Who's Not In School?

Economic Barriers to Universal Primary Education in Papua New Guinea

John Gibson

Abstract

Many studies recommend making primary education the priority investment in developing countries, because of its impact on economic growth and other development goals. Yet few developing countries achieve universal primary education despite numerous international commitments to this goal. This study focuses on Papua New Guinea, where over one-quarter of children are out of school. Household survey data are used to see the effect of individual, household and community characteristics on whether a child attends primary school. Increases in household income and in men's education raise both boys' and girls' enrolments (slightly favouring girls) but women's education has a significant impact only on girls' schooling. Even after controlling for observable factors, girls' enrolments lag behind those of boys and have significant unexplained differences across regions.

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WHO'S NOT IN SCHOOL?

ECONOMIC BARRIERS TO UNIVERSAL PRIMARY EDUCATION IN PAPUA NEW GUINEA

In new models of economic growth, human capital is central to the growth process (McMahon, 1998). This importance is reinforced by studies of the rates of return to investments in education. According to the influential review by Psacharopoulos (1994), primary education continues to be the leading investment priority in developing countries. Moreover, these rates of return studies typically capture only the market benefits of education; there are also many non-market benefits such as improvements in health and the decreased risk of premature child death (Mellington and Cameron, 1999).

The importance of education to development goals is reflected in the numerous international commitments to universal basic education. For example, at the World Conference on Education for All, held in Thailand in 1990, governments from 155 countries committed to universal access to primary education and an end to gender inequalities by the year 2000. But in spite of this commitment, 125 million primary school-aged children in developing countries – most of them girls – are not in school (Oxfam, 2000). In response to this failure to achieve universal primary education, subsequent meetings such as the 1995 Summit for Social Development and the World Conference on Women have postponed the target date for universal primary education to the year 2015. The goal of universal primary education is evidently more difficult to achieve than initially thought.

Given these difficulties, analyses of the barriers to universal primary education in developing countries may be helpful. The purpose of this paper is to report empirical evidence from Papua New Guinea that can help to answer questions about the barriers to education. This is

an interesting setting for such a study because there is an overall shortfall in primary school enrolments – over one-quarter of children are out of school – and substantial gaps between regions and between boys and girls. Four main questions are addressed in the analysis:

- What is the role of family background variables, such as income and parental schooling levels, in the demand for children's education?
- Are the household factors affecting education different for boys and girls?
- What role does the availability of school facilities play in determining children's school attendance?
- Should interventions to raise enrolment rates be targeted at individual, household or regional levels?

This paper is based on household survey data, collected in 1996 as part of a World Bank-sponsored assessment of poverty in Papua New Guinea (Gibson and Rozelle, 1998).[1] These data are used to describe the primary school enrolment rates of boys and girls across the different regions and income groups of the country. Further insights come from an econometric model of the probability of a child being enrolled in primary school. Studies from other developing countries show differences across boys and girls in the effect of community, household and parental characteristics on education (Oey-Gardiner, 1991; Glick and Sahn, 1999), so the econometric model is estimated on a gender-disaggregated sample. The model is used to decompose the gender gap in enrolments into the part due to observed characteristics and the 'unexplained' part reflecting differences in the way that households treat boys and girls. The model is also used to simulate the effect that various interventions have on the primary school enrolment rate.

[1] In addition to the household survey, the World Bank also commissioned a set of case studies. These studies covered agriculture, education, health, formal and informal social safety nets, and the delivery of services by non-governmental organizations. The most relevant one, from the point of view of this paper, is by the National Research Institute (1996) "Education and the Quality of Life in Papua New Guinea: Five Village Case Studies".

Participation in Primary Education in Papua New Guinea

How successful has Papua New Guinea been at achieving universal primary education? The available estimates vary but no source reports primary school enrolment rates that exceed 80 percent.[2] The estimates used here are based on a nationwide household survey (described below) that took place in 1996, and refer to enrolments in the 1995 school year. According to these survey data, there is no point on the age distribution where more than two-thirds of children are in school (Figure 1).

(Figure 1 about here)

The *age-specific* enrolment rates in Figure 1 show the proportion of children of a particular age attending any level of school. The more commonly reported figure is the *gross* enrolment rate, which is the ratio of children in primary school of any age relative to the total number of children in the target age group. In Papua New Guinea, children are meant to begin Community School (i.e., Grades 1-6) at age eight years, so the target age group is 8-13 years. The survey estimate of the gross enrolment rate is 72 percent but with considerable variation across income groups and regions (Table 1). Enrolment rates in (especially) the National Capital District (NCD) and the New Guinea Islands are almost 50 percent higher than in the Highlands region. The gap in enrolments between the richest and poorest population quartiles is almost as large.

(Table 1 about here)

[2] The *World Development Indicators* of the World Bank report a gross enrolment rate of 80 percent and no information on the net enrolment rate, while the *Human Development Report* indicates that the net enrolment rate is 78.9 percent but does not report a gross enrolment rate.

Figure 1 and Table 1 also indicate a substantial gender gap. By the time a boy reaches 20 years of age, the probability that he has ever attended school is over 90 percent, but for a similarly aged girl the probability is only 75 percent. There is considerable variability across regions and income groups in the gender gap in enrolments. Girls have a gross enrolment rate of almost 100 percent in the New Guinea Islands, which is higher than for boys, while in the Momase region female enrolment rates are just over 50 percent and are only two-thirds of the regional rate for boys. The enrolments of girls appear to be sensitive to household income because the gender gap is largest in the lowest income groups.

The gross enrolment rate can be inflated by overage enrolments (e.g., 17 year old children still in primary school), which may explain the 101 percent rate for males in the NCD. The efficiency of the educational system in capturing students and providing schooling in a timely manner is measured best by the *net* enrolment rate, which depends on the number of children who are in the schooling level appropriate for their age group. The net enrolment rate for the richest quartile of the population is almost twice as high as for the poorest quartile (Table 1). There are large regional disparities in net enrolment rates: less than one-half of highlands children of community school age are in community school, while the NCD and New Guinea Islands achieve 80 percent and 73 percent net enrolment rates.

The 1996 Papua New Guinea Household Survey

Data used in this paper come from the Papua New Guinea Household Survey (PNGHS) – the first national survey of living standards in Papua New Guinea. The survey covered a random sample of 1200 households, residing in 120 rural and urban communities ("clusters"), who were interviewed between January and December 1996. The clusters came from all provinces except North Solomons. A set of sampling weights, based on variation between the 1990

Census estimates of the size of each cluster and the actual size found during the survey, and on the deviation of the actual number of households surveyed in each cluster from the target number, allow the results reported to be representative of Papua New Guinea in 1996.

The survey interviewed each household twice, with the start of the two-week consumption recall period signalled by the first interview. This first interview also collected demographic details on each member of the selected households and information about their education. The expenditure estimates include the imputed value of own-production, net gifts received, food stock changes, and the flow of services from durable assets so they should be a good measure of permanent income (Gibson and Rozelle, 1998). In addition to the household interviews, a community survey collected information on the amount of time needed to reach the nearest primary schools. One omission from the survey was indicators of the quality of primary schools, such as the ratio of the number of desks or number of text books per student, so the models estimated with these survey data can only be used to estimate quantity effects such as increases in the number or availability of primary schools.

The survey started while students were still on school holidays, so all questions about current enrolments refer to the previous (1995) year. The sample for the econometric analysis is based on all members of respondent households aged between 7-17 years in 1995, who had not completed Community School (i.e., Grade 6) before the 1995 school year. This wide age interval is needed because over-age enrolment is common (e.g., over one-quarter of those attending Community School were of age 15 years and above). These selection criteria gave a sample of 1528 children.

Details of the Analysis

The demand for children's education can be derived from a model of household production where it is assumed that parents (or elders) make decisions regarding child schooling (Handa, 1996). Households maximise a utility function, where consumption of commodities, leisure and non-market goods such as child quality are the arguments, and budget and time endowments and a production function are the constraints. This production function relates the output of non-market goods to inputs of time and market goods and to an efficiency parameter that depends on factors such as the ability or experience of the household workers and their access to complimentary public inputs. Solving the household's constrained optimisation problem yields demand functions, relating optimal consumption of each non-market good to the exogenous variables:

$$D_s = s(x_j, x_h, x_c, e_j)$$

where x_j are child characteristics, x_h are household characteristics, x_c are community-level and regional characteristics, and e_j is a child-specific random error.

The particular aspect of the demand for education that the model seeks to explain is the Community School enrolment status of children, as captured by the question "Did you go to school in 1995?" Because the data are dichotomous (that is, the child is either in school or not), the probit estimator is appropriate. The survey contains several exogenous variables that have been used in similar analyses in other countries (Handa, 1996; Ravallion and Wodon, 2000). These variables include:

- *Child characteristics:* a linear and quadratic term in the child's age and an indicator variable for whether the child's parent is the head of the household.
- *Household characteristics*: (log) household size, the share of young children (age 0-6), older children (age 7-14), and prime-age adults (age 15-50), plus a binary variable for

female-headed households. It is difficult to identify the parents of many of the children in the sample, because household members were classified only by their relationship to the household head. So in place of the usual variables of mother's and father's education levels, the household averages of the completed school years for adult males and adult females are used. These variables should still capture the potential demand by educated adults for child enrolments because there is evidence of considerable educational spillovers within households in Papua New Guinea (Gibson, 2001).

- *Community and regional characteristics*: the travelling time to the nearest Community School by the transport method most typically used by students within the survey cluster. Dummy variables for the five regions in Table 1 are also used and if these dummies remain significant after controlling for the other observables, it may suggest that geographical targeting is a sensible basis for programs that seek to raise school enrolment rates.

In addition to these exogenous variables, income is likely to be a key household characteristic determining the demand for children's education. Measures of household income or wealth are also interesting policy variables because of concern about the role of education in increasing social mobility and reducing the intergenerational transmission of poverty. However, household income may not be exogenous because children who are out of school can engage in market work. Moreover, the survey uses expenditures as the measure of permanent income (Anand and Harris, 1994), so expenditures may be affected by enrolment decisions if outlays for schooling are significant. One approach to checking for the potential endogeneity of expenditures is to include the residuals from a first stage regression (predicting expenditures) in the probit model (Rivers and Vuong, 1988); if these added residuals are insignificant, the endogeneity issue can safely be ignored.

School fees are another variable that may affect enrolments but the available data are plagued by endogeneity and other econometric problems. The survey only observed fees for children who were enrolled, so the school fees that non-enrolees would have faced must be imputed. Even for those children who were enrolled, fees may be endogenous because parents could choose to send their child to a more expensive school if one is available, so reported fees may not reflect exogenous prices. Using cluster-level averages of the reported fees to deal with the missing data and endogeneity issues creates two further problems. First, in clusters where few children attend school, the average will be noisy because it is based on only a few reports of fees, so the probit coefficients may be biased. Second, fees at Community School level reflect community characteristics, with higher fees charged in wealthier areas,[3] creating the potential for a positive correlation between fees and enrolment rates. In light of these problems, a variable measuring the cluster-level average of school fees will be added to the model only as a check for robustness, to see if the results for the other variables are affected by the inclusion or exclusion of the fees variable.

Descriptive statistics for the variables are reported in Table 2 for the sample of 1528 children. A total of 755 children in the sample attended school in 1995, corresponding to population-weighted proportions of 0.43 for girls and 0.48 for boys. This gender gap in enrolments is also apparent in the educational attainment of adults; the average years of schooling for adult women (2.6 years) are only two-thirds of the average for men. The other feature apparent from Table 2 is the inaccessibility of primary schools; on average, children in the sampled clusters face a one-way journey of one hour to reach the nearest school.

(Table 2 about here)

[3] There is a correlation of 0.58 between the cluster averages of fees per Community School student and household total expenditures.

Estimation Results

Table 3 reports probit estimates of the enrolment equations. To test whether estimating the model separately for boys and girls was appropriate, a dummy variable for the gender of the child was interacted with all slope variables and the model was re-estimated on the pooled sample. The hypothesis that the male intercept dummy plus all 16 of the interacted slope dummy variables were jointly zero was rejected at the $p<0.02$ level.[4] Thus, the estimation of separate models for the enrolments of boys and girls is appropriate.

(Table 3 about here)

In general, the results in Table 3 suggest that the probability of being in school is significantly affected by the age of the child, by household economic resources, by the education level of adults, and by the distance to the nearest Community School. However, the relationship of the child to the household head, and the size, demographic composition and female headship of the household are less statistically significant explanatory variables.

Three differences between the equations for boys and girls are apparent. First, boys' enrolments are more sensitive to household size and demographic composition. Second, men's education raises both boys' and girls' enrolments (slightly favouring girls) but women's education has a significant impact only on girls' schooling. This is similar to findings from other developing countries (Al-Samarria and Peasgood, 1998; Glick and Sahn, 1999). Third, the coefficients on the regional fixed effects show that the observed characteristics of children, households and communities can account for all regional

[4] This statistical test controls for the effect of sampling weights and clustering. Even with the more conservative criteria of basing the degrees of freedom on the number of clusters rather than the number of observations, the pooling assumption is rejected at the $p<0.08$ level.

differences in the enrolment rates of boys but not of girls. In particular, other regions lag significantly behind the New Guinea Islands in the enrolment of girls.

To see if the results in Table 3 are affected by endogeneity bias, the model was re-estimated by adding the residuals from a first-stage regression of (log) expenditures per adult equivalent on the exogenous variables and a set of instruments (Rivers and Vuong, 1988). The results in Table A1 show that endogeneity bias is not apparent in either of the equations because the *t*-statistics on the added residuals are always statistically insignificant. This lack of feedback from enrolments to expenditures may not be surprising, because the survey estimate of the average outlay per Community School student is equivalent to less than one percent of household total expenditures. Therefore, the estimates that treat expenditures as exogenous are used for the remainder of the paper. The other test of robustness was to add a variable measuring the cluster averages of school fees; this variable was statistically insignificant in the probit equations for both boys ($p<0.35$) and girls ($p<0.29$) and its presence did not change the coefficients on any of the other variables in the model.

Decomposing the Gender Gap in Enrolments

The gender gap in enrolments that is predicted by the probit equation can be decomposed following a method used by Even and Macpherson (1993):

$$\text{GAP} = P\left(X_m, \hat{b}_m\right) - P\left(X_f, \hat{b}_f\right) = 0.4768 - 0.4250 = 0.0518$$

where X_i is the vector of observed characteristics (including household and community effects) for the child of sex i, and b_i is the corresponding vector of coefficients. This gap can be decomposed into an explained portion, due to differences in characteristics (i.e., differences in the X_i vectors) and an unexplained portion that reflects gender differences in the returns to characteristics (i.e., differences in the coefficients).

The first step in the decomposition is to compare the enrolment rate that girls would have if they had the observed characteristics of the boys in the sample with the enrolment rate predicted from their own characteristics:

$$\text{EXPLAINED GAP} = P\left(X_m, \hat{b}_f\right) - P\left(X_f, \hat{b}_f\right) = 0.4188 - 0.4250 = -0.0062.$$

Thus, the enrolment rate for girls would be slightly lower if they were to have the characteristics of the boys in the sample, so differences in observable characteristics are not going to emerge as an explanation for the gender gap in enrolment rates. Instead, it is the unexplained portion of the enrolment gap that dominates. This unexplained component is found from the predicted change in enrolment that would occur if the probability of enrolment for girls was determined by the probit coefficients for boys:

$$\text{UNEXPLAINED GAP} = P\left(X_f, \hat{b}_m\right) - P\left(X_f, \hat{b}_f\right) = 0.4772 - 0.4250 = 0.0522.$$

The explained and unexplained components do not add exactly to the predicted gap in enrolment rates, with the difference made up by a residual of 0.0058. Thus, the gap in enrolments between boys and girls cannot be explained by differences in observable characteristics of the two groups, and instead essentially represents differences in the way that households treat boys and girls.

Simulation Results

The probit models clearly indicate differences in the way that household factors affect the education of boys and girls. They also support targeting interventions at both individual level (to favour girls), and at regional level (to transfer the success of enrolling girls in the New Guinea Islands to other regions). However, the estimates in Table 3 are less suitable for answering the other two questions that motivated the analysis –the role of family background

variables and school availability – because the probit coefficients cannot be directly interpreted as marginal effects.

To overcome this interpretation difficulty, the probit models were used for some policy simulations (Figure 2). The first simulation shows that improving the access to Community School by reducing the required travelling time by 15 minutes would raise the enrolments of both boys and girls by approximately three percentage points. This similarity across boys and girls is in contrast to previous evidence, from Indonesia, that school availability has a stronger effect on female enrolments (Oey-Gardiner, 1991).

(Figure 2 about here)

The second simulation shows the effect of a half-unit increase in (log) expenditures per equivalent person, which is equivalent to an increase in the underlying variable of approximately 50 percent at the (geometric) mean. This simulated increase in permanent income would raise enrolments by about 2.5 percentage points, with a slightly larger effect for girls than for boys. Although this is a significant rise in the enrolment rate, it comes from a proportionate increase in income that exceeds the proportionate decrease in travelling time in the first simulation and yet the travelling time decrease produced a larger change in enrolments. This suggests that the availability of school facilities can play an important role in determining school attendance, although attention also needs to be paid to the quality of the resources available at schools (Glewwe, 1996).

The final simulations look at changing the level of education of adults in the household (as a proxy for parental education levels). Increasing the average years of schooling of each adult female by one year would raise girls' enrolments by about 2.5 percentage points and boys'

enrolments by only 0.5 points. The response to increases in adult men's schooling is lower and more evenly distributed; girls' enrolment probability goes up by about 2.2 percentage points and boys' enrolment rate goes up by about 1.8 percentage points. This tendency for men's education to raise both boys' and girls' enrolments while women's education has a significant impact only on girls' schooling has been found elsewhere (Al-Samarria and Peasgood, 1998; Glick and Sahn, 1999). The result also points to a vicious circle: girls have lower enrolments because adult women have not accumulated many years of schooling, and adult women have not accumulated many years of schooling because girls have low enrolment rates.

Summary and Implications

Nationally representative household survey data have been used in this paper to answer four questions about economic barriers to universal primary education in Papua New Guinea. The failure to achieve universal education in Papua New Guinea is likely to reduce future economic growth and impedes progress on other development goals. Hence, there may be some benefit in understanding the barriers to education.

The results suggest that family background variables such as income and parental schooling have a strong effect on the demand for children's education. However, differences in enrolments between boys and girls cannot be explained by observable characteristics and thus reflect some differential treatment within the household. One aspect of this is that girls' enrolments respond strongly to the higher schooling of adult women while boys' enrolments do not.

The results also show that the availability of school facilities has a major effect on children's school attendance. According to the simulation results, reductions in travelling time to the nearest school would raise enrolments by more than would the same proportionate increases in household incomes. This effect of increased school availability is likely to have an equal impact on the enrolments of boys and girls. The results of the econometric model also show that the substantial regional variation in enrolment rates for boys can be explained by variation in observable characteristics, such as household incomes and access to schools. But the regional variation in the enrolment rates for girls are not explained: controlling for individual, household and community characteristics, other regions lag significantly behind the New Guinea Islands in the enrolment of girls. Hence, targeted interventions at both individual level (to favour girls), and at regional level (to transfer the success of enrolling girls in the New Guinea Islands to other regions) may be required.

What can account for the success of the New Guinea Islands region in enrolling girls in primary school? A complete answer is beyond the scope of this paper because it may need to consider the wider social, cultural and institutional context but two points can be made here. First, women's economic and social status appears to be generally higher in the New Guinea Islands region than in other parts of the country. For example, it was only in this region that the household survey found better indicators of adult nutrition for women than for men.[5] This higher status of women may perhaps be traced back to the importance of matrilineal societies in the region (for example, the Tolai in East New Britain). Second, the success in enrolling girls in primary school cannot be isolated from the enrolment patterns at post-primary level because one of the benefits of primary education is that it is a necessary condition for post-

[5] The indicators considered are the body mass (or Quetelet) index, which is weight (kg) / [height (m)]^2, and the proportion with chronic energy deficiency, which occurs when the body mass index is below 18.5. Details are in Gibson and Rozelle (1998, p.89).

primary education (Appleton, Hoddinott and Knight, 1996). Hence, if parents do not expect their daughters to attend secondary school it may also reduce the demand for them to complete primary school. One barrier to secondary school enrolments for girls in many parts of Papua New Guinea is the need for long-distance movements away from the home area, which parents may be reluctant to allow because of the reduction in personal safety. This barrier may have been less apparent in the New Guinea Islands region, especially because there was correspondence school ("School of the Air") through to Grade 10 for children who stayed in their home villages in Manus province.

In summary, the evidence in this paper suggests that general-purpose economic growth and improvements in infrastructure in Papua New Guinea will help to raise the primary school enrolment rate. However, these policies will not break the cycle of low enrolments for girls and lower educational attainment for adult women because policies addressing incomes and infrastructure have fairly even effects on boys and girls. Instead, it may take more targeted policies to close the gender gap in enrolments and a good place to look for indigenous solutions would be in the New Guinea Islands region.

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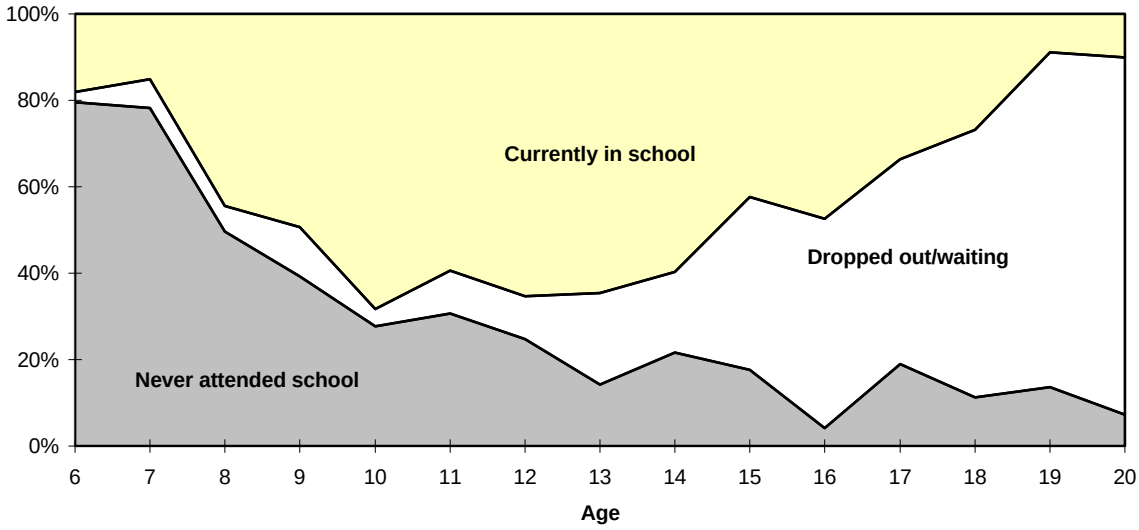
Figure 1 **Educational Status of Boys, 1995**



Educational Status of Girls, 1995

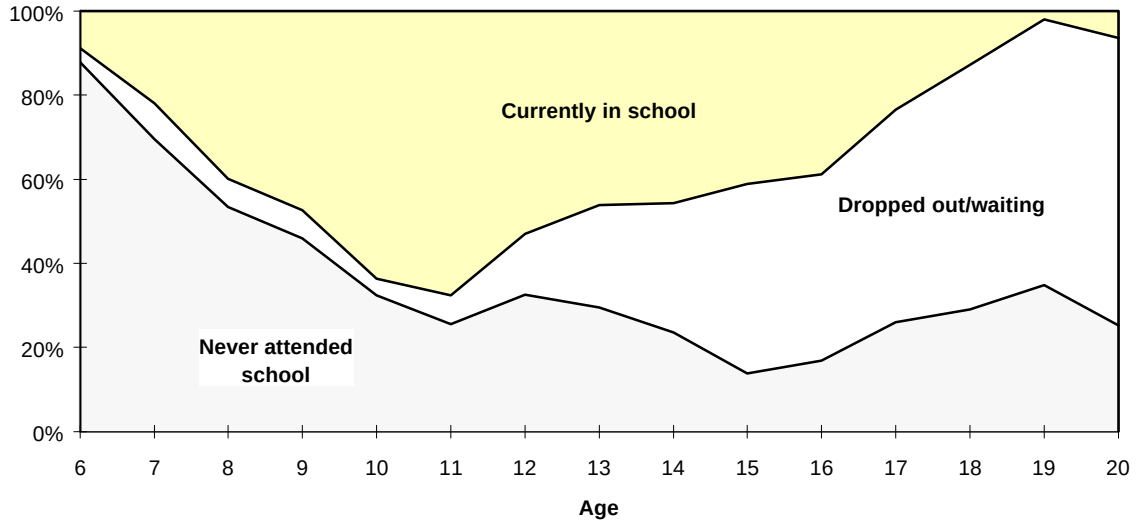
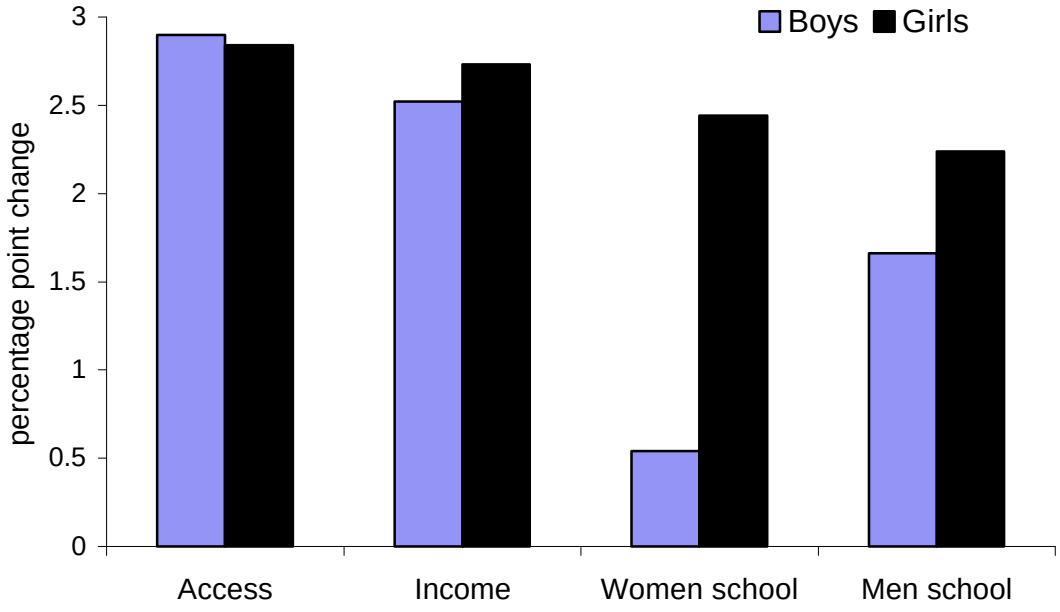


Figure 2 **Change in Probability of Enrolment**



Note: Probabilities are calculated for a 15 minute decrease in travelling time to the nearest community school (access), for a 0.5 unit increase in (log) expenditures per adult equivalent (income), for an extra year of education for each adult female in the household (women school) and for an extra year of education for each adult man in the household (men school).

Table 1 **Gross and Net Primary School Enrolment Rates, Papua New Guinea**

	Gross Enrolments			Net Enrolments		
	Male	Female	Total	Male	Female	Total
Income Group (Quartile)						
I (poorest)	69.9	53.7	62.0	45.9	38.0	42.0
II	63.1	58.4	61.3	47.6	34.6	42.6
III	80.3	74.6	77.7	61.3	64.5	62.8
IV (richest)	92.0	89.8	91.0	79.4	71.4	75.9
Region						
National Capital District	100.6	86.2	93.5	82.3	77.5	80.0
Papuan/South Coast	64.7	70.2	67.1	57.5	58.3	57.9
Highlands	66.9	61.7	64.7	46.6	45.6	46.1
Momase/North Coast	83.2	57.3	71.5	62.9	40.1	52.6
New Guinea Islands	92.1	97.7	95.1	73.5	71.6	72.5
Papua New Guinea	74.9	67.5	71.5	56.9	50.8	54.1

Notes: 1.The gross primary school enrolment rate is the ratio of the number, of any age, enrolled in Grades 1-6 to the number in the target age group (8-13 years). The net enrolment rate is the ratio of the number of 8-13 year old students enrolled in Grades 1-6 to the target age population. 2. The income groups are formed by ranking households according to the real value of consumption expenditure per adult-equivalent.

Source: Author's calculation from the results of the 1996 Papua New Guinea Household Survey.

Table 2 **Data description for model of primary school enrolments**

	Girls		Boys	
Variable	Mean	Std. Dev	Mean	Std. Dev
Child characteristics				
Enrolled in school in 1995?	0.425	(0.49)	0.475	(0.50)
Age of the child (years)	12.187	(2.99)	12.073	(2.94)
Child of household head	0.770	(0.42)	0.782	(0.41)
Household characteristics				
log expenditure per adult equivalent	6.315	(0.80)	6.326	(0.74)
log household size	1.961	(0.44)	1.983	(0.42)
Share of children 0-6	0.150	(0.13)	0.156	(0.13)
Share of children 7-14	0.303	(0.14)	0.312	(0.14)
Share of adults <51	0.478	(0.18)	0.478	(0.17)
Female household head	0.068	(0.25)	0.075	(0.26)
Men's years of school	4.038	(3.81)	4.027	(3.42)
Women's years of school	2.646	(2.92)	2.578	(2.95)
Community characteristics				
Travel time to school (minutes)	60.961	(98.68)	57.886	(86.80)
NCD	0.042	(0.20)	0.038	(0.19)
Papuan/South Coast	0.140	(0.35)	0.130	(0.34)
Highlands	0.418	(0.49)	0.457	(0.50)
Momase/North Coast	0.292	(0.45)	0.290	(0.45)
Number of observations	700		828	

Notes: 1. The means and standard deviations are weighted by household sampling weights. 2. Expenditure per adult equivalent is in national average prices, where the value of the regional poverty line is used as the spatial price deflator.

Source: Author's calculation from the results of the 1996 Papua New Guinea Household Survey.

Table 3 **Probit estimates of the determinants of primary school enrolments**

	Girls		Boys	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Child characteristics				
Age of the child	1.404	(6.17)***	1.529	(8.06)***
(Age of child)^2	-0.053	(5.93)***	-0.057	(7.79)***
Child of household head	0.256	(1.51)	0.033	(0.21)
Household characteristics				
log expenditure per adult equivalent	0.199	(2.54)**	0.169	(2.11)**
log household size	0.103	(0.62)	0.313	(1.89)*
Share of children 0-6	-0.328	(0.47)	-0.046	(0.06)
Share of children 7-14	-0.069	(0.09)	-0.393	(0.56)
Share of adults <51	-0.786	(1.30)	-1.095	(1.69)*
Female household head	-0.055	(0.20)	0.326	(1.34)
Men's years of school	0.082	(3.81)***	0.056	(2.51)**
Women's years of school	0.089	(3.09)***	0.018	(0.64)
Community characteristics				
Travel time to school (minutes)	-0.007	(3.63)***	-0.007	(3.14)***
NCD	-0.614	(2.29)**	0.170	(0.62)
Papuan/South Coast	-0.600	(2.04)**	-0.072	(0.25)
Highlands	-0.526	(2.03)**	-0.243	(1.13)
Momase/North Coast	-0.552	(2.09)**	0.117	(0.47)
Constant	-10.028	(5.83)***	-10.702	(7.10)***
F-statistic for overall model	$F_{(16,87)}$=13.13***		$F_{(16,87)}$=7.50***	
Number of observations	700		828	

Notes: 1. Each one-unit increase in an explanatory variable causes the standard deviation of an index to change by the magnitude of the associated probit coefficient. Applying the standard cumulative normal distribution to this index gives the predicted probability that the dependent variable equals one (i.e., that the child attends school). 2. Results corrected for the effects of clustering, sampling weights and stratification. 3. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Source: Author's calculation from the results of the 1996 Papua New Guinea Household Survey.

Appendix Table 1 **Endogenous probit estimates of the determinants of primary school enrolments**

	Girls		Boys	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Child characteristics				
Age of the child	1.407	(6.24)***	1.521	(8.00)***
(Age of child)^2	-0.053	(6.02)***	-0.057	(7.71)***
Child of household head	0.251	(1.47)	0.048	(0.30)
Household characteristics				
log expenditure per adult equivalent	0.139	(0.58)	0.341	(1.78)*
First stage residuals	0.074	(0.24)	-0.203	(1.07)
log household size	0.074	(0.40)	0.392	(2.11)**
Share of children 0-6	-0.321	(0.47)	-0.006	(0.01)
Share of children 7-14	-0.096	(0.13)	-0.261	(0.36)
Share of adults <51	-0.790	(1.30)	-1.020	(1.54)
Female household head	-0.062	(0.22)	0.348	(1.48)
Men's years of school	0.085	(3.53)***	0.046	(1.89)*
Women's years of school	0.092	(2.74)***	0.008	(0.25)
Community characteristics				
Travel time to school (minutes)	-0.007	(3.55)***	-0.006	(3.08)***
NCD	-0.603	(2.24)**	0.117	(0.44)
Papuan/South Coast	-0.583	(1.92)*	-0.116	(0.40)
Highlands	-0.500	(1.70)*	-0.324	(1.41)
Momase/North Coast	-0.540	(1.98)*	0.075	(0.30)
Constant	-9.627	(3.79)***	-11.896	(5.75)***
F-statistic for overall model	$F_{(17,86)}$=12.33***		$F_{(17,86)}$=7.03***	
Number of observations	700		828	

Notes: 1. Endogenous probit estimates allow for the possibility that expenditures are determined jointly with children's enrolments, rather than expenditures being an exogenous cause of enrolments. 2.The first stage regression predicting ln(expenditures per adult equivalent) uses all of the exogenous variables reported in model in Table 3, and as instruments includes variables measuring characteristics of the dwelling (floor area, number of rooms and whether the roof was iron), characteristics of the household head (age, literacy, years of schooling and whether working for wages), and indicator variables for the ownership of agricultural capital goods and pigs (the main form of wealth). The R^2 from the first stage regression was 0.37 and the *F*-test for excluding the instruments was $F_{(9,97)}$=6.96 which is significant at the p<0.01 level.

Source: Author's calculation from the results of the 1996 Papua New Guinea Household Survey.