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How much might human capital policies affect earnings inequalities and poverty?

¿Cuánto afectan las políticas en capital humano a la desigualdad del ingreso y a la pobreza?

JERE R. BEHRMAN*

Abstract

Economic inequality and poverty have persisted in Latin America despite important changes in political and policy regimes. This paper explores the relationship between various human capital programs aimed to reduced poverty and how improvements of those in poverty in the left tail of the earning income distribution are likely to reduce inequality. First it reviews some recent benefit/cost estimates for human capital intervention in LAC, suggesting some investments in which the returns appear quite high. Then it turns over to how much increases in schooling attainment targeted to the poor would reduce poverty and income inequality. This is illustrated empirically using the 2004 Chilean Social Protection Survey data. Alternative simulations suggest significant impacts of well targeted increases in schooling attainment on reducing poverty and inequality.

Key words: *Inequality, Poverty, Human capital.*

Resumen

La desigualdad económica y la pobreza han persistido en América Latina a pesar de importantes cambios en los regímenes políticos y en la política social. Este artículo explora la relación entre diversos programas de capital humano

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destinados a reducir la pobreza y cómo una reducción de la pobreza tiende a reducir la desigualdad. En primer lugar, se presentan estimaciones de costo/beneficio recientes de distintas intervenciones en capital humano en América Latina, sugiriendo que en algunas de estas inversiones los rendimientos parecen bastante altos. Luego, se profundiza en cómo un aumento en la escolaridad de las personas en situación de pobreza reduciría los niveles de pobreza y la desigualdad de ingresos. Para ilustrar empíricamente este punto se utilizan los datos de la ronda 2004 de la Encuesta de Protección Social de Chile. Simulaciones alternativas sugieren un impacto significativo del aumento en los años de escolaridad, focalizados en personas pobres, en la reducción de la pobreza y la desigualdad.

Palabras clave: *Desigualdad, Pobreza, Capital humano.*

JEL Classification: *I24, I3, J24.*

As is well-known, economic inequality long has been relatively high in most of Latin America and the Caribbean (LAC) in comparison with most other areas of the world. These inequalities generally have persisted despite some variations due to changes in political and policy regimes and markets and significant policy innovations in recent decades in LAC countries from Chile to Mexico.

At the start of the 1970s, for example, LAC income inequality measured by the income Gini coefficient ranged from a low of 0.43 in Argentina and Uruguay, to a high of 0.62 in Honduras (Table 1). Average income inequality in the region as a whole for this period was 0.53 compared with 0.36 for high-income OECD countries, and 0.43 for East Asia. Schooling inequality was also high in Latin America in the early 1970s, with the schooling attainment Gini coefficients averaging 0.46. The countries with the highest schooling inequality were also some of the poorest in the region (Guatemala, Honduras, Nicaragua and El Salvador). In contrast, Argentina and Chile were well below the LAC average on both measures. The average LAC income Gini coefficient subsequently declined to 0.50 in the early 1980s but increased to about 0.54 in 2000, though the Gini coefficient for schooling attainment stayed at about 0.46 for 1980 and then declined somewhat to about 0.42 in 2000.

Conceptually distinct from the question about inequality is the question of poverty. Most governments profess an interest in reducing poverty and have undertaken programs that purportedly are directed towards doing so. In the short run, transfers to the poor are often thought to be among the more effective ways of reducing short-run poverty, though such transfers might be conditional on activities such as work in employment programs in order to screen beneficiaries or to limit negative effects on labor supplies. In the longer run, investments in human resources of the poor are usually thought to be among the most effective ways of reducing poverty because the basic resource of the poor is their time and

TABLE 1
LAC INCOME AND SCHOOLING GINI COEFFICIENTS FOR EARLY 1970s, EARLY 1980s AND AROUND 2000

	Early 1970s		Early 1980s		1998-2000	
	Income Gini Coefficient 1970	Schooling Gini Coefficient (people over 15) 1970	Income Gini Coefficient 1980-1985	Schooling Gini Coefficient (people over 15) 1980	Income Gini Coefficient 1998-2000	Schooling Gini Coefficient (people over 15) 2000
Argentina	0.49	0.29	0.41	0.29	0.52	0.27
Bolivia	0.46	0.52	n/a	0.52	0.63	0.47
Brazil	0.61	0.48	0.57	0.48	0.61	0.43
Chile	0.50	0.37	0.53	0.37	0.60	0.37
Colombia	0.57	0.47	0.53	0.47	0.57	0.48
Costa Rica	0.52	0.40	0.48	0.40	0.50	0.42
Ecuador	n/a	0.39	0.44	0.39	0.56	0.43
El Salvador	0.47	0.49	0.53	0.49	0.54	0.53
Guatemala	0.54	0.63	0.54	0.63	0.60	0.59
Honduras	0.62	0.57	0.57	0.57	0.53	0.43
Mexico	0.54	0.50	0.50	0.50	0.54	0.36
Nicaragua	n/a	0.62	n/a	0.62	0.56	0.52
Paraguay	n/a	0.38	0.45	0.38	0.52	0.36
Peru	0.55	0.41	0.51	0.41	0.51	0.36
Uruguay	0.43	0.36	0.44	0.36	0.45	0.35
Venezuela	0.55	0.43	0.48	0.43	0.46	0.38
Group mean (unweighted)	0.53	0.46	0.50	0.46	0.54	0.42

* All income Gini coefficient estimates are population based. For 1970 the data for Argentina, Mexico and Nicaragua are for 1960 and for Venezuela 1961. Source is Behrman, Birdsall and Pettersson (2006) based on data from WDI (2005), WHI2a (2005), Thomas, Wang and Fan (2001) and Deininger and Squire (1996).

enhancing their human resources is likely to increase the return to the use of their time. In recent years in LAC, for example, there has been considerable expansion of conditional cash transfer programs based on the Mexican *PROGRESA/Oportunidades* example in which the transfers are conditional on indicators of investments in human capital, most notably in schooling attainment (but also on investments in health and nutrition)¹. Feasible improvements in the positions of those in poverty in the left tail of the earnings income distribution, of course, are likely to reduce inequality.

This paper first considers some recent benefit/cost estimates for human capital interventions in LAC (Section 1). These suggest that there are some human capital investments in which the estimated returns appear quite high. Then the paper turns to rough calculations of how much increases in schooling attainment—the most emphasized form of human capital investments—targeted towards the poorer members of society will reduce poverty and income inequalities (Section 2). To illustrate the empirical orders of magnitude, earnings and wage rate function estimates and the distribution of earnings from the 2004 Chilean Social Protection Survey are used. Section 3 then concludes regarding the implications of the previous two sections for the possibility of using human capital investments to reduce poverty and inequality in LAC.

1. BENEFIT/COST ESTIMATES FOR HUMAN CAPITAL INVESTMENTS IN LATIN AMERICA

There is a surprising paucity of good estimates of benefit/cost estimates for human capital interventions in Latin America and in other developing regions. This is in important part because of the difficulties in making good estimates². On the benefit side, for example, there often are difficulties in:

- Obtaining good estimates of important impacts given behavioral choices in the presence of unobserved heterogeneities (so that, for example, schooling is not incorrectly credited in part with the effects of unobserved abilities, motivations and family background that in part cause more schooling and also directly affect outcomes that might be directly affected by schooling) and that impacts may be distributed over many decades over the life cycle;
- Placing values on all the relevant impacts so that they can be aggregated, which is particularly difficult (e.g., for averted mortality) but also difficult

¹ There are a number of studies that report positive impact of these programs on schooling, nutrition and other outcomes (e.g., Behrman and Hoddinott (2005); Behrman, Parker and Todd (2009a,b); Behrman, Sengupta and Todd (2005); Fiszbein and Schady (2009); Gertler (2004); Hoddinott and Adato (2009); Rivera *et al.* (2004); Schultz (2004).

² For discussion in much more detail of these difficulties and some illustrative estimates of benefit/cost ratios for developing countries, including some in LAC, see Behrman, Alderman and Hoddinott (2004) and Knowles and Behrman (2004, 2005).

- if projects are large enough to have impact on market prices or if prices are very distorted by market or policy failures;
- Selecting appropriate discount rates to permit aggregation across time (Table 2 illustrates how much the choice of discounting matters, as well as that impacts of human capital investments depend on life-cycle patterns in survival probabilities); and
 - Distinguishing between private and social (beyond the private) benefits, a distinction that is central for the efficiency motive for policies.

TABLE 2
 PDV OF \$ 1000 RECEIVED WITH VARIOUS LAGS STARTING FROM BIRTH AT
 ALTERNATIVE DISCOUNT RATES, ADJUSTED FOR SURVIVAL PROBABILITIES*

Discount Rate	3.00%	5.00%	10.00%	Survival Prob
Lag in Years				
10	\$ 717	\$ 592	\$ 372	0.964
40	\$ 281	\$ 130	\$ 20	0.915
60	\$ 134	\$ 42	\$ 3	0.787
100	1	0	0	0.007

Survival probabilities based on WHO Life Tables for Brazil at <http://www.who.int/countries>.

On the cost side, there often are difficulties in:

- Identifying the true private and public resource costs (not the governmental budgetary costs), including distortion costs but excluding transfers;
- Assessing the costs when a project is scaled-up, including not only the possibility of changing marginal costs at a micro level but changing marginal resource costs through impacts on markets; and
- Distinguishing between private and social costs, again important for efficiency considerations.

However there are some recent estimates of benefit/cost ratios for human capital investments in developing countries that attempt to deal with some of these problems –but at the same time illustrate some of the problems. Sections 1.1 summarizes selected estimates for educational interventions in LAC and Section 1.2 summarizes selected estimates for nutrition/health interventions with adjustments to place them in a LAC context.

1.1. Benefit/Cost Estimates for Three Recent LAC Education-Related Programs

If education means learning, then education is a life-long process –and not limited to schooling though at times the literature inappropriately seems to equate education with schooling. Recent estimates of adult cognitive achievement production functions in Guatemala, for example, illustrate that assuming

only schooling matters in the production of adult cognitive skills leads to a substantial overestimates of the impact of schooling and underestimates of the importance of pre- and post-schooling experiences (Behrman *et al.* (2008)). In part for this reason, I here summarize three interventions – one pre-school, one related to schooling, and one post-schooling.

1.1.1. *Bolivian PIDI (Proyecto Integral de Desarrollo Infantil) Pre-School Program*³

Program: PIDI provided daycare, nutritional, and educational services to children between the ages of 6 months and 72 months who lived in poor, predominantly urban areas. The goals were to improve health and early cognitive/social development by providing children with better nutrition, adequate supervision, and stimulating environments. It was hoped that the program also eased the transition to elementary school, improved progression through elementary grades, and raised school performance, all of which were expected to increase post-school productivity. Through PIDI, children attended full-time child care centers located in the homes of women living in low-income areas targeted by the program. These women were given training in child care and loans and grants (up to \$ 500) to upgrade facilities in their homes. Each PIDI center had up to 15 children and approximately one staff member per five children, with additional staff provided when there was a larger proportion of infants. The program provided food to supply 70% of the children's nutritional needs as well as health and nutrition monitoring and educational activity programs.

Program benefits: Longitudinal information is available on a sample of program participants, a sample of other children in the same age range living in program areas and a sample of children in the same age range living in roughly comparable areas that did not have the program. This includes information on pre-school child anthropometrics, cognitive development and psychosocial development. However baseline pre-program data on critical child attributes (e.g., anthropometrics) are not available. Based on a dynamic model of investing in children, a range of estimation methods were used to assess the robustness of estimated program impacts under alternative assumptions about the selection into the program –standard cross-sectional regressions, propensity score matching with the two samples of children not in the program, and marginal propensity score matching (with the advantage of controlling for unobserved factors that determined program participation) focusing on changes in the outcomes with different program exposures and conditional on child age when entering the program. The estimates show that the program significantly increased cognitive achievement and psychosocial test scores, especially for children who participated in the program for at least seven months. The impact estimates are fairly robust to the use of alternative comparison groups and estimators. Estimates obtained by the marginal matching estimator tend to be larger, particularly at longer durations and for children aged 6-36 months, than those obtained using traditional econometric estimators that impose stronger functional form assumptions.

³ Based on Behrman, Cheng and Todd (2004).

To obtain the program benefits, the impacts of these pre-school characteristics need to be translated in the value of their impact on lifetime productivity. Four channels through which the preschool program can affect lifetime earnings are considered: (1) increasing cognitive skills as an adult (conditional on grades completed), which directly affects earnings, (2) increasing physical stature as an adult, which directly affects earnings, (3) increasing the number of grades completed, which directly affects earnings and the age of school completion, and (4) decreasing the age of school completion without changing the number of grades completed. Available data from Bolivia are used for some dimensions of these processes, such as grade repetition, distribution of completed schooling attainment and related earnings. In the absence of estimates from Bolivia on other needed components, estimates from previous studies on other developing countries are used (e.g., Thomas and Strauss' (1997) estimate of the relationship between adult earnings and height in Brazil, the Alderman *et al.* (1996) estimate of the cognitive skills– earnings relationship in Pakistan) under the assumption that increases in height and cognitive ability as a child have persistent effects that translate into equiproportional increases as an adult. This last assumption may result in an overstatement of the impacts. On the other hand, in some respects these estimates probably understate the program benefits because (1) they do not incorporate non-labor-market effects such as increased productivity in the production of health and nutrition and (2) they do not incorporate the value of time gained through less time in childcare of the children's mothers or other caregivers due to the program.

Program costs: The program cost was estimated by Ruiz (1996) to have been approximately \$ 43 per beneficiary per month, which is substantial in a country where per capita annual GDP at the time was \$ 800 in exchange-rate-converted pesos, or \$ 2540 in purchasing power parity terms. Approximately 40% of the expenditure went to the nutritional component of the program. This study uses the Ruiz estimate, with an adjustment in alternative estimates of 25% for the distortion cost of raising revenues for the program (e.g., see Knowles and Behrman 2004). Such estimates may overstate somewhat the costs if part of the nutritional supplementation for the children effectively was a transfer that replaced food that the children otherwise would have been provided by their families, as suggested by some previous studies.⁴

Benefit/cost ratios: Table 3 summarizes the estimated benefit/cost ratios with alternative assumptions concerning discount rates (3% and 5%), schooling levels, and whether distortion costs are included. The included estimates range from 1.4 to 3.7, all of which mean that the program has benefits greater than its costs, but the range indicates considerable sensitivity to the alternative assumptions.

⁴ Alternatively, the benefits are underestimated because they in part are reaped by other household members.

TABLE 3
BENEFIT/COST RATIOS FOR BOLIVIAN PIDI PRE-SCHOOL PROGRAM*

Schooling Level	Mean Annual Earnings (\$)		Discount Rate 3%			Discount Rate 5%		
	From	To	Cost	Benefit	Benefit/Cost Ratio	Cost	Benefit	Benefit/Cost Ratio
Intermediate (8)	1224	1352	1394	5107	3.7	1301	3230	2.5
Secondary (11)	1422	1550	1394	3969	2.9	1301	2232	1.7
Intermediate (8)	1224	1352	1743	5107	2.9	1626	3230	2.0
Secondary (11)	1422	1550	1743	3069	2.3	1626	2232	1.4

* Assumes that children participate in program for three years starting at age 2. Impact: shortens time to complete schooling by 1 year; increases schooling level by 1 grade; increases cognitive skills by 5%. Costs in first two rows are \$ 516 per year based on Ruiz (1996); costs in the second two rows also include a 25% adjustment for distortions due to raising public revenues for the program.

1.1.2. Colombian Programa de Ampliación de Cobertura de la Educación Secundaria (PACES) Scholarship Program for Poor Urban Secondary School Students⁵

Program: The Colombian government created the PACES voucher program for poor secondary school-age children in 1991 to enable them to attend private secondary schools. By 1996, the program was covering about 100,000 students. At the time the program was launched, enrollment in primary school (covering grades 1-5) was almost universal, while the enrollment rate in secondary school (i.e., covering grades 6-11) was 73% overall and 55% for the poorest quintile of students. The vouchers were designed to cover about one-half of the cost of private secondary schools. They could be renewed as long as students maintained satisfactory academic performance. The vouchers were targeted to children residing in poor urban residential areas and who previously had attended public primary schools.

Program benefits: The PACES scholarship program (and scholarship programs generally) might be expected to have the following effects:

- Increased schooling attainment (however, there may be negative effects via school crowding).
- Earlier completion of given schooling levels.
- Improved cognitive achievement for a given level of schooling attainment (assuming that private schools attended by some voucher recipients provided

⁵ Based on Angrist *et al.* (2002) as summarized in Knowles and Behrman (2004).

better-quality schooling than that provided by the public schools that would have been attended in the absence of the vouchers).

- Reduced work effort by other family members (any reduction in work effort by the scholarship recipient is considered to be part of the opportunity cost of schooling).

Evaluation of the PACES program was facilitated by the fact that vouchers were initially awarded by lottery in municipalities in which the number of students applying for vouchers exceeded the estimated shortfall in the number of spaces available in public schools that was used by local authorities to decide how many new vouchers to make available in a given school year. This in effect created a “natural experiment” that made it possible to estimate the effect of the vouchers on the target population much as one could do if the voucher scheme had been conducted as a randomized experiment^{6, 7}.

This evaluation did not find any significant impact on enrollment. However, it did find that lottery winners were 15 percent more likely to attend a private school⁸. After three years, lottery winners also had completed 0.12-0.16 more grades of schooling (primarily due to lower repetition rates) and were about 10 percentage points more likely to have completed the 8th grade at the end of the program’s third year. Although the program had no effect on dropout rates, lottery winners scored 0.2 standard deviations higher on standardized tests. In addition, lottery winners reported working 2.2 hours per week less than non-winners and were less likely to be either married or cohabiting as teenagers (however, this last difference affected only about one percent of the sample).

The evaluation study estimates that the additional 0.12-0.16 grades of schooling completed by lottery winners would raise their annual incomes by about \$ 36-48 per year (based on an estimated rate of return to schooling of 10 percent in Colombia and predicted average annual earnings of \$ 3,000).

⁶ The implicit assumption is that the excess demand for vouchers occurred randomly across municipalities (and therefore was not associated with other municipality-level factors that might affect education). If, for example, excess demand for vouchers more likely occurred where recent expectations were higher regarding the returns to schooling because of greater economic activity than elsewhere, the estimated impacts may not be applicable to other municipalities with lower expectations regarding the returns to schooling. Unfortunately, the study does not provide information with which to assess whether the “excess-demand” municipalities were similar to or different from other municipalities.

⁷ In fact, the evaluation found that only about 90% of lottery winners actually used their vouchers, while about 24% of lottery users received scholarships from other sources. To correct for the effects of such “contamination”, the evaluation also used lottery success as an instrument to predict whether a given youth received a scholarship. The instrumental variable estimates of the grade completion effect were about 50% greater than the “reduced-form” OLS estimates of being a lottery winner. The estimates of effectiveness used in the published study to obtain the cost-benefit estimates are the reduced-form estimates. In this case, the presumably more accurate instrumental variable estimates arguably should have been used.

⁸ Because of the reported poor quality in some of the new secondary schools that emerged to serve voucher recipients, eligibility to participate in the program was limited to not-for-profit schools from 1996 on.

Program costs: The economic cost of the PACES program includes:

- Additional schooling costs (some of which may be incurred directly by households, including the opportunity cost of the additional time scholarship students are engaged in schooling-related activities).
- Program administration costs.
- Distortionary costs related to the financing of the program (e.g., the deadweight cost of collecting the necessary taxes to finance the program) or to reduced work effort on the part of other household members (due to a possible income effect).

The costs of scholarship programs do not include the cost of the scholarships themselves (i.e., the cost of the voucher, in the PACES program), which is a transfer.

Table 4 summarizes information on the costs of the PACES program as reported in the evaluation study. The table indicates that the reported social costs of the program (the last column in the table) are at least US\$ 195 per lottery winner for three years (after adjusting for different rates of voucher take-up in each year of the program). However, several cost items are not reported, including the deadweight cost of financing the additional governmental expenditure of \$ 109 per lottery winner, the possible distortionary cost on adult work effort in lottery-winning households, and the program's administrative costs.

TABLE 4
THREE-YEAR COSTS PER LOTTERY WINNER IN THE COLOMBIA
PACES PROGRAM (US\$)

Item	Government	Lottery Winners	All Households	Society
Cost of the vouchers	-336	336		0
Deadweight cost of government financing			?	?
Effect of voucher on adult work effort		?		?
Administrative costs	?			?
Reduced public expenditure on secondary schooling	227			227
Additional amount spent on schooling by lottery winners		-236		-236
Opportunity cost of student time ^a		-186		-186
Totals	-109	-86	0	-195

Source: Angrist, *et al.* (2003).

^a Estimated on the basis of reported reductions in time worked by lottery winners as compared to non-winners.

Program benefit/cost estimates: The evaluation does not include a formal benefit/cost analysis, concluding that the benefits clearly exceed the costs using any plausible discount rate. However Knowles and Behrman (2004) build on the evaluation study results to obtain benefit/cost estimates. A life-cycle approach is used with the following assumptions:

- The three-year costs of the program include the estimated project costs of \$ 195 per lottery winner from Table 4 but also administrative and distortionary costs of \$ 32.65 per lottery winner (i.e., 30% of the increase in government expenditure from Table 4)⁹ and that all program costs occur at ages 13-15 in equal annual installments.
- Lottery winners complete 0.12 additional grades of schooling, with each additional grade of schooling resulting in a 10% increase in annual earnings of \$ 3,000 per year.
- Annual benefits occur at ages 16 to 60.
- The discount rate is alternatively 3, 5 or 10% per annum, and benefits and costs are discounted to age 13.

Under these assumptions, the benefit-cost ratio is 3.8 with a discount rate of 3%, 2.7 with a discount rate of 5%, and 2.4 with a discount rate of 10%. The discount rate again, as in the pre-school program considered in Section 1.1.1 and the health and nutrition programs considered in Section 1.2, has a strong effect on the estimated benefit/cost ratio because the benefits are spread over an extended period of time. Table 5 presents the estimated benefits and costs at selected ages for illustrative purposes using a discount rate of 5%. The estimated benefits from the increased number of school years completed are presented in column 1, while the program's cost is presented in column 4 (the other columns are discussed below). The calculations show that the benefits are heavily discounted (comparing the last two rows of the table).

These estimates of the benefit/cost ratio are conservative, however, not only because they assume the lower limit to the estimated gain in the number of school grades completed (0.12, as compared to the upper limit of 0.16)¹⁰ but also because they neglect the other estimated effects of the intervention, i.e., the finding that lottery winners were 10% more likely to have completed the 8th grade at the time of the evaluation and that they scored 0.2 standard deviations higher on standardized tests¹¹.

⁹ The 30% estimate for administrative *and* distortionary costs is probably conservative, based on the discussion in Knowles and Behrman (2004, Section 3.2.3) where it is recommended that an estimate of 20-25% be used as an estimate of the cost of raising additional tax revenue.

¹⁰ If the estimated impact of the voucher scheme on the number of school years completed is assumed to be 0.16, instead of 0.12, the estimated benefit/cost ratio increases from 2.7 to 3.6 with a discount rate of 5%.

¹¹ There may be other biases as well that are not explored here. On one hand, the estimate of a 10% rate of return to schooling attainment may be upward-biased due to the failure to control for unobserved endowments (e.g., innate ability, family connections, motivations) in the earnings function estimates. On the other hand, there may be non-labor-market returns that are additional to labor market returns.

TABLE 5
CALCULATIONS OF DISCOUNTED BENEFITS AND COSTS (US\$) PER LOTTERY WINNER FOR THE COLOMBIA PACES VOUCHER SCHEME

Age	Benefits			Cost
	Increased number of school grades completed	Earlier completion of schooling	Improved test scores	
13	0.00	0.00	0.00	75.88
14	0.00	0.00	0.00	75.88
15	0.00	303.60	0.00	75.88
16	36.00	0.00	360.00	0.00
17	36.00	0.00	360.00	0.00
18	36.00	0.00	360.00	0.00
19-59	36.00	0.00	360.00	0.00
60	36.00	0.00	360.00	0.00
61	0.00	0.00	0.00	0.00
62	0.00	0.00	0.00	0.00
63-69	0.00	0.00	0.00	0.00
70	0.00	0.00	0.00	0.00
Totals	1,620.00	303.60	16,200.00	227.65
Discounted to age 13 ^a	580.38	275.37	5,803.78	216.98

Source: See text.

^a Using a discount rate of 5%.

Considering first the effect of the voucher scheme on the age of completing the 8th grade, it is assumed that the estimated effect implies that lottery winners gain an additional 0.1 year of full-time work at age 15. This additional benefit is displayed in row 3, column 2 of Table 5. Like costs, this benefit is only slightly discounted because it occurs at age 15. The effect of adding this benefit is to increase the estimated benefit-cost ratio from 2.7 to 3.9 (using a discount rate of 5%). This is a significant increase, indicating that in the context of economic analysis earlier completion of a given grade or level of schooling is an important schooling outcome¹².

The PACES evaluation study estimates that the increase of 0.2 standard deviations in standardized test scores among lottery winners is equivalent to about one full additional grade of schooling completed (based on the mean test scores by grade of United States Hispanic students taking the same test). If correct, this translates into an additional annual earnings benefit of \$ 300, compared to the previously included annual earnings benefit of \$ 36 based on the number of additional grades completed. This additional benefit is displayed in column 3 of Table 5. Like the benefit associated with the increased number of school grades completed, this benefit is heavily discounted because it occurs during the person's entire assumed working life (ages 16-60). Not surprisingly, including this benefit increases the estimated benefit/cost ratio dramatically, from 3.9 (including the earlier completion benefit and using a discount rate of 5%) to 30.7.

1.1.3. Argentinean Programa Joven Youth Job Training Program¹³

Program: The target population of *Programa Joven* was the large number of poor youth, male and female, with limited education and without work experience and who were unemployed, under-employed or inactive. The selection criteria for the program were minimum age of 16 years, no more than secondary education completed, member of a poor household, and not currently employed. The program provided intensive training (200 hours over a period of 6 to 12 weeks) for positions in the productive sectors of the economy, including reimbursement of transportation expenses, a stipend for females with children under 5, medical checkups, books, materials, work clothing and an 8-week internship in a firm.

Program benefits: Program impacts were estimated by using propensity score matching to compare program participants with one or more "similar" (in terms of observed characteristics) non-participants using three different samples/sources of information:

¹² Moreover, its relative importance increases with the discount rate. For example, with a 5% discount rate, the earlier completion benefit accounts for 32% of total estimated benefits in this example, whereas with a 10% discount rate it accounts for 46% of total estimated benefits. Of course the gain from completing a given level of schooling at a younger age has been noted in other studies, including the one in Section 1.1.1, going back at least to Glewwe and Jacoby (1995).

¹³ Based on Aedo and Nuñez (2001) as summarized in Knowles and Behrman (2004).

1. Administrative data on all individuals who registered and qualified to take training programs during the period March 1996 to December 1997 (about 140,000 persons).
2. The same administrative data as above but restricted to a sample of 3,340 individuals consisting of equal numbers of persons extracted from the above group in each of the following two groups: 1) persons who completed the program training, selected to be representative in terms of sex and region of residence, and 2) a “comparison” group of persons who were qualified to enter the training programs but who did not participate and who resembled those who did participate in terms of age, sex, level of education, labor force participation, socioeconomic level and whether they had children under age 5 years.
3. Additional survey data available only for the restricted sample of 3,340 persons in the second data base.

Separate logit functions explaining participation (with participation defined as successful completion of the technical knowledge phase of the training) were estimated using the three different samples/information sources described above to obtain three different sets of propensity scores¹⁴. The authors conjectured that use of different propensity scores would result in significantly different estimates of program impact. The estimation was done separately for: adult males (21-35), young males (16-20), adult females (21-35) and young females (16-20) –as well as for all four groups combined. The outcome variables considered were earnings and employment in the 12th month following completion of the program.

Estimates of program effects on earnings were statistically significant only for young males (16-20) and adult females (21-35). For young males, the estimated impact of the program on monthly earnings varied from \$ 17.17 to \$ 23.75 depending on the assumptions¹⁵. For adult females, the corresponding estimates varied from \$ 23.40 to \$ 32.40. Estimates of the program’s impact on monthly earnings for all four groups combined varied from \$ 15.67 to \$ 22.26. Estimates of the program effect on the probability of employment were statistically significant only for adult females, with the estimated effect varying from 0.104 to 0.135. The evaluation study concludes that these differences in estimated program impact among groups probably reflect mainly the different labor market conditions facing each group.

Program costs: The evaluation study separated the program’s costs into direct and indirect components. Direct costs were defined to include the cost of program training services provided by competitively-selected providers, the cost of employee insurance during the internships, and the cost of stipends provided to

¹⁴ The samples were re-weighted prior to estimation with the sample of 3,340 to correct for choice-based sampling (i.e., the fact that the sample was constructed to have equal numbers of participants and non-participants).

¹⁵ Within the statistically significant groups, the impact estimates were not very sensitive either to the sample/information used to estimate the propensity score functions or to the number of nearest neighbors used (5, 10, 20, or 30). This result was surprising in the case of the propensity scores since the three sets of propensity scores were not very highly correlated.

the trainees (for example, the stipends paid to female participants with children under 5)¹⁶. The study assumes that the opportunity cost of trainee time is zero, which is a strong assumption¹⁷. The study also assumes a zero deadweight loss for the governmental resources used to fund the program (although a 50% deadweight loss is alternatively assumed in sensitivity analysis reported in the study). Indirect costs were estimated to be 32.7% of direct costs (with an indirect cost ratio of 15% used in sensitivity analysis).

Program benefit/cost estimates: Benefit/cost analysis was done for young males and adult females (representing a targeted program) and all four groups combined (representing the actual program). The estimated effect of the program on monthly earnings (the average of the estimates obtained for each group) was assumed to be the program's only benefit and was assumed to remain constant during a period of time that was alternatively assumed to last for 1, 3, 6, 9, 12, 15 years or for an unlimited period of time. Two alternative discount rates were used (5% and 10%).

In the case of the four groups combined, representing the actual program, the estimated net present value of benefits was positive with a discount rate of 5% after 12 years (but was still negative with a discount rate of 10% after 15 years).¹⁸ With the analysis restricted to young males and adult females, representing a program targeted only to these two groups, the estimated net present benefits are positive after 9 years with a discount rate of 5% (or with an indirect cost ratio of 15%) and after 12 years with a discount rate of 10%. If a deadweight loss of 50% of the program's total expenditure is assumed as the distortionary cost of governmental financing, estimated net present benefits of the existing program are non-positive after 15 years, even with a discount rate of 5%, while for a targeted program (i.e., one restricted to young males and adult females), they are positive only after 15 years with a discount rate of 5% (but only when an unlimited time period is assumed with a discount rate of 10%).

1.2. Human Capital Investments to Reduce Hunger and Malnutrition

Behrman, Alderman and Hoddinott (2004) present benefit/cost ratios for four sets of interventions related to hunger and malnutrition in a low-income country context, based on extensive discussion of the available information with which to assess benefits and costs and the sensitivity of the estimates to different assumptions. This was part of the "Copenhagen Consensus" in which a panel of eight distinguished economists, including four Nobel Laureates, ranked about 40 projects in ten broad topic areas on the basis in part of benefit/cost analyses

¹⁶ This last category is actually a transfer and should not have been included in the program resource costs.

¹⁷ Presumably, many of the trainees would have been employed in the informal sector or in housework if they had not participated in the program. This assumption also implicitly assumes that interns did not contribute positively to the output of the firms in which they were working for 8 weeks.

¹⁸ However, with an indirect cost rate of 15% estimated net present benefits were positive after 15 years even with a discount rate of 10%. In addition, under the basic assumptions used, the program had estimated positive net benefits over an infinite time period.

prepared by experts in each of the areas (Lomborg 2004). In the final ranking of the alternatives projects related to hunger and malnutrition were highly ranked in terms of priorities.

Here, I present new estimates based on a similar approach, but using prices and incomes for the LAC 2005 average¹⁹, Brazilian survival probabilities²⁰ and alternative means of valuing averted mortality in terms of the value placed on value per DALY (Disability Adjusted Life Years) of \$1,000 (“low”) and \$ 5,000 (“high”), which are the values suggested by the Copenhagen Consensus for new estimates in initial Problem Papers for a 2008 Copenhagen Consensus exercise²¹. I consider three sets of nutritional interventions:

Reducing the Prevalence of low birth weight (LBW): Many of the 12 million LBW infants born each year die at young ages, contributing significantly to neonatal mortality, which makes up the largest proportion of infant mortality in many developing countries. Unfortunately, rates of LBW have remained relatively static in recent decades. Because LBW infants are 40% more likely to die in the neonatal period than their normal weight counterparts, addressing LBW is essential to achieve reductions in infant mortality. Moreover, many of the LBW children who survive infancy suffer cognitive and neurological impairment and are stunted as adolescents and adults. Thus, in addition to contributing to excess mortality, LBW is associated with lower productivity in a range of economic and other activities. LBW also may be important in light of new evidence that shows that LBW infants may have an increased risk of cardiovascular disease, diabetes and hypertension later in life. LBW may also be an intergenerational problem because LBW girls who survive tend to be undernourished when pregnant with relatively high incidence of LBW children. While the prevalence of LBW is particularly high in South Asia, there are substantial numbers of LBW babies in other parts of the developing world, including in LAC.

The benefits from reducing LBW encompass the PDV of the six impacts over the lifecycle and the one across generations that are summarized in the previous paragraph. Under the assumptions used here, the most important effects are from averted mortality (11 to 50% of the total), intergeneration effects (18-39%), chronic diseases (8-38%), and productivity (6-27%). Note that these relative contributions differ a lot depending on the discount rates (5% or 10%) and the DALYS (\$ 1,000 or \$ 5,000). The higher the discount rate, the more

¹⁹ In particular, I use the Gross National Income per capita (Atlas method) of \$4008 for Latin America in 2005 from <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0> (24 November 2006) relative to the \$ 500 value for the target population in a context such as South Asia in Behrman, Alderman and Hoddinott (2004) to adjust all the prices and incomes in that study for the present purpose.

²⁰ Survival probabilities are relevant since some impacts occur only if the individual affected by the intervention lives long enough. The source used is the WHO Life Table for Brazil at <http://www.who.int/countries> as of 24 November 2006.

²¹ In Behrman, Alderman and Hoddinott (2004) for our preferred estimates we followed Summers (1992, 1994) and used instead of DALYs at such levels, the alternative resource cost that these societies had chosen to allocate to avert an infant mortality, which was estimated to be \$ 1250 in PDV terms (from inoculations) – a much lower value than implied by DALYs of \$ 1,000 or \$ 5,000.

important is averting infant mortality (and to a lesser extent, neonatal and infant illnesses). The larger the DALYS, the more important is the effect on chronic diseases, as well of averting infant mortality. Tables 6 and 7 summarize the benefits and costs for three interventions to reduce LBW. The benefit-to-cost ratios range from 2.5 to 292.6 –with higher values for the “low” (5%) discount rate, the “high” DALY (\$ 5,000) and the intervention of providing drugs for pregnant women with poor obstetric histories.

Improving Infant and Child Nutrition: The nutritional literature emphasizes that undernutrition is most common and severe during periods of greatest vulnerability (Martorell 1997, UNICEF 1998). One such period is *in utero*, that is addressed above with regard to LBW. A second vulnerable period is the first two years or so of life. Young children have high nutritional requirements, in part because they are growing so fast. Unfortunately, the diets commonly offered to young children in developing countries to complement breast milk are of low quality (i.e., with low energy and nutrient density), and as a result, multiple nutrient deficiencies are common. Young children are also very susceptible to infections because their immune systems are both developmentally immature and compromised by poor nutrition. In poor countries, foods and liquids are often contaminated and are thus key sources of frequent infections that both reduce appetite and increase metabolic demands. Furthermore, in many societies, suboptimal traditional remedies for childhood infections, including withholding of foods and breast milk, are common. Thus infection and malnutrition reinforce each other. Improving the nutrition of infants and young children has effects at most points of the life cycle described above (except for reduced neonatal care and reduced costs of chronic diseases associated with LBW). While the prevalence of stunting is relatively high in South Asia and Sub-Saharan Africa, there is considerable stunting in other parts of the developing world including LAC. Tables 6 and 7 summarize the benefits and costs for two interventions to reduce stunting. The benefit/cost ratios range from 25.6 to 930.3 –with higher values for the “low” (5%) discount rate, the “high” DALY (\$ 5,000) and the intervention of breastfeeding promotion in hospitals.

Reducing the Prevalence of Iron, Iodine and Vitamin A Deficiencies: Deficiencies in iron, iodine, and Vitamin A all have both immediate and long-term consequences. Iodine deficiency adversely affects development of the central nervous system and individuals with an iodine deficiency have, on average, lower IQs. Approximately 2 billion people are affected by iodine deficiency including 285 million children aged 6 to 12 years. Adequate iron intake is also necessary for brain development. More than 40% of children age 0-4 years in developing countries suffer from anemia; further anemia in school-age children may also affect schooling whether or not there had been earlier impaired brain development. Vitamin A deficiencies, which are estimated to affect 140 million pre-school children, are associated with increased risk of infant and child mortality. Some of these micronutrient deficiencies are considerable in LAC. Lessening these micronutrient deficiencies has effects at most points of the life cycle noted above. Tables 6 and 7 summarize the benefits and costs for three such interventions. The benefit/cost ratios range

TABLE 6
OVERVIEW TABLE ON COSTS AND BENEFITS FOR SELECTED INTERVENTIONS GIVEN DISCOUNT RATES AND DALYS

Objectives/Interventions	DALY	Discount Rate			
		5%		10%	
		Benefit	Cost	Benefit	Cost
1. Reducing LBW for pregnancies with high probabilities LBW	\$ 1,000	\$ 13,135	\$ 1,100	\$ 2,766	\$ 1,100
1a. Treatments for women with asymptomatic bacterial infections	\$ 5,000	\$ 45,062	\$ 1,100	\$ 7,460	\$ 1,100
1b. Treatment for women with presumptive STD	\$ 1,000	\$ 13,135	\$ 276	\$ 2,766	\$ 276
1c. Drugs for pregnant women with poor obstetric history	\$ 5,000	\$ 45,062	\$ 154	\$ 2,766	\$ 154
2. Improving infant and child nutrition in populations with high prevalence of child malnutrition (fairly widespread in poor populations in developing countries)	\$ 1,000	\$ 142,219	\$ 599	\$ 26,542	\$ 599
2a. Breastfeeding promotion in hospitals in which norm was promotion of infant formula	\$ 5,000	\$ 556,814	\$ 599	\$ 89,484	\$ 599
2b. Integrated child care programs (adding improved home child care practices)	\$ 1,000	\$ 2,839	\$ 40	\$ 1,024	\$ 40
3. Reducing micro nutrient deficiencies in populations in which they are prevalent	\$ 5,000	\$ 2,839	\$ 40	\$ 1,024	\$ 40
3a. Iodine (per woman of child bearing age)	\$ 1,000	\$ 12,244	\$ 3	\$ 2,304	\$ 3
3b Vitamin A (pre child under six years)	\$ 5,000	\$ 40,607	\$ 3	\$ 5,147	\$ 3
3c. Iron (pregnant women and then over life cycle of children)	\$ 1,000	\$ 520	\$ 6	\$ 257	\$ 6
	\$ 5,000	\$ 2,377	\$ 6	\$ 1,221	\$ 6
	\$ 1,000	\$ 14,831	\$ 16	\$ 3,261	\$ 14
	\$ 5,000	\$ 46,758	\$ 16	\$ 7,955	\$ 14

Benefits are calculated as described in Behrman, Alderman and Hoddinott (2004), but with the discount rates and DALYs indicated at the column head of this table and with the survival probabilities implied by life tables from India. Costs are mid-points of costs from Behrman, Alderman and Hoddinott (2004, Table 6). For iron the costs are the mid-point for pregnant women initially with the per capital costs in subsequent years.

TABLE 7
OVERVIEW TABLE FOR BENEFIT/COST RATIOS

Discount Rate	5%			10%		
	DALY	\$ 1,000	\$ 5,000	\$ 1,000	\$ 5,000	\$ 5,000
1. Reducing LBW for pregnancies with high probabilities LBW						
1a. Treatments for women with asymptomatic bacterial infections		11.9	41.0	2.5		6.8
1b. Treatment for women with presumptive STD		47.6	163.3	10.0		27.0
1c. Drugs for pregnant women with poor obstetric history		85.3	292.6	18.0		48.4
2. Improving infant and child nutrition in populations with high prevalence of child malnutrition (fairly widespread in poor populations in developing countries)						
2a. Breastfeeding promotion in hospitals in which norm was promotion of infant formula		237.6	930.3	44.3		149.5
2b. Integrated child care programs (adding improved home child care practices)		71.0	71.0	25.6		25.6
3. Reducing micro nutrient deficiencies in populations in which they are prevalent						
3a. Iodine (per woman of child bearing age)		4,664.5	15,469.3	877.6		1,960.8
3b Vitamin A (pre child under six years)		94.6	432.1	46.8		222.0
3c. Iron (pregnant women and then over life cycle of children)		903.3	2,847.8	229.8		560.6

from 46.8 to 15,469 –with higher values for the “low” (5%) discount rate, the “high” DALY (\$ 5,000) and for the provision of iodine.

1.3. Summary of Benefit/Cost Estimates for Human Capital Interventions in LAC

To my knowledge, there are but a limited number of benefit/cost estimates for human capital interventions in LAC or even more broadly in the developing world, and a number of the estimates that do exist have problems with interpretation because, for example, the definition of benefits used is very limited or confounding resource costs with transfers or other estimation problems. The selected survey of benefit/cost estimates in this section includes studies that probably are better than most others in regard to the many estimation issues, but still have their flaws, as noted. And they appear quite sensitive to some critical assumptions, particularly regarding the appropriate discount rate and the value of averting mortality (or increasing the number of healthy years of life). In a number of cases for the nutritional interventions, moreover, the benefit/cost ratios are so high as to strain credibility. If benefit/cost ratios are anywhere near this high, how is it possible that such opportunities have been bypassed? Part of the answer to this question may relate to the underlying estimates of impacts and costs (e.g., is scaling-up really captured adequately?) or to, particularly in the general LAC context and probably even more so for Chile in particular, there being only relatively small and dispersed groups for which the deficiencies exist for which the returns are high. Nevertheless, despite all their warts and flaws, the benefit/cost ratios reviewed suggest that even if these estimates might be high, there are likely to be some attractive human capital-related interventions in LAC more generally and in Chile in particular.

2. SCHOOLING ATTAINMENT AND EARNINGS DISTRIBUTION IN THE 2004 CHILEAN SOCIAL PROTECTION SURVEY

Given the qualified, but nevertheless definitely positive assessment of a number of human capital-related interventions from the selected review in Section 1, it is of interest in the context of this volume to ask what would be the impact on the income distribution were there have been some targeted increases in human capital. The review in Section 1 would seem to suggest that some of these effects might be considerable. Therefore I explore this question in this section by simulating impacts of hypothetical changes in schooling attainment in Chile. I focus on schooling attainment because it is the most-emphasized among human capital investments –indeed many studies empirically seem to equate schooling attainment with human capital. I focus on Chile not only because it is the focus of this volume and but also because I am involved, with some other colleagues in collection and analysis of the Chilean Social Protection Survey (SPS) that is described in more detail in Appendix A. The purpose of this exercise, however, is not so much to describe real-world policy options for Chile, but to use the SPS to generate some illustrative simulations about the impact of changed human capital distributions on the earnings distributions –and to calculate suggestive orders of magnitude of the effects.

Basic description of inequality and “poverty” in the 2004 Chilean SPS: Table 8 summarizes some relevant sample-weighted statistics from the 2004 SPS regarding the distribution of schooling attainment, labor market earnings, and wage rates per hour for the 51,244 adults age 21 years or older for whom this information all is available. As is well-known, average schooling attainment levels in Chile are relatively high in comparison with many developing countries, including a number of others in LAC. These estimates suggest that the distribution of schooling attainment also is relatively equal, with a Gini coefficient of 0.23, in comparison numbers reported for other countries in LAC (Table 1)²². Almost a fifth of the sample (18%) had schooling attainment below six grades, and about three tenths had schooling attainment below eight grades.

TABLE 8
CHILEAN 2004 SPS, BASIC STATISTICS FOR SCHOOLING, EARNINGS AND WAGE RATES FOR 51,244 ADULTS AGE 21+ YEARS*

	Mean SD	Gini Coefficient SE	Poverty Headcount	
			Low SE	Higher SE
Schooling Attainment	9.5	0.23	0.18	0.30
(Grades)	4.3	0.001	0.002	0.002
Earnings	2149	0.53	0.20	0.36
(1000 Pesos per year)	3195	0.003	0.002	0.002
Wage Rate	1193	0.49	0.17	0.33
(Pesos per hour)	1751	0.004	0.002	0.002

* The “low” and “higher” poverty lines for schooling are < 6 and < 8 grades, for earnings < 500000 and < 1000000 pesos per year, and for wages < 400 and < 600 pesos per hour. The standard errors for the Gini coefficients are calculated by bootstrapping with 50 repetitions. All estimates are weighted to reflect the sample design.

The 2004 SPS earnings Gini coefficient is 0.53, significantly below the value for Chile given in Table 1 for around 2000 and at about the mean for LAC in that table. The 2004 wage rate Gini coefficient is somewhat lower at 0.49, suggesting that some of the inequality in actual earnings income is due to choices of those who have higher market wage rates to spend more time working. Therefore the Gini coefficient for the wage rate or, equivalently, for full income, is somewhat lower. For both earnings and the wage rate I define “low” and “higher” “poverty” cutoffs. These are *not* related to any official or unofficial efforts to define poverty consumption baskets in any meaningful way, for which reason I put “poverty” in quotation marks here. They are just convenient benchmarks at rounded values of pesos per year and per hour, respectively, that demarcate the points below which in the 2004 SPS distribution there are about a fifth (0.20 for earnings,

²² Including the Gini coefficient reported for Chile in 2000 in Table 1. I do not have an explanation for the difference.

0.17 for the wage rate) and about a third (0.36 for earnings, 0.33 for the wage rate) of the individuals with positive earnings and wage rates.

Semilog earnings and wage rate functions based on the 2004 SPS: To be able to simulate how different hypothetical patterns of schooling attainment would affect the earnings and wage rate distributions, I need estimates of these relations. Of course there is considerable controversy about how best to estimate these relations and to what extent and in what direction OLS estimates are biased (e.g., Card 1999, Behrman and Rosenzweig 1999). For the illustrative purposes here, I nevertheless use OLS estimates, with splines in schooling to allow for nonlinearities with differential returns to the first six grades (“primary”) versus the second six grades (“secondary”) versus more than 12 grades (“tertiary”). I also include a quadratic in potential work experience (age-schooling attainment – six) and allow for all the coefficient estimates to differ between males and females.

Table 9 summarizes the resulting estimates. The first two rows of coefficient estimates refer to the semilog earnings function and the second two rows refer to the semilog wage rate function, with *t* values in italics beneath each point estimate. Within each pair of rows, the first row gives the estimates for females and the second row gives the extent to which the point estimate for males differs significantly (at the 5% level) if it does.

TABLE 9
WEIGHTED SEMI-LOG EARNINGS AND WAGE FUNCTIONS FOR 51,244 ADULTS
AGE 21+ IN 2004 CHILEAN SPS*

	Spline in Schooling			Pot Experience		Const	R sq
	Prim	Sec	Ter	Level	Square		F
ln Earnings	0.040	0.102	0.235	0.040	-0.00048	12.412	0.201
	<i>5.31</i>	<i>22.90</i>	<i>36.69</i>	<i>28.79</i>	<i>-22.50</i>	<i>286.00</i>	1009
xMale	0.036	0.015	-0.038			0.169	
	<i>4.16</i>	<i>2.84</i>	<i>-4.20</i>			<i>4.05</i>	
ln Wage	0.039	0.104	0.227	0.022	-0.00030	5.481	0.339
	<i>9.06</i>	<i>49.16</i>	<i>77.89</i>	<i>21.37</i>	<i>-16.44</i>	<i>220.08</i>	2810
xMale	0.041						
	<i>30.42</i>						

* *t*-statistics in italics beneath coefficient estimates; potential experience is age – schooling attainment – 6; the row with “xMale” includes all significant coefficients for the interaction between “male” and the right-side variable in that column.

Overall the semilog earnings function is consistent with about a fifth of the sample variance and the semilog wage rate function is consistent with about a third of the sample variance. That means, of course, that there are considerable

shares of the variance that are not affected by schooling attainment –four-fifths for ln earnings and two-thirds for ln wage rates. The quadratics in experience are highly significant, and suggest an increasing impact at a diminishing rate of experience with no significant differences between females and males. The schooling coefficient estimates also are highly significant and also suggest strong nonlinearities, with much larger effects for an additional grade of tertiary school attainment than for an additional grade of secondary school attainment and a much larger effect for an additional grade of secondary school attainment than for an additional grade of primary school attainment. Males have an estimated 16.9% greater earnings independent of schooling attainment and potential experience, and have significantly higher schooling coefficients for both primary and secondary schooling, though females have a significantly higher coefficient for tertiary schooling in the ln earnings function. However, except for the higher coefficient for males for primary schooling, the gender differences in the ln earnings function estimates basically reflect gender differences in hours worked in the paid labor force. Therefore, with the exception again of primary schooling, there are no significant gender differences in the ln wage rate function.

Simulations of the impact of alternative targeted schooling attainment increases on inequality and poverty: Table 10 summarizes eight simulations of the impact of alternative targeted changes in schooling attainment on Gini coefficients for inequality and the low and higher poverty cutoff headcounts for earnings and for wage rates. These simulations assume that the semilog earnings and wage rate relations in Table 9 hold. That is, they assume that the coefficient estimates are unbiased estimates of the true causal effects of schooling attainment on ln earnings and ln wages²³, that none of the simulation interventions is so large to change the relevant coefficients, and that each individual receives the same shock (i.e., has the same residual) as in the estimates in Table 9²⁴. The Gini coefficients and the poverty headcount measures are in bold, with the standard errors to the right in italics. Note that the standard errors generally are small relative to the simulated changes, so the simulated changes generally are significant.

At the top of Table 10 the Gini coefficient estimates and poverty headcounts for the base data are given, as in Table 8, for easy reference. The question of interest is how much do each of the alternative simulations differ from these base values. The eight simulations that are included in the table are:

²³ That is, that there are not omitted variable biases because these estimates do not control for unobserved ability and other aspects of family background and for school quality, though some available estimates suggest that the failure to control for such factors may result in substantial overestimates of the impact of schooling attainment because schooling attainment partially is proxying for individual and family background and school quality (e.g., Behrman and Birdsall (1983), Behrman and Rosenzweig (1999)). An alternative interpretation of the simulations with regard to school quality is that the underlying assumption is that school quality is positive correlated with schooling attainment (as suggested by the modeling and the empirical results in Behrman and Birdsall (1983)) and that in the simulations schooling quality is being increased together with schooling attainment in order to maintain the association between the two that exists in the sample data.

²⁴ From one cross-section one can not identify whether these are transitory or permanent shocks.

1. Increasing schooling attainment by one grade for all individuals whose wage rate is below 400 Pesos per hour in the SPS.
2. Increasing schooling attainment by three grades for all individuals whose wage rate is below 400 Pesos per hour in the SPS.
3. Increasing schooling attainment by five grades for all individuals whose wage rate is below 400 Pesos per hour in the SPS.
4. Increasing schooling attainment by three grades for all individuals whose wage rate is below 600 Pesos per hour in the SPS.
5. Increasing schooling attainment by three grades for all individuals whose schooling attainment is equal to or below six grades in the SPS.
6. Increasing schooling attainment by three grades for all individuals whose schooling attainment is equal to or below nine grades in the SPS.
7. Increasing schooling attainment to six grades for all individuals whose schooling is below six grades in the SPS.
8. Increasing schooling attainment to nine grades for all individuals whose schooling is below nine grades in the SPS.

The first four simulations each have increases in schooling attainment for individuals who are low in the wage rate distribution. The second set of four simulations each have increases in schooling attainment for individuals low in the schooling distribution.

Of course these eight simulations differ, perhaps substantially, with regard to the resource costs of the changes in schooling attainment that are considered. This is indicated by the column in Table 10 titled “Added School Grades” which gives the number of added school grades per 100 representative people that would be required for each simulation. In simulation 1, for example, the 17% of the population with wage rates below 400 pesos per hour are given one more grade of school, so 17 added school grades are needed per 100 people – and in simulation 2 since the same individuals are given three more school grades each, 51 added school grades are needed per 100 people. Under the assumption that the cost per added grade of school attained is the same for all grades of primary and secondary school for all people whatever their actual schooling and that the inequality and poverty measures also are approximately linear over small ranges, the changes in Gini coefficients and in poverty headcounts can be standardized by the added school grades to obtain the changes in Gini coefficients and in poverty headcounts across the eight simulations (each in comparison with the baseline) relative to the same costs in terms of schooling attainment. Table 11 presents these estimates, which are more informative than are those in Table 10 because of the control for costs across alternatives.

Some observations that come out of this exercise include:

Schooling inequality: With the exception of simulation 1, these simulations reduce the Gini coefficient for schooling. These reductions are much larger (about twice as large) for the simulations targeted towards those with low schooling (i.e., simulations 5-8) rather than those targeted to those with low wage rates (i.e.,

TABLE 10
SIMULATIONS OF IMPACTS OF CHANGED SCHOOLING DISTRIBUTION ON INEQUALITY AND POVERTY BASED ON 2004
CHILEAN SOCIAL PROTECTION SURVEY*

Simulation		Added School Grades	Gini Coefficient		Poverty Headcount			
Schooling Change	Target Pop		Level	SE	"Low" Cutoff	"Higher" Cutoff		
Base			0.23	0.001	0.18	0.002	0.30	0.002
			0.53	0.003	0.20	0.002	0.36	0.002
			0.49	0.003	0.17	0.002	0.33	0.002
1	Wage <400	17	0.24	0.001	0.17	0.002	0.29	0.002
			0.53	0.003	0.19	0.002	0.34	0.002
			0.48	0.004	0.15	0.002	0.33	0.330
2	Wage <400	51	0.22	0.001	0.14	0.002	0.26	0.002
			0.51	0.003	0.18	0.002	0.32	0.002
			0.47	0.004	0.11	0.001	0.32	0.002
3	Wage <400	85	0.21	0.001	0.13	0.002	0.23	0.002
			0.50	0.003	0.16	0.002	0.30	0.002
			0.46	0.004	0.08	0.001	0.29	0.002
4	wage <600	100	0.21	0.001	0.11	0.001	0.22	0.002
			0.50	0.003	0.17	0.002	0.30	0.002
			0.45	0.004	0.11	0.001	0.20	0.002
5	sch <=6	81	0.18	0.001	0.06	0.001	0.18	0.002
			0.52	0.003	0.18	0.002	0.33	0.002
			0.48	0.003	0.15	0.002	0.30	0.002
6	sch <=9	141	0.16	0.001	0.06	0.001	0.15	0.002
			0.51	0.003	0.17	0.002	0.31	0.002
			0.47	0.004	0.13	0.002	0.26	0.002
7	sch < 6	56	0.19	0.000	0.00	0.000	0.30	0.002
			0.52	0.003	0.19	0.002	0.34	0.002
			0.48	0.003	0.16	0.002	0.32	0.002
8	sch < 9	212	0.12	0.001	0.00	0.000	0.00	0.000
			0.50	0.003	0.16	0.002	0.30	0.002
			0.46	0.005	0.12	0.002	0.26	0.002

* Based on the estimates in Table 9. The "low" and "higher" poverty lines for schooling are <6 and <8 grades, for earnings < 500000 and < 1000000 pesos per year, and for wages < 400 and < 600 pesos per hour. Standard errors are to the right of the estimates in italics. The standard errors for the Gini coefficients are calculated by bootstrapping with 50 repetitions. All estimates are weighted to reflect the sample design. "Added school grades" is the added school grades per 100 representative people required by the simulation.

TABLE 11
SIMULATIONS OF IMPACTS OF CHANGED SCHOOLING DISTRIBUTION ON
INEQUALITY AND POVERTY HEADCOUNT MEASURES, NORMALIZED BY
REQUIRED SCHOOL GRADE INCREASES, BASED ON 2004 CHILEAN SPS*

Simulation				Gini	Poverty Headcount	
Schooling Change	Target Pop			Coefficient	“Low”	“Higher”
1	1 grade	wage <400	Schooling	0.01	-0.07	-0.04
			Earnings	-0.03	-0.08	-0.07
			Wage Rates	-0.03	-0.11	0.00
2	3 grades	wage <400	Schooling	-0.03	-0.08	-0.09
			Earnings	-0.03	-0.05	-0.06
			Wage Rates	-0.03	-0.12	-0.02
3	5 grades	wage <400	Schooling	-0.03	-0.07	-0.09
			Earnings	-0.03	-0.05	-0.07
			Wage Rates	-0.04	-0.11	-0.06
4	3 grades	wage <600	Schooling	-0.03	-0.07	-0.08
			Earnings	-0.03	-0.03	-0.06
			Wage Rates	-0.04	-0.06	-0.14
5	3 grades	sch <=6	Schooling	-0.07	-0.15	-0.15
			Earnings	-0.01	-0.02	-0.03
			Wage Rates	-0.01	-0.03	-0.04
6	3 grades	sch <=9	Schooling	-0.06	-0.09	-0.11
			Earnings	-0.02	-0.02	-0.04
			Wage Rates	-0.02	-0.03	-0.05
7	to 6 grades	sch < 6	Schooling	-0.08	-0.33	0.00
			Earnings	-0.01	-0.02	-0.03
			Wage Rates	-0.02	-0.03	-0.03
8	to 9 grades	sch < 9	Schooling	-0.06	-0.09	-0.14
			Earnings	-0.01	-0.02	-0.03
			Wage Rates	-0.01	-0.02	-0.03

* Based on the estimates in Table 10, normalized by the required additional grades of schooling for each simulation that are given in that table. The “low” and “higher” poverty lines for schooling are < 6 and < 8 grades, for earnings < 500000 and < 1000000 pesos per year, and for wages < 400 and < 600 pesos per hour.

simulations 1-4). This pattern emphasizes the point that while schooling attainment and wage rates (and earnings) are positively correlated, the correlations are far from one²⁵. The normalized changes in the Gini coefficients for schooling are from 0.01 to -0.03 for the four simulations with low wage rates targeted and are from -0.06 to -0.08 for the four simulations with low schooling targeted. The largest simulated decline of -0.08 is for bringing all with less than six grades of completed schooling up to six grades of schooling attainment. In order to reduce schooling inequality, hardly surprisingly, the most effective policy is to focus on those in the left-hand part of the schooling distribution²⁶.

²⁵ The correlations are 0.36 between schooling attainment and either the wage rate or earnings. The correlation between the wage rate and earnings is 0.80.

²⁶ If the cost per added schooling grade attainment increases with schooling levels (e.g., is higher for secondary than for primary school), then the relative advantage in terms of reducing schooling inequality of focusing on the left-hand tail of the schooling distribution is even greater than indicated by these simulations.

Schooling “poverty” headcounts: The same general point holds, also not surprisingly, for the schooling poverty headcounts. For the simulations targeted towards those with low wage rates, the proportion of the population below the “low” cutoff of six grades of attained school drop by -0.07 or -0.08 and the proportion below the “higher” cutoff of eight grades drops by from -0.04 to -0.09 . For the simulations targeted towards those with low schooling attainment, the proportion of the population below the “low” cutoff of six grades of attained school drop by -0.09 to -0.33 ²⁷ and the proportion below the “higher” cutoff of eight grades drops by from 0.00 to -0.15 . Notice, however, that there is a nuance. Policies targeted toward increasing schooling only below the “low” cutoff (e.g., simulation 7) reduce the proportion below the “high” cutoff less (by 0.0 in this case) than policies directed towards increasing the schooling attainment of those with low wage rates (simulations 1-4).

Earnings inequality: All of these simulations reduce the Gini coefficient for earnings. These reductions are much larger (from 1.5 to three times as large) for the simulations targeted towards those with low wage rates (i.e., simulations 1-4) rather than those targeted to those with low schooling attainment (i.e., simulations 5-8). This pattern again reinforces the point that while schooling attainment and wage rates (and earnings) are positively correlated, the correlations are far from one. The normalized changes in the Gini coefficients for earnings are -0.03 for the four simulations with low wage rates targeted and are -0.01 to -0.02 for the four simulations with low schooling targeted. If the goal were only to reduce earnings inequality, thus, it would be desirable to target effectively those with low wage rates²⁸ but in terms of this criterion alone it does not matter which of the four alternatives considered with low wage rate targeting (simulations 1-4) is used (though it does matter for other possible objectives such as lowering those below poverty cutoffs). Of course how to target those with low wage rates for interventions to increase schooling attainment is a trickier question than how to target those with low schooling given the concentration of schooling in childhood and youth and that wage outcomes are revealed only later in the life cycle.

Earnings “poverty” headcounts: The same general point again holds, not surprisingly, for the earnings poverty headcounts. For the simulations targeted towards those with low wage rates, the proportion of the population below the “low” cutoff of 500000 pesos per year drop by from -0.03 to -0.08 and the proportion below the “higher” cutoff of 1000000 pesos per year drops by from -0.06 to -0.07 . For the simulations targeted towards those with low schooling attainment, the proportion of the population below the “low” cutoff of 500000

²⁷ That this drop is greater than the 0.18 in the base simulation is because of the normalization. Obviously this policy could be pursued only to the point at which the proportion below the cutoff became 0 .

²⁸ To keep the number of simulations discussed to a reasonable limit, I do not present simulations that target low earnings; these are somewhat more effective than targeting low wage rate recipients in reducing earnings inequality, but the difference is not as great as between targeting low wage recipients versus those with low schooling (given the much higher correlation between earnings and wage rates noted above than between either and schooling attainment).

pesos per year drop by -0.02 and the proportion below the “higher” cutoff of 1000000 pesos per year drops by from -0.03 to -0.04 . Though all four of the simulations directed towards low wage rate recipients have the same impact on reducing the earnings Gini coefficient, they differ a fair amount with respect to their impacts on the proportions below the poverty cutoffs. In particular increasing schooling attainment by one grade for all those with wage rates below 400 Pesos per hour is simulated to reduce the normalized proportion below the “low” poverty cutoff of 500000 pesos per year by -0.08 (simulation 1), while at the other extreme among the first four simulations, increasing schooling attainment by three grades for all those with wage rates below 600 pesos per hour is simulated to reduce the normalized proportion below the same “low” poverty cutoff by only -0.03 (simulation 4). This is an interesting illustration of why it is important not to presume that reducing inequality and reducing poverty are sufficiently similar objectives that they lead to the same policy priorities.

Wage rate inequality: All of these simulations reduce the Gini coefficients for wage rates at least as much or slightly more (i.e., by an additional -0.01 in three of the eight simulations) than for earnings. That the simulations, if anything, are slightly more effective for reducing wage rate than earnings inequalities reflects that the simulations presented are targeted towards low wage rates rather than low earnings but that the differences are not all that great reflects the relatively high correlation between earnings and wage rates. As for earnings, these reductions are much larger (from 1.5 to four times as large) for the simulations targeted towards those with low wage rates (i.e., simulations 1-4) rather than those targeted to those with low schooling attainment (i.e., simulations 5-8). The normalized changes in the Gini coefficients for wage rates are -0.03 to -0.04 for the four simulations with low wage rates targeted and are -0.01 to -0.02 for the four simulations with low schooling targeted. If the goal were only to reduce wage rate or full income inequality, thus, it would be desirable to target effectively those with low wage rates. The question of how to target those with low wage rates for interventions to increase schooling attainment, of course, remains a challenge given life-cycle schooling-earnings sequencing patterns.

Wage rate “poverty” headcounts: The same general point again holds, again not surprisingly, for the wage rate poverty headcounts. For the simulations targeted towards those with low wage rates, the proportion of the population below the “low” cutoff of 400 pesos per hour drop by -0.06 to -0.12 and the proportion below the “higher” cutoff of 600 pesos per hour drops by from -0.00 to -0.14 . For the simulations targeted towards those with low schooling attainment, the proportion of the population below the “low” cutoff of 400 pesos per hour drop by -0.02 to -0.03 and the proportion below the “higher” cutoff of 1000000 pesos per year drops by from -0.03 to -0.05 . Though all four of the simulations directed towards low wage rate recipients have about the same impact on reducing the wage rate Gini coefficient, they differ a fair amount with respect to their impacts on the proportions below the poverty cutoffs. In particular increasing schooling attainment alone for those with wage rates below 400 pesos per hour is simulated to reduce the normalized proportion below the “low” poverty cutoff of 400 pesos per hour by -0.11 or -0.12 (simulations 1-3), while increasing schooling attainment by three grades for all those with wage rates below 600 pesos per

hour is simulated to reduce the normalized proportion below the same “low” poverty cutoff by only about half as much at -0.06 (simulation 4). On the other hand the latter simulation is much more effective at reducing the proportion below the “higher” poverty cutoff of 600 pesos per hour (by -0.14) than the first three simulations (from 0.00 to -0.06). This is an interesting illustration of how sensitive policy effectiveness rankings might be to which part of the lower end of the wage rate distribution is of interest²⁹.

3. CONCLUSIONS

Human resource investments targeted towards the lower part of wage rate, earnings or income distributions are often thought to be major means through which the persistent high LAC inequalities in general, including those in Chile, might effectively be addressed, with concomitant effects of reducing poverty.

Previous and new benefit/cost estimates for a range of human resource investments pertaining to different aspects of education and health/nutrition, though subject to a number of caveats because of the problems in making such estimates and their sensitivity to alternative assumptions such as regarding discount rates and the value of averting mortality, suggest that there are likely to be a number of high rate-of-return options for such investments in LAC. These include different dimensions of education, including pre- and post-school experiences and not just schooling, and a number of possibly higher rate-of-return interventions in health/nutrition. These estimates suggest that there are opportunities that LAC governments should evaluate in their own particular contexts, including the extent of the subpopulations for which deficits are important and the nature of delivery mechanisms. This is likely to lead to some high rate-of-return options for human resource interventions.

Will such human resource interventions, if well-targeted, reduce substantially inequality in the and poverty region? To partially explore this question, the Chilean 2004 SPS data are used to examine the impact of schooling attainment, the most emphasized human capital investment (and one through which in important part other interventions such as those related to early childhood health and nutrition may work), using wage rate and earnings functions that probably are optimistic about the impact of schooling (because they ignore such factors as ability bias and market-level effects). Alternative simulations suggest significant impacts of well-targeted increases in schooling attainment on reducing inequality and poverty headcounts in schooling, earnings, and wage rates. They also illustrate the desirability of targeting directly towards the outcome of interest (e.g., towards those with low wage rates, not low schooling, if full income is of primary concern) despite the possible difficulties in doing so (since wage experiences typically are not revealed until after most people have

²⁹ This point is closely related, of course, to the question of what poverty measure to use – i.e., headcount versus poverty gap versus poverty depth measures within the Foster, Greer and Thorbecke (1984) measures. For simplicity in this paper I present only the headcount measures, though as part of the analysis for the paper all three of the measures have been simulated.

finished their schooling), the possible complementarities and tradeoffs between reducing inequality and reducing poverty, that policies with the same impact on inequality may have very different effects on poverty, and that the poverty impact may depend importantly on what part of the lower end of distributions is of interest. But, though the magnitudes of some of the simulated impacts on the poverty headcounts are fairly large, the magnitudes of the reductions in the Gini coefficient estimates for earnings and for wage rates are not very large even though the simulated changes in schooling attainment are considerable. Of course the benefit/cost ratios suggest that some other human capital interventions may have higher rates of return than increasing schooling attainment, and this may carryover to greater impacts on inequality and on poverty. But all in all it would seem that these simulations suggest that while there is significant scope for reducing inequality and probably somewhat more poverty through human capital interventions, expectations should not be for massive changes through these mechanisms alone unless there really are massive improvements in the human capital of the poorer members of society.

APPENDIX A

THE CHILEAN SOCIAL PROTECTION SURVEY

In 2002, the Microdata Center of the Department of Economics of the Universidad de Chile under the Directorship of David Bravo conducted a new household survey (2002 EPS, *Encuesta de Protección Social*, or Social Protection Survey). This is a very valuable research asset providing researchers a host of useful new individual-level information for addressing numerous research questions – information that previously was unavailable³⁰. The interview sample was drawn from a sampling frame of approximately 8.1 million current and former affiliates of the Chilean old-age systems compiled from official databases obtained from the Chilean Ministry of Labor and Social Security; the frame included about three-quarters of the population age 15+ in 2001. The survey was fielded between April and December of 2002, collecting data from individuals who were working, unemployed, out of the labor force, receiving pensions, or deceased (in the latter case, information was collected from surviving relatives).

The 2002 EPS survey included socio-demographic information and current labor market data for each member of the household, detailed information about receipt of pensions and types of pension plan participation and retrospective labor market history going back to 1980. The 2002 survey contains data on 17,246 respondents (937 of them were reports by surviving relatives) affiliated with

³⁰ The 2002 survey was initially called the 2002 History of Labor and Social Security (HLSS, *Historia Laboral y Seguridad Social*) survey. But the follow-up 2004, 2006 and 2009 longitudinal surveys are called Social Protection Surveys (SPS, *Encuesta de Protección Social*). The interested reader is referred to <http://www.proteccionsocial.cl> for access to the public use data, codebooks, and documentation of the survey.

the old or the new retirement system for at least one month at any time during the 1981-2001 time span³¹.

Another round of the survey was administered in 2004, which included a second wave for previously surveyed respondents, plus new surveys for a subsample of individuals not affiliated with the social security system (individuals never employed in the formal sector) and also a subsample of new entrants into the AFP system between 2002 and 2004. In addition a host of new health and wealth questions were introduced for the first time³². Accordingly, the 2004 survey is representative of the entire Chilean population³³. Furthermore in 2004, the research project received permission to merge responses to the sampled respondents with administrative records on pension contributions and earnings in the PAYGO and AFP systems since 1980, data on the amounts of recognition bonds; and monthly data on account changes in the individual investment accounts, switches between AFPs, AFP commissions charged, and investment returns earned on all accounts in the AFP system. The survey data has also been merged with monthly Social Security records, available since 1981³⁴. The 2004 EPS was the last round available when this paper was written for the December 2006 workshop.

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³¹ Information on the methodology and extent of the survey can be found in Bravo (2004), Bravo *et al.* (2006) and Bravo *et al.* (2008). Members of the Armed Forces or police covered by separate government pension systems were excluded, as well as a very small percentage of the Chilean population residing in inaccessible or sparsely populated areas (e.g. islands).

³² A number of the questions were adapted from the United States' Health and Retirement Study (HRS) with the intention of providing cross-national comparisons.

³³ Weights are available to reweight to random sampling proportions.

³⁴ Additional rounds of the survey were administered in 2006 and 2009 and there are plans to undertake further rounds in the future (see www.proteccionsocial.cl).

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