HUMAN CAPITAL, GROWTH AND INEQUALITY IN THE SPANISH REGIONS

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1. OVERVIEW

- We analyze the macro-economic effects of schooling in the Spanish regions and the potential role of investment in human capital as a tool for promoting regional growth and cohesion.

- *Questions:*

1) How have regional attainment levels evolved since 1960?

2) How does school attainment affect aggregate productivity at the regional level?

3) What is the social return to investment in schooling ?

4) How do the returns on human capital compare to those on infrastructures and other capital? How should this affect the formulation of regional and growth policies?

2. THE EVOLUTION OF NATIONAL AND REGIONAL ATTAINMENTS

- We have used data from the national census and the municipal registers to construct new regional series of educational attainment in Spain and its regions covering the period 1960-2000.
- Average attainment has risen sharply and the dispersion of educational levels has fallen significantly, especially after 1980.
- But there remain i) a significant education gap with other advanced countries and

ii) considerable cross-regional differences.

- Solving these problems may be crucial for real convergence and for internal cohesion.

Figure 1: Average years of schooling in Spain and CV of regional attainment levels (1960 = 100)

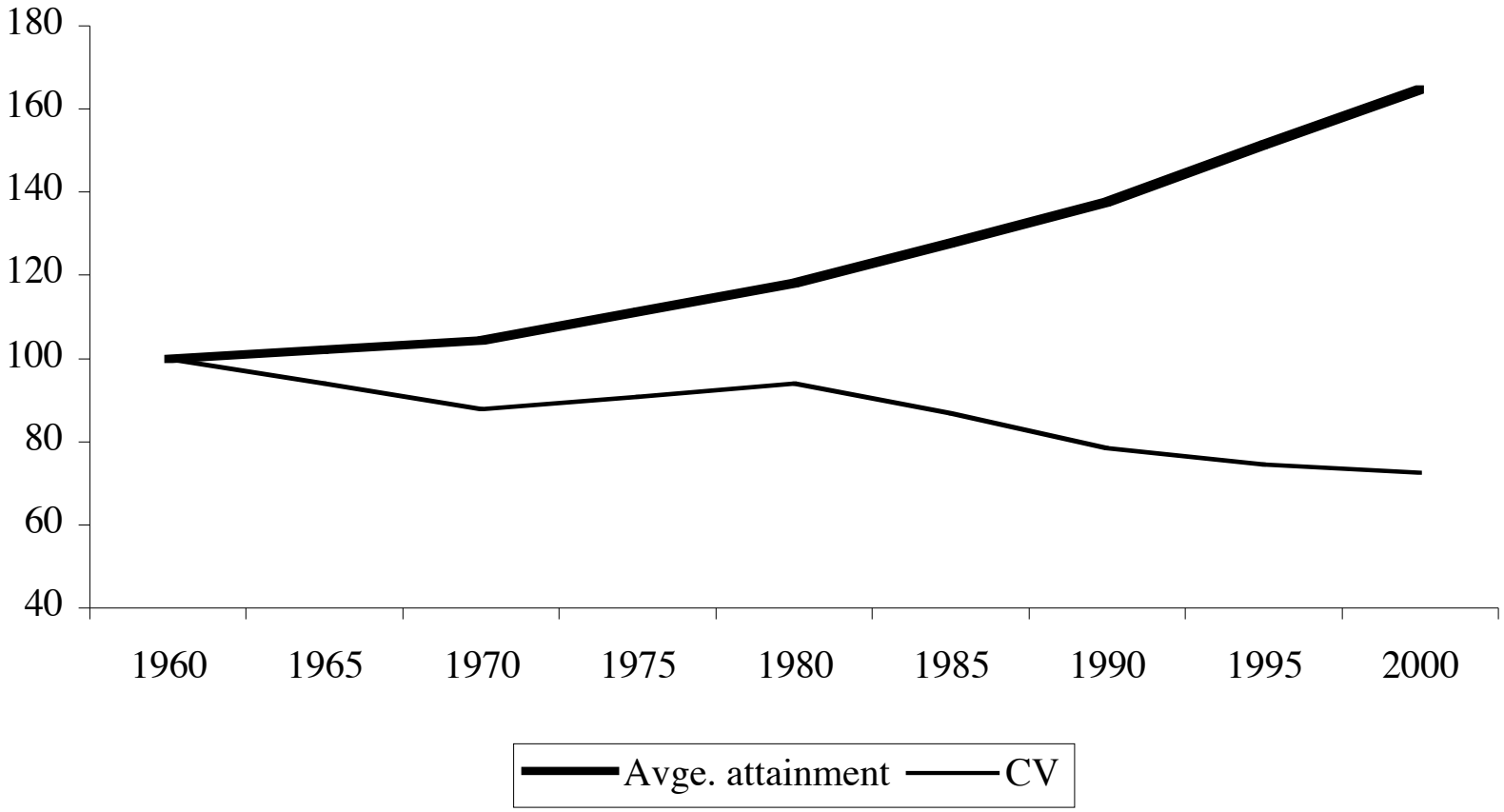


Figure 2: Educational gap (years of schooling)
Spain relative to the US and EU15

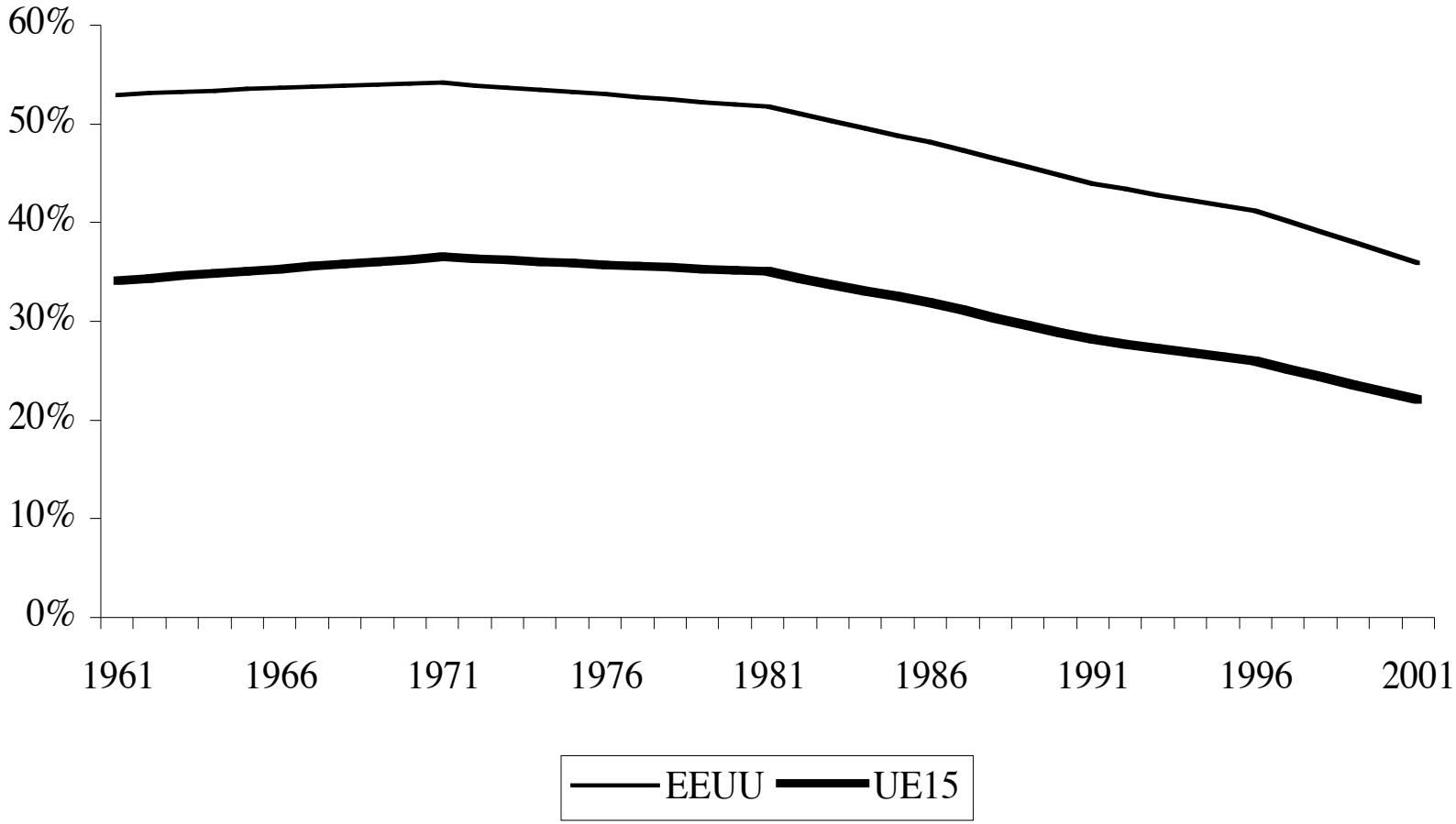


Figure 3: Average years of schooling by region (Spain = 100)

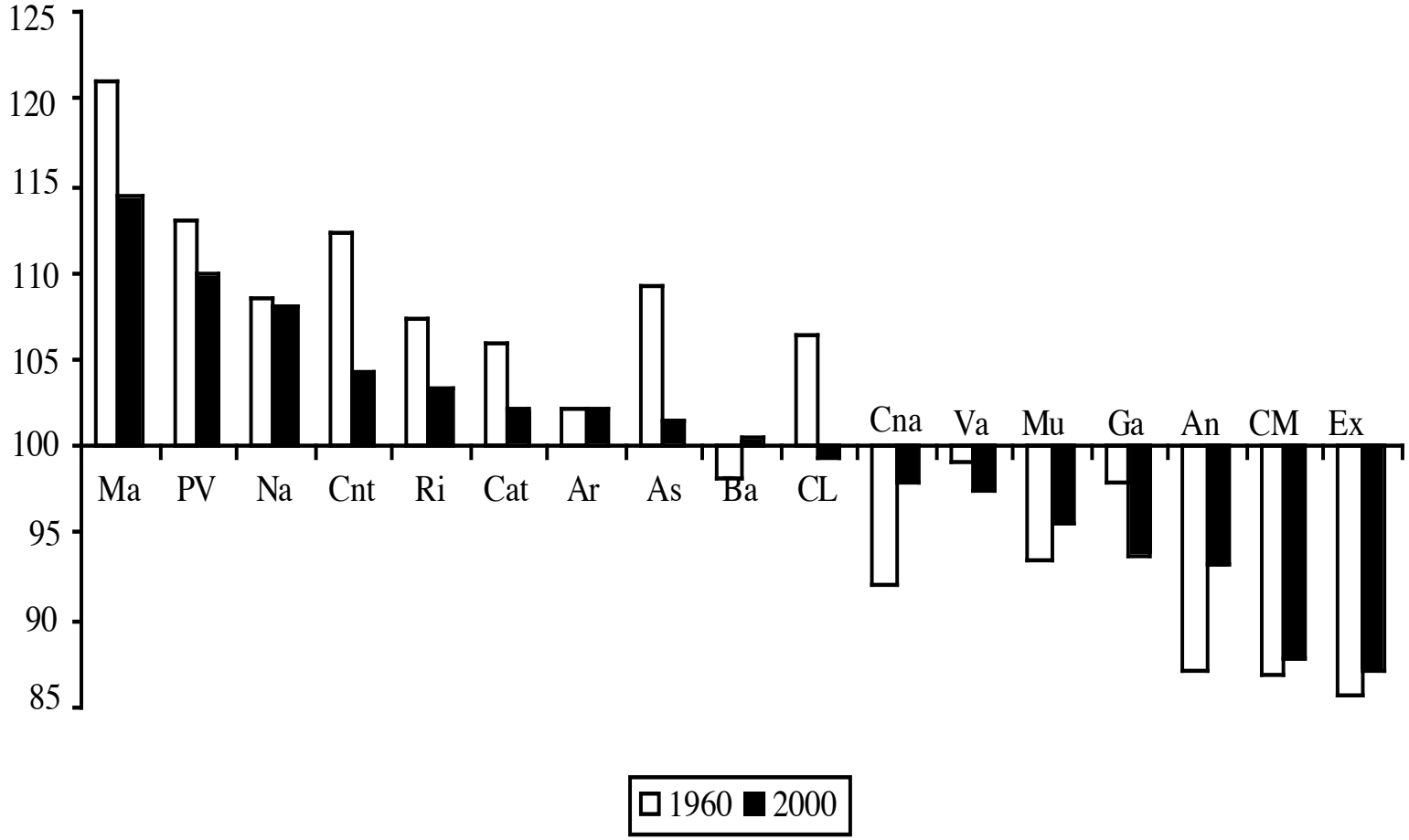
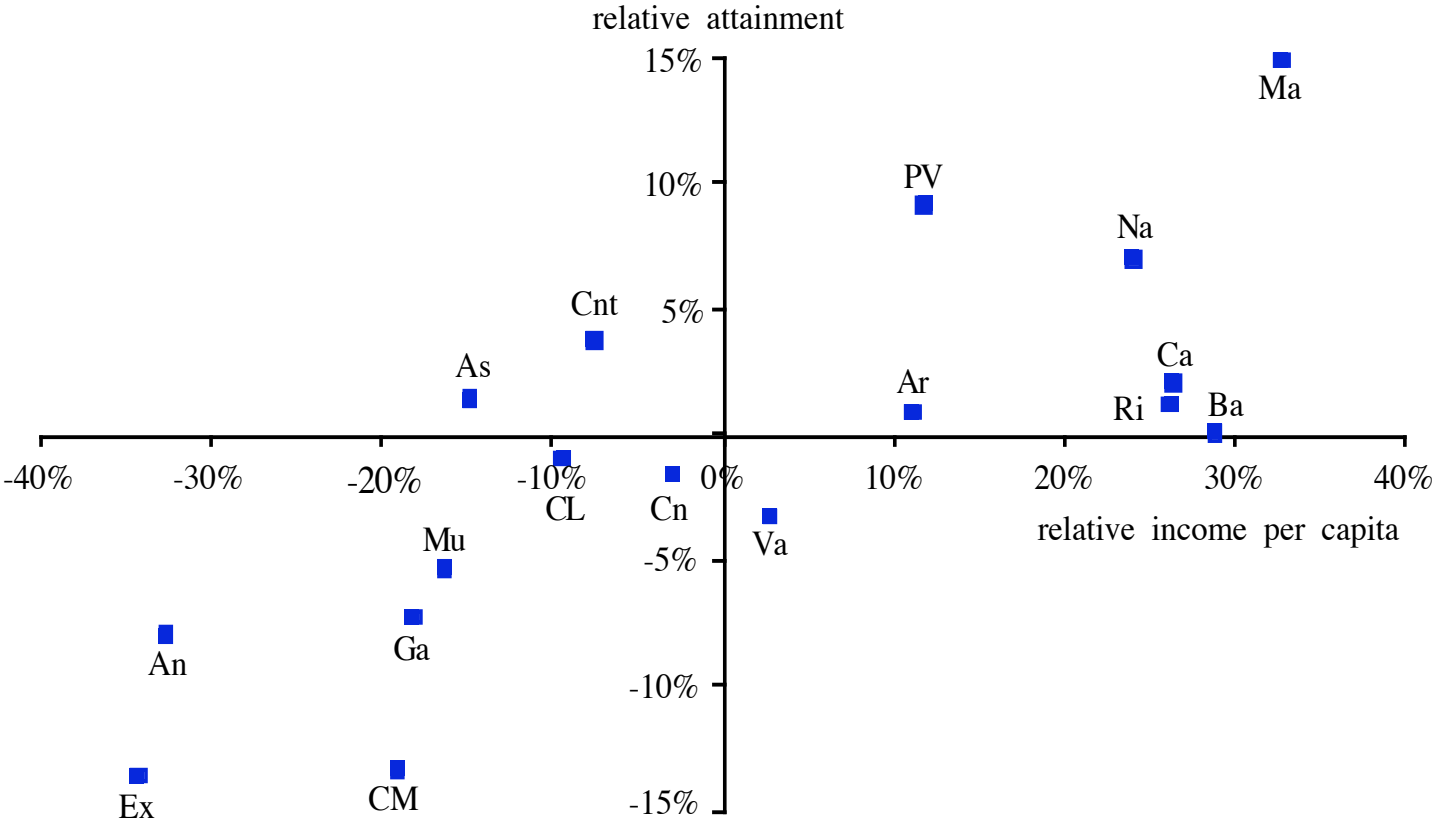


Figure 4: Relative attainment vs. relative GDP per capita in 1995



3. THE EFFECTS OF SCHOOLING ON REGIONAL PRODUCTIVITY

- We estimate a growth specification that combines a production function and a technical progress relation allowing for technological catch-up across regions,

$$(10)\ \Delta q_{it} = \Gamma + \mu_i + \eta_t + \lambda b_{it} + \alpha_k \Delta k_{it} + \alpha_x \Delta x_{it} + \beta \Delta s_{it} + \varepsilon_{it}$$

$$(11)\ b_{it} = (q_{Mt} - \alpha_k k_{Mt} - \alpha_x x_{Mt} - \beta s_{Mt}) - (q_{it} - \alpha_k k_{it} - \alpha_x x_{it} - \beta s_{it})$$

using both our new series and the IVIE estimates of attainment based on the labour force survey.

- The information content of our series, measured by their reliability rate, is much higher than that of the IVIE series (due to the small size of EPA regional samples?)

The growth results also improve considerably.

Table 1: Growth estimates with alternative schooling series and specifications

	[1]	[2]	[3]	[4]
S data from:	*MPUSS*	*D&D*	*MPUSS*	*D&D*
α_k	0.161	0.171	0.161	0.171
	(3.05)	(3.27)	(3.24)	(3.50)
α_x	0.062	0.0567	0.062	0.0560
	(3.52)	(3.25)	(4.33)	(3.88)
β	-0.013	0.835	-0.013	0.835
	(0.11)	(2.04)	(0.11)	(4.13)
λ	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.

- The human capital coefficient, β, is quite large, but consistent with our previous results for an OECD sample (D&D, 2002).

- The coefficient of private capital appears to be too low. For the calculations below, we scale it up so the sum of the coefficients of private and public capital is equal to capital's share in output (31.4%).

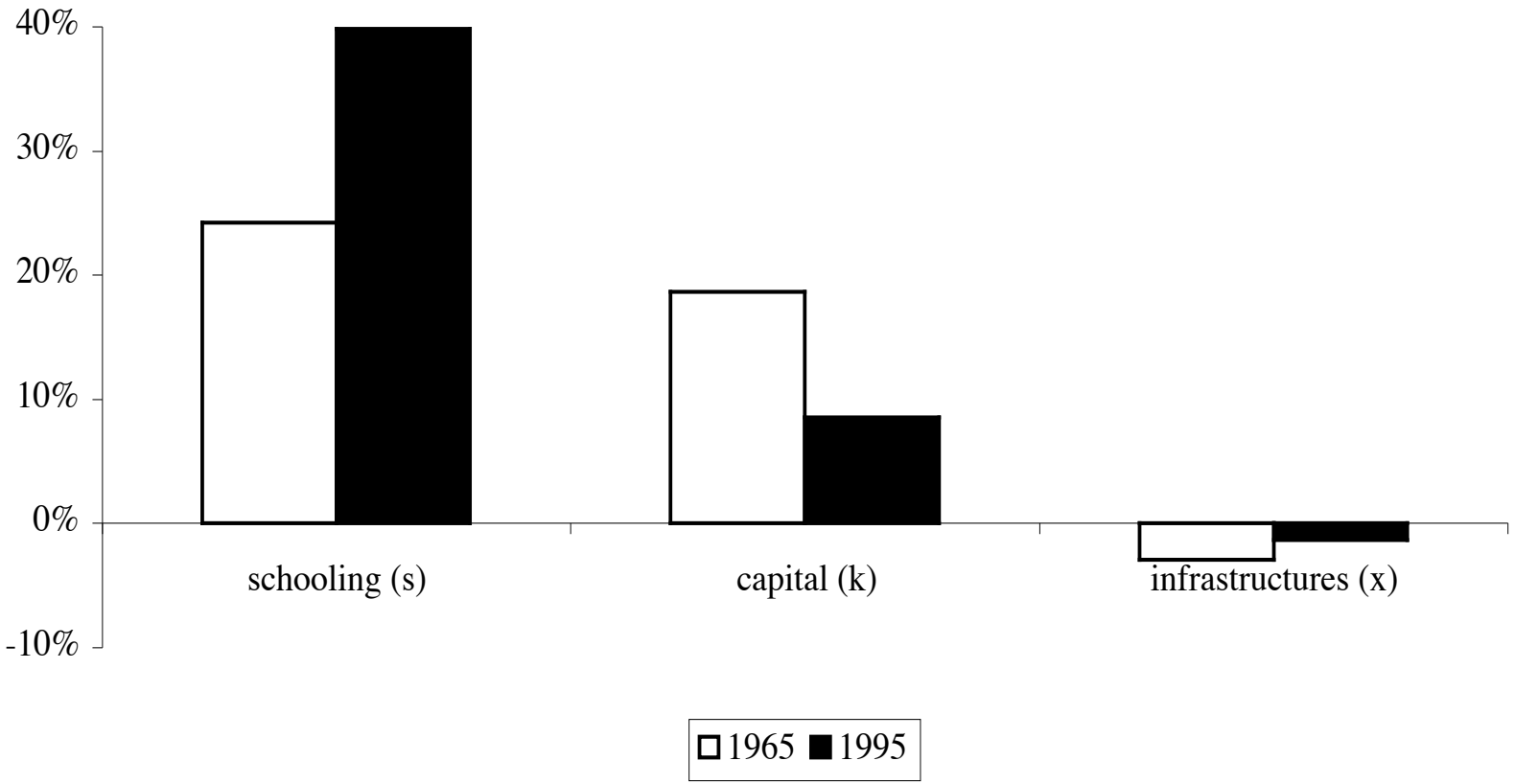
- Infrastructure coefficient is lower than in previous studies.

- Differences in educational attainment account for 40% of observed productivity differentials.

The contribution of private capital to productivity disparities is considerably smaller,

and that of infrastructures is actually negative.

Figure 5: Shares of different factors in relative productivity



4. THE SOCIAL RETURN TO SCHOOLING: THEORY

• We derive an almost closed-form expression for the social return to schooling within the framework of a simple growth model that allows for both level and rate effects from human capital.

• Production function:

$$(1)\ Y_{it} = A_{it}\, K_{it}^{\alpha_k} S_{it}^{\alpha_S} L_{it}^{\alpha_l} \ \Rightarrow\ (2)\ Q = Af(S) = AZ_{it}^{\alpha_k} S_{it}^{\alpha_S}$$

• Technical progress: $(4)\ A_{it} = B_t X_{it}$

where B_t denotes the national technological frontier and $X_{it} = A_{it}/B_t$ the technological gap between region i and the frontier. We assume that B_t grows exogenously at rate, g, and that

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

• *Note:* There are two human capital parameters (α_S and γ), but we have estimated only one (β). We'll come back to this.

• We define the macro *mincerian return* to schooling by

$$(3)\ \rho = \frac{Af'(S)}{Af(S)} = \frac{\alpha_S}{S}$$

This parameter gives the percentage increase in average output associated with a one-year increase in average attainment.

• We calculate the social return to schooling as the internal rate of return to a marginal increase in attainment for a single generation -- i.e. as the discount rate that equates the present value of the streams of benefits and costs associated with a small increase in the level of education that lasts for a generation.

- Representative agent:

in school from 0 to S, works part-time a fraction $1-\phi$ of time

works full time from S to U and then retires

probability of being employed is a function of attainment, $p(S)$ for adult workers and $\eta p(S)$ for students

- The direct cost of "year" of schooling is a fixed fraction of the output of a mature worker of average attainment, $\mu A f(S_o)$.

- We define a function that describes this generation's contribution to output net of schooling costs as a function of attainment, differentiate it and solve for the discount rate.

$$V(S) = \int_0^S (1-\phi)\eta p(t) A_t f(t) e^{-rt} dt \qquad \textit{(output while in school)}$$

$$+ \int_S^U p(S) A_t(S) f(S) e^{-rt} dt \qquad \textit{(output as adult workers)}$$

$$-\int_0^S \mu A_t f(S_o) e^{-rt} dt \qquad \textit{(direct costs of education)}$$

$$+ \int_U^\infty p(S_o) A_t(S) f(S_o) e^{-rt} dt \qquad \textit{(impact on future generations through } A_u\textit{)}$$

- Solving $V'(S_o) = 0$ for r, we have: *(7)* $r_s = R_s + g$

where R_s is the value of R that solves the following equation:

$$(8) \quad \frac{R}{1-e^{-RH}} = \frac{\rho + \varepsilon + \dfrac{\gamma}{R+\lambda}}{\left(1-(1-\phi)\eta\right) + \dfrac{\mu}{p_o}} \equiv \frac{\rho + \varepsilon + EXT}{OPPC + DIRC}$$

- Interpretation:

R_s is the ratio of benefits to costs,

adjusted by the finite life of the "asset" ($H = U - S$)

Benefits come from level effects, the increase in employment and rate effects (externalities)

and costs are opportunity costs (lost working time) and direct costs.

5. THE SOCIAL RETURN TO SCHOOLING: PARAMETER VALUES AND DATA

- Parameter values are based on our econometric estimates but with some corrections -- to be on the safe side.

- The coefficient of private capital is adjusted upward as indicated above.

- Main problem: the model has two human capital parameters, but we have only estimated one (results were not satisfactory when we tried to estimate both).

Why do we insist on including rate effects?

• Our estimate of β implies private returns to schooling way above those obtained from the estimation of wage regressions.

• This suggests there are important externalities*. But

- the most plausible source of externalities identified in the literature has to do with the effects of schooling on technical progress through innovation and absorption

- our assumption amounts to saying that externalities take time. This is more conservative, since part of the benefits of schooling accrue over time and must therefore be discounted.

(*) or reverse causation bias, but we do not think this is a problem given the data and the specification.

How do we choose α_S and γ?

• We interpret β as an estimate of the effect of schooling on steady state output. This implies

$$(12)\ \frac{\beta}{S} = \frac{\alpha_s}{S} + \frac{\gamma}{\lambda}$$

• We use this equation to recover the value of γ that is consistent with our estimate of β and with an outside estimate of α_s.

• The estimate of α_s is taken from a previous paper (D&D, 2002) and is consistent with the available evidence on the individual returns to schooling in Europe.

Table 4: Parameter values used to calculate social returns

human capital:	
level effects: α_S	0.394-*0.587*
rate effects: γ	0-*0.15%*
others:	
physical capital: α_k	0.171-*0.258*
infrastructure: α_x	*0.056*
technological diffusion: λ	*0.045*
exog. technical progress: g	*0.015*
time in school: ϕ	*0.80*
retirement age: U	*60.5*
depreciation, private c.: δ_k	*7.86%*
depreciation, infrastr.: δ_k	*4.33%*

Reference values (considered most likely) in italics.

Other variables

- Direct costs of schooling *(μ)*. Calculated from various INE sources on private and public educational expenditure. We use a weighted average of expenditure per student at the secondary and university levels.

- Response of employment to educational attainment. Taken from DDJ (2005), where we estimate participation and employment equations using a Heckman specification with individual data from EPA.

These are partial equilibrium, individual-level estimates. To try to approximate general equilibrium effects, we divide them by three. Obviously ad-hoc. Just trying to get a feeling for the likely order of magnitude.

6. THE SOCIAL RETURN TO SCHOOLING: RESULTS AND IMPLICATIONS

- We calculate the social return to investment in education, private capital and infrastructures in each region in 1995.
- The economic return to investment in schooling is probably higher than that on private physical capital.
- For Spain as a whole and for its richest areas, the return on infrastructure is even higher. For many of the poorest regions, however, human capital seems to have the highest return.

Figure 6: Social rate of return to schooling in the Spanish regions

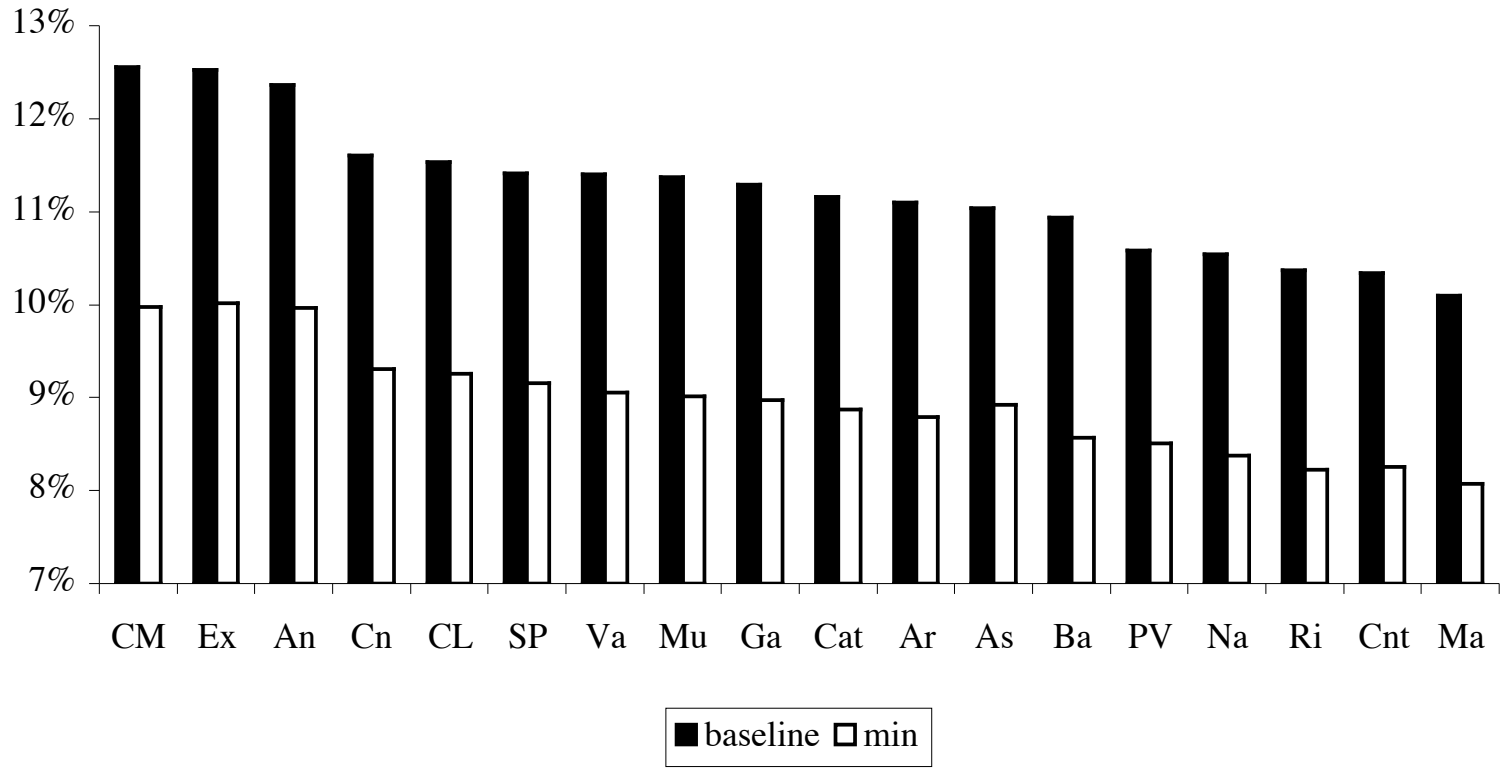


Figure 7: Social rate of return to schooling under different scenarios and returns on physical capital and infrastructures in Spain

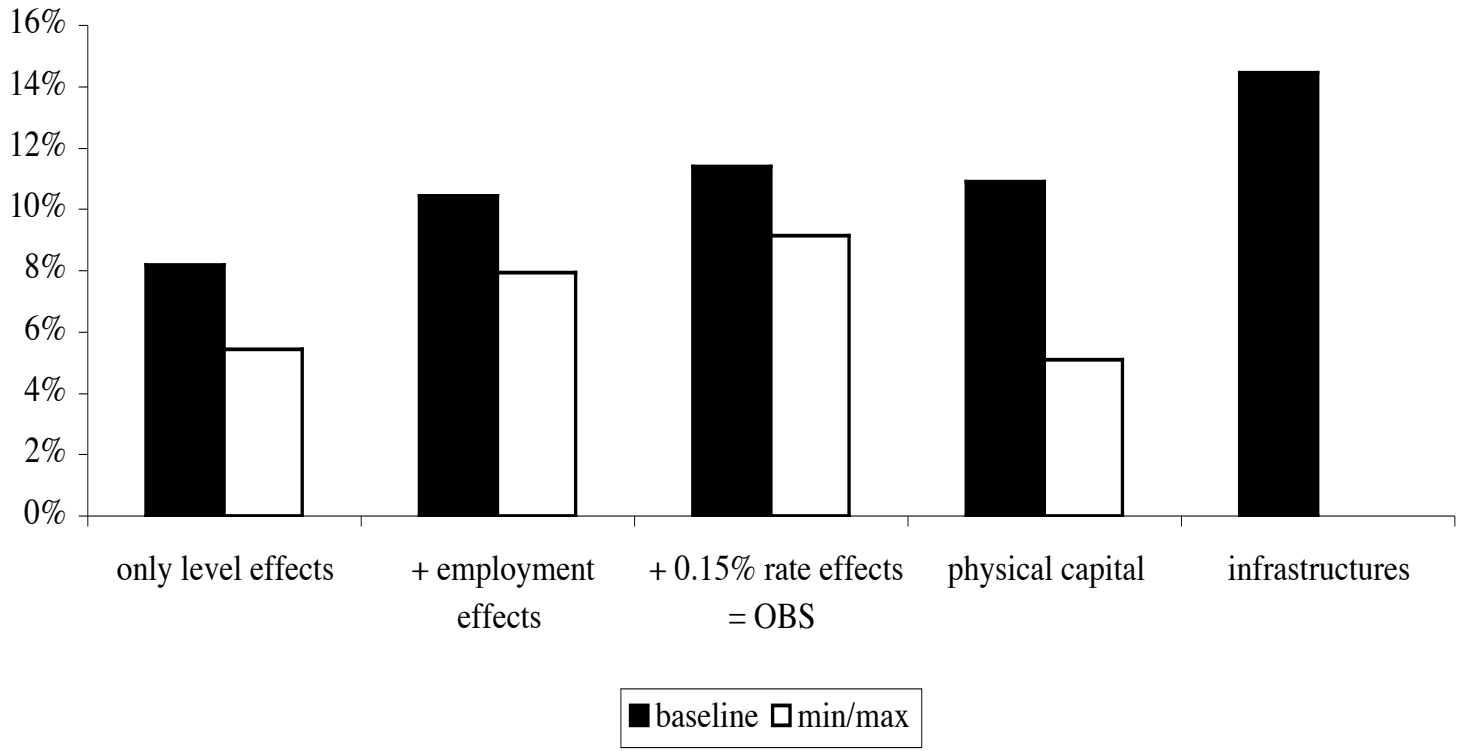
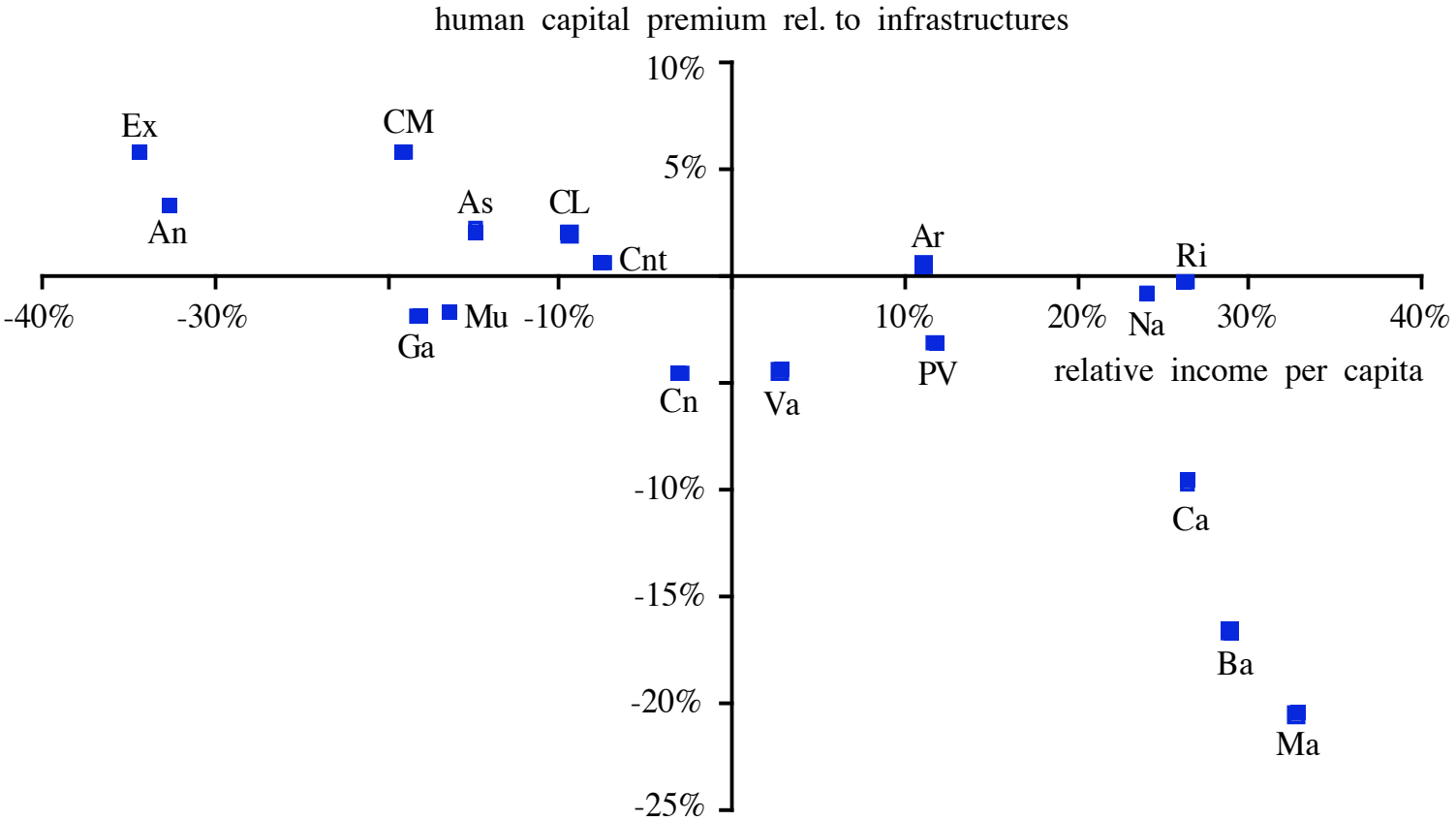


Figure 32: Human capital premium relative to infrastructures vs. relative income per capita in 1995



Implications for cohesion + growth policies

- There is more scope for regional redistribution through investment in human capital than in infrastructures,

and there is no trade-off between real convergence and internal cohesion in the case of education.

- It may be possible to reconcile both goals by

increasing investment in education, targeted to disadvantaged groups (which will benefit poor regions more)

and directing part of infrastructure investment to richer ones