest territories. In most of the poorest regions, however, human capital appears to be the investment alternative with the highest expected social payoff.

**Implications for cohesion policy**

Infrastructure investment and training schemes, together with location incentives for private investment, have traditionally been the main instruments of regional policy and have played a key role in EU efforts to increase internal cohesion. Our results indicate that both schooling levels and infrastructure endowments are significant and quantitatively important determinants of income. One direct implication is that investment in both education and infrastructures can be effective in reducing internal disequilibria within Spain and in promoting the country's convergence toward average EU income levels.

Our results also suggest that there are important differences in the role that these two types of investment can and should play in achieving these two objectives. First, there seems to be more room for reducing internal inequality through investment in human capital than in infrastructures. Differences in schooling levels account for around 40% of productivity differentials across regions, while the distribution of infrastructure stocks contributes very little to such differences and actually reduces them marginally. Second, the pattern of returns across regions is very different for the two factors. While the expected returns to infrastructure are generally higher in the richer regions and reach extremely high levels in Madrid, Baleares and Cataluña, the return to education tends to be higher in the poorest territories, where it also exceeds that on infrastructures. Hence, a conflict between the two



goals of cohesion policy, national convergence to EU income levels and the reduction of internal disparities, arises in relation to infrastructures, but not with regard to education.

These considerations suggest that it may be possible to increase the effectiveness of both national and EU cohesion and growth policies by devoting greater resources to investment in human capital in poorer regions and by redirecting part of EU and national financing for infrastructures towards richer regions. As one of us has argued elsewhere (see de la Fuente, 2002d), a shift in the pattern of infrastructure investment in this direction, by itself, is likely to generate a net welfare gain because the operation of the standard mechanisms for personal redistribution within Spain will channel a substantial part of the resulting output gains back to the poorer regions and to the needier segments of the population. If part of the reduction in infrastructure investment in Objective 1 regions is compensated by an increase in educational funding, the net welfare gains are likely to be considerably larger, for aggregate output will rise faster without a substantial increase in internal inequality.

Focusing on human capital, our analysis suggests that raising attainment levels in the poorer regions can have a substantial payoff in the middle and long run both in terms of overall growth and of increased internal cohesion. Although we have not formally analyzed the effects of adult training in this report, we believe that EU-financed investment in human capital should be chanelled through the public school system to a considerably greater extent than in the past. The reason is that public schools have two important advantages over the adult training schemes that have absorbed the bulk of EU expenditure on human capital in Spain. First, they provide a more efficient vehicle for reaching a broad segment of the population, and for doing so before skill shortages begin to build up. And second, working increasingly through this more consolidated and more closely monitored channel can be expected to increase the quality of training while improving the management and control of ESF resources. A determined effort should also be made to identify and exploit any potential synergies and complementarities between the adult training and public school systems, particularly at the vocational and university levels. Sharing facilities and personnel can help reduce costs and increase the quality of both systems. Increased collaboration between them would also make it possible to draw on the experience of the social partners to help make the formal school system more responsive to the needs of the productive sector.

Our finding that the private returns to schooling compare quite favourably to those available from financial assets suggest that our previous conclusion that the private incentives to invest in schooling are generally adequate in Europe applies to all the Spanish regions as well. As in previous reports, we interpret this as an indication that the main obstacles to increased educational attainment have little to do with an insufficient financial return, and are more likely related with the skill deficits with which many students from disadvantaged socioeconomic backgrounds reach the end of mandatory schooling, and with liquidity constraints that prevent a large fraction of these students from continuing their training. If our diagnostic is correct, additional educational expenditure should target these problems directly. Increasing pre-primary enrollments and giving special attention to disadvantaged students and low performers at early ages is likely to be crucial to compensate for socioeconomic handicaps and to ensure a true equality of opportunities later on. At the university level, student loans and means-tested grants are likely to be more effective in increasing access by working-class youngsters than further reductions of already very low tuition fees because this last alternative would divert an important fraction of any increase in funding towards additional subsidies to high income groups.

The resources required to finance additional investment in these areas should come from the Spanish national and regional governments as well as from the EU's Structural Funds. In our view, the central government's main responsibility in this regard is to gradually eliminate the important differences that we now find across territories in terms of the resources per capita available to regional governments,[44] which are the administrations that are directly responsible for the provision of education and health care as well as other basic services. EU structural expenditure should co-finance the building and equipment of schools in needy areas and also subsidize in part their personnel costs to ensure that adequate human resources are available to broaden access, strengthen remedial programmes and raise overall academic standards. Such expenditure should be subject to strict additionality requirements so as to prevent the diversion of resources to other uses. Regional cofinancing rates for operating expenses should be higher than those for capital investment, and should gradually rise over time so that regional governments eventually assume the full cost of these programmes as increased attainment begins to translate into higher income and tax revenues.

44 Some progress in this direction may have already taken place through the last revision of the regional financing system which took place in 2001, but the data required to analyze its effects are still not available.



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**APPENDIX**

**1. Expenditure on secondary and university education in 2000**

This section discusses the construction of our estimates of private and public expenditure in secondary and university education at the regional level. Table A.1 lists the sources of the data used in the calculation. Table A.2 disaggregates total educational expenditure for the country as a whole in the year 2000 by source of funds and by educational level.

**Table A.1: Sources used to estimate expenditure in education by region**

*PUBEXP* = Estadística del Gasto Público en Educación (Statistics on Public Expenditure on Education). Ministry of Education (http://www.mec.es/ estadistica/Gasto.html).

*PRIVEXP* = Encuesta de financiación y gastos de la enseñanza privada, curso 1999-2000. (Survey of financing and expenditure of the private eduational sector). National Statistical Institute (http://www.ine.es/inebase/cgi/um?M=2Ft132Fp122&O=inebase&N=&L=).

*SCH* = Estadística de becas (Statistics on scholarships and grants). Ministry of Education (http://www.mec.es/estadistica/Becas.html).

*R&D* = Estadística de I+D. Indicadores básicos año 2000 (R&D statistics, basic indicators). National Statistical Institute.

*UNIV* = Estadística Universitaria (University statistics). Ministry of Education (http://www.mec.es/consejou/estadis/index.html).

*LOC* = Liquidación de presupuestos de las Entidades Locales. Ejercicio 2000. (Budget liquidation for the local administrations). Ministry of Finance.

*INF* = Informe sobre el estado y situación del sistema educativo español (various years). (Report on the state of the Spanish Educational System). Consejo Escolar del Estado. Ministerio de Educación, Madrid.

*CIF* = Las cifras de la educación en España. Estadísticas e indicadores. (Facts and Figures of Education). Ministerio de Educación, Madrid, 2002.

The first three columns of Table A.2 refer to public expenditure. The data are taken from *PUBEXP*, which is published by the Ministry of Education using information supplied in part by the regional governments and by other public administrations. They are based on liquidated budgets (recognized budget obligations) rather than on ex-ante appropriations and include all (current and capital) educational expenditure financed with public funds, independently of whether it was chanelled through private or public educational institutions. These figures include the cost of administrative and support programmes, subsidies to concerted private educational centers and scholarships and other transfers to



households (many of which take the form of tuition waivers at the university level). *PUBEXP* also gives a global estimate (not disaggregated by administration or by educational level) of the social contributions imputable to the teaching staff who are public servants. This figure is shown separately as part of the last column of Table A.2. Public expenditure is disaggregated by administrations distinguishing between the national Ministry of Education, the education departments of the regional governments and other administrations. This last item includes educational expenditure by other national and regional departments and by the local administrations (diputaciones provinciales, cabildos insulares and municipalities), with local expenditure accounting for 80 of the total. The budgets of the different administrations are consolidated to avoid double counting, and expenditure is allocated to its final executor.

**Table A.2: Public Expenditure in Education in Spain in 2000 (Meuros)**

| | *Ministry of Education* | *Regional ed. depts.* | *Other pub. administr.* | *private sec. (households)* | *total* |
|---|---|---|---|---|---|
| *NON-UNIVERSITY EDUCATION* | | | | | |
| educational programmes | | | | | |
| childhood and primary | 260.3 | 7,436.7 | 825.5 | | 8,522.5 |
| secondary and vocational training | 213.0 | 7,448.2 | 146.2 | | 7,807.4 |
| other programmes | 114.9 | 924.9 | 320.9 | | 1,360.7 |
| not allocated by programme | | 235.0 | | 1,455.7 | 1,690.7 |
| *total direct expenditure* | *588.2* | *16,044.8* | *1,292.6* | *1,455.7* | *19,381.3* |
| administration and service programmes | 120.8 | 1,161.8 | 237.4 | | 1,520.0 |
| ***total non-university*** | ***709.0*** | ***17,206.6*** | ***1,530.0*** | ***1,455.7*** | ***20,901.3*** |
| *UNIVERSITY EDUCATION* | | | | | |
| direct expenditure | 92.9 | 4,529.4 | 40.1 | 1,525.7 | 6,188.1 |
| tuition waivers | 173.3 | 7.0 | | | 180.3 |
| ***total university*** | ***266.2*** | ***4,536.4*** | ***40.1*** | ***1,525.7*** | ***6,368.4*** |
| *ALL LEVELS COMBINED* | | | | | |
| other scholarships and grants | 448.1 | 72.6 | 30.9 | | 551.6 |
| imputed social contr. of teaching staff | | | | | 1,833.2 |
| ***total, all levels combined*** | ***448.1*** | ***72.6*** | ***30.9*** | ***0.0*** | ***2,384.8*** |
| **TOTAL** | **1,423.3** | **21,815.6** | **1,601.0** | **2,981.4** | **29,654.5** |

- Sources: *PUBEXP* and *PRIVEXP* (see Table A.1).

Tuition fees paid by households to public universities have been subtracted from the expenditures of these institutions and are shown as part of private expenditure in the fourth column of the table together with academic fees charged by private institutions. This last variable has been taken from *PRIVEXP*, which is based on an exahustive survey of private educational centers that is carried out periodically by the National Statistical Institute. This source, however, does not disaggregate the revenues of private centers by educational level.

Within each column, expenditure is broken down into three main components: non-university formal education, university education, and a third component that includes two items that are not broken down by educational level in our main source, namely scholarships (excluding university tuition waivers) and the imputed social contributions of teachers. There is also some information on how non-university expenditure is allocated across educational levels. This breakdown, however, is incomplete and not very reliable because some regions do not disaggregate their expenditure by programme and some of those who do mix secondary and vocational expenditure with that of other programmes for various reasons.

This section describes the construction of our estimates of private and public expenditure in each region in formal education at the secondary and university levels. We will leave out the North-African territories of Ceuta and Melilla and the two national univerities mentioned in section 2 of the text. Table A.3 describes how our expenditure variables are computed. Public expenditure includes the operating costs of public educational institutions (net of research expenditure by universities),[45] subsidies to concerted private centers, an estimate of the relevant indirect costs and two types of subsidies to households: tuition-related grants (which take almost exclusively the form of tuition waivers at the university level), and other subsidies to households to help defray living expenses and other costs. Private expenditure is defined as the difference between academic fees paid by households and non-tuition subsidies paid to them. Hence, we do not take into account expenditure on books, school materials or (aside from a minor exception) transportation. Total expenditure is defined as the sum of public and private expenditure. Notice that this definition means that non-tuiton grants will cancel and drop out of the total.

**Table A.3: Construction of private and public expenditure on education**

*public expenditure on education*
= direct expenditure by regional governments on educational centers (including subsidies to private centers)
+ imputed indirect costs (administration and support programmes)
+ imputed social contributions of the public teaching staff
+ expenditure by other administrations
+ university tuition waivers
+ non-tuition subsidies
- R&D expenditure by universities

*private expenditure on education*
= academic fees paid by households
- non-tuition subsidies

[45] Because the available data does not allow us to disaggregate it, we are implicitly assuming that all research expenditure is carried out in public universities. This is probably a good approximation, as private universities are generally much more teaching-oriented and, in any event, has no effect at all on the variables we will use in the rate of return calculations, for the likely misclassification of expenditure will not affect either the total or the private costs of education.



The remainder of the section is divided into five parts. First, we consider the expenditure of the regional education departments. Second, we discuss the allocation across levels and regions of scholarhsips and grants using additional information from *SCH*. Next, we turn to private expenditure and to the allocation of expenditure by other public administrations and imputed social contributions. In the final subsection we calculate average expenditure by student at the university and secondary levels by dividing total expenditure by student enrollment. The main difficulties that arise have to do with the estimation of the distribution by levels of non-university spending. This task is complicated due to the limitations of the existing information, which arise in part from differences across regions in accounting practices. As a result, we have had to use a number of indirect indicators in order to estimate the breakdown of expenditure. Similar problems also arise in connection with the regional allocation of public expenditure not chanelled through regional education departments.

**a. Direct expenditure by regional education departments**

***i. Secondary and vocational education***

Table A.4 summarizes the information provided in *PUBEXP* about the distribution by region and programme of non-university expenditure by the regional education departments. The bulk of this expenditure corresponds to two main programmes: i) early childhood and primary schooling and ii) secondary and vocational training. In addition, there are a number of other expenditure programmes that may be classified into two groups. The first one includes other educational programmes (for various disadvantaged groups, arts and foreign language training, adult education, educational services abroad, military training, etc.), and the second one refers to service and administration services that generally support several educational programmes (general administration, educational research, teacher training, and complementary services).

Inspection of the table reveals several anomalies. First, Cantabria provides no disaggregation of expenditure on non-university education. Second, Castilla and León disaggregates only between primary, secondary and special education and, in addition, its reported figures do not seem reliable. In particular, the ratio of secondary to primary expenditure in this region is several times smaller than in the rest of the country. Third, some regions do not separate special or compensatory education[46] or some service programmes, and

[46] Special education refers to the schooling of students with special needs derived from physical or mental handicaps. The compensatory education programme finances various measures, both in and out of school, aimed at children from socially disadvantaged groups (mainly gipsies, recent immigrants and migrant rural workers). In both cases there is a considerable overlap with the regular school system, as most of these students are enrolled in ordinary schools. They may, however, be assigned to special classrooms, with specialized personnel and low student/teacher ratios, and participate in remedial and other special programmes.

presumably impute the relevant costs to primary and secondary education. Finally, the methodological notes to *PUBEXP* warn that in the cases of Andalucía, Galicia and Canarias some expenditure in secondary programmes is counted as primary spending because centers that offer both primary and secondary courses are included in the first category for budget purposes.

To try to increase the comparability of expenditure estimates across regions, we have used other data to estimate the breakdown of expenditure in regions where the data are incomplete or unreliable and introduced a number of corrections that try to neutralize the effect of cross-regional differences in accounting practices. The adjustments are discussed below and the relevant calculations are summarized in the upper part of Table A.5.

*Imputation of special and compensatory education and overhead costs*

Since the budget treatment of special and compensatory education varies across regions, we have allocated expenditure in these two programmes to primary and secondary education in those regions that report it separately. For each region, expenditure in special education has been distributed between primary and secondary education in proportion to the number of special education students that are enrolled in each of these two levels.[47] In the case of compensatory education, the only relevant piece of information we could find is the number of primary and secondary students who benefitted from special actions during the 1998-99 school year within the territory then managed directly by the Ministry of Education *(INF)*. We apply the weight of secondary students in the total number of beneficiaries (0.181) to allocate expenditure across programmes in all regions.

We have also imputed overhead costs (expenditure in general administration and in support programmes) to the different educational levels. This is necessary to correct differences in accounting practices regarding some of these programmes but is also important to obtain an accurate estimate of the full costs of education. For most programmes, the imputation is proportional to their direct cost (after the adjustments discussed in the previous paragraph). The one exception to this rule is the programme called "complementary services," which finances transport, school meals and residential services for students from rural areas who attend schools located far from their residences. Since these services are only provided to students enrolled in compulsory schooling levels (primary and lower secondary education), their cost in each region is allocated between primary and secondary education in proportion to their public-school enrollments.

[47] Enrollment figures correspond to the school year 1999-2000 and are taken from *CIF*. They refer to special education students enrolled in ordinary public and private institutions. Some students are enrolled in special centers, but enrollment in these institutions is not broken down between primary and secondary education.



*Estimation of secondary expenditure in special cases*

The calculations we have just described yield an estimate of a magnitude we will call adjusted direct expenditure by regional governments. The figures obtained in this manner seem to be reasonably homogeneous for 12 out of the 17 Spanish regions. In the remaining five, however, the breakdown of expenditure by level is incomplete or unreliable for reasons that have already been discussed. We estimate this breakdown as follows. First, we regress the ratio of adjusted seconday to primary expenditure on the ratio of secondary to primary enrollment using the 12 regions where the data do not seem to be problematic.[48] The estimated equation is of the form:

$$(A.1)\ \text{expenditure ratio} = \underset{(t=)\ (1.10)}{0.2504} + \underset{(3.92)}{1.0046}^{*}\ \text{student ratio}, \qquad R^2 = 0.605$$

Using the estimated equation and the observed secondary to primary student ratio, we estimate the ratio of secondary to primary expenditure in each of the five problem regions and then apply it to the sum of adjusted direct public expenditures in primary and secondary programmes to obtain an estimate of secondary spending. Before carrying out this last calculation, in the case of Cantabria and Castilla y León we have to estimate the part of total adjusted expenditure that corresponds to primary and secondary programmes. To do this, we assume that the combined weight of these programmes (including imputed overhead costs and special and compensatory education) in total expenditure is the same as for the average of all other regions (96.71). The estimates of adjusted direct secondary expenditure shown in bold type in the first block of Table A.5 are constructed using this indirect procedure. The second block of the same table shows the relevant (observed and estimated) primary to secondary student and expenditure ratios. The first entry for each region in Table A.6 gives adjusted direct expenditure on secondary education, which is the main component of public educational spending. The estimation of the remaining components will be discussed below.

***ii. University education***

*PUBEXP* reports the total consolidated expenditure of public universities and regional education departments at the university level. We adjust this figure by subtracting from it tuition payments by households, scholarships that take the form of tuition waivers (which are mostly financed by the national government) and R&D expenditure by universities. The first two figures are taken from *PUBEXP* and will be included in other categories of university expenditure as discussed below. R&D figures are taken from the R&D statistics published by the National Statistical Institute *(R&D)*. The lower part of Table A.5 contains all the relevant data. Table A.7 lists adjusted direct expenditure on university education together with other expenditure items that will be discussed below.

[48] The data on the number of students are taken from *CIF*. We use total enrollment in public and private centers during the 1999-2000 school year.

**b. Scholarships and grants**

*PUBEXP* reports the total amount of public scholarhips and grants during 2000 broken down by the administration that finances them. With the exception of scholarships that take the form of university tuition wavers, however, these grants are not disaggregated by educational level or by the region of residence of their beneficiaries. There is also no information in this source regarding the breakdown of aid into tuition grants and transfers to finance living and other expenditures. To get around these limitations, we have used the information provided by *SCH* concerning the distribution by regions and levels of scholarhips and grants given during the school year 1999-2000 by the national ministry and the regional education departments. Total expenditure by these administrations according to *PUBEXP* is allocated across levels and regions in proportion to their respective weights in total grants awarded as given in *SCH*.[49]

It remains to break down scholarship expenditures into two types: grants earmarked to pay for tuition charges and those designed to help cover living expenses or other educational costs such as books, materials or transport. In the case of Spain, tuition grants at the university level take almost exclusively the form of tuition wavers (that is, the government pays the relevant fees directly to the university). At the secondary level, public and concerted schools are free even beyond the compulsory stage, and there are no cash grants for tuition purposes. Hence, we assume that all grants at the secondary level are for non-tuition purposes. At the university level, we subtract from the estimate obtained in this manner of total grants in each region the amount of tuition waivers according *PUBEXP* to obtain the amount of non-tuition subsidies. Tables A.6 and A.7 show our estimates of the various educational subsidies received by households.

**c. Private expenditure**

Private expenditure in education is defined as the difference between the academic fees paid by households and the non-tuition subsidies they receive. We have already discussed how the second of these variables is estimated.

***i. Secondary and vocational education***

We count as private expenditure on non-university education the fees paid by households to private educational centers for educational services (tuition fees and fees for other extracurricular and complementary activities) and "other revenues of private origin." This second item (which amounts to 13.1 of the total estimated expenditure) is included here because it seems likely it is comprised essentially of quotas paid through parents'

[49] The total expenditure figures given by the two sources are close but do not coincide exactly. The reason is that *PUBEXP* refers to expenditure liquidated during the natural year 2000 and SCH to the grants awarded during the1999-2000 school year.



associations that may be considered as voluntary tuition payments in the case of concerted centers. We do not take into account payments for other services such as transport, cafeteria and housing.

Since the data provided by *PRIVEXP* are disaggregated by region but not by educational level, we need to estimate the fraction of total expenditure that corresponds to secondary and vocational training (including the relevant part of special education). To do this, we will use the information provided by the same source regarding enrollments and average current revenues per student (including concertation subsidies and fees for complementary services) at each educational level.

We proceed as follows. First, for each region we divide average current revenue per student for each educational level by the average revenue per student for all educational levels combined to obtain an index of relative revenues per student that will vary both across levels and across regions. We will use these indices to weigh enrollments before using them to allocate various revenue items across educational levels.

We allocate "other private revenues" in proportion to the number of students of each level that are enrolled in concerted units, after weighting enrollments by relative revenues per capita. In the case of special education, we use data on the fraction of students that are enrolled in secondary-level courses to estimate the part of special education revenues that should be imputed to secondary schooling.[50] Tuition fees, in the strict sense of term, are allocated in proportion to the number of students enrolled in non-concerted units, weighted as above by relative revenues, and fees for extracurricular and complementary activities are allocated in proportion to total enrollment in each level, similarly weighted. The results of the calculations are shown in Table A.6.

***ii. University education***

Tuition fees paid by households to public and private universities are taken from *PUBEXP* and *PRIVEXP* respectively. In the case of private universities, we consider only academic fees, excluding those charged for other services (such as housing and meals). *PRIVEXP* provides an incomplete regional breakdown of revenues that aggregates together several regions where private university enrollment is relatively unimportant. We allocate total expenditure for this territory across regions in proportion to their private university enrollments, which are taken from *UNIV*.[51] The results are shown in Table A.7.

[50] We use the same procedure to estimate the amount of concertation subsidies that corresponds to secondary education. We apply the weights constructed as discussed in the text to total concertation subsidies in each region according to *PUBEXP*. This estimate is used below to allocate imputed social security contributions across regions and levels.

[51] We use a weighted average of enrollment in the 1999-2000 and 2000-2001 academic years with weights of 2/3 and 1/3 respectively.

**d. Other public expenditures and adjustments**

*Imputed social contributions of the public teaching staff*

*PUBEXP* reports a single figure for this item that should be allocated among all regionos and educational levels in proportion to their shares in the payroll of teachers who are civil servants. Since this information is unavailable, we have attributed to each educational level and region a share of total social contributions that is equal to the ratio between the two quantities described in Table A.8.

In all cases, the denominator is an estimate of the relevant expenditure at all educational levels in the country as a whole. This magnitude measures total consolidated expenditure by the national ministry, the public universities and the regional education departments in the entire country, excluding only subsidies to private educational centers (whose staff are not civil servants and therefore pay full social security contributions) and non-tuition subsidies to households. Notice that this variable includes overhead costs (because of differences in their treatment across regions and, more importantly, because these costs are not identified separately at the university level) and all expenditure by public universities, including R&D (because this contains a share of faculty salaries) and expenditures financed by tuition fees paid by families and by the central government through tuition wavers. The numerator is constructed in a similar way, but working only with the expenditure imputable to the relevant educational level and region and excluding research expenditure by universities.

*Educational expenditure by other administrations*

Educational expenditures at the secondary level by local corporations and by non-education departments of other administrations is allocated across regions in proportion to their respective shares in total educational expenditure by local administrations, which is taken from *LOC*. We use this criterion because, as noted above, local administrations account for around 80 of this expenditure and because we could find no additional information on the distribution of the rest of the expenditure. Prior to this calculation, secondary spending is augmented by a share of expenditure in special education (based on enrollment by level in special education in Spain as a whole, using ordinary public centers) and by its share in overhead costs (which are allocated in proportion to direct expenditure in each program as in subsection a). University expenditure by this administations is ignored because it is almost negligible and seems to correspond mostly to the military academies.



**Table A.8: Construction of the variables used in the imputation of imputed social security contributions of the public teaching staff**

***National public expenditure over which social contributions must be distributed =***

*NON-UNIVERSITY*

= total national expenditure by the Ministry of Education and regional education departments for all levels of schooling, excluding scholarships and grants

- subsidies to private educational centers

*UNIVERSITY*

= total national expenditure by the Ministry of Education and regional education departments excluding non-tuition subsidies (but including tuition waivers, tuition fees paid by households and research expenditure by universities).

***Regional public expenditure used to calculate the region's share in contributions =***

*SECONDARY AND VOCATIONAL TRAINING*

= adjusted direct expenditure by the education department of the region in secondary and vocational training (including imputed overhead costs and a share of expenditure in compensatory and special education)

- estimated subsidies to private educational centers at this level

*UNIVERSITY*

= total consolidated university expenditure by public universities and the regional education department (including tuition waivers, tuition fees paid by households and research expenditure by universities)

- research expenditure by universities

Finally, we have to consider the direct expenditure of the national Ministry of Education, aside from that devoted to scholarhips and grants, which has already been allocated. Remaining expenditure corresponds to educational centers managed directly by it (and in particular to the two national universities and the north-african territories), and to overhead programmes that should be allocated across regions and educational levels. We have been unable to do so due to the lack of information that may be used to approximate this second component of central expenditure, but given that its size is minor relative to the other items considered above, this will not have a significant effect on our estimates.

**e. Enrollments and expenditure per capita**

Table A.9 shows student enrollments in 2000 at the university and secondary levels. University enrollments are taken from *UNIV* and are weighted averages of enrollments during the school years 1999-2000 and 2000-2001 with weights of 2/3 and 1/3 respectively. Secondary and vocational enrollments are taken from *CIF* and refer to the school year 1999-2000 (which is the last one for which data are available). We have counted in this category an estimate of special education enrollment at the secondary level.[52] The last column of the table shows the percentage of secondary students in private institutions (including special education) that are enrolled in concerted units. The information is taken from *PRIVEXP*.

**Table A.9: Student enrollments in 2000**

| | *UNIVERSITY* | | | *SECONDARY AND VOCATIONAL* | | | |
|---|---|---|---|---|---|---|---|
| | *total* | *public* | *private* | *total* | *public* | *private* | *concert.* |
| Andalucía | 269,720 | 260,324 | 9,396 | 668,846 | 515,930 | 152,916 | 83.8 |
| Aragón | 42,602 | 39,280 | 3,322 | 85,640 | 53,808 | 31,832 | 80.9 |
| Asturias | 40,190 | 38,396 | 1,795 | 84,073 | 62,036 | 22,037 | 72.0 |
| Baleares | 13,578 | 12,129 | 1,449 | 58,646 | 37,879 | 20,768 | 85.0 |
| Canarias | 49,680 | 49,680 | 0 | 163,021 | 135,935 | 27,086 | 64.5 |
| Cantabria | 13,626 | 12,827 | 799 | 45,118 | 30,953 | 14,165 | 86.6 |
| C-M | 32,583 | 32,583 | 0 | 138,014 | 113,520 | 24,494 | 83.4 |
| CyL | 104,982 | 93,717 | 11,265 | 198,686 | 138,497 | 60,190 | 81.8 |
| Cataluña | 205,481 | 163,479 | 42,002 | 439,011 | 259,046 | 179,965 | 81.8 |
| Valencia | 140,259 | 132,442 | 7,817 | 317,416 | 227,115 | 90,301 | 79.7 |
| Extremadura | 27,591 | 26,831 | 759 | 91,967 | 75,307 | 16,660 | 85.9 |
| Galicia | 98,249 | 93,977 | 4,272 | 224,775 | 175,545 | 49,230 | 72.7 |
| Madrid | 250,956 | 198,060 | 52,895 | 422,317 | 256,291 | 166,026 | 61.3 |
| Murcia | 37,876 | 35,499 | 2,376 | 102,077 | 80,418 | 21,659 | 82.8 |
| Navarra | 21,031 | 9,562 | 11,469 | 38,557 | 23,928 | 14,630 | 96.9 |
| País Vasco | 76,070 | 57,198 | 18,873 | 159,489 | 74,506 | 84,983 | 87.5 |
| Rioja | 7,240 | 6,480 | 760 | 20,404 | 13,847 | 6,557 | 82.7 |
| *TOTAL* | *1,431,714* | *1,262,465* | *169,249* | *3,258,058* | *2,274,560* | *983,498* | *78.3* |

Dividing the expenditure totals calculated above by the total enrollments shown in Table A.9, we obtain average expenditure per student. Table A.10 shows the results of this calculation at the secondary and university levels. Notice that since the denominator is total enrollment, without distinguishing between students enrolled in private and public centers, our average cost estimates refer to a hypothetical average student. The last row of the table shows average expenditure per student in euros in Spain as a whole (again, excluding Ceuta and Melilla).

[52] *CIF* breaks down special education enrollment by educational level only for the case of students enrolled in special units of ordinary schools, but not the enrollment in special education centers. To allocate this last figure by level we have assumed that for each region the weight of secondary in total special education enrollment is the same as in ordinary centers.



**Table A.10: Average expenditure per student in 2000**
**euros per capita**

| | *UNIVERSITY* | | *SECONDARY* | | *COMBINED* | |
|---|---|---|---|---|---|---|
| | *private* | *total* | *private* | *total* | *private* | *total* |
| *Andalucía* | 374 | 2,530 | 22 | 2,585 | 140 | 2,567 |
| *Aragón* | 829 | 3,413 | 157 | 3,538 | 381 | 3,496 |
| *Asturias* | 603 | 3,200 | 129 | 3,294 | 287 | 3,263 |
| *Baleares* | 733 | 2,350 | 166 | 3,308 | 355 | 2,988 |
| *Canarias* | 247 | 3,059 | 94 | 3,593 | 145 | 3,415 |
| *Cantabria* | 929 | 4,454 | 51 | 3,249 | 344 | 3,650 |
| *C-M* | 226 | 3,010 | 9 | 2,949 | 81 | 2,969 |
| *CyL* | 557 | 3,179 | 73 | 3,317 | 235 | 3,271 |
| *Cataluña* | 1,390 | 3,619 | 353 | 3,615 | 699 | 3,616 |
| *Valencia* | 632 | 3,388 | 138 | 3,252 | 302 | 3,297 |
| *Extremadura* | -71 | 2,731 | -37 | 2,606 | -48 | 2,647 |
| *Galicia* | 448 | 2,782 | 91 | 3,490 | 210 | 3,254 |
| *Madrid* | 1,549 | 3,936 | 386 | 2,791 | 774 | 3,173 |
| *Murcia* | 567 | 3,274 | 29 | 2,698 | 209 | 2,890 |
| *Navarra* | 1,180 | 2,594 | 96 | 4,712 | 458 | 4,006 |
| *País Vasco* | 904 | 2,903 | 309 | 4,953 | 507 | 4,269 |
| *Rioja* | 734 | 5,736 | 66 | 3,346 | 288 | 4,143 |
| *average* | *829* | *3,233* | *159* | *3,204* | *382* | *3,214* |

**2. Estimates of educational attainment by region and cohort**

This section describes the procedure used to estimate educational attainment levels of the population aged 25 and over between 1960 and 2000 and gives the detailed results by region and year.[53]

Attainment levels at the national level have been taken from de la Fuente and Doménech (2002b) and from the advance of the results of the 2001 Census published by the National Statistical Institute. These estimates are taken directly from the 1981, 1991 and 2001 Census reports and use census data from 1961 and 1970 after some minor corrections. In the case of the 1960 census, the breakdown of the population by educational level is coarser than in latter reports and its results appear implausible in the light of more recent data. Hence, we do not use this source (except for illiterates), and construct attainment estimates for 1960 using the 1970 census (which gives a very fine breakdown by age), and the actual age structure of the population in 1960. We interpolate to estimate missing observations. For the 1970 Census, the only problem concerns the reported illiteracy rate, which appears implausibly high when compared with the 1960 figure and with a backward extrapolation using the 1981 census data. Hence, we ignore this figure and estimate L0 in 1970 by interpolation between the 1960 and

[53] See de la Fuente and Doménech (2002b and 2003) for additional details.

1981 estimates. Then, we estimate L1 so that the sum of the shares of the different attainment levels is equal to 1. Table A.11 shows our estimates of national attainment levels in benchmark years. As indicated in the notes to the table, different types are used to identify the source of the data.

**Table A.11: National attainment levels in benchmark years**

| | *L0* | *L1* | *L2.1* | *L2.2* | *L3.1* | *L3.2* |
|---|---|---|---|---|---|---|
| *1960* | ***0.1120*** | ***0.8153*** | ***0.0217*** | ***0.0203*** | ***0.0159*** | ***0.0148*** |
| *1970* | 0.1005 | *0.8012* | **0.0324** | **0.0261** | **0.0211** | **0.0187** |
| *1975* | 0.0948 | 0.7590 | 0.0521 | 0.0400 | 0.0277 | 0.0264 |
| *1981* | **0.0879** | **0.7084** | **0.0757** | **0.0567** | **0.0356** | **0.0357** |
| *1986* | 0.0657 | 0.6602 | 0.1082 | 0.0875 | 0.0391 | 0.0393 |
| *1991* | **0.0435** | **0.6120** | **0.1406** | **0.1184** | **0.0427** | **0.0428** |
| *2001* | **0.0295** | **0.3997** | **0.2565** | **0.1759** | **0.0649** | **0.0736** |

- *Note:* Different character types are used to distinguish between original census data and those constructed in various different ways as follows:
**bold =** original census data
**bold italic** = backward estimate using data from the 1970 census broken down by age group.
*italic* = estimated so that attainment levels add up to 1.0 (L1 in 1970)
normal = lineal interpolation between existing census observations

To obtain estimates of attainment levels by region, we have proceeded in a similar way. The main difference with the procedure described above is that we have not used a backward extrapolation to estimate 1960 attainments using 1970 data broken down by age group because this may yield misleading results as a result of heavy interregional migration in those years. Instead, we have used the census data for 1960 and 1975 data from the municipal register to calculate regional attainments in 1960 relative to the national average.[54] These ratios are then applied to our original estimate of 1960 attainment for Spain as a whole to obtain preliminary estimates of attainment levels by region in 1960. Since the population shares obtained in this manner do not add up across educational levels exactly to 1.00 for each region, we renormalize our preliminary estimates by their sum (across levels for each region) so that they do add up.

***Detailed results***

Tables A.12-A.17 contain our estimates of the percentage of the adult population of each region that has attained each of the educational levels described in the text. Table A.18 shows our estimates of average years of schooling.

[54] As noted, the 1960 census data are less detailed than those available for later years. In particular this census does not disaggregate secondary schooling into its two cycles, L2.1 and L2.2. To estimate their relative weights in each region, we use the ratio L2.1/L2.2 observed in the population over 40 in 1975 according to the municipal register for this year.



**Table A.12: University attainment, second level, percentage (L3.2)**

| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.87 | 1.11 | 1.36 | 2.01 | 2.66 | 2.98 | 3.22 | 4.24 | 5.47 |
| *Aragón* | 1.50 | 1.66 | 1.82 | 2.52 | 3.22 | 3.71 | 4.15 | 5.35 | 6.78 |
| *Asturias* | 1.43 | 1.50 | 1.57 | 2.20 | 2.83 | 3.21 | 3.55 | 4.70 | 6.09 |
| *Baleares* | 1.43 | 1.57 | 1.72 | 2.43 | 3.14 | 3.40 | 3.56 | 4.31 | 5.22 |
| *Canarias* | 1.02 | 1.37 | 1.73 | 2.45 | 3.18 | 3.50 | 3.71 | 4.53 | 5.52 |
| *Cantabria* | 1.35 | 1.47 | 1.59 | 2.17 | 2.75 | 3.18 | 3.57 | 4.68 | 5.99 |
| *C. y León* | 1.60 | 1.70 | 1.81 | 2.44 | 3.08 | 3.49 | 3.84 | 5.00 | 6.40 |
| *C.-Mancha* | 0.58 | 0.78 | 0.98 | 1.35 | 1.72 | 1.99 | 2.23 | 3.11 | 4.18 |
| *Cataluña* | 1.46 | 1.57 | 1.68 | 2.54 | 3.39 | 3.84 | 4.20 | 5.47 | 7.02 |
| *Valencia* | 1.28 | 1.36 | 1.43 | 2.08 | 2.72 | 3.15 | 3.54 | 4.72 | 6.14 |
| *Extremadura* | 0.62 | 0.85 | 1.08 | 1.57 | 2.06 | 2.26 | 2.37 | 3.18 | 4.18 |
| *Galicia* | 1.09 | 1.15 | 1.21 | 1.74 | 2.27 | 2.56 | 2.80 | 3.96 | 5.39 |
| *Madrid* | 4.10 | 4.35 | 4.60 | 5.96 | 7.32 | 7.97 | 8.44 | 10.62 | 13.29 |
| *Murcia* | 1.42 | 1.42 | 1.42 | 2.00 | 2.58 | 2.97 | 3.32 | 4.22 | 5.29 |
| *Navarra* | 2.10 | 2.26 | 2.42 | 3.02 | 3.62 | 4.24 | 4.87 | 6.31 | 7.99 |
| *P. Vasco* | 1.75 | 1.90 | 2.04 | 2.82 | 3.60 | 4.37 | 5.15 | 6.93 | 9.03 |
| *Rioja* | 1.99 | 1.79 | 1.59 | 2.13 | 2.66 | 3.06 | 3.44 | 4.65 | 6.11 |
| *Spain* | *1.48* | *1.67* | *1.87* | *2.64* | *3.41* | *3.82* | *4.22* | *5.65* | *7.08* |

**Table A.13: University attainment, first level, percentage (L3.1)**

| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Andalucía* | 1.13 | 1.45 | 1.78 | 2.53 | 3.28 | 3.74 | 4.12 | 5.03 | 6.10 |
| *Aragón* | 1.36 | 1.74 | 2.12 | 2.68 | 3.24 | 3.80 | 4.37 | 5.62 | 7.08 |
| *Asturias* | 1.90 | 2.13 | 2.37 | 2.93 | 3.50 | 4.04 | 4.59 | 5.63 | 6.85 |
| *Baleares* | 1.02 | 1.38 | 1.75 | 2.28 | 2.82 | 3.23 | 3.61 | 4.44 | 5.41 |
| *Canarias* | 1.98 | 2.12 | 2.26 | 3.10 | 3.93 | 4.45 | 4.89 | 5.52 | 6.22 |
| *Cantabria* | 3.06 | 2.79 | 2.52 | 3.15 | 3.77 | 4.19 | 4.55 | 5.42 | 6.45 |
| *C. y León* | 0.95 | 1.59 | 2.24 | 2.92 | 3.59 | 4.07 | 4.51 | 5.66 | 7.03 |
| *C.-Mancha* | 0.40 | 0.96 | 1.51 | 2.05 | 2.59 | 2.86 | 3.07 | 3.91 | 4.93 |
| *Cataluña* | 2.18 | 2.12 | 2.06 | 2.68 | 3.31 | 3.63 | 3.89 | 4.86 | 6.03 |
| *Valencia* | 1.80 | 1.81 | 1.82 | 2.48 | 3.13 | 3.52 | 3.85 | 4.63 | 5.54 |
| *Extremadura* | 0.54 | 1.07 | 1.61 | 2.27 | 2.93 | 3.26 | 3.51 | 4.60 | 5.92 |
| *Galicia* | 0.84 | 1.31 | 1.78 | 2.32 | 2.85 | 3.13 | 3.35 | 4.16 | 5.14 |
| *Madrid* | 3.37 | 3.27 | 3.17 | 3.92 | 4.67 | 5.01 | 5.25 | 6.30 | 7.58 |
| *Murcia* | 1.39 | 1.62 | 1.85 | 2.39 | 2.94 | 3.49 | 4.06 | 4.97 | 6.00 |
| *Navarra* | 0.68 | 1.55 | 2.41 | 3.21 | 4.01 | 4.50 | 4.93 | 6.15 | 7.60 |
| *P. Vasco* | 2.79 | 2.70 | 2.61 | 3.07 | 3.53 | 4.12 | 4.74 | 5.75 | 6.88 |
| *Rioja* | 1.25 | 1.63 | 2.01 | 2.57 | 3.14 | 3.62 | 4.09 | 5.35 | 6.85 |
| *Spain* | *1.59* | *1.85* | *2.11* | *2.77* | *3.43* | *3.82* | *4.20* | *5.24* | *6.28* |

**Table A.14: Upper secondary attainment, percentage (L2.2)**

| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Andalucía* | 1.30 | 1.56 | 1.82 | 2.79 | 3.77 | 6.11 | 8.84 | 11.43 | 14.11 |
| *Aragón* | 1.91 | 2.03 | 2.15 | 3.17 | 4.18 | 6.95 | 10.21 | 13.48 | 16.91 |
| *Asturias* | 2.18 | 2.49 | 2.80 | 4.22 | 5.64 | 8.51 | 11.82 | 14.96 | 18.22 |
| *Baleares* | 2.10 | 2.53 | 2.96 | 4.38 | 5.81 | 8.62 | 11.82 | 14.97 | 18.25 |
| *Canarias* | 1.78 | 2.54 | 3.29 | 4.40 | 5.51 | 8.21 | 11.37 | 14.44 | 17.62 |
| *Cantabria* | 2.51 | 2.75 | 2.99 | 4.55 | 6.11 | 9.34 | 13.04 | 16.51 | 20.07 |
| *C. y León* | 2.35 | 2.15 | 1.96 | 3.13 | 4.29 | 7.01 | 10.18 | 12.95 | 15.76 |
| *C.-Mancha* | 1.06 | 1.02 | 0.97 | 1.68 | 2.39 | 4.47 | 6.95 | 9.35 | 11.83 |
| *Cataluña* | 2.04 | 2.42 | 2.80 | 4.94 | 7.08 | 9.98 | 13.12 | 16.02 | 19.01 |
| *Valencia* | 1.85 | 2.04 | 2.24 | 3.14 | 4.04 | 6.55 | 9.51 | 12.50 | 15.63 |
| *Extremadura* | 1.15 | 1.14 | 1.13 | 1.78 | 2.44 | 4.41 | 6.74 | 8.73 | 10.72 |
| *Galicia* | 1.79 | 1.82 | 1.86 | 2.77 | 3.69 | 5.99 | 8.68 | 11.56 | 14.61 |
| *Madrid* | 4.27 | 4.92 | 5.58 | 7.41 | 9.25 | 12.50 | 16.18 | 18.79 | 21.27 |
| *Murcia* | 1.59 | 1.80 | 2.02 | 2.77 | 3.52 | 6.11 | 9.21 | 12.18 | 15.24 |
| *Navarra* | 2.46 | 2.65 | 2.85 | 4.26 | 5.67 | 9.20 | 13.32 | 16.50 | 19.62 |
| *P. Vasco* | 2.69 | 3.07 | 3.45 | 5.55 | 7.66 | 11.36 | 15.53 | 19.11 | 22.71 |
| *Rioja* | 2.66 | 2.45 | 2.24 | 3.58 | 4.92 | 7.80 | 11.13 | 14.75 | 18.59 |
| *Spain* | *2.03* | *2.32* | *2.61* | *4.00* | *5.40* | *8.34* | *11.28* | *14.17* | *17.07* |

**Table A.15: Lower secondary attainment, percentage (L2.1)**

| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Andalucía* | 1.56 | 2.05 | 2.55 | 4.02 | 5.49 | 8.42 | 11.77 | 17.25 | 23.47 |
| *Aragón* | 2.19 | 2.45 | 2.71 | 4.65 | 6.58 | 9.90 | 13.64 | 19.59 | 26.31 |
| *Asturias* | 2.14 | 2.59 | 3.04 | 4.93 | 6.82 | 9.85 | 13.24 | 18.55 | 24.55 |
| *Baleares* | 2.20 | 2.84 | 3.48 | 5.99 | 8.50 | 12.43 | 16.80 | 23.74 | 31.59 |
| *Canarias* | 1.91 | 3.62 | 5.34 | 6.37 | 7.41 | 11.02 | 15.36 | 20.35 | 25.72 |
| *Cantabria* | 2.84 | 3.11 | 3.38 | 5.66 | 7.94 | 11.05 | 14.42 | 21.17 | 29.01 |
| *C. y León* | 2.27 | 2.23 | 2.19 | 3.73 | 5.26 | 8.07 | 11.26 | 16.75 | 23.02 |
| *C.-Mancha* | 1.15 | 1.23 | 1.31 | 2.36 | 3.41 | 6.52 | 10.21 | 15.96 | 22.43 |
| *Cataluña* | 2.37 | 2.86 | 3.36 | 6.16 | 8.97 | 11.95 | 15.04 | 20.02 | 25.67 |
| *Valencia* | 2.15 | 2.54 | 2.92 | 4.63 | 6.33 | 9.71 | 13.57 | 19.55 | 26.29 |
| *Extremadura* | 1.21 | 1.41 | 1.62 | 2.58 | 3.53 | 6.58 | 10.21 | 15.52 | 21.45 |
| *Galicia* | 1.68 | 1.90 | 2.11 | 3.49 | 4.86 | 7.51 | 10.52 | 15.92 | 22.11 |
| *Madrid* | 4.21 | 5.51 | 6.80 | 9.50 | 12.21 | 14.59 | 16.94 | 19.98 | 23.32 |
| *Murcia* | 2.11 | 2.33 | 2.55 | 3.89 | 5.23 | 8.86 | 13.13 | 19.21 | 25.97 |
| *Navarra* | 2.56 | 2.98 | 3.40 | 5.69 | 7.98 | 10.80 | 13.81 | 21.00 | 29.47 |
| *P. Vasco* | 2.56 | 3.16 | 3.77 | 5.97 | 8.18 | 11.13 | 14.33 | 19.50 | 25.36 |
| *Rioja* | 2.48 | 2.54 | 2.60 | 4.77 | 6.93 | 9.77 | 12.82 | 19.80 | 27.99 |
| *Spain* | *2.17* | *2.70* | *3.24* | *5.21* | *7.18* | *10.33* | *13.47* | *19.03* | *24.59* |



**Table A.16: Primary attainment, percentage (L1)**

| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Andalucía* | 74.62 | 74.20 | 73.78 | 70.83 | 67.88 | 65.26 | 62.66 | 54.77 | 45.31 |
| *Aragón* | 84.50 | 84.30 | 84.10 | 80.61 | 77.12 | 71.42 | 65.05 | 54.01 | 41.42 |
| *Asturias* | 89.57 | 88.41 | 87.25 | 82.64 | 78.04 | 71.99 | 65.45 | 55.05 | 43.30 |
| *Baleares* | 81.06 | 80.14 | 79.23 | 74.70 | 70.17 | 65.24 | 60.12 | 49.46 | 37.06 |
| *Canarias* | 74.95 | 73.42 | 71.89 | 69.62 | 67.34 | 62.97 | 57.98 | 49.91 | 40.77 |
| *Cantabria* | 87.63 | 87.37 | 87.12 | 82.17 | 77.23 | 70.59 | 63.40 | 51.41 | 37.78 |
| *C. y León* | 88.11 | 87.75 | 87.39 | 83.53 | 79.66 | 74.20 | 68.24 | 58.13 | 46.62 |
| *C.-Mancha* | 78.60 | 78.59 | 78.57 | 76.68 | 74.79 | 71.93 | 68.77 | 60.78 | 51.33 |
| *Cataluña* | 85.34 | 84.39 | 83.45 | 76.99 | 70.52 | 65.35 | 60.40 | 50.75 | 39.58 |
| *Valencia* | 81.14 | 81.17 | 81.19 | 77.98 | 74.76 | 70.15 | 65.10 | 55.11 | 43.55 |
| *Extremadura* | 76.77 | 76.54 | 76.31 | 74.26 | 72.22 | 70.00 | 67.70 | 60.47 | 51.79 |
| *Galicia* | 84.28 | 83.86 | 83.44 | 80.45 | 77.45 | 73.92 | 70.19 | 61.04 | 50.23 |
| *Madrid* | 79.81 | 77.60 | 75.40 | 68.65 | 61.91 | 56.11 | 50.44 | 41.95 | 32.42 |
| *Murcia* | 76.69 | 76.64 | 76.59 | 73.99 | 71.40 | 67.50 | 63.21 | 54.08 | 43.45 |
| *Navarra* | 88.55 | 87.14 | 85.73 | 80.87 | 76.01 | 69.19 | 61.74 | 48.91 | 34.27 |
| *P. Vasco* | 87.80 | 86.71 | 85.62 | 80.02 | 74.41 | 66.82 | 58.60 | 47.33 | 34.86 |
| *Rioja* | 85.92 | 86.37 | 86.82 | 82.71 | 78.59 | 72.98 | 66.87 | 54.24 | 39.55 |
| *Spain* | *81.53* | *80.83* | *80.12* | *75.90* | *71.68* | *66.88* | *62.08* | *51.99* | *41.90* |

**Table A.17: Illiteracy rates (percentage)**

| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Andalucía* | 20.53 | 19.62 | 18.72 | 17.82 | 16.91 | 13.50 | 9.39 | 7.28 | 5.54 |
| *Aragón* | 8.54 | 7.82 | 7.10 | 6.38 | 5.65 | 4.22 | 2.59 | 1.95 | 1.50 |
| *Asturias* | 2.78 | 2.88 | 2.98 | 3.08 | 3.18 | 2.39 | 1.36 | 1.09 | 0.99 |
| *Baleares* | 12.19 | 11.53 | 10.87 | 10.22 | 9.56 | 7.08 | 4.09 | 3.08 | 2.47 |
| *Canarias* | 18.36 | 16.93 | 15.49 | 14.06 | 12.63 | 9.86 | 6.69 | 5.26 | 4.15 |
| *Cantabria* | 2.61 | 2.50 | 2.40 | 2.30 | 2.20 | 1.66 | 1.01 | 0.81 | 0.71 |
| *C. y León* | 4.71 | 4.56 | 4.41 | 4.26 | 4.11 | 3.15 | 1.97 | 1.50 | 1.17 |
| *C.-Mancha* | 18.20 | 17.42 | 16.65 | 15.88 | 15.10 | 12.22 | 8.75 | 6.89 | 5.31 |
| *Cataluña* | 6.59 | 6.63 | 6.66 | 6.69 | 6.72 | 5.25 | 3.36 | 2.88 | 2.68 |
| *Valencia* | 11.78 | 11.09 | 10.40 | 9.70 | 9.01 | 6.92 | 4.43 | 3.49 | 2.84 |
| *Extremadura* | 19.70 | 18.98 | 18.26 | 17.54 | 16.81 | 13.50 | 9.47 | 7.51 | 5.95 |
| *Galicia* | 10.32 | 9.96 | 9.59 | 9.23 | 8.87 | 6.89 | 4.46 | 3.36 | 2.52 |
| *Madrid* | 4.25 | 4.35 | 4.46 | 4.56 | 4.66 | 3.83 | 2.75 | 2.37 | 2.12 |
| *Murcia* | 16.80 | 16.19 | 15.57 | 14.95 | 14.34 | 11.07 | 7.07 | 5.34 | 4.04 |
| *Navarra* | 3.65 | 3.41 | 3.18 | 2.95 | 2.72 | 2.08 | 1.32 | 1.13 | 1.05 |
| *P. Vasco* | 2.41 | 2.46% | 2.51% | 2.57% | 2.62% | 2.20% | 1.65% | 1.38% | 1.16% |
| *Rioja* | 5.71% | 5.22% | 4.73% | 4.24% | 3.76% | 2.77% | 1.64% | 1.21% | 0.91% |
| *Spain* | *11.20%* | *10.63%* | *10.05%* | *9.48%* | *8.90%* | *6.83%* | *4.75%* | *3.91%* | *3.07%* |

**Table A.18: Average years of schooling**

| | *1960* | *1965* | *1970* | *1975* | *1980* | *1985* | *1990* | *1995* | *2000* |
|---|---|---|---|---|---|---|---|---|---|
| *Andalucía* | 4.32 | 4.45 | 4.59 | 4.89 | 5.20 | 5.70 | 6.26 | 6.91 | 7.62 |
| *Aragón* | 5.07 | 5.18 | 5.29 | 5.59 | 5.89 | 6.36 | 6.89 | 7.58 | 8.35 |
| *Asturias* | 5.42 | 5.48 | 5.54 | 5.82 | 6.09 | 6.52 | 6.99 | 7.62 | 8.31 |
| *Baleares* | 4.87 | 5.00 | 5.13 | 5.47 | 5.81 | 6.32 | 6.88 | 7.52 | 8.22 |
| *Canarias* | 4.56 | 4.80 | 5.03 | 5.37 | 5.71 | 6.23 | 6.81 | 7.40 | 8.02 |
| *Cantabria* | 5.57 | 5.59 | 5.61 | 5.92 | 6.23 | 6.66 | 7.13 | 7.80 | 8.54 |
| *C. y León* | 5.27 | 5.34 | 5.40 | 5.67 | 5.95 | 6.36 | 6.82 | 7.44 | 8.14 |
| *C.-Mancha* | 4.31 | 4.42 | 4.53 | 4.74 | 4.95 | 5.39 | 5.90 | 6.51 | 7.18 |
| *Cataluña* | 5.26 | 5.30 | 5.35 | 5.74 | 6.13 | 6.58 | 7.05 | 7.67 | 8.35 |
| *Valencia* | 4.92 | 4.99 | 5.06 | 5.35 | 5.63 | 6.10 | 6.62 | 7.27 | 7.98 |
| *Extremadura* | 4.25 | 4.37 | 4.49 | 4.72 | 4.95 | 5.39 | 5.91 | 6.50 | 7.13 |
| *Galicia* | 4.87 | 4.94 | 5.02 | 5.26 | 5.49 | 5.89 | 6.34 | 6.97 | 7.67 |
| *Madrid* | 6.01 | 6.11 | 6.21 | 6.64 | 7.08 | 7.53 | 7.99 | 8.64 | 9.36 |
| *Murcia* | 4.63 | 4.70 | 4.78 | 5.02 | 5.26 | 5.81 | 6.45 | 7.12 | 7.82 |
| *Navarra* | 5.38 | 5.52 | 5.65 | 5.97 | 6.30 | 6.78 | 7.31 | 8.04 | 8.85 |
| *P. Vasco* | 5.61 | 5.66 | 5.71 | 6.05 | 6.40 | 6.91 | 7.48 | 8.20 | 9.00 |
| *Rioja* | 5.33 | 5.35 | 5.37 | 5.67 | 5.97 | 6.39 | 6.86 | 7.61 | 8.44 |
| *Spain* | *4.97* | *5.08* | *5.19* | *5.53* | *5.87* | *6.35* | *6.84* | *7.52* | *8.19* |

**Attainment by cohort**

The 2001 Census has a rather fine breakdown of the population by age group and by educational level (see Table A.19). Using these data, we have constructed estimates of attainment levels and average years of schooling by cohort. The main results are given in Tables A.20-A.23.

**Table A.19: Attainment levels used in the 2001 census and cumulative durations**

| | *duration* |
|---|---|
| illiterates | 0 |
| incomplete primary schooling | 2 |
| primary schooling | 5 |
| lower secondary (EGB) | 8 |
| basic vocational training (FP I) | 10 |
| upper secondary (bachillerato) | 12 |
| advanced vocational training (FP II) | 13 |
| university, 1st cycle (diplomatura) | 15 |
| university, 2nd cycle (licenciatura) | 17 |
| university 3r cycle (doctorate) | 21 |



**Table A.20: Average years of schooling by cohort, 2001**

| | *25+* | *25-34* | *35-44* | *45-54* | *55-64* | *65+* |
|---|---|---|---|---|---|---|
| *Andalucía* | 7.19 | 9.83 | 8.66 | 7.19 | 5.41 | 3.68 |
| *Aragón* | 8.20 | 11.21 | 10.12 | 8.66 | 6.91 | 4.90 |
| *Asturias* | 8.12 | 11.20 | 10.11 | 8.48 | 6.72 | 5.01 |
| *Baleares* | 8.02 | 9.94 | 9.22 | 8.17 | 6.88 | 4.90 |
| *Canarias* | 7.74 | 9.77 | 8.89 | 7.66 | 6.03 | 4.25 |
| *Cantabria* | 8.46 | 10.92 | 10.01 | 8.69 | 7.26 | 5.52 |
| *C.-León* | 7.99 | 11.16 | 9.89 | 8.33 | 6.61 | 4.97 |
| *C.-Mancha* | 6.62 | 9.72 | 8.60 | 7.02 | 4.88 | 3.17 |
| *Cataluña* | 8.12 | 10.73 | 9.82 | 8.25 | 6.51 | 4.87 |
| *Valencia* | 7.71 | 10.25 | 9.21 | 7.87 | 6.18 | 4.48 |
| *Extremadura* | 6.59 | 9.76 | 8.44 | 6.81 | 4.91 | 3.24 |
| *Galicia* | 7.28 | 10.65 | 9.22 | 7.48 | 5.79 | 4.11 |
| *Madrid* | 9.23 | 11.71 | 10.83 | 9.17 | 7.51 | 5.46 |
| *Murcia* | 7.43 | 9.78 | 9.00 | 7.51 | 5.59 | 3.81 |
| *Navarra* | 8.86 | 11.43 | 10.37 | 8.95 | 7.47 | 5.73 |
| *P. Vasco* | 8.96 | 11.88 | 10.77 | 8.95 | 7.23 | 5.58 |
| *Rioja* | 8.38 | 11.03 | 10.00 | 8.62 | 7.03 | 5.32 |
| *Spain* | *7.93* | *10.61* | *9.56* | *8.07* | *6.32* | *4.55* |
| | *25+* | *25-34* | *35-44* | *45-54* | *55-64* | *65+* |
| *Andalucía* | 90.7 | 92.6 | 90.6 | 89.1 | 85.5 | 80.8 |
| *Aragón* | 103.4 | 105.6 | 105.8 | 107.3 | 109.3 | 107.8 |
| *Asturias* | 102.4 | 105.5 | 105.7 | 105.1 | 106.2 | 110.2 |
| *Baleares* | 101.1 | 93.7 | 96.4 | 101.3 | 108.8 | 107.6 |
| *Canarias* | 97.6 | 92.0 | 92.9 | 95.0 | 95.4 | 93.4 |
| *Cantabria* | 106.7 | 102.8 | 104.7 | 107.7 | 114.8 | 121.3 |
| *C.-León* | 100.7 | 105.2 | 103.4 | 103.3 | 104.6 | 109.3 |
| *C.-Mancha* | 83.5 | 91.6 | 89.9 | 87.0 | 77.1 | 69.6 |
| *Cataluña* | 102.5 | 101.1 | 102.6 | 102.3 | 102.9 | 107.0 |
| *Valencia* | 97.3 | 96.6 | 96.2 | 97.6 | 97.7 | 98.4 |
| *Extremadura* | 83.1 | 92.0 | 88.2 | 84.4 | 77.6 | 71.2 |
| *Galicia* | 91.8 | 100.4 | 96.4 | 92.7 | 91.5 | 90.4 |
| *Madrid* | 116.4 | 110.3 | 113.2 | 113.7 | 118.7 | 119.9 |
| *Murcia* | 93.7 | 92.1 | 94.1 | 93.0 | 88.4 | 83.8 |
| *Navarra* | 111.8 | 107.7 | 108.4 | 110.9 | 118.2 | 125.9 |
| *P. Vasco* | 113.0 | 111.9 | 112.6 | 110.9 | 114.3 | 122.6 |
| *Rioja* | 105.7 | 103.9 | 104.6 | 106.9 | 111.2 | 117.0 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| *coeff. of var.* | *9.2* | *6.8* | *7.6* | *8.7* | *12.9* | *17.0* |
| *max* | 116.4 | 111.9 | 113.2 | 113.7 | 118.7 | 125.9 |
| *min* | 83.1 | 91.6 | 88.2 | 84.4 | 77.1 | 69.6 |
| *max/min* | 1.40 | 1.22 | 1.28 | 1.35 | 1.54 | 1.81 |

- *Note:* The upper panel of the table shows average years of schooling, estimated using the durations given in Table A.52. The lower panel shows values normalized by the overall Spanish average (which includes Ceuta and Melilla as well as the 17 autonomous regions shown in the table).

**Table A.21: Lower secondary attainment or better by cohort, 2001**

| | 25+ | 20-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+ |
|---|---|---|---|---|---|---|---|
| Andalucía | 31.37% | 84.70% | 83.87% | 77.71% | 61.15% | 41.24% | 21.45% |
| Aragón | 33.83% | 91.70% | 94.20% | 99.26% | 87.40% | 60.33% | 28.32% |
| Asturias | 33.48% | 92.79% | 95.03% | 96.27% | 84.50% | 56.25% | 27.69% |
| Baleares | 42.07% | 84.70% | 82.17% | 86.48% | 77.82% | 58.23% | 34.30% |
| Canarias | 35.48% | 83.12% | 81.80% | 78.66% | 66.40% | 46.78% | 27.60% |
| Cantabria | 38.60% | 92.00% | 92.72% | 95.98% | 88.01% | 64.97% | 35.99% |
| C.-León | 30.52% | 91.50% | 92.60% | 94.19% | 78.45% | 52.80% | 25.35% |
| C.-Mancha | 26.91% | 85.41% | 87.35% | 78.53% | 60.21% | 34.78% | 13.69% |
| Cataluña | 35.03% | 87.09% | 87.01% | 91.52% | 81.32% | 55.13% | 31.20% |
| Valencia | 34.99% | 86.90% | 88.15% | 86.10% | 71.03% | 48.57% | 24.83% |
| Extremadura | 26.39% | 87.39% | 88.53% | 76.18% | 55.60% | 33.49% | 13.99% |
| Galicia | 28.94% | 91.41% | 94.37% | 89.00% | 66.98% | 41.16% | 19.58% |
| Madrid | 38.57% | 90.79% | 89.35% | 94.06% | 87.04% | 63.30% | 39.50% |
| Murcia | 33.29% | 83.72% | 83.42% | 81.46% | 67.00% | 43.92% | 21.29% |
| Navarra | 38.74% | 92.60% | 97.04% | 98.04% | 92.61% | 70.17% | 40.96% |
| P. Vasco | 36.07% | 94.09% | 97.33% | 100.50% | 93.36% | 66.30% | 37.83% |
| Rioja | 36.51% | 90.10% | 93.76% | 95.11% | 87.46% | 63.47% | 33.88% |
| *Spain* | *33.57%* | *87.93%* | *88.09%* | *87.84%* | *75.02%* | *51.50%* | *27.61%* |

| | 25+ | 20-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+ |
|---|---|---|---|---|---|---|---|
| Andalucía | 93.4 | 96.3 | 95.2 | 88.5 | 81.5 | 80.1 | 77.7 |
| Aragón | 100.8 | 104.3 | 106.9 | 113.0 | 116.5 | 117.1 | 102.6 |
| Asturias | 99.7 | 105.5 | 107.9 | 109.6 | 112.6 | 109.2 | 100.3 |
| Baleares | 125.3 | 96.3 | 93.3 | 98.5 | 103.7 | 113.1 | 124.3 |
| Canarias | 105.7 | 94.5 | 92.9 | 89.5 | 88.5 | 90.8 | 100.0 |
| Cantabria | 115.0 | 104.6 | 105.3 | 109.3 | 117.3 | 126.1 | 130.4 |
| C.-León | 90.9 | 104.1 | 105.1 | 107.2 | 104.6 | 102.5 | 91.8 |
| C.-Mancha | 80.2 | 97.1 | 99.2 | 89.4 | 80.3 | 67.5 | 49.6 |
| Cataluña | 104.3 | 99.0 | 98.8 | 104.2 | 108.4 | 107.0 | 113.0 |
| Valencia | 104.2 | 98.8 | 100.1 | 98.0 | 94.7 | 94.3 | 90.0 |
| Extremadura | 78.6 | 99.4 | 100.5 | 86.7 | 74.1 | 65.0 | 50.7 |
| Galicia | 86.2 | 104.0 | 107.1 | 101.3 | 89.3 | 79.9 | 70.9 |
| Madrid | 114.9 | 103.3 | 101.4 | 107.1 | 116.0 | 122.9 | 143.1 |
| Murcia | 99.2 | 95.2 | 94.7 | 92.7 | 89.3 | 85.3 | 77.1 |
| Navarra | 115.4 | 105.3 | 110.2 | 111.6 | 123.5 | 136.2 | 148.4 |
| P. Vasco | 107.5 | 107.0 | 110.5 | 114.4 | 124.4 | 128.7 | 137.1 |
| Rioja | 108.7 | 102.5 | 106.4 | 108.3 | 116.6 | 123.2 | 122.7 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| *coeff. of var.* | *12.2* | *3.9* | *5.6* | *9.0* | *15.4* | *20.8* | *28.9* |
| *max* | 125.3 | 107.0 | 110.5 | 114.4 | 124.4 | 136.2 | 148.4 |
| *min* | 78.6 | 94.5 | 92.9 | 86.7 | 74.1 | 65.0 | 49.6 |
| *max/min* | 1.59 | 1.13 | 1.19 | 1.32 | 1.68 | 2.10 | 2.99 |

- *Note:* The upper panel of the table shows the percentage of each age group that has completed lower secondary schooling or a higher degree. The lower panel shows values normalized by the overall Spanish average (which includes Ceuta and Melilla as well as the 17 autonomous regions shown in the table).



**Table A.22: Upper secondary attainment or better by cohort, 2001**

| | 25+ | 20-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+ |
|---|---|---|---|---|---|---|---|
| Andalucía | 26.57% | 49.80% | 45.51% | 34.60% | 23.35% | 13.39% | 6.79% |
| Aragón | 31.90% | 67.20% | 63.06% | 48.00% | 29.80% | 15.52% | 6.32% |
| Asturias | 32.21% | 66.37% | 62.14% | 49.40% | 30.80% | 16.37% | 7.85% |
| Baleares | 29.81% | 45.10% | 47.10% | 38.38% | 26.83% | 18.10% | 9.09% |
| Canarias | 30.23% | 48.75% | 46.36% | 37.00% | 26.40% | 16.88% | 8.80% |
| Cantabria | 33.56% | 63.10% | 60.45% | 48.15% | 31.27% | 17.90% | 8.19% |
| C.-León | 30.18% | 64.30% | 60.65% | 45.95% | 29.20% | 15.00% | 6.38% |
| C.-Mancha | 21.75% | 49.75% | 43.00% | 32.44% | 20.08% | 8.90% | 3.32% |
| Cataluña | 33.09% | 59.46% | 58.55% | 46.65% | 29.06% | 16.78% | 8.36% |
| Valencia | 28.29% | 53.90% | 49.84% | 38.16% | 25.27% | 14.20% | 7.49% |
| Extremadura | 21.58% | 50.75% | 42.68% | 31.20% | 19.70% | 9.49% | 3.88% |
| Galicia | 26.11% | 60.94% | 54.43% | 38.88% | 23.10% | 11.98% | 5.72% |
| Madrid | 43.28% | 65.57% | 66.28% | 56.64% | 38.70% | 26.00% | 14.65% |
| Murcia | 27.46% | 47.55% | 45.46% | 37.00% | 24.00% | 12.41% | 6.11% |
| Navarra | 36.33% | 70.90% | 64.41% | 51.65% | 33.17% | 18.60% | 7.76% |
| P. Vasco | 39.85% | 75.78% | 70.87% | 57.36% | 35.80% | 20.00% | 9.67% |
| Rioja | 32.76% | 66.00% | 60.61% | 48.00% | 30.27% | 15.80% | 7.06% |
| *Spain* | *31.43%* | *57.76%* | *54.97%* | *43.36%* | *28.39%* | *16.30%* | *7.93%* |

| | 25+ | 20-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+ |
|---|---|---|---|---|---|---|---|
| Andalucía | 84.5 | 86.2 | 82.8 | 79.8 | 82.3 | 82.1 | 85.7 |
| Aragón | 101.5 | 116.3 | 114.7 | 110.7 | 105.0 | 95.2 | 79.8 |
| Asturias | 102.5 | 114.9 | 113.0 | 113.9 | 108.5 | 100.4 | 99.1 |
| Baleares | 94.8 | 78.1 | 85.7 | 88.5 | 94.5 | 111.0 | 114.7 |
| Canarias | 96.2 | 84.4 | 84.3 | 85.3 | 93.0 | 103.6 | 111.0 |
| Cantabria | 106.8 | 109.2 | 110.0 | 111.0 | 110.2 | 109.8 | 103.4 |
| C.-León | 96.0 | 111.3 | 110.3 | 106.0 | 102.9 | 92.0 | 80.5 |
| C.-Mancha | 69.2 | 86.1 | 78.2 | 74.8 | 70.7 | 54.6 | 41.9 |
| Cataluña | 105.3 | 102.9 | 106.5 | 107.6 | 102.4 | 103.0 | 105.4 |
| Valencia | 90.0 | 93.3 | 90.7 | 88.0 | 89.0 | 87.1 | 94.5 |
| Extremadura | 68.7 | 87.9 | 77.6 | 72.0 | 69.4 | 58.2 | 48.9 |
| Galicia | 83.1 | 105.5 | 99.0 | 89.7 | 81.4 | 73.5 | 72.2 |
| Madrid | 137.7 | 113.5 | 120.6 | 130.6 | 136.3 | 159.5 | 184.8 |
| Murcia | 87.4 | 82.3 | 82.7 | 85.3 | 84.6 | 76.1 | 77.1 |
| Navarra | 115.6 | 122.7 | 117.2 | 119.1 | 116.8 | 114.1 | 98.0 |
| P. Vasco | 126.8 | 131.2 | 128.9 | 132.3 | 126.1 | 122.7 | 122.0 |
| Rioja | 104.2 | 114.3 | 110.3 | 110.7 | 106.6 | 96.9 | 89.0 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| *coeff. of var.* | *17.8* | *15.2* | *16.0* | *18.1* | *18.1* | *25.1* | *32.4* |
| *max* | 137.7 | 131.2 | 128.9 | 132.3 | 136.3 | 159.5 | 184.8 |
| *min* | 68.7 | 78.1 | 77.6 | 72.0 | 69.4 | 54.6 | 41.9 |
| *max/min* | 2.01 | 1.68 | 1.66 | 1.84 | 1.96 | 2.92 | 4.41 |

- *Note:* The upper panel of the table shows the percentage of each age group that has completed uppper secondary schooling (including lower or upper vocational training) or a higher degree. The lower panel shows values normalized by the overall Spanish average (which includes Ceuta and Melilla as well as the 17 autonomous regions shown in the table).

**Table A.23: University attainment by cohort, 2001**

| | *25+* | *25-34* | *35-44* | *45-54* | *55-64* | *65+* |
|---|---|---|---|---|---|---|
| *Andalucía* | 11.98% | 19.95% | 14.90% | 11.58% | 6.69% | 3.24% |
| *Aragón* | 14.38% | 28.01% | 20.30% | 14.20% | 7.91% | 3.21% |
| *Asturias* | 13.40% | 26.85% | 18.76% | 12.60% | 7.39% | 3.71% |
| *Baleares* | 10.97% | 17.56% | 13.63% | 10.11% | 6.70% | 3.40% |
| *Canarias* | 12.04% | 17.05% | 14.90% | 11.70% | 7.49% | 3.78% |
| *Cantabria* | 12.85% | 22.25% | 17.72% | 12.49% | 7.80% | 3.66% |
| *C.-León* | 13.92% | 28.58% | 19.42% | 13.20% | 7.70% | 3.54% |
| *C.-Mancha* | 9.48% | 18.59% | 12.87% | 9.49% | 4.70% | 1.77% |
| *Cataluña* | 13.54% | 23.81% | 18.58% | 12.73% | 7.19% | 3.20% |
| *Valencia* | 12.10% | 21.18% | 15.58% | 11.69% | 6.40% | 3.18% |
| *Extremadura* | 10.51% | 20.84% | 14.00% | 10.00% | 5.49% | 2.15% |
| *Galicia* | 10.96% | 22.15% | 15.53% | 10.30% | 5.69% | 2.75% |
| *Madrid* | 21.57% | 33.94% | 26.87% | 19.40% | 13.70% | 7.02% |
| *Murcia* | 11.67% | 18.33% | 14.90% | 11.60% | 6.21% | 3.10% |
| *Navarra* | 16.15% | 29.68% | 21.72% | 14.19% | 8.50% | 3.85% |
| *P. Vasco* | 16.49% | 30.89% | 23.72% | 13.50% | 7.70% | 3.95% |
| *Rioja* | 13.48% | 25.72% | 18.50% | 12.49% | 6.90% | 3.04% |
| *Spain* | *13.84%* | *24.17%* | *18.24%* | *13.01%* | *7.73%* | *3.62%* |

| | *25+* | *25-34* | *35-44* | *45-54* | *55-64* | *65+* |
|---|---|---|---|---|---|---|
| *Andalucía* | 86.6 | 82.5 | 81.7 | 89.0 | 86.6 | 89.6 |
| *Aragón* | 103.9 | 115.9 | 111.3 | 109.2 | 102.3 | 88.7 |
| *Asturias* | 96.8 | 111.1 | 102.8 | 96.9 | 95.5 | 102.6 |
| *Baleares* | 79.3 | 72.6 | 74.7 | 77.7 | 86.7 | 93.9 |
| *Canarias* | 87.0 | 70.5 | 81.7 | 90.0 | 96.9 | 104.4 |
| *Cantabria* | 92.9 | 92.0 | 97.1 | 96.0 | 100.9 | 101.0 |
| *C.-León* | 100.6 | 118.2 | 106.5 | 101.5 | 99.6 | 97.8 |
| *C.-Mancha* | 68.5 | 76.9 | 70.6 | 73.0 | 60.8 | 48.8 |
| *Cataluña* | 97.8 | 98.5 | 101.9 | 97.8 | 93.0 | 88.4 |
| *Valencia* | 87.4 | 87.6 | 85.4 | 89.9 | 82.8 | 87.8 |
| *Extremadura* | 75.9 | 86.2 | 76.7 | 76.9 | 71.1 | 59.4 |
| *Galicia* | 79.2 | 91.6 | 85.1 | 79.2 | 73.6 | 75.9 |
| *Madrid* | 155.8 | 140.4 | 147.3 | 149.2 | 177.2 | 194.0 |
| *Murcia* | 84.3 | 75.8 | 81.7 | 89.2 | 80.3 | 85.6 |
| *Navarra* | 116.7 | 122.8 | 119.1 | 109.1 | 110.0 | 106.3 |
| *P. Vasco* | 119.1 | 127.8 | 130.0 | 103.8 | 99.6 | 109.1 |
| *Rioja* | 97.4 | 106.4 | 101.4 | 96.0 | 89.3 | 84.0 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| *coeff. of var.* | *20.8* | *20.8* | *20.9* | *17.8* | *25.5* | *30.7* |
| *max* | 155.8 | 140.4 | 147.3 | 149.2 | 177.2 | 194.0 |
| *min* | 68.5 | 70.5 | 70.6 | 73.0 | 60.8 | 48.8 |
| *max/min* | 2.27 | 1.99 | 2.09 | 2.04 | 2.91 | 3.98 |

- *Note:* The upper panel of the table shows the percentage of each age group that has completed at least the first cycle of university. The lower panel shows values normalized by the overall Spanish average (which includes Ceuta and Melilla as well as the 17 autonomous regions shown in the table).



Attainment data by cohort can be useful in trying to project the future evolution of average attainment in each region and of educational disparities across regions. It is instructive, in particular, to compare the average attainment of the adult population (25+) with that of the youngest cohort that is old enough to have completed each educational level (25-34 or 20-24), as the second variable can be seen as an estimate of future average attainment, conditional on the maintenance of current enrollment patterns and on the absence of significant population in or outflows. One way to gauge the likely future reduction in regional educational disparities that would be induced by the combination of current policies and demographics is to estimate a "convergence equation" relating the incremental attainment of the youngest cohort relative to the entire adult population to currrent average attainment, with those variables measured in relative terms.

More specifically, let $att_i(C)$ be the average attainment of cohort *C* in region *i* measured in percentage deviations from average national attainment for the same cohort. We now define the incremental relative attainment of the youngest cohort by

$$(A.2)\ \Delta att_i(youngest) = att_i(youngest) - att_i(25+)$$

and estimate an equation of the form

$$(A.3)\ \Delta att_i(youngest) = -b*att_i(25+)$$

The parameter *b* then measures how quickly regional educational levels are converging as we move across cohorts. For a hypothetical average region, this coefficient tells us what fraction of the current deviation from average adult attainment will disappear as we go from the entire adult population (25+) to the youngest relevant cohort.

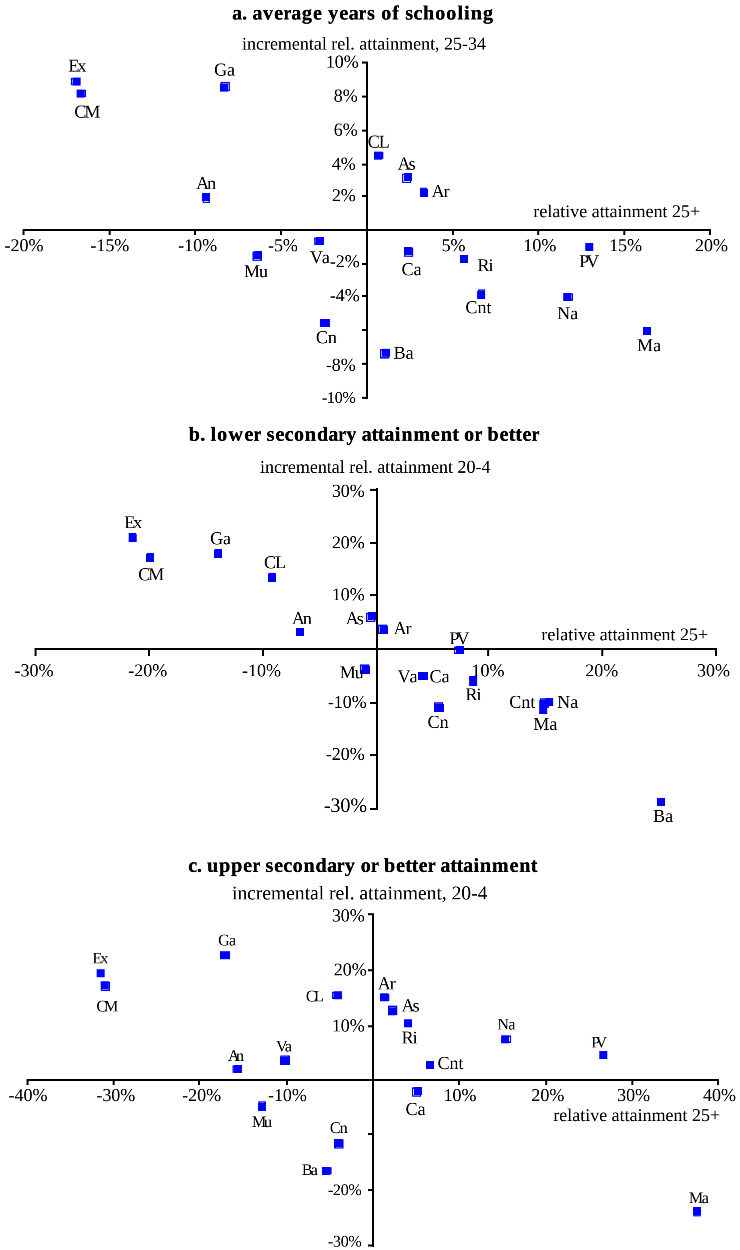
Figure A.1 and Figure 6 in the text show the scatter of $\Delta att_i(youngest)$ versus $att_i(25+)$ for four alternative attainment measures: average years of schooling, lower secondary attainment or better, upper secondary or better and university attainment. Table A.24 shows the estimated ("beta") convergence coefficients. Notice that for each attainment level we estimate two separate convergence coefficients, one for a sample comprised by all the regions and a second one for a sample that excludes Madrid. The reason for this is that, as is apparent from Figures A.1c or Figure 6 in the text, Madrid displays a rather atypical behaviour.

**Table A.24: Beta convergence in attainment across cohorts**

| | *all regions* | *w/o Madrid* |
|---|---|---|
| *avge. years of schooling* | 0.373 | 0.373 |
| | (3.82) | (3.34) |
| *lower sec. or better* | 0.945 | 0.959 |
| | (11.74) | (11.19) |
| *upper sec. or better* | 0.382 | 0.286 |
| | (2.35) | (1.50) |
| *university attainment* | 0.119 | -0.006 |
| | (0.96) | (0.04) |

- *Note:* *t* statics in parentheses below each coefficient.

**Figure A.1: Convergence in relative attainment across cohorts**






Our estimates of the beta convergence parameter reinforce the conclusions drawn in the text from a comparison of regional educational disparities across cohorts. As a result of compulsory schooling laws, lower secondary attainment is practically universal in all regions for younger cohorts. This homogeneization can be expected to contribute significantly to convergence across regions in average years of schooling in the future. On the other hand, convergence is much less clear for post-compulsory attainment levels, and the expected reduction in regional disparities is only of the order of one third. Hence, current enrollment patterns would still leave substantial regional differences in average attainment in the future.

**Other educational indicators**

Table A.25 shows the raw (non-normalized) values of the educational indicators given in Table 5 of the text.

**Table A.25: Selected educational indicators**

| | *pre-school years* | *enr17pc %* | *enr20univ %* | *adeq12 %* | *adeq15 %* | *uppsec %* | *univ %* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 2.553 | 59.4 | 27.6 | 87.8 | 57.7 | 56.9 | 65.1 |
| *Aragón* | 3.043 | 74.5 | 34.6 | 91.9 | 65.1 | 55.2 | 58.9 |
| *Asturias* | 2.974 | 71.0 | 36.7 | 92.6 | 66.5 | 49.7 | 96.2 |
| *Baleares* | 3.066 | 52.4 | 20.4 | 85.2 | 54.8 | 45.3 | 41.3 |
| *Canarias* | 2.938 | 60.6 | 19.7 | 85.2 | 58 | 35.8 | 53.5 |
| *Cantabria* | 2.954 | 63.7 | 24.4 | 92.2 | 61.5 | 43.9 | 66.0 |
| *C.-León* | 3.042 | 69.0 | 37.4 | 91.4 | 60.3 | 44.9 | 79.9 |
| *C.-Mancha* | 2.987 | 56.8 | 29.9 | 89.6 | 57 | 47.9 | 61.4 |
| *Cataluña* | 3.761 | 64.4 | 25.9 | 93.6 | 82.9 | 48.1 | 85.7 |
| *Valencia* | 2.896 | 57.8 | 27.8 | 90.4 | 61.3 | 46.4 | 80.0 |
| *Extremadura* | 2.949 | 55.9 | 26.4 | 90.6 | 57.3 | 45.3 | 50.9 |
| *Galicia* | 2.866 | 64.0 | 21.0 | 89.5 | 60.6 | 42.0 | 58.8 |
| *Madrid* | 3.242 | 70.8 | 30.0 | 91.3 | 63.7 | 49.3 | 89.8 |
| *Murcia* | 3.118 | 58.8 | 22.8 | 89 | 57.6 | 43.6 | 59.6 |
| *Navarra* | 2.978 | 79.5 | 38.1 | 93.8 | 72.2 | 65.9 | 76.2 |
| *P. Vasco* | 3.599 | 81.4 | 37.9 | 92.6 | 72.7 | 62.4 | 82.6 |
| *Rioja* | 3.049 | 70.6 | 22.6 | 92.5 | 65.3 | 51.7 | 58.9 |
| *Spain* | *3.073* | *63.9* | *32.0* | *90.1* | *63.9* | *49.1* | *77.7* |

**3. Schooling, wages and employment, detailed results**

Tables A.26-A.31 show the detailed results of the estimation of the wage equations and the participation and employment probits discussed in sections 3.a and 3.b of the text. In the last two cases, the coefficients we report are not the direct estimates of the original parameters of the probit model, but the estimated marginal effects (calculated at the sample means of all the regressors) that measure the expected change in the relevant probability in response to a marginal increase in each of the explanatory variables.

It is somewhat surprising at first sight that the coefficient of the dummy for non-university students in the participation equation is smaller than that of the dummy for university students. One possible explanation may be that, in addition to young people enrolled in upper secondary courses, the non-university group also includes many adults who are enrolled part-time in non-standard courses (theater and dance, foreign languages, computers...).

**4. Reliability ratios for two alternative attainment series**

Mas et al (MPUSS, 2002) construct educational attainment series for the Spanish regions using the data taken from the Labor Force Survey (LFS) of the National Statistical Institute. These series cover the period 1964-2001 at an annual frequency and break down the working-age population (16-65) into inactive, unemployed and employed workers.

Using the MPUSS series for the working-age population, we have constructed a series of average years of educational attainment that we have compared with our own attainment series in order to obtain measures of the information content of both data sets as given by their estimated reliability ratios. Following the methodology proposed by Krueger and Lindhal (2001) and briefly reviewed in de la Fuente and Ciccone (2002), we estimate the reliability ratio $r_k$ of a given series of average years of schooling (say $S_k$) by using $S_k$ to try to explain alternative estimates of the same variable ($S_j$ with $j \neq k$). In particular, our estimate of the reliability ratio of data set $k$ is the slope coefficient in a regression of the form

(A.4) $S_j = c + r_{kj} S_k$

where $j$ denotes the "reference" data set.

The exercise we have just described is repeated for several transformations of average years of schooling using data covering the period 1965-95 at two-year intervals.[55] In particular, we estimate reliability ratios for years of schooling measured in levels ($S_{it}$) and in logs ($s_{it}$), for average annual changes in both levels and logs measured across successive (biennial) observations ($\Delta S_{it}$ and $\Delta s_{it}$), for log years of schooling and for their annualized changes measured in deviations from their respective country means ($s_{it} - s_i$ and $\Delta s_{it} - \Delta s_i$). Notice that $\Delta s_{it}$ corresponds to annual growth rates and that $s_{it} - s_i$ and $\Delta s_{it} - \Delta s_i$ are the "within" transformations often used to remove fixed effects. We also estimate all the reliability ratios twice, once with the raw data and a second time after removing the period means from the different schooling series. Since all our growth estimates (reported in the text and in de la Fuente and Doménech, 2003) include fixed period effects, this second set of reliability ratios is the relevant one for the analysis of the sensitivity of human capital estimates to data quality we will carry out in a later section.

[55] Our own attainment data are originally constructed for quinquennial intervals. We interpolate years of schooling linearly between benchmark years to construct the biennial series prior to estimating equation (A.6).



**Table A.32: Reliability ratios for the D&D (2003) and MPUSS (2002) attainment series**

| *raw data* | $S_{it}$ | $s_{it}$ | $\Delta S_{it}$ | $\Delta s_{it}$ | $s_{it}$-$s_i$ | $\Delta s_{it}$-$\Delta s_i$ | *average* |
|---|---|---|---|---|---|---|---|
| *D&D (2003)* | 1.216 | 1.088 | 1.258 | 0.979 | 1.203 | 0.996 | *1.123* |
| *MPUSS (2002)* | 0.701 | 0.785 | 0.392 | 0.367 | 0.719 | 0.357 | *0.554* |
| *deviations from period means:* | | | | | | | |
| *D&D (2003)* | 0.874 | 0.770 | 1.019 | 0.885 | 0.825 | 0.900 | *0.879* |
| *MPUSS (2002)* | 1.001 | 1.150 | 0.047 | 0.071 | 0.467 | 0.035 | *0.462* |

- *Note:* the upper half of the table corresponds to the variables as originally measured. The estimates shown in the lower part of the table are obtained after removing the corresponding period means. This is done by introducing period dummies in equation (A.4).

The results are shown in Table A.32, both for the raw data and for the data in deviations from period means. The last column of the table shows the average value of the reliability ratio of each data set taken across data transformations. Somewhat surprisingly, the information content of our census-based data seems to be about twice that of the LFS-based MPSS series. We hypothesize that the relatively small size of the LFS regional samples may introduce spurious variability in the MPUSS attainment estimates. The increase in the estimated reliability ratio is particularly marked for the data in differences, a fact that helps explain the pattern of results shown in the text.[56]

It is interesting to note that the information content of our census-based regional data seems to be higher than that of de la Fuente and Doménech's (2002) cross-country data set. The average reliability ratio for the data in deviations from period means is almost 40% higher for the regional data set (0.879 vs. 0.633). This result should be interpreted with some caution because our estimataes of reliability ratios can be expacted to be less precise at the regional level than at the national one, where more alternative attainment estimates are available. At any rate, the finding is not surprising given that cross-country heterogeneity in classification criteria and reporting practices, which is a major source of noise in the international data, should not be a problem at the regional level, and it does suggest that measurement error bias should be a somewhat less important problem when regional data are used.

[56] It should be noted that, while reliability ratios must lie between zero and one, some of the estimates reported in Table A.48 fall outside these bounds. We interpret these results as an indication that measurement error is likely to be positively correlated across data sets.

## 5. The private rate of return to schooling. Additional details.

### a. Average earnings of full-time salaried employees in manufacturing, construction and services

**Table A.33: Average gross earnings and working hours**

| | *hourly wage ptas.* | *full-time hours* | *yearly earnings, ptas.* | *yearly earnings euros* |
|---|---|---|---|---|
| *Andalucía* | 1,470 | 1,717.1 | 2,524,137 | 15,170 |
| *Aragón* | 1,631 | 1,737.7 | 2,834,189 | 17,034 |
| *Asturias* | 1,747 | 1,721.4 | 3,007,286 | 18,074 |
| *Baleares* | 1,451 | 1,735.2 | 2,517,775 | 15,132 |
| *Canarias* | 1,363 | 1,763.2 | 2,403,242 | 14,444 |
| *Cantabria* | 1,579 | 1,731.7 | 2,734,354 | 16,434 |
| *Cast.-Mancha* | 1,358 | 1,741.7 | 2,365,229 | 14,215 |
| *Cast. y León* | 1,579 | 1,726.3 | 2,725,828 | 16,383 |
| *Cataluña* | 1,673 | 1,746.2 | 2,921,393 | 17,558 |
| *Valencia* | 1,433 | 1,763.0 | 2,526,379 | 15,184 |
| *Extremadura* | 1,343 | 1,730.5 | 2,324,062 | 13,968 |
| *Galicia* | 1,413 | 1,742.5 | 2,462,153 | 14,798 |
| *Madrid* | 1,882 | 1,736.8 | 3,268,658 | 19,645 |
| *Murcia* | 1,323 | 1,744.4 | 2,307,841 | 13,870 |
| *Navarra* | 1,762 | 1,717.2 | 3,025,706 | 18,185 |
| *P. Vasco* | 1,967 | 1,710.9 | 3,365,340 | 20,226 |
| *Rioja* | 1,495 | 1,750.5 | 2,616,998 | 15,728 |
| *Spain* | *1,620* | *1,738.0* | *2,815,560* | *16,922* |

The first column of Table A.33 shows the average gross hourly earnings (before income taxes and employee social security contributions are witheld) of salaried employees working in establishments employing five or more workers in the manufacturing, construction and service sectors in the year 2000, measured in pesetas. These data are taken from the Encuesta de Salarios en la Industria y los Servicios, published by the National Statistical Institute (INE).[57] The second column shows the average number of working hours per year for full-time workers, as established in collective agreements and labour contracts, according to the INE's Encuesta sobre el Tiempo de Trabajo en España 2000. Multiplying these two columns, we obtain average gross yearly earnings in each region measured in pesetas.[58] The last column shows the same quantity converted to euros.

[57] These data are available on-line at http://www.ine.es/inebase/cgi/um?M=%2Ft22%2Fp131&O=inebase&N=&L=.

[58] The average yearly wage computed in this manner is 12.8% higher than APW average earnings as reported by the OECD for the same year. The discrepancy may arise from differences in the sectoral coverage of both statistics, but we find it a bit surprising that focusing on manufacturing as the OECD does



### b. The Spanish tax system in 2000 and calculation of the marginal tax rate

In 2000, labour income in (most regions of) Spain was taxed as follows. First, mandatory social security contributions paid by employees are levied on gross wage income at a flat rate of 6.35%.[59] Income tax, which includes both a national and a regional component, is calculated by applying a progressive schedule to taxable income. Taxable income is calculated by substracting from gross income social security contributions, a fixed personal allowance and a deduction for work-related expenses. This deduction is a fixed amount for individuals with incomes above a given ceiling or below a given floor, and falls with income (net of social security tax) for those with labour earnings in between these two levels. There are additional allowances and deductions for dependants, housing expenditure and other reasons, but these will be ignored here.

Within each income bracket *i*, total tax liability *(T)* is a linear function of gross income *(y)* given by

$$(A.4)\quad T_i(y) = \tau_{ss}y + T_{min_i} + \tau_i\left\{y - \tau_{ss}y - \left[A_o + A_{1i} - a_i\left((1-\tau_{ss})y - B_{1i}\right)\right] - B_{min_i}\right\}$$

where $\tau_{ss}$ is the social security tax rate, $\tau_i$ the marginal rate of income tax applicable to the relevant bracket and $T_{mini}$ the amount of income tax due at the lower limit of the bracket for taxable income $(B_{mini})$. The term inside brackets is the difference between taxable income and this lower limit, with taxable income calculated by subtracting from gross income social security contributions, the personal allowance $(A_o)$, and the deduction for work-related expenses. Notice that the formula allows this deduction to fall with income (if $a_i > 0$), but this only happens for a certain interval of relatively low incomes (that is, $a_i = 0$ in most cases). Differentiating (A.4), the marginal tax rate is given by

$$(A.5)\quad T_i'(y) = \tau_{ss} + \tau_i\left\{(1-\tau_{ss}) + a_i(1-\tau_{ss})\right\} = \tau_{ss} + \tau_i(1-\tau_{ss})(1+a_i)$$

which is the expression used to calculate the values of $T'$ used in the rate of return calculations.

As noted elsewhere, the Foral regions of Navarra and Basque Country have a slightly different tax system. In Navarra, the personal allowance is a bit higher than in the rest of Spain, and the allowance for work-related expenses in the tax base is replaced by a fixed deduction from the quota for all wage earners. In the Basque country there is a single tax allowance that, for a certain income bracket, decreases with net wage income (as the allowance for work expenses does in the general case). The tax schedules for these two regions are slightly different from those applied in the rest of Spain.

should yield lower wages. Since we divide expenditure per student by yearly earnings to calculate the private rate of return to schooling, this difference will affect our normalized expenditure variable and hence the estimated rate of return.

[59] This flat rate applies for incomes within a floor and a ceiling, the latter of which is relevant for our calculations of the returns to university schooling in a few regions. For incomes about the ceiling, the marginal social security tax rate is zero.

The net replacement ratio induced by unemployment benefits is calculated as the ratio between net income after taxes in employment and out of employment for an individual who earns ASW earnings when employed. Unemployment benefits are paid at a rate of 70% of reference earnings, defined as average gross earnings over the last six months of employment, with a floor and a ceiling that becomes binding at relatively low income levels. Benefits are considered wage income and are therefore taxable but generate deductions for work expenses. Social security contributions are paid (at a reduced rate) not on benefits themselves but on reference earnings.

**c. Detailed results for average years of schooling**

The upper panel of Table A.34 shows the observed rate of return to schooling in each Spanish region and its four cost and benefit "components." To interpret this table, recall the rate of return formula given in equation (10) in the text,

$$R' \equiv \frac{R}{1-e^{-RH}} = \frac{\theta_{net}+\varepsilon_{net}}{OPPC+DIRC} \equiv \frac{NUM}{DENOM}$$

In this expression, $\theta_{net}$ and $\varepsilon_{net}$ capture the net after-tax benefits of a marginal increase in schooling that are linked, respectively, to higher earnings and to higher employment probabilities, while *OPPC* and *DIRC* measure the opportunity and direct costs of schooling, with all variables measured as fractions of the expected after-tax earnings of an adult worker. Thus, *NUM* measures the total payoff to an additional year of schooling and *DENOM* its total cost. (Notice that $\theta_{net}$ and $\varepsilon_{net}$ are normalized by the average value of their sum, *NUM*, and *OPPC* and *DIRC* are normalized by the average value of *DENOM*).

Inspection of Table A.34 shows that the return to schooling is primarily determined by its wage-related benefits and its opportunity cost. Direct costs and employment-related effects play a secondary role, but it must be noted that the relative importance of the latter is considerably higher than in our previous estimates (de la Fuente (2003), whose values for Spain are shown in the last row of panel a of the table). For the country as a whole, 90.5% of the payoff to schooling comes from its impact on earnings and 96.5% of its costs take the form of foregone wages. There is considerable variation across regions in this respect, however. As may be expected, direct costs are lower in the poorer territories, both because government subsidies are higher and because enrollment in non-subsidized private centers are lower in these regions.

Table A.35 shows estimates of the private rate of return to schooling under each of the scenarios discussed in section 4.a of the text. The first block of the table gives the actual rates of return, and the second one a set of normalized rates of return that are obtained by setting the average value for each scenario to 100. Table A.36 shows the change in the rate of return as we move across scenarios (i.e. the tax or subsidy wedges defined in the text) and Table A.37 converts these wedges into the implied subsidy or tax rates by dividing them by the rate of



return in the baseline scenario (except in the last column, where the denominator is the observed rate of return).

**Table A.34: Observed private rate of return to schooling and its components**

**a. Observed values**

| | $r_{obs}$ | *NUM* | $\theta_{net}$ | $\varepsilon_{net}$ | *DENOM* | *OPPC* | *DIRC* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 10.73% | 8.01% | 7.37% | 0.65% | 85.61% | 86.05% | -0.45% |
| *Madrid* | 10.34% | 7.90% | 7.30% | 0.60% | 87.77% | 82.41% | 5.36% |
| *C.-Mancha* | 10.17% | 7.54% | 7.17% | 0.37% | 85.41% | 84.68% | 0.73% |
| *Baleares* | 9.76% | 7.04% | 6.72% | 0.32% | 83.33% | 80.37% | 2.96% |
| *Cataluña* | 9.51% | 7.04% | 6.45% | 0.59% | 85.76% | 80.55% | 5.22% |
| *Murcia* | 9.42% | 7.13% | 6.79% | 0.35% | 87.81% | 85.90% | 1.91% |
| *Canarias* | 8.99% | 6.40% | 6.00% | 0.40% | 82.82% | 81.55% | 1.27% |
| *Valencia* | 8.75% | 6.47% | 5.99% | 0.48% | 86.13% | 83.56% | 2.57% |
| *C.-León* | 8.43% | 6.26% | 5.80% | 0.45% | 86.65% | 84.77% | 1.88% |
| *Galicia* | 8.41% | 6.46% | 6.03% | 0.43% | 89.78% | 87.94% | 1.83% |
| *Andalucía* | 8.36% | 6.19% | 5.40% | 0.79% | 86.57% | 85.35% | 1.22% |
| *Rioja* | 8.29% | 6.29% | 6.03% | 0.26% | 88.55% | 86.17% | 2.37% |
| *País Vasco* | 7.66% | 5.60% | 4.86% | 0.74% | 85.37% | 81.94% | 3.43% |
| *Cantabria* | 7.59% | 5.78% | 5.23% | 0.55% | 89.16% | 86.37% | 2.79% |
| *Navarra* | 7.30% | 5.14% | 4.92% | 0.22% | 82.40% | 79.14% | 3.26% |
| *Aragón* | 7.22% | 5.19% | 4.92% | 0.28% | 84.26% | 81.36% | 2.90% |
| *Asturias* | 6.85% | 5.16% | 4.55% | 0.62% | 88.34% | 86.18% | 2.16% |
| *Spain* | *9.50%* | *7.11%* | *6.43%* | *0.67%* | *86.63%* | *83.63%* | *3.01%* |
| *de la F. (2003)* | 9.36% | 7.34% | 7.19% | 0.15% | 90.92% | 85.80% | 5.12% |

**b. Normalized values**

| | $r_{obs}$ | *NUM* | $\theta_{net}$ | $\varepsilon_{net}$ | *DENOM* | *OPPC* | *DIRC* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 112.9 | 112.7 | 103.6 | 9.1 | 98.8 | 99.3 | -0.5 |
| *Madrid* | 108.8 | 111.2 | 102.7 | 8.5 | 101.3 | 95.1 | 6.2 |
| *C.-Mancha* | 107.1 | 106.1 | 100.9 | 5.2 | 98.6 | 97.7 | 0.8 |
| *Baleares* | 102.7 | 99.0 | 94.6 | 4.5 | 96.2 | 92.8 | 3.4 |
| *Cataluña* | 100.1 | 99.1 | 90.8 | 8.3 | 99.0 | 93.0 | 6.0 |
| *Murcia* | 99.1 | 100.4 | 95.5 | 4.9 | 101.4 | 99.2 | 2.2 |
| *Canarias* | 94.7 | 90.1 | 84.4 | 5.7 | 95.6 | 94.1 | 1.5 |
| *Valencia* | 92.1 | 91.0 | 84.3 | 6.7 | 99.4 | 96.5 | 3.0 |
| *C.-León* | 88.7 | 88.0 | 81.7 | 6.4 | 100.0 | 97.8 | 2.2 |
| *Galicia* | 88.5 | 90.9 | 84.9 | 6.1 | 103.6 | 101.5 | 2.1 |
| *Andalucía* | 87.9 | 87.1 | 76.0 | 11.1 | 99.9 | 98.5 | 1.4 |
| *Rioja* | 87.3 | 88.5 | 84.8 | 3.7 | 102.2 | 99.5 | 2.7 |
| *País Vasco* | 80.6 | 78.8 | 68.3 | 10.5 | 98.5 | 94.6 | 4.0 |
| *Cantabria* | 79.8 | 81.3 | 73.6 | 7.7 | 102.9 | 99.7 | 3.2 |
| *Navarra* | 76.8 | 72.3 | 69.2 | 3.1 | 95.1 | 91.3 | 3.8 |
| *Aragón* | 76.0 | 73.1 | 69.2 | 3.9 | 97.3 | 93.9 | 3.3 |
| *Asturias* | 72.1 | 72.6 | 64.0 | 8.7 | 102.0 | 99.5 | 2.5 |
| *Spain* | *100.0* | *100.0* | *90.5* | *9.5* | *100.0* | *96.5* | *3.5* |

**Table A.35: Net private rates of return to schooling under different scenarios -- all levels combined, Mincerian specification**

| | baseline | +subsidies | + taxes | OBS + benefits | - diffstU |
|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] |
| *Andalucía* | 12.22% | 15.08% | 14.23% | 8.36% | 8.67% |
| *Aragón* | 7.59% | 9.32% | 8.66% | 7.22% | 7.48% |
| *Asturias* | 8.30% | 10.10% | 9.52% | 6.85% | 7.39% |
| *Baleares* | 10.59% | 12.78% | 11.77% | 9.76% | 9.95% |
| *Canarias* | 10.38% | 13.47% | 12.50% | 8.99% | 9.13% |
| *Cantabria* | 9.16% | 11.59% | 10.80% | 7.59% | 8.11% |
| *C.-León* | 9.66% | 11.93% | 11.11% | 8.43% | 8.92% |
| *C.-Mancha* | 10.53% | 13.28% | 12.22% | 10.17% | 10.66% |
| *Cataluña* | 10.55% | 12.65% | 11.85% | 9.51% | 9.71% |
| *Valencia* | 10.35% | 12.94% | 12.00% | 8.75% | 9.10% |
| *Extremadura* | 12.25% | 15.63% | 14.60% | 10.73% | 11.23% |
| *Galicia* | 10.29% | 13.00% | 11.94% | 8.41% | 9.08% |
| *Madrid* | 11.68% | 13.43% | 12.61% | 10.34% | 10.76% |
| *Murcia* | 9.93% | 12.39% | 11.31% | 9.42% | 9.96% |
| *Navarra* | 7.26% | 9.05% | 8.34% | 7.30% | 7.40% |
| *P. Vasco* | 8.59% | 10.66% | 10.09% | 7.66% | 7.96% |
| *Rioja* | 8.66% | 11.27% | 10.32% | 8.29% | 8.92% |
| *Spain* | *11.32%* | *13.75%* | *12.89%* | *9.50%* | *9.91%* |

| | baseline | +subsidies | + taxes | OBS + benefits | - diffstU |
|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] |
| *Andalucía* | 108.0 | 109.7 | 110.4 | 87.9 | 87.5 |
| *Aragón* | 67.0 | 67.8 | 67.2 | 76.0 | 75.5 |
| *Asturias* | 73.3 | 73.4 | 73.8 | 72.1 | 74.6 |
| *Baleares* | 93.6 | 92.9 | 91.3 | 102.7 | 100.4 |
| *Canarias* | 91.7 | 98.0 | 97.0 | 94.7 | 92.1 |
| *Cantabria* | 81.0 | 84.3 | 83.8 | 79.8 | 81.8 |
| *C.-León* | 85.4 | 86.8 | 86.2 | 88.7 | 90.1 |
| *C.-Mancha* | 93.0 | 96.6 | 94.8 | 107.1 | 107.6 |
| *Cataluña* | 93.2 | 92.0 | 91.9 | 100.1 | 98.0 |
| *Valencia* | 91.5 | 94.1 | 93.1 | 92.1 | 91.9 |
| *Extremadura* | 108.2 | 113.6 | 113.2 | 112.9 | 113.3 |
| *Galicia* | 90.9 | 94.5 | 92.7 | 88.5 | 91.7 |
| *Madrid* | 103.2 | 97.6 | 97.8 | 108.8 | 108.6 |
| *Murcia* | 87.7 | 90.1 | 87.7 | 99.1 | 100.6 |
| *Navarra* | 64.2 | 65.8 | 64.7 | 76.8 | 74.7 |
| *P. Vasco* | 75.9 | 77.5 | 78.3 | 80.6 | 80.3 |
| *Rioja* | 76.5 | 81.9 | 80.0 | 87.3 | 90.1 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |



**Table A.36: tax or subsidy wedge induced by various public interventions and by differential student unemployment**

| | educational subsidies | personal taxes | social benefits | all gov't | student unempl. |
|---|---|---|---|---|---|
| | [2]-[1] | [2]-[3] | [3]-[4] | [1]-[4] | [4]-[5] |
| *Andalucía* | 2.86% | 0.86% | 5.87% | 3.86% | 0.32% |
| *Aragón* | 1.73% | 0.66% | 1.44% | 0.36% | 0.26% |
| *Asturias* | 1.80% | 0.58% | 2.67% | 1.45% | 0.54% |
| *Baleares* | 2.19% | 1.00% | 2.01% | 0.83% | 0.19% |
| *Canarias* | 3.09% | 0.97% | 3.51% | 1.39% | 0.14% |
| *Cantabria* | 2.43% | 0.79% | 3.21% | 1.58% | 0.52% |
| *C.-León* | 2.27% | 0.83% | 2.68% | 1.23% | 0.49% |
| *C.-Mancha* | 2.76% | 1.06% | 2.05% | 0.36% | 0.49% |
| *Cataluña* | 2.10% | 0.80% | 2.34% | 1.04% | 0.21% |
| *Valencia* | 2.59% | 0.94% | 3.25% | 1.60% | 0.35% |
| *Extremadura* | 3.38% | 1.03% | 3.86% | 1.52% | 0.50% |
| *Galicia* | 2.71% | 1.05% | 3.54% | 1.88% | 0.68% |
| *Madrid* | 1.75% | 0.81% | 2.27% | 1.34% | 0.42% |
| *Murcia* | 2.46% | 1.08% | 1.89% | 0.51% | 0.54% |
| *Navarra* | 1.79% | 0.71% | 1.05% | -0.03% | 0.11% |
| *P. Vasco* | 2.07% | 0.57% | 2.43% | 0.92% | 0.29% |
| *Rioja* | 2.61% | 0.95% | 2.02% | 0.37% | 0.63% |
| *Spain* | *2.43%* | *0.86%* | *3.39%* | *1.82%* | *0.41%* |
| *de la F. (2003)* | 2.47% | 1.05% | 0.81% | 0.61% | 0.70% |

**Table A.37: Net implicit subsidy or tax rate induced by various public interventions and by differential student unemployment**

| | educational subsidies | personal taxes | social benefits | all gov't | student unempl. |
|---|---|---|---|---|---|
| | [2]-[1] | [2]-[3] | [3]-[4] | [1]-[4] | [4]-[5] |
| *Andalucía* | 23.42% | 7.01% | 48.03% | 31.62% | 3.79% |
| *Aragón* | 22.85% | 8.66% | 18.97% | 4.79% | 3.59% |
| *Asturias* | 21.71% | 7.03% | 32.12% | 17.44% | 7.92% |
| *Baleares* | 20.67% | 9.49% | 19.00% | 7.81% | 1.92% |
| *Canarias* | 29.74% | 9.34% | 33.77% | 13.37% | 1.50% |
| *Cantabria* | 26.49% | 8.66% | 35.06% | 17.22% | 6.88% |
| *C.-León* | 23.51% | 8.55% | 27.71% | 12.75% | 5.86% |
| *C.-Mancha* | 26.17% | 10.07% | 19.47% | 3.37% | 4.79% |
| *Cataluña* | 19.94% | 7.61% | 22.17% | 9.84% | 2.16% |
| *Valencia* | 24.97% | 9.09% | 31.35% | 15.47% | 4.03% |
| *Extremadura* | 27.61% | 8.43% | 31.55% | 12.37% | 4.62% |
| *Galicia* | 26.34% | 10.24% | 34.36% | 18.26% | 8.03% |
| *Madrid* | 14.99% | 6.98% | 19.47% | 11.46% | 4.08% |
| *Murcia* | 24.75% | 10.86% | 19.02% | 5.12% | 5.78% |
| *Navarra* | 24.63% | 9.77% | 14.41% | -0.45% | 1.49% |
| *P. Vasco* | 24.08% | 6.60% | 28.24% | 10.77% | 3.84% |
| *Rioja* | 30.08% | 11.00% | 23.36% | 4.28% | 7.62% |
| *Spain* | *21.49%* | *7.59%* | *29.94%* | *16.05%* | *4.26%* |
| *de la F. (2003)* | 26.11% | 8.81% | 7.47% | -6.41% | 6.91% |

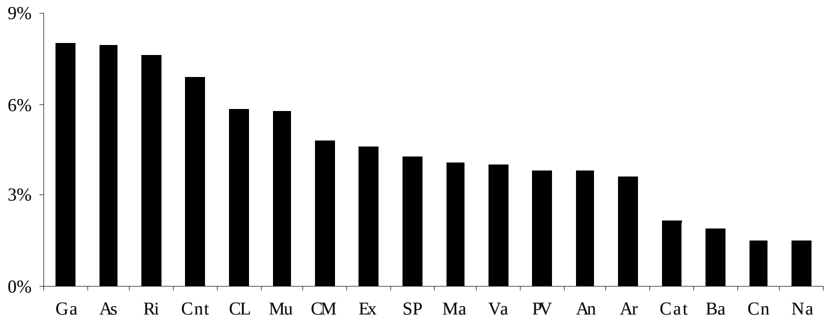
The last row of Tables A.36 and A.37 give de la Fuente's (2003) estimates of the same magnitudes for Spain as a whole. It should be kept in mind that the results of the two studies are not strictly comparable because the assumptions underlying the different scenarios are a bit different (see footnote no. 24 in the text). In the case of Table A.37, there are also some differences in the way the effective tax rates are constructed in the two studies (see footnote no. 25 in the text).

**d. The disincentive effects of student unemployment**

In Spain it appears to be relatively difficult for students to find part-time employment while attending school. This phenomenon lowers the return to schooling by increasing its oportunity cost. To quantify the resulting disincentives, we can calculate an effective tax rate similar to those discussed in section 4.a of the text. In particular, we can define the effective tax rate implicit in the student unemployment differential by

$$(A.6) \quad etr_{stU} = \frac{wedge_{stU}}{r_{obs}} = \frac{r_{nstU} - r_{obs}}{r_{obs}}.$$

**Figure A.2: Effective tax rate implicit in differential student unemployment ($etr_{stU}$)**




These effective tax rates are displayed in Figure A.2. On the whole, they are fairly modest. The difficulty of finding part-time work while attending schoool reduces the expected return of schooling by only 0.4 percentage points for the country as a whole (which amounts to an effective tax rate of 4.26%), but the effect is almost twice as large in Galicia, Asturias and Rioja and only half as large in Cataluña, Baleares, Canarias and Navarra.



**e. Data and detailed results for the private return calculations by level**

***i. Estimation of average wages and employment probabilities for each educational level***

When we calculate the rate of return to each educational level, we assume that the opportunity cost of each year of schooling within a given educational cycle is given by the average earnings of workers who have completed the immediately preceding school cycle. Since we do not have data on average earnings by educational level, we estimate this variable using the estimated wage equations and the overall average wages given in Table A.33 *(Wavge)*. The estimation procedure is as follows: First, we use the Mincerian version of the wage equation to estimate average earnings for the lowest attainment category $(W_o)$ as

$$(A.7) \quad \ln W_{oi} = \ln Wavge_i - \theta_i(S_i - S_o)$$

where $\theta_i$ is the estimated Mincerian parameter for region $i$ (first column of Table 8 in the text), $S_o$ = 5 the average attainment of the lowest-skill category in the WSS sample and $S_i$ the average attainment in region $i$ calculated using the WSS sample and the cumulative durations given in Table 7 in the text. Next, we recover an estimate of the average wage of workers with qualification $q$ in region $i$ using

$$(A.8) \quad \ln W_{qi} = \ln W_{oi} + \Gamma_{qi}$$

where $\Gamma_{qi}$ is the estimated coefficient of the dummy corresponding to educational level $q$ in region $i$ in the second version of the wage equation (or rather, the marginal effect recovered from the coefficient of the dummy). Notice that we use directly the coefficients that measure the total contribution of each schooling cycle rather than the annualized effects given in Table 8 of the text. Prior to the calculation, however, the original coefficients given in Table A.27 are corrected to eliminate negative marginal returns in the manner discussed in footnote 14 of the text.

The procedure used to estimate average employment probabilities by educational level is exactly the same. We adjust the estimates of overall average employment probabilities obtained in the previous section using both versions of the estimated employment equation (and correcting the relevant dummy coefficients if necessary to eliminate any negative marginal returns).

Tables A.38 and A.39 show the estimates of average wages and employment probabilities by educational level constructed in this manner. The upper panel of each table shows actual values, and the second one relative values normalized by the Spanish average for each variable.

**Table A.38: Observed average wage and estimated average wage by educational level**

**a. millions of pesetas**

| | *all levels* | *primary* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|---|
| *P. Vasco* | 3.365 | 2.623 | 2.682 | 3.691 | 3.236 | 3.618 | 4.725 | 6.456 |
| *Madrid* | 3.269 | 2.013 | 2.102 | 3.129 | 2.538 | 3.279 | 4.396 | 5.983 |
| *Navarra* | 3.026 | 2.411 | 2.483 | 3.220 | 3.043 | 3.512 | 4.337 | 5.593 |
| *Asturias* | 3.007 | 2.452 | 2.467 | 3.389 | 3.087 | 3.267 | 4.675 | 5.318 |
| *Cataluña* | 2.921 | 2.119 | 2.251 | 3.402 | 2.875 | 3.394 | 4.531 | 5.857 |
| *Aragón* | 2.834 | 2.305 | 2.305 | 3.237 | 2.718 | 3.226 | 4.023 | 5.348 |
| *Cantabria* | 2.734 | 2.110 | 2.395 | 3.416 | 3.001 | 3.180 | 4.016 | 5.996 |
| *C.-León* | 2.726 | 2.085 | 2.284 | 3.409 | 2.825 | 3.431 | 4.273 | 5.742 |
| *Rioja* | 2.617 | 2.026 | 2.200 | 3.519 | 2.975 | 3.116 | 4.200 | 5.285 |
| *Valencia* | 2.526 | 1.911 | 2.081 | 3.246 | 2.531 | 3.140 | 4.041 | 4.927 |
| *Andalucía* | 2.524 | 1.874 | 1.958 | 3.135 | 2.466 | 3.085 | 3.871 | 5.108 |
| *Baleares* | 2.518 | 1.838 | 1.943 | 3.224 | 2.997 | 2.997 | 4.047 | 4.466 |
| *Galicia* | 2.462 | 1.860 | 2.062 | 3.224 | 2.750 | 3.172 | 4.271 | 5.422 |
| *Canarias* | 2.403 | 1.851 | 2.010 | 3.085 | 2.409 | 2.809 | 4.151 | 5.629 |
| *C.-Mancha* | 2.365 | 1.848 | 2.023 | 3.302 | 2.635 | 3.359 | 4.302 | 4.918 |
| *Extremadura* | 2.324 | 1.767 | 2.116 | 3.299 | 2.651 | 2.812 | 4.019 | 5.554 |
| *Murcia* | 2.308 | 1.780 | 2.205 | 3.236 | 2.638 | 2.796 | 3.760 | 4.935 |
| *Spain* | *2.816* | *2.010* | *2.131* | *3.307* | *2.738* | *3.301* | *4.335* | *5.889* |

**b. normalized values, Spain = 100**

| | *all levels* | *primary* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|---|
| *P. Vasco* | 119.5 | 130.5 | 125.8 | 111.6 | 118.2 | 109.6 | 109.0 | 109.6 |
| *Madrid* | 116.1 | 100.2 | 98.7 | 94.6 | 92.7 | 99.3 | 101.4 | 101.6 |
| *Navarra* | 107.5 | 120.0 | 116.5 | 97.4 | 111.1 | 106.4 | 100.0 | 95.0 |
| *Asturias* | 106.8 | 122.0 | 115.7 | 102.5 | 112.8 | 99.0 | 107.8 | 90.3 |
| *Cataluña* | 103.8 | 105.4 | 105.6 | 102.9 | 105.0 | 102.8 | 104.5 | 99.5 |
| *Aragón* | 100.7 | 114.7 | 108.1 | 97.9 | 99.3 | 97.7 | 92.8 | 90.8 |
| *Cantabria* | 97.1 | 105.0 | 112.4 | 103.3 | 109.6 | 96.3 | 92.6 | 101.8 |
| *C. y León* | 96.8 | 103.7 | 107.2 | 103.1 | 103.2 | 103.9 | 98.6 | 97.5 |
| *Rioja* | 92.9 | 100.8 | 103.2 | 106.4 | 108.6 | 94.4 | 96.9 | 89.7 |
| *Valencia* | 89.7 | 95.1 | 97.6 | 98.2 | 92.5 | 95.1 | 93.2 | 83.7 |
| *Andalucía* | 89.6 | 93.2 | 91.9 | 94.8 | 90.0 | 93.5 | 89.3 | 86.7 |
| *Baleares* | 89.4 | 91.5 | 91.2 | 97.5 | 109.5 | 90.8 | 93.4 | 75.8 |
| *Galicia* | 87.4 | 92.5 | 96.8 | 97.5 | 100.4 | 96.1 | 98.5 | 92.1 |
| *Canarias* | 85.4 | 92.1 | 94.3 | 93.3 | 88.0 | 85.1 | 95.8 | 95.6 |
| *C.-Mancha* | 84.0 | 92.0 | 94.9 | 99.8 | 96.2 | 101.7 | 99.2 | 83.5 |
| *Extremadura* | 82.5 | 87.9 | 99.3 | 99.7 | 96.8 | 85.2 | 92.7 | 94.3 |
| *Murcia* | 82.0 | 88.6 | 103.5 | 97.8 | 96.4 | 84.7 | 86.7 | 83.8 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |



**Table A.39: Predicted probability of employment by attainment level**

**a. actual values**

| | *all levels* | *primary* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|---|
| *Navarra* | 90.88% | 88.78% | 89.25% | 89.25% | 90.53% | 92.93% | 93.84% | 93.84% |
| *Baleares* | 90.26% | 85.97% | 86.90% | 91.12% | 91.90% | 93.78% | 92.27% | 93.86% |
| *Aragón* | 89.02% | 86.37% | 87.92% | 91.94% | 90.26% | 92.23% | 92.43% | 92.94% |
| *Cataluña* | 87.17% | 80.98% | 83.83% | 89.76% | 86.77% | 89.14% | 92.19% | 92.19% |
| *Rioja* | 84.23% | 81.49% | 81.75% | 86.87% | 86.15% | 88.03% | 90.37% | 90.37% |
| *Madrid* | 83.67% | 76.68% | 78.54% | 86.69% | 83.64% | 85.06% | 87.42% | 87.68% |
| *P. Vasco* | 83.15% | 76.61% | 76.61% | 84.55% | 79.83% | 85.96% | 89.87% | 89.87% |
| *Canarias* | 82.89% | 77.66% | 80.51% | 86.58% | 81.33% | 85.72% | 90.66% | 91.10% |
| *Valencia* | 82.77% | 76.93% | 79.00% | 86.89% | 81.45% | 86.45% | 89.18% | 89.94% |
| *C. y León* | 82.44% | 77.75% | 81.27% | 87.35% | 81.46% | 87.18% | 88.82% | 88.82% |
| *C.-Mancha* | 82.10% | 77.73% | 82.56% | 87.87% | 82.56% | 86.65% | 90.28% | 90.28% |
| *Murcia* | 80.89% | 76.35% | 80.42% | 85.88% | 80.42% | 85.11% | 88.17% | 88.57% |
| *Asturias* | 79.81% | 74.68% | 75.54% | 83.45% | 79.99% | 82.52% | 86.34% | 87.55% |
| *Galicia* | 78.85% | 73.51% | 76.06% | 81.58% | 76.18% | 82.77% | 87.26% | 87.93% |
| *Cantabria* | 78.11% | 72.37% | 72.37% | 77.24% | 72.95% | 82.25% | 84.82% | 85.60% |
| *Extremadura* | 74.61% | 66.49% | 74.47% | 82.95% | 74.47% | 82.76% | 84.96% | 87.73% |
| *Andalucía* | 72.25% | 62.28% | 70.29% | 79.73% | 72.01% | 76.96% | 84.05% | 84.69% |
| *Spain* | *80.96%* | *73.60%* | *78.66%* | *85.54%* | *80.86%* | *85.12%* | *88.02%* | *88.24%* |

**b. normalized values, Spain = 100**

| | *all levels* | *primary* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|---|
| *Navarra* | 112.2 | 120.6 | 113.5 | 104.3 | 112.0 | 109.2 | 106.6 | 106.4 |
| *Baleares* | 111.5 | 116.8 | 110.5 | 106.5 | 113.7 | 110.2 | 104.8 | 106.4 |
| *Aragón* | 110.0 | 117.4 | 111.8 | 107.5 | 111.6 | 108.4 | 105.0 | 105.3 |
| *Cataluña* | 107.7 | 110.0 | 106.6 | 104.9 | 107.3 | 104.7 | 104.7 | 104.5 |
| *Rioja* | 104.0 | 110.7 | 103.9 | 101.5 | 106.5 | 103.4 | 102.7 | 102.4 |
| *Madrid* | 103.3 | 104.2 | 99.8 | 101.3 | 103.4 | 99.9 | 99.3 | 99.4 |
| *P. Vasco* | 102.7 | 104.1 | 97.4 | 98.8 | 98.7 | 101.0 | 102.1 | 101.9 |
| *Canarias* | 102.4 | 105.5 | 102.4 | 101.2 | 100.6 | 100.7 | 103.0 | 103.2 |
| *Valencia* | 102.2 | 104.5 | 100.4 | 101.6 | 100.7 | 101.6 | 101.3 | 101.9 |
| *C. y León* | 101.8 | 105.6 | 103.3 | 102.1 | 100.7 | 102.4 | 100.9 | 100.7 |
| *C.-Mancha* | 101.4 | 105.6 | 105.0 | 102.7 | 102.1 | 101.8 | 102.6 | 102.3 |
| *Murcia* | 99.9 | 103.7 | 102.2 | 100.4 | 99.5 | 100.0 | 100.2 | 100.4 |
| *Asturias* | 98.6 | 101.5 | 96.0 | 97.6 | 98.9 | 96.9 | 98.1 | 99.2 |
| *Galicia* | 97.4 | 99.9 | 96.7 | 95.4 | 94.2 | 97.2 | 99.1 | 99.7 |
| *Cantabria* | 96.5 | 98.3 | 92.0 | 90.3 | 90.2 | 96.6 | 96.4 | 97.0 |
| *Extremadura* | 92.2 | 90.3 | 94.7 | 97.0 | 92.1 | 97.2 | 96.5 | 99.4 |
| *Andalucía* | 89.2 | 84.6 | 89.4 | 93.2 | 89.1 | 90.4 | 95.5 | 96.0 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

### ii. Data used in the rate of return calculations by level and detailed results

Tables A.40-A.45 show the data used in the rate of return calculations by level. Tables A.46-A.55 contain the detailed results, that is, the estimates of the all-in and baseline rates of return and the effective tax wedges and tax rates.

**Table A.40: Data used in the calculation of the private rate of return to lower secondary schooling**

| | $U$ | $H$ | $\theta_{ls}$ | $\mu_S$ | $\mu$ | $p_O$ | $p_S$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 60.5 | 46.5 | 1.47% | 0.20% | 22.96% | 62.28% | 44.31% |
| *Aragón* | 60.5 | 46.5 | 0.00% | 1.14% | 25.54% | 86.37% | 70.28% |
| *Asturias* | 60.5 | 46.5 | 0.20% | 0.87% | 22.35% | 74.68% | 42.02% |
| *Baleares* | 60.5 | 46.5 | 1.85% | 1.51% | 29.94% | 85.97% | 76.60% |
| *Canarias* | 60.5 | 46.5 | 2.75% | 0.84% | 32.31% | 77.66% | 69.13% |
| *Cantabria* | 60.5 | 46.5 | 4.22% | 0.40% | 25.61% | 72.37% | 38.18% |
| *Cast. y León* | 60.5 | 46.5 | 3.04% | 0.59% | 26.48% | 77.75% | 53.56% |
| *Cast.-Mancha* | 60.5 | 46.5 | 3.01% | 0.08% | 26.55% | 77.73% | 56.00% |
| *Cataluña* | 60.5 | 46.5 | 2.01% | 2.77% | 28.38% | 80.98% | 71.06% |
| *Valencia* | 60.5 | 46.5 | 2.84% | 1.20% | 28.31% | 76.93% | 58.20% |
| *Extremadura* | 60.5 | 46.5 | 6.01% | -0.35% | 24.54% | 66.49% | 44.03% |
| *Galicia* | 60.5 | 46.5 | 3.45% | 0.81% | 31.23% | 73.51% | 39.13% |
| *Madrid* | 60.5 | 46.5 | 1.45% | 3.19% | 23.07% | 76.68% | 53.13% |
| *Murcia* | 60.5 | 46.5 | 7.14% | 0.27% | 25.22% | 76.35% | 47.95% |
| *Navarra* | 60.5 | 46.5 | 0.98% | 0.67% | 32.52% | 88.78% | 84.18% |
| *P. Vasco* | 60.5 | 46.5 | 0.74% | 1.96% | 31.42% | 76.61% | 61.20% |
| *Rioja* | 60.5 | 46.5 | 2.75% | 0.54% | 27.48% | 81.49% | 47.36% |
| *Spain* | *60.5* | *46.5* | *1.96%* | *1.32%* | *26.53%* | *73.60%* | *54.14%* |

| | $\eta$ | $\varepsilon$ | $\tau_O$ | $T'$ | $\tau_S$ | $a$ | $b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.712 | 4.29% | 14.41% | 33.15% | 6.35% | 75.70% | 0.00% |
| *Aragón* | 0.814 | 0.60% | 17.60% | 28.83% | 6.35% | 76.00% | 0.00% |
| *Asturias* | 0.563 | 0.39% | 18.27% | 28.83% | 6.35% | 0.00% | 74.47% |
| *Baleares* | 0.891 | 0.36% | 14.05% | 33.15% | 6.35% | 75.61% | 0.00% |
| *Canarias* | 0.890 | 1.22% | 14.18% | 33.15% | 6.35% | 75.64% | 0.00% |
| *Cantabria* | 0.528 | 0.00% | 16.51% | 33.15% | 6.35% | 76.14% | 0.00% |
| *C.-León* | 0.689 | 1.51% | 16.31% | 33.15% | 6.35% | 76.12% | 0.00% |
| *C.-Mancha* | 0.721 | 2.07% | 14.16% | 33.15% | 6.35% | 75.63% | 0.00% |
| *Cataluña* | 0.878 | 1.17% | 16.58% | 33.15% | 6.35% | 76.14% | 0.00% |
| *Valencia* | 0.757 | 0.90% | 14.78% | 33.15% | 6.35% | 75.79% | 0.00% |
| *Extremadura* | 0.662 | 4.00% | 13.28% | 33.15% | 6.35% | 75.41% | 0.00% |
| *Galicia* | 0.532 | 1.16% | 14.27% | 33.15% | 6.35% | 75.66% | 0.00% |
| *Madrid* | 0.693 | 0.81% | 15.71% | 33.15% | 6.35% | 76.04% | 0.00% |
| *Murcia* | 0.628 | 1.78% | 13.42% | 33.15% | 6.35% | 75.45% | 0.00% |
| *Navarra* | 0.948 | 0.18% | 17.57% | 29.76% | 6.35% | 0.00% | 74.78% |
| *P. Vasco* | 0.799 | 0.00% | 18.55% | 34.91% | 6.35% | 0.00% | 71.48% |
| *Rioja* | 0.581 | 0.11% | 15.82% | 33.15% | 6.35% | 76.06% | 0.00% |
| *Spain* | *0.736* | *2.29%* | *15.68%* | *33.15%* | *6.35%* | *76.03%* | *0.00%* |

- *Note:* Reference wages (used to compute the tax and benefit parameters and to normalize expenditure per student) and employment probabilities ($p_O$ and $p_S$) are those corresponding to the average worker with primary or no schooling.



**Table A.41: Data used in the calculation of the private rate of return to upper secondary schooling**

| | $U$ | $H$ | $\theta_{us}$ | $\mu_S$ | $\mu$ | $p_O$ | $p_S$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 60.5 | 42.5 | 11.76% | 0.19% | 21.96% | 70.29% | 52.33% |
| *Aragón* | 60.5 | 42.5 | 8.49% | 1.14% | 25.54% | 87.92% | 71.83% |
| *Asturias* | 60.5 | 42.5 | 7.95% | 0.87% | 22.22% | 75.54% | 42.89% |
| *Baleares* | 60.5 | 42.5 | 12.66% | 1.42% | 28.33% | 86.90% | 77.52% |
| *Canarias* | 60.5 | 42.5 | 10.71% | 0.77% | 29.75% | 80.51% | 71.98% |
| *Cantabria* | 60.5 | 42.5 | 8.87% | 0.36% | 22.57% | 72.37% | 38.18% |
| *Cast. y León* | 60.5 | 42.5 | 10.01% | 0.53% | 24.17% | 81.27% | 57.08% |
| *Cast.-Mancha* | 60.5 | 42.5 | 12.25% | 0.07% | 24.25% | 82.56% | 60.84% |
| *Cataluña* | 60.5 | 42.5 | 10.33% | 2.61% | 26.72% | 83.83% | 73.91% |
| *Valencia* | 60.5 | 42.5 | 11.12% | 1.10% | 26.00% | 79.00% | 60.28% |
| *Extremadura* | 60.5 | 42.5 | 11.10% | -0.29% | 20.49% | 74.47% | 52.01% |
| *Galicia* | 60.5 | 42.5 | 11.17% | 0.73% | 28.15% | 76.06% | 41.69% |
| *Madrid* | 60.5 | 42.5 | 9.94% | 3.06% | 22.09% | 78.54% | 54.99% |
| *Murcia* | 60.5 | 42.5 | 9.59% | 0.22% | 20.36% | 80.42% | 52.03% |
| *Navarra* | 60.5 | 42.5 | 6.51% | 0.65% | 31.58% | 89.25% | 84.64% |
| *P. Vasco* | 60.5 | 42.5 | 7.98% | 1.92% | 30.73% | 76.61% | 61.20% |
| *Rioja* | 60.5 | 42.5 | 11.74% | 0.50% | 25.30% | 81.75% | 47.63% |
| *Spain* | *60.5* | *42.5* | *10.98%* | *1.24%* | *25.01%* | *78.66%* | *59.20%* |

| | $\eta$ | $\varepsilon$ | $\tau_O$ | $T'$ | $\tau_S$ | $a$ | $b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.744 | 3.36% | 15.22% | 33.15% | 6.35% | 75.91% | 0.00% |
| *Aragón* | 0.817 | 1.14% | 17.60% | 28.83% | 6.35% | 76.00% | 0.00% |
| *Asturias* | 0.568 | 2.62% | 18.34% | 28.83% | 6.35% | 0.00% | 74.07% |
| *Baleares* | 0.892 | 1.21% | 15.08% | 33.15% | 6.35% | 75.87% | 0.00% |
| *Canarias* | 0.894 | 1.88% | 15.68% | 33.15% | 6.35% | 76.03% | 0.00% |
| *Cantabria* | 0.528 | 1.68% | 18.03% | 28.83% | 6.35% | 75.92% | 0.00% |
| *C.-León* | 0.702 | 1.87% | 17.50% | 28.83% | 6.35% | 76.02% | 0.00% |
| *C.-Mancha* | 0.737 | 1.61% | 15.80% | 33.15% | 6.35% | 76.06% | 0.00% |
| *Cataluña* | 0.882 | 1.77% | 17.33% | 28.83% | 6.35% | 76.05% | 0.00% |
| *Valencia* | 0.763 | 2.50% | 16.28% | 33.15% | 6.35% | 76.11% | 0.00% |
| *Extremadura* | 0.698 | 2.85% | 16.56% | 33.15% | 6.35% | 76.14% | 0.00% |
| *Galicia* | 0.548 | 1.81% | 16.13% | 33.15% | 6.35% | 76.10% | 0.00% |
| *Madrid* | 0.700 | 2.60% | 16.45% | 33.15% | 6.35% | 76.13% | 0.00% |
| *Murcia* | 0.647 | 1.70% | 17.09% | 28.83% | 6.35% | 76.09% | 0.00% |
| *Navarra* | 0.948 | 0.00% | 17.92% | 29.76% | 6.35% | 0.00% | 72.84% |
| *P. Vasco* | 0.799 | 2.59% | 18.89% | 29.76% | 6.35% | 0.00% | 70.12% |
| *Rioja* | 0.583 | 1.56% | 17.07% | 28.83% | 6.35% | 76.09% | 0.00% |
| *Spain* | *0.753* | *2.19%* | *16.68%* | *33.15%* | *6.35%* | *76.15%* | *0.00%* |

- *Note:* Reference wages (used to compute the tax and benefit parameters and to normalize expenditure per student) and employment probabilities ($p_O$ and $p_S$) are those corresponding to the average worker with lower secondary schooling.

**Table A.42: Data used in the calculation of the private rate of return to lower vocational training**

| | $U$ | $H$ | $\theta_{lv}$ | $\mu_S$ | $\mu$ | $p_O$ | $p_S$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 60.5 | 44.5 | 11.52% | 0.19% | 21.96% | 70.29% | 52.33% |
| *Aragón* | 60.5 | 44.5 | 8.26% | 1.14% | 25.54% | 87.92% | 71.83% |
| *Asturias* | 60.5 | 44.5 | 11.22% | 0.87% | 22.22% | 75.54% | 42.89% |
| *Baleares* | 60.5 | 44.5 | 21.68% | 1.42% | 28.33% | 86.90% | 77.52% |
| *Canarias* | 60.5 | 44.5 | 9.05% | 0.77% | 29.75% | 80.51% | 71.98% |
| *Cantabria* | 60.5 | 44.5 | 11.27% | 0.36% | 22.57% | 72.37% | 38.18% |
| *Cast. y León* | 60.5 | 44.5 | 10.63% | 0.53% | 24.17% | 81.27% | 57.08% |
| *Cast.-Mancha* | 60.5 | 44.5 | 13.21% | 0.07% | 24.25% | 82.56% | 60.84% |
| *Cataluña* | 60.5 | 44.5 | 12.24% | 2.61% | 26.72% | 83.83% | 73.91% |
| *Valencia* | 60.5 | 44.5 | 9.80% | 1.10% | 26.00% | 79.00% | 60.28% |
| *Extremadura* | 60.5 | 44.5 | 11.28% | -0.29% | 20.49% | 74.47% | 52.01% |
| *Galicia* | 60.5 | 44.5 | 14.38% | 0.73% | 28.15% | 76.06% | 41.69% |
| *Madrid* | 60.5 | 44.5 | 9.40% | 3.06% | 22.09% | 78.54% | 54.99% |
| *Murcia* | 60.5 | 44.5 | 8.97% | 0.22% | 20.36% | 80.42% | 52.03% |
| *Navarra* | 60.5 | 44.5 | 10.17% | 0.65% | 31.58% | 89.25% | 84.64% |
| *P. Vasco* | 60.5 | 44.5 | 9.39% | 1.92% | 30.73% | 76.61% | 61.20% |
| *Rioja* | 60.5 | 44.5 | 15.07% | 0.50% | 25.30% | 81.75% | 47.63% |
| *Spain* | *60.5* | *44.5* | *12.53%* | *1.24%* | *25.01%* | *78.66%* | *59.20%* |

| | $\eta$ | $\varepsilon$ | $\tau_O$ | $T'$ | $\tau_S$ | $a$ | $b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.744 | 1.23% | 15.22% | 33.15% | 6.35% | 75.91% | 0.00% |
| *Aragón* | 0.817 | 1.33% | 17.60% | 28.83% | 6.35% | 76.00% | 0.00% |
| *Asturias* | 0.568 | 2.95% | 18.34% | 28.83% | 6.35% | 0.00% | 74.07% |
| *Baleares* | 0.892 | 2.88% | 15.08% | 33.15% | 6.35% | 75.87% | 0.00% |
| *Canarias* | 0.894 | 0.51% | 15.68% | 33.15% | 6.35% | 76.03% | 0.00% |
| *Cantabria* | 0.528 | 0.40% | 18.03% | 28.83% | 6.35% | 75.92% | 0.00% |
| *C.-León* | 0.702 | 0.12% | 17.50% | 28.83% | 6.35% | 76.02% | 0.00% |
| *C.-Mancha* | 0.737 | 0.00% | 15.80% | 33.15% | 6.35% | 76.06% | 0.00% |
| *Cataluña* | 0.882 | 1.76% | 17.33% | 28.83% | 6.35% | 76.05% | 0.00% |
| *Valencia* | 0.763 | 1.55% | 16.28% | 33.15% | 6.35% | 76.11% | 0.00% |
| *Extremadura* | 0.698 | 0.00% | 16.56% | 33.15% | 6.35% | 76.14% | 0.00% |
| *Galicia* | 0.548 | 0.08% | 16.13% | 33.15% | 6.35% | 76.10% | 0.00% |
| *Madrid* | 0.700 | 3.25% | 16.45% | 33.15% | 6.35% | 76.13% | 0.00% |
| *Murcia* | 0.647 | 0.00% | 17.09% | 28.83% | 6.35% | 76.09% | 0.00% |
| *Navarra* | 0.948 | 0.72% | 17.92% | 29.76% | 6.35% | 0.00% | 72.84% |
| *P. Vasco* | 0.799 | 2.10% | 18.89% | 29.76% | 6.35% | 0.00% | 70.12% |
| *Rioja* | 0.583 | 2.69% | 17.07% | 28.83% | 6.35% | 76.09% | 0.00% |
| *Spain* | *0.753* | *1.40%* | *16.68%* | *33.15%* | *6.35%* | *76.15%* | *0.00%* |

- *Note:* Reference wages (used to compute the tax and benefit parameters and to normalize expenditure per student) and employment probabilities ($p_O$ and $p_S$) are those corresponding to the average worker with lower secondary schooling.



**Table A.43: Data used in the calculation of the private rate of return to upper vocational training**

| | $U$ | $H$ | $\theta_{uv}$ | $\mu_S$ | $\mu$ | $p_O$ | $p_S$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 60.5 | 41.5 | 7.47% | 0.15% | 17.45% | 72.01% | 54.05% |
| *Aragón* | 60.5 | 41.5 | 5.71% | 0.96% | 21.65% | 90.26% | 74.17% |
| *Asturias* | 60.5 | 41.5 | 1.89% | 0.69% | 17.75% | 79.99% | 47.34% |
| *Baleares* | 60.5 | 41.5 | 0.00% | 0.92% | 18.36% | 91.90% | 82.52% |
| *Canarias* | 60.5 | 41.5 | 5.13% | 0.65% | 24.82% | 81.33% | 72.80% |
| *Cantabria* | 60.5 | 41.5 | 1.93% | 0.28% | 18.01% | 72.95% | 38.76% |
| *Cast. y León* | 60.5 | 41.5 | 6.47% | 0.43% | 19.54% | 81.46% | 57.28% |
| *Cast.-Mancha* | 60.5 | 41.5 | 8.09% | 0.06% | 18.62% | 82.56% | 60.84% |
| *Cataluña* | 60.5 | 41.5 | 5.53% | 2.04% | 20.92% | 86.77% | 76.86% |
| *Valencia* | 60.5 | 41.5 | 7.18% | 0.90% | 21.37% | 81.45% | 62.72% |
| *Extremadura* | 60.5 | 41.5 | 1.97% | -0.23% | 16.35% | 74.47% | 52.01% |
| *Galicia* | 60.5 | 41.5 | 4.76% | 0.55% | 21.12% | 76.18% | 41.80% |
| *Madrid* | 60.5 | 41.5 | 8.55% | 2.53% | 18.30% | 83.64% | 60.09% |
| *Murcia* | 60.5 | 41.5 | 1.94% | 0.18% | 17.01% | 80.42% | 52.03% |
| *Navarra* | 60.5 | 41.5 | 4.78% | 0.53% | 25.77% | 90.53% | 85.93% |
| *P. Vasco* | 60.5 | 41.5 | 3.73% | 1.59% | 25.47% | 79.83% | 64.43% |
| *Rioja* | 60.5 | 41.5 | 1.55% | 0.37% | 18.72% | 86.15% | 52.03% |
| *Spain* | *60.5* | *41.5* | *6.24%* | *0.97%* | *19.47%* | *80.86%* | *61.40%* |

| | $\eta$ | $\varepsilon$ | $\tau_O$ | $T'$ | $\tau_S$ | $a$ | $b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.751 | 2.29% | 18.33% | 28.83% | 6.35% | 0.00% | 74.10% |
| *Aragón* | 0.822 | 0.72% | 19.31% | 28.83% | 6.35% | 0.00% | 67.72% |
| *Asturias* | 0.592 | 1.05% | 20.45% | 28.83% | 6.35% | 0.00% | 60.09% |
| *Baleares* | 0.898 | 0.68% | 20.19% | 28.83% | 6.35% | 0.00% | 61.80% |
| *Canarias* | 0.895 | 1.80% | 18.09% | 28.83% | 6.35% | 0.00% | 75.68% |
| *Cantabria* | 0.531 | 4.25% | 20.21% | 28.83% | 6.35% | 0.00% | 61.72% |
| *C.-León* | 0.703 | 2.34% | 19.67% | 28.83% | 6.35% | 0.00% | 65.32% |
| *C.-Mancha* | 0.737 | 1.65% | 19.01% | 28.83% | 6.35% | 0.00% | 69.71% |
| *Cataluña* | 0.886 | 0.91% | 19.83% | 28.83% | 6.35% | 0.00% | 64.27% |
| *Valencia* | 0.770 | 2.05% | 18.61% | 28.83% | 6.35% | 0.00% | 72.33% |
| *Extremadura* | 0.698 | 3.71% | 19.07% | 28.83% | 6.35% | 0.00% | 69.32% |
| *Galicia* | 0.549 | 2.88% | 19.42% | 28.83% | 6.35% | 0.00% | 67.00% |
| *Madrid* | 0.718 | 0.57% | 18.63% | 28.83% | 6.35% | 0.00% | 72.17% |
| *Murcia* | 0.647 | 1.95% | 19.02% | 28.83% | 6.35% | 0.00% | 69.63% |
| *Navarra* | 0.949 | 0.88% | 20.10% | 29.76% | 6.35% | 0.00% | 60.47% |
| *P. Vasco* | 0.807 | 2.56% | 20.75% | 29.76% | 6.35% | 0.00% | 58.92% |
| *Rioja* | 0.604 | 0.73% | 20.13% | 28.83% | 6.35% | 0.00% | 62.24% |
| *Spain* | *0.759* | *1.75%* | *19.38%* | *28.83%* | *6.35%* | *0.00%* | *67.27%* |

- *Note:* Reference wages (used to compute the tax and benefit parameters and to normalize expenditure per student) and employment probabilities ($p_O$ and $p_S$) are those corresponding to the average worker with lower vocational training.

**Table A.44: Data used in the calculation of the private rate of return to lower university schooling**

| | $U$ | $H$ | $\theta_{lu}$ | $\mu_S$ | $\mu$ | $p_O$ | $p_S$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 60.5 | 39.5 | 7.03% | 1.99% | 13.43% | 79.73% | 71.87% |
| *Aragón* | 60.5 | 39.5 | 7.25% | 4.26% | 17.55% | 91.94% | 85.93% |
| *Asturias* | 60.5 | 39.5 | 10.72% | 2.96% | 15.71% | 83.45% | 68.96% |
| *Baleares* | 60.5 | 39.5 | 7.58% | 3.78% | 12.13% | 91.12% | 89.27% |
| *Canarias* | 60.5 | 39.5 | 9.89% | 1.33% | 16.50% | 86.58% | 85.91% |
| *Cantabria* | 60.5 | 39.5 | 5.39% | 4.52% | 21.70% | 77.24% | 74.23% |
| *Cast. y León* | 60.5 | 39.5 | 7.53% | 2.72% | 15.52% | 87.35% | 72.00% |
| *Cast.-Mancha* | 60.5 | 39.5 | 8.82% | 1.14% | 15.17% | 87.87% | 76.61% |
| *Cataluña* | 60.5 | 39.5 | 9.55% | 6.80% | 17.70% | 89.76% | 83.62% |
| *Valencia* | 60.5 | 39.5 | 7.30% | 3.24% | 17.36% | 86.89% | 76.84% |
| *Extremadura* | 60.5 | 39.5 | 6.58% | -0.36% | 13.78% | 82.95% | 74.46% |
| *Galicia* | 60.5 | 39.5 | 9.38% | 2.31% | 14.36% | 81.58% | 60.83% |
| *Madrid* | 60.5 | 39.5 | 11.34% | 8.24% | 20.93% | 86.69% | 84.71% |
| *Murcia* | 60.5 | 39.5 | 5.01% | 2.92% | 16.84% | 85.88% | 75.53% |
| *Navarra* | 60.5 | 39.5 | 9.92% | 6.10% | 13.40% | 89.25% | 84.72% |
| *P. Vasco* | 60.5 | 39.5 | 8.23% | 4.07% | 13.09% | 84.55% | 73.04% |
| *Rioja* | 60.5 | 39.5 | 5.90% | 3.47% | 27.12% | 86.87% | 70.98% |
| *Spain* | *60.5* | *39.5* | *9.02%* | *4.17%* | *16.27%* | *85.54%* | *76.33%* |

| | $\eta$ | $\varepsilon$ | $\tau_O$ | $T'$ | $\tau_S$ | $a$ | $b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.901 | 1.80% | 20.57% | 28.83% | 6.35% | 0.00% | 59.22% |
| *Aragón* | 0.935 | 0.18% | 20.83% | 28.83% | 6.35% | 0.00% | 57.45% |
| *Asturias* | 0.826 | 1.15% | 21.33% | 32.85% | 6.35% | 0.00% | 55.06% |
| *Baleares* | 0.980 | 0.42% | 20.80% | 28.83% | 6.35% | 0.00% | 57.67% |
| *Canarias* | 0.992 | 1.57% | 20.44% | 28.83% | 6.35% | 0.00% | 60.13% |
| *Cantabria* | 0.961 | 3.27% | 21.42% | 32.85% | 6.35% | 0.00% | 54.67% |
| *C.-León* | 0.824 | 0.56% | 21.39% | 32.85% | 6.35% | 0.00% | 54.77% |
| *C.-Mancha* | 0.872 | 0.91% | 21.02% | 32.85% | 6.35% | 0.00% | 56.39% |
| *Cataluña* | 0.932 | 0.90% | 21.37% | 32.85% | 6.35% | 0.00% | 54.87% |
| *Valencia* | 0.884 | 0.88% | 20.86% | 28.83% | 6.35% | 0.00% | 57.29% |
| *Extremadura* | 0.898 | 0.81% | 21.01% | 32.85% | 6.35% | 0.00% | 56.44% |
| *Galicia* | 0.746 | 2.32% | 20.80% | 28.83% | 6.35% | 0.00% | 57.67% |
| *Madrid* | 0.977 | 0.28% | 20.56% | 28.83% | 6.35% | 0.00% | 59.34% |
| *Murcia* | 0.879 | 0.89% | 20.83% | 28.83% | 6.35% | 0.00% | 57.46% |
| *Navarra* | 0.949 | 1.72% | 20.63% | 29.76% | 6.35% | 0.00% | 57.34% |
| *P. Vasco* | 0.864 | 2.10% | 21.92% | 34.45% | 6.35% | 0.00% | 52.01% |
| *Rioja* | 0.817 | 1.35% | 21.75% | 32.85% | 6.35% | 0.00% | 53.20% |
| *Spain* | *0.892* | *0.97%* | *21.04%* | *32.85%* | *6.35%* | *0.00%* | *56.31%* |

- *Note:* Reference wages (used to compute the tax and benefit parameters and to normalize expenditure per student) and employment probabilities ($p_O$ and $p_S$) are those corresponding to the average worker with upper secondary schooling.



**Table A.45: Data used in the calculation of the private rate of return to upper university schooling**

| | $U$ | $H$ | $\theta_{uu}$ | $\mu_S$ | $\mu$ | $p_O$ | $p_S$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 60.5 | 37.5 | 13.86% | 1.61% | 10.87% | 84.05% | 76.18% |
| *Aragón* | 60.5 | 37.5 | 14.23% | 3.43% | 14.11% | 92.43% | 86.42% |
| *Asturias* | 60.5 | 37.5 | 6.44% | 2.14% | 11.39% | 86.34% | 71.85% |
| *Baleares* | 60.5 | 37.5 | 4.92% | 3.01% | 9.66% | 92.27% | 90.42% |
| *Canarias* | 60.5 | 37.5 | 15.23% | 0.99% | 12.26% | 90.66% | 90.00% |
| *Cantabria* | 60.5 | 37.5 | 20.04% | 3.85% | 18.46% | 84.82% | 81.81% |
| *Cast. y León* | 60.5 | 37.5 | 14.78% | 2.17% | 12.38% | 88.82% | 73.46% |
| *Cast.-Mancha* | 60.5 | 37.5 | 6.70% | 0.87% | 11.64% | 90.28% | 79.01% |
| *Cataluña* | 60.5 | 37.5 | 12.84% | 5.11% | 13.29% | 92.19% | 86.05% |
| *Valencia* | 60.5 | 37.5 | 9.91% | 2.60% | 13.95% | 89.18% | 79.13% |
| *Extremadura* | 60.5 | 37.5 | 16.18% | -0.29% | 11.31% | 84.96% | 76.48% |
| *Galicia* | 60.5 | 37.5 | 11.93% | 1.74% | 10.84% | 87.26% | 66.51% |
| *Madrid* | 60.5 | 37.5 | 15.41% | 5.86% | 14.90% | 87.42% | 85.44% |
| *Murcia* | 60.5 | 37.5 | 13.60% | 2.51% | 14.49% | 88.17% | 77.82% |
| *Navarra* | 60.5 | 37.5 | 12.72% | 4.53% | 9.95% | 93.84% | 89.32% |
| *P. Vasco* | 60.5 | 37.5 | 15.61% | 3.18% | 10.22% | 89.87% | 78.37% |
| *Rioja* | 60.5 | 37.5 | 11.49% | 2.91% | 22.72% | 90.37% | 74.49% |
| *Spain* | *60.5* | *37.5* | *15.32%* | *3.18%* | *12.41%* | *88.02%* | *78.81%* |

| | $\eta$ | $\varepsilon$ | $\tau_O$ | $T'$ | $\tau_S$ | $a$ | $b$ |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 0.906 | 0.38% | 22.76% | 32.85% | 6.35% | 0.00% | 48.68% |
| *Aragón* | 0.935 | 0.27% | 23.14% | 32.85% | 6.35% | 0.00% | 46.95% |
| *Asturias* | 0.832 | 0.70% | 24.27% | 28.30% | 6.35% | 0.00% | 40.70% |
| *Baleares* | 0.980 | 0.86% | 23.20% | 32.85% | 6.35% | 0.00% | 46.68% |
| *Canarias* | 0.993 | 0.24% | 23.44% | 32.85% | 6.35% | 0.00% | 45.58% |
| *Cantabria* | 0.964 | 0.46% | 23.13% | 32.85% | 6.35% | 0.00% | 47.03% |
| *C.-León* | 0.827 | 0.00% | 23.71% | 32.85% | 6.35% | 0.00% | 44.34% |
| *C.-Mancha* | 0.875 | 0.00% | 23.77% | 32.85% | 6.35% | 0.00% | 44.05% |
| *Cataluña* | 0.933 | 0.00% | 24.14% | 28.30% | 6.35% | 0.00% | 41.93% |
| *Valencia* | 0.887 | 0.42% | 23.19% | 32.85% | 6.35% | 0.00% | 46.76% |
| *Extremadura* | 0.900 | 1.63% | 23.13% | 32.85% | 6.35% | 0.00% | 47.00% |
| *Galicia* | 0.762 | 0.38% | 23.71% | 32.85% | 6.35% | 0.00% | 44.35% |
| *Madrid* | 0.977 | 0.15% | 23.97% | 32.85% | 6.35% | 0.00% | 43.14% |
| *Murcia* | 0.883 | 0.22% | 22.46% | 32.85% | 6.35% | 0.00% | 50.03% |
| *Navarra* | 0.952 | 0.00% | 24.38% | 32.57% | 6.35% | 0.00% | 43.83% |
| *P. Vasco* | 0.872 | 0.00% | 24.39% | 30.00% | 6.35% | 0.00% | 41.41% |
| *Rioja* | 0.824 | 0.00% | 23.55% | 32.85% | 6.35% | 0.00% | 45.07% |
| *Spain* | *0.895* | *0.12%* | *23.84%* | *32.85%* | *6.35%* | *0.00%* | *43.73%* |

- *Note:* Reference wages (used to compute the tax and benefit parameters and to normalize expenditure per student) and employment probabilities ($p_O$ and $p_S$) are those corresponding to the average worker with lower university schooling.
- In Asturias, País Vasco and Cataluña, the upper ceiling on Social Security contributions is binding for estimated average earnings at this level (i.e. those corresponding to the average worker with lower university attainment). As a result, the marginal Social Security tax rate is zero. This accounts for the atypically low value given for $T'$ in the table for these regions.

**Table A.46: Estimated private returns to schooling, summary of resuls, Mincerian and by level all-in rates of return *(OBS)***

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 10.73% | 7.03% | 12.67% | 11.76% | 2.01% | 7.51% | 18.92% |
| *Madrid* | 10.34% | -0.15% | 10.24% | 10.31% | 8.65% | 11.80% | 16.50% |
| *C.-Mancha* | 10.17% | 3.29% | 7.80% | 13.64% | 8.93% | 10.10% | 7.83% |
| *Baleares* | 9.76% | 0.74% | 13.60% | 22.54% | -6.46% | 9.07% | 6.17% |
| *Cataluña* | 9.51% | 1.46% | 11.91% | 14.15% | 6.46% | 10.36% | 15.24% |
| *Murcia* | 9.42% | 7.70% | 10.07% | 10.06% | 1.16% | 5.78% | 14.75% |
| *Canarias* | 8.99% | 2.70% | 11.71% | 9.95% | 5.58% | 12.12% | 17.95% |
| *Valencia* | 8.75% | 2.57% | 13.11% | 10.67% | 7.85% | 8.54% | 11.37% |
| *C.-León* | 8.43% | 3.18% | 12.17% | 11.96% | 7.57% | 8.24% | 16.14% |
| *Galicia* | 8.41% | 3.29% | 12.14% | 14.06% | 5.22% | 10.76% | 13.21% |
| *Andalucía* | 8.36% | 1.36% | 12.21% | 12.00% | 7.28% | 8.26% | 15.06% |
| *Rioja* | 8.29% | 2.10% | 11.52% | 16.57% | -0.06% | 6.84% | 12.70% |
| *País Vasco* | 7.66% | -3.41% | 10.62% | 9.53% | 4.80% | 9.49% | 17.93% |
| *Cantabria* | 7.59% | 4.09% | 11.08% | 12.23% | 2.63% | 6.81% | 21.03% |
| *Navarra* | 7.30% | -1.49% | 7.28% | 11.49% | 6.06% | 11.52% | 14.64% |
| *Aragón* | 7.22% | -7.27% | 8.36% | 10.08% | 6.71% | 8.45% | 16.08% |
| *Asturias* | 6.85% | -5.97% | 13.04% | 10.73% | 0.77% | 11.40% | 8.21% |
| *Spain* | *9.50%* | *1.66%* | *11.93%* | *13.23%* | *6.96%* | *9.73%* | *16.76%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 112.9 | 423.6 | 106.1 | 88.8 | 28.9 | 77.1 | 112.9 |
| *Madrid* | 108.8 | -8.8 | 85.8 | 77.9 | 124.2 | 121.2 | 98.5 |
| *Cast. la M.* | 107.1 | 198.1 | 65.4 | 103.1 | 128.2 | 103.8 | 46.7 |
| *Baleares* | 102.7 | 44.3 | 113.9 | 170.3 | -92.7 | 93.2 | 36.8 |
| *Cataluña* | 100.1 | 87.8 | 99.8 | 107.0 | 92.8 | 106.4 | 90.9 |
| *Murcia* | 99.1 | 463.8 | 84.4 | 76.1 | 16.7 | 59.4 | 88.0 |
| *Canarias* | 94.7 | 162.9 | 98.2 | 75.2 | 80.1 | 124.5 | 107.1 |
| *Valencia* | 92.1 | 154.9 | 109.9 | 80.7 | 112.7 | 87.8 | 67.9 |
| *Cast. y León* | 88.7 | 191.3 | 102.0 | 90.4 | 108.8 | 84.7 | 96.3 |
| *Galicia* | 88.5 | 198.4 | 101.7 | 106.3 | 74.9 | 110.6 | 78.8 |
| *Andalucía* | 87.9 | 81.9 | 102.3 | 90.7 | 104.5 | 84.8 | 89.9 |
| *Rioja* | 87.3 | 126.2 | 96.5 | 125.2 | -0.8 | 70.3 | 75.8 |
| *País Vasco* | 80.6 | -205.1 | 89.0 | 72.0 | 69.0 | 97.5 | 107.0 |
| *Cantabria* | 79.8 | 246.4 | 92.9 | 92.4 | 37.8 | 70.0 | 125.5 |
| *Navarra* | 76.8 | -89.9 | 61.0 | 86.8 | 87.0 | 118.3 | 87.4 |
| *Aragón* | 76.0 | -437.9 | 70.0 | 76.2 | 96.3 | 86.8 | 96.0 |
| *Asturias* | 72.1 | -359.7 | 109.3 | 81.1 | 11.1 | 117.1 | 49.0 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |



**Table A.47: Estimated private returns to schooling, summary of resuls, Mincerian and by level raw rates of return *(NO GOV'T)***

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 12.25% | 9.39% | 13.72% | 11.31% | 5.91% | 8.52% | 20.17% |
| *Andalucía* | 12.22% | 5.45% | 14.44% | 12.36% | 10.20% | 10.15% | 16.47% |
| *Madrid* | 11.68% | 1.08% | 12.37% | 12.50% | 9.70% | 12.46% | 17.42% |
| *Baleares* | 10.59% | 0.94% | 13.52% | 22.90% | -3.76% | 9.71% | 7.08% |
| *Cataluña* | 10.55% | 2.53% | 11.97% | 13.70% | 6.91% | 11.65% | 14.81% |
| *C.-Mancha* | 10.53% | 4.86% | 13.51% | 12.95% | 10.30% | 11.02% | 7.88% |
| *Canarias* | 10.38% | 3.36% | 11.95% | 9.28% | 7.03% | 12.93% | 17.98% |
| *Valencia* | 10.35% | 3.13% | 12.98% | 11.01% | 9.53% | 9.10% | 11.84% |
| *Galicia* | 10.29% | 3.79% | 11.66% | 12.90% | 7.51% | 12.76% | 14.06% |
| *Murcia* | 9.93% | 8.63% | 11.40% | 9.23% | 3.57% | 6.47% | 15.41% |
| *C.-León* | 9.66% | 4.21% | 11.63% | 10.64% | 9.19% | 9.09% | 16.62% |
| *Cantabria* | 9.16% | 3.62% | 10.02% | 11.04% | 6.12% | 9.06% | 21.49% |
| *Rioja* | 8.66% | 1.87% | 12.55% | 16.37% | 0.79% | 7.12% | 11.86% |
| *P. Vasco* | 8.59% | -3.20% | 9.77% | 10.60% | 6.14% | 11.85% | 18.08% |
| *Asturias* | 8.30% | -3.80% | 10.23% | 13.44% | 1.99% | 12.98% | 8.32% |
| *Aragón* | 7.59% | -3.58% | 9.79% | 9.79% | 6.83% | 8.42% | 16.46% |
| *Navarra* | 7.26% | -1.52% | 6.39% | 10.70% | 5.81% | 13.51% | 15.31% |
| *Spain* | *11.32%* | *3.80%* | *12.68%* | *13.37%* | *8.42%* | *11.16%* | *17.51%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 108.2 | 247.1 | 108.1 | 84.6 | 70.2 | 76.4 | 115.2 |
| *Andalucía* | 108.0 | 143.4 | 113.9 | 92.5 | 121.0 | 91.0 | 94.0 |
| *Madrid* | 103.2 | 28.4 | 97.6 | 93.5 | 115.1 | 111.7 | 99.5 |
| *Baleares* | 93.6 | 24.8 | 106.6 | 171.3 | -44.6 | 87.0 | 40.4 |
| *Cataluña* | 93.2 | 66.6 | 94.3 | 102.5 | 82.0 | 104.4 | 84.6 |
| *C.-Mancha* | 93.0 | 127.8 | 106.5 | 96.9 | 122.3 | 98.8 | 45.0 |
| *Canarias* | 91.7 | 88.4 | 94.2 | 69.4 | 83.4 | 115.9 | 102.7 |
| *Valencia* | 91.5 | 82.5 | 102.4 | 82.4 | 113.1 | 81.5 | 67.6 |
| *Galicia* | 90.9 | 99.9 | 91.9 | 96.5 | 89.1 | 114.4 | 80.3 |
| *Murcia* | 87.7 | 227.3 | 89.8 | 69.0 | 42.4 | 58.0 | 88.0 |
| *C.-León* | 85.4 | 111.0 | 91.7 | 79.6 | 109.1 | 81.5 | 94.9 |
| *Cantabria* | 81.0 | 95.3 | 79.0 | 82.6 | 72.6 | 81.2 | 122.7 |
| *Rioja* | 76.5 | 49.3 | 98.9 | 122.5 | 9.4 | 63.8 | 67.7 |
| *P. Vasco* | 75.9 | -84.2 | 77.0 | 79.3 | 72.8 | 106.2 | 103.3 |
| *Asturias* | 73.3 | -100.0 | 80.6 | 100.6 | 23.7 | 116.4 | 47.5 |
| *Aragón* | 67.0 | -94.3 | 77.2 | 73.3 | 81.0 | 75.5 | 94.0 |
| *Navarra* | 64.2 | -40.1 | 50.4 | 80.0 | 69.0 | 121.1 | 87.4 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

**Table A.48: Estimated tax wedge --total (all government)**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 3.86% | 4.09% | 1.78% | 0.36% | 2.92% | 1.89% | 1.41% |
| *Galicia* | 1.88% | 0.50% | 0.14% | -1.16% | 2.29% | 2.00% | 0.85% |
| *Valencia* | 1.60% | 0.56% | 0.85% | 0.33% | 1.68% | 0.55% | 0.47% |
| *Cantabria* | 1.58% | -0.47% | -0.05% | -1.19% | 3.49% | 2.25% | 0.46% |
| *Extremadura* | 1.52% | 2.35% | 1.51% | -0.45% | 3.90% | 1.02% | 1.24% |
| *Asturias* | 1.45% | 2.18% | 2.43% | 2.71% | 1.22% | 1.59% | 0.11% |
| *Canarias* | 1.39% | 0.65% | 0.04% | -0.67% | 1.45% | 0.81% | 0.03% |
| *Madrid* | 1.34% | 1.22% | 1.75% | 2.19% | 1.05% | 0.66% | 0.92% |
| *C.-León* | 1.23% | 1.04% | -0.09% | -1.32% | 1.61% | 0.85% | 0.48% |
| *Cataluña* | 1.04% | 1.07% | -0.21% | -0.46% | 0.45% | 1.29% | -0.42% |
| *P. Vasco* | 0.92% | 0.21% | 1.41% | 1.07% | 1.33% | 2.36% | 0.15% |
| *Baleares* | 0.83% | 0.21% | -0.08% | 0.36% | 2.70% | 0.63% | 0.91% |
| *Murcia* | 0.51% | 0.93% | 0.31% | -0.84% | 2.41% | 0.68% | 0.66% |
| *Rioja* | 0.37% | -0.22% | -0.49% | -0.20% | 0.85% | 0.28% | -0.84% |
| *Aragón* | 0.36% | 3.69% | -0.45% | -0.28% | 0.12% | -0.03% | 0.38% |
| *C.-Mancha* | 0.36% | 1.57% | 0.40% | -0.69% | 1.38% | 0.92% | 0.05% |
| *Navarra* | -0.03% | -0.03% | -0.90% | -0.79% | -0.25% | 1.99% | 0.67% |
| *Spain* | *1.82%* | *2.14%* | *0.75%* | *0.14%* | *1.46%* | *1.42%* | *0.75%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 212.8 | 191.3 | 236.8 | 269.0 | 199.9 | 133.0 | 186.2 |
| *Galicia* | 103.4 | 23.4 | 19.2 | -859.7 | 156.7 | 140.3 | 112.6 |
| *Valencia* | 88.2 | 26.3 | 113.1 | 247.9 | 114.9 | 38.9 | 61.9 |
| *Cantabria* | 86.9 | -22.1 | -7.0 | -882.2 | 238.8 | 158.1 | 61.4 |
| *Extremadura* | 83.4 | 110.0 | 201.4 | -332.2 | 267.1 | 71.4 | 164.9 |
| *Asturias* | 79.7 | 101.8 | 323.3 | 2008.6 | 83.4 | 111.7 | 13.9 |
| *Canarias* | 76.4 | 30.6 | 5.1 | -495.2 | 99.3 | 57.0 | 4.4 |
| *Madrid* | 73.7 | 57.3 | 233.5 | 1623.7 | 71.7 | 46.5 | 121.3 |
| *C.-León* | 67.8 | 48.5 | -11.3 | -978.8 | 110.5 | 59.5 | 63.6 |
| *Cataluña* | 57.1 | 50.2 | -27.5 | -337.9 | 30.8 | 90.7 | -55.8 |
| *P. Vasco* | 50.9 | 9.7 | 187.9 | 791.5 | 91.2 | 166.0 | 19.8 |
| *Baleares* | 45.5 | 9.7 | -10.5 | 265.7 | 184.6 | 44.5 | 120.4 |
| *Murcia* | 28.0 | 43.6 | 41.4 | -619.2 | 164.7 | 48.0 | 87.6 |
| *Rioja* | 20.4 | -10.5 | -65.8 | -147.6 | 58.1 | 19.4 | -110.7 |
| *Aragón* | 20.0 | 172.7 | -59.7 | -210.1 | 8.2 | -2.3 | 50.4 |
| *C.-Mancha* | 19.5 | 73.2 | 53.5 | -512.4 | 94.1 | 64.9 | 6.3 |
| *Navarra* | -1.8 | -1.3 | -119.3 | -587.6 | -17.1 | 140.1 | 88.8 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |



**Table A.49: Estimated wedge induced by educational subsidies**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 3.38% | 3.67% | 4.06% | 3.33% | 1.68% | 1.75% | 3.14% |
| *Canarias* | 3.09% | 2.19% | 4.68% | 3.66% | 2.53% | 2.55% | 2.55% |
| *Andalucía* | 2.86% | 2.39% | 4.76% | 4.04% | 2.66% | 1.63% | 2.00% |
| *C.-Mancha* | 2.76% | 2.11% | 4.20% | 4.01% | 2.51% | 1.96% | 1.17% |
| *Galicia* | 2.71% | 2.16% | 4.23% | 4.65% | 2.23% | 1.98% | 1.57% |
| *Rioja* | 2.61% | 1.49% | 3.88% | 5.10% | 1.03% | 2.28% | 2.80% |
| *Valencia* | 2.59% | 1.82% | 4.30% | 3.63% | 2.61% | 1.66% | 1.66% |
| *Murcia* | 2.46% | 2.93% | 2.98% | 2.43% | 1.27% | 1.33% | 2.27% |
| *Cantabria* | 2.43% | 1.82% | 3.14% | 3.40% | 1.78% | 2.24% | 4.05% |
| *C.-León* | 2.27% | 1.91% | 3.54% | 3.23% | 2.35% | 1.49% | 2.06% |
| *Baleares* | 2.19% | 1.45% | 4.53% | 7.91% | 0.75% | 1.01% | 0.67% |
| *Cataluña* | 2.10% | 1.57% | 3.65% | 4.16% | 1.82% | 1.48% | 1.40% |
| *P. Vasco* | 2.07% | 1.22% | 3.89% | 4.15% | 2.27% | 1.34% | 1.52% |
| *Asturias* | 1.80% | 0.89% | 2.95% | 3.82% | 1.12% | 2.10% | 1.06% |
| *Navarra* | 1.79% | 1.33% | 2.76% | 4.09% | 2.16% | 1.16% | 0.96% |
| *Madrid* | 1.75% | 1.10% | 3.03% | 3.04% | 1.93% | 1.87% | 1.91% |
| *Aragón* | 1.73% | 0.93% | 2.95% | 2.91% | 1.90% | 1.40% | 2.07% |
| *Spain* | *2.43%* | *1.88%* | *4.01%* | *4.21%* | *2.15%* | *1.69%* | *1.98%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Extremadura* | 139.0 | 195.0 | 101.1 | 78.9 | 78.0 | 103.3 | 158.2 |
| *Canarias* | 127.0 | 116.4 | 116.6 | 86.8 | 117.5 | 150.6 | 128.5 |
| *Andalucía* | 117.7 | 127.2 | 118.6 | 95.9 | 123.5 | 96.4 | 101.0 |
| *C.-Mancha* | 113.3 | 112.4 | 104.7 | 95.1 | 116.7 | 115.7 | 59.2 |
| *Galicia* | 111.4 | 115.0 | 105.4 | 110.4 | 103.7 | 116.8 | 79.0 |
| *Rioja* | 107.1 | 79.0 | 96.6 | 120.9 | 47.7 | 134.6 | 141.1 |
| *Valencia* | 106.3 | 96.9 | 107.2 | 86.2 | 121.2 | 98.2 | 83.8 |
| *Murcia* | 101.0 | 155.8 | 74.1 | 57.8 | 58.9 | 78.8 | 114.5 |
| *Cantabria* | 99.8 | 96.8 | 78.2 | 80.7 | 82.6 | 132.1 | 204.3 |
| *C.-León* | 93.4 | 101.7 | 88.3 | 76.6 | 109.0 | 88.1 | 103.7 |
| *Baleares* | 90.0 | 77.0 | 112.8 | 187.7 | 35.0 | 59.7 | 33.8 |
| *Cataluña* | 86.5 | 83.3 | 91.0 | 98.8 | 84.4 | 87.4 | 70.7 |
| *P. Vasco* | 85.0 | 64.7 | 96.8 | 98.4 | 105.3 | 79.3 | 76.9 |
| *Asturias* | 74.1 | 47.1 | 73.6 | 90.7 | 51.8 | 124.0 | 53.6 |
| *Navarra* | 73.6 | 70.6 | 68.8 | 96.9 | 100.3 | 68.6 | 48.2 |
| *Madrid* | 72.0 | 58.3 | 75.5 | 72.2 | 89.7 | 110.7 | 96.4 |
| *Aragón* | 71.3 | 49.2 | 73.5 | 69.2 | 88.1 | 82.8 | 104.3 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

**Table A.50: Estimated wedge induced by personal taxes**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Murcia* | 1.08% | 1.85% | 1.37% | 1.35% | 0.24% | 0.50% | 1.68% |
| *C.-Mancha* | 1.06% | 0.84% | 2.72% | 2.98% | 0.90% | 1.28% | 0.73% |
| *Galicia* | 1.05% | 1.04% | 2.41% | 3.11% | 0.52% | 0.82% | 1.26% |
| *Extremadura* | 1.03% | 1.50% | 2.31% | 2.45% | 0.12% | 0.95% | 1.51% |
| *Baleares* | 1.00% | 0.85% | 2.99% | 5.06% | -0.13% | 0.71% | 0.59% |
| *Canarias* | 0.97% | 0.87% | 2.43% | 2.13% | 0.65% | 0.79% | 1.42% |
| *Rioja* | 0.95% | 1.00% | 1.69% | 2.13% | 0.27% | 0.88% | 1.28% |
| *Valencia* | 0.94% | 0.91% | 2.39% | 2.14% | 0.85% | 0.67% | 1.13% |
| *Andalucía* | 0.86% | 0.32% | 2.66% | 2.67% | 0.89% | 0.60% | 1.57% |
| *C.-León* | 0.83% | 0.79% | 1.36% | 1.50% | 0.65% | 1.15% | 1.53% |
| *Madrid* | 0.81% | 0.59% | 2.13% | 2.00% | 1.12% | 1.21% | 1.63% |
| *Cataluña* | 0.80% | 0.61% | 1.45% | 1.71% | 0.61% | 1.46% | 0.38% |
| *Cantabria* | 0.79% | 1.20% | 1.18% | 1.50% | 0.12% | 0.73% | 2.25% |
| *Navarra* | 0.71% | 0.39% | 1.05% | 1.45% | 0.54% | 1.10% | 1.15% |
| *Aragón* | 0.66% | -0.08% | 1.17% | 1.13% | 0.68% | 0.72% | 1.59% |
| *Asturias* | 0.58% | 0.10% | 1.00% | 1.39% | 0.26% | 1.54% | 0.11% |
| *P. Vasco* | 0.57% | 0.68% | 1.02% | 1.21% | 0.34% | 1.32% | 0.74% |
| *Spain* | *0.86%* | *0.52%* | *2.31%* | *2.64%* | *0.68%* | *1.43%* | *1.55%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Murcia* | 125.5 | 358.8 | 59.5 | 51.3 | 35.6 | 34.7 | 107.9 |
| *C.-Mancha* | 123.4 | 163.2 | 118.0 | 112.8 | 132.2 | 89.2 | 46.8 |
| *Galicia* | 122.6 | 200.9 | 104.6 | 117.8 | 76.7 | 57.3 | 80.8 |
| *Extremadura* | 120.2 | 291.6 | 100.0 | 92.7 | 18.0 | 66.6 | 96.8 |
| *Baleares* | 116.9 | 164.6 | 129.7 | 191.5 | -19.2 | 49.4 | 38.0 |
| *Canarias* | 112.9 | 169.3 | 105.2 | 80.7 | 95.4 | 54.9 | 91.5 |
| *Rioja* | 110.9 | 193.2 | 73.0 | 80.6 | 38.8 | 61.3 | 82.3 |
| *Valencia* | 109.6 | 177.0 | 103.4 | 81.0 | 125.1 | 47.1 | 72.5 |
| *Andalucía* | 99.8 | 61.6 | 115.4 | 101.0 | 130.9 | 41.8 | 101.2 |
| *C.-León* | 96.2 | 153.4 | 58.9 | 56.7 | 94.6 | 80.3 | 98.4 |
| *Madrid* | 94.8 | 115.3 | 92.2 | 75.5 | 164.1 | 84.9 | 104.9 |
| *Cataluña* | 93.5 | 117.9 | 62.9 | 64.8 | 89.0 | 102.0 | 24.8 |
| *Cantabria* | 92.3 | 232.2 | 51.0 | 56.9 | 17.2 | 51.1 | 144.7 |
| *Navarra* | 82.6 | 75.9 | 45.4 | 55.0 | 79.2 | 77.0 | 74.2 |
| *Aragón* | 76.5 | -14.8 | 50.8 | 42.7 | 100.0 | 50.4 | 102.4 |
| *Asturias* | 67.9 | 18.6 | 43.4 | 52.6 | 38.3 | 107.6 | 7.2 |
| *P. Vasco* | 66.0 | 132.3 | 44.2 | 45.8 | 49.8 | 91.9 | 47.6 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |



**Table A.51: Estimated wedge induced by unemployment benefits**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 5.87% | 6.16% | 3.87% | 1.74% | 4.69% | 2.93% | 1.83% |
| *Extremadura* | 3.86% | 4.52% | 3.26% | 0.43% | 5.46% | 1.81% | 2.88% |
| *Galicia* | 3.54% | 1.63% | 1.96% | 0.38% | 4.00% | 3.15% | 1.16% |
| *Canarias* | 3.51% | 1.97% | 2.29% | 0.86% | 3.33% | 2.57% | 1.16% |
| *Valencia* | 3.25% | 1.47% | 2.77% | 1.83% | 3.43% | 1.54% | 1.00% |
| *Cantabria* | 3.21% | 0.15% | 1.91% | 0.71% | 5.15% | 3.75% | 2.26% |
| *C.-León* | 2.68% | 2.16% | 2.10% | 0.41% | 3.31% | 1.19% | 1.01% |
| *Asturias* | 2.67% | 2.97% | 4.38% | 5.15% | 2.07% | 2.15% | 1.06% |
| *P. Vasco* | 2.43% | 0.74% | 4.28% | 4.01% | 3.26% | 2.39% | 0.93% |
| *Cataluña* | 2.34% | 2.03% | 1.99% | 2.00% | 1.66% | 1.31% | 0.60% |
| *Madrid* | 2.27% | 1.73% | 2.65% | 3.24% | 1.86% | 1.32% | 1.19% |
| *C.-Mancha* | 2.05% | 2.84% | 1.88% | 0.33% | 2.98% | 1.60% | 0.49% |
| *Rioja* | 2.02% | 0.27% | 1.70% | 2.77% | 1.61% | 1.68% | 0.68% |
| *Baleares* | 2.01% | 0.81% | 1.45% | 3.21% | 3.58% | 0.94% | 0.99% |
| *Murcia* | 1.89% | 2.01% | 1.91% | 0.24% | 3.43% | 1.52% | 1.25% |
| *Aragón* | 1.44% | 4.69% | 1.33% | 1.50% | 1.33% | 0.65% | 0.86% |
| *Navarra* | 1.05% | 0.91% | 0.82% | 1.84% | 1.37% | 2.05% | 0.47% |
| *Spain* | *3.39%* | *3.50%* | *2.46%* | *1.71%* | *2.93%* | *1.68%* | *1.18%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 173.2 | 176.0 | 157.7 | 101.7 | 159.9 | 173.8 | 155.1 |
| *Extremadura* | 114.0 | 128.9 | 132.7 | 25.1 | 186.3 | 107.6 | 243.2 |
| *Galicia* | 104.3 | 46.4 | 79.8 | 22.3 | 136.4 | 187.2 | 98.1 |
| *Canarias* | 103.4 | 56.3 | 93.3 | 50.3 | 113.6 | 152.9 | 97.8 |
| *Valencia* | 95.8 | 42.0 | 112.6 | 107.1 | 117.2 | 91.6 | 84.7 |
| *Cantabria* | 94.8 | 4.3 | 77.7 | 41.4 | 175.7 | 222.9 | 191.4 |
| *C.-León* | 79.0 | 61.7 | 85.5 | 23.9 | 113.1 | 70.6 | 85.1 |
| *Asturias* | 78.6 | 84.7 | 178.3 | 301.5 | 70.7 | 127.6 | 89.3 |
| *P. Vasco* | 71.6 | 21.2 | 174.1 | 234.7 | 111.2 | 141.8 | 79.0 |
| *Cataluña* | 69.0 | 58.0 | 81.2 | 117.0 | 56.6 | 77.8 | 50.4 |
| *Madrid* | 67.1 | 49.3 | 108.0 | 189.9 | 63.4 | 78.4 | 101.1 |
| *C.-Mancha* | 60.5 | 81.0 | 76.6 | 19.6 | 101.8 | 95.3 | 41.7 |
| *Rioja* | 59.7 | 7.6 | 69.2 | 162.2 | 54.9 | 99.6 | 57.6 |
| *Baleares* | 59.4 | 23.0 | 59.2 | 188.0 | 122.2 | 55.6 | 83.5 |
| *Murcia* | 55.7 | 57.4 | 77.9 | 14.3 | 117.1 | 90.3 | 105.9 |
| *Aragón* | 42.5 | 134.0 | 54.1 | 88.1 | 45.5 | 38.4 | 72.5 |
| *Navarra* | 30.9 | 25.9 | 33.3 | 107.6 | 46.7 | 121.9 | 40.0 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

**Table A.52: Estimated effective tax rate --total (all government)**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 31.62% | 43.90% | 12.30% | 2.94% | 28.65% | 18.64% | 8.54% |
| *Galicia* | 18.26% | 56.98% | 1.24% | -9.00% | 30.51% | 15.64% | 6.05% |
| *Asturias* | 17.44% | | 23.72% | 20.18% | 61.16% | 12.23% | 1.26% |
| *Cantabria* | 17.22% | 50.28% | -0.53% | -10.79% | 57.03% | 24.82% | 2.16% |
| *Valencia* | 15.47% | 58.11% | 6.54% | 3.04% | 17.63% | 6.09% | 3.95% |
| *Canarias* | 13.37% | 65.18% | 0.32% | -7.21% | 20.64% | 6.27% | 0.18% |
| *C.-León* | 12.75% | 45.38% | -0.73% | -12.43% | 17.57% | 9.31% | 2.89% |
| *Extremadura* | 12.37% | 39.06% | 11.02% | -3.97% | 66.01% | 11.92% | 6.17% |
| *Madrid* | 11.46% | 101.60% | 14.16% | 17.54% | 10.81% | 5.31% | 5.26% |
| *P. Vasco* | 10.77% | | 14.43% | 10.09% | 21.73% | 19.93% | 0.83% |
| *Cataluña* | 9.84% | 61.87% | -1.72% | -3.33% | 6.51% | 11.08% | -2.84% |
| *Baleares* | 7.81% | 153.53% | -0.58% | 1.57% | | 6.52% | 12.84% |
| *Murcia* | 5.12% | 33.93% | 2.73% | -9.06% | 67.45% | 10.56% | 4.29% |
| *Aragón* | 4.79% | | -4.57% | -2.90% | 1.75% | -0.39% | 2.31% |
| *Rioja* | 4.28% | 79.39% | -3.94% | -1.22% | 107.12% | 3.88% | -7.05% |
| *C.-Mancha* | 3.37% | 43.54% | 2.97% | -5.34% | 13.35% | 8.37% | 0.61% |
| *Navarra* | -0.45% | | -14.01% | -7.42% | -4.30% | 14.75% | 4.38% |
| *Spain* | *16.05%* | *56.28%* | *5.92%* | *1.01%* | *17.35%* | *12.75%* | *4.31%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 197.1 | 78.0 | 207.9 | 290.8 | 165.2 | 146.2 | 198.0 |
| *Galicia* | 113.8 | 101.2 | 20.9 | -890.9 | 175.9 | 122.7 | 140.3 |
| *Asturias* | 108.7 | | 400.9 | 1997.1 | 352.6 | 95.9 | 29.3 |
| *Cantabria* | 107.3 | 89.3 | -8.9 | -1068.1 | 328.7 | 194.7 | 50.1 |
| *Valencia* | 96.4 | 103.2 | 110.5 | 301.0 | 101.6 | 47.8 | 91.6 |
| *Canarias* | 83.3 | 115.8 | 5.4 | -713.4 | 119.0 | 49.2 | 4.3 |
| *C.-León* | 79.4 | 80.6 | -12.4 | -1230.1 | 101.3 | 73.1 | 67.0 |
| *Extremadura* | 77.1 | 69.4 | 186.2 | -392.7 | 380.5 | 93.5 | 143.1 |
| *Madrid* | 71.4 | 180.5 | 239.3 | 1736.1 | 62.3 | 41.6 | 121.9 |
| *P. Vasco* | 67.1 | | 244.0 | 998.5 | 125.2 | 156.3 | 19.2 |
| *Cataluña* | 61.3 | 109.9 | -29.1 | -329.8 | 37.5 | 86.9 | -65.9 |
| *Baleares* | 48.7 | 272.8 | -9.8 | 155.1 | | 51.1 | 297.8 |
| *Murcia* | 31.9 | 60.3 | 46.1 | -896.9 | 388.8 | 82.8 | 99.5 |
| *Aragón* | 29.9 | | -77.3 | -286.7 | 10.1 | -3.1 | 53.6 |
| *Rioja* | 26.6 | 141.1 | -66.6 | -120.5 | 617.5 | 30.4 | -163.5 |
| *C.-Mancha* | 21.0 | 77.4 | 50.2 | -528.8 | 77.0 | 65.7 | 14.1 |
| *Navarra* | -2.8 | | -236.9 | -734.2 | -24.8 | 115.7 | 101.6 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

- *Note:* some entries are blank because the tax rate is not computed for those regions where baseline returns are negative.



**Table A.53: Estimated effective subsidy rate induced by educational subsidies**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Rioja* | 30.08% | 79.39% | 30.91% | 31.13% | 129.63% | 32.01% | 23.58% |
| *Canarias* | 29.74% | 65.18% | 39.16% | 39.44% | 36.00% | 19.72% | 14.17% |
| *Extremadura* | 27.61% | 39.06% | 29.57% | 29.41% | 28.39% | 20.51% | 15.55% |
| *Cantabria* | 26.49% | 50.28% | 31.32% | 30.80% | 29.07% | 24.69% | 18.84% |
| *Galicia* | 26.34% | 56.98% | 36.28% | 36.08% | 29.74% | 15.49% | 11.14% |
| *C.-Mancha* | 26.17% | 43.54% | 31.11% | 30.95% | 24.38% | 17.77% | 14.88% |
| *Valencia* | 24.97% | 58.11% | 33.15% | 33.01% | 27.38% | 18.28% | 14.03% |
| *Murcia* | 24.75% | 33.93% | 26.11% | 26.38% | 35.52% | 20.62% | 14.72% |
| *Navarra* | 24.63% | | 43.22% | 38.19% | 37.17% | 8.60% | 6.24% |
| *P. Vasco* | 24.08% | | 39.80% | 39.15% | 36.94% | 11.32% | 8.43% |
| *C.-León* | 23.51% | 45.38% | 30.48% | 30.37% | 25.53% | 16.41% | 12.37% |
| *Andalucía* | 23.42% | 43.90% | 32.95% | 32.68% | 26.07% | 16.09% | 12.16% |
| *Aragón* | 22.85% | | 30.10% | 29.76% | 27.78% | 16.65% | 12.56% |
| *Asturias* | 21.71% | | 28.88% | 28.44% | 56.00% | 16.17% | 12.77% |
| *Baleares* | 20.67% | 153.53% | 33.48% | 34.54% | | 10.41% | 9.46% |
| *Cataluña* | 19.94% | 61.87% | 30.52% | 30.41% | 26.29% | 12.70% | 9.46% |
| *Madrid* | 14.99% | 101.60% | 24.49% | 24.34% | 19.92% | 15.03% | 10.97% |
| *Spain* | *21.49%* | *49.51%* | *31.64%* | *31.53%* | *25.55%* | *15.17%* | *11.32%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Rioja* | 140.0 | 160.4 | 97.7 | 98.7 | 507.4 | 210.9 | 208.3 |
| *Canarias* | 138.4 | 131.7 | 123.8 | 125.1 | 140.9 | 129.9 | 125.2 |
| *Extremadura* | 128.5 | 78.9 | 93.4 | 93.3 | 111.1 | 135.2 | 137.4 |
| *Cantabria* | 123.3 | 101.6 | 99.0 | 97.7 | 113.8 | 162.7 | 166.5 |
| *Galicia* | 122.6 | 115.1 | 114.7 | 114.5 | 116.4 | 102.1 | 98.4 |
| *C.-Mancha* | 121.8 | 87.9 | 98.3 | 98.2 | 95.4 | 117.1 | 131.5 |
| *Valencia* | 116.2 | 117.4 | 104.8 | 104.7 | 107.2 | 120.5 | 123.9 |
| *Murcia* | 115.2 | 68.5 | 82.5 | 83.7 | 139.0 | 135.9 | 130.1 |
| *Navarra* | 114.6 | | 136.6 | 121.1 | 145.5 | 56.7 | 55.2 |
| *P. Vasco* | 112.1 | | 125.8 | 124.2 | 144.6 | 74.6 | 74.5 |
| *C.-León* | 109.4 | 91.7 | 96.3 | 96.3 | 99.9 | 108.1 | 109.3 |
| *Andalucía* | 109.0 | 88.7 | 104.1 | 103.7 | 102.1 | 106.0 | 107.4 |
| *Aragón* | 106.3 | | 95.1 | 94.4 | 108.7 | 109.8 | 111.0 |
| *Asturias* | 101.0 | | 91.3 | 90.2 | 219.2 | 106.6 | 112.9 |
| *Baleares* | 96.2 | 310.1 | 105.8 | 109.6 | | 68.6 | 83.6 |
| *Cataluña* | 92.8 | 125.0 | 96.5 | 96.5 | 102.9 | 83.7 | 83.6 |
| *Madrid* | 69.8 | 205.2 | 77.4 | 77.2 | 78.0 | 99.1 | 96.9 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

- *Note:* some entries are blank because the tax rate is not computed for those regions where baseline returns are negative.

**Table A.54: Estimated effective tax rate induced by personal taxes**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Rioja* | 11.00% | 53.22% | 13.44% | 13.01% | 33.48% | 12.32% | 10.79% |
| *Murcia* | 10.86% | 21.43% | 12.04% | 14.67% | 6.81% | 7.67% | 10.88% |
| *Galicia* | 10.24% | 27.31% | 20.70% | 24.14% | 6.98% | 6.43% | 8.93% |
| *C.-Mancha* | 10.07% | 17.33% | 20.16% | 23.02% | 8.76% | 11.58% | 9.24% |
| *Navarra* | 9.77% | | 16.42% | 13.60% | 9.31% | 8.16% | 7.54% |
| *Baleares* | 9.49% | 90.00% | 22.14% | 22.09% | | 7.28% | 8.35% |
| *Canarias* | 9.34% | 25.98% | 20.31% | 22.98% | 9.27% | 6.08% | 7.92% |
| *Valencia* | 9.09% | 29.10% | 18.38% | 19.44% | 8.96% | 7.42% | 9.51% |
| *Aragón* | 8.66% | | 11.97% | 11.51% | 10.01% | 8.57% | 9.67% |
| *Cantabria* | 8.66% | 33.07% | 11.74% | 13.61% | 1.91% | 8.08% | 10.47% |
| *C.-León* | 8.55% | 18.76% | 11.69% | 14.10% | 7.03% | 12.65% | 9.20% |
| *Extremadura* | 8.43% | 16.02% | 16.82% | 21.66% | 2.08% | 11.18% | 7.46% |
| *Cataluña* | 7.61% | 24.02% | 12.14% | 12.49% | 8.79% | 12.53% | 2.60% |
| *Asturias* | 7.03% | | 9.78% | 10.33% | 13.13% | 11.86% | 1.35% |
| *Andalucía* | 7.01% | 5.82% | 18.43% | 21.58% | 8.77% | 5.89% | 9.55% |
| *Madrid* | 6.98% | 55.07% | 17.20% | 15.96% | 11.55% | 9.75% | 9.37% |
| *P. Vasco* | 6.60% | | 10.45% | 11.43% | 5.54% | 11.10% | 4.10% |
| *Spain* | *7.59%* | *13.57%* | *18.19%* | *19.77%* | *8.10%* | *12.83%* | *8.88%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Rioja* | 144.9 | 392.1 | 73.9 | 65.8 | 413.1 | 96.0 | 121.6 |
| *Murcia* | 143.0 | 157.9 | 66.2 | 74.2 | 84.0 | 59.8 | 122.6 |
| *Galicia* | 134.9 | 201.2 | 113.8 | 122.1 | 86.1 | 50.1 | 100.6 |
| *C.-Mancha* | 132.7 | 127.7 | 110.8 | 116.5 | 108.1 | 90.3 | 104.0 |
| *Navarra* | 128.8 | | 90.2 | 68.8 | 114.8 | 63.6 | 84.9 |
| *Baleares* | 125.0 | 663.1 | 121.7 | 111.8 | | 56.8 | 94.0 |
| *Canarias* | 123.1 | 191.4 | 111.6 | 116.2 | 114.4 | 47.4 | 89.2 |
| *Valencia* | 119.8 | 214.4 | 101.1 | 98.4 | 110.6 | 57.8 | 107.2 |
| *Aragón* | 114.1 | | 65.8 | 58.2 | 123.5 | 66.8 | 108.9 |
| *Cantabria* | 114.0 | 243.7 | 64.5 | 68.9 | 23.6 | 63.0 | 117.9 |
| *C.-León* | 112.7 | 138.2 | 64.3 | 71.3 | 86.7 | 98.5 | 103.7 |
| *Extremadura* | 111.1 | 118.0 | 92.4 | 109.6 | 25.6 | 87.1 | 84.1 |
| *Cataluña* | 100.3 | 177.0 | 66.7 | 63.2 | 108.5 | 97.7 | 29.3 |
| *Asturias* | 92.6 | | 53.8 | 52.3 | 162.0 | 92.4 | 15.2 |
| *Andalucía* | 92.4 | 42.9 | 101.3 | 109.2 | 108.2 | 45.9 | 107.6 |
| *Madrid* | 91.9 | 405.7 | 94.6 | 80.7 | 142.6 | 76.0 | 105.5 |
| *P. Vasco* | 87.0 | | 57.5 | 57.8 | 68.3 | 86.5 | 46.1 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

- *Note:* some entries are blank because the tax rate is not computed for those regions where baseline returns are negative.



**Table A.55: Estimated effective tax rate induced by unemployment benefits**

**a. observed values**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 48.03% | 113.13% | 26.81% | 14.04% | 45.96% | 28.83% | 11.14% |
| *Cantabria* | 35.06% | 4.15% | 19.06% | 6.40% | 84.18% | 41.43% | 10.53% |
| *Galicia* | 34.36% | 42.84% | 16.82% | 2.94% | 53.27% | 24.70% | 8.25% |
| *Canarias* | 33.77% | 58.67% | 19.18% | 9.25% | 47.37% | 19.91% | 6.43% |
| *Asturias* | 32.12% | | 42.81% | 38.28% | 104.04% | 16.54% | 12.69% |
| *Extremadura* | 31.55% | 48.11% | 23.77% | 3.79% | 92.32% | 21.25% | 14.26% |
| *Valencia* | 31.35% | 46.93% | 21.30% | 16.61% | 36.04% | 16.95% | 8.46% |
| *P. Vasco* | 28.24% | | 43.78% | 37.81% | 53.13% | 20.15% | 5.16% |
| *C.-León* | 27.71% | 51.24% | 18.06% | 3.84% | 36.08% | 13.08% | 6.06% |
| *Rioja* | 23.36% | 14.19% | 13.54% | 16.91% | 203.27% | 23.56% | 5.74% |
| *Cataluña* | 22.17% | 80.27% | 16.67% | 14.58% | 24.01% | 11.25% | 4.02% |
| *C.-Mancha* | 19.47% | 58.44% | 13.92% | 2.58% | 28.96% | 14.55% | 6.25% |
| *Madrid* | 19.47% | 160.02% | 21.44% | 25.92% | 19.18% | 10.59% | 6.86% |
| *Murcia* | 19.02% | 23.30% | 16.80% | 2.64% | 96.16% | 23.51% | 8.13% |
| *Baleares* | 19.00% | 85.50% | 10.76% | 14.01% | | 9.65% | 13.96% |
| *Aragón* | 18.97% | | 13.56% | 15.35% | 19.53% | 7.69% | 5.20% |
| *Navarra* | 14.41% | | 12.79% | 17.18% | 23.57% | 15.19% | 3.09% |
| *Spain* | *29.94%* | *92.22%* | *19.36%* | *12.77%* | *34.79%* | *15.09%* | *6.75%* |

**b. normalized values (Spain = 100)**

| | *all* | *lower sec* | *upper sec* | *lower voc* | *upper voc* | *lower univ* | *upper univ* |
|---|---|---|---|---|---|---|---|
| *Andalucía* | 160.4 | 122.7 | 138.5 | 109.9 | 132.1 | 191.1 | 165.0 |
| *Cantabria* | 117.1 | 4.5 | 98.4 | 50.1 | 242.0 | 274.5 | 155.9 |
| *Galicia* | 114.8 | 46.5 | 86.9 | 23.1 | 153.1 | 163.7 | 122.2 |
| *Canarias* | 112.8 | 63.6 | 99.0 | 72.5 | 136.2 | 131.9 | 95.3 |
| *Asturias* | 107.3 | | 221.1 | 299.8 | 299.0 | 109.6 | 188.0 |
| *Extremadura* | 105.4 | 52.2 | 122.7 | 29.7 | 265.4 | 140.8 | 211.1 |
| *Valencia* | 104.7 | 50.9 | 110.0 | 130.1 | 103.6 | 112.3 | 125.3 |
| *P. Vasco* | 94.3 | | 226.1 | 296.1 | 152.7 | 133.5 | 76.5 |
| *C.-León* | 92.5 | 55.6 | 93.2 | 30.1 | 103.7 | 86.7 | 89.7 |
| *Rioja* | 78.0 | 15.4 | 69.9 | 132.4 | 584.2 | 156.1 | 85.0 |
| *Cataluña* | 74.0 | 87.0 | 86.1 | 114.2 | 69.0 | 74.5 | 59.6 |
| *C.-Mancha* | 65.0 | 63.4 | 71.9 | 20.2 | 83.3 | 96.4 | 92.6 |
| *Madrid* | 65.0 | 173.5 | 110.7 | 203.0 | 55.1 | 70.2 | 101.6 |
| *Murcia* | 63.5 | 25.3 | 86.7 | 20.7 | 276.4 | 155.8 | 120.4 |
| *Baleares* | 63.4 | 92.7 | 55.6 | 109.7 | | 63.9 | 206.7 |
| *Aragón* | 63.4 | | 70.0 | 120.2 | 56.1 | 50.9 | 77.1 |
| *Navarra* | 48.1 | | 66.0 | 134.5 | 67.7 | 100.7 | 45.7 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

- *Note:* some entries are blank because the tax rate is not computed for those regions where baseline returns are negative.

## 6. The social returns to schooling. Detailed results

**Table A.56: Observed social rate of return to schooling (baseline estimate) and its components**

**a. Observed values**

| | $r_{S\,(OBS)}$ | *NUM* | $\rho$ | *EXT* | $\varepsilon$ | *DENOM* | *OPPC* | *DIRC* |
|---|---|---|---|---|---|---|---|---|
| *C.-Mancha* | 12.55% | 12.42% | 9.01% | 0.96% | 2.44% | 111.69% | 96.49% | 15.21% |
| *Extremadura* | 12.53% | 12.79% | 9.04% | 0.97% | 2.79% | 115.31% | 97.82% | 17.48% |
| *Andalucía* | 12.37% | 12.40% | 8.49% | 0.98% | 2.93% | 113.37% | 97.01% | 16.36% |
| *Canarias* | 11.60% | 11.36% | 7.93% | 1.03% | 2.40% | 111.46% | 94.11% | 17.34% |
| *C.-León* | 11.54% | 11.25% | 7.89% | 1.03% | 2.33% | 111.05% | 95.68% | 15.37% |
| *Valencia* | 11.40% | 11.06% | 8.07% | 1.04% | 1.95% | 110.59% | 94.67% | 15.92% |
| *Murcia* | 11.37% | 11.24% | 8.25% | 1.04% | 1.95% | 112.74% | 96.45% | 16.29% |
| *Galicia* | 11.29% | 11.61% | 8.42% | 1.05% | 2.14% | 117.37% | 97.55% | 19.82% |
| *Cataluña* | 11.16% | 10.51% | 7.65% | 1.06% | 1.80% | 107.54% | 94.23% | 13.31% |
| *Aragón* | 11.09% | 10.51% | 7.74% | 1.06% | 1.70% | 108.25% | 94.01% | 14.24% |
| *Asturias* | 11.04% | 11.41% | 7.70% | 1.07% | 2.64% | 118.15% | 99.39% | 18.75% |
| *Baleares* | 10.94% | 10.14% | 7.80% | 1.08% | 1.26% | 106.10% | 95.35% | 10.75% |
| *P. Vasco* | 10.58% | 10.39% | 7.16% | 1.10% | 2.13% | 112.57% | 95.88% | 16.70% |
| *Navarra* | 10.55% | 10.06% | 7.30% | 1.11% | 1.65% | 109.40% | 95.15% | 14.25% |
| *Rioja* | 10.37% | 10.59% | 7.72% | 1.12% | 1.75% | 117.31% | 99.29% | 18.02% |
| *Cantabria* | 10.33% | 10.63% | 7.53% | 1.12% | 1.98% | 118.30% | 99.52% | 18.78% |
| *Madrid* | 10.10% | 9.63% | 6.80% | 1.15% | 1.69% | 109.69% | 97.95% | 11.75% |
| *Spain* | *11.41%* | *11.15%* | *7.81%* | *1.04%* | *2.30%* | *111.41%* | *96.23%* | *15.18%* |

**b. Normalized values**

| | $r_{S\,(OBS)}$ | *NUM* | $\rho$ | *EXT* | $\varepsilon$ | *DENOM* | *OPPC* | *DIRC* |
|---|---|---|---|---|---|---|---|---|
| *C.-Mancha* | 110.0 | 111.4 | 80.8 | 8.6 | 21.9 | 100.3 | 86.6 | 13.6 |
| *Extremadura* | 109.8 | 114.7 | 81.0 | 8.7 | 25.0 | 103.5 | 87.8 | 15.7 |
| *Andalucía* | 108.4 | 111.2 | 76.1 | 8.8 | 26.3 | 101.8 | 87.1 | 14.7 |
| *Canarias* | 101.7 | 101.9 | 71.1 | 9.2 | 21.5 | 100.0 | 84.5 | 15.6 |
| *C.-León* | 101.1 | 100.9 | 70.7 | 9.3 | 20.9 | 99.7 | 85.9 | 13.8 |
| *Valencia* | 100.0 | 99.2 | 72.4 | 9.3 | 17.5 | 99.3 | 85.0 | 14.3 |
| *Murcia* | 99.7 | 100.8 | 74.0 | 9.4 | 17.5 | 101.2 | 86.6 | 14.6 |
| *Galicia* | 99.0 | 104.1 | 75.5 | 9.4 | 19.2 | 105.4 | 87.6 | 17.8 |
| *Cataluña* | 97.8 | 94.2 | 68.6 | 9.5 | 16.2 | 96.5 | 84.6 | 12.0 |
| *Aragón* | 97.2 | 94.2 | 69.4 | 9.5 | 15.3 | 97.2 | 84.4 | 12.8 |
| *Asturias* | 96.8 | 102.3 | 69.1 | 9.6 | 23.7 | 106.0 | 89.2 | 16.8 |
| *Baleares* | 95.8 | 90.9 | 70.0 | 9.7 | 11.3 | 95.2 | 85.6 | 9.7 |
| *P. Vasco* | 92.7 | 93.1 | 64.2 | 9.9 | 19.1 | 101.0 | 86.1 | 15.0 |
| *Navarra* | 92.4 | 90.2 | 65.5 | 9.9 | 14.8 | 98.2 | 85.4 | 12.8 |
| *Rioja* | 90.9 | 94.9 | 69.2 | 10.1 | 15.7 | 105.3 | 89.1 | 16.2 |
| *Cantabria* | 90.6 | 95.4 | 67.5 | 10.1 | 17.8 | 106.2 | 89.3 | 16.9 |
| *Madrid* | 88.5 | 86.3 | 60.9 | 10.3 | 15.1 | 98.5 | 87.9 | 10.5 |
| *Spain* | *100.0* | *100.0* | *70.0* | *9.3* | *20.6* | *100.0* | *86.4* | *13.6* |

Table A.56 gives the values of the baseline estimate of the all-in social return to schooling, $r_S$ ,and of its various cost and benefit components (see equation (7) in Box 1). As in the case of the private rate of return, productivity effects and opportunity costs are the dominant determinants of the social rate of return to schooling. For the country as a whole, level effects on productivity *(ρ)* account for 70% of the total benefits of schooling and employment effects *(ε)* for an additional 20.6%, while opportunity costs *(OPPC)* make up almost 87% of total costs. Table A.57 shows the detailed *baseline* and *min* results by region under the different scenarios.

**Table A.57: Social rate of return to schooling under different scenarios**

| | *level effects* | | *+ empl. eff.* | | *+ rate eff. = OBS* | |
|---|---|---|---|---|---|---|
| | *min* | *baseline* | *min* | *baseline* | *min* | *baseline* |
| *Andalucía* | 5.87% | 8.73% | 8.87% | 11.48% | 9.97% | 12.37% |
| *Aragón* | 5.56% | 8.35% | 7.47% | 10.06% | 8.79% | 11.09% |
| *Asturias* | 5.01% | 7.64% | 7.74% | 10.09% | 8.93% | 11.04% |
| *Baleares* | 5.74% | 8.58% | 7.18% | 9.86% | 8.57% | 10.94% |
| *Canarias* | 5.55% | 8.32% | 8.11% | 10.64% | 9.31% | 11.60% |
| *Cantabria* | 4.86% | 7.45% | 6.96% | 9.32% | 8.26% | 10.33% |
| *C.-León* | 5.53% | 8.30% | 8.04% | 10.57% | 9.25% | 11.54% |
| *C.-Mancha* | 6.35% | 9.36% | 8.85% | 11.67% | 9.97% | 12.55% |
| *Cataluña* | 5.53% | 8.31% | 7.56% | 10.13% | 8.87% | 11.16% |
| *Valencia* | 5.71% | 8.52% | 7.81% | 10.42% | 9.06% | 11.40% |
| *Extremadura* | 6.16% | 9.11% | 8.93% | 11.66% | 10.01% | 12.53% |
| *Galicia* | 5.60% | 8.39% | 7.78% | 10.35% | 8.97% | 11.29% |
| *Madrid* | 4.66% | 7.23% | 6.63% | 8.97% | 8.07% | 10.10% |
| *Murcia* | 5.72% | 8.54% | 7.78% | 10.40% | 9.01% | 11.37% |
| *Navarra* | 5.12% | 7.80% | 7.00% | 9.47% | 8.38% | 10.55% |
| *P. Vasco* | 4.83% | 7.43% | 7.19% | 9.53% | 8.51% | 10.58% |
| *Rioja* | 5.06% | 7.70% | 6.92% | 9.35% | 8.23% | 10.37% |
| *Spain* | *5.45%* | *8.19%* | *7.93%* | *10.43%* | *9.15%* | *11.41%* |
| *de la F. (2003)* | | | | | 8.87% | 11.34% |

| | *level effects* | | *+ empl. eff.* | | *+ rate eff. = OBS* | |
|---|---|---|---|---|---|---|
| | *min* | *baseline* | *min* | *baseline* | *min* | *baseline* |
| *Andalucía* | 107.7 | 106.5 | 111.9 | 110.0 | 108.9 | 108.4 |
| *Aragón* | 102.1 | 101.9 | 94.2 | 96.4 | 96.0 | 97.2 |
| *Asturias* | 92.0 | 93.2 | 97.6 | 96.7 | 97.5 | 96.8 |
| *Baleares* | 105.4 | 104.7 | 90.6 | 94.6 | 93.6 | 95.8 |
| *Canarias* | 101.9 | 101.5 | 102.3 | 102.0 | 101.7 | 101.7 |
| *Cantabria* | 89.2 | 90.9 | 87.9 | 89.3 | 90.2 | 90.6 |
| *C.-León* | 101.5 | 101.3 | 101.4 | 101.3 | 101.1 | 101.1 |
| *C.-Mancha* | 116.5 | 114.2 | 111.7 | 111.8 | 108.9 | 110.0 |
| *Cataluña* | 101.5 | 101.4 | 95.3 | 97.1 | 96.9 | 97.8 |
| *Valencia* | 104.7 | 104.0 | 98.5 | 99.9 | 99.0 | 100.0 |
| *Extremadura* | 113.0 | 111.2 | 112.7 | 111.8 | 109.4 | 109.8 |
| *Galicia* | 102.8 | 102.3 | 98.2 | 99.2 | 98.0 | 99.0 |
| *Madrid* | 85.5 | 88.2 | 83.7 | 86.0 | 88.2 | 88.5 |
| *Murcia* | 105.0 | 104.2 | 98.2 | 99.7 | 98.5 | 99.7 |
| *Navarra* | 94.0 | 95.2 | 88.3 | 90.7 | 91.6 | 92.4 |
| *P. Vasco* | 88.6 | 90.7 | 90.8 | 91.4 | 93.0 | 92.7 |
| *Rioja* | 92.8 | 94.0 | 87.3 | 89.6 | 89.9 | 90.9 |
| *Spain* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |

**Table A.58: Social rate of return to schooling and other assets**

| | schooling (all in) | | phys. capital | | infrastr. |
|---|---|---|---|---|---|
| | *min* | *baseline* | *min* | *baseline* | *baseline* |
| *Andalucía* | 9.97% | 12.37% | 4.51% | 10.05% | 9.17% |
| *Aragón* | 8.79% | 11.09% | 4.07% | 9.38% | 10.67% |
| *Asturias* | 8.93% | 11.04% | 2.64% | 7.22% | 8.99% |
| *Baleares* | 8.57% | 10.94% | 4.33% | 9.76% | 27.68% |
| *Canarias* | 9.31% | 11.60% | 4.99% | 12.48% | 16.27% |
| *Cantabria* | 8.26% | 10.33% | 3.07% | 10.76% | 9.86% |
| *C.-León* | 9.25% | 11.54% | 3.27% | 7.87% | 9.62% |
| *C.-Mancha* | 9.97% | 12.55% | 2.93% | 7.66% | 6.85% |
| *Cataluña* | 8.87% | 11.16% | 5.73% | 8.17% | 20.89% |
| *Valencia* | 9.06% | 11.40% | 6.13% | 11.88% | 15.99% |
| *Extremadura* | 10.01% | 12.53% | 1.85% | 6.03% | 6.86% |
| *Galicia* | 8.97% | 11.29% | 3.81% | 8.98% | 13.28% |
| *Madrid* | 8.07% | 10.10% | 8.92% | 16.70% | 30.71% |
| *Murcia* | 9.01% | 11.37% | 6.16% | 12.53% | 13.16% |
| *Navarra* | 8.38% | 10.55% | 4.45% | 9.96% | 11.48% |
| *P. Vasco* | 8.51% | 10.58% | 3.58% | 8.64% | 13.78% |
| *Rioja* | 8.23% | 10.37% | 6.62% | 13.22% | 10.80% |
| *Spain* | *9.15%* | *11.41%* | *5.09%* | *10.91%* | *14.46%* |

Table A.58 reproduces our estimates of the all-in social return to schooling and the returns to non-infrastructure and infrastructure physical capital ($r_k$ and $r_x$). The estimates of these magnitudes that are labeled as *baseline* have been obtained using the baseline values of the relevant output elasticities shown in italics in Table 23 (that is, $\alpha_k$ = 0.258, $\alpha_x$ = 0.056, $\alpha_s$ = 0.587 and $\gamma$ = 0.15%). The *min* estimate of the return on human capital uses the value of $\alpha_s$ estimated by de la Fuente and Doménech (2002) without correcting for measurement error bias (0.394), and that of $\alpha_k$ is based on the uncorrected estimate of 0.171 given in Table 12 in section 3.c of the text.