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The IPTS REPORT

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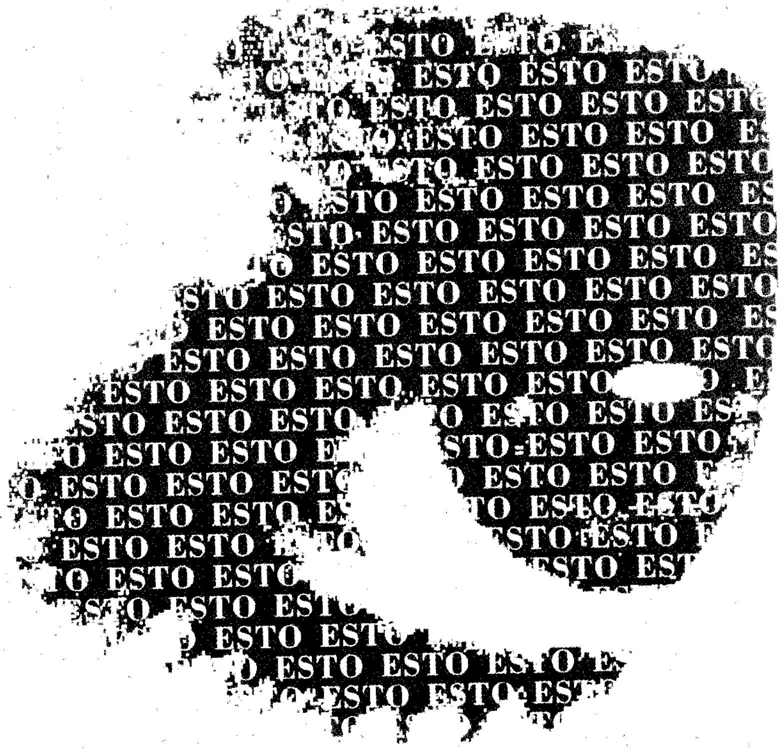

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CONTENTS

publication in the popular press may ride the coat-tails of other debates heating up in parallel. It then may compound and exponentially widen the scope of any problems the academic publication of the same material could conceivably cause. In the case at hand, apparently, the ad in the NYT coincided with and exacerbated a politically charged regional debate on the teaching of science.

To be fair to academic journals, they are charged with two functions that are not always easy to reconcile: to disseminate research results as well as to filter out patently wrong or insignificant results.

Nevertheless, in retrospect it might have been more appropriate and less troublesome to publish the iconoclastic views/criticism in question (which Ohio State University Astronomy Professor Andrew Gould deemed harmlessly incorrect) in the academic journals, instead of unwittingly channelling them towards a wider, more easily impressionable audience, and having them complicate further, other unrelated debates with wider social impacts. It would also have been simpler in an academic journal context to evaluate Prof. Robitaille's criticisms of the gaseous model of the sun, and any alternative models of the sun's nature. Note that such alternative models may be easier to refute than the criticisms to the gaseous model itself, which is presumably why he devotes most of the NYT ad to the latter.

More generally, and borrowing a page from game theory and the work of John Nash (to whom we devoted last month's editorial), it is not a good idea for anyone to drive a rival/competitor to desperation. For instance it may be counterproductive for the academic community to drive those (e.g. by shunning them), who would like to put forth and subject to scientific (not theological) debate their harmless, if unorthodox, views, to view their situation in extreme, desperate ways. The strategies of those shunned may change as a result, they may seek unlikely, even unsaviory, bedfellows, and the academic community may end up in an undesirable 'equilibrium' as the outcome of this confrontation.

Another paradoxical effect of academic journals' overdoing their filtering role – if indeed they overdo it - and driving scientists to alternative publication venues, is that the journals may be undermining indirectly their own predominance. If an unforeseen side effect of bypassing academic journals, drawing the public's attention, and perhaps becoming a *cause célèbre* in the process, is to open doors (e.g. for research funding or well rewarded careers) for the authors spurned by academic journals, then more may start considering it. One wonders what the future may hold for communicating scientific work – TV commercials?

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- Though all errors are solely the author's, the help and clarifications by Univ. of Athens philosophy of science professor T. Arabatzis is gratefully acknowledged in this context.
- Glanz,J., "Ripples in Ohio From Ad on the Big Bang", NYT, March 19, 2002, **http://www.nytimes.com/2002/03/19/national/19ASTR.html**

with implementing advanced technologies. That is, education-based measures could give a misleading picture especially for countries with a workforce trained in a very different set of technologies, such as the workforce of formerly socialist countries, which dominate the present group of candidate countries.

At face value, the available educational statistics on quantity, quality, and resources point to most PACs-accession countries having a fairly good record relative to the EU average.[1] For instance:

- all the PACs except Slovenia and Turkey achieve a higher score than the EU average in terms of average years of education;
- in all PACs, net primary enrolment is close to the average EU level of 100 percent;
- net secondary enrolment is lagging behind the EU average (94 percent) in most PACs countries, but not by more than 20 percent, except for Turkey;
- the quality of education as measured by test scores in international comparisons of student performance (IEA 1998) does not seem to differ substantially between EU countries and PACs;
- the variation of class size in the PACs vary considerably, but do not generally differ much from those in the EU. That is, Latvia has an average class size which is comparable to that of Austria or Belgium, whereas Poland has an average class size which is larger but still comparable to that of Spain (Turkey appears to be an outlier with a class size about twice as large as the EU average).

The problem is that a good record on recent educational statistics may only slowly translate into a high stock of human capital once the workforce gains experience with new technologies. A good record on educational measures that were accumulated under socialism may not have contributed to a stock of human capital that is economically relevant today. The disturbing fact remains that given the conventional measures of human capital discussed, the formerly socialist countries in particular display a rather low level of productivity as measured by their GDP per capita.

Overall, the education measures certainly allow for alternative interpretations and are always subject to possible statistical ambiguities. But if anything, there seems to be a negative correlation between per capita output and average years of education across the formerly socialist PACs (Figure 1). When Cyprus and Turkey are included in the sample, there appears to be no statistically significant relationship at all. By contrast, the correlation between per capita output and average years of education is generally found to be statistically significantly positive in cross-country studies (Hall and Jones 1999, Gundlach et al. forthcoming). This seems to suggest that for most formerly socialist countries, the reported conventional measures of education should not be taken as a reliable proxy for the economically relevant stock of human capital. In this respect, East Germany's experience with EU membership provides some additional evidence.

The productivity of human capital after EU accession: the case of east Germany

East Germany's average number of years of education among the population aged 15 and above was estimated to be about 10 percent above that of West Germany in 1990 (Barro and Lee 1996). Hence it is no surprise that German unification (and hence East Germany's EU membership) in 1990 immediately raised high expectations of "blossoming landscapes" in the eastern Länder within less than a decade. Physical capital rather than human capital was seen as the most serious bottleneck for growth and development, and that bottleneck was thought to be addressed by substantial net

On standard measures such as average years of education, test scores, class sizes, etc. most pre-accession countries have a similar score to EU Member States

The problem is that a good record in terms of recent educational statistics may only slowly translate into a high stock of human capital once the workforce gains experience with new technologies

In the case of most formerly socialist countries, the reported conventional measures of education a perhaps not a reliable proxy for the economically relevant stock of human capital

and the West German workforce. The available measures of formal schooling and training may only allow for a partial picture of the economically relevant stock of human capital as long as there are important unobserved abilities such as, say, familiarity with advanced technologies or basic differences in behaviour in response to the incentives offered by a given set of work contracts. The brain drain that occurred in the early years after unification also seems to indicate that probably some of the most motivated (young) and most productive (skilled) workers have left the East German labour force. So differences in the average quality of the work force are likely to exist but cannot be quantified on the basis of formal measures of education.

One possible way of identifying an East German human capital deficit is to simulate the recent productivity record with the help of a simple growth model (for details, see Gundlach (2001)). Starting with a level of labour productivity of 50 percent of the West German level (as in 1993) and given that investment as a share of GDP is about twice as high as in West Germany (as is observed) and also given that human capital per worker does not differ from the West German level (as conventional measures of education suggest), the model in fact predicts an average annual growth rate of output per worker of 4.6 percent for the period 1993-2000. But East German output per worker actually grew only by 2.6 percent in 1993-2000.

Assuming a lower stock of human capital in East Germany appears to be the most obvious possibility to reconcile the predicted and the actual growth rates of productivity. For an otherwise unchanged parameterization, the simulation model predicts a growth rate close to the observed growth rate of 2.6 percent for 1993-2000 if the East German stock of human capital is arbitrarily set to 30 percent of the West German level. Future research will have to prove whether such simulations bear any empirical significance. But for the time being, these simulations may be considered as a reminder not to confuse the average level of formal schooling and training of the workforce with a measure of the economically relevant stock of human capital.

This possibility should dampen overly optimistic growth expectations of EU membership in the present group of accession countries. Central European countries in particular, like East Germany before them, display measures of average years of schooling which tend to exceed the EU average. However, if East Germany's stock of effective human capital per worker is only about 30 percent of the West German level, then conventional measures of education may grossly overestimate the effective stock of human capital in Central European accession countries as well. If so, the question arises how such presumed human capital deficiencies in Central European accession countries could be eliminated.

Worker Retraining Programmes as a Short Run Investment in Human Capital

In principle, retraining measures can improve and enhance the human capital of workers and thereby raise their reemployment chances and their future wages. Retraining measures can also help to adjust the quality of the existing labour supply to structural changes in labour demand caused by new technologies, increased competition on world markets or, as in the case of the PACs, by EU membership. However, publicly funded retraining measures can have unintended side effects. Future employers may interpret participation in a retraining programme as a signal of low worker productivity, or retraining may actually downgrade the qualification of workers as compared to their previous level of human capital, or alternatively reemployment of trained workers

To obtain the actual growth rate using the model, human capital would have to be just 30 percent of that in West Germany, rather than the 50 implied by standard measures. The model therefore points to the risks of using average schooling as a measure of economically relevant human capital

When East German productivity increases are simulated using a growth model the expected annual growth rate of output per worker is 4.6 percent for the period 1993-2000. The actual figure was just 2.6 percent

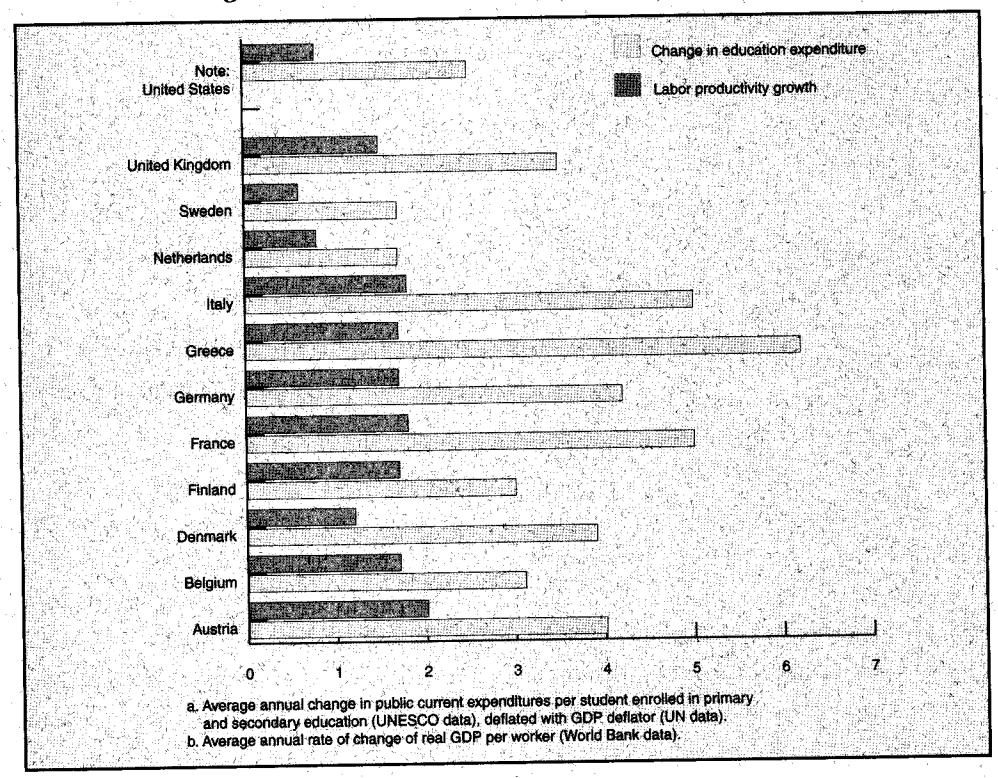
For a start, one would expect that educational expenditure per student should rise over time. This is because schooling is likely to face an increase in the relative price of each unit of output. The reason is that services like schooling face an inherently slower productivity increase relative to other sectors like manufacturing. Sectors with relatively low (or zero) productivity growth will necessarily face increasing costs. As a benchmark, theoretical considerations suggest that inflation-adjusted educational expenditure per student should rise in line with average labour productivity growth if the same amount of schooling resources per student always produces the same amount of schooling quality in the form of student performance (Gundlach et al. 2001).

However, in most EU countries educational expenditure per student rose much faster than average labour productivity growth, with Sweden and the Netherlands as possible exceptions (Figure 2). Inflation-adjusted education expenditure per student increased by almost 200 percent in Germany and by more than 200 percent in France and Italy. By contrast, the average productivity record of these countries suggests that for a given quality of schooling output, educational expenditure should have increased by only about 50 percent. Hence either there was a large increase in the average performance of students or the additional expenditure just did not work. If anything, the available empirical evidence suggests that the performance of students in Germany, France and Italy has remained at best constant at best over the period 1979-1994 (Gundlach et al. 2001). What is more, the only countries with a slight improvement in measured student performance, namely Sweden and the

Although devoting more resources to public education tends to be considered a good strategy for meeting the challenges of the "knowledge-based" economy, experience in Europe has not been straightforward

The lack of hard evidence of a positive link between increased educational expenditure and improved schooling outcomes may mean more attention needs to be focused on the efficiency with which the resources are used

Figure 2. Changes in Education Expenditure per Student[a] and Average Labour Productivity Growth[b], 1970-1994



Source: Gundlach and Wößmann (2001)

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