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ABSTRACT

Cross-Country Evidence on the Returns to Education: Patterns and Explanations*

This Paper examines cross-country variations in the return to schooling for men and women and considers some of the stylised facts that have emerged from the extensive international literature on private returns to schooling. We examine the relationship across countries between these returns and a range of controls that can be grouped into three broad areas (i) supply factors, (ii) demand factors, and (iii) governmental policies and institutional factors. We find that the returns are decreasing in both labour force participation and, in some cases, in the average level of schooling in the population. In the multivariate analysis the only education variables that consistently matter are the proportions completing primary or third level education, which has negative and positive effects respectively. Standard measures of openness such as trade volume have positive effects, and we also find that measures of protection raise the return to schooling. Net inflows of foreign investment are associated with lower schooling returns - a result difficult to reconcile with the argument that capital is complementary to high skill labour and hence increases the skill premium.

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I. Introduction

While there are a small number of papers which have empirically analysed either the return to schooling or some closely related measure of human capital returns (Psacharopoulos, 1994 and Ashenfelter *et al.,* 1999) there are few examples that explicitly try to predict how the return to schooling might vary with characteristics of the economy. In this paper we examine cross-country patterns in the return to education, and focus on the differences in the return both within and between countries. This allows us to address a number of competing (and complementary) explanations for the observed differences.

We examine whether the observed patterns in the return to education can be attributed to existing theories on changes in the wage-structure such as those proposed in Freeman and Katz (1995). We also consider the extent to which changes in trade patterns are a source of shifts in relative supply and demand. Measures of trade openness and protectionism are also used as potential explanatory variables. Finally we explore the extent to which the variance is attributable to the quality of education (see Burtless, 1996).

We implicitly identify the skill premium, the feature of much of both the trade and labour literature, with the Mincerian return[1]. While the trade literature relies heavily on defining distinct factors, such as 'skilled' and 'unskilled' labour, there is no consensus about what exactly these correspond to or how they should be measured. If one is to make cross-country comparisons it is clearly essential for the definitions of what skilled labour is to be as consistent as possible[2]. A useful discussion of various approaches to measuring and defining

[1] This is a non-trivial step since it contrasts with the trend elsewhere to identify the skill premium with the difference in the mean wages of the 'skilled' and 'unskilled' (however defined).

[2] A further problem with using a difference in mean wages to proxy for the skill premium is that one normally thinks of a premium as a *marginal* effect. In the wage discrimination literature, rather than simply compare the

skill groups is provided by Johnson and Stafford (1999), who note that a difficulty with using school-based measures of skill (as we suggest) is that different degrees of learning take place across countries within the educational system.

Section II briefly considers some stylised facts on the issues involved. Section III considers competing explanations for examining the returns to education in a cross-country context while Section IV presents the results of our regression analysis. Section V concludes.

II. Stylised Facts

The empirical approximation of the human capital theoretical framework is the familiar functional form of the Mincer (1974) earnings equation. The availability of micro data and the ease of estimation have resulted in many studies which estimate the simple Mincer specification[3]. However, observed patterns in the returns to education, either over time or between countries, have not been as well documented (Trostel *et al.* (2001) and Psacharopoulos (1981, 1985, 1994) are the exceptions).

Table 1 presents estimates of the rate of return to education based on OLS estimates from the International Social Survey Programme (ISSP) data. This is drawn from national surveys designed to be consistent across countries (see Trostel *et al.*, 2000). The results (sorted in order of magnitude of the estimated return for males) show significant variation in

mean wages of males and females one will typically partial out other variables either by measuring the premium by a dummy variable in the wage equation or using the Blinder-Oaxaca procedure. It can therefore be argued that the return to schooling from the Mincer equation is a sensible estimate of the premium to *certain* skills, i.e. those that are provided by formal full time education.

[3] In this specification the schooling measure is treated as exogenous, although education is clearly potentially an endogenous choice variable in the underlying human capital theory. See the survey by Card (1999) for further discussion.

the return across countries with Great Britain, Northern Ireland and the Republic of Ireland showing large returns relative to international standards.

Table 1 Cross Country Evidence on the Returns to Schooling: ISSP 1995

	Male		Female	
Norway	0.0229	*0.0025*	0.0265	*0.0032*
East Germany	0.0265	*0.0032*	0.0450	*0.0041*
Czech Rep	0.0291	*0.0069*	0.0454	*0.0077*
Netherlands	0.0331	*0.0025*	0.0181	*0.0050*
West Germany	0.0353	*0.0020*	0.0441	*0.0036*
Austria	0.0364	*0.0033*	0.0621	*0.0049*
Canada	0.0367	*0.0072*	0.0498	*0.0083*
Sweden	0.0367	*0.0047*	0.0416	*0.0047*
Italy	0.0398	*0.0025*	0.0568	*0.0036*
Greece	0.0410	*0.0110*	0.0642	*0.0111*
Russia	0.0421	*0.0042*	0.0555	*0.0043*
New Zealand	0.0424	*0.0050*	0.0375	*0.0058*
Switzerland	0.0427	*0.0065*	0.0523	*0.0143*
Bulgaria	0.0495	*0.0100*	0.0624	*0.0091*
Slovakia	0.0496	*0.0070*	0.0635	*0.0078*
Australia	0.0509	*0.0042*	0.0568	*0.0071*
Spain	0.0518	*0.0071*	0.0468	*0.0099*
Denmark	0.0561	*0.0112*	0.0442	*0.0104*
France	0.0570	*0.0104*	0.0651	*0.0099*
Israel	0.0603	*0.0069*	0.0694	*0.0077*
Hungary	0.0699	*0.0053*	0.0716	*0.0051*
Finland	0.0722	*0.0103*	0.0822	*0.0101*
Poland	0.0737	*0.0044*	0.1025	*0.0046*
Japan	0.0746	*0.0066*	0.0917	*0.0151*
USA	0.0783	*0.0045*	0.0979	*0.0058*
Slovenia	0.0892	*0.0104*	0.1121	*0.0091*
Portugal	0.0790	*0.0087*	0.0771	*0.0105*
Rep of Ireland	0.1023	*0.0051*	0.1164	*0.0081*
Great Britain	0.1299	*0.0057*	0.1466	*0.0069*
N Ireland	0.1766	*0.0111*	0.1681	*0.0127*
Average	**0.0565**		**0.0693**	

Notes: Source Trostel *et al.* (2001), standard errors in italics. Estimates of the return to schooling in Portugal, France, Denmark, Finland and Greece are taken from the PURE sample described below.

At the other extreme countries such as the Netherlands, Norway, Austria, Germany and Sweden have relatively low returns. In a majority of the countries the education premium is considerably higher for women than it is for men. Even if these estimates were corrected for selectivity, it is unlikely that this pattern would disappear entirely. Other patterns are harder to determine, for example it is difficult to say whether those countries that could loosely be

defined as 'developing' or 'transition' economies have relatively higher or lower estimated returns to schooling.

While these estimates have the advantage that they are all derived from common data, and are therefore reasonably comparable, they do so at the cost of simplicity - in particular the estimated models contain controls only for age, age squared, marital status and union status. It is therefore interesting to consider cross-country rates of return derived from national surveys rather than a single consistent source such as ISSP. A recent EU funded research network entitled Public Funding and Private Returns to Education (or PURE) gathered this information as part of their work programme. All PURE partners adopted a common specification and estimated the return to education using log of the hourly gross wage where available allowing a substantial dataset of returns to be collected[4].

The advantage of this is that it allows us to derive estimates from national datasets in a way that exploits the strengths of each country's data. Based on the PURE dataset the same stylised facts emerge. The lowest returns to one extra year of education are found in the Scandinavian countries (Norway, Sweden, and Denmark) while the highest returns are again found in Ireland and the UK. Furthermore, reaffirming the general result from the research by Trostel *et al.*, we find that for some countries like the UK, Ireland, Germany, Greece and Italy there is a substantial variation in returns between genders, i.e. returns to women are significantly higher than returns to men[5].

[4] For further details see www.etla.fi/PURE

[5] Harmon, Oosterbeek and Walker (2001) use meta analysis of the returns to schooling in the PURE data and find a remarkable similarity in the estimated return for a number of possible cuts of the data. The average return is around 6.5%. Notable exceptions are that Nordic countries generally have lower returns to schooling while the returns for the UK and Ireland are indeed higher than average. Time effects seem to be present with estimates produced using samples from the 1960's showing higher than average returns .

3. Examining the Return to Schooling

3.1 Time & Regional Variation

It is interesting to consider how the returns have varied over time. This is particularly relevant to explanations such as increased globalisation as a cause of rising returns. We use two sources of data for analysing the trend in schooling returns. The paper by Psacharopoulos (1994) builds on a series of studies that collected estimates of schooling returns from around the world. Many of the estimates in the earlier studies are of the social rate of return and are based on calculations of net present value rather than on econometric estimation of the Mincer model so in this study we only consider estimates of the Mincer model.

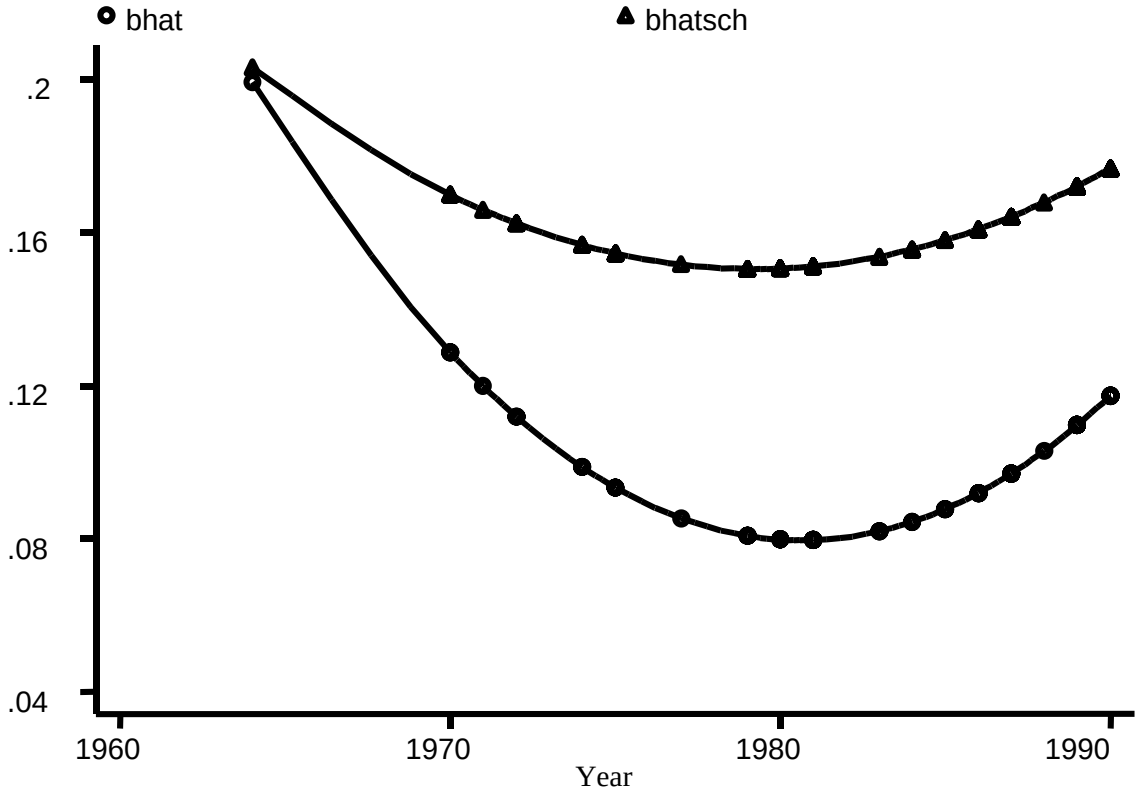
The information from each study (there are 57 usable data points) is relatively sparse: the Mincer coefficient, average level of schooling, the year of the data and the country on which it is based. A second source we use is the data set of over 1000 studies collected by Ashenfelter *et al.* (1999). This source is somewhat richer in that we have details of the sample and the estimation method used to generate the different estimates. Moreover, unlike Psacharopoulos (1994), we have multiple estimates for many countries, for example there are 44 separate estimates for the USA. This allows us to do some simple 'meta analysis' taking into account the fact the series we are modelling is a set of estimated parameters.

Table 2 Time variation in the returns to schooling

	(1)		(2)		(3)	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Year	-0.0696	-2.437	-0.0359	-1.242	0.01701	0.575
Year^2	0.0004	2.432	0.0002	1.267	-0.0001	-0.619
Schooling	--	--	-0.0074	-3.272	--	--
South/Central America	--	--	--	--	0.07296	4.832
Africa	--	--	--	--	0.07077	2.938
Asia	--	--	--	--	0.02074	1.896
Constant	2.8894	2.527	1.5735	1.369	-0.5655	-0.475
Adjusted R^2	0.089		0.273		0.365	
N	57		57		57	

In Table 2 we present three simple regressions where the dependent variable is the estimated rate of return. The first simply controls for a quadratic in year. The results indicate that the rate of return does indeed follow a quadratic trend falling initially and then rising. The only data on the economy available to us for this data is the average years of schooling completed. The second specification includes this as a regressor and it can be seen that this has the immediate effect of making the time trend statistically insignificant. The most obvious interpretation of the negative coefficient on schooling is a supply side one. The third specification includes dummies based on the continent of the country. The reference category consists of the OECD countries but also includes Cyprus and Israel for example. Notwithstanding such issues the results show that the quadratic trend in column one is no longer present given these controls. Figure 1 graphs the trend in the estimated returns based on the second and third specifications reported above.

Figure 1 Return to Schooling 1965-1993: Psacharopoulos Data



Notes: *bhat* is the predicted rate of return. *bhatsch* is the predicted rate of return controlling for schooling.

Based on the richer dataset from Ashenfelter *et al.* (1999) we can check on the robustness of the results from the Psacharopoulos data. The first column of Table 3 replicates the simple quadratic trend estimated in Table 2 and finds essentially the same pattern: the rate of return falling until the beginning of the 1980's and rising thereafter. A very useful feature of this data set is that we have details of the estimation of the parameters from the original studies (number of observations, method of estimation and so on). As we are analysing data derived from a set of independent econometric estimates we may want to take into account the uncertainty associated with these estimates. The simplest way to do this is use weighted least squares with the weight being the reciprocal of the standard error of the estimated return from the original study. The results of this exercise are shown in column 2, and they prove to be

fairly close to the unweighted. Figure 2 graphs the trends implied by these two estimates and one can see again that they are very close though the weighted estimates rise more slowly from the early 1980s.

Table 3 Time variation in the return to schooling: Meta-analysis

	(1)		(2)		(3)		(4)	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Year	-0.014	-5.861	-0.014	-7.395	-0.014	-7.273	-0.020	-12.829
Year^2	0.000	5.956	0.000	7.494	0.000	7.374	0.000	12.806
Constant	0.659	6.428	0.653	8.112	0.632	8.000	0.898	13.977
Adjusted R^2	0.034		0.056		0.092		0.487	
N	1010		969		969		969	

Notes: (1) Basic regression. (2) Weighted regression – weights given by the standard error of the estimate of the returns to schooling; (3) As (2) but additional estimation method fixed effects controls included; (4) As (2) but additional country fixed effects included.

In the third specification we include a set of dummies to control for the use of different estimation methods since there is a view in the literature that particular techniques tend to give rise to higher or lower estimates[6]. As noted in Ashenfelter *et al.* (1999) there may be trends in the use of particular econometric techniques. Consequently, one wants to ensure that trends in the return do not represent trends in econometric practice. However as column 3 shows controls for estimation methods make little impact on the estimated trend in the rate of return. In column 4 we include country dummies. There are 17 different countries in the data and unlike the Psacharopoulos data they are all relatively advanced western economies. The broad picture remains the same - the returns follow a quadratic trend falling until the early 1980's.

Figure 2 'Meta analysis': weighted versus unweighted trend

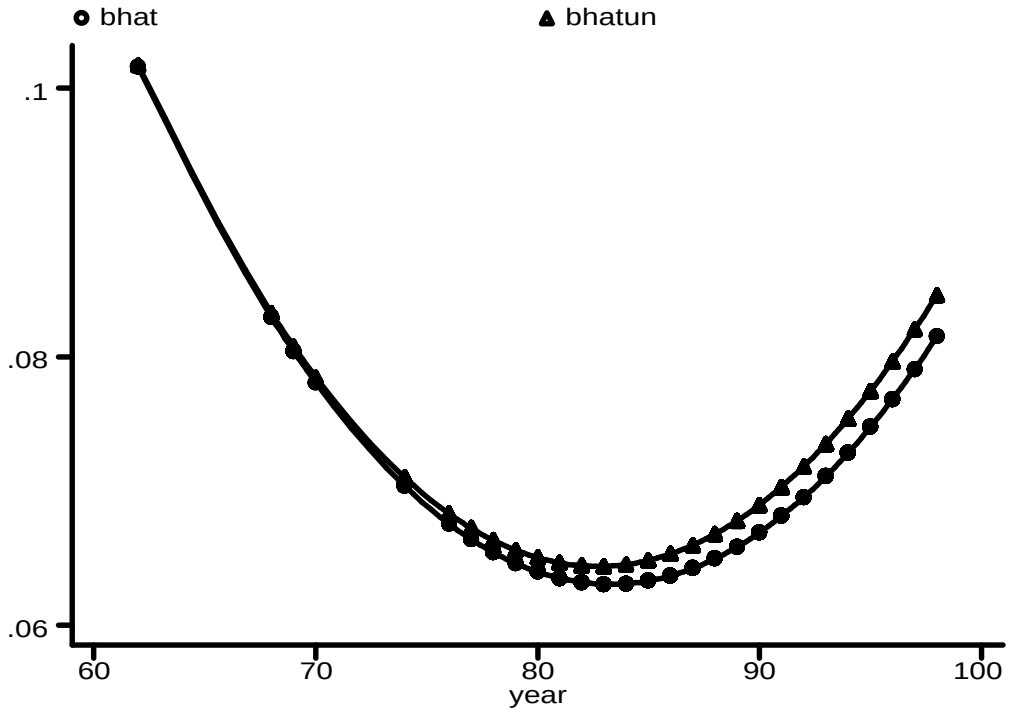
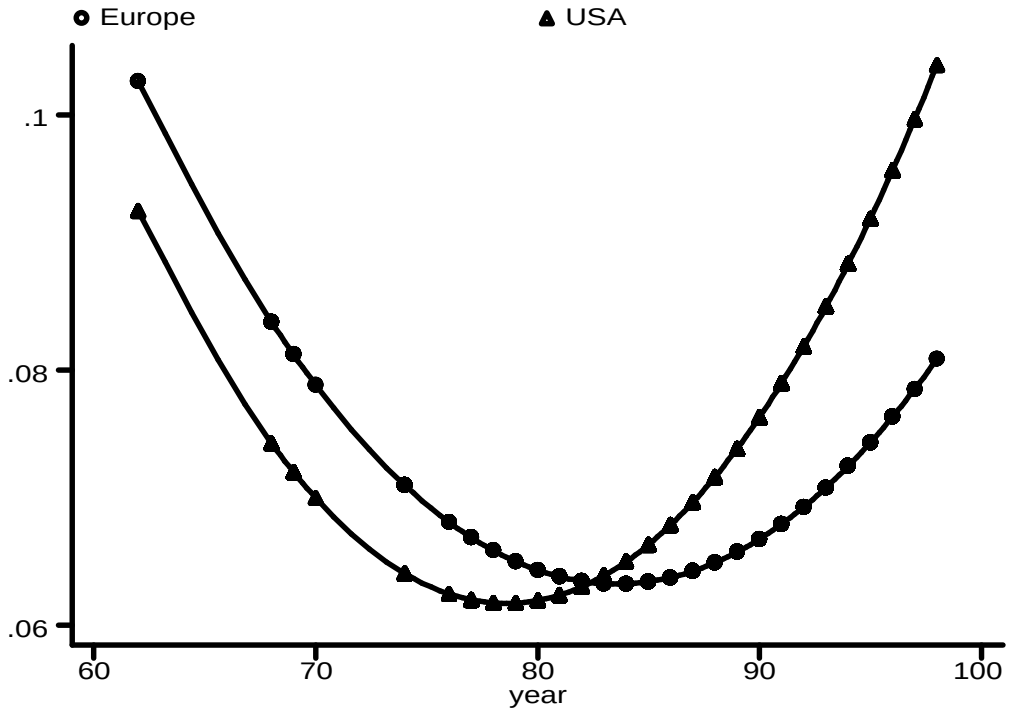


Figure 3 shows the consequences of splitting the data into US and European studies. While the US rate of return starts off lower and falls at a similar rate it starts to rise earlier and does so at a faster rate than in Europe so that by the end of the period (1997) the rate of return to a year of schooling is about 3 percentage points higher[7]. Figure 3 suggests that there may be significant variation in the trends between countries, and it is this variation that we consider further in the following sections of the paper.

Figure 3 US versus Europe

[6] The 4 dummies represent: Twins data, Instrumental Variables (IV) based on family background, IV based on natural experiments and Sample Selection correction. OLS is the default and accounts for 85% of the observations.

[7] The rising skill premium in the US in the 1980s is well documented in the literature on the US wage structure. See, for example, the Freeman and Katz (1995) volume. One possible cause of the "U" shaped pattern in the rate of return is suggested by the literature on wage and earnings inequality. The move to a more unregulated labour market with weaker unions and less social protection might suggest a higher rate of return to skills and the



3.2 The Effect of the Macroeconomy and Trade

Taking the paper by Trostel *et al.* (2001) to obtain the majority of our estimates of the returns to education, and augmenting these using results obtained under the PURE programme, we have a resulting data of the returns to education for a sample of 31 countries. Given multiple time observations for each country the resulting panel has over 300 estimates of the return, along with the standard error of the estimate and the corresponding number of observations[8]. All of our the estimates of the return to education are the results from OLS estimations of

evidence for the US is that the skill premium - as usually defined by a mean difference in wages – has been rising for college graduates (see Borjas and Ramey, 1994).

[8] The exact sample-years that we used to construct the data set are listed in Table A4 at the end of the paper.

standard Mincerian (gross) earnings equations in (potential) experience and experience squared[9].

The data set of explanatory variables includes a wide-range of factors that influence the returns to education in a country at any one time. These factors can be grouped under three main headings: (i) measures of the direct supply and demand effects on the education premium; (ii) measures of the indirect effects of supply and demand, largely derived from the effects of trade and investment flows on the wage structure; and (iii) aggregate measures of the quality of education in a country. Precise information on how each of the variables is calculated is available in the codebook that accompanies this paper[10].

We use the *World Development Indicators* (2000) database from the World Bank, and the IMF's *International Financial Statistics* to construct the macroeconomic explanatory variables for the regression analysis. These include variables such as *foreign direct investment, GDP per capita* and *import duties*. The data on cross-country educational attainment and quality of education comes from a series of well-known papers by Barro and Lee (1997, 1998 and 2000). A selection of summary statistics for the data is listed in the appendix[11].

We start by considering some of the simple bivariate relationships that have been posited in the literature to examine whether these relationships are well determined. We then

[9] Unfortunately the return to education in Greece is calculated on the basis of *net* earnings, as opposed to *gross* earnings. For simplicity however, we add an amount equal to the average tax rate to the return to make the results for Greece directly comparable.

[10] See www.ucd.ie/~economic/staff/kdenny/codebook.pdf

[11] This dataset and a detailed codebook, can be downloaded from www2/cid.harvard.edu/ciddata/barrolee.

consider a multivariate analysis allowing for a wide range of possible determinants[12]. Table 4 contains five regressions each with one explanatory variable. The estimates are for shown for the repeated cross-section data. The gender dummy-variable equals one for a female estimate and zero otherwise. As we would expect the coefficient is positive and well determined. The other stylised fact, low returns in Scandinavian countries is supported by the data with returns being about 2.5% lower. The major obvious distinction within the data is between the transition economies and non-transition but the difference in the return for these areas is not statistically significant given the evidence in Column III.

Table 4 Simple two-variable explanations

	I	II	III	IV	V
Gender	0.010 (7.42)	--	--	--	--
Scandinavian	--	-0.025 (-2.59)	--	--	--
Transition	--	--	-0.004 (-0.85)	--	--
(Log) GDP Per capita*	--	--	--	-0.045 (-2.62)	--
Unemployment rate*	--	--	--	--	0.001 (2.79)
Constant	0.086 (7.33)	0.091 (7.42)	0.086 (7.40)	0.119 (2.93)	0.064 (6.23)
N	349	349	347	327	293

Notes: t-ratios in parentheses. The regressions control for country fixed effects.

[12] Note that in what follows some controls (such as labour force participation, average schooling or unemployment rates) are gender *and* country specific (identified by an asterisk) while others are country specific only.

This is somewhat at odds with the stylised fact noted by Psacharopoulos (1994) that returns were higher in less developed countries. However his sample of LDCs largely consisted of African and Asian countries. We tested this hypothesis more precisely in column IV, using the log of GDP per capita. We find a well-determined negative effect consistent with Psacharopoulos' observation. The negative coefficient on GDP per capita in column is also broadly consistent with the recent work of Freeman and Oostendorp (2000) who use more conventional measures of skill differentials for a large number of countries.

Column V in Table 4 uses gender-specific unemployment as the regressor. When demand changes in a given industry, one might expect employment to change in the same direction. However, the effect on the skill premium depends very much on the industry. The microeconomic evidence also suggests that higher education typically corresponds to a lower probability of unemployment for individuals (e.g., Nickell, 1979 or Ashenfelter and Ham, 1979). Given these various influences it is difficult, in a bivariate context, to have any prior about the effect of unemployment on the skill premium.

An alternative to the simple two-variable model above is to consider the findings of Acemoglu (1999). In Table 5 we attempt to replicate his results. For the sample as a whole we find a downward sloping relationship between the schooling return and average schooling in the working age population. Splitting the data into non-transition and transition economies we find that it is in the latter that is really driving this negative relationship even allowing for the small number of observations (nine countries). This is broadly comparable with the Acemoglu results insofar as we expect the transition economies to be technology importers.

Table 5 'Acemoglu' Model

	ALL		***Non Transition Economy***		***Transition Economy***	
Average Schooling in population aged 15-64	-0.0046	*-3.80*	-0.0033	*-2.87*	-0.0111	*-3.86*
Constant	0.133	*7.99*	0.111	*6.06*	0.171	*6.65*
N	**347**		**304**		**43**	

Notes: t-ratios in italics. Estimates control for country fixed effects.

Our multivariate analysis is contained in Table 6. As potential covariates we experimented with a range of variables which can be classified as belonging to one of three categories (i) general supply and demand controls (ii) trade variables and (iii) indicators of education quality or quantity. The first specification in column I of table 6 contains our basic model. Unlike the bivariate regressions in table 4, we find that log GDP per capita actually has a positive impact on the return to education. In columns V and VI it becomes insignificant, mainly due to the inclusion of a measure of research and development expenditure, which is highly correlated with GDP per capita.

Rows (ii) and (iii) in table 6 include controls for the level of educational attainment in the population: the proportion of population who have completed primary education and the proportion of the population who have completed third-level education. One could also view these variables as controlling for the average educational quality of the labour force. Not surprisingly, the higher the proportion of the population with primary education only, the lower the return to education in a given country. Given this result, we would expect the proportion of the cohort with third-level education to have a positive effect, and this is indeed the case.

Table 6 Extended Models

		(I)	(II)	(III)	(IV)	(V)	(VI)
i.	Log GDP per capita	0.012 (3.05)	0.015 (4.37)	0.011 (2.50)	0.002 (0.31)	0.002 (0.31)	0.002 (0.29)
ii.	% 25-64 Cohort with primary education only	-0.001 (-3.25)					
iii.	% 25-64 Cohort with primary education only		0.001 (2.54)	0.001 (3.55)	0.001 (2.01)	-0.001 (-1.30)	-0.001 (-1.30)
iv.	Net inflows of FDI as % of GDP	-0.004 (-3.74)	-0.005 (-3.89)			-0.004 (-3.36)	-0.003 (-2.91)
v.	Flow of inward direct investment as % GDP			-0.009 (-6.34)	-0.012 (-7.09)		
vi.	(Flow of inward direct investment)*(stock inward of direct investment)				0.005 (3.30)		
vii.	Flow of outward direct investment as % GDP			0.003 (2.64)	0.002 (1.32)		
viii.	(Flow of outward direct investment)*(stock of outward investment)				0.000 (0.68)		
ix.	Import duties as % imports	0.004 (7.22)	0.004 (7.47)	0.004 (4.88)	0.005 (5.27)		
x.	Export and imports as % of GDP	0.0002 (3.060)	0.0002 (3.63)	0.0003 (4.50)	0.0004 (5.25)	0.0005 (5.96)	0.001 (7.29)
xi.	(Export and imports as % of GDP)*(R & D)						-0.0004 (-5.02)
xii.	Labour force participation	-0.040 (-3.92)	-0.044 (-4.21)	-0.050 (-4.56)	-0.044 (-4.05)	-0.042 (-3.97)	-0.048 (-5.15)
xiii.	Scandinavia	-0.034 (-13.73)	-0.034 (-13.89)	-0.036 (-14.04)	-0.034 (-12.90)	-0.034 -(11.04)	-0.30 (-10.89)
xiv.	Transition	-0.018 (-2.75)	-0.020 (-3.14)			-0.038 (-4.90)	-0.045 (-6.42)
xv.	Expenditure per student @ third level, as % of GDP per capita					-0.0003 (-3.01)	-0.0002 (-1.80)
xvi.	Research and Development Expenditure as % of GNI					0.017 (6.30)	0.037 (8.76)
xvii.	Constant	-0.004 (-0.09)	-0.049 (-1.44)	-0.011 (-0.260)	-0.033 (-0.78)	0.051 (0.94)	0.032 (2.69)
	R-squared	0.47	0.46	0.52	0.55	0.58	0.63
	Observations	302	302	281	281	206	206

Notes: t-statistics, in parentheses, are calculated using standard errors accounting for the fact that observations are not necessarily independent within country groups (clustering).

Rows (iv)-(viii) consider the impact of foreign direct investment on the return to education. The complementarity of certain types of labour and capital has been shown to have a significant effect on the skill premium. Krussell *et al*. (2000) show that when the degree of capital skill complementarity is accounted for, the rising skill premium in the US since the 1970s can be largely explained by changes in observed factor inputs. The implication is that for the US capital flows during this period were complementary to high skilled labour. However, our results draw on a sample of quite diverse countries so it is less obvious that in general the skill premium should be associated with capital. In almost all specifications the coefficient on net FDI is negative and significant. Specification III splits the net FDI inflows into its two constituents, inflows and outflows[13]. The results show that it is inflows of direct investment that are driving the negative coefficient on net inflows. Specification IV includes an interaction term that is the product of the two different investment flows and their respective stocks[14]. For inward direct investment the results are interesting: for those countries with a higher stock of inward investment the negative effect of investment inflows are reduced (these countries include Australia, Netherlands, Great Britain, Ireland, New Zealand, Switzerland, Spain and Canada; see table A1).

Several trade related variables also appear in the specifications in table 6. The import duties variable is an indicator of protectionism, essentially an average tariff. In two-by-two neo-classical trade theory the Stolper-Samuleson theorem indicates the mechanism through protection affects factor prices. The empirical implications of the theorem are discussed by

[13] We lose twenty-one observations in moving from specification II to III. This is due to the fact that the data on inflows and outflows and net inflows are taken from two different sources (IMF and World Bank respectively). We lose all of the transition countries from the sample, as information on capital flows for these countries is sparse.

[14] The stock measures are based on calculations by Lane and Milesi-Ferreti (1999).

Leamer and Levinsohn (1995) - they conclude that in higher dimensional models a corollary of the theorem is that "if a factor is *scarce enough* it will be helped by trade barriers" (emphasis in the original text). Since trade theory relies on variations across sectors (within countries) one could use the theorem to interpret the result but clearly one cannot purport to test it. If indeed skilled labour is scarce enough then the results are broadly sympathetic to the theorem. In fact, when we add an interaction term equal to the product of import duties and the average number of schooling years in the population the coefficient on this variable is negative and significant – implying that the more scarce educated labour is, the greater the positive effect of trade barriers on the return to education.

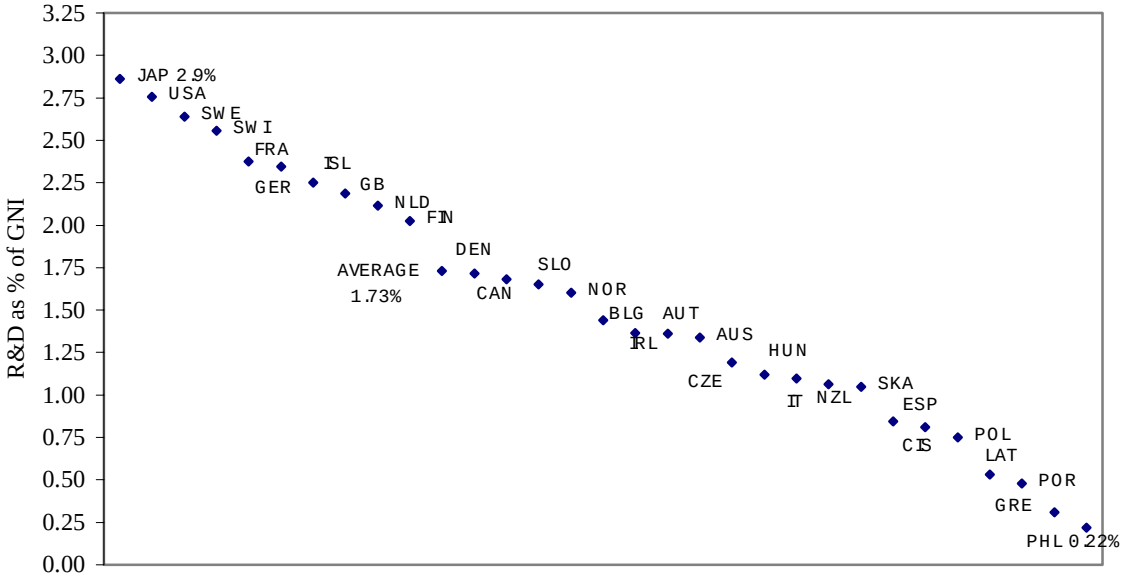
All of the specifications include a standard measures of openness – trade volume (exports plus imports) as a share of GDP[15]. There is considerable disagreement among economists as to the role of international trade in accounting for changes in the wage structure both within and between countries (see the discussion in Baldwin and Cain, 2000). We find a consistently positive impact for trade on the return to education. This is somewhat surprising giving the negative effect we find for net inflows of FDI - the reason being that just as international trade can be carrier of productivity gains through a variety of channels (e.g., technology transfer, cross-boarder learning, reverse engineering, etc) so is FDI – indeed, we would have expected both of them to have the same sign.

One important channel through which foreign trade can increase the productivity (and wages) of an existing stock of human capital in a country is by making available foreign products that already embody foreign knowledge – thereby making available useful

[15] There is considerable debate about what is the appropriate measure of openness (e.g. Rodriguez and Rodrik, 1999). For reasons of data availability we use the most straightforward.

information that would otherwise be costly to acquire. Such an effect is likely to be more important for those countries that can be identified as 'technology followers' (Acemoglu, 1999). We test this hypothesis in specification VI where we include an interaction term equal to the product of trade openness and the level of research and development occurring in the country (see Figure 4). As we would expect, the negative sign on the interaction term implies that the positive trade effects on the return to education are greater for those countries with low levels of research and development.

Figure 4 R & D as a percentage of GNI

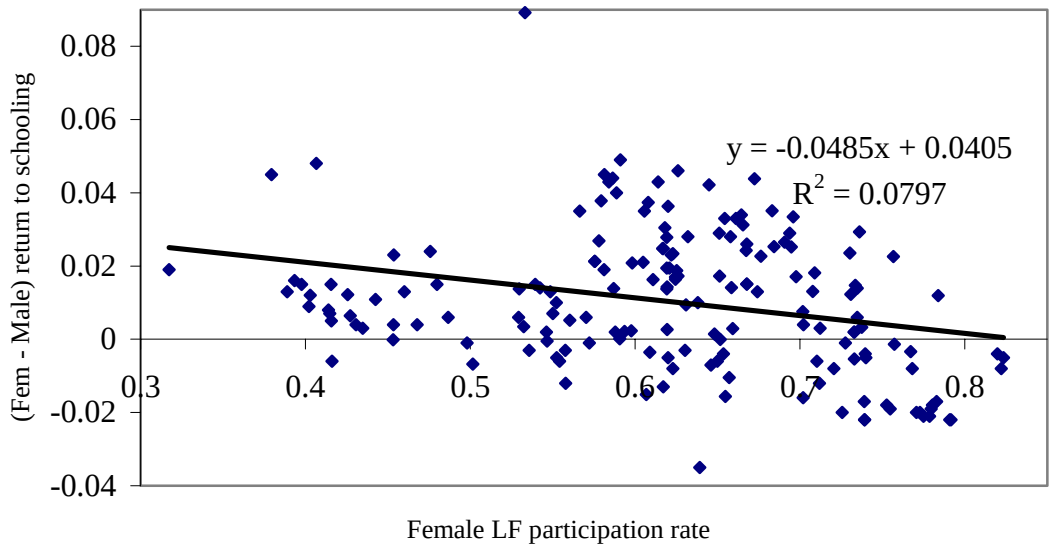


Source: World Bank: World Development Indicators, 2000.

The inclusion of labour force participation rates in table 6 is associated with a lower return. The differences in the returns to schooling between men and women may in part be explained by differences in the participation rates between men and women and the gender dummy is no longer significant in the multivariate analysis when we control for labour force participation. Figure 5 examines the relationship between the average participation rate for women in employment and the percentage difference between male and female returns to

schooling. The figure shows that countries with the highest rates of female participation (typically the Nordic grouping) have the lowest differences in schooling returns while the countries with the lowest participation (including Ireland and the UK) have the largest.

Figure 5 Relationship between participation and returns to education for females



Source: Data on the labour force participation of women is taken from the World Bank's *World Development Indicators.* The repeated observations on the cross-country returns to education were obtained from the Trostel *et al.* data set and the PURE network.

We experimented with several other measures of educational attainment as well as indicators of 'quality' of the human capital stock including student/teacher ratios, average schooling, public expenditure on education (per capita or as a share of public spending), and teacher's compensation relative to current education expenditure. Somewhat surprisingly the only variable that consistently features is that shown in specifications (V) and (VI): expenditure per student at third level as a percentage of GDP per capita. The basic economic model of the demand for education predicts that the demand rises as the costs of education fall, and this may be why we observe a negative coefficient on the expenditure per student variable –it is a direct subsidy to the costs of education and the higher it is, the cheaper it is to obtain a third level qualification.

Finally, in specifications (V) and (VI) we also include a measure of research and development expenditure (R&D) in the regression (as in figure 5). We expect the level of R&D expenditure to have a positive effect on the return to human capital investments for the following two reasons. Firstly, R&D impacts directly on the productivity of the workers concerned. Most R&D is undertaken by workers with lots of human capital, science and engineering occupations are where the vast majority of R&D takes place (see Goolsbee, 1998). We would therefore expect R&D to increase the productivity of workers with more education, *certeris paribus*. Secondly, as pointed out by Goolsbee (1998) the majority of R&D spending is actually just a salary payment for R&D workers. The high levels of skill required for such work, however, means that the labour supply of R&D workers is quite inelastic, so a significant proportion of R&D spending actually goes directly into higher wages for R&D workers. The R&D effect on the return to education is large and ranges from 1.7% to 3.7%, depending on whether or not we include the trade interaction term (specification VI).

IV. Conclusions

In this paper we examine cross-country variations in the return to schooling for men and women. We consider some of the stylised facts that have emerged from the extensive international literature on private returns to schooling and examine the relationship across countries between these returns and a range of general supply and demand controls, trade variables and indicators of education quality and quantity.

The returns are decreasing in both labour force participation and, in a simple bivariate regression, in GDP per capita - consistent with recent findings by Freeman and Oostendorp (2000) who considers a similar issue with respect to wage differentials. The results for the education variables are more problematic. In a bivariate analysis average schooling in the population exerts a negative effect, consistent with increases in the relative supply of skilled

workers. In the multivariate analysis by contrast the only education variables that consistently matter are the proportion of the population with a given level of education, which have negative or positive effects depending on whether we look at primary or tertiary schooling.

The trade variables are even more intriguing. Standard measures of openness such as trade volume or its separate components (exports, imports) have a small positive effect. However a measure of protection significantly raises the return to schooling. Net FDI inflows decrease the return. This is not consistent with the evidence that investment is complementary to skilled labour.

Understanding this interaction between the labour market and trade literatures is a pressing challenge. Proponents of the 'trade' approach suggest that recent changes in wage structures are primarily the effect of trade liberalisation while the 'labour' approach suggests that the increased openness of national economies has had no discernible impact on income distribution (Neary, 2000). Empirical work such as this paper suggests that international differences in the returns to schooling are affected by structural characteristics of national economies. Extending this work may clarify the mechanisms through which foreign competition affects domestic firms, and would help to reconcile the differences between the trade and labour approaches.

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Appendix

Table A1 Summary of macroeconomic data

Country	*Log GDP per Capita*	*FDI (Net inflows as % GDP)*	*Stock of outward direct investment (% of GDP)*	*Stock of inward direct investment (% of GDP)*	*Import duties (% of imports)*
Australia	9.692	2.169	0.069	0.144	7.445
Germany	9.900	0.243	0.092	0.024	0.004
Great Britain	9.667	2.007	0.206	0.133	0.005
USA	10.015	0.832	0.071	0.061	3.340
Austria	9.783	0.520	0.025	0.037	1.601
Italy	9.799	0.470	0.022	0.024	0.048
Hungary	9.092	4.211			11.934
Switzerland	9.899	1.345	0.316	0.130	4.106
Poland	8.688	1.558			15.718
Netherlands	9.806	2.648	0.389	0.184	0.000
Ireland	9.465	1.316	0.020	0.132	0.000
Israel	9.669	0.742	0.042	0.051	1.041
Norway	9.947	0.893	0.073	0.059	0.968
Philippines	8.056	0.430	0.001	0.078	18.315
New Zealand	9.673	4.951	0.147	0.376	3.750
Russian Fed.	9.010	0.158			2.932
Slovenia	9.409	0.913			
Sweden	9.876	4.809	0.187	0.067	1.105
Bulgaria	8.521	0.458			4.850
Canada	10.047	1.625	0.196	0.201	1.292
Czech Republic	9.386	3.536			3.039
Japan	10.020	0.008	0.059	0.003	4.061
Spain	9.581	1.404	0.027	0.132	0.053
Latvia	8.501	3.662			1.781
Slovakia	9.046	1.357			
Portugal	9.165	1.640	0.011	0.087	1.985
Greece	9.359	1.198	0.000	0.104	0.163
France	9.840	1.661	0.059	0.038	0.013
Denmark	9.702	0.795	0.043	0.038	0.092
Finland	9.647	0.532	0.085	0.028	1.271
AVERAGE	**9.475**	**1.603**	**0.104**	**0.087**	**3.247**

Notes: The data on FDI flows, import duties and GDP per capita comes from the World Bank's *World Development Indicators*. The data on capital stocks are adjusted for relative price variations and are estimated from the flow of inward and outward investment published in the International Monetary Fund's *International Financial Statistics.*

Table A1 (cont.)

Country	R&D as % of GNI	Export + Imports as % of GNI	Expenditure per student at 3rd level as % of GDP per capita
Australia	1.34	34.64	58.45
Germany	2.35	45.82	36.33
Great Britain	2.19	52.18	48.10
USA	2.76	20.30	25.35
Austria	1.36	75.52	37.00
Italy	1.10	43.68	22.83
Hungary	1.12	66.60	66.25
Switzerland	2.56		
Poland	0.75	48.68	40.70
Netherlands	2.12	99.87	54.19
Ireland	1.36	122.72	43.13
Israel	2.25	80.58	37.07
Norway	1.60	72.93	37.29
Philippines	0.22		
New Zealand	1.06	58.86	54.19
Russian Fed.	0.81		
Slovenia	1.65		
Sweden	2.64	57.19	39.23
Bulgaria	1.44	92.04	33.77
Canada	1.68		
Czech Republic	1.19	107.84	39.16
Japan	2.86	16.31	16.47
Spain	0.85	41.33	17.72
Latvia	0.53	96.15	46.81
Slovakia	1.05		
Portugal	0.48	66.65	33.10
Greece	0.31	44.25	22.21
France	2.38	44.50	27.30
Denmark	1.72	65.52	53.55
Finland	2.02	55.51	46.02
AVERAGE	**1.73**	**58.54**	**39.36**

Table A2 Schooling Attainment

	Men aged 15-65 in population			Women aged 15-65 in population		
	Average schooling (Years)	Percentage completed secondary school	Percentage completed 3rd level	Average schooling (Years)	Percentage completed secondary school	Percentage completed 3rd level
Australia	11	17	17	10	22	7
Germany	10	29	7	10	21	4
Great Britain	9	8	9	9	14	4
USA	12	18	27	12	26	18
Austria	9	26	5	7	17	2
Italy	7	12	5	6	12	2
Hungary	9	13	9	8	11	7
Switzerland	11	29	10	10	29	3
Poland	10	18	5	9	16	4
Netherlands	9	11	10	9	16	5
Ireland	9	16	8	9	17	5
Israel	10	17	11	9	16	8
Norway	12	49	8	11	45	4
Philippines	7	17	9	8	16	12
New Zealand	12	12	15	11	12	11
Russian Fed.	10	18	8	10	22	9
Slovenia	7	17	6	6	12	6
Sweden	10	35	11	10	34	7
Czechoslovakia	11	22	6	10	18	3
Bulgaria	9	13	9	9	12	11
Canada	11	14	11	11	14	7
Czech Republic	10	21	7	9	19	4
Japan	9	10	16	9	17	4
Spain	7	13	4	6	10	2
Latvia	10	14	8	9	15	8
Slovakia	9	18	7	9	16	5
Portugal	5	9	4	5	6	2
Greece	9	40	4	7	12	8
France	7	15	6	7	13	3
Denmark	10	43	8	9	35	6
Finland	10	37	8	9	36	5

Notes: Taken from Barro-Lee (2000). This data set, along with a detailed code book, can be downloaded from http://www2/cid.harvard.edu/ciddata/barrolee.

Table A3 – Quality of Education and Spending on Education

	Pupil Teacher Ratios			Public spending on education				Teacher's Pay*
				% GNP	% GNP per capita			
	Primary	*Secondary*	*Tertiary*	*Total*	*Primary*	*Secondary*	*Tertiary*	
Australia	16.6	12.6	17.3	5.37	17.20	37.80	55.40	54.16
Germany	16.6	15.2	8.2	4.77	.	30.90	37.30	.
Great Britain	.	15.2	15.5	5.08	.	24.20	44.53	52.15
USA	15.7	15.5	16.6	5.36	20.90	20.73	22.43	.
Austria	11.1	9.6	12.7	5.73	21.35	25.00	37.65	50.44
Italy	11.2	10.5	23.5	5.01	18.85	17.60	22.65	69.36
Hungary	11.9	10.4	7.1	6.20	17.60	23.67	68.34	29.09
Switzerland	.	.	.	4.75	26.35	25.90	47.73	61.16
Poland	16.2	20.3	9.9	5.39	13.50	17.63	54.98	.
Netherlands	22.1	17.1	11.5	5.70	.	20.90	47.40	63.97
Ireland	25.2	15.9	15.0	6.01	13.70	21.95	39.25	75.83
Israel	17.4	.	.	7.27	16.00	.	39.37	53.28
Norway	6.2	.	14.6	7.71	31.50	18.08	38.23	.
Philippines	32.8	49.6	25.2	2.30	7.93	4.90	12.40	61.24
New Zealand	18.2	14.3	12.5	7.22	17.53	18.95	51.35	51.76
Russian Fed.	19.6	.	12.0	3.75	.	.	36.80	.
Slovenia	14.8	.	13.3	5.78	20.40	.	37.50	59.23
Sweden	7.9	9.5	8.5	8.01	28.00	34.40	74.00	48.47
Czechoslovakia	.	.	.	.	.	.	.	.
Bulgaria	14.3	12.2	9.3	5.75	31.07	.	23.53	.
Canada	16.5	18.8	22.4	6.88	.	50.10	39.80	56.37
Czech Republic	20.6	11.2	9.1	5.33	.	.	.	39.73
Japan	19.6	15.4	9.7	3.64	16.17	17.27	38.43	48.76
Spain	21.6	.	19.0	4.29	14.13	.	17.45	.
Latvia	13.6	8.4	9.9	4.85	.	44.10	30.73	40.53
Slovakia	21.4	.	10.3	5.18	23.20	.	44.57	37.91
Portugal	15.3	12.6	10.2	4.45	16.97	20.00	34.10	85.42
Greece	20.9	14.1	16.8	2.38	8.05	11.90	20.55	84.11
France	16.1	12.6	16.4	5.57	12.10	21.70	23.40	68.91
Denmark	10.6	8.6	18.5	7.44	28.70	26.83	50.83	44.12
Finland	16.5	.	.	6.30	21.80	27.85	43.23	51.87

Notes: **Teacher's pay* is a measure of total teacher's compensation as a percentage of total spending on education.

Table A4 Country-year observations

Country	Years in Sample
Australia	1986, 1987, 1990
Austria	1981, 1983, 1985, 1987, 1989, 1991, 1993, 1995, 1997
Bulgaria	1992, 1993
Canada	1995
Czech Republic	1994, 1995
Denmark	1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995
Finland	1984, 1987, 1989, 1991, 1993, 1995
France	1970, 1977, 1985, 1993
Germany	1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997
Great Britain	1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995
Greece	1974, 1988, 1994
Hungary	1990, 1994, 1995
Ireland	1987, 1994, 1995
Israel	1993, 1994
Italy	1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1986, 1987, 1989, 1991, 1993, 1995
Japan	1993, 1994, 1995
Latvia	1995
Netherlands	1986, 1988, 1990, 1992, 1994, 1996
New Zealand	1991, 1992, 1993, 1994, 1995
Norway	1980, 1983, 1987, 1989, 1991, 1993, 1995
Philippines	1992
Poland	1991, 1992, 1993, 1994, 1995
Portugal	1982, 1987, 1991, 1995
Russian Federation	1991, 1992, 1993, 1994, 1995
Slovakia	1995
Slovenia	1993, 1993, 1995
Spain	1980, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996
Sweden	1968, 1974, 1981, 1984, 1986, 1991, 1993, 1996
Switzerland	1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999
USA	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995

Table A5 Extended Models: splitting the non-transition and transition samples

	Non-transition	Transition
Log GDP per capita	0.0060	0.0236
	(1.58)	(1.01)
% 25-64 Cohort with completed third level education	-0.0009	0.0015
	(-4.21)	(0.83)
Net FDI as % of GDP	-0.0024	0.0012
	(-2.00)	(0.63)
Import duties as % imports	0.0034	0.0028
	(5.69)	(1.98)
Export and imports as % of GDP	0.0016	-0.0014
	(8.48)	(-2.83)
(Export and imports as % of GDP)*R&D	-0.0007	0.0009
	(-7.17)	(-1.65)
RD	0.0526	-0.0399
	(9.38)	(-2.21)
Scan	-0.0353	
	(-11.14)	
Constant	-0.0225	-0.0751
	(-1.71)	(-0.39)
R-squared	0.64	0.81
Observations	239	22

Notes: t-statistics, in parentheses, are calculated using standard errors accounting for the fact that observations are not necessarily independent within country groups (clustering).