

On the Return-Risk Link in Education

Corrado Andini*

ABSTRACT

In a contribution to *Economics Letters*, Pereira and Martins (2002) point out that there exists a positive link between risk and return in education. We perform a sensitivity analysis and argue that the evidence on this link is not robust.

Keywords: Return to Schooling, Wage Risk, Quantile Regression.
JEL Classification: C29, I21, J24

* Assistant Professor, University of Madeira, Department of Management and Economics, Funchal, Portugal. Email: andini@uma.pt, Tel.: +351 291 70 50 53, Fax: +351 291 70 50 40.

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I. INTRODUCTION

In a seminal contribution to *Economics Letters*, Pereira and Martins (2002) argue that there is a positive association between the conditional mean return to schooling, based on the standard Mincer (1974) equation, and its conditional risk. The authors measure the latter as difference between the return to schooling at the ninth decile of the conditional wage distribution and the return at the first decile, reporting that a one-percent increase in the conditional risk implies a two-percent increase in the conditional mean return.

The definition of risk used by Pereira and Martins is widely accepted in the literature looking at the impact of schooling on within-groups wage inequality, started with a paper by Buchinsky (1994). Examples of more recent studies using the standard quantile-regression techniques due to Koenker and Bassett (1978) are provided, among others, by Machado and Mata (2001), Hartog *et al.* (2001), Martins and Pereira (2004) and Andini (2006a). Quantile-regression estimates that keep the problem of schooling endogeneity into account are provided by Arias *et al.* (2001), Lee (2004) and Andini (2006b).

Started with a famous paper by Levhari and Weiss (1974), the debate on the risk involved in the educational investment has recently benefited by several new contributions, often related to the research project *Education as a Risky Asset* carried out at the University of Aarhus¹. This is, for instance, the case of a paper by Hogan and Walker (2003), who have modelled the optimal choice of schooling years under uncertainty about future returns using the theory of options, or the case of a paper by Christiansen *et al.* (2006), who have presented mean-variance plots of educational assets, or the case of a paper by Harmon *et al.* (2003), who have modelled the Mincerian return to schooling as a random coefficient. A further important branch of related

¹ See <http://www.econ.au.dk/vip_htm/hnielsen/educationrisk/> (accessed: June 9th, 2006).

research is carried out at the University of Amsterdam² where, as a matter of example, Hartog *et al.* (2004) have simulated the ex-ante risk of university education.

This paper deals with one of the most important empirical results in the literature on schooling and wage-risk. We question the *existence* and the *magnitude* of the return-risk link suggested by Pereira and Martins (2002).

II. ESTIMATION PROCEDURE

Current section describes the estimation procedure adopted by Pereira and Martins (2002). The next section presents our critique, based on a simple sensitivity analysis.

In a first step, Pereira and Martins use micro-data on male workers and estimate a standard Mincer (1974) equation:

$$(1) \quad \ln w_i = \alpha + \beta s_i + \gamma \exp_i + \delta \exp_i^2 + \varepsilon_i$$

for 16 countries and different years³, using ordinary least squares and quantile-regression techniques *a la* Koenker and Bassett (1978). Notice that letter *i* indicates the *i*-th individual in the sample, *s* represents schooling years, and *exp* is labour-market experience defined as usual ($\exp_i = \text{age}_i - s_i - 6$).

The ordinary-least-squares estimator provides the conditional mean return to schooling (labelled *ols* in the original paper) in terms of observed earnings:

$$(2) \quad \hat{\beta}_M = \frac{\partial E(\ln w_i | s_i, \exp_i, \exp_i^2)}{\partial s_i}$$

² See <<http://www1.fee.uva.nl/scholar/>> (accessed: June 9th, 2006).

³ One year for each country. Sample years go from 1991 for Sweden to 1996 for the Netherlands. The median year is 1995.

under the assumption that $E(\varepsilon_i | s_i, \text{exp}_i, \text{exp}_i^2) = 0$, while the quantile-regression estimator provides a measure of conditional risk:

$$(3) \quad \hat{\beta}_{90} - \hat{\beta}_{10} = \frac{\partial Q_{90}(\ln w_i | s_i, \text{exp}_i, \text{exp}_i^2)}{\partial s_i} - \frac{\partial Q_{10}(\ln w_i | s_i, \text{exp}_i, \text{exp}_i^2)}{\partial s_i}$$

under the assumptions that $Q_{10}(\varepsilon_{10i} | s_i, \text{exp}_i, \text{exp}_i^2) = 0$ and $Q_{90}(\varepsilon_{90i} | s_i, \text{exp}_i, \text{exp}_i^2) = 0$.

In a second step, Pereira and Martins estimate the following return-risk model:

$$(4) \quad \hat{\beta}_{cM} = \omega + \lambda(\hat{\beta}_{c90} - \hat{\beta}_{c10}) + \sum_{j=1}^N \pi_j Z_{cj} + \xi_c$$

and obtain an ordinary-least-squares estimate of the coefficient λ under the assumption that $E(\xi_c | \hat{\beta}_{c90} - \hat{\beta}_{c10}, Z_{c1}, \dots, Z_{cN}) = 0$. Notice that model (4) contains a set of control-variables Z including year effects (labelled *year91*, and so on), a variable indicating whether hourly wages are net or gross (labelled *net*), and a variable on the public financial support to education in each country c (labelled *financing*). In one of the four specifications, the authors use the absolute value of the difference $\hat{\beta}_{c90} - \hat{\beta}_{c10}$ (labelled *absdif*) rather than the arithmetic value (labelled *dif*).

III. SENSITIVITY ANALYSIS

As shown in Table 1, we are able to perfectly replicate the results of all the four regression-specifications proposed by Pereira and Martins (2002) in *Economics Letters*, two of which presented in the appendix of their paper (i.e. 3 and 4 in our Table 1). In

addition, as shown in Table 2, using slightly different data⁴ provided by Martins and Pereira (2004) in *Labour Economics*, we obtain results on the return-risk link which are consistent with those of Pereira and Martins (2002).

However, by looking at the point in the upper-right corner of all the left-hand-side plots in Figure 1, one starts suspecting that Portugal behaves as an outlier. Indeed, if we disregard the case of Portugal, as we do in the right-hand side plots in Figure 1, the existence of a positive association between risk and return becomes less intuitive.

Tables 3 and 4 present regression results of model (4) without considering Portugal. In both the two main-text specifications of Pereira and Martins (2002), i.e. 1 and 2, the return-risk link seems to disappear as the estimate of λ is not statistically significant.

Instead, when we focus on the appendix-specifications, i.e. 3 and 4, the results are different. Specifically, the analysis of the sub-sample of countries whose data on *financing* are available shows that the return-risk link re-appears, regardless of controlling for the public financial support to education. The estimate of λ , however, is lower than the one proposed by Pereira and Martins (2002).

IV. CONCLUSION

Depending on the specification of the return-risk model, the estimate of λ provided by Pereira and Martins is statistically significant at 1% level (or so) and ranges between 0.49 and 0.57. Therefore, according to Pereira and Martins, there exists a positive return-risk link in education. In our view, however, the empirical evidence provided by the authors is not conclusive as Portugal behaves as an outlier. A return-risk link in education seems to be either absent or weaker than the one suggested by Pereira and

⁴ These data, reported by Martins and Pereira (2004) on page 361, are very similar, although not identical, to those reported by Pereira and Martins (2002) on page 33.

Martins. Particularly, based on our computations, if the link exists, the estimated λ coefficient is around 0.36-0.38.

A further note is about the reliability of both the study by Pereira and Martins (2002) and our study. Specifically, it seems worth stressing that a common weakness has to do with the fact that, in both the two studies, the empirical analyses are based on very small samples, and therefore the estimation results are highly case-sensitive.

It is not controversial, in our view, that the attempt of Pereira and Martins (2002) of shedding light on the existence and the magnitude of a return-risk link in education is of a crucial importance, not only for the academy but also for policy-making. Nevertheless, we believe that additional research is needed and welcome. Particularly, a primary objective of new research efforts should be that of substantially increasing the size of the sample which underlies the estimation of a return-risk model in education.

Another key-research question is about understanding why Portugal represents a special case. Fortunately, this topic is not neglected by the existing literature, which is rich in contributions aiming, very often, at measuring the impact of schooling (or education levels) on the mean and the shape of the conditional wage distribution⁵. However, even in this field, further research is desirable because, despite substantial empirical support to the stylized fact that return and risk of education in Portugal are positive and high, the reasons behind this stylized fact have received less attention than the fact itself.

⁵ As a matter of example, see Andini (2006b) for a brief review and a research advance.

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Table 1. Replication using data in *Economics Letters*

Specification 1

Number of obs = 16
 F(5, 9) = .
 Prob > F = .
 R-squared = 0.9831
 Root MSE = 1.3989

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.0594735	.4831846	-0.12	0.905	-1.152513	1.033566
dif_EL	.5565127	.169201	3.29	0.009	.1737533	.939272
year91	1.985252	.642964	3.09	0.013	.5307662	3.439737
year93	6.471456	.9839524	6.58	0.000	4.245601	8.697311
year94	7.534957	.2900354	25.98	0.000	6.878851	8.191063
year95	6.490306	.7973708	8.14	0.000	4.686527	8.294084
year96	5.330462	.5076031	10.50	0.000	4.182184	6.47874

Specification 2

Number of obs = 16
 F(5, 9) = .
 Prob > F = .
 R-squared = 0.9818
 Root MSE = 1.4512

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.5700131	.5674445	-1.00	0.341	-1.853662	.7136356
absdif_EL	.56264	.1762516	3.19	0.011	.1639312	.9613489
year91	1.961968	.6697562	2.93	0.017	.446874	3.477062
year93	6.616513	.9744813	6.79	0.000	4.412083	8.820943
year94	6.719066	.86393	7.78	0.000	4.764721	8.673412
year95	6.529603	.7854792	8.31	0.000	4.752726	8.306481
year96	5.31208	.5287549	10.05	0.000	4.115953	6.508207

Specification 3

Number of obs = 12
 F(6, 4) = .
 Prob > F = .
 R-squared = 0.9990
 Root MSE = .45912

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-1.368064	.416876	-3.28	0.030	-2.525497	-.2106304
dif_EL	.4978072	.0804668	6.19	0.003	.2743955	.7212189
year91	4.56652	.9562222	4.78	0.009	1.911622	7.221419
year93	8.724262	.7059449	12.36	0.000	6.764245	10.68428
year94	8.616383	.4805917	17.93	0.000	7.282047	9.95072
year95	7.891754	.4213586	18.73	0.000	6.721875	9.061633
year96	7.092256	.6629041	10.70	0.000	5.25174	8.932773
financing	-.0406584	.0143584	-2.83	0.047	-.0805237	-.0007931

Specification 4

Number of obs = 12
 F(5, 5) = .
 Prob > F = .
 R-squared = 0.9960
 Root MSE = .80911

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.4306854	.4268493	-1.01	0.359	-1.527936	.6665658
dif_EL	.5716725	.1296016	4.41	0.007	.2385209	.904824
year91	1.927644	.4924861	3.91	0.011	.6616687	3.19362
year93	6.9714	.7190141	9.70	0.000	5.123115	8.819685
year94	7.715257	.4092897	18.85	0.000	6.663144	8.76737
year95	6.861542	.6554843	10.47	0.000	5.176566	8.546518
year96	5.284983	.3888048	13.59	0.000	4.285528	6.284437

Table 2. Results using data in *Labour Economics*

Specification 1

Number of obs = 16
 F(5, 9) = .
 Prob > F = .
 R-squared = 0.9834
 Root MSE = 1.3343

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.0572848	.5021035	-0.11	0.912	-1.193122	1.078552
dif_LE	.5502034	.1894276	2.90	0.017	.1216884	.9787183
year91	2.119268	.6819393	3.11	0.013	.576614	3.661922
year93	6.376836	1.009258	6.32	0.000	4.093737	8.659936
year94	7.313582	.2914444	25.09	0.000	6.654289	7.972875
year95	6.355725	.790068	8.04	0.000	4.568467	8.142982
year96	5.25943	.5303973	9.92	0.000	4.059588	6.459272

Specification 2

Number of obs = 16
 F(5, 9) = .
 Prob > F = .
 R-squared = 0.9820
 Root MSE = 1.3894

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.5381205	.5709522	-0.94	0.371	-1.829704	.7534631
absdif_LE	.5516909	.2007139	2.75	0.023	.0976445	1.005737
year91	2.113913	.72257	2.93	0.017	.4793457	3.74848
year93	6.531566	1.007545	6.48	0.000	4.252341	8.810792
year94	6.56051	.8834987	7.43	0.000	4.561897	8.559123
year95	6.40528	.7793662	8.22	0.000	4.642231	8.168329
year96	5.255265	.561999	9.35	0.000	3.983935	6.526595

Specification 3

Number of obs = 12
 F(6, 4) = .
 Prob > F = .
 R-squared = 0.9988
 Root MSE = .47242

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-1.389318	.5238491	-2.65	0.057	-2.843757	.0651198
dif_LE	.4861573	.0945006	5.14	0.007	.2237816	.748533
year91	4.727913	1.115653	4.24	0.013	1.630365	7.825461
year93	8.663563	.8659657	10.00	0.001	6.259256	11.06787
year94	8.408826	.5106011	16.47	0.000	6.99117	9.826482
year95	7.768035	.6229167	12.47	0.000	6.038541	9.497529
year96	7.037813	.7750869	9.08	0.001	4.885827	9.189799
financing	-.0410014	.015824	-2.59	0.061	-.084936	.0029332

Specification 4

Number of obs = 12
 F(5, 5) = .
 Prob > F = .
 R-squared = 0.9956
 Root MSE = .82165

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.4370076	.4625594	-0.94	0.388	-1.626055	.7520393
dif_LE	.5678636	.1494774	3.80	0.013	.1836197	.9521075
year91	2.055691	.5381187	3.82	0.012	.6724129	3.438969
year93	6.89705	.7704688	8.95	0.000	4.916497	8.877603
year94	7.498145	.388529	19.30	0.000	6.499399	8.496891
year95	6.728305	.7284719	9.24	0.000	4.855709	8.600902
year96	5.209982	.4185368	12.45	0.000	4.134099	6.285865

Table 3. Results using data in *Economics Letters* without Portugal

Specification 1

Number of obs = 15
 F(5, 8) = .
 Prob > F = .
 R-squared = 0.9840
 Root MSE = 1.3266

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.3011803	.6575959	-0.46	0.659	-1.817599	1.215239
dif_EL	.2947378	.2101878	1.40	0.198	-.1899561	.7794318
year91	2.979996	.7987136	3.73	0.006	1.138159	4.821833
year93	7.625301	1.16535	6.54	0.000	4.937998	10.3126
year94	7.747432	.5283037	14.66	0.000	6.529161	8.965702
year95	6.922382	.7505767	9.22	0.000	5.19155	8.653215
year96	6.115787	.6305634	9.70	0.000	4.661705	7.569868

Specification 2

Number of obs = 15
 F(5, 8) = .
 Prob > F = .
 R-squared = 0.9826
 Root MSE = 1.3852

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.5898864	.7323668	-0.81	0.444	-2.278727	1.098954
absdif_EL	.2399661	.266355	0.90	0.394	-.3742496	.8541818
year91	3.188129	1.012149	3.15	0.014	.8541093	5.522148
year93	7.946101	1.309432	6.07	0.000	4.926546	10.96566
year94	7.455019	1.116624	6.68	0.000	4.880079	10.02996
year95	7.072807	.7586669	9.32	0.000	5.323318	8.822296
year96	6.280102	.7990649	7.86	0.000	4.437455	8.122749

Specification 3

Number of obs = 11
 F(6, 3) = .
 Prob > F = .
 R-squared = 0.9997
 Root MSE = .24804

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-1.37669	.3249103	-4.24	0.024	-2.4107	-.3426807
dif_EL	.3732288	.0499605	7.47	0.005	.2142321	.5322255
year91	4.734902	.4644104	10.20	0.002	3.25694	6.212863
year93	9.159365	.4975139	18.41	0.000	7.576054	10.74268
year94	8.61171	.2232071	38.58	0.000	7.901365	9.322054
year95	7.924351	.2906514	27.26	0.000	6.999368	8.849333
year96	7.260894	.3259533	22.28	0.000	6.223565	8.298223
financing	-.0353995	.0066126	-5.35	0.013	-.0564436	-.0143554

Specification 4

Number of obs = 11
 F(5, 4) = .
 Prob > F = .
 R-squared = 0.9971
 Root MSE = .69275

ols_EL	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.6113819	.4719119	-1.30	0.265	-1.921619	.6988557
dif_EL	.3850461	.1415131	2.72	0.053	-.0078572	.7779494
year91	2.636825	.5377497	4.90	0.008	1.143792	4.129857
year93	7.892236	.882724	8.94	0.001	5.441401	10.34307
year94	7.870925	.2782896	28.28	0.000	7.098269	8.643581
year95	7.092296	.6841417	10.37	0.000	5.192815	8.991778
year96	5.844862	.4245392	13.77	0.000	4.666152	7.023572

Table 4. Results using data in *Labour Economics* without Portugal

Specification 1

Number of obs = 15
 F(5, 8) = .
 Prob > F = .
 R-squared = 0.9846
 Root MSE = 1.2576

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.3240414	.6916185	-0.47	0.652	-1.918917	1.270834
dif_LE	.2704641	.2377211	1.14	0.288	-.2777217	.81865
year91	3.126329	.8557959	3.65	0.006	1.15286	5.099798
year93	7.509183	1.192814	6.30	0.000	4.758549	10.25982
year94	7.530882	.5648062	13.33	0.000	6.228436	8.833327
year95	6.785435	.7604784	8.92	0.000	5.031769	8.539102
year96	6.0427	.6656192	9.08	0.000	4.50778	7.577621

Specification 2

Number of obs = 15
 F(5, 8) = .
 Prob > F = .
 R-squared = 0.9833
 Root MSE = 1.3098

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.5867236	.7446631	-0.79	0.453	-2.30392	1.130473
absdif_LE	.1952184	.296065	0.66	0.528	-.4875087	.8779455
year91	3.397214	1.065834	3.19	0.013	.9393962	5.855031
year93	7.87741	1.323166	5.95	0.000	4.826184	10.92864
year94	7.333404	1.131807	6.48	0.000	4.723453	9.943354
year95	6.963307	.7723041	9.02	0.000	5.182371	8.744243
year96	6.253389	.8289821	7.54	0.000	4.341752	8.165025

Specification 3

Number of obs = 11
 F(6, 3) = .
 Prob > F = .
 R-squared = 0.9994
 Root MSE = .33777

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-1.405307	.4678344	-3.00	0.057	-2.894165	.0835508
dif_LE	.3616815	.0755824	4.79	0.017	.1211444	.6022186
year91	4.88813	.7983023	6.12	0.009	2.347576	7.428684
year93	9.052813	.7457639	12.14	0.001	6.679459	11.42617
year94	8.404526	.3421403	24.56	0.000	7.315683	9.493369
year95	7.797224	.5284205	14.76	0.001	6.115555	9.478894
year96	7.19276	.5574673	12.90	0.001	5.41865	8.96687
financing	-.0360376	.0109527	-3.29	0.046	-.0708941	-.0011811

Specification 4

Number of obs = 11
 F(5, 4) = .
 Prob > F = .
 R-squared = 0.9965
 Root MSE = .73167

ols_LE	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
net	-.6273814	.5378089	-1.17	0.308	-2.120578	.8658154
dif_LE	.3730091	.1697024	2.20	0.093	-.0981602	.8441785
year91	2.757167	.6109286	4.51	0.011	1.060957	4.453377
year93	7.771655	.9801905	7.93	0.001	5.050209	10.4931
year94	7.651788	.3195699	23.94	0.000	6.76452	8.539057
year95	6.95317	.770919	9.02	0.001	4.812755	9.093584
year96	5.755574	.4751667	12.11	0.000	4.4363	7.074849

Figure 1. Return-risk plots, with and without Portugal

