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Diminishing Marginal Returns and the Production of Education: An International Analysis

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can be rejected. DMR therefore does not appear to explain the differences in results between developing and developed nations.

Key Words:

Economics of scale resource allocation economic development

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Notes

Domestic 1. The a **Product** X operation and Dev tions. 2. For ex and Johnson ages of individu ive relations s in an at countries exten with' 3. A rela to years of educatio uld not be confused evement, which is 4. Some mple, Dewey et al., <u>2000</u>; Figlio, <u>1999</u>; Hanushek et al., <u>1996</u>).

- 5. Harris (2001) summarizes results of the Tennesseee and Wisconsin class size experiments (Nye et al., 1999; Molnar et al., 1999, respectively), as well as a metaanalysis of previous small-scale experiments (Glass and Smith, 1979). He finds that a reasonable estimate of the average effect of reducing class size by one student for one grade is 0.0008-0.0020 test score standard deviations. The same study compares these results with a sample of non-experimental estimates: Akerhielm (1995), Dolan and Schmidt (1987), Eide and Showalter (1998), Ehrenberg and Brewer (1994), Ferguson (1991), Goldhaber and Brewer (1997), and Hanushek et al. (1996). Harris finds that very few of these non-experimental estimates of the class size effect are within the range identified from the experimental literature; and nearly all are below it.
- 6. The results in the Tennessee STAR experiment are not available by race.
- 7. Hanushek and Luque write that 'it has been conventionally held, particularly following Heyneman and Loxley (1983), that schools and school resources are more important than families in developing countries' (2003, p. 498).
- 8. An alternative possibility, not tested by Heyneman and Loxley, is that there may be weaker correlations between measures of socioeconomic status and actual home environment in poor countries. Heyneman and Loxley seem to highlight this possibility when they write that 'the pressure on students to do well on examinations does not 1983, p. appear t

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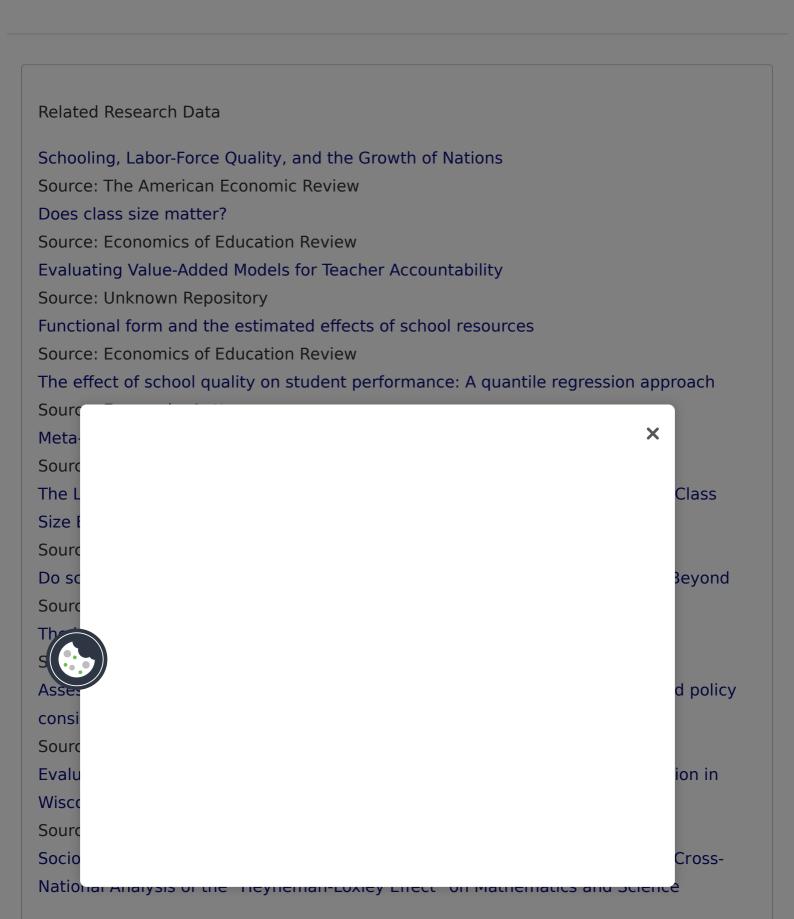
- 10. One possible reason for DMR that is unique to production functions in education is the possibly non-metric nature of output. While psychometricians do try to place achievement scores on a 'developmental' vertically linked scale, there is some controversy about how well this can be done and therefore about what differences in scores across students (or across time within students) actually mean (McCaffrey et al., 2003). The author wishes to thank an anonymous referee for raising this point.
- 11. Figlio's plots the marginal effects of class size and teacher salaries as various input levels, and finds, for instance, that the class size effect is relatively unaffected by most input levels, except school size (number of students in the school). DMR does appear to be present in teacher salaries with respect to parent income levels and perhaps instructional hours. Figlio does find that the class size effect becomes larger in schools that have more students.
- 12. The standard errors for y $_1$, y $_2$, and y $_3$ were estimated using the 'stdp' command in Stata. Note that the subscript on the sample size becomes irrelevant because the sample size is the same for each prediction within each country.
- 13. To see why this is the case, note that as a matter of notation. Also, is true by assumption and is true because of the constant returns assumption. Thus, and, by substitution, it is therefore true that is exactly equal to $\Delta y_H^{CMR} \Delta y_H^{DMR}$.



statistic (6.730) rejects the null at similar levels of significance.

16. I also tested whether the results were sensitive to the value of λ , but they are not. The correlation in the $\Delta y_L - \Delta y_H$ estimates using the base value $\lambda = 0.25$ with $\lambda = 0.5$ in Equation ($\underline{7}$) is 0.907.

17. The input indices were created by placing each of the input variables on a 0–1 scale, summing and dividing by the number of variables (for school and non-school categories, respectively). The national income data are taken from World Bank (1996).



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