



PERGAMON

Social Science & Medicine 48 (1999) 1599–1611

SOCIAL  
SCIENCE  
— & —  
MEDICINE

# Economic and health efficiency of education funding policy

T.R.C. Curtin<sup>a, 1</sup>, E.A.S. Nelson<sup>b,\*</sup>

<sup>a</sup>*Department of Treasury, Papua New Guinea*

<sup>b</sup>*Department of Paediatrics, The Chinese University of Hong Kong, Shatin, Hong Kong*

---

## Abstract

Public spending programmes to reduce poverty, expand primary education and improve the economic status of women are recommended priorities of aid agencies and are now gradually being reflected in third world governments' policies, in response to aid conditions imposed by the World Bank and OECD countries. However outcomes fall short of aspiration. This paper shows that donors' lending policies, especially those restricting public spending on education to the primary level, (1) perpetuate poverty, (2) minimise socio-economic impact of public health programmes and (3) prevent significant improvement in the economic status of women. These effects are the result of fundamental flaws in donors' education policy model.

Evidence is presented to show that health status in developing countries will be significantly enhanced by increasing the proportion of the population which has at least post-primary education. Heads of households with just primary education have much the same probability of experiencing poverty and high mortality of their children as those with no education at all.

Aid donors' policies, which require governments of developing countries to limit public funding of education to the primary level, have their roots in what is contended here to be an erroneous interpretation of human capital theory. This interpretation focuses only on the declining marginal internal rates of return on public investments in successive levels of schooling and ignores the opposite message of the increasing marginal net present values of those investments. Cars do not travel fastest in their lowest gear despite its fastest acceleration, life's long journey is not most comfortable for those with only primary schooling. © 1999 Elsevier Science Ltd. All rights reserved.

*Keywords:* Education policy; Health; Developing countries; World Bank

---

## Introduction

Formal education remains largely neglected by the medical research community and is dismissed as

'demographic' information unrelated to the pathogenesis of disease (Pincus and Callahan, 1994). Thus, doctors generally avoid becoming involved with the wider issues of social policy, despite the profound effects that such policy can have on health. Much social policy is driven by political interpretation of economic analyses and theory. Despite growing evidence that it is post-primary education, rather than primary schooling, that makes the larger impact on the health status of a population (Harrison, 1997), international aid agencies like the World Bank have accepted economists' theoretical arguments in favour of concentrating public investment in education at the

---

\* Corresponding author. Department of Paediatrics, 6th Floor Clinical Sciences Building, Prince of Wales Hospital, Shatin, Hong Kong. Tel.: +852-26-322-859; fax: +852-26-360-020.

*E-mail address:* tony-nelson@cuhk.edu.hk. (E.A.S. Nelson)

<sup>1</sup> Current address: 3 Magrath Place, Spence, Canberra, ACT 2615, Australia.

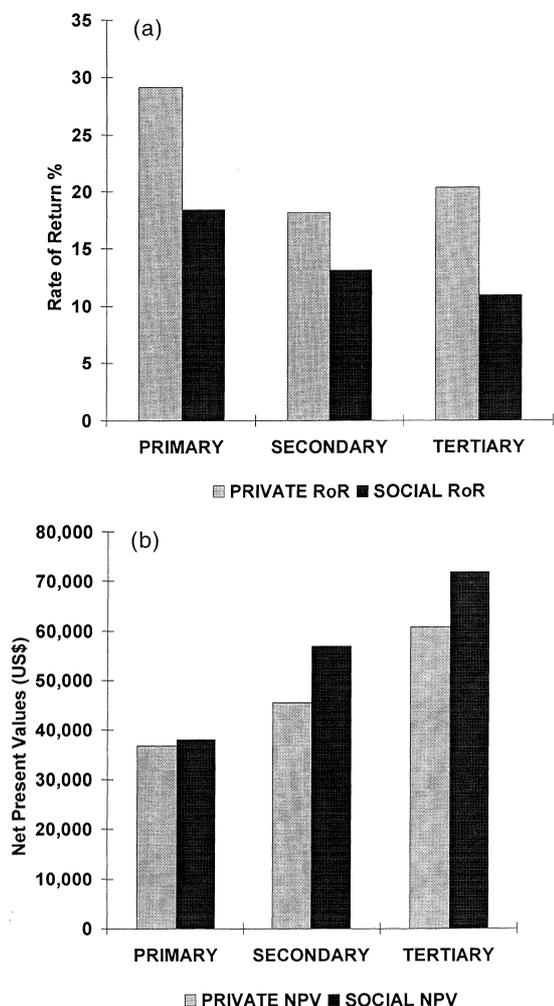


Fig. 1. (A) World-wide rates of return (RoR). (B) World-wide net present values (NPV). (A) reproduces Fig. 1 in Psacharopoulos (1994). Psacharopoulos sets out simple averages of the private and social RoR reported for various countries; using the RoR formula and assuming standardised US\$ costs per level of schooling, the earnings flows (in US\$) implied by the RoR can be derived and used to generate the net present values shown in (B). These estimates are derived from Psacharopoulos' RoR using equation Eq. (4) for an assumed 4% external discount rate. The private NPVs are net of taxes, with estimated marginal rates of tax on incremental earnings over earnings of those with previous level of schooling at primary 8%, secondary 28% and graduates 30%. Note 1: private costs reported by Psacharopoulos usually comprise only forgone earnings. Note 2: strictly speaking the average of rates of return reported in Psacharopoulos (1994) are meaningless, because a yield of 5% on US\$100 plus a yield of 10% on US\$1000 does not imply, as per Psacharopoulos, an average rate of 7.5% but rather 9.55% on US\$1100.

primary level (Psacharopoulos, 1994). The resulting misdirection of resources as a result of Structural

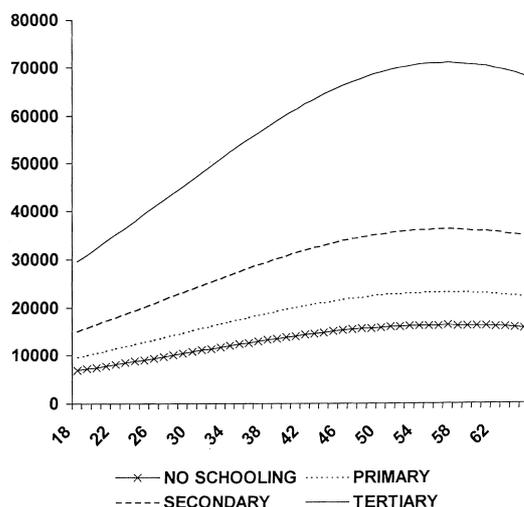


Fig. 2. Lifetime earnings profiles by highest level of attained schooling, Venezuela 1987 (Psacharopoulos and Alam, 1991).

Adjustment Programmes has often had significant negative impacts on education and health within the poorer sections of society (Logie and Woodroffe, 1993; Nelson, 1994; Wakhweya, 1995; Hsiao and Liu, 1996; United Nations Development Programme, 1996). These negative impacts flow directly from conditions imposed by the Structural Adjustment Programmes of the World Bank and International Monetary Fund. Although these conditions emphasise the importance of maintaining levels of public spending on social services, they also require that funding be reallocated from post-primary education to primary and from advanced health care to primary health care. That limits post-primary education to those who can afford to pay full-cost fees to private schools and colleges.

This study evaluates evidence from various sources, including the World Bank, to show that it is public investment in post-primary education which gives the largest pay-off per dollar spent. This is in terms both of the health status of developing countries and of the growth rates of their GNP. We suggest that this contradiction between third world experience and first world prescriptions is due to methodological errors in the World Bank's education policy model.

Bennell describes how the World Bank's education model derives its education priorities from the views of the Bank's most senior education economist, George Psacharopoulos (Bennell, 1996). Fig. 1(A) summarises Psacharopoulos' data on what are termed social rates of returns, i.e. additional pre-tax personal

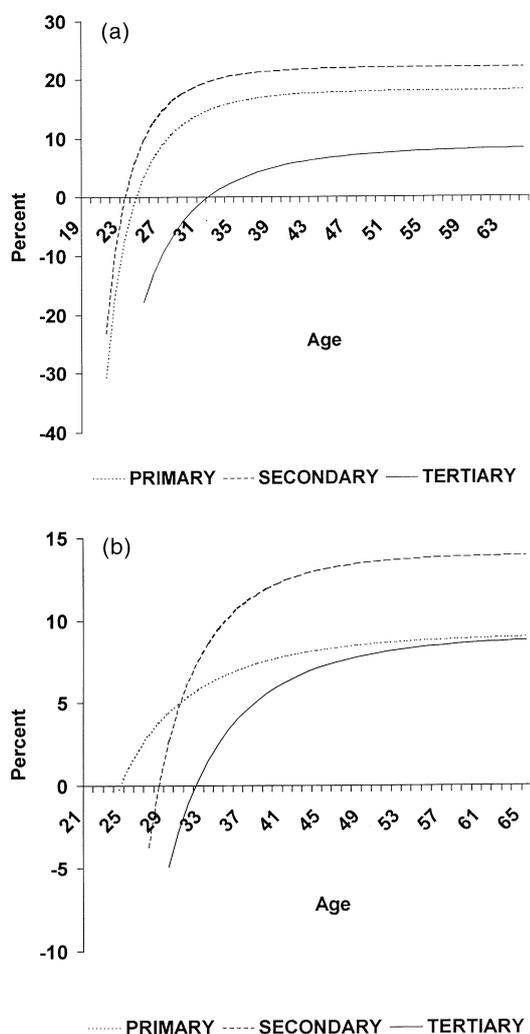


Fig. 3. (A) Marginal rates of return (from age 7 for all levels of schooling), Venezuela 1987 (Psacharopoulos and Alam, 1991). (B) Marginal internal rates of return (from ages of transition to next level of schooling), Venezuela 1987, adapted from Psacharopoulos and Alam (1991).

income associated with total public and private costs of each successive level of schooling (Psacharopoulos, 1994). These rates of return decline continuously

<sup>2</sup> However using the same earnings data (Psacharopoulos and Alam, 1991) but beginning the discounting process for the rates of return at the point of decision whether to allow students to proceed from primary to secondary and from secondary to tertiary, respectively, Fig. 3(B) shows that the actual (as opposed to reported) discounted marginal rates of return are higher for secondary than for primary schooling and barely higher for primary than for tertiary, another example of the selective reporting by Psacharopoulos described by Bennell (1996).

from the primary through the secondary to the tertiary levels. In contrast Psacharopoulos' data for Venezuela in 1987 (Psacharopoulos and Alam, 1991) in Fig. 2 show that average earnings progressively rise with each successive level of schooling. Fig. 3(A) shows the marginal net present values of the same extra lifetime incomes obtained by leavers from each level of schooling (provided gainfully employed), with the highest values for graduates despite having the lowest rate of return<sup>2</sup>. The differences between rates of return and net present values will be explained further in Section 3.

Although Bennell suggests that Psacharopoulos has under-reported rates of return for 15 out of 21 African countries (Psacharopoulos, 1994; Bennell, 1996), he does not query the validity of the rate of return methodology as a means of determining investment priorities in education. We attempt to resolve this contradiction between the predicted and actual outcomes of the World Bank's education priorities by showing how the rate of return methodology misleads, even if correctly reported. This is because users of the rate of return methodology fail to compute the net present values of the benefits of investment in schooling (the value produced over and above the initial cost of investment), despite the fact that net present values have long been known in general investment theory to be the only valid criterion for evaluating alternative investments (Fisher, 1930; Brealey and Myers, 1996).

We show that the net present value model, unlike the rate of return model, predicts the greater social impact of post-primary education on enhancing both incomes and health status. Evidence presented suggests that the social benefits from public health programmes are maximised when governments and donor agencies allocate additional resources to investment in all levels of education, not just the primary. In Section 2 of this paper we look at empirical outcomes of donors' education funding policy on poverty and health status in some East Asian countries. In Section 3, since this evidence suggests that the economic models on which donors base their education policies are misconceived, we propose the alternative net present value model which delivers results consistent with the evidence. Using this model to challenge aid donors' education priorities, health professionals can better advocate for the health needs of their patients.

## Education links to poverty and health

### *Education and poverty in East Asia*

The World Bank has recently sponsored household

Table 1

Poverty and education of household head, East Asia 1991–1996. ‘Vocational’ in Papua New Guinea denotes schooling equivalent to grades 7 and 8. Source: Ahuja (1997)

Education of household head	Contributions to total poverty (%)				
	Thailand (1992)	Philippines (1991)	Lao PDR (1992–1993)	Vietnam (1992–1993)	Papua New Guinea (1996)
No formal education	16.3	5.6	57.3	14.7	50.6
Primary	81.8	66.1	42.0	38.9	37.4
Grades 1–5		35.0			23.3
Grade 6		31.1			14.1
Secondary	1.7	24.3	48.9	45.4	4.9
Lower		12.3	33.8	34.7	
Upper		12.0	15.1	9.8	
Vocational	0.1	n.a.	n.a.	1.4	7.1
University	0.0	4.2	0.0	0.6	0.0

surveys in five East Asian and Pacific countries (Ahuja, 1997). The evidence from these surveys suggests that restriction of public funding for education in developing countries to only the primary level of schooling will achieve very little in terms of poverty reduction, improvements in health status of women and children and acceleration of economic growth. Table 1 summarises this study’s data and shows an inverse association between the education of heads of households and the level of household pov-

erty. Primary schooling is shown to reduce the incidence of poverty by around only 10% as compared with households whose heads have no formal education. In contrast hardly any household heads with some post-primary education are to be found amongst the poor.

For example, the Philippines has long had universal primary education so there are now few household heads with no education, but those with only primary schooling account for most (66%) of the poor. In Thailand, poverty is shown to be almost exclusively confined to those with either no or only primary education. In a study by Ahuja (1997) household heads with no schooling accounted for 16.3% of the poor and those with primary schooling only accounted for 81.85%. Only 1.8% of the poor had household heads with post-primary schooling. Those with just primary schooling accounted for 75% of the population, and for 79% of the poor in 1992 (Ahuja, 1997). A similar situation is seen in Papua New Guinea where about 90% of poor households had only primary schooling or none.

Regression analysis of the Papua New Guinea data used in this East Asia poverty study shows that in urban areas the highest positive probability (9.5%) of poverty was for those unemployed. Fig. 5 uses 1990 census data from Papua New Guinea to show that unemployment is highly correlated with having only primary schooling. Years of schooling had an inverse probability of predicting poverty, i.e. one year of extra schooling decreased the probability of poverty by 1.6%. A post-school degree or diploma added an even higher negative probability of 6.4% (Gibson, 1996).

Despite these correlations, neither the East Asia

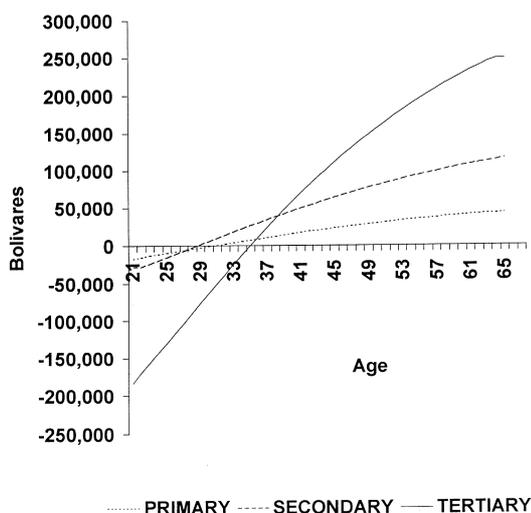


Fig. 4. Net present values at 4% discount rate of incremental earnings and schooling costs by level of schooling, Venezuela 1987. Implied but not reported by Psacharopoulos and Alam (1991).

Table 2

Comparative contributions of primary and secondary education enrolment rates in 1980 to literacy rates in 1993. Data is for 55 out of the 90 countries in the low and middle income groups. The other 35 countries did not have complete sets for these variables (World Bank, 1997, Table 7)

	Dependent variable: illiteracy rate	
	coefficients	t statistic
Intercept	92.17	21.41
Primary	-0.451	-6.25
Secondary	-0.521	-4.35
Adjusted $R^2$	0.77	
F	89.98	
Intercept	95.884	19.61
Primary	-0.666	-10.95
Adjusted $R^2$	0.692	
F	119.8	
Intercept	70.835	20.48
Secondary	-1.035	-9.01
Adjusted $R^2$	0.6	
F	81.19	

study's authors nor the foreword contributed by the World Bank draw the conclusion that primary schooling alone is manifestly not sufficient to enable poor households help themselves to escape poverty (Ahuja, 1997). Yet the study's demonstration that most of the poor in countries as different as the Philippines, Thailand and Papua New Guinea are primary school leavers must cast serious doubt on the World Bank education model's contention that public investment routinely yields higher social returns in primary than in secondary and tertiary education.

Although the health benefits of educating women are increasingly appreciated (Harrison, 1997), the economic, in the sense of pecuniary, benefits of educating women in developing countries may still seem doubtful. This is because lower labour force participation rates of women tend to result in lower rates of return and net present values than for men. However, in most developed countries increasing education of women has resulted in an increased percentage of women in the workforce. In the longer term a similar pattern might be expected to occur in developing countries. This is already apparent in Singapore, where the proportion of economically active women in the total labour force rose from 37% in 1986 to 42% in 1996,

whilst the proportion of women in the labour force with upper secondary education and above rose from 53 to 66%. Employment of women increased by 269,991 (59%) between 1986 and 1996 and no less than 87% of this increase was accounted for by women with completed secondary schooling and above (Ministry of Labour, 1997).

Literacy has often been identified as a necessary condition for improving women's health status and for this it is usually assumed that primary schooling is enough. However regression analysis of the World Bank's data on overall literacy in 1993 must question this (World Bank, 1997). Table 2 shows comparative contributions of primary and secondary education enrolment rates in 1980 to literacy rates in 1993. The analysis uses data for 55 poor and middle income countries and gives a high correlation coefficient ( $R^2=0.77$ ). However secondary education had a larger negative correlation coefficient (0.52) than primary (0.45). Simple correlation tests show primary alone does not fully explain observed literacy rates, whereas secondary does provide a complete explanation.

The World Bank's East Asian poverty study dealt only with poverty defined as household expenditures of US\$1 per capita per day in 1985 prices. Since the majority of those living in poverty so defined had either no or just primary schooling, it is evident that most of those heads of household with this level of schooling were not earning more than US\$5 per day (for a family of five). This should indicate that the high private rates of return for primary education reported for Thailand (56%), Papua New Guinea (36%) and the Philippines (18%) are not sufficient to secure even this minimal level of income of US\$5 a day (Psacharopoulos, 1994).

#### *Education and health in Papua New Guinea*

Associations of socioeconomic status with health were described more than 150 years ago (Pincus and Callahan, 1994). Hammer provides data showing female adult mortality rates by cause of death and income (Hammer, 1997). The rate for infectious diseases is more than three times higher for the lowest quartile by income (at 1.4) than for the richest quartile (0.4). For non-infectious diseases and injuries the rates are 25 and 50% lower for the richest quartile than for the poorest.

The same inverse relation between poverty and level of education shown for Papua New Guinea by the World Bank's East Asia poverty study is replicated for health indicators and level of education in that country's Demographic and Health Survey 1996 (DHS) (National Statistical Office, 1997). Papua New Guinea has low life expectancy and a high infant mortality

rate (IMR). The latest estimate for IMR is 69 per 1,000 births in the period 1992–1996 (National Statistical Office, 1997).

Neonatal mortality rate declines from 39.8 for those without any schooling and 40.5 for those mothers with 5 years of primary schooling to 26.9 for those with 6 years of primary and 24.6 for those with at least some secondary schooling (7 years and more). Corresponding post-neonatal mortality rates by level of schooling were 65.7, 27.1, 24.3 and 15.6 (National Statistical Office, 1997). The overall IMR for those mothers with just 5 years of primary schooling was 67.6 and for those with some secondary was 40.2. Unfortunately women with any post-primary schooling are a small minority (14.4% in 1996) of all women aged 15 and over (DHS, Provincial Summary, Table 6).

Underlying such data are the qualitative effects of more extended schooling. 26% of secondary schooled mothers who had births reported in the survey period were willing and able to obtain ante-natal care from a doctor. Corresponding figures for those with either no or only 5 years of primary schooling were 4.2 and 8.1% (National Statistical Office, 1997). Similarly 86% of mothers with secondary schooling secured tetanus toxoid injections during pregnancy, but less than 75% of mothers with no or only primary schooling did so.

Similar trends are apparent in the DHS data on awareness of and responses to the risks of AIDS amongst women in Papua New Guinea. 89% of those with some secondary schooling were aware of AIDS but only 66% or less of those with only primary or no schooling were. The former mostly derived their information from the radio, TV, and newspapers. 49% of those knowing about AIDS mentioned newspapers as a source of information. However only 1.4% of those with no schooling and 5.3% of those with 5 years of primary mentioned this source, small comfort for those believing that primary schooling and literacy are enough on their own to meet all practical needs of the modern world. The same trends apply to the responses to the risks of AIDS. For those with knowledge of AIDS, avoidance through condom use was recognised by 37.6% of women with secondary schooling but by 21% or less of those with only primary or no schooling. 76% of the former considered single partner as a means of avoidance, compared to only 57% of the latter (National Statistical Office, 1997).

There is a further contradiction between the World Bank's advocacy of slower population growth rates in developing countries on one hand and its priority for primary schooling on the other. In Papua New Guinea it is secondary schooling of women which has the most significant impact on both desired and actual total fer-

tility rates, at 3.3 and 3.8, respectively. Those with less education had both higher desired rates (3.8) and much higher actual rates of 5 or more (National Statistical Office, 1997).

The DHS data for Papua New Guinea are also consistent with cross-sectional analysis of data from 98 countries (Barro, 1997). Barro showed that an increase of 10% in the proportion of the total (male and female) relevant age-group attending primary school reduced the number of children born to each woman by 0.13. This reduction doubled (0.26) for each increase in the secondary school population by 10% of the relevant cohort. Data from the Alan Guttmacher Institute shows that teenagers give birth to more than 14 million children each year. However, women who stay in school are far less likely to have a child before the age of 18 (Anonymous, 1998). In Bangladesh, 54% of women now aged 20–24 with less than 7 years schooling became teenage mothers, whereas only 19% with more than 7 years schooling did so.

The DHS reports other relevant variables underlying the fertility statistics in Papua New Guinea. Mothers living in urban areas and more developed regions of the country were more likely to obtain medical care. Levels of education are higher for those living in the towns: 35% of the urban population aged over 5 had some secondary schooling and only 8.6% of the rural, while in all 75% of the urban had some primary or secondary, but only 49% of the rural. Indeed it is clear that the most urgent health problems confronting Papua New Guinea are in its rural areas, but that is precisely where restrictive public spending ceilings imposed by the World Bank have slowed the expansion of secondary schooling.

These data support the increasing recognition amongst health professionals of education's important role in promoting health and in reducing morbidity and mortality (Gibson, 1996; Harrison, 1997). However, the health benefits arising from post-primary education reported above for Papua New Guinea were not restricted to employed secondary-educated women. The mother with secondary education working 'only' as a housewife who follows sound health practices in bringing up her children produces economic benefits from their enhanced life expectancy and ability to profit from education in the future.

The above evidence for the stronger impact of post-primary education on health indicators, literacy and economic growth provides a vivid contrast with aid donors' commitment, based on education economists' advice, to get recipient governments to concentrate their resources on primary education, because of its supposed but questionable higher social rates of return. If those comparative rates of

return were valid, they should show up in primary schooling having a larger measured impact than post-primary on health status, literacy and national income growth.

One reason why this is not so is because the rates of return reported for primary schooling on its own are all grossly overstated. For example, Bennell and Jolliffe have pointed out that the rates of return reported by Psacharopoulos are exaggerated because they refer only to the wage-employed output from each level of education; moreover Jolliffe's data for Ghana reveal no measurable impact of cognitive skills derived in school on non-wage-earning rural households' income from farming (Psacharopoulos, 1994; Bennell, 1996; Jolliffe, 1998).

Given the substantial evidence that unemployment in both advanced and developing economies is concentrated amongst those with the least education, the reported rates of return seriously misrepresent the facts. For example, in the USA in 1979, the unemployment rate for white men with less than 12 years of schooling was 7% and only 1.9% for those with more than 16 years (i.e. college graduates and above) (Mincer, 1989). In Papua New Guinea in 1990 only 8% (69,638) of 881,647 primary school leavers were in employment and of 4,621 graduates only 391 (9%)

were unemployed. This very strong association in Papua New Guinea between educational attainment and employment is displayed in Fig. 5.

### A mistaken methodology

The priorities for educational investment applied by the World Bank and other donors are based on the so-called rates of return reported for individuals with differing levels of education. Those with only primary schooling are usually found to have private rates of return as high as 50% in respect of their (or their parents') personal costs of financing their education. The social rates of return, which take into account the government's costs are lower but still around 20%. By contrast rates of return on university education are generally lower than these figures, at about 20 and 10% for the private and social rates, respectively. Rates for secondary schooling are usually in between the primary and tertiary rates (Fig. 1A).

This ordering of the social rates has persuaded many governments to give priority in their education budgets to primary schooling, then secondary, and last tertiary. In addition the evidently higher private than social rates at the secondary and tertiary levels appear to in-

Table 3  
Society cannot benefit less than the sum of its members.

	Rates of return (%)			Net present values (£)		
	private	public	social	private	public	social
Lower quartile	12.25	5.41	8.17	34,529	8,233	42,762
Median	12.49	6.14	8.87	48,828	15,007	63,835
Upper quartile	12.67	6.53	9.46	79,970	23,081	103,052

Private and social rate of return and net present values for graduates (Great Britain, 1990). (1) The private rates of return exceed the social but the social NPVs exceed the private (see also Fig. 1A and B). (2) The private rates of return are those discount rates which equate the present value of the extra after-tax lifetime earnings of graduates vis a vis year 12 (A level) leavers (by respective quartiles) with the present value of the private costs of higher education, comprising mainly forgone earnings, deemed equal to after-tax earnings of year 12 leavers, while an under-graduate. The social rates of return equate the present values of before-tax earnings with present values of all costs of higher education, including by assumption full tuition and maintenance grants for all, at an average all-in cost for 3 year degrees of £22,500. The public rates of return equate the present values of the extra taxes payable on the difference between graduates' and non-graduates' earnings with those of the public costs of higher education (tuition and maintenance) and exclude private forgone earnings (but include the taxes on those earnings forgone by government during taxpayers' periods of study). Taxes deducted from graduates' earnings include PAYE, VAT at 17.5% on assumed taxable consumption expenditures of 70% of after-income tax earnings, and NIC, but exclude taxes on savings. (3) The impact of ability on relative earnings is controlled here by comparing earnings of graduates and non-graduates by respective quartiles and median. (4) The net present values are for the same cash flows as in (1) but discounted at the Government's real (net of inflation) cost of borrowing, here assumed to be 4%. (5) Note that the private and public rates of return do not add to the social, nor can the government or public rate of return be derived by subtracting the private from the social. However the social NPV is in all cases equal to the sum of the private and the public. It can therefore be seen clearly that although the private rates of return exceed the social, in all cases the social NPVs exceed the private. That is because the public NPVs are all positive and reveal no net lifetime subsidy in respect of the public costs of graduates' degrees. Note that government should seek to assist individuals to maximise their private NPVs whilst minimising its own. Source: Incomes by education, General Household Survey, HMSO, London, 1994; tax calculations (Curtin, 1996).

dicating no need for public funding, since education is almost too good an investment for the individual, as a result of the public ‘subsidies’. Examples of such arguments as applied to higher education funding in Britain are to be found in the Dearing Report (National Committee of Inquiry into Higher Education, 1997). However, since all reported private rates of return are based on pre-tax incomes (Psacharopoulos, 1994), adjustment for tax largely eliminates the disparity between private and social rates. In addition when the discounted *net present values* of government’s spending on education at post-primary levels relative to its extra tax receipts from the more educated by virtue of their higher incomes are computed, no net subsidies are visible, as shown by the data for Great Britain in 1990 in Table 3. In any case the gap between private and social rates for primary schooling is even higher than at the post-primary levels. This should indicate a case for ending public funding at primary level also, if the same logic is to be applied. However, the World Bank and other agencies consider that the apparent higher social rates of return at the primary level justify ‘subsidies’. Moreover, non-pecuniary social benefits of education are considered, but without precise evidence, to be higher for primary school leavers.

The data outlined in Section 2 indicated outcomes at variance with this model of educational rates of return. We believe that the explanation lies in some fundamental mis-interpretations of the model’s results. We now offer a heuristic explanation of these errors.

Reported rates of return are all derivatives of the actual changes in income with respect to additional investment in schooling, i.e. they are ‘marginal’ rates, not the total rates of return on such investments. That means they are not to be compared (as by Becker, 1993) with rates of return on commercial investments such as dividend yields, which are never quoted in marginal terms. The rate of change of a rate of profit is not the same entity as the rate of profit.

What we have here is a confusion between the speed of a car and its acceleration in various gears. All cars go fastest in their top, usually third or fourth gear, but all accelerate fastest in their first gear (Fig. 6). Despite their cars’ faster acceleration (or more correctly ‘slower deceleration’) in ‘primary gear’, most prefer to drive whenever possible in ‘tertiary gear’, where a car’s top speed becomes available, despite its more rapid deceleration rate. Moreover, no driver seeking to reach top speed as soon as possible changes gear, from 1st to 2nd or 2nd to 3rd, when the intra-gear rate of acceleration is at its highest, as implied by the interpretations of the education model, but remains in that gear while its marginal contribution to extra speed is greater than can be obtained in the next gear.

In fact if the educational model were valid, the most profitable level of schooling is just grade 1, which

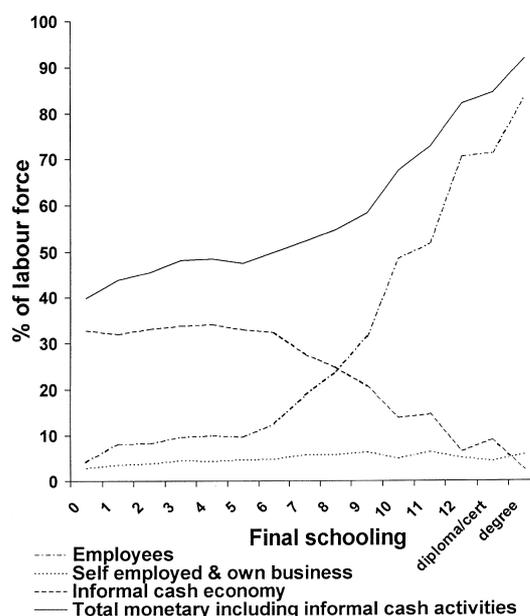


Fig. 5. Education and employment Papua New Guinea (1990 census from Papua New Guinea).

implies public funding should cease at that level, since its rate of return is the highest of all. But educational rates are all rates of acceleration, and not rates of speed. Just as higher acceleration in first gear does not warrant always driving in that gear, so the higher marginal rate of return on primary schooling is no reason to cease schooling at the age of 12, or on this account to restrict public funding to that level. If governments wish to maximise the rate of economic growth (GNP), they need to maximise the incomes of ALL since the

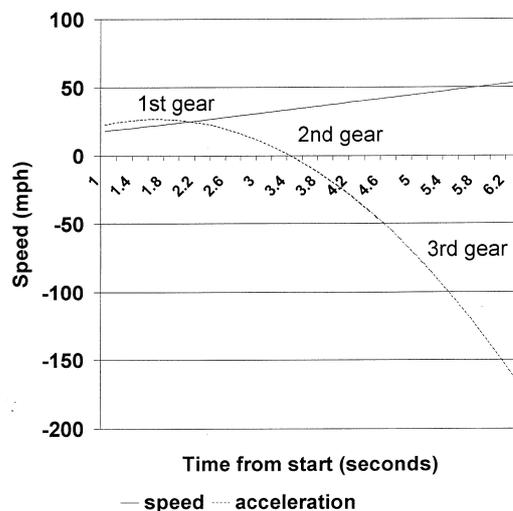


Fig. 6. Car acceleration through gears.

GNP is the sum of incomes of all persons in the econ-

<sup>3</sup> Note the similarity in the formulae for acceleration of a car and rates of return: If the distance  $s$  travelled by a car  $t$  seconds after starting from rest is given by

$$s = 20t + 8t^2 - t^3 \tag{1}$$

then its speed over that distance is  $s/t$  and its acceleration rate  $s'$  at any time  $t$  is

$$s' = 20 + 16t - 3t^2 \tag{2}$$

Mincer's formula for the educational rate of return  $b$  for a graduate individual  $i$  relative to a non-graduate  $j$  is derived from regressions of earnings data to obtain  $b$  and is in the same quadratic form as Eq. (2) (Mincer, 1974):

$$\ln Y_{i(22...n)} = a + bS_{i(17...21)} + cEX_{i(22...n)} - dEX_{i(22...n)}^2 \tag{3}$$

where  $\ln Y$  is the normal log of the difference between the graduate's and the non-graduate's earnings until  $n$  years after graduation from say 4 years of college  $S$  (ages 17 to 21) and  $EX$  represents years of work experience from age 22 (see Psacharopoulos and Alam (1991) for the worked example depicted in Fig. 3). Note that Eq. (3) does not provide the distance travelled or speed (read incomes and growth of incomes, respectively) given by Eq. (1), but only the acceleration or rate of change as in Eq. (2). Mincer's formula has been found to produce similar results to those of the formula for the discounted internal rate of return. That formula seeks to find the discount rate  $r$  that equates the present value of the streams of costs of schooling at each level with the present value of the future extra income benefits over time:

$$\sum_{t=m+1}^n (Y_b - Y_a)^t / (1+r)^t = \sum_{t=1}^m (Y_a + C_b)^t (1+r)^t \tag{4}$$

where  $Y_a$  and  $Y_b$  refer to the earnings associated with successive levels of schooling and  $C_b$  and  $Y_a$  are the direct and indirect (forgone earnings) costs of schooling at say the college level  $b$  (Psacharopoulos and Alam, 1991). The difference between Eq. (3) and Eq. (4) is that the former does not discount future income flows, but it is possible to apply Eq. (4) to the data used with Eq. (3), with  $r'$  as an externally given discount rate replacing the internal rate  $r$ , to produce the net present values in Fig. 4. For an example of correct application of Eq. (4), using  $r'$  as the external discount rate, to demonstrate the greater economic efficacy of AZT than other then available treatments for AIDS, by comparing the net present values of earnings of patients using AZT with those in a control group, see Meyer et al. (1994).

<sup>4</sup> Poiseuille's Law states that the velocity (i.e. speed in centimetres per second) of blood  $r$  centimetres from the central axis of an artery may be represented by

$$v(r) = k(R^2 - r^2) \tag{5}$$

where  $k$  is a constant and  $R$  is the radius of the artery (Tan, 1987). If for a certain artery  $k=1000$  and  $R=0.2$ , the velocity can be computed and plotted for varying  $r$ . The slope (i.e. first derivative) of this curve at any point yields the deceleration rate  $v'$  of the blood at that distance from the central axis:

omy. This can only be achieved if all are assisted to travel at their fastest 'speed', i.e. by earning to the maximum of their learning capabilities<sup>3</sup>. Poiseuille's Law on blood circulation rates provides a similar analogy<sup>4</sup>.

Thus the policy significance of rates of return, or acceleration, of cars is the opposite of the conclusions drawn by education economists. The correct decision rule is to continue with investment until the marginal rate of return has been minimised or not to remain in a low gear after its acceleration ceases to increase total speed. Now just as no drivers exult in their speed of acceleration as they proceed along highways in first gear at 15 mph, so none of those obliged to join the labour force at the age of 12 are likely to console themselves with their higher rate of return, when their earnings are at best only 20% of those of their contemporaries who succeed in getting tertiary education and training before embarking on employment.

Our point here is that most people measure their economic welfare by their incomes, not by their rates of return. When such incomes accrue over a lifetime it is appropriate to derive their 'present value' by discounting them at the current rate of interest. Such present values, like the speed of cars relative to their acceleration rates through the gears, are inversely related to educational rates of return (Fig. 1B, Fig. 6 and Table 3) (Curtin, 1991, 1993, 1996).

Education economists' counter-argument to the above analysis is that, although of course all would prefer more education to less, budget funds are not unlimited. It is therefore argued that scarcity of funds validates the comparative marginal rates of return because (1) any given sum of money will fund many more primary leavers than secondary or tertiary, given the lower costs per pupil of educating the former and (2) it is more equitable to educate all to say year 6 and none beyond, than say 50% of children to year 6 and 10% to year 16. However, although money will indeed stretch further if limited to expanding primary schools, this is not helpful if most of those emerging from these schools with no further education are at the end of the day not measurably better off than if they had never been to school at all (see the World Bank's poverty data for Thailand, Philippines and Papua New Guinea in Section 2).

The much greater cost-effectiveness per achieved job and per US\$1 of extra national income of Papua New Guinea's investment in post-primary schooling relative to primary is demonstrated in Fig. 7. The latter's lower unit costs, no more than its higher rates of return, do not offset its low yield in terms of employment generation and income. The resources wasted in Papua New Guinea by not expanding the post-primary education system in step with the primary are staggeringly large for such a poor country:

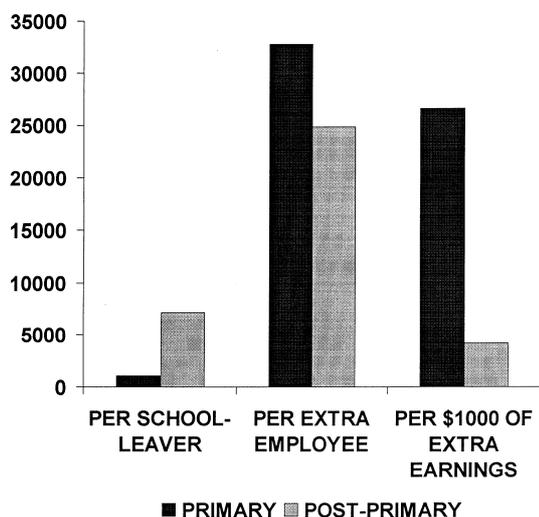


Fig. 7. Cost-effectiveness of education spending per employee and US\$ of incomes per US\$ of pupil costs.

The total number of those with only primary schooling in the labour force aged 10+ in 1990 was 881,647; according to unit costs data their schooling cost the government no less than US\$859 million

$$v'(r) = 2kR - 2kr \quad (6)$$

The gradual deceleration of the blood flow does not of course mean blood flow should be terminated surgically at the point where the rate of change of its speed is highest. The equivalent is true of the marginal rates of return deployed to justify reallocating funds from tertiary to primary schooling, they merely show utterly normal diminishing marginal rates of return as education progresses without implying smaller absolute levels of earnings at the tertiary than the primary levels.

<sup>5</sup>When developed world university attendance rates are already high and still rising, it is conceivable there could be saturation of the market for graduates and that they would then tend to fill jobs previously undertaken by non-graduates for the same pay as the latter. However, there is no evidence for any such general tendency, because as yet there is nowhere any indication of falling average remuneration of graduates. One country where this should be most likely to happen is Singapore, which more than doubled the number of graduates in its labour force in just five years, from 95,256 in 1990 to 228,374 in 1995 (Ministry of Labour, 1997). However in the event the proportion of these graduates earning less than S\$5,000 per month did not increase, but actually fell, from 72% in 1990 to 52% in 1995. Singapore's experience is repeating the USA's (Jorgenson, 1995), which also belies any suggestion of falling average incomes of graduates such that economic returns in the form of net present values would fall away.

(McGavin and Ross, 1988). However only 69,638 (8%) were employed and thereby gaining vis a vis those without any schooling. The \$859 million would have produced an extra 28,633 graduates over the ten years and with all the evidence both in Papua New Guinea and in countries like Singapore showing full employment of graduates, these graduates would have generated enough taxation to fund yet more schooling at all levels. For example, with average graduate earnings of \$19,000 p.a. (McGavin and Gill, 1987), their average tax rate of 25% would have produced no less than \$136 million p.a. This would have been enough to double the total annual education budget and to provide a multiplier effect by doubling of the total post-primary output, in a virtuous circle as exemplified by Singapore<sup>5</sup>. This is in contrast to the zero social return from taxation from the earnings of the 8% of primary leavers in employment (none of whom reached the income tax threshold) and the 92% paying nil tax on their nil regular cash income (McGavin and Ross, 1988). This tax evidence indicates the high cost of the conventional wisdom that lower unit costs and equity considerations all favour priority for primary schooling.

International confirmation of the poor return in terms of national income growth from just producing primary leavers can be found in Barro's seminal work (Barro, 1997). His exhaustive investigation of comparative growth rates in over 100 countries from 1960 to 1990 found that the most significant determinants included male secondary and higher schooling, life expectancy and the fertility ratio. The proportion of the labour force with only primary schooling proved to have a negative but insignificant impact. Barro concluded that raising the average level of schooling of the male labour force by one year would increase the growth rate of GNP by as much as 1%, i.e. by 50% if a country's growth rate was previously 2%, all other things equal.

Barro's data also showed that although the proportion of the female labour force with any level of education was not significantly directly related to economic growth, female education made a major impact through lower fertility rates. This is consistent with the association noted in the Papua New Guinea data above, and through the overall life expectancy rate, closely related in turn to infant mortality rates. Health and education are not of course sufficient on their own for high economic growth rates, and Barro's model also confirmed the importance of the rule of law and democratic institutions as contributory to observed comparative growth rates of the countries in his sample.

Barro's evidence supports our model's demonstration of a compelling case for governments to increase the share of education in the total national

budget. They will not be able to demonstrate comparably large positive gains in incomes from any of their other expenditures apart possibly from those on health (which provide essential insurance of those gains against disease and premature mortality). Our approach could also provide a first approximation for determining the size of the health budget, which should as a minimum be expanded until the gain in the present values of earnings from work days saved from reducing illness and mortality of the workforce falls short of the extra costs. Beyond that minimum, which few if any developing countries have reached, health budgets should on ethical grounds attract funds to the point of maintaining life for all, even those not in the labour force, irrespective of their earning capacity, for as long as medically justifiable<sup>6</sup>.

Yet donors' insistence on restricting public financing of education to the primary level largely vitiates their equally strong pressure on client governments to expand their primary health care systems in accordance with cost-effectiveness criteria and the ability of patients to pay medical fees. For when as in Papua New Guinea, India and most African countries, 90% of primary leavers never achieve permanent employment or any other regular cash income, the ability to pay fees is limited to the 10% of primary leavers who are employed. This makes the World Bank's emphasis on user pays financing of health services in Papua New Guinea rather questionable, when the *fiscal* return from providing the 90% with any health care can only be nil, setting on one side the ethical arguments. Our evidence suggests the strongest economic justification for increasing health care is increasing enrollments at the post-primary levels of education, since that is where the economic value of the extra lives protected by improved and expanded health care tends to be largest both to themselves and to their government's budget.

## Discussion

Education economists' rates of return pertain to the respective differences in, and not the absolute levels of, the earnings of those with successive levels of final education. They are on firm ground when they test these marginal rates against the cost of borrowing funds to pay for education, i.e. the applicable interest rate, which for most developing country governments is

probably the rate on World Bank loans (around 7% for all but the poorest countries). If the marginal rate is above the borrowing rate, investment in that level is profitable. But these economists go beyond that to draw significance from the difference between the marginal rate and the interest rate. Thus, if the latter is 7%, then marginal rates of 20% on primary and 10% on tertiary are considered to indicate that primary is more profitable than tertiary. In reality the disparity from the interest rate implies under-investment in *both* levels, but the difference in the difference (i.e.  $20-7=13$  for primary and  $10-7=3$  for tertiary) says nothing about the actual profitability in either case. All economics is about maximising profits: tertiary's lower marginal rate is consistent with it yielding the highest 'profits' or incomes as shown by both Psacharopoulos' incomes data for Venezuela in Fig. 2 and the net present values of those incomes in Fig. 4.

Moreover, the high primary rate of return for one individual signifies not that he/she should spend more on primary but that he/she suffers from under-investment in schooling if they leave school at that point. The individual's optimal level of education is that where the personal marginal rate is just at equality with the interest rate, which for many is not until they have completed post-graduate studies. Now whether investment in all primary education is profitable depends on the marginal rate of return of the last member of annual cohorts entering the labour force with just that level of schooling. Our evidence is that when 90% of primary leavers are unemployed as in Papua New Guinea that rate is negative since none of these achieve the cited rates of return derived from the earnings of the employed 10%, even when engaged in subsistence farming (Jolliffe, 1998).

Best-practice investment appraisal always requires computation of both rates of return and net present values, whereas education economists mostly report only the former. When applied to educational investment priorities, the correct methodology shows an overwhelming need for more public investment at all levels where the marginal net present values are positive. Governments should either reallocate funds from those activities which show lower or nil economic net benefits, or borrow sufficiently to fund expansion of education at all levels with positive net present values, with priority at the margin to those where the social net present values are highest, which are invariably the post-primary levels. Those net present values support the evidence above for the positive impacts on health indicators of investing in post-primary education.

Provision of extra funding for post-primary education should not, of course, be achieved at the expense of funding for expanding/improving primary education, but so long as both yield positive net present values at governments' cost of funds, they should

<sup>6</sup> This approach differs from that described by the World Bank which measures cost-effectiveness merely by the *number* of disability-adjusted life years saved per dollar spent on medical interventions without valuing those lives, in contrast with its willingness to value primary leavers' lives more highly than graduates' (World Bank, 1993).

borrow to expand funding for both primary and post-primary. It is worth noting that the goal of achieving universal primary education will rarely be achieved unless there are publicly funded places in secondary schools for the total output of primary schools. In most developing countries parents and their children often see little utility in the efforts involved in completing primary schooling if that leads nowhere, either in terms of employment prospects, or when there are too few places at the secondary level<sup>7</sup>.

Although it may well be naive to hope for quantum leaps in public funding for education in the world's poorer countries, donors like the World Bank should rethink their insistence on reductions in public education spending beyond the primary level. This does not mean that we advocate shifting funds from primary to higher education, despite Psacharopoulos' "best assumption that whatever goes to higher education will come from the government's education budget" and therefore implies lower allocations to primary and secondary schools (Psacharopoulos, 1996). When the national education budget of a poor country like India is a fraction (1/7) of its defence budget there must be some scope for reallocation to all levels of education. Wakhweya has raised the issue of how policy makers in poorer countries are to be persuaded that money spent on arms would be better spent on educating women and providing basic health care (Wakhweya, 1995). Perhaps the World Bank and other western donors need to put more of their energies into this than to redirecting education spending to the least cost-effective level evident in Fig. 7.

It is also clear that donor aid could do a great deal more to promote education at all levels. Donor nations give on average only 0.3% of their gross national products (GNP) as Official Development Assistance (ODA or overseas aid) and approximately one third of this

(0.1% GNP) is spent in the world's least developed countries. Although ODA budgets as percentages of GNP have fallen in recent years, the absolute flows to low income countries doubled between 1987 and 1993 (because of sustained growth of donors' own large GNPs). ODA amounted to US\$23.7 per capita and 12.6% of GNP in low income economies (other than China and India) in 1994 (World Bank, 1997). Since very few countries' recurrent expenditure on social services is as much as 10% of GDP, it is clear that if they wished to concentrate their aid in the way they urge their clients, donors themselves could effectively more than double spending on education and health. However, only about 10% of their aid is spent on social development (health, education, housing, water and sanitation). In other words a mere 0.01% of donor GNP and 1.26% of recipients' GNP is spent by donors on social development in the world's poorest countries (Nelson and Yu, 1996). Such sectorally unbalanced distribution of aid could well be more important than shortfalls in its total quantum, especially when attention is paid to the progressive impact of additional education on poverty, health and economic growth. This paper's evidence implies that both the overall socioeconomic and the health impact of aid could be greatly enhanced if more of the existing volume of aid was applied to post-primary education.

## Conclusion

Education and social policy impact significantly on health and health professionals should better understand some of the policy issues involved. Education has important links to both health and economic development. High mortality rates in the world's least developed countries are as much a result of social factors and poverty as they are of inadequate health services. The mistaken theories of education economists have resulted in the World Bank recommending to developing countries that government's funds should be diverted from post-primary education to primary. However, this paper provides evidence supporting an alternative model which demonstrates that the value of investment in primary education is captured only when it leads on to further education and training, from both an economic and a social equity perspective. Primary education is necessary but not sufficient, and current trends to boost primary education at the expense of post-primary education should be opposed. Emphasis should be placed on providing education of improved quality at all levels. Politicians in both the developed and developing world need to find the political will to make this happen.

<sup>7</sup> This voluntary dropping out from primary schooling has been documented in Papua New Guinea by the World Bank (World Bank, 1995), with an evident correlation between grade 1 enrolment rates and transition rates from grade 6 (age 12) to grade 7, but the Bank commented only that this indicated 'some misjudgment on the part of parents'. In the 1980s parents could see that with at best a 1 in 5 chance of their children reaching the first grade of secondary schooling (grade 7), even the minimal fees payable to primary schools (to cover the cost of teaching materials) were a doubtful investment. Expansion of the country's secondary schools since then has met with little support from donors but has led to an increase in enrollments at the primary level. As so often elsewhere, peasants in that country appear to have been more 'savvy' in weighing up economic options than those seeking to persuade them that their children would all achieve Gannicott's rates of return of 19% if they left school at primary grade 6 (Gannicott, 1989).

## References

- Ahuja, V., 1997. In: *Everyone's Miracle? Revisiting Poverty and Inequality in East Asia, Directions in Development series*, . World Bank, Washington, DC.
- Anonymous, 1998. Teenage mothers. *Economist* May 23, 347(8069)106.
- Barro, R.J., 1997. Determinants of economic growth: a cross-country empirical study. In: *Lionel Robbins Lectures*. MIT Press, Cambridge and London.
- Becker, G.S., 1993. *Human Capital: A theoretical and empirical analysis with special reference to education*. University of Chicago Press, Chicago. Third Edition.
- Bennell, P., 1996. Rates of return to education: does the conventional pattern prevail in sub-Saharan Africa? *World Development* 24, 183–199.
- Brealey, R.A., Myers, S.C., 1996. *Principle of Corporate Finance*. McGraw-Hill, New York.
- Curtin, T.R.C., 1991. *The Economics of Public Investment in Education in Papua New Guinea*. University of Papua New Guinea, Port Moresby.
- Curtin, T.R.C., 1993. The political economy of education in South Africa. *African Affairs* 92, 417–430.
- Curtin, T.R.C., 1996. Project appraisal and human capital theory. *Project Appraisal* 11, 66–78.
- Fisher, I., 1930. *The Theory of Interest*. Macmillan, New York.
- Gannicott, K., 1989. The evaluation of human capital in Papua New Guinea. *Papua New Guinea Journal of Education* 21, 23–48.
- Gibson, J., 1996. *Baseline Poverty Estimates for Urban Areas of Papua New Guinea*. Institute of National Affairs, Port Moresby.
- Hammer, J.S., 1997. Economic analysis for health projects. *World Bank Research Observer* 12, 47–71.
- Harrison, K.A., 1997. The importance of the educated healthy woman in Africa. *Lancet* 349, 644–647.
- Hsiao, W.C., Liu, Y., 1996. Economic reform and health: lessons from China [editorial]. *New England Journal of Medicine* 335, 430–432.
- Jolliffe, D., 1998. Skills, schooling and household income in Ghana. *The World Bank Economic Review* 12, 81–104.
- Jorgenson, D.W., 1995. In: *Productivity*, vol. 1: Postwar US economic growth. MIT Press, Cambridge and London.
- Logie, D.E., Woodroffe, J., 1993. Structural adjustment: the wrong prescription for Africa? *BMJ* 307, 41–44.
- McGavin, P.A., Gill, R.A., 1987. *Professional and Skills Earnings in Papua New Guinea: 1986 Market Sector Survey Data*. Institute of National Affairs, Port Moresby.
- McGavin, P.A., Ross, M.A., 1988. *Rates of Return to Education in Papua New Guinea*. Institute of National Affairs, Port Moresby.
- Meyer, S.L., Lasser, M., Reekie, W.D., 1994. Economics and the treatment of AIDS: a preliminary assessment. *Applied Economics* 26, 1093–1098.
- Mincer, J., 1974. *Schooling, Experience and Earnings*. NBER, New York.
- Mincer, J., 1989. Human capital and the labour market: a review of current research. *Educational Researcher* 27, 186–193.
- Ministry of Labour, 1997. *Report on the Labour Force Survey of Singapore*. Ministry of Labour, Singapore.
- National Committee of Inquiry into Higher Education, 1997. *Report ('The Dearing Report')*. HMSO, London.
- National Statistical Office, 1997. *Papua New Guinea Demographic and Health Survey 1996*. Port Moresby, National Statistical Office.
- Nelson, E.A., 1994. Development aid: the way forward. *BMJ* 308, 481.
- Nelson, E.A., Yu, L.M., 1996. Poverty focused assistance: new category of development aid. *Lancet* 348, 1642–1643.
- Pincus, T., Callahan, L.F., 1994. Associations of low formal education level and poor health status: behavioral, in addition to demographic and medical, explanations? *Journal of Clinical Epidemiology* 47, 355–361.
- Psacharopoulos, G., 1994. Returns to investment in education: a global update. *World Development* 22, 1325–1343.
- Psacharopoulos, G., 1996. Economics of education: a research agenda. *Economics of Education Review* 15, 339–344.
- Psacharopoulos, G., Alam, A., 1991. Earnings and education in Venezuela: an update from the 1987 household survey. *Economics of Education Review* 10, 29–36.
- Tan, S.T., 1987. *Calculus for the Managerial, Life and Social Sciences*. Prindle, Weber and Schmidt, Boston.
- United Nations Development Programme, 1996. *Human Development Report: 1996*. Oxford University Press, New York and Oxford.
- Wakhweya, A.M., 1995. Structural adjustment and health [editorial]. *BMJ* 311, 71–72.
- World Bank, 1993. *World Development Report, 1993: Investing in Health*. Oxford University Press, New York.
- World Bank, 1995. *Papua New Guinea: Delivering Public Services*. Oxford University Press, New York.
- World Bank, 1997. *World Development Report 1997*. Oxford University Press, New York.