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Segmented Life-cycle Labor Markets – Portuguese Evidence *

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ABSTRACT

Segmented Life-cycle Labor Markets – Portuguese Evidence

It is the purpose of this research to provide and contrast the pattern of returns to human capital in different economic sectors. As job mobility, especially across sectors, is limited, it is argued that coefficients of experience in earnings regressions may capture or be interpreted as the growth rate – net of depreciation – of earnings ability propitiated by schooling when years of education are also included in the right hand-side of the equation. As a consequence, under long-term contracts, labor market equilibrium is compatible with different "gross" rates of return to schooling, provided initial earnings levels allow for the same accumulated present value. That implies a special relation between the intercept and experience coefficient of earnings regressions performed for different sectors.

Additionally, implications of (log-stable) nonstationary environments for rate of return inference from log-earnings regressions – appropriate for pooled (or panel) estimation and nominal earnings information - are also investigated. Then, the trend coefficient measures the (steady-state) nominal productivity growth; the experience coefficients approximate individuals' earnings profiles growth rates net of the human capital depreciation rate; schooling's, the nominal rate of return in the economy net of the nominal productivity growth rate.

Tests of the hypothesises are provided, along with the inspection of the determinants – including financial ratios and productive organization indicators, calculated from aggregate balance sheet information - of the observed differences across industries. A study of the estimated variances of rate of return estimates was also conducted, as an attempt to capture features of financial risk in human capital investment.

JEL Classification: J24; J31; J42; I2; G30; C13; C39.

Keywords: Returns to Schooling; Earnings/Wage Growth; Wage Determinants; Segmented Labor Markets. Industry-Specific Human Capital. Human Capital Risk. Financial Structure and Performance. Weighted Principal Components.

Theme: Education and Training

Segmented Life-cycle Labor Markets – Portuguese Evidence

Introduction.

Job stability seems to be a dominant feature of the labor market: mean tenure of Portuguese employed labor force in years 95-99 registered in "Quadros de Pessoal" can be roughly approximated by 7.6 years. Job transitions are, thus, relatively infrequent – job attachment a dominant characteristic of the labor market –, and it is suspected that job changes between sectors are even rarer. Across industries, wage and employment characteristics vary substantially, and human capital theory – after names like Schultz (1960), Becker (1962, 1975) – provides a framework to relate both under competitive equilibrium assumptions. Yet, as segmented labor market literature has documented [1], residual but non-negligible importance of institutional and other factors in the explanation of wage/earnings dispersion seems to remain. It is the primary purpose of this research to point out the role of industry-specific (or made-specific) human capital acquired through schooling in the making of part of observed heterogeneity possible, and adapt standard empirical inference on inherent rates of return in accordance.

One of the salient features of earnings profiles is an increasing pattern with either schooling on the one hand, and with age, tenure and years of experience on the other [2]. The former is commonly accepted to be due to general human capital investment – even if the screening hypothesis would explain a residual causality. The latter, to on-the-job training (O.J.T.), and/or – specially tenure - (more or less) implicit contract arrangements within internal (to the firm) labor markets. Experience and tenure are unavoidably entangled, and some schooling – specially at higher levels – is oriented to provide skill specialization only productive-enhancing in specific tasks or professions.

Financially speaking, schooling years, requiring full opportunity costs of the use of time, can be seen to generate a pattern of potential earnings stream over an individual's lifetime. Earning's growth pattern of the alternative profiles available in the market to a given schooling category do not have to coincide in a competitive environment; they can diverge, provided that switch between – mobility across - profiles (not only of jobs; in fact, the access of some earnings profiles may require job switches…) in mid-careers is impossible – say, one has to "start all over" with low earnings - and earnings flows profiles yield the same net present value at the decision point.

[1] See McNabb and Ryan (1990) for a survey. Also Magnac (1991).

[2] See Willis (1986) for an early survey.

The Mincerian – Mincer (1974) - interpretation of log-earnings regressions is based on the separation of human capital generated by schooling [3] and O.J.T. It is a first endeavour of this research to re-assess them in the light of the previous reasoning: schooling provides an earnings (net of eventual O.J.T. costs) growth potential which may differ across industries and still be compatible with the same financial profitability. The analysis is extended to accommodate the possibility of depreciation of human capital acquired through schooling – even if that was also dealt with by Mincer – and/of on-the-job training, and, more importantly, to the presence of general productivity or nominal growth - under which assumption younger cohorts (even if all infinitely-lived) can be expected to systematically experience better lifetime-earnings prospects than those of their ancestors - and the use of pooled (time series waves of cross-section samples, or panel) data. Interestingly, even if education and growth have been formally related in other branches of economics [4], no attempt has been made to incorporate its dynamics in log-earnings regressions [5].

An empirical application is then forwarded. On the one hand, we reinterpret homogeneous log earnings regressions; the analysis provided new (and recent) estimates of – average - returns to schooling for Portugal – that adds to those of studies surveyed in Asplund and Pereira (1999) [6] , but also of the new indicators. On the other, we re-estimate them assuming that earnings profiles – average profiles – available to each schooling category are industry-specific. This disaggregation is dictated by the available data. We estimate industry rates of return to schooling, earnings growth and nominal productivity growth rates, and test the compatibility with equilibrium conditions. The lack of consistency made us look for further segmentation factors.

The evidence in support of the existence of (other) segmentation to explain wage inequality or dispersion is blurred by potential unobservable worker productive skills or more or less attractive job characteristics – gender, and other demographic factors, industry concentration, firm or plant size (public sector, unionisation) [7]. Little attention is given to short or medium run effects of (necessarily unanticipated) swings in returns to physical capital, of profitability or financial restrictions faced by the firms on wage determination. The above analysis justifies part of earnings heterogeneity, usually not accounted for in standard research. Still, it is a matter of inquiry how financial or productive arrangements determine or affect the several indicators - rates of return, earnings growth or nominal productivity dynamics -, which may represent long-run or structural features of the productive process itself. In part, such patterns may be compatible with equilibrium; in part they still may not.

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[3] An appraisal of recent related literature can be found in Card (1999).

[4] See Topel (1999) and Krueger and Lindhal (2001) for recent surveys.

[5] An early theoretical discussion can be found in Martins (1987).

[6] That include Soares, São Pedro and Magalhães (1984), Silva (1985), Martins (1991), Kiker and Santos (1991), Kiker and Santos e Oliveira (1997) among others.

[7] See, for example, Kiker and Santos (1991), Kiker and Santos e Oliveira (1997) and Martins (1998) for Portugal.

Another neglected topic in human capital empirical evidence is financial risk. If one regresses a series on a constant term, the coefficient estimator is the mean of the variable and the variance of the coefficient estimate is the variance of the *mean* of the variable, of the estimator of the parameter. By analogy, to obtain the variance of the variable itself one should multiply by the number of observations used in the regression. Hence, we essayed with the directly estimated variances of the schooling coefficient estimates and also with their values multiplied by number of workers employed in the industry.

The exposition proceeds as follows: section 1 provides the required theoretical extensions to the standard Mincerian log-earnings regression interpretation to allow for steep earnings profiles and an environment of general nominal productivity growth; section 2 provides the compatible sector-invariant rate estimates. In section 3, estimations are repeated under different assumptions of sector segmentation, which is tested in some directions. Section 4 theorizes on an appropriate rate of return to physical capital when aggregate information is available on both capital stock and investment flows. Section 5 introduces financial ratios and productive indicators. Sections 6, 7 and 8 provide inference on the determinants of log earnings, sector-specific rates of return to schooling, and their estimated variances, and earnings and productivity growth rates respectively. The research ends with an overall appraisal in section 9.

1. Theoretical Background: Log-Earnings Regressions and Earnings Growth

. The methodology for inference of human capital "internal rates of return" is well established since the work of Mincer (1974). It is based on a convenient log-linear relation between labor earnings, years of education and years of experience – with the latter eventually included both in levels and in higher powers; tenure (and higher powers) could be included as well.

Let us assume that the only source of human capital accumulation is formal schooling. Denote by E_t^j earnings at age (minus 6, number of years at which school enrollment is possible) t of an individual that graduated with j years of schooling. Let $E_t^j = E^j$ for any j = 0, 1,... and t ≥ j and that money costs of school enrollment (e.g., tuition,) are negligible, i.e., $C_t = 0$. That is

- the yearly earnings flow is constant.
- schooling costs are mainly opportunity costs of time use

Admit individuals live or can stay in the schooling-and-labor market for T periods. Then we can summarize the Earnings profiles of two schooling worker categories, say with 0 years of schooling and s years of schooling as:

Yearly Earnings at Age (Minus 6) t

	0	1	...	s-1	s	s+1	....	T
0 Years of School:	E^0	E^0	...	E^0	E^0	E^0	...	E^0
s Years of School:	0	0	...	0	E^s	E^s	...	E^s

An individual facing interest rate r_s will only accept to enroll in the s-year program iff: $\sum_{t=0}^{T} \frac{E^0}{(1+r_s)^t} \leq \sum_{t=s}^{T} \frac{E^s}{(1+r_s)^t}$. Competitive forces are expected to attract people to the program and drive down E^s (and up E^0) till – in equilibrium - equality holds. Let $T \rightarrow \infty$. Then such equality becomes:

$$\frac{E^0}{1-\frac{1}{1+r_s}} = \frac{\frac{E^s}{(1+r_s)^s}}{1-\frac{1}{1+r_s}}$$

and $$E^s = E^0 \ (1 + r_s)^s$$

Taking logs:

(1) $$\ln E^s = \ln E^0 + s \ln(1 + r_s)$$

Once that, for small r_s, $\ln(1 + r_s) \approx r_s$,

(2) $$\ln E^s = \ln E^0 + r_s \ s$$

If every individual faces the same interest rate, the internal rate of return of the "investment" will be the same as that rate and equal for the different years of school. With a cross-section sample of individuals, with different education and yearly earnings, the previous regression can be performed and r_s easily inferred.

. Assume that human capital depreciates at a constant rate δ_s, i.e., in such a way that earnings capacity at age t is $E_t^s = E^s (1 - \delta_s)^{t-s}$. Such hypothesis may capture the actual erosion of the investment, but also the finiteness of human lives, assumed to tend to ∞ under the estimable forms. E^0 depreciates at rate δ_0, and $E_t^0 = E^0 (1 - \delta_0)^t$. In equilibrium:

$$\sum_{t=0}^{T} \frac{E_t^0}{(1+r_s)^t} = \sum_{t=s}^{T} \frac{E_t^s}{(1+r_s)^t} \quad \text{that is} \quad \sum_{t=0}^{T} \frac{E^0(1-\delta_0)^t}{(1+r_s)^t} = \sum_{t=s}^{T} \frac{E^s(1-\delta_s)^{t-s}}{(1+r_s)^t}$$

Let, again, $T \rightarrow \infty$. Then the last equality becomes:

$$\frac{E^0}{1-\frac{1-\delta_0}{1+r_s}} = \frac{\frac{E^s}{(1+r_s)^s}}{1-\frac{1-\delta_s}{1+r_s}} \qquad \frac{E^0}{r_s+\delta_0} = \frac{\frac{E^s}{(1+r_s)^s}}{r_s+\delta_s}$$

and $$E^s = E^0 \frac{r_s+\delta_s}{r_s+\delta_0} (1 + r_s)^s$$

What is observed is E_t^j; as $E_t^s = E^s (1 - \delta_s)^{t-s}$. Hence, multiplying both sides by $(1 - \delta_s)^{t-s}$, and taking logs:

(3) $$\ln E_t^s = \ln\left(E^0 \frac{r_s+\delta_s}{r_s+\delta_0}\right) + s \ln(1+r_s) + (t-s)\ln(1-\delta_s)$$

Provided r_s and δ_s are constant for all schooling categories for s > 0, with the previous cross-section sample, and information on years of labor market experience of the individuals, (t – s), we can approximate:

(4) $$\ln E_t^s = \text{constant} + r_s\, s - \delta_s (t - s)$$

Alternatively, if we prefer using age minus 6 years, t, of schooling as a regressor:

(5) $$\ln E_t^s = \ln\left(E^0 \frac{r_s+\delta_s}{r_s+\delta_0}\right) + s \ln\left(\frac{1+r_s}{1-\delta_s}\right) + t\ln(1-\delta_s)$$

And:

(6) $$\ln E_t^s = \text{constant} + (r_s+\delta_s)\, s - \delta_s\, t$$

. As is well-known, earnings growth observed over the working life is usually attributed to on-the-job training, and involvement in job training interpreted as arising from workers' financial optimisation decisions. Admit otherwise:

Suppose that job engagement in a particular sector offers a specific pattern of training and compatible earnings growth in such a way that individuals that enter the sector must follow a strict, specific "work-cum-training" basket offered by or specific to that sector. Then, a sector may offer a perfectly competitive earnings profile even if implying different earnings levels at the same point of the work-cycle for individuals of the same schooling category.

For simplicity, admit that the earnings growth rate (per year of experience) is constant in each sector i and equal to $gr_{s,i}$. Then earnings at year of experience t – s of workers with s years of schooling working in sector i are $E_{i,t}^s = E_i^s\,(1 + gr_{s,i} - \delta_{s,i})^{t-s} = E_i^s\,(1 + g_{s,i})^{t-s}$, where E_i^s denotes first yearly earnings in sector i of individuals with s years of schooling. Obviously, (3) holds *for each sector i* with δ_s replaced by $- g_{s,i}$, provided $r_{s,i} > g_{s,i}$ for all s for the sums of the infinite series to converge, and we can write:

(7) $$\ln E_{i,t}^s = \ln\left(E_i^0 \frac{r_{s,i}-g_{s,i}}{r_{s,i}-g_{0,i}}\right) + s \ln(1+r_{s,i}) + (t-s)\ln(1+g_{s,i})$$

For equilibrium, the accumulated present value of any earnings profile must be equalized *across sectors*. Imposing such condition on the profile with 0 years of schooling, i.e., $\sum_{t=0}^{T} \frac{E_{i,t}^0}{(1+r_{s,i})^t}$ $= \sum_{t=0}^{T} \frac{E_{j,t}^0}{(1+r_{s,j})^t}$ and for $T \to \infty$:

(8) $$\frac{E_i^0}{1-\frac{1+g_{0,i}}{1+r_{s,i}}} = \frac{E_i^0(1+r_{s,i})}{r_{s,i}-g_{0,i}} = \frac{E_j^0(1+r_{s,j})}{r_{s,j}-g_{0,j}}$$

Let $g_{s,i}$ be sector specific but constant for any positive schooling level, i.e., $g_{s,i} = g_i$ for s > 0 - $g_{0,i}$ is left sector-specific. Then (7) becomes:

(9) $$\ln E_{i,t}^s = \ln(E_i^0 \frac{r_{s,i}-g_i}{r_{s,i}-g_{0,i}}) + s\ \ln(1+r_{s,i}) + (t-s)\ln(1+g_i) \approx$$
$$\approx a_i + b_i\ s + c_i\ (t-s) \qquad i = 1,2,..$$

In this context, assuming a stationary environment, $r_{s,i}$ and g_i are real rates.

Across sectors, restriction (8) must be obeyed. Imposing it in (9), denoting by d a constant, it requires that:

(10) $$a_i = d - b_i + \ln[\exp(b_i) - \exp(c_i)] \approx d - b_i + \ln[b_i - c_i]$$

Equation (9) can easily be estimated using OLS and industry dummies - isolated and interacted both with experience and education. Using NLS, one can estimate the model also with restriction (10) across sectors – and then test (10). (10) can be tested more roughly by OLS considering in the regression of the estimated coefficients:

(11) $$a_i + b_i = d + \gamma \ln[\exp(b_i) - \exp(c_i)] \approx d + \gamma \ln[b_i - c_i]$$

the test of the null H_0: $\gamma = 1$; or in the form

(12) $$\exp(a_i + b_i) = d' + \eta\ [\exp(b_i) - \exp(c_i)] \approx d' + \eta\ [b_i - c_i]$$

the test of the null H_0: d’ = 0.

. Obviously, in equilibrium, the internal rate of return is expected to equalize across sectors, i.e., $r_{s,i} = r_s$ all i. Then (8) implies:

(13) $$\frac{E_i^0}{r_s - g_{0,i}} = \frac{E_j^0}{r_s - g_{0,j}}$$

(9) becomes:

(14) $\ln E^s_{i,t} = \ln(E^0_i \frac{r_s - g_i}{r_s - g_{0,i}}) + s \ln(1 + r_s) + (t - s) \ln(1 + g_i) =$

$$= a_i + b\ s + c_i\ (t - s) \quad i = 1,2,..$$

Across sectors, restriction (13), denoting by e a constant, implies:

(15) $a_i = e + \ln[\exp(b) - \exp(c_i)] \approx e + \ln[b - c_i]$

Equation (14) can easily be estimated using OLS with industry dummies – isolated and interacted with experience. Using NLS, one can, again, both estimate the fully restricted model – and also test (15). (15) can be tested again by OLS considering in the regression

(16) $a_i = e + \gamma \ln[\exp(b) - \exp(c_i)] \approx e + \gamma \ln[b - c_i]$

the test of the null H_0: $\gamma = 1$; or in the form

(17) $\exp(a_i) = e' + \eta [\exp(b) - \exp(c_i)] \approx e' + \eta [b - c_i]$

the test of the null H_0: $e' = 0$.

. The previous derivations apply to a stationary context, i.e., at "birth" individuals of <u>any</u> cohort expect to have the same accumulated present value of net wealth. In growing economies, that may not be a reasonable assumption [8]. Admit then that productivity growth – say, technical progress - allows for a continuous increase of yearly earnings of any category at constant rate b_i, and that each sector offers to each schooling category s a particular deviation from that pattern, cohort invariant, according to the principles previously hypothesised. Let $E^s_{i(t-s)}$ denote the first yearly earnings in sector i of individuals of (current) age t with s years of schooling. Then, under the assumption of different acceleration of earnings profiles:

$$E^s_{i,t} = E^s_{i(t-s)}\ (1 + g_{s,i})^{t-s}\ (1 + b_i)^{t-s}$$

g_{si}, characterizing the sector-specific steepness of earnings profiles offered to individuals with s years of schooling, must be a real – or net of productivity growth - rate, even if it compounds (may compound) over nominal flows: if b_i captures only nominal growth or effects, the earnings of individuals with s years of schooling measured at today's (or constant) prices exhibit a growing pattern at (real) rate g_{si} over their labor market time – it represents a proportional deviation from a,

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[8] See Martins (1987) for an exposition of similar conclusions.

say, "standard" lifetime earnings profile offered to the individuals with s years of schooling of the same age cohort.

For people of the *same age cohort t, sector i* must offer the same prospects for any schooling category: $\sum_{t=0}^{T} \frac{E_{i,t}^{0}}{(1+r_{s,i})^t} = \sum_{t=s}^{T} \frac{E_{i,t}^{s}}{(1+r_{s,i})^t}$, which implies for T → ∞, provided $1 + r_{s,i} > (1 + g_{s,i})(1 + b_i)$:

$$E_{i,t}^{s} = E_{i(t)}^{0} \frac{1+r_{s,i}-(1+g_{s,i})(1+b_i)}{1+r_{s,i}-(1+g_{0,i})(1+b_i)} (1+r_{s,i})^{s}(1+g_{s,i})^{t-s}(1+b_i)^{t-s} \tag{18}$$

At a given point in time, sectors must offer the same prospects for individuals of the same cohort – in particular, at the decision point, t=0. Then, *across sectors*, $\sum_{t=0}^{T} \frac{E_{i,t}^{0}}{(1+r_{s,i})^t} = \sum_{t=0}^{T} \frac{E_{j,t}^{0}}{(1+r_{s,j})^t}$ which implies:

$$\frac{E_{i(t)}^{0}}{1-\frac{(1+g_{0,i})(1+b_i)}{1+r_{s,i}}} = \frac{E_{i(t)}^{0}(1+r_{s,i})}{1+r_{s,i}-(1+g_{0,i})(1+b_i)} = \frac{E_{j(t)}^{0}(1+r_{s,i})}{1+r_{s,j}-(1+g_{0,j})(1+b_j)}$$

Imposing a constant rate of return across sectors:

$$\frac{E_{i(t)}^{0}}{1+r_{s}-(1+g_{0,i})(1+b_i)} = \frac{E_{j(t)}^{0}}{1+r_{s}-(1+g_{0,j})(1+b_j)} \tag{19}$$

As $E_{i(t)}^{0} = \frac{E_{i(0)}^{0}}{(1+b_i)^t}$ - this implies that b_i captures any and all nominal effects -, where $E_{i(0)}^{0}$ is today's earnings of an individual with 0 years of schooling, that enters the labor market, a general expression applying to all cohorts of a particular sector observed at a given point in time is:

$$E_{i,t}^{s} = E_{i(0)}^{0} \frac{1+r_{s}-(1+g_{s,i})(1+b_i)}{1+r_{s}-(1+g_{0,i})(1+b_i)} \left(\frac{1+r_s}{1+b_i}\right)^{s} (1+g_{s,i})^{t-s} \tag{20}$$

or yet:

$$E_{i,t}^{s} = E_{i(0)}^{0} \frac{1+r_{s}-(1+g_{s,i})(1+b_i)}{1+r_{s}-(1+g_{0,i})(1+b_i)} \left[\frac{1+r_s}{(1+b_i)(1+g_{s,i})}\right]^{s} (1+g_{s,i})^{t} \tag{21}$$

With $g_{s,i}$ constant for any schooling category of sector i for which s > 0 (say, $g_{s,i} = g_i$, leaving $g_{0,i}$ free), (20) is easily linearizeable and estimable for a particular cross-section sample.

(19) implies: $$\frac{E^0_{i(0)}}{[1+r_s-(1+g_{0,i})(1+b_i)](1+b_i)^t} = \frac{E^0_{j(0)}}{[1+r_s-(1+g_{0,j})(1+b_j)](1+b_j)^t}$$

Then, in equilibrium b_i must be constant across, $b_i = b$ (or, admitting market impreciseness and closeness to 1, the effect of $(1 + b_i)^t$ negligible for all t). In (20), the same coefficient should hold for education in a log earnings regression across different sectors, approximating the nominal interest rate minus the nominal productivity growth rate in the economy.

With $g_{s,i}$ constant for any schooling category for which s > 0, the restriction

(22) $$\frac{E^0_{i(0)}}{1-\dfrac{(1+g_{0,i})(1+b_i)}{1+r_s}} = \frac{E^0_{j(0)}}{1-\dfrac{(1+g_{0,j})(1+b_j)}{1+r_s}} = \text{constant}$$

becomes easily testable in form (21) – in which we may (should…) impose or not the requirement of $b_i = b$ for all i.

g_i must be a real rate. r_s and b_i are indifferently nominal or real rates: notice that (20) (with constant r_s) can be written as:

(23) $$E^s_{i,t} = E^0_{i(0)} \frac{\dfrac{1+r_s}{1+b_i}-(1+g_{s,i})}{\dfrac{1+r_s}{1+b_i}-(1+g_{0,i})} \left(\frac{1+r_s}{1+b_i}\right)^s (1+g_{s,i})^{t-s}$$

Only the term $\dfrac{1+r_s}{1+b_i}$ is in fact identified, approaching 1 plus the real interest rate net of the economic growth rate of the economy.

(20) is estimable for a particular cross-section sample of individuals, contemporaneously observed. For different yearly waves, $E^0_{i(0)}$ - and the antilog of the intercept of the yearly linearized equations - must rise at annual rate b_i; slopes must remain constant over different years. Then, with pooled data, b_i – or, more precisely, $\ln(1 + b_i)$ - are recoverable from the coefficients of a time trend interacted with sector dummies (additionally) included in the regression and with it, we are able to disentangle r_s and b_i as well. Let the subscript j refer to observations of wave (sample year) j, j = 0, 1, 2, …; $E^0_{i(0)_j} = E^0_{i(0)_0}(1 + b_i)^j$ and we can write:

$$(24) \qquad E^{s}_{i,t_j} = E^{0}_{i(0)_0} \frac{\frac{1+r_s}{1+b_i} - (1+g_i)}{\frac{1+r_s}{1+b_i} - (1+g_{0,i})} (1+r_s)^s (1+g_i)^{t-s} (1+b_i)^{j-s}$$

Using nominal earnings directly, the inferred rates r_s and b_i are nominal. (22) can be superimposed and/or tested – applying to j=0 -, as well as (with or without) the requirement of a constant $b_i = b$ across sectors – entailing a common trend (or trend minus schooling, j–s) and schooling coefficient across sectors in log earnings regressions, but not intercept nor experience's.

. As is well-known, if a variable Z = ln(Y) is normal with mean E[Z] = μ and variance $Var(Z) = \sigma^2$, Y = exp(Z) is lognormal and $E[Y] = \exp(\mu + \sigma^2 / 2)$ and $Var(Y) = \exp(2\mu + \sigma^2) [\exp(\sigma^2) - 1]$ [9]. We have an unbiased estimator of b, $\hat{b}$, $E[\hat{b}] = b = \ln(1 + r_s)$ and $Var(\hat{b}) = \sigma_b^2$. Then $E[\exp(\hat{b})] = \exp[\ln(1 + r_s) + \sigma_b^2 / 2]$ and $Var[\exp(\hat{b})] = \exp[2 \ln(1 + r_s) + \sigma_b^2] [\exp(\sigma_b^2) - 1]$. An unbiased estimator of r_s will be:

$$(25) \qquad \hat{r}_s = \exp(\hat{b} - \sigma_b^2 / 2) - 1$$

$Var(\hat{r}_s) = Var[\exp(\hat{b})] \exp(-\sigma_b^2) = \exp[2 \ln(1 + r_s) + \sigma_b^2] [1 - \exp(-\sigma_b^2)] = (1 + r_s)^2 [\exp(\sigma_b^2) - 1]$; it can be approximated by: $[\exp(\hat{b} - \sigma_b^2 / 2)]^2 [\exp(\sigma_b^2) - 1]$.

In the theoretical developments above, we always took an implicit discrete annual approach: r, g and b are annual discrete rates – and, empirically, we rely on discrete data. One can admit that the log-earnings regression coefficients give (directly) the implicit instantaneous rates – $r_{s,instantaneous} = \ln(1 + r_{s,discrete})$ -, even if also referred in percentage per year units. As we are comparing the rates to discrete approximations of physical and financial capital ones, it was thought more appropriate to experiment with the adjustment.

2. Uniform Log-Earnings Regression

The empirical analysis is based on two semi-compatible (semi-coincident) data sets, built from aggregate information for 2-digit CAE industry classification collected from "Quadros de Pessoal", from which sector averages were either available or could be computed – as mean age (IDMED), education (EDUCM) and tenure (ANTIG), as described in Appendix 1.A. The expanded Data Set 1 relies on information per schooling category (with consistent disaggregation of earnings,

[9] See Greene (2003), p. 854, for example.

hours of work and employment in the publication), and covers more than 500 observations – sector means are replicated whenever necessary as independent covariates. Data Set 2 includes one observation per industry per year and allows for regressions with around 140 observations (it covers disaggregation of manufacturing industries). A description of observations is provided in Appendix 1.B. Pertaining descriptive statistics are available upon request.

Two proxies of experience were then constructed: EXPM = IDMED – EDUCM – 6 as before and, SSEXPM admitting that whenever EDUCM + 6 is smaller or equal to 16, SSEXPM = IDMED – 16. SZEXPM is a similar variable, also used in the analysis, with 14 instead of 16 as the threshold. In general, only the former proxy is used in empirical research; the others, assume that the individuals did not enter the labor market prior to the threshold (that minimum age required for legal labor market participation) – that is, no child labor [10].

Weighted Least Squares – by the number of workers employed in the sector in the observation class (industry or sector) – were always used in the calculations.

We present in Table 1 the results of the estimated log-earnings regressions including yearly dummies – ANO95-ANO99 – and yearly dummies interacted with schooling – EDU95-EDU99 - and experience – EXP95-EXP99 -, that is, we reproduce yearly regressions. IRR's denote the log-normal [11] adjusted rates of return to schooling minus the productivity growth rate – in fact, $\frac{r_s - b}{1+b}$; GR's correspond to g. Inc Interc establishes the compatible proportional deviation of the intercept for each year relative to 1999.

[10] We might have as well experimented to replace the observations of EDUCM by 10 and 8 years respectively for cases also replaced in the experience proxy, admitting that the whole period before the threshold was spent in schooling, even if with recurrent failures.

[11] We admit the asymptotic normal approximation to the parameter estimates distribution as valid.

Table 1. Yearly Cross-Section Regressions

	Data Set 1				Data Set 2			
Variable	(1)	(2) with EXPM	(3) with SSEXPM	(4) with SZEXPM	(1)	(2) with EXPM	(3) with SSEXPM	(4) with SZEXPM
ANO95	11.0169 (.056220)	9.22617 (.277606)	10.1087 (.218504)	10.0010 (.251764)	10.3330 (.194432)	9.11766 (.322328)	9.52509 (.239869)	9.28623 (.280056)
ANO96	11.0780 (.056480)	9.29428 (.284704)	10.2035 (.224516)	10.0916 (.258311)	10.3795 (.199492)	9.19210 (.343578)	9.56954 (.258296)	9.32749 (.304575)
ANO97	11.1040 (.055362)	9.35849 (.275527)	10.2511 (.218820)	10.1250 (.251200)	10.4182 (.195030)	9.21440 (.338612)	9.57734 (.257952)	9.34209 (.303846)
ANO98	11.1441 (.054838)	9.39673 (.293148)	10.3860 (.232865)	10.2483 (.266929)	10.4731 (.194149)	9.15420 (.363746)	9.48770 (.282894)	9.24926 (.333286)
ANO99	11.1622 (.053833)	9.46083 (.301509)	10.5191 (.238679)	10.3684 (.273560)	10.5076 (.188664)	9.10547 (.376654)	9.44777 (.294322)	9.19071 (.348598)
EDU95	.072189 (.00640592)	.127506 (.010068)	.085666 (.00680994)	.094501 (.00810863)	.161189 (.023996)	.174324 (.019309)	.135063 (.019821)	.154077 (.018899)
EDU96	.070712 (.00630012)	.126016 (.010233)	.084298 (.00683859)	.092887 (.00822307)	.159708 (.024098)	.176098 (.019603)	.139334 (.019668)	.158765 (.018912)
EDU97	.069381 (.00607936)	.124131 (.00997632)	.083378 (.00670945)	.092102 (.00808805)	.155477 (.023159)	.177141 (.019182)	.140958 (.018589)	.161668 (.018237)
EDU98	.069485 (.00586867)	.125083 (.010487)	.083018 (.00685909)	.091235 (.00843100)	.151851 (.022443)	.183417 (.019496)	.147189 (.017713)	.170295 (.018170)
EDU99	.069803 (.00567372)	.124437 (.010729)	.081766 (.00688765)	.089563 (.00856913)	.149070 (.021446)	.185848 (.019300)	.149639 (.016893)	.173943 (.017854)
EXP95		.061129 (.00933337)	.041766 (.00974817)	.040837 (.00989391)		.050262 (.011699)	.050961 (.011645)	.051450 (.011543)
EXP96		.060396 (.00950002)	.039631 (.00988386)	.039143 (.010030)		.047725 (.012253)	.048566 (.012293)	.049255 (.012233)
EXP97		.058918 (.00916166)	.038363 (.00955770)	.038587 (.00968454)		.046708 (.011682)	.047864 (.011796)	.047861 (.011674)
EXP98		.057939 (.00959490)	.033128 (.00992221)	.034438 (.010067)		.047761 (.011929)	.050368 (.012165)	.049482 (.011985)
EXP99		.056142 (.00983221)	.027836 (.010094)	.030256 (.010245)		.049529 (.012206)	.051804 (.012419)	.051228 (.012277)
IRR95	0.074836	0.13593	0.089417	0.099074	0.17457	0.19022	0.14438	0.16637
IRR96	0.073251	0.13424	0.087927	0.097300	0.17283	0.19233	0.14929	0.17185
IRR97	0.071825	0.13211	0.086928	0.096441	0.16790	0.19358	0.15118	0.17528
IRR98	0.071938	0.13318	0.086535	0.095488	0.16369	0.20109	0.15839	0.18546
IRR99	0.072279	0.13245	0.085176	0.093656	0.16049	0.20401	0.16125	0.18980
GR95		0.062990	0.042601	0.041631		0.051475	0.052211	0.052727
GR96		0.062209	0.040376	0.039867		0.048804	0.049686	0.050410
GR97		0.060644	0.039061	0.039292		0.047744	0.048955	0.048953
GR98		0.059601	0.033632	0.034986		0.048846	0.051581	0.050651
GR99		0.057696	0.028175	0.030664		0.050698	0.053089	0.052484
Inc Interc 95	-0.13792	-0.27287	-0.37048	-0.35371	-0.19042	-0.10478	0.0052466	-0.0044439
Inc Interc 96	-0.083578	-0.22316	-0.30879	-0.29359	-0.15279	-0.042397	0.046126	0.030087
Inc Interc 97	-0.059359	-0.16951	-0.27417	-0.26829	-0.11854	-0.019150	0.054409	0.045471
Inc Interc 98	-0.020882	-0.14146	-0.17194	-0.17569	-0.068636	-0.084564	-0.042471	-0.056105
RBAR2	.532031	.595713	.543288	.551936	.452972	.696144	.720393	.714373
SIG2	.129416	.096628	.114996	.112848	.080890	.040937	.037844	.038621
F-Test Educyear	0.0351516 [.99763]	0.01809052 [.99936]	0.04536901 [.99611]	0.04873871 [.99553]	0.05029883 [.99520]	0.06635144 [.99183]	0.1043676 [.98080]	0.1996886 [.93811]
F-Test GroY		0.04258829 [.99656]	0.3199462 [.86464]	0.1795123 [.94897]		0.01519265 [.99954]	0.01871739 [.99931]	0.01603839 [.99949]
F-Test EducGroY		0.04849049 [.99995]	0.1785929 [.99373]	0.1085373 [.99893]		0.04279613 [.99997]	0.06264502 [.99985]	0.1045266 [.99902]
F-Test EducGroYTr	0.08595524 [.99897]	0.06783704 [.99999]	0.1617531 [.99910]	0.1106091 [.99986]	0.05083134 [.99981]	0.04676127 [1.00000]	0.06039662 [.99999]	0.09061074 [.99994]

Note: Standard deviations in parenthesis. Significance level in square brackets.

Both coefficients of education and experience showed a remarkable stability over the sample years – uniformity tests are presented in the last rows of the table (the first of these testing equality of yearly education coefficients; the second of yearly and experience coefficients; the third, both restrictions simultaneously; the last, both restrictions and also the common trend of the intercept) and coefficient equality is never rejected even at high significance levels.

The use of the two samples – as of the different experience proxies – did generate different results. In general, the education coefficient is around .05 (5%) larger in Data Set 2 – where it ranged from 14% to 19% - than in the expanded Data Set 1 – 7 to 13%; inversely, the experience coefficient is around .01 (1%) larger in the expanded data set – ranging from 3 to 6% -, the same occurring for the trend coefficient.

The experience proxy with 16-year threshold adjustment generated a sizeable decrease of the returns to education estimate in both samples; it originated a noticeable decrease of the experience coefficient in Data Set 1, but not in Data Set 2.

Finally, we present the uniform regressions of type (24) in Table 1.A – we regress log-earnings on an intercept, education, schooling and an yearly trend. BR denotes the log-normal adjusted productivity growth rate – of b - coefficient estimate, with higher estimates under Data Set 1 (.01 higher than with Data Set 2). IRRN denotes the implicit nominal rate of return.

Table 1.A. General Homogeneous Regressions

Variable	Data Set 1 (1)	Data Set 1 (2) with EXPM	Data Set 1 (3) with SSEXPM	Data Set 1 (4) with SZEXPM	Data Set 2 (1)	Data Set 2 (2) with EXPM	Data Set 2 (3) with SSEXPM	Data Set 2 (4) with SZEXPM
INTERC.	11.0399 (.028038) [.000]	9.29816 (.126155) [.000]	10.2362 (.099992) [.000]	10.1107 (.114664) [.000]	10.3891 (.084289) [.000]	9.13165 (.148775) [.000]	9.50015 (.113198) [.000]	9.26210 (.133465) [.000]
EDU	.070250 (.00268783) [.000]	.125553 (.00455159) [.000]	.083916 (.00301289) [.000]	.092301 (.00366097) [.000]	.155084 (.010020) [.000]	.179585 (.00826158) [.000]	.142873 (.00788198) [.000]	.164208 (.00781761) [.000]
EXP		.058911 (.00418972) [.000]	.036228 (.00434803) [.000]	.036706 (.00440850) [.000]		.048068 (.00509770) [.000]	.049451 (.00513853) [.000]	.049145 (.00507647) [.000]
TREND	.030712 (.00723196) [.000]	.023929 (.00618219) [.000]	.026323 (.00682039) [.000]	.026216 (.00682199) [.000]	.017558 (.011027) [.114]	.015781 (.00863283) [.070]	.014183 (.00856843) [.100]	.015139 (.00854446) [.079]
IRRN	0.10620	0.16120	0.11652	0.12580	0.18833	0.21568	0.16999	0.19637
IRRR	0.072772	0.13376	0.087532	0.096688	0.16770	0.19668	0.15355	0.17842
GR		0.060671	0.036882	0.037378		0.049229	0.050681	0.050359
BR	0.031162	0.024198	0.026648	0.026539	0.017651	0.015868	0.014247	0.015217
RBAR2	.538228	.604770	.555108	.562739	.478637	.721320	.742423	.737517
SIG2	.127746	.094467	.111975	.110093	.077112	.037571	.034901	.035547

Note: Standard deviations in parenthesis. Significance level in square brackets.

3. The Segmented Hypothesis

The next step of empirical work resumed in the estimation of segregated rates by industry. Log-normality corrected estimates are presented in Tables 2 – rates of return - and 3 – growth rates -

when EXPM was used for experience – Tables 2.A. and 3.A replicate the inference with the threshold-based measure SSEXPM. In Table 2, we also report (only possible) for Data Set 1, the yearly estimates of rates of return to schooling from simple regressions – yet estimated with dummies in a sole equation/system for testing purposes - of log earnings on schooling performed for each sector.

All other regressions include industry dummies. For instance, Overall Mean includes industry dummies and industry dummies interacted with education and experience as well as yearly dummies. Regressions "without trend" always included year dummies – a common trend could be used instead to replicate constant bi's. For some cases, regressions (Overall Mean 99) allowed for a systematic yearly change in returns from the 1999 estimation for each sector – in which case the difference to 1999 is reported. For others, common to all sectors, yet yearly variable rates of return were assumed and its estimates reported (Fixed Year RR). Finally, a unique rate is allowed (Fixed RR).

Regressions "with trend" entailed the interaction of trend with sector dummies in order to capture industry-specific bi's – with Data Set 2, only an homogeneous rate of return across industries assumption allowed estimation with minimal degrees of freedom.

In the three last rows of Table 2, we provide tests of constancy of estimates across industries. The first of those rows essays constancy of rates of return across industries – and it is frequently not rejected. The second row tests constancy of both education and experience coefficients; it is generally rejected at 10% level except for the cases with trends included in the regression. The final row contrasts the reported model with another with only year effects – the latter always rejected. (In general compatible year dummies or year-dummy interacted variables are left - free – in the restricted regressions.)

Table 2. Rates of Return

	Data Set 1											Data Set 2				
Sector	1995	1996	1997	1998	1999	Overall Mean, 99	Overall Mean, 99 (Fixed Year RR)	Overall Mean	Overall Mean (Fixed RR)	Overall Mean with Trend	Overall Mean with Trend	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	Overall Mean with Trend
1	0.05369	0.05103	0.05193	0.05536	0.05162	0.066624		0.10532		0.0010970		0.067133		0.27599		
2	0.04136	0.03247	0.02414	0.03112	0.03333	0.058935		0.072274		-0.14763		-0.21468		-0.23205		
3	0.05222	0.04697	0.04991	0.05000	0.04683	-0.0086497		0.016173		-0.32825		0.072028		0.14909		
4	0.07247	0.06982	0.06996	0.07016	0.07010	0.086413		0.083601		0.098249						
4												0.065591		0.12632		
5												0.48374		0.18503		
6												0.47398		0.072653		
7												0.21336		0.17553		
8												0.14106		0.16545		
9												-0.0042086		0.083761		
10												-0.051122		0.10506		
11												0.33779		0.29991		
12												0.24219		0.26075		
13												0.19792		0.18109		
14												0.22570		0.19808		
15												0.11844		0.039886		
16												0.17047		0.24061		
17												0.33922		0.29756		
5 / 18	0.04151	0.03933	0.03876	0.03831	0.03959	0.0032569		0.034518		0.030755		-0.068126		0.14872		
6 / 19	0.05195	0.05240	0.05257	0.05391	0.05587	0.028574		0.029164		0.027271		0.14771		0.11062		
7 / 20	0.06012	0.05958	0.05548	0.05704	0.05688	0.014215		0.056746		0.17412		0.19738		0.20524		
8 / 21	0.04141	0.03636	0.03347	0.03401	0.03487	0.056549		0.051260		-0.046260		0.15318		0.092432		
9 / 22	0.05176	0.05397	0.05071	0.05189	0.05889	-0.023423		-0.051413		-0.038250		-0.17706		-0.063256		
10 / 23	0.03962	0.03949	0.03461	0.03179	0.03042	0.028200		0.010337		0.063809		-0.013453		0.17965		
11 / 24	0.06979	0.06806	0.07111	0.06935	0.07074	0.0080248		0.016493		0.066858		0.23074		0.23199		
12 / 25	0.05282		0.10549	0.09750	0.10211	-0.015980		-0.021173		0.032185		1.18332		1.34520		
13 / 26	0.07734	0.07524	0.07470	0.08131	0.08131	0.062311		0.090327		-0.36210		0.11811		0.27547		
14 / 27	0.05432	0.05066	0.05164	0.05568	0.05678	0.038515		0.056156		0.032090		0.086580		0.17791		
15 / 28	0.08691	0.08595	0.08810	0.08652	0.07897	0.16231		0.17618		-0.39430		0.086580		0.057040		
16 / 29					-0.74538	-0.90269		-0.89901		-0.95228		-1.00000		-1.00000		
1995						-0.0035815	0.060344					-0.026768	0.10269			
1996						-0.0054540	0.057331					-0.023727	0.10203			
1997						-0.00098733	0.062070					-0.014752	0.10451			
1998						-0.0014200	0.062611					-0.0071117	0.10772			
1999							0.065381						0.11152			
Total									0.056405		0.11427*				0.10365	0.24534*
F-Test Educyear						0.08529434 [1.000]		0.1133850 [.99999]		0.03487031 [1.0000]		1.648549 [.06841]		1.899315 [.02312]		
F-Test EducGroY			0.26766 [1.000]			1.383026 [.08817]	2.75964 [.00042]	1.411848 [.07516]	2.786243 [.00036]	0.2845210 [.99995]	0.550927 [.91100]	3.032056 [.00012]	3.51623 [.00001]	3.511584 [.00001]	3.88540 [.00000]	0.764389 [.77736]
F-Test EducGIntY			5.70794 [.000]			13.13883 [.000]	20.2442 [.000]	13.35805 [.000]	20.5402 [.00000]	9.760083 [.00000]	13.40966 [.00000]	234.0961 [.000]	278.9691 [.000]	238.9169 [.00000]	271.035 [.00000]	155.9982 [.0000]

* Nominal

Note: Significance level in square brackets.

Table 3. Earnings Growth Rate (Net of Depreciation)

	Data Set 1								Data Set 2					
Sector	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	(g) (1)	(b) (1)	(g) (2)	(b) (2)	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	(g)	(b)
1	0.012155	0.010762	0.049084	0.0027763	-0.049659	0.045538	0.011102	0.043462	0.071675	0.044597	0.031042	0.082211	-0.0021336	0.030188
2	0.019685	0.024057	0.032799	0.017016	-0.17932	-0.034543	0.0064859	0.023907	0.043340	0.041065	0.079846	0.052328	-0.0035948	0.045284
3	-0.057210	0.012878	-0.033412	0.0046675	-0.36091	0.026259	0.019535	0.034851	0.090115	0.077711	0.087604	0.088604	0.043374	0.021334
4	0.014631	-0.0049790	0.012235	-0.013071	0.025915	0.025880	0.0062487	0.032911						
4									0.10362	0.041671	0.074151	0.053619	-0.051752	0.025778
5									-0.0073571	0.040651	0.010360	0.017725	0.052322	0.0040661
6									0.039439	0.044604	0.032135	0.022205	0.035496	0.010062
7									0.043418	0.062834	0.043235	0.055141	0.071724	0.0083452
8									0.080302	0.10464	0.074953	0.10793	0.062760	0.010313
9									-0.042957	0.035447	-0.030237	-0.0049193	0.057534	-0.052507
10									-0.012461	-0.081305	-0.00067593	-0.050603	0.11340	-0.00065021
11									0.25896	0.048045	0.21658	0.046603	0.095721	0.018817
12									-0.0076086	0.049788	-0.022289	0.045612	0.037191	0.014780
13									0.037933	0.082877	0.013707	0.065210	-0.078451	0.020466
14									0.033449	0.077864	0.029707	0.064793	0.021946	0.018247
15									-0.00015547	-0.00088924	-0.014525	-0.0038531	0.019548	-0.010186
16									0.050068	0.034989	0.045674	0.030234	0.042127	0.022646
17									0.041171	0.060567	0.0053664	0.041349	-0.13246	0.077878
5 / 18	-0.035734	0.023677	-0.0056577	0.015233	-0.0090463	0.037907	0.029444	0.037578	-0.011739	0.036935	0.013019	0.0054291	0.031650	0.0088920
6 / 19	-0.024031	0.010698	-0.023236	0.0025103	-0.025027	0.029900	0.034440	0.021277	0.023030	-0.0038156	0.0050270	-0.021313	-0.019190	0.0032544
7 / 20	-0.041311	0.0069990	-0.00087832	-0.0010851	0.11001	0.029263	0.023649	0.028997	0.063927	0.020595	0.094053	0.033123	0.15289	0.030677
8 / 21	0.019625	0.027973	0.014777	0.019617	-0.079323	0.030583	0.050269	0.022288	0.072396	0.033771	0.064771	-0.0026267	-0.0039203	0.0057232
9 / 22	-0.073311	0.010629	-0.099704	0.0021687	-0.087254	0.037031	0.010597	0.046371	-0.14394	-0.011602	-0.13949	-0.037773	-0.10942	-0.027182
10 / 23	-0.0072287	0.028284	-0.024358	0.019592	0.027301	0.046915	0.029952	0.044715	0.022667	0.029399	0.024249	0.0066832	0.060253	0.030709
11 / 24	-0.058154	-0.0047981	-0.049994	-0.012746	-0.0029044	0.040178	0.0023505	0.038958	0.019804	-0.033110	0.019941	-0.030027	0.023082	0.023533
12 / 25	-0.10188	-0.031164	-0.10643	-0.038975	-0.057744	0.089882	-0.053249	0.065989	-0.036790	-0.15374	-0.052509	-0.16106	0.037056	0.20486
13 / 26	-0.015396	-0.012464	0.010874	-0.020523	-0.40840	0.020800	-0.0069565	0.038970	0.12548	0.031557	0.16899	-0.011350	0.20345	0.033796
14 / 27	-0.015203	0.010123	0.0017906	0.0019937	-0.021015	0.031301	0.028277	0.026244	0.0025432	0.0095128	0.0097088	0.020068	0.0071036	0.015677
15 / 28	0.070181	-0.019044	0.083231	-0.027009	-0.44194	0.054386	-0.023503	0.050130	-0.17299	-0.12338	-0.21310	-0.12996	-0.10692	0.011578
16 / 29	-0.73100	-0.41948	-0.72533	-0.41775	-0.81677	-0.98813	-0.54084	-0.59781	-0.91484	0.090514	-0.92029	0.084402	0.078803	-0.10029
1995	-0.0044019	-0.0055574							-0.017391	-0.0064135				
1996	-0.0052689	-0.0073459							-0.013727	-0.0074020				

1997	0.00035117	-0.0019188							-0.0071771	-0.0033867				
1998	-0.00089129	-0.0020912							-0.0049308	-0.0028738				
Interc 1995	-0.10049	-0.027163	-0.12231	-0.13671					0.50866	0.10401	-0.084697	-0.10435		
Interc 1996	-0.031912	0.095432	-0.075711	-0.087731					0.48289	0.18752	-0.046418	-0.061384		
Interc 1997	-0.13536	-0.044157	-0.059657	-0.069657					0.23888	0.082306	-0.034112	-0.047970		
Interc 1998	-0.045098	0.00023711	-0.022836	-0.025499					0.15701	0.074610	-0.016246	-0.019501		
Constancy Test	.053769 [.000]	.021070 * [.004]	.053620 [.000]	.019620 * [.009]	.053879 [.000]		.047450 [.000]		.166416 [.003]	.069583 * [.000]	.159312 [.000]	.069469 * [.000]	.156191 [.000]	
Constancy Test	-268.793 [.955]	-6942.04 * [.418]	185.128 [.974]	-7589.10 * [.543]	-13.7838 [.693]		-713.006 [.906]		153592 [.209]	-243064 * [.004]	139477 [.287]	-304280 * [.005]	-17829.8 [.079]	
Corr RR-Growth	0.99594 [.000]		0.99578 [.000]		0.99398 [.000]**	0.80518 *** [.000]	iv		0.62510 [.000]		0.60465 [.001]		v	

* Badly specified standard errors
** Correlations with "nominal" rates: 0.96987 [.000]; Correlations with b: 0.74337 [.001]
*** Correlations with "nominal" rates: 0.85310 [.000]
iv Correlations with b: 0.97171 [.000]
v Correlations with b: -0.076701 [.693]

Note: Significance level in square brackets.

. Tests of $\exp(a_i)$ = constant $(d_i - e_i)$, and of $(d_i - e_i)$ = constant' $\exp(a_i)$ - where a_i denotes the intercept dummy coefficient estimates for sector i, and d_i and e_i those of the education and experience respectively for that same sector (with yearly dummies or sector trends being included in the right hand-side), are depicted in the two before-last rows of Table 3 and 3.A. In general, at least one of the forms rejects equilibrium condition – but in most, the other does not. The conflicting evidence suggests more sophisticated econometric treatment – nonlinear estimation – that we did not pursue here.

The last row of Table 3 and 3.A. presents the simple correlations between the estimates of $\ln\left(\frac{1+r_s}{1+b_i}\right)$ and of $\ln(1 + g_{s,i})$ presented in the Tables – weighted correlations between some of the direct (not log-normally corrected) estimates are available upon request. Theoretically, $\ln\left(\frac{1+r_s}{1+b_i}\right)$ might be independent of $g_{s,i}$ and we could find no direct connection required between them; yet, positive and significant correlations were registered: sectors of higher rates of return net of productivity growth (possibly, real rates of return to h.c.) also exhibit steeper earnings profiles. Positive and significant correlations were also found between gi's and bi's in Data Set 1, but nil in Data Set 2, and – more unexpectedly – between the inferred bi's and the estimates of $\ln\left(\frac{1+r_s}{1+b_i}\right)$, the rates of return when industry dummies interacted with trend were included in the regression.

Table 2.A. Rates of Return (With SSEXPM)										
	Data Set 1						Data Set 2				
Sector	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	Overall Mean with Trend (1)	Overall Mean with Trend (2)	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	Overall Mean with Trend
1	0.022759		0.027495		0.023883		-0.087885		0.26628		
2	0.025462		0.029664		0.018559		-0.21552		-0.29694		
3	0.0076280		0.012694		0.012439		-0.14201		0.0053519		
4	0.023534		0.029284		0.023474						
4							-0.064210		0.063938		
5							0.48658		0.17539		
6							0.38548		0.033708		
7							0.14109		0.12997		
8							0.052987		0.092604		
9							-0.012431		0.094212		
10							-0.093939		0.096467		
11							0.051036		0.083476		
12							0.20065		0.27997		
13							0.13715		0.17437		
14							0.18439		0.18018		
15							0.15984		0.074343		
16							0.11577		0.21365		
17							0.28275		0.29851		
5 / 18	-0.0082474		-0.0028431		-0.0022047		-0.087994		0.15353		
6 / 19	-0.00046691		0.0049043		0.0046494		0.10572		0.12450		
7 / 20	0.0085746		0.013436		0.014476		0.15209		0.12317		
8 / 21	0.0036182		0.0089867		0.0066000		0.058065		0.029939		
9 / 22	0.018827		0.024345		0.022820		-0.050761		0.10863		
10 / 23	0.017926		0.027215		0.022397		0.13779		0.21307		
11 / 24	0.0050103		0.0096363		0.0082309		0.34733		0.31098		
12 / 25	0.019443		0.025734		0.019356		1.26014		1.52605		
13 / 26	0.0033467		0.0073560		0.0078355		0.29352		0.31588		
14 / 27	0.0026073		0.0068429		0.0060713		0.079062		0.19692		
15 / 28	0.048094		0.052841		0.052718		0.30492		0.35841		
16 / 29	-0.61106		-0.60823		-0.69965		-1.00000		-1.00000		
1995	0.0098549	0.025159					-0.00055697	0.050820			
1996	0.0059469	0.020859					-0.0051526	0.051469			
1997	0.0063806	0.021022					-0.0031228	0.053083			
1998	0.0013369	0.015686					-0.0017766	0.059592			
1999		0.014241						0.063125			
Total				0.020022		0.074889 *				0.062713	0.26504 *
F-Test Educyear	1.225231 [.24849]		1.283342 [.20806]		2.465586 [.00173]		1.868474 [.03164]		2.078052 [.01153]		
F-Test EducGroY	4.635872 [.000]	7.990273 [.000]	4.663512 [.000]	7.974233 [.000]	3.122552 [.000]	3.612669 [.00001]	3.208640 [.00006]	3.388319 [.00002]	3.751851 [.00000]	3.92567 [.000]	0.712610 [.83331]
F-Test EducGrInt	41.43473 [.000]	61.10937 [.000]	41.42810 [.000]	60.96947 [.000]	32.08063 [.000]	40.10031 [.00000]	243.6732 [.00000]	271.5653 [.00000]	245.5366 [.00000]	265.731 [.000]	155.2948 [.0000]

* Nominal

Note: Significance level in square brackets.

Table 3.A. Earnings Growth Rate (Net of Depreciation; With SSEXPM)

	Data Set 1								Data Set 2					
Sector	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	(g) (1)	(b) (1)	(g) (2)	(b) (2)	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	(g)	(b)
1	-0.079930	-0.093853	-0.076951	-0.089614	-0.086227	0.066829	-0.091246	0.054070	0.062147	0.083184	0.032614	0.073617	0.00048484	0.027213
2	-0.028793	-0.042487	-0.028127	-0.040606	-0.060701	0.082624	-0.047686	0.053192	0.020823	0.043971	0.087853	0.042698	-0.035945	0.066060
3	-0.10189	-0.089855	-0.098929	-0.086019	-0.099546	0.055219	-0.097048	0.059006	0.085642	0.062399	0.092874	0.036873	-0.054903	0.028606
4	-0.10396	-0.11783	-0.099508	-0.11343	-0.11193	0.073440	-0.11594	0.055337						
4									0.096148	0.043607	0.074871	0.031329	-0.062773	0.030096
5									-0.0021522	0.042091	0.017744	0.015212	0.051014	-0.0029971
6									0.050689	0.043753	0.038072	0.018901	0.037230	0.0043577
7									0.040182	0.061805	0.051168	0.040814	0.093120	-0.015247
8									0.083894	0.050022	0.078913	0.055343	0.076254	-0.015157
9									-0.040098	-0.0031320	-0.025501	-0.037411	0.067581	-0.063300
10									0.0065129	-0.055122	0.012788	-0.017231	0.11297	-0.024731
11									0.26418	0.15254	0.20967	0.11676	0.058166	-0.012170
12									-0.0054135	0.048826	-0.014423	0.033341	0.022690	0.011649
13									0.038944	0.066121	0.018911	0.042405	-0.14902	0.048900
14									0.040450	0.063142	0.032423	0.051642	0.0090381	0.014318
15									0.0080971	-0.025427	-0.010478	-0.030210	0.029680	-0.018957
16									0.052814	0.037129	0.046213	0.032425	0.049417	0.017928
17									0.043749	0.060078	0.011825	0.036145	0.043627	-0.00025896
5 / 18	-0.083886	-0.050358	-0.080209	-0.046402	-0.079213	0.046395	-0.065068	0.066497	-0.012115	-0.0020978	0.015793	0.010774	0.041230	-0.0038374
6 / 19	-0.12197	-0.098471	-0.11770	-0.093729	-0.11814	0.054729	-0.11266	0.065395	0.027286	0.024643	0.0090806	-0.0081280	-0.010293	0.0018590
7 / 20	-0.093372	-0.084362	-0.090588	-0.080374	-0.089727	0.029553	-0.071653	0.047963	0.10358	0.061830	0.10744	0.067137	0.12584	-0.0068844
8 / 21	-0.081429	-0.062988	-0.076677	-0.057656	-0.082605	0.060471	-0.081272	0.066183	0.084551	0.034940	0.072265	0.0090660	-0.013365	0.0054341
9 / 22	-0.062676	-0.069505	-0.058486	-0.064951	-0.062232	0.036006	-0.052948	0.045219	-0.13329	-0.068537	-0.14197	-0.11534	-0.098696	-0.0024125
10 / 23	-0.019086	-0.023267	-0.010445	-0.018476	-0.017621	0.034770	-0.0063992	0.041854	0.045021	0.034433	0.028437	-0.0028672	0.062505	0.028074
11 / 24	-0.11192	-0.098305	-0.10901	-0.093912	-0.11233	0.026360	-0.090239	0.051169	0.11524	-0.062443	0.090689	-0.072122	0.073641	0.025548
12 / 25	-0.12748	-0.13253	-0.12152	-0.12720	-0.13314	0.031840	-0.12180	0.045506	-0.035059	-0.15960	-0.056218	-0.16837	0.054935	0.20643
13 / 26	-0.10991	-0.095265	-0.10846	-0.091618	-0.10781	0.047810	-0.097686	0.058254	0.25531	0.044120	0.19290	-0.043842	0.21659	0.031623
14 / 27	-0.093575	-0.075749	-0.091450	-0.071528	-0.092922	0.051457	-0.086143	0.063117	0.0034983	0.0056717	0.0091805	0.025279	-0.0052482	0.014712
15 / 28	-0.062207	-0.11013	-0.059711	-0.10624	-0.059875	0.052889	-0.077060	0.032447	-0.17946	0.33736	-0.22246	0.37688	-0.10568	0.030661
16 / 29	-0.47814	-0.32102	-0.47416	-0.31660	-0.57427	-0.91295	-0.36860	-0.36188	-0.91048	0.086708	-0.91253	0.079726	0.081907	-0.098748
1995	0.0039754	0.0051908							-0.022419	-0.0055830				
1996	0.00016711	0.00092980							-0.017667	-0.0057339				

1997	0.0066399	0.0067812							-0.010388	-0.0022442				
1998	0.00071575	0.00067472							-0.0056874	-0.0021102				
Interc 1995	-0.31222	-0.33508	-0.18354	-0.18635					0.36309	0.088652	-0.071429	-0.11601		
Interc 1996	-0.18021	-0.19765	-0.12284	-0.12477					0.37734	0.14325	-0.037117	-0.069877		
Interc 1997	-0.26272	-0.26777	-0.10405	-0.10551					0.20361	0.073484	-0.026284	-0.053663		
Interc 1998	-0.069087	-0.069751	-0.032404	-0.033119					0.11731	0.048537	-0.013901	-0.022768		
Constancy Test	.074494 [.000]	.029452 * [.041]	.075056 [.000]	.030135 * [.041]	.080537 [.000]		.062116 [.001]		.112287 [.023]	.011401 * [.365]	.142160 [.004]	.022258 * [.107]	.180082 [.000]	
Constancy Test	85513.3 [.751]	-2158.59 * [.988]	58689.1 [.809]	1225.90 * [.902]	73738.7 [.743]		30052.1 [.835]		86444.7 [.256]	47752.9 * [.541]	44292.6 [.413]	29421.4 * [.798]	-12962.2 [.170]	
Corr RR-Growth	0.96266 [.000]		0.96258 [.000]		0.97771 [.000] **	***0.99592 [.000]	iv		0.51855 [.004]		0.45688 [.013]		v	

* Badly specified standard errors
** Correlations with "nominal" rates: 0.97593 [.000]; Correlations with b: 0.97271 [.000]
*** Correlations with "nominal" rates: 0.99880 [.000]
iv Correlations with b: 0.91311 [.000]
v Correlations with b: -0.21101 [.272]

Note: Significance level in square brackets.

A first inspection of the data fell on the yearly estimates, depicted in Fig. 1. In general, sector rates are similar across the sample years. Public Administration, Defence and Social Security, Other Collective and Personal Services, Education, Manufacturing Industries and Real Estate and Service to Firms exhibit high rates. Fishing, Restoration and Lodging, Banking and Insurance, Electricity, Water and Gas, and Mining have low rates.

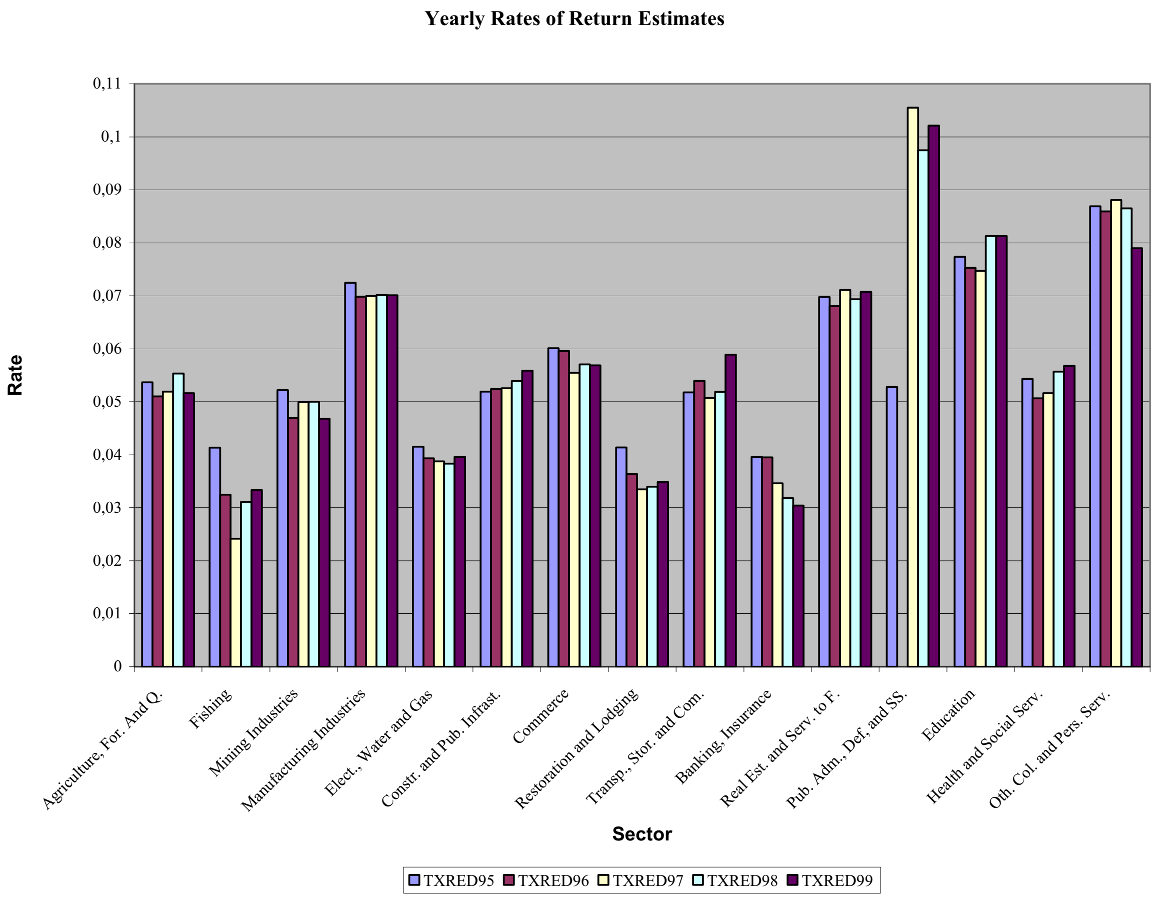

Fig. 1

Experience is not controlled for in the calculation of the previous estimates. They are not always positively nor significantly correlated – not reported – with the sector estimates from other regressions.

We confront in Figs 2 and 3 the “net” rates of return estimates for the major sectors, and for manufacturing sub-sectors only.

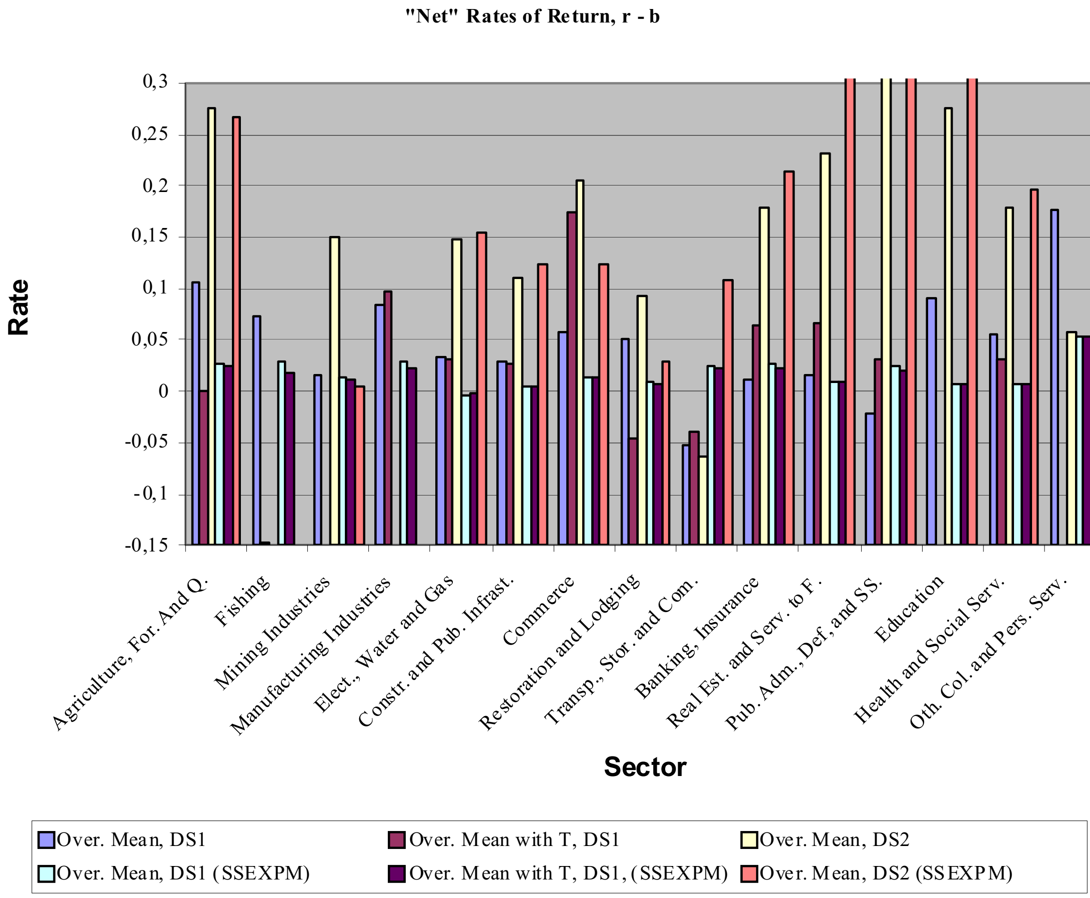

Fig. 2

The correlation between the several estimates is always positive – not reported –, and "net" rates are positively related to "nominal" rates.

Consistently, "net" rates are high in Agriculture, Other Collective and Personal Services, and – under Data Set 1 – in the whole of Manufacturing Industries; they are often high also in Education. Yet a clear pattern of low or medium net rates is hard to devise – these would include Restoration and Lodging, and International Organizations, which, due the small number of observations, are imprecisely estimated -, the pattern changing substantially with the data set or the experience proxy used. The estimates for Data Set 2 also suffer, in general, of high imprecision once dummies interacted with experience as sector dummies are included in the regressions; this has consequences for the reliability of the ordering of the disaggregated Manufacturing Industries, depicted below.

In MI, high net rates pertain to Non-Specified Manufacturing, Transportation Material, Other Non-Metallic Industries and Machinery and Equipment. Low rates appear in Leather and Leather Articles, Chemicals from Oil and Coke, Electric and Optical Equipment, Food, Beverages and Tobacco.

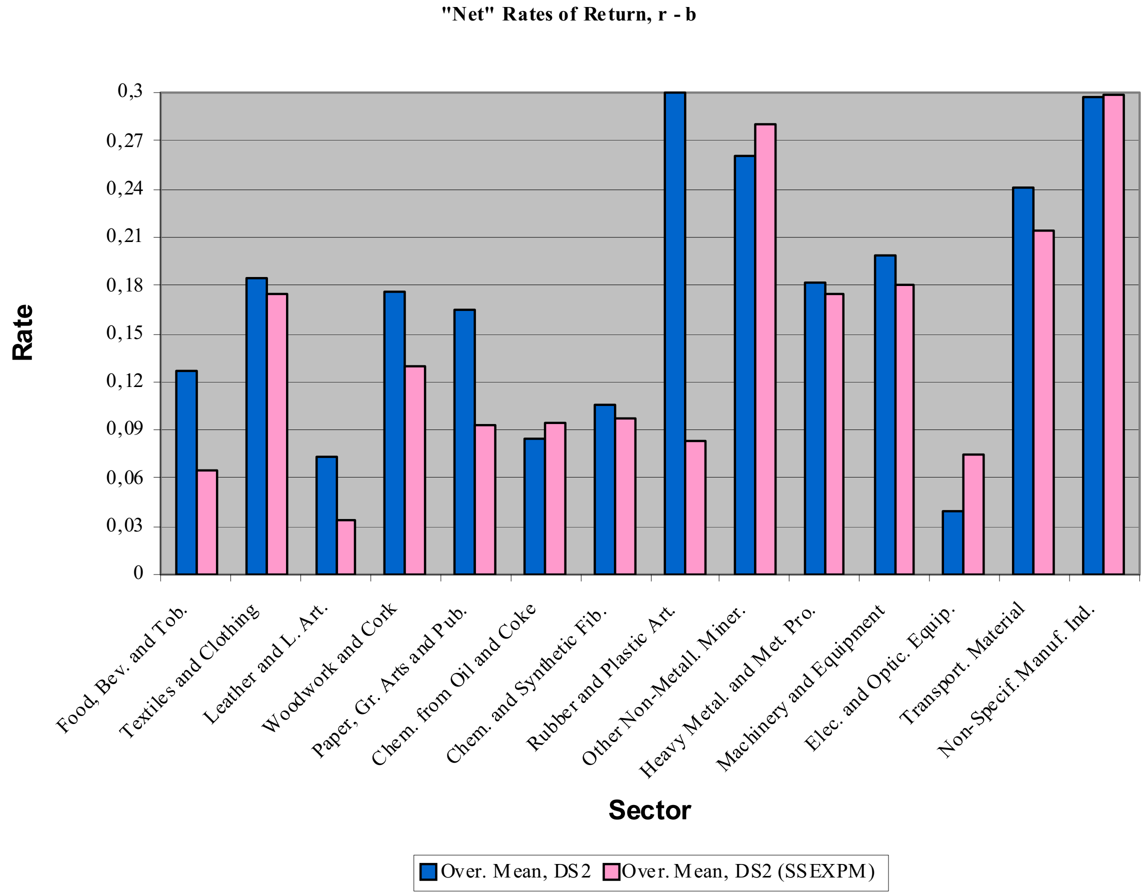

Fig. 3

Fig. 4 depicts the pattern of "nominal" rates – only estimated for Data Set 1. The pattern is, thus similar to that of the net rates. Mining joins the low rate sectors with EXPM; Commerce, Real Estate, Banking and Insurance, and Public Administration the high rate ones. With SSEXPM, the opposite would occur.

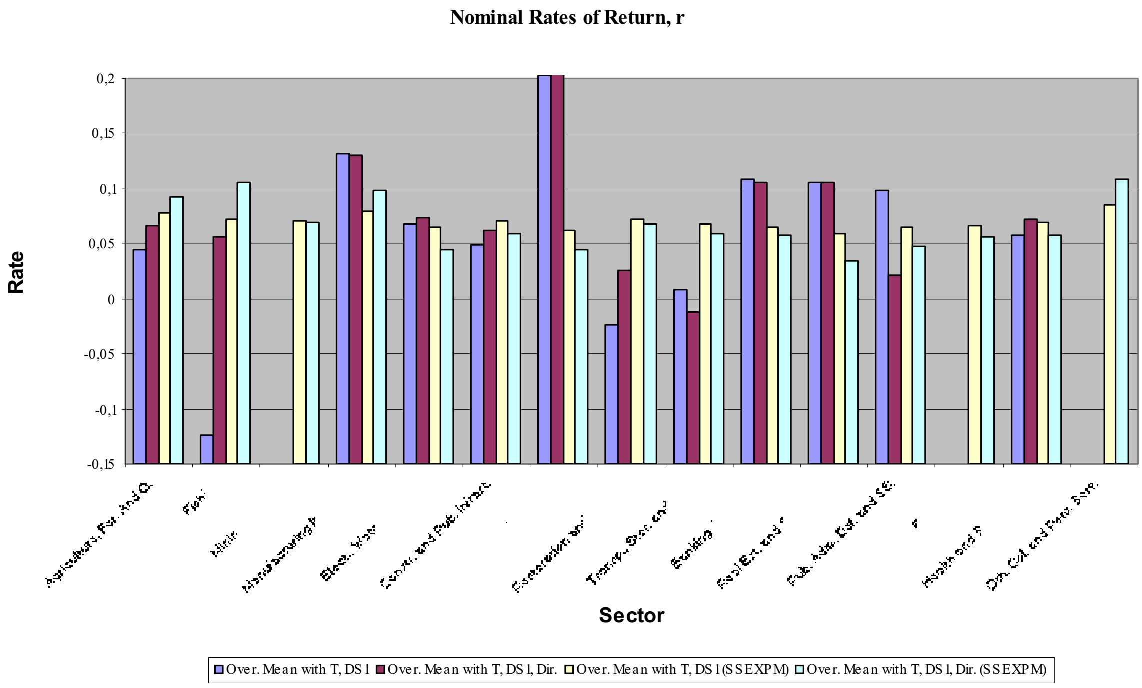

Fig. 4

We confront in Figs 5 and 6 the estimates of the g. In Data Set 2, they vary inversely to rates of return – not reported -, positively with Data Set 1.

Steeper profiles (higher gi's) seem to occur in Agriculture, Fishing and Commerce. Flatter or more negatively sloped profiles occur in Real Estate, Transportation and Storage, Public Administration, and Construction and Public Infrastructure.

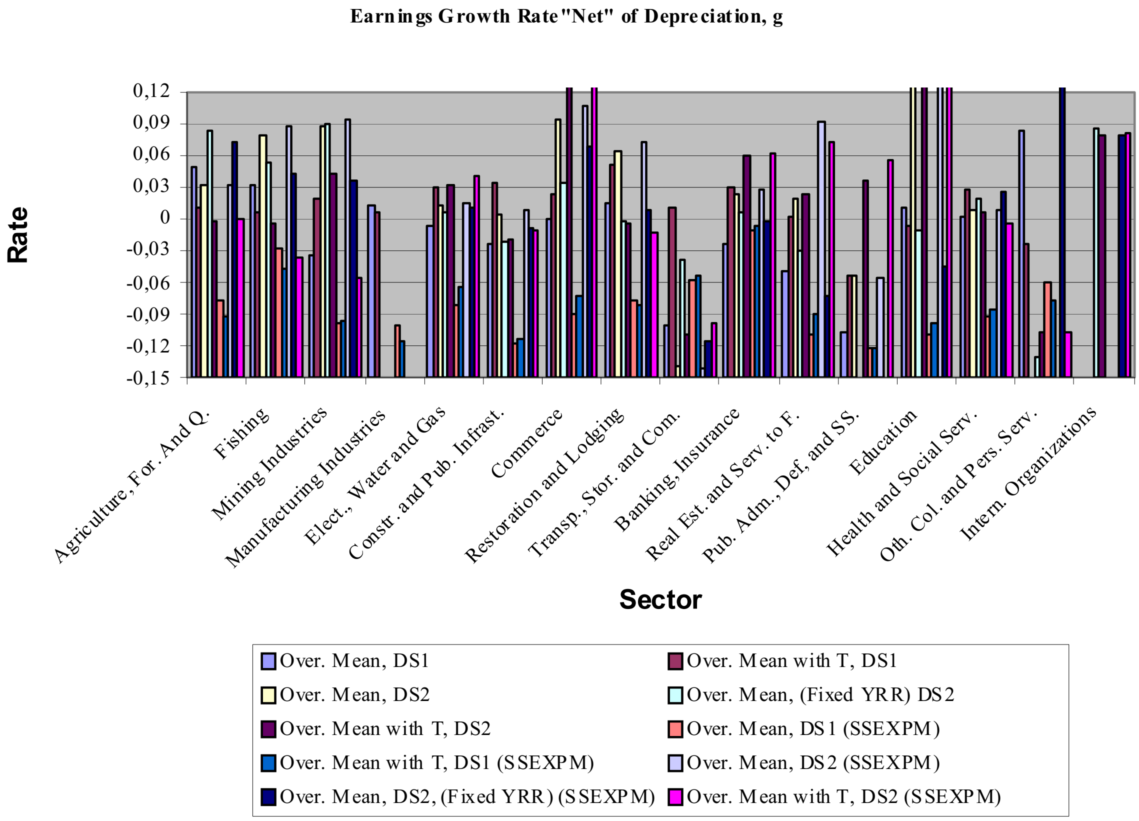

Fig. 5

Within MI, high net of depreciation earnings growth rates belong in Paper and Graphical Arts, Woodwork and Cork, Rubber and Plastic. Low rates appear in Electric and Optical Equipment, and often in Chemical and Synthetic Fibres.

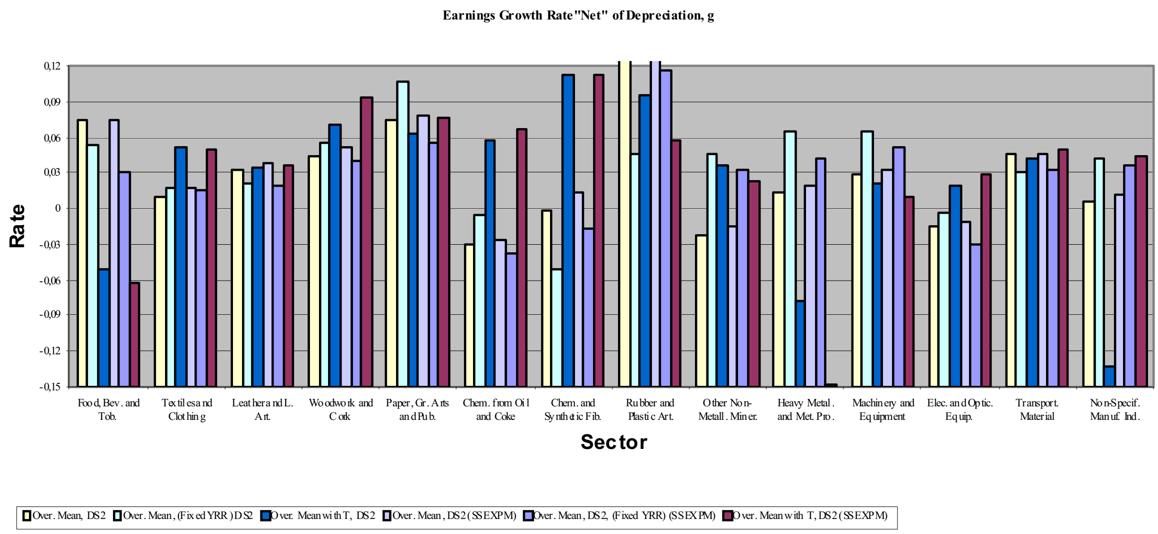

Fig. 6

If the "nominal" rate was homogeneous across sectors, we would expect negative correlations of the net rates with the inferred bi's – one can see that that is not the case, and that rather a positive and strong correlation seems to emerge between them. The implied ordering of the estimates of b – below in Figs 7 and 8. And – thus show a similar pattern of those of the rates of return.

High bi's – more dynamic sectors – are in Public Administration, Banking and Insurance, and Education. Low bi's are in International Organizations, Transportation and Storage, Construction and Public Infrastructure.

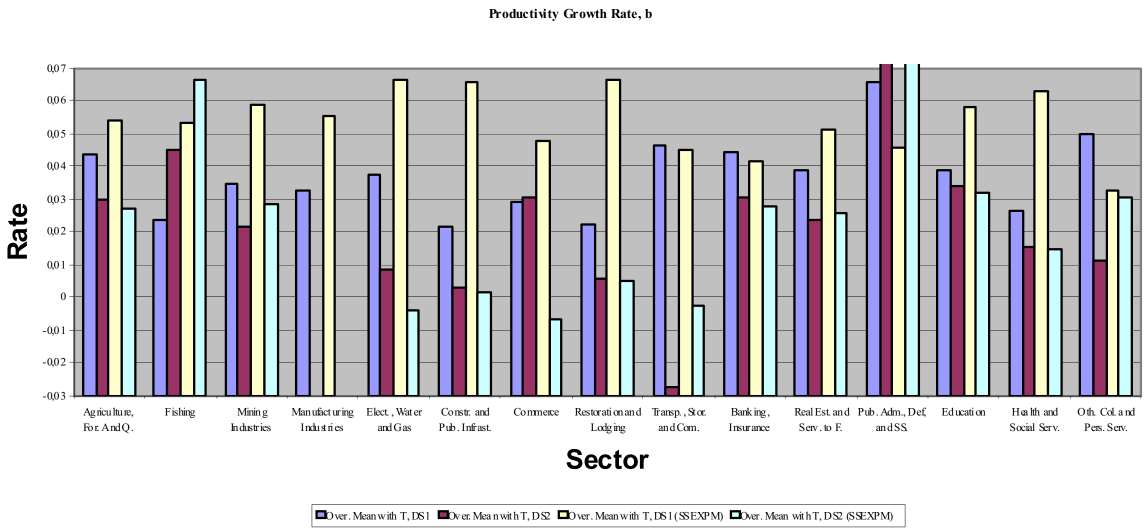

Fig. 7

In MI, high rates show up in Food and Beverages, Transportation Material, Heavy Metallurgy. Low rates in Chemicals from Oil and Coke, Chemical and Synthetic Fibres, Electric and Optical Equipment, Woodwork and Cork.

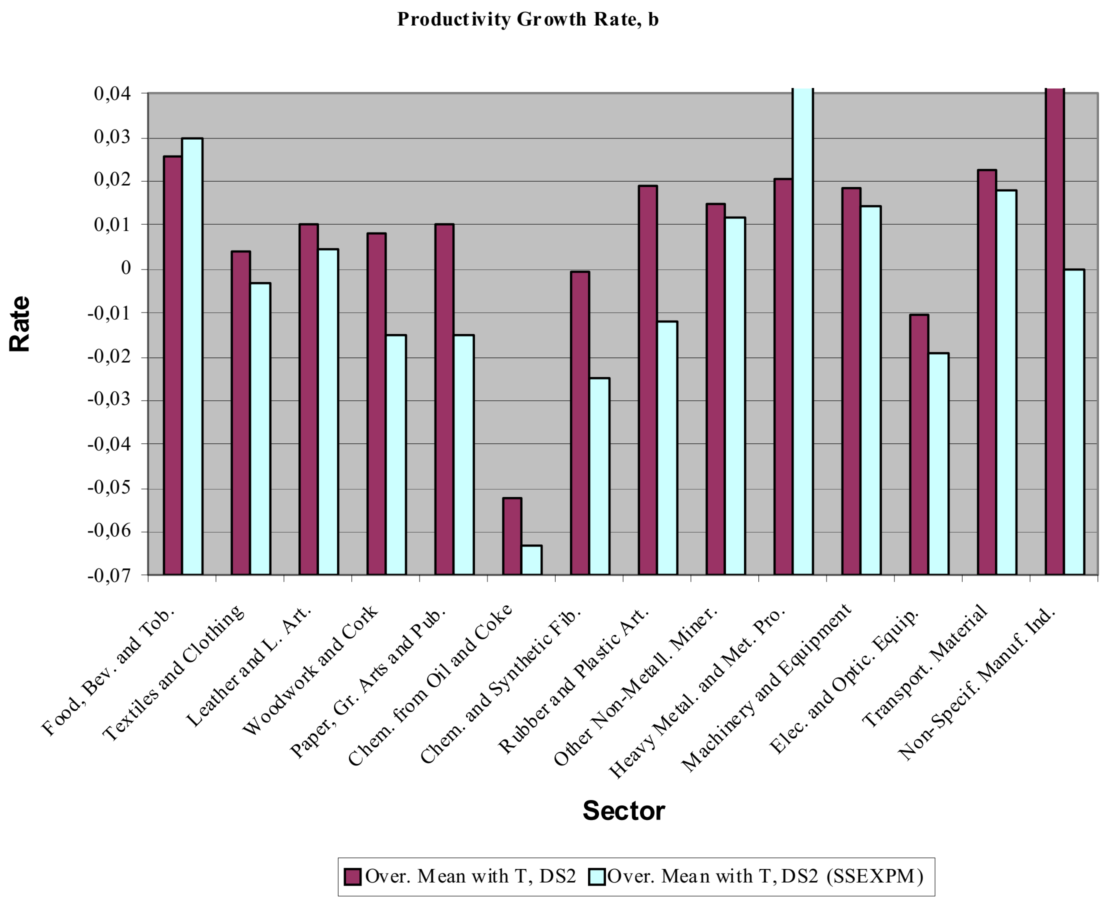

Fig. 8

As a final remark we note a positive correlation between bi's and the gi's of Data Set 1, but negative – suggesting some compensation effects – for the more precisely estimated gi's of Data Set 2 (as was noted before for "Trend" regressions results).

. Apart from return rates, their estimated variances could be important, hypothetically associated to risk in investment. We report in Tables 4 and 4.A the corrected estimates of the previously reported rates of return.

Table 4. Variance of Rates of Return																
	Data Set 1											Data Set 2				
Sector	1995	1996	1997	1998	1999	Overall Mean, 99	Overall Mean, 99 Fixed Yea RR)	Overall Mean	Overall Mean Fixed RR	Overall Mean with Trend	Overall Mean with Trend	Overall Mean, 99	Overall Mean, 9	Overall Mean	Overall Mean	Overall Mean with Trend
1	0.002010	0.001750	0.001632	0.001426	0.001410	.039187		0.026992		0.096574		.062641		009788		
2	0.014286	0.014179	0.014100	0.013873	0.014050	.039113		0.037637		0.46407		. 0 6 8 1 4		060134		
3	0.003991	0.004778	0.004015	0.004063	0.003926	0.17328		0.172748		0.72163		. 0 7 3 5 6		037015		
4	0.000073	0.000072	0.000068	0.000066	0.000062	.001849		0.001514		0.014570						
4												0.028856		014559		
5												0.082405		022353		
6												0.23541		080476		
7												0.026981		012372		
8												0.0034446		003108		
9												0.0075424		004894		
10												0.014239		008474		
11												0.044330		038390		
12												0.044069		031177		
13												0.012773		004193		
14												0.0087509		005988		
15												0.0079670		003274		
16												0.016159		.01544		
17												0.022157		.01168		
5 / 18	0.001719	0.001681	0.001709	0.001713	0.001864	.052521		0.047159		0.053217		0.018448		005500		
6 / 19	0.000308	0.000278	0.000249	0.000229	0.000212	.006721		0.006301		0.025294		0.016284		003097		
7 / 20	0.000116	0.000110	0.000103	0.000099	0.000091	0.10930		0.102019		0.10270		0.0089115		006933		
8 / 21	0.000515	0.000465	0.000419	0.000379	0.000356	.006649		0.005968		0.16297		0.011900		004214		
9 / 22	0.000296	0.000293	0.000276	0.000257	0.000248	.039978		0.016367		0.075744		0.010042		006188		
10 / 2	0.000608	0.000633	0.000651	0.000649	0.000653	.017572		0.010204		0.039224		0.051726		012481		
11 / 2	0.000269	0.000240	0.000214	0.000171	0.000160	.016835		0.016489		0.042440		0.015452		010645		
12 / 2	0.012174		0.011628	0.011222	0.010100	.061128		0.058631		0.24789		0.27404		.3010		
13 / 2	0.000707	0.000740	0.000673	0.000644	0.000612	0.17610		0.170179		1.16882		0.053664		015259		
14 / 2	0.000559	0.000522	0.000461	0.000414	0.000366	.015004		0.013745		0.042501		.008079		005278		
15 / 2	0.000909	0.000832	0.000802	0.000733	0.000659	0.32188		0.320945		0.56017		. 0 2 1 2 5		.01940		
16 / 2					0.991741	. 1 7 2 5		1.168628		1.22326		.		.		
1995						0002406	0007511					00090839	002025			
1996						0002655	0007872					00049411	002059			
1997						0002007	0007815					00027183	002039			
1998						0001339	0009206					00005002	002085			
1999							0010022						002079			
Total									0006361		.0030505				001985	0039856

* Nominal

Table 4.A. Variance of Rates of Return (With SSEXPM)											
	Data Set 1						Data Set 2				
Sector	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	Overall Mean with Trend (1)	Overall Mean with Trend (2)	Overall Mean, 99	Overall Mean, 99 (Fixed Yearly RR)	Overall Mean	Overall Mean (Fixed RR)	Overall Mean with Trend
1	0.00034548		0.000337		0.00037112		0.050416		0.016823		
2	0.0023422		0.002346		0.0032636		0.073515		0.053593		
3	0.0010464		0.001048		0.0010906		0.13594		0.14531		
4	0.00002689		0.000016		0.00001772						
4							0.043522		0.038756		
5							0.096192		0.032673		
6							0.23262		0.092433		
7							0.030179		0.022910		
8							0.010861		0.011010		
9							0.0071936		0.004667		
10							0.029929		0.033882		
11							0.0069471		0.004432		
12							0.080282		0.078704		
13							0.021635		0.016717		
14							0.015962		0.014203		
15							0.0059101		0.002567		
16							0.011280		0.010905		
17							0.021011		0.018494		
5 / 18	0.00071346		0.000703		0.00069929		0.014465		0.003878		
6 / 19	0.00007096		0.000062		0.000066867		0.014116		0.003932		
7 / 20	0.00004362		0.000035		0.000034634		0.0030013		0.002277		
8 / 21	0.00010131		0.000092		0.00010688		0.018836		0.013237		
9 / 22	0.00011235		0.000101		0.00010071		0.0073067		0.003110		
10 / 23	0.00042305		0.000402		0.00042055		0.065349		0.013083		
11 / 24	0.00009498		0.000088		0.000086525		0.014581		0.009247		
12 / 25	0.0048565		0.004901		0.0059292		0.20730		0.24038		
13 / 26	0.00044070		0.000436		0.00043385		0.070878		0.016142		
14 / 27	0.00018420		0.000179		0.00018734		0.0094455		0.006852		
15 / 28	0.00032116		0.000315		0.00031232		0.0095963		0.008736		
16 / 29	1.00382		1.017246		1.11856		.		.		
1995	0.000021762	0.000014556					0.00076605	0.0016731			
1996	0.000021575	0.000014839					0.00038332	0.0017241			
1997	0.000020977	0.000014543					0.00020497	0.0016846			
1998	0.000020898	0.000015744					0.000034135	0.0017252			
1999		0.000016216						0.0017064			
Tota				.55500D-0		.0000165 *				0.0016014	0037982 *

* Nominal

Fig. 9 depicts some of the estimated variances for the aggregated sectors, 10 for the Manufacturing Industries sub-sectors.

High variance (risk in schooling returns) sectors would appear to be Mining, Education, International Organizations, and Fishing, and also often, Electricity, Gas and Water. Low variance would occur in Manufacturing, Construction, Restoration and Lodging and Transportation and Storage.

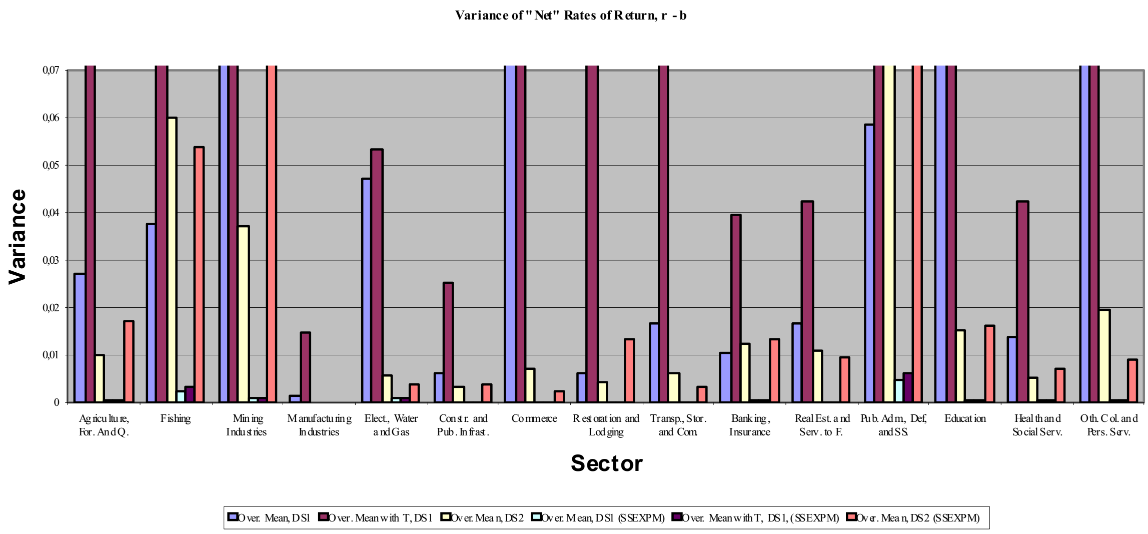

Fig. 9

In MI, high variance occurred in Leather and Leather Articles, Other Non-Metallic Products, Textiles and Clothing, and Food and Beverages. Low variances, in Electric and Optical Equipment, Paper and Graphical Art, Chemicals from Oil and Coke, Machinery and Equipment.

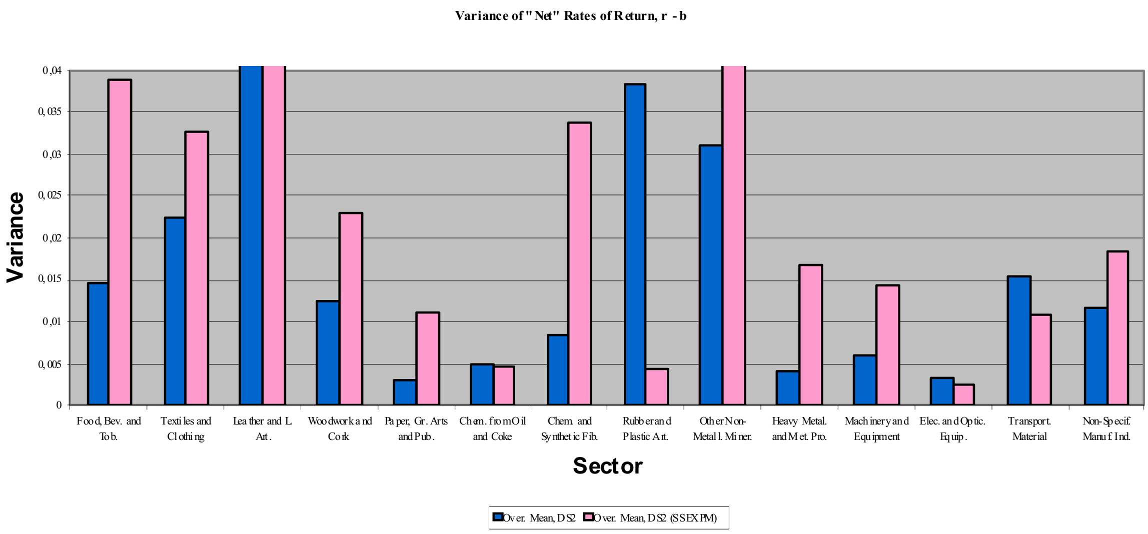

Fig. 10

The use of the trend allows in some instances, an easy form to capture the variances of the "nominal" rates directly. They are reported in Fig. 11. They did not show a different pattern than that of variances of the "net" rates – not surprisingly, once the size of the bi's is generally very small compared to the estimates of the ri's.

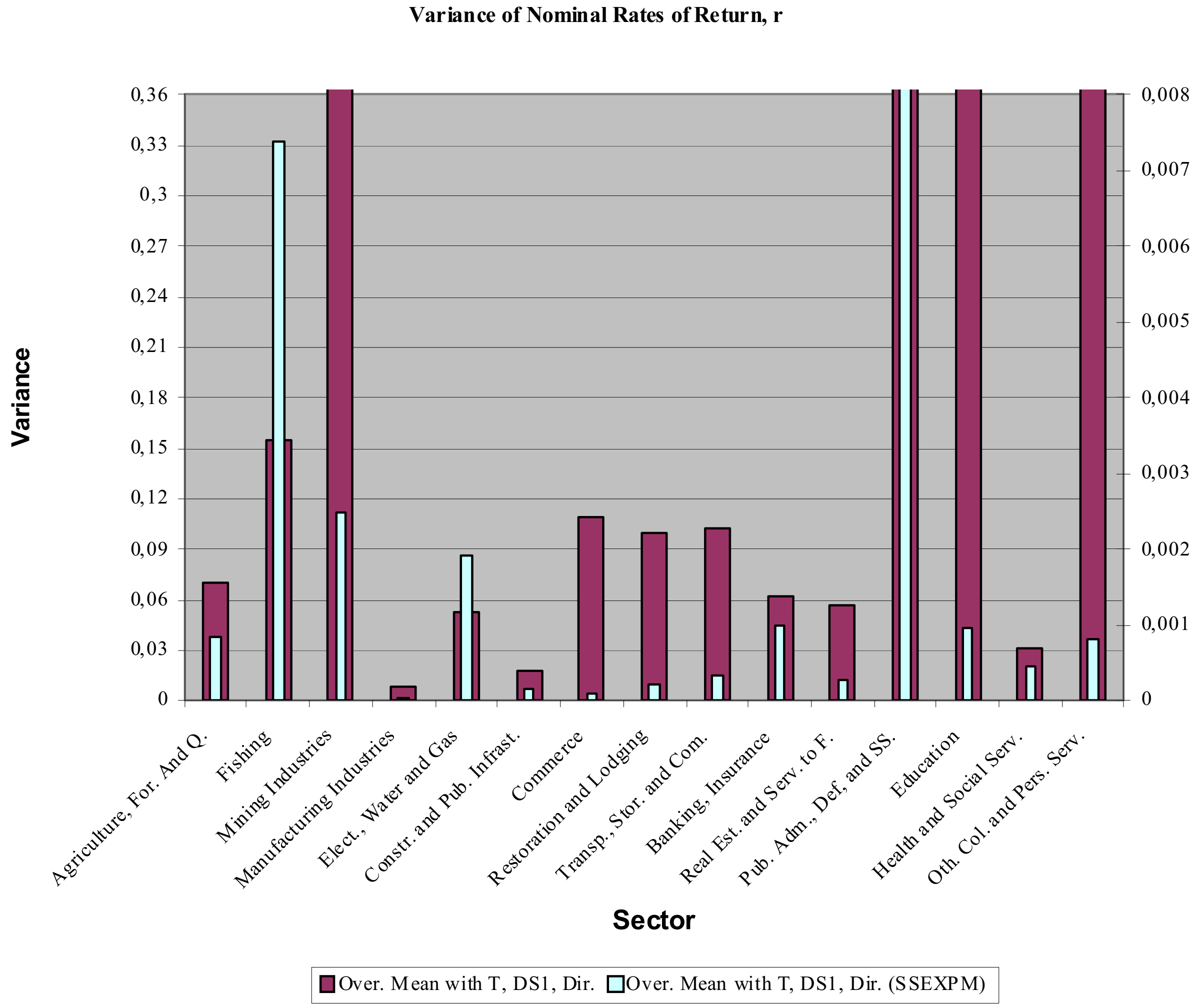

Fig. 11

. A final inspection fell on the individual OLS estimates of the variance of each sector estimate of the rate of return from Data Set 1. The rate of return estimate is the same as obtained with above, yet, the standard deviation of the parameter is different, being (the uncorrected variance) stored as VTXREM – the correlation between them is 0.65463 (p-value of .000) but weighted by the number of people employed –0.059631 (.611). We multiplied both series also by the number of people employed in each sector – and created series RVCOXM for system-wide estimations and VTXREMM for individual equation estimates; the correlation between them is 0.14053 (p-value of .229) and weighted by the number of people employed 0.50164 (.000); finally, we constructed the standard deviation taking the square root of both series – DVTXREM and DVTXREMM.

The yearly variances are reported in Fig. 12 and, when multiplied by number of workers in Fig. 13.

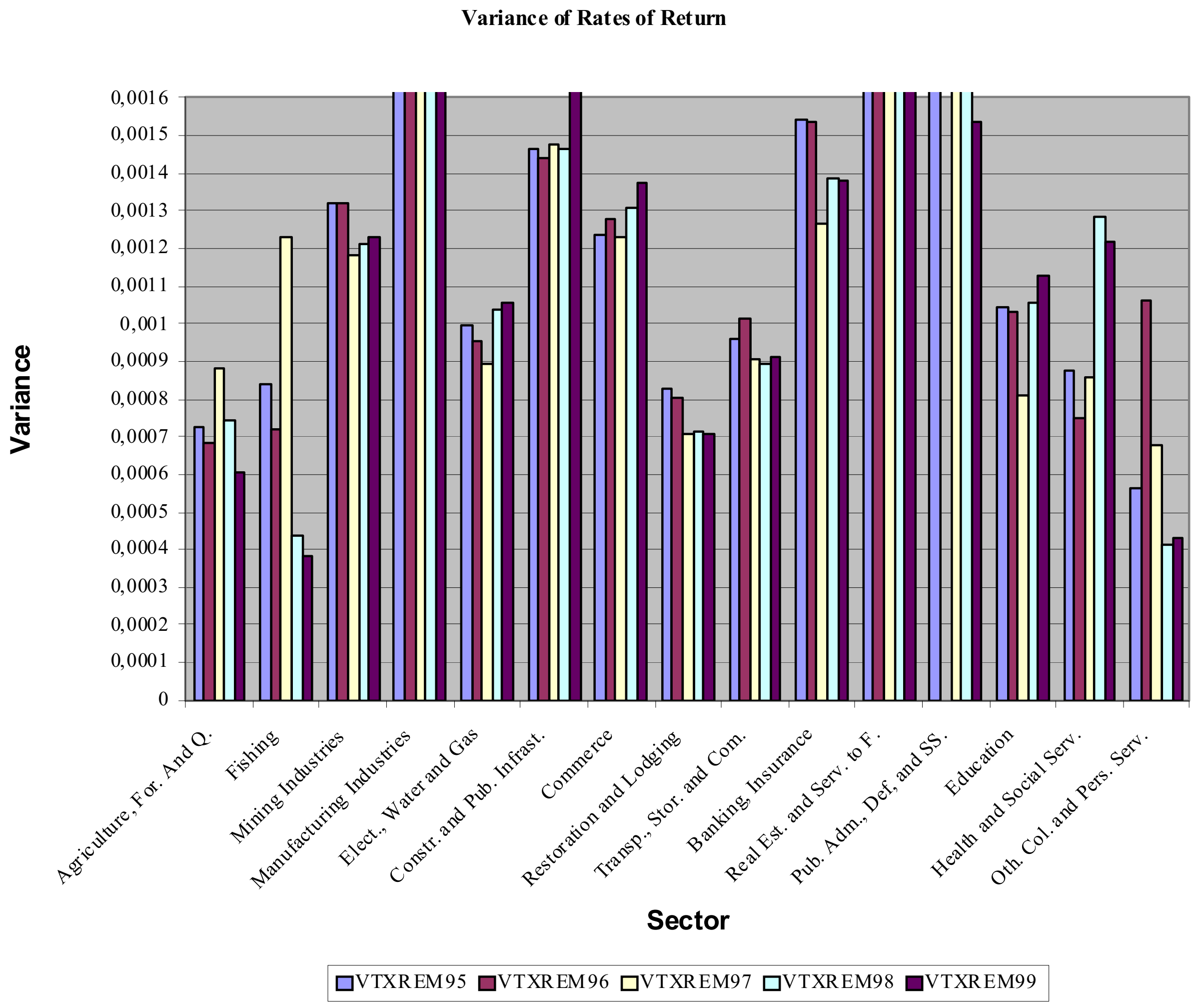
Variance of Rates of Return
Variance
0,0016
0,0015
0,0014
0,0013
0,0012
0,0011
0,001
0,0009
0,0008
0,0007
0,0006
0,0005
0,0004
0,0003
0,0002
0,0001
0
Agriculture, For. And Q.
Fishing
Mining Industries
Manufacturing Industries
Elect., Water and Gas
Constr. and Pub. Infrast.
Commerce
Restoration and Lodging
Transp., Stor. and Com.
Banking Insurance
Real Est. and Serv. to F.
Pub. Adm., Def, and SS.
Education
Health and Social Serv.
Oth. Col. and Pers. Serv.
Sector
VTXREM95
VTXREM96
VTXREM97
VTXREM98
VTXREM99

Fig. 12

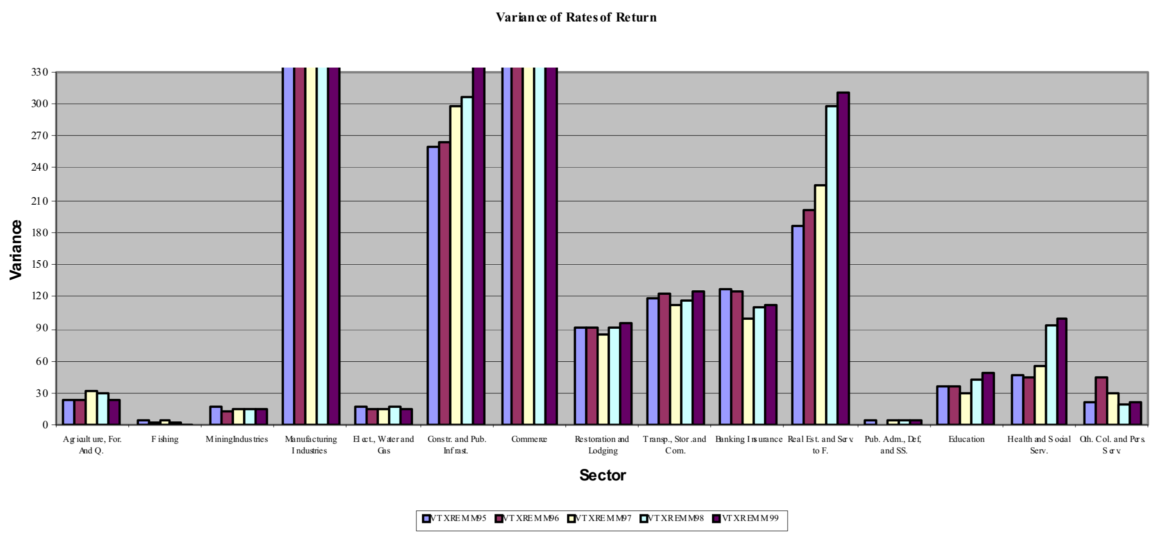
Variance of Rates of Return
Variance
330
300
270
240
210
180
150
120
90
60
30
0
Agriculture, For. And Q.
Fishing
MiningIndustries
Manufacturing Industries
Elect., Water and Gas
Constr. and Pub. Infrast.
Commerce
Restoration and Lodging
Transp., Stor .and Com.
Banking Insurance
Real Est. and Serv. to F.
Pub. Adm., Def, and SS.
Education
Health and Social Serv.
Oth. Col. and Pers. Serv.
Sector
VTXREMM95
VTXREMM96
VTXREMM97
VTXREMM98
VTXREMM99

Fig. 13

The individual yearly OLS variances are usually negatively correlated with those of the System-wide estimation – not reported. The ordering of the sectors is thus almost opposite to that found for the other variances. High yearly variance sectors are Public Administration, Manufacturing, Real Estate and Service to Firms, Banking and Insurance and Construction and Public Infrastructure.

Often the correlations between the overall variances and the rates of return estimates is negative and in some cases, not significant. However, one can find positive correlations between the yearly estimates of returns and yearly OLS variances – under the isolated OLS estimation, implying no experience effects being controlled for. In fact, the linear correlation between

- RCOX (the system-wide estimators of the yearly sector return rates, which equals the individual OLS estimates, TXREDM) and RVCOX (the system-wide estimate of the variances for the yearly rates of return) is -0.19202 (p-value of .099); weighted is -0.051199 (p-value of .663).

- RCOX and RVCOXM (RVCOX multiplied by the number of workers for each sector observation) is -0.52817 (p-value of .000); weighted is -0.14394 (p-value of .218).

- TXREDM and VTXREM is 0.074024 (p-value of .528); weighted is 0.54665 (p-value of .000).

- TXREDM and VTXREMM is 0.17974 (p-value of .123); weighted is 0.61446 (p-value of .000).

The correlation of the variances with the gi's is negative or non-significant. With the bi's–, it can be considered more often negative than positive.

4. Long-Run Internal Rate of Return of Physical Capital: An Economic Indicator for Aggregate Information

. Admit a physical capital investment K generating a stream of constant cashflows EBE for T periods. The internal rate of return to the investment is r_k such that:

$$K = \sum_{t=1}^{T} \frac{EBE}{(1+r_k)^t} = \frac{EBE}{r_k} \; [1 - \frac{1}{(1+r_k)^T}]$$

For the effective stock existing at a point in time to continuously generate the flow EBE – to generate a perpetuity - till infinity, investment I must be (is…) made per period. Then, it must be the case that, under a stationary equilibrium environment:

$$K = \sum_{t=1}^{\infty} \frac{EBE - I}{(1+r_k)^t} = \frac{EBE - I}{r_k}$$

. Assume now that the economy grows at rate b: EBE generated by K grows at rate b, the required investment to insure growth also grows at rate b. Then the previous formula at a particular moment in time becomes:

$$K_0 = \sum_{t=1}^{\infty} \frac{EBE_t - I_t}{(1+r_k)^t} = \sum_{t=1}^{\infty} (EBE_0 - I_0) \frac{(1+b)^t}{(1+r_k)^t} = (EBE_0 - I_0) \frac{1+b}{r_k - b}$$

or

(26) $$EBE_0 - I_0 = \frac{r_k - b}{1+b} K_0$$

That is, the coefficient of the linear regression of the current cashflow net of investment on the existing capital stock – without an intercept – performed across industries or sectors observed at a given point in time should approximate $\frac{r_k - b}{1+b}$. If we admit an immediate generation of net cashflow, i.e., $K_0 = \sum_{t=0}^{\infty} \frac{EBE_t - I_t}{(1+r_k)^t}$, then, under the same assumptions, such coefficient should approximate $\frac{(1+r_k)(r_k - b)}{(1+b)}$:

(27) $$EBE_0 - I_0 = \frac{(1+r_k)(r_k - b)}{(1+b)} K_0$$

Provided employment is relatively stable – that individual productivity stands in line with aggregate growth - such coefficient should have a correspondence with equation (20) estimates of the logarithm of the base of s, once, for $\frac{1+r_s}{1+b_i}$ close to 1, $\ln\left(\frac{1+r_s}{1+b_i}\right) \approx \frac{1+r_s}{1+b_i}$ - 1 = $\frac{r_s - b_i}{1+b_i}$.

It is unclear whether current gross or net capital stock should be used in (26) and (27). Presumably, the salvage value of existing capital is well approximated by net capital – the value of today's "fresh" units that we would have to install to "start" the infinitely-lived project. Yet, the real physical units in place are more appropriately measured by gross capital. Under an hypothetical growth model of the economy, the matter will be determined by which aggregate – net or gross capital – enters the firms' production function.

5. (Available) Balance Sheet Indicators

Several indicators were constructed in order to inspect interaction with physical capital and other characteristics of the production process – potential patterns of the sector rates; some are reported in INE's publication, *Sistema de Contas Integradas das Empresas*; others were constructed from the aggregates therein. Some were derived from "Quadros de Pessoal" – see A.1 of Appendix 1 for further description:

- Other "Demographic" characteristics: Mean tenure, ANTIG; Proportion of Male Employment, TH.

- Employment Qualification Category: QUMESU, ENCPAQ, PQESQ, PNQEAP.

- Hours of Work and Overtime: Work-week duration, HORNOR, HORNTC, HORTOT; percent of employment with overtime, PTCOHEX, and mean duration of overtime, DUTEXTR.

- Industry Organization: firm size, DIMEMP; plant size, DIMEST; employment concentration in firms, IG; mean age of firms, IDEMP.

Definitions of indicators derived from balance sheet information and are summarized in A.2 of Appendix 1. These can be generally classified into:

- Employment Technology:

Labor Costs Share: CPESCA, REMPVA;

Labor Productivity: PRPES, VAPES; VABH, VABHA

- Productive Organization Technology: VAPRO, MGCOVA, FSEXPR

- Capital Technology:

Gross Trading Profits Share: EBEVA;

Capital Intensity: IMCPES, IMCEPE, IMBPE, CAPRPE, ACBUPE, ACLIPE, INTKA, INTKAA, KINTE.

Capital Productivity: VABACB, VABACL, VABIMO

- Inventory/Stock Rotation: VEVA, VEPRO, EXIPRO.

- Tangible Capital and Assets Rotation: INVVAB, INVIMC, RAB RIMOB, RIMOBC.

- Rates of Return:

Economic: EBEACB, REB, REBF;

Financial: RAL, RCP, RFIN, RFIN1, RFINL1

Long-Run Adjusted: R1, RL1, R2, RL2, R3, RL3, R4, RL4

- Financial Autonomy:

Structure: PASACB, PASACL, DIDIA, DDPDIA

Dynamics: AUFINV, AUFILU, LUDILU

- Financial Intermediacy Costs and Returns (Prices): CUFDIA, JUPMEL, GFIDDB, GAFDDT

- Tax Burden: IMPLU, IMPLU1

Descriptive statistics and simple correlations (weighted by people employed in the education class and sector, TED, for Data Set 1 and by TCOCHM in Data Set 2) are reported in Appendix 2.

6. Log Earnings Alignment with Physical (Financial) Capital Indicators: Log Earnings Regressions

A first attempt was made to incorporate some of the financial and other indicators in the log-earnings regressions. In later sections, the estimates of the sector rates previously estimated were also regressed in the same indicators. No sector dummies nor interactions with education, experience or trend were considered here – which could be akin to the whole approach taken, but not quite: our segmentation hypothesis is one of sector specific rates, yet constant over time.

Using stepwise procedures, the most interesting feature of the results was the recurrent disappearance of the experience variable and – not unexpectedly – a replacement of education by the hourly productivity indicators or even other indicators. Given the high colinearity in data, we ended up by trying OLS manually, guided by the correlation results with RED for Data Set 1 – for which, the indicators were replicated for each sector - and GANBAS for Data Set 2 not reported.

From those tables we conclude that:

- RED as GANBAS seem to show the same significance and sign correlation pattern – as expected -, except with the experience proxies (EXPM, SSEXP, SZEXPM), for which the expanded Data Set 1 indicates positive correlations and Data Set 2 negative ones.

- the correlations of the education proxies – ED and EDUM - are those that more closely approximate those of earnings.

- individual earnings as education are higher in sectors of lower labor share (CPESVA), of higher reliance on external services by firms (FSEXPR), and higher capital intensity.

- both earnings and education are higher in sectors of high tangible investment intensity (INVVAB and INVIMO).

- long-run adjusted rates of return on capital are negative and strongly associated to both earnings as education of sector employment. Other return rates show a conflicting pattern: financial rates positively associated to both but only significantly for education; economic rates of return negatively associated to earnings but barely and positively affecting education.

- financial intermediation active ("lending") rates (GFIDDB and GAFDDT) enhance education and earnings, passive ("borrowing") rates (CUFDIA, JUPEML) are detrimental.

Also of interest from the correlations are the ones relative to firm and plant size, industry concentration and age of firms. Interestingly, they usually show the same correlation pattern except for the long-run adjusted rates of return, for which concentration exhibits negative impact while the others show positive, and for tangible capital intensity, where, partly, the opposite occurs.

We present below some of the most significant regressions explaining log earnings for each data set:

Table 5. Log Earnings Regressions, Weighted by RED/TCOCHM

	Data Set 1 (308 obs.)				Data Set 2 (92 obs.)			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
INTERC.	9.01215 (.320903) [.000]	9.14584 (.294964) [.000]	11.1163 (.202512) [.000]	11.2085 (.221185) [.000]	8.99609 (.098899) [.000]	9.01610 (.094703) [.000]	9.29732 (.072017) [.000]	9.12406 (.084274) [.000]
EDUCM	.104736 (.00980808) [.000] {1.232}	.099257 (.00836430) [.000] {1.168}	.046495 (.00358188) [.000] {.547}	.039195 (.00490518) [.000] {.461}	.147748 (.00570524) [.000] {.724}	.148096 (.00548135) [.000] {.726}	.121751 (.00513483) [.000] {.599}	.136220 (.00519364) [.000] {.670}
EXPM	.043958 (.00960536) [.000] {.555}	.038435 (.00809837) [.000] {.485}			.034195 (.00307912) [.000] {.293}	.031824 (.00279269) [.000] {.273}		
SSEXPM			-.033915 (.00651950) [.000] {-.261}				.032459 (.00257914) [.000] {.277}	
SZEXPM				-.033481 (.00668204) [.000] {-.319}				.031122 (.00259855) [.000] {.266}
TREND	.059390 (.014452) [.000] {.208}	.058552 (.014294) [.000] {.205}	.00990838 (.013626) [.468] {.035}	.010605 (.013669) [.438] {.037}	.041986 (.00644594) [.000] {.185}	.043509 (.00626835) [.000] {.191}	.043034 (.00587157) [.000] {.189}	.045679 (.00610132) [.000] {.201}
TH	.304984 (.051123) [.000] {.164}	.315964 (.050191) [.000] {.170}	.354662 (.050514) [.000] {.190}	.354986 (.050687) [.000] {.190}	.470356 (.024826) [.000] {.392}	.488581 (.024162) [.000] {.407}	.483233 (.022716) [.000] {.402}	.482357 (.023555) [.000] {.401}
DIMEMP					-.00130339 (.000392845) [.001] {-.116}	-.00124862 (.000379848) [.002] {-.112}	-.00119795 (.000355223) [.001] {-.107}	-.00110166 (.000365769) [.003] {-.100}
IG	.758998 (.112632) [.000] {.307}	.803166 (.105358) [.000] {.325}	1.40386 (.096856) [.000] {.569}	1.39648 (.097408) [.000] {.566}	.828205 (.056116) [.000] {.510}	.836075 (.054296) [.000] {.515}	.801344 (.050914) [.000] {.490}	.817558 (.052583) [.000] {.502}
MGCOVA	.154928 (.021809) [.000] {.254}	.170765 (.025550) [.000] {.279}	.108563 (.020815) [.000] {.178}	.106433 (.020964) [.000] {.174}	.098210 (.013788) [.000] {.240}	.115564 (.014569 [.000] {.276}	.105102 (.013299) [.000] {.250}	.109536 (.013891) [.000] {.262}
FSEXPR	.027455 (.089572) [.759] {.012}	.106707 (.090271) [.238] {.046}	.126560 (.087683) [.150] {.054}	.124096 (.087930) [.159] {.053}	-.159130 (.061022) [.011] {-.094}	-.097246 (.058047) [.098] {-.062}	-.103809 (.054489) [.060] {-.064}	-.068461 (.056153) [.226] {-.047}
EBEACB	-1.39690 (.740576) [.060] {-.073}		2.25148 * (.654224) [.001] {.117}	2.25201 * (.661250) [.001] {.117}	-1.09294 (.310061) [.001] {-.007}			
RFIN		-.639789 (.324136) [.049] {-.080}				-.640402 (.148798) [.000] {-.110}	-.630658 (.139410) [.000] {-.110}	-.639833 (.144144) [.000] {-.111}
RL4	-.063573 (.023283) [.007] {-.090}	-.063231 (.023118) [.007] {-.090}	-.140353 (.022146) [.000] {-.199}	-.139886 (.022255) [.000] {-.198}	-.053132 (.012102) [.000] {-.101}	-.048169 (.011913) [.000] {-.092}	-.045935 (.011189) [.000] {-.087}	-.048069 (.011544) [.000] {-.091}
CUFDIA	3.90548 (1.58233) [.014] {.158}	3.21136 (1.47501) [.030] {.130}	-3.58452 (1.42561) [.012] {-.145}	-3.49330 (1.43175) [.015] {-.142}	2.39755 (.550545) [.000] {.129}	2.13939 (.526093) [.000] {.115}	2.18275 (.493614) [.000] {.119}	2.39489 (.514044) [.000] {.131}
RBAR2	.818124	.820465	.789991	.782717	.951416	.956198	.961562	.959402
SIG2	.048974	.048830	.067180	.069208	.00437000	.00393955	.00345112	.00365305

* When EBEACB was replaced by RFIN in the regression, the coefficient of the later became negative and insignificant. The regression performed slightly worse.

Note: Standard deviations in parenthesis. Significance level in square brackets. Standardized coefficients in curly brackets

Relative to the results reported in Tables 1 and 1.A, the coefficients of education and experience decreased, part of the effect being now captured by other variables. Under the expanded data set, the inclusion of the threshold measures of experience seems to have raised substantial colinearity: the experience proxies have negative coefficients and other variables show switch signs; even if we present the regression to the reader for the sake of completeness, we will only discuss the results of the remaining regressions.

Consistently, proportion of male employment (TH) and industry concentration (IG) seem to enhance observed earnings. This is in line with the theory – discrimination and women smaller attachment to the labor market enhancing male earnings, market power leading to a share of industry profits between capital and labor. Firm size (DIMEMP) – the effect of which is, nevertheless, mingled with industry concentration (IG) – has a negative impact (when it usually has a positive effect); its effect disappeared in the expanded Data Set 1 (and we report for this the regressions without DIMEMP).

Commercial Margins (MGCOVA) seem to consistent and strongly feed labor earnings. Under Data Set 2, the reliance of external service supply (FSEXPR) competes with labor earnings – the effect and its significance disappeared in Data Set 1.

Financial and economic capital returns also oppose labor earnings – as could be expected; financial costs seem to move in the same direction as worker earnings (CUFDIA has positive coefficients).

In general, conclusions on the impact of financial and physical capital returns appear robust to colinearity: one can contrast the multiple regression effects with those of the simple correlations of GANBAS or RED – earnings but in levels – with other indicators – not reported - and confirm the same significance and sign for most. Exceptions in other variables are firm size (already discussed), DIMEMP, commercial margins, (MCGCOVA, which shows null simple correlations with GANBAS and RED), reliance on external services, FSEXPR (which has positive correlations with earnings), and financial costs (CUFDIA, negative correlations). These were left in the regressions to capture the eventual linear links among them and with other indicators.

The new experience proxies SSEXPM as SZEXPM, in multiple regression with the expanded Data Set 1, exhibit a negative coefficient (which, in any case, also showed up in single correlations of Data Set 1 between RED and EXPM).

Another salient feature, is the absence of tenure (ANTIG) in the regressions, which, due to the small number of observations and colinearity, became statistically redundant. In fact, tenure is significant in regressions with only education, experience and either trend or year dummies with either Data Set or experience proxy – but in Data Set 2, threshold-based experience proxies become highly insignificant with its inclusion. At this stage, we did not provide a theoretical framework to accommodate for job-specific investment – but, as it turned out, neither did tenure became includable or correctly signed in the search for enlarged regressions.

7. (Net) Internal Rate of Return Regressions

Using the rates of return previously derived, we tried to inspect a pattern to their sector variability. We inspected the weighted (by number of workers) correlations of the estimated series – which were recalculated with the merged sectors 9 and 10 for Data Set 2 - with the different indicators, these taken as means from 1996 to 1998 (mid years of the Quadros de Pessoal sample, from which the rates of return were derived using years 1995 to 1999) when appropriate.

Also of interest would be the variance of those rates of return – possibly measuring risk in human capital investment. Sattinger (1993, p. 870), admits that, under the simple stationary non-depreciable human capital assumption, the rate of return is a random variable and the earnings function written as:

(28) $$\ln E_i^s = \ln E^0 + r_{si}\, s_i$$

E_i^s denotes income of individual i, r is the average rate of return to schooling for worker i and s_i the number of years of schooling beyond the minimum for worker i. He points to the fact that that if the rate of return r and the level of schooling i are independently distributed:

(29) $$\text{Var}(\ln E) = \bar{r}^2\ \text{Var}(s) + \bar{s}^2\ \text{Var}(r) + \text{Var}(s)\ \text{Var}(r\ )$$

where $\bar{r}$ and $\bar{s}$ denote average rate of return and level of schooling of all workers and Var(ln E) the variance of log-earnings. Then, we can infer that:

(30) $$\text{Var}(r) = \frac{Var(\ln E) - \bar{r}^2\, Var(s)}{Var(s) + \bar{s}^2}$$

It is easy to show that if we use for $\bar{r}$ the OLS coefficient estimate of regression (28), expression (30) approximates the formula for the estimated variance of the OLS estimator $\bar{r}$.

We thus considered the variance of the parameter (of the estimator of the rate of return) estimate as the appropriate indicator and also included the correlations in the tables [12].

Yet, as we are using sector averages of earnings, the variance of ln E differs from ours in a different way that Var(s) does. If we admit grouped data of a particular series, the weighted least squares variance automatic estimate of the regression of the variable on only a constant approximates the

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[12] Note that we use a monthly earnings series, measured in October. We implicitly assume that yearly earnings are the same constant (around 12 to 14) times the reported monthly earnings. That may not be reasonable.

variance of the variable (divided by the number of classes, supposedly small, minus 1) [13]; but if we are using mean and not grouped data, we may be approximating by the variance of the estimate the variance of the *mean* of the dependent variable.

Putting it differently, the estimated variance of the parameter of a regression on a constant term is the variance of the mean of the variable – of the estimator of the parameter; to obtain the variance of the dependent series, we must multiply it by the number of observations [14].

For each rate or variance series, we contrasted correlations of the direct OLS estimate with the log-normal corrected or adjusted parameter. As it turned out, correlations are almost coincidental and therefore we only report the regressions of the former in multiple regression analysis.

The series suffer from colinearity, derived from the small number of observations available. That is specially acute for estimates of Data Set 1 – with the exception of the Yearly Rate Estimates -, for which only a correlation analysis is possible. Therefore, we present below some regression of the Yearly Rates for Data Set 1 – others provide a very small number of observations - and for the two derived series of Data Set 2 [15] (Overall Mean estimates).

[13] This would provide a rationale to divide the variance by number of workers, the total weights, to obtain the appropriate variance of the estimated mean rate…

[14] We essayed multiplying the variances by number of workers but in general it did not work well.

[15] We essayed including the variance as dependent variable of the rates of return. In general, it was insignificant.

Table 6. Rates of Return Regressions						
	Rates of Return			Variance of Estimates		
Variable	Data Set 1 (44 obs.)	Data Set 2 (23 obs.)	Data Set 2 with SSEXPM (23 obs.)	Data Set 1 (22 obs.)	Data Set 2 (23 obs.)	Data Set 2 with SSEXPM (23 obs.)
Intercept	.00562589 (.024463) [.820]	1.61309 (.267620) [.000]	1.23568 (.369002) [.003]	-.025601 (.00820379) [.011]	-.016042 (.024798) [.526]	-.032033 (.039060) [.424]
EDUCM	.00897666 (.00119924) [.000]					-.00585987 (.00287875) [.058]
EXPM				.000827629 (.000193904) [.002]		
HORTOT	-.00111744 (.528464) [.042]	-.037086 (.00612333) [.000]	-.024622 (.00896122) [.013]	.000255169 (.000139097) [.096]		
DIMEMP	-.713947E-04 (.408908E-04) [.090]					
DIMEL				.541552E-04 (.182212E-04) [.014]		
TXCNET					-.054580 (.041791) [.208]	
TXCVABL						-.085638 (.057293) [.153]
LPRPESL				-.00366867 (.000999816) [.004]		
LVAPESL				.00405197 (.00121615) [.008]		
MGCOVAL	-.011036 (.00248796) [.000]					
FSEXPRLM						.059782 (.038283) [.137]
EBEVAL	-.074467 (.015512) [.000]					
LACLIPEL	.011957 (.00209734) [.000]				-.00673621 (.00395494) [.106]	
LINTKAAL				-.00313250 (.000940503) [.008]		
VEPROL		2.22180 (.737815) [.008]				-.521060 (.297924) [.098]
EXIPROL				.00642957 (.00202678) [.010]		
RIMOBL			-.207143 (.137024) [.147]	.012640 (.00375692) [.007]		
RIMOBCL	-.052225 (.020276) [.015]					
REBL	-.097018 (.024732) [.000]			-.021524 (.00657666) [.008]		
RALL		-1.13666 (.525490) [.046]				
RCPL				-.00967445 (.00379926) [.029]		
R1L			-.402528 (.226052) [.091]			

R4L		1.18981 (.200035) [.000]			-.051878 (.036005) [.167]	
DIDIAL	.058948 (.013894) [.000]	-.159232 (.070439) [.038]				
AUFINVL				.00260810 (.00103628) [.031]		
CUFDIAL	.435757 (.051277) [.000]	1.67548 (.897849) [.080]			.661441 (.272915) [.026]	1.36299 (.406539) [.004]
RBAR2	.884241	.580395	.277736	.776835	.248576	.534486
SIG2	.262191E-04	.256748E-02	.477205E-02	.367858E-06	.171528E-03	.588575E-03

Note: Standard deviations in parenthesis. Significance level in square brackets.

Consistently, hours of work negatively affected rates of return, as well as, in 2 out of the 3 cases, one rotation indicator of assets.

Usually, rates of return to schooling are negatively related to a financial or physical capital rate of return, suggesting some competition between the two types of assets. On the other hand – and somehow consistently -, financial costs from the point of view of the firm (CUFDIAL) seem to go together with human capital returns.

Variances of returns to schooling would appear to decrease with aggregate growth (TXCNET, TXCVABL) and physical capital intensity (LACLIPEL, LINTKAAL). Financial costs would still go along with variance of human capital returns, financial returns would counteract them.

Inspecting the OLS individual estimates, we reproduce below the results of some of the regressions – results could differ, specially because experience is now never controlled for (in Table 6, neither for Data Set 1, but it was for Data Set 2). The most important addition to the rate of return regression is a positive influence of the estimated variance (multiplied by n).

With respect to the variances estimates, a clear positive influence of plant size (DIMEST) is noticeable and negative of both physical capital productivity (VABACL) and the assets rotation indicator RIMOBCL. Now, financial indicators move in the same direction of the variance. A positive effect of the education level or a negative of the experience indicator is recorded – somehow oppositely to what was found before.

Table 6.A Rates of Return Regressions – Individual OLS Equations					
	Data Set 1 (44 obs.)				
Variable	TXREDM	VTXREM	VTXREMM	DVTXREM	DVTXREMM
Intercept	-.042724 (.00953373) [.000]	.00128835 (.000273789) [.000]	3602.97 (291.798) [.000]	.042447 (.00447932) [.000]	35.1589 (13.6827) [.015]
EDUCM	.010903 (.000661356) [.000]	.000129222 (.0000290621) [.000]		.00200574 (.000753428) [.011]	
EXPM			-115.954 (13.0330) [.000]		-2.59823 (.218841) [.000]
ANTIG	-.000734419 (.000250919) [.006]				
DIMEMP	-.0000673704 (.0000360304) [.070]				
DIMEST		.0000693967 (.00000572750) [.000]	59.2356 (5.06393) [.000]	.000351392 (.0000917176) [.000]	1.58624 (.097472) [.000]
LVABHAL		-.00100504 (.0000859382) [.000]			-21.3268 (3.24979) [.000]
VAPROL		.000964482 (.000388762) [.018]		-.014188 (.00823048) [.093]	
MGCOVAL	-.018115 (.00120209) [.000]				
FSEXPRL		.000438993 (.000233926) [.069]	-900.640 (215.839) [.000]		
EBEVAL	-.066603 (.012123) [.000]				-40.8013 (7.94652) [.000]
LIMCPESL					13.7655 (2.36730) [.000]
LACLIPEL	.012222 (.00155632) [.000]				
VABACLL		-.00272046 (.000282865) [.000]	-927.796 (486.446) [.064]	-.015341 (.00736136) [.044]	-47.9714 (18.8875) [.016]
RIMOBCL	-.052294 (.015477) [.002]	-.00277221 (.000316370) [.000]	-1967.64 (243.808) [.000]	-.041110 (.00691834) [.000]	-31.2331 (6.80073) [.000]
EBEACBL			3667.26 (1968.71) [.070]		220.152 (60.6396) [.001]
RALL					102.334 (28.0163) [.001]
RCPL		.00137124 (.000167183) [.000]		.020954 (.00531386) [.000]	
PASACBL		.000983421 (.000389332) [.016]			51.4056 (12.5520) [.000]
DIDIAL	.021775 (.010660) [.049]				
DDPDIAL					21.4483 (6.30043) [.002]
CUFDIAL	.326531 (.038109) [.000]				
VTXREMM	.970725E-05 (.138748E-05) [.000]				
RBAR2	.912922	.821094	.491201	.300006	.944805
SIG2	.187871E-04	.255425E-07	100186.	.279143E-04	5.83435

Note: Standard deviations in parenthesis. Significance level in square brackets.

8. Earnings (Net) Growth Rate Regressions

As demonstrated, if not for internal rate of return, different earnings growth rates over the life-cycle are compatible with labor market equilibrium.

Table 7. Growth Rates Regressions, Data Set 2 (23 obs.)

	g (EXPM)			g (SSEXPM)			b	
Variable	Overall Mean	Overall Mean (Fixed Y RR)	Including Trend	Overall Mean	Overall Mean (Fixed Y RR)	Including Trend	With EXPM	With SSEXPM
Intercept	.556033 (.124570) [.001]	.00923990 (.033954) [.789]	-.146678 (.086951) [.111]	1.16235 (.845450) [.192]	-.061338 (.057103) [.297]	.316569 (.120616) [.018]	-.00205906 (.029509) [.945]	.295972 (.094594) [.006]
EDUCM			.024549 (.00973303) [.023]					-.00409707 (.00265589) [.141]
EXPM	-.012918 (.00415882) [.008]							
SSEXPM				.066177 (.051273) [.219]		-.00932387 (.00483687) [.071]		
IDMED				-.073521 (.050392) [.168]				
TH			-.117779 (.042271) [.013]	-.100206 (.050142) [.067]				
HORTOT								-.00664254 (.00207864) [.005]
IG	-.217549 (.057460) [.002]	-.106004 (.037338) [.011]	-.108366 (.077393) [.181]	-.240529 (.085808) [.015]			-.058761 (.022795) [.019]	
TXCPSER		-.450804 (.132249) [.003]						
TCDIMEL								.132362 (.089966) [.159]
VAPROL	-.321647 (.151071) [.053]							
MGCOVAL	-.050767 (.026236) [.075]		.051958 (.025248) [.056]	-.052765 (.032505) [.129]	.073626 (.014120) [.000]	.088197 (.030928) [.011]		
FSEXPRL	.366834 (.106016) [.004]							
LINTKAL	.037701 (.017079) [.046]							
VEVAL						1.52078 (.638257) [.029]		-.342851 (.163378) [.051]
EXIPROL								.055671 (.041447) [.197]
INVVAB		.110166 (.039392) [.012]			-.133642 (.036382) [.002]			
RABL							.098165 (.053081) [.081]	
RIMOBCL				.390148 (.133113) [.012]				
RCPL				.183893 (.137731) [.205]	-.534528 (.075524) [.000]			
RFINL1L						.854675 (.304093) [.012]		
R4L	1.70428 (.264911) [.000]	.393637 (.149021) [.017]					.098576 (.045810) [.045]	
PASACBL						-.596190 (.212216) [.012]	-.067010 (.053922) [.230]	

DDPDIAL	-.205714 (.070424) [.012]		-.163515 (.093177) [.098]					
AUFINVL		.049533 (.033831) [.161]	.198727 (.047816) [.001]	.203341 (.054156) [.002]				
CUFDIAL					1.87069 (.750844) [.023]			
IMPLU1	.159030 (.027918) [.000]			.117772 (.042934) [.017]				
RBAR2	.716271	.768103	.501778	.579344	.670843	.321545	.162141	.246090
SIG2	.248788E-02	.739320E-03	.310747E-02	.432640E-02	.221064E-02	.412986E-02	.314081E-03	.252173E-03

Note: Standard deviations in parenthesis. Significance level in square brackets.

Performing multiple regression, we consistently find that industry employment concentration (IG) decreases both g and b, the steepness or growth of earnings profiles. That is, competition increases g and b.

Steepness (g) appears to be lower for men (high TH). In general, financial returns increase the steepness of profiles or b. Financial independence (high AUFINV) or financial constraints (low DDPDIAL) raise g.

9. Conclusion

It was theoretically justified that human capital investment in schooling may be seen to provide access to a rising earnings profile, potentially differing across sectors in equilibrium. Under such scenario, the coefficient of experience in log earnings regressions approximates the growth rate of the earnings life-cycle profile offered in the economy (or sector) net of the depreciation rate of human capital; under stationary nominal and real environment, the schooling coefficient approximates the real - equal to the nominal - rate of return. Competitive earnings growth rates may differ across sectors - provided different initial earnings are sufficiently compensating.

Under non-stationary backgrounds, and with pooled or panel data, the coefficient of schooling in log earnings regressions approximates the nominal rate of return (the nominal interest rate) minus the nominal growth rate of individual productivity, provided that (along with experience) a trend is used in the regressions – the coefficient of the latter approximates the nominal productivity growth rate; that of experience, the growth rate of sector-specific individual's earnings profiles net of the human capital depreciation rate.

The theories were illustrated with available semi-aggregate information for years 1995-1999. In the period, the annual (discrete) nominal productivity growth rate inferred was about 1.4-3.1%; the average (real, discrete) growth rate of individuals' earnings profiles of 4-6% per year; and the (discrete) "nominal" rate of return to schooling varied substantially – from 10.6% to 21.6% per annum with the Data Set or experience proxy used (the use of a threshold minimum age to work in its construction decreasing the inferred rate of return estimate). Tests of equality of net present value of "job-cycle" earnings across sectors pointed in general to rejection of the null – and to the existence of further segmentation of earnings dispersion than accommodated by the theory. Yet, homogeneity of rates of return to human capital across sectors was often accepted.

Determinants – the pattern - of sector "net of growth" rates of return and of the two growth rates were also inspected. For such an inquiry, financial indicators for aggregate balance sheet indicators were constructed and computed for yearly published information (for years 1996-1999). Additional inclusion of the financial variables in the log earnings regressions themselves was also performed.

Overall, and as major empirical contributions of this research, we registered:

- a consistent negative impact of physical capital and financial rates of return indicators both in log earnings as sector rates of return to schooling regressions, suggesting market competition between the two assets.

- an often positive influence of either firm or plant size on the variance of the rates of return estimates, with system-wide variances exhibiting a different pattern from those inferred for yearly, sector-specific OLS regressions. No or slight evidence of positive relation between mean and variance of rates of return was registered.

- earnings or productivity growth rates as negatively related to industry-sector concentration and positively to physical capital and financial rates of return.

- a major sensitivity of the results to the experience proxy - pointing to the advantage of direct inquiry of time of labor market experience (past employment or participatory time) in generally conducted surveys - and also often, to the level of aggregation of the data set in use.

Empirical findings should, nevertheless, be regarded as exploratory, relying only on aggregate information and severely restricted degrees of freedom.

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Appendix 1: Data Sources

A. Variables

A.1. "QUADROS DE PESSOAL"

PESSER – Personnel in the industry (Table 9, "Quadros de Pessoal", 1995-99.)

NEMPR – Number of Firms in the industry (Table 7, "Quadros de Pessoal", 1995-99.)

NEST – Number of Plants in the industry (Table 11, "Quadros de Pessoal", 1995-99.)

TCOCI –Number of Partial Time and Full-Time Workers in the industry (Table 43, "Quadros de Pessoal", 1995-99.)

TCOC –Number of Full-Time Workers in the industry (Table 45, "Quadros de Pessoal", 1995-99.)

TCOCHM – Number of Not Self-Employed Workers in the industry (Table 31, "Quadros de Pessoal", 1995-99.)

TCOCH – Men of Not Self-Employed Workers in the industry (Table 33, "Quadros de Pessoal", 1995-99.)

TCOCM – Women of Not Self-Employed Workers in the industry (Table 35, "Quadros de Pessoal", 1995-99.)

TH – Proportion of Men in Industry Employment (From Tables 31 and 33, "Quadros de Pessoal", 1995-99.)

QUMESU – Proportion of Highly and Medium Technical Professionals in Industry Employment (From Tables 31, "Quadros de Pessoal", 1995-99.)

ENCPAQ – Proportion of Foremen, and Highly Skilled Professionals in Industry Employment (From Tables 31, "Quadros de Pessoal", 1995-99.)

PQESQ – Proportion of Skilled and Medium-Skilled Professionals in Industry Employment (From Tables 31, "Quadros de Pessoal", 1995-99.)

PNQEAP – Proportion of Unskilled Professionals and Apprentices in Industry Employment (From Tables 31, "Quadros de Pessoal", 1995-99.)

HORNOR – Average Standard Work Week Hours, Partial Time and Full-Time Workers, (Table 48, "Quadros de Pessoal", 1995-99.)

HORNTC – Average Standard Work Week Hours, Full-Time Workers, (Table 49, "Quadros de Pessoal", 1995-99.)

HORTOT – Average Total Work Week Hours, Partial Time and Full-Time Workers (Table 50, "Quadros de Pessoal", 1995-99.)

REMBASE – Standard Work Monthly Base-Wages (Table 63, "Quadros de Pessoal", 1995-99, Portuguese escudos)

GANHO – Total Monthly Earnings (Table 64, "Quadros de Pessoal", 1995-99, Portuguese escudos)

REMHOR – Standard Work Hourly Base-Wages (Table 73, “Quadros de Pessoal”, 1995-99, Portuguese escudos)

PTCOHEX – Percentage of Workers With Overtime Relative to Industry Total (Table 53, “Quadros de Pessoal”, 1995-99.)

DUTEXTR – Average Hours Length of Weekly Overtime Work (Table 54, “Quadros de Pessoal”, 1994.)

EDUC – Average years of education of workers employed in the industry (From Table 28, “Quadros de Pessoal”, 1995-99, assigning

Inferior ao 1º Ciclo – 2 years

Habilitados com o 1º Ciclo – 4 years

Habilitados com o 2º Ciclo – 6 years

Habilitados com o 3º Ciclo – 9 years

Ens. Sec. Cursos e Escolas Profissionais – 12 years

Bacharelato – 15 years

Licenciatura – 17 years.)

EDUCM – Average years of education of workers employed in the industry (From Table 28, “Quadros de Pessoal”, 1995-99, assigning

Inferior ao 1º Ciclo – 2 years

Habilitados com o 1º Ciclo – 5 years

Habilitados com o 2º Ciclo – 7.5 years

Habilitados com o 3º Ciclo – 10.5 years

Ens. Sec. Cursos e Escolas Profissionais – 13.5 years

Bacharelato – 16 years

Licenciatura – 17 years.

ANTIG – Average years of tenure of workers employed in the industry (From Table 30, “Quadros de Pessoal”, 1995-99, assigning

Less than 1 year – 0.5 years

1 to 4 years – 2.5 years

5 to 9 years – 7.5 years

10 to 14 years – 12.5 years

15 to 19 years – 17.5 years

20 and more years – 27.5 years.)

IDMED - Average age of workers employed in the industry (From Table 39, “Quadros de Pessoal”, 1995-99, assigning

Less than 15 years – 14 years

15 to 24 years – 20 years

25 to 34 years – 30 years

35 to 44 years – 40 years

45 to 54 years – 50 years

55 to 64 years – 60 years

65 and more years – 67.5 years.)

IDEMP - Average age of firms in the industry (From Table 25, “Quadros de Pessoal”, 1995-99, assigning

Less than 1 year – 0.5 years

1 to 4 years – 3 years

5 to 9 years – 7.5 years

10 to 19 years – 15 years

20 to 49 years – 35 years

50 and more years – 60 years.)

DIMEMP – Average firm size in the industry in number of workers employed (From Tables 7 and 9, “Quadros de Pessoal”, 1995-99.)

DIMEST – Average plant size in the industry in number of workers employed (From Tables 11 and 13, “Quadros de Pessoal”, 1995-99.)

ESTEMP – Average number of plants per firm in the industry (From Tables 7 and 11, “Quadros de Pessoal”, 1994.)

IG – Industry concentration measured by the Gini coefficient on the distribution of employment by firm size (From Tables 7 and 9, “Quadros de Pessoal”, 1995-99.)

TXCPSER – Yearly Growth rate of sector total personnel from year t-1 to year t (i.e. of PESSER) from 1995-99.

TXCTCO – Yearly Growth rate of employment from year t-1 to year t (i.e. of TCOCHM), 1995-99.

TXCDIME – Yearly Growth rate of average firm size from year t-1 to year t (i.e. of DIMEMP), 1995-99.

A.2. “SISTEMA DE CONTAS INTEGRADAS DAS EMPRESAS”

Each issue of the statistical publication has data for two consecutive years but not for the same number of enterprises. We used, from each issue, the older year reported, assuming that it would represent a more stabilized or definite accounting. Years 1996 to 1999 were covered

DIME – Firm Size: Total Employment / Total Number of Firms (Number of People per Firm)

TXCNET – Growth Rate of Total Employment (Year t-1 to year t)

TCDIME – Growth Rate of DIME (Year t-1 to year t)

TXCVAB – Growth Rate of Total Gross Value Added (Year t-1 to year t)

CPVESVA – Total Labor Costs / Gross Value Added

REMPVA – Total Wages and Salaries / Gross Value Added

PRPES – Production / Total Employment (1000000 PTE per person employed)

VAPES – Gross Value Added / Total Employment (1000000 PTE per person employed)

VABH – Mean Hourly Labor Productivity (1000 PTE per hour; firms with 20 employees or more; for years 1996 and 1997, the only reported figure for hourly labor productivity was used)

VABHA – Aggregate Hourly Labor Productivity (1000 PTE per hour; firms with 20 employees or more; for years 1996 and 1997, the only reported figure for hourly labor productivity was used)

VAPRO – Gross Value Added / Total Production

MGCOVA – Commercial Margins / Gross Value Added

FSEXPR – Expenses in External Services / Total Production

EBEVA – Trading Profits / Gross Value Added

IMCPES – Tangible Assets / Total Employment (1000000 PTE per hour; firms with 20 employees or more)

IMCEPE – (Tangible Assets plus Inventory) / Total Employment (1000000 PTE per hour; firms with 20 employees or more)

IMBPE – Fixed Assets (= Tangible, Intangible and Financial Assets) / Total Employment (1000000 PTE per hour; firms with 20 employees or more)

CAPRPE – Equity / Total Employment (1000000 PTE per hour; firms with 20 employees or more)

ACBUPE – Total Gross Assets / Total Employment (1000000 PTE per hour; firms with 20 employees or more)

ACLIPE – Total Net Assets / Total Employment (1000000 PTE per hour; firms with 20 employees or more)

INTKA – (Tangible) Capital Intensity (1000000 PTE per worker; firms with 20 employees or more)

INTKAA – Aggregate (Tangible) Capital Intensity (1000000 PTE per worker; firms with 20 employees or more)

KINTE – Dummy variable taking the value 1 for sectors with capital intensity above average (in 2000), 0 otherwise

VABACB – Capital Productivity: Gross Value Added / Total Gross Assets (firms with 20 employees or more)

VABACL – Capital Productivity: Gross Value Added / Total Net Assets (firms with 20 employees or more)

VABIMO – Capital Productivity: Gross Value Added / Fixed Assets (firms with 20 employees or more)

VEVA – Change in Inventory / Gross Value Added (firms with 20 employees or more)

VEPRO – Change in Inventory / Production (firms with 20 employees or more)

EXIPRO – Inventory / Production (firms with 20 employees or more)

INVVAB – Tangible Investment / Gross Value Added (firms with 20 employees or more)

INVIMO – Tangible Investment / Tangible Assets (firms with 20 employees or more)

RAB – Total Net Assets / Total Gross Assets (firms with 20 employees or more)

RIMOB – “Net” Fixed Assets / Gross Fixed Assets (firms with 20 employees or more)

RIMOBC – “Net” Tangible Assets / Gross Tangible Assets (firms with 20 employees or more)

EBEACB – “Gross” Economic Profit Rate: Trading Profits / Total Gross Assets (firms with 20 employees or more)

REB – Economic Profit Rate: Trading Profits / (Tangible plus Intangible Assets) (firms with 20 employees or more)

REBF – Economic Profit Rate: Trading Profits / Fixed Assets (firms with 20 employees or more)

RAL – Return of Net Assets: Net Retained Earnings / Total Net Assets (firms with 20 employees or more)

RCP – Return of Equity: Net Retained Earnings / Equity (firms with 20 employees or more)

RFIN – Return on Equity (?) or Financial Return: Gross Profits / (Equity plus Accumulated Amortization) (firms with 20 employees or more)

RFIN1 – Return on Equity (?) or Financial Return: (Gross Profits plus Irregular Net Income) / (Equity plus Accumulated Amortization) (firms with 20 employees or more)

RFINL1 – Return on Equity or Financial Return, net of Taxes: (Gross Profits plus Irregular Net Income, minus Business Income Tax) / (Equity plus Accumulated Amortization) (firms with 20 employees or more)

R1 – (Trading Profits, minus Investment) / (Tangible and Intangible Assets) (firms with 20 employees or more)

R1L – (Trading Profits, minus Investment) / (Tangible and Intangible Assets minus Accumulated Amortization) (firms with 20 employees or more)

R2 – (Trading Profits, minus Investment, minus Increase in Assets) / Total Assets (firms with 20 employees or more)

R2L – (Trading Profits, minus Investment, minus Increase in Assets) / (Total Net Assets minus Increase in Assets) (firms with 20 employees or more)

R3 – (Trading Profits minus Business Income Tax, minus Investment, minus Increase in Assets) / Total Assets (firms with 20 employees or more)

R3L – (Trading Profits minus Business Income Tax, minus Investment, minus Increase in Assets) / (Total Net Assets minus Increase in Assets) (firms with 20 employees or more)

R4 – (Self-Financing plus Distributed Earnings, plus Business Income Tax, minus Investment minus Increase in Assets) / (Equity plus Accumulated Amortization) (firms with 20 employees or more)

R4L – (Self-Financing plus Distributed Earnings, plus Business Income Tax, minus Investment, minus Increase in Assets) / (Equity minus Increase in Assets) (firms with 20 employees or more)

PASACB –Total Liabilities / Total Gross Assets (firms with 20 employees or more)

PASACL –Total Liabilities / Total Net Assets (firms with 20 employees or more)

DIDIA – External Credits / External Liabilities (firms with 20 employees or more)

DDPDIA – (External Credits plus Bank Deposits) / External Liabilities (firms with 20 employees or more)

AUFINV – Self-Financing / Tangible Investment (firms with 20 employees or more)

AUFILU – Self-Financing / Gross Profits (firms with 20 employees or more)

LUDILU – Distributed (Net of Taxes) Profits / Gross Profits (firms with 20 employees or more)

GFIDDB – Strictly Financial Receipts / (External Credits plus Bank Deposits) (firms with 20 employees or more)

CUFDIA – Strictly Financial Expenses / External Liabilities (firms with 20 employees or more)

JUPEML – Interest Paid / Medium and Long-Run Loans Outstanding (firms with 20 employees or more)

GAFDDT – Strictly Financial Receipts / (External Credits plus Bank Deposits plus Detained Securities plus Financial Assets) (firms with 20 employees or more)

IMPLU – (Business Income Tax plus Net of Subsidies Production Tax) / Gross Profits (firms with 20 employees or more)

IMPLU1 – (Business Income Tax plus Net of Subsidies Production Tax) / (Gross Profits plus Business Income Tax plus Net of Subsidies Production Tax) (firms with 20 employees or more)

Conversion of euros into escudos – required for the two more recent years - used a rate of 200.482 PTE per euro. Data was never deflated. Even if not in correlations, in regressions, nominal variables were usually included in logarithms.

B. Observations

The observation classification comes from CAE "Classificação de Actividades Económicas" used in Quadros de Pessoal for 1995-99:

1 – Agriculture, Forestation and Quarry

2 – Fishing

3 –Mining

4 – Food, Beverages and Tobacco Manufacturing Industries

5 – Textiles and Clothing

6 – Leather and Leather Products

7 – Wood and Cork Manufacturing Industries

8 – Paper, Graphical Arts and Publishing

9 – Chemical Industries from Oil and Coke, and Nuclear Fuels

10 – Chemical Industries and Synthetic Fibres

11 –Rubber and Plastic Manufactures

12 – Other Non Metallic Ore Manufacturing

13 – Heavy Metallurgy and Metallic Products

14 – Machinery and Engineering Manufactures

15 – Electric and Optic Equipment

16 - Transportation Material Manufacturing

17 – Other Manufacturing Industries
18 – Electricity, Gas Fuel, Steam and Water Supply
19 – Construction and Public Infrastructure
20 – Wholesale and Retail Trade, Vehicle Maintenance
21 – Restoration and Lodging
22 – Transportation, Storage and Communications
23 – Banking, Insurance and Other Monetary and Financial Institutions
24 – Real Estate and Service to Firms
25 – Public Administration, Defense and Social Security
26 – Education
27 – Health and Social Services
28 – Other Collective and Personal Services
29 – International Organizations

Under Data Set 1, sectors 4 to 17 are absent and an observation for the aggregated "Manufacturing Industries" is available instead – with 16 observations available per year.

Agriculture, Forestation and Quarry (sector 1), Fishing (2), Financial Services (23), Public Administration, Defense and Social Security (25), and International Organizations (29) do not have balance sheet information, for which Chemical Industries from Oil and Coke, and Nuclear Fuels (9) and Chemical Industries and Synthetic Fibres (10) are merged. Per year, 23 observations are, thus, covered.