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## **Demand for Skills, Supply of Skills and Returns to Schooling in Cambodia**

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**Abstract:** In this paper I take a detailed look into the returns to schooling in Cambodia using the 1997 and 2003-04 Socioeconomic Surveys of Households and alternative estimation techniques (OLS vs. Family Fixed Effects and Instrumental Variables). The main focus of the analysis has to do with differences by sector (public vs. private). In Cambodia, the average educational attainment of workers in the public sector is significantly higher compared to the private sector. Without considering issues of selection into the public vs. the private sector, the wage premium for one additional year of schooling in the private sector is about twice that in the public sector for both men and women. Furthermore, the average return to one additional year of potential labor market experience is higher in the private sector. This raises questions about the reasons for the self-selection of more educated workers in the public sector in Cambodia. The picture changes drastically, especially in the case of female employment, once the assumption that the location of individuals in the public and private sectors is the outcome of a random process. However, after correcting for selection bias using Heckman's correction, one additional year of schooling still increases earnings by more in the private sector for men, but the spread between sectors narrows. However for women, one additional year of schooling increases earnings in the public sector by more than in the private sector. Furthermore, now the return to one additional year of potential labor market experience is significantly higher in the public sector, for both men and women. Other findings indicate that the supply of more educated workers has outstripped demand, resulting in a decline in the return to tertiary education and a stable return to secondary education. The dynamics of the demand and supply of skills and their changes over the time suggest that the supply of post-primary skills is adequate, except perhaps in the private sector.

## **Introduction**

Standard educational attainment indicators for Cambodia are among the lowest in the region and the world, with illiteracy rates higher than those of its neighbors except Laos. Despite a remarkable improvement in enrolment rates in recent years, repetition and dropout rates in primary school remain very high. The inefficiency of the Cambodian education system represents a significant burden in terms of public and private cost of education that reduces the private and social returns to schooling and thus economic growth.

In 2003, the Royal Government of Cambodia adopted the Education For All National Plan for 2003-2015, whose fundamental thrust was to ensure that all Cambodia's children and youth have equal opportunity to access formal and non-formal education, independent of economic status, gender geography, physical disability and ethnicity.

From 2000 to 2004, public pre-schools increased from 952 to 1275 and the number of classes increased from 1628 to 2249. Primary school enrolment has grown by 13% from 2.4 million to 2.7 million over the four year period, with the majority of growth being in rural areas. Primary enrolment in remote areas has grown from 54,000 to 81,000 over the same period. The overall primary net enrolment rate (NER) has increased from 83.8% to 90.1% since 2000, with an 8% growth in female NER. Lower secondary education enrolments have increased significantly since 2000, from around 284,000 to 460,000. The number of lower secondary schools has increased from 511 to 688, mainly in remote communes (Quinio 2005).

While in every country, part of the direct or indirect costs of education are met by the household, the indirect costs (such as foregone earnings) constitute a heavy burden for some households, particularly the poorest, and can be a significant determinant of whether or not a child attends school. Bray (1999) showed that in the late 1990s households and communities in Cambodia were meeting an estimated 59.0 per cent of the total resources for primary

schooling, even in the public system of education. The government was providing an estimated 12.5 per cent, while the remaining cost was met by politicians, NGOs and external agencies. The proportion of costs met by households was, therefore, very large, larger than in most countries. This has implications for urban/rural and socioeconomic inequalities in Cambodia. The direct and indirect household costs reinforce each other to produce a critical barrier for the poor in upper primary and lower secondary schooling (Bray and Bunly 2005).

Labor force participation in Cambodia is high by international standards, at about 90 percent (95 percent for men and about 86 percent for women) in 2004. Overall, the largest single category of employment status was self-employment, at about 43 percent (57 percent for men and 31 percent for women), while for women, unpaid family labor is still the largest single category of employment status and the proportion of paid employment for women was very low at 13 percent (compared to 25 percent for men). Once domestic workers are excluded from paid employment, the share of women employed for wages is only 7 percent (compared to 16.5 percent of men) (Table 1). This means that only 8.3 percent of employed women and 17.4 of employed men worked for wages.

Years of schooling of the adult population vary widely in several dimensions: by employment status, gender, location of residence and family background. In 2004 the general adult population had 4.3 years of schooling on average (5.4 for men and 3.3 for women).

**Table 1: Summary Statistics (22-65 Age Group) - Cambodia 2003-4**

	All	Male	Female
<b>Education</b>			
- Years of schooling (general population)	4.28	5.44	3.33
- Paid employees	6.56	7.37	5.28
- For wages	8.39	8.83	7.55
- Public sector	8.36	9.34	9.41
- Private sector	7.29	7.99	6.47
- Self-Employed/Employers	3.88	4.42	3.08
- Employed in family business	3.35	5.46	2.78
- Out of LF/Unemployed	3.72	6.14	3.65
- % with no schooling (general population)	28.1	17.7	36.7
- Paid employees	16.4	10.7	25.3
- For wages	5.0	4.2	6.5
- % with primary incomplete (general population)	36.6	34.1	38.6
- Paid employees	25.4	22.8	29.3
- For wages	18.4	15.4	24.2
- % with primary (general population)	19.7	25.5	14.9
- Paid employees	22.6	23.9	20.5
- For wages	25.3	23.8	28.2
- % with lower secondary (general population)	11.8	16.8	7.6
- Paid employees	24.2	28.5	17.3
- For wages	33.5	36.5	27.6
- % with upper secondary (general population)	2.3	3.5	1.3
- Paid employees	6.8	8.0	5.0
- For wages	10.6	11.4	9.9
- % with university (general population)	0.9	1.6	0.4
- Paid employees	4.3	5.4	2.5
- For wages	6.8	8.1	4.4
<b>Labour Force Participation (%)</b>			
- Employed	89.9	95.0	85.7
- Share of paid employment	18.3	24.8	13.0
- For wages (excludes domestic workers)	11.3	16.5	7.1
- Share of self-employed/employers	42.7	56.7	31.1
- Share of unpaid employment	28.9	13.5	41.7
- Out of LF/unemployed	10.1	5.0	14.3
<b>Sectoral Composition of Employment (%)</b>			
- Primary	65.6	62.7	68.2
- Industry	7.8	8.4	7.2
- Services, other	26.6	29.0	24.6

Source: Socioeconomic Survey of Households 2003-05

Furthermore, average years of schooling vary from 3.8 for the self-employed to 8.4 for those employed for wages (4.4 and 8.8 for men and 3.1 and 7.6 for women, respectively) in 2003 (Table 1). This represents an increase from 3.5 years for the self employed (4.3 and 2.8 for men and women respectively) and 6.9 years for those employed for wages (7.2 and 5.9 for men and women respectively) in 1997. Twice as many women have no formal schooling compared to men, while the proportion of men with upper secondary and university qualifications is three and four times that of women, respectively. Among workers employed for wages, gender disparities in years of schooling are much narrower, but still one quarter of women in wage employment have not completed primary school, compared to 15 percent of men, while twice as many men employed for wages have university qualifications compared to women (8.1 vs. 4.4 percent).

There is a lack of empirical evidence on returns to education and in general on the nature of the wage structure in the labor market in Cambodia. Ridao-Cano (2003) used data which lacked a continuous earnings variable (2001 Labor Force Survey), in examining the links between skills and economic growth through the labor market. He found that, although the current supply of skills is low, there does not appear to be a strong demand for skills in the labor market, and that the high and increasing estimated returns to schooling (from OLS) in the labor market reflect a shortage in the supply of skills rather than an excess demand for skills.

In this paper, I take a detailed look into the returns to schooling in Cambodia using a more appropriate dataset (the 2004 Socioeconomic Survey of Households) and alternative estimation techniques (OLS vs. Instrumental Variables); I also examine returns for various sub-groups (men vs. women and public vs. private sector).

## Returns to Schooling in Cambodia

The analysis is based on the standard human capital model (Mincer, 1974). Earnings are modeled as a function of years of schooling (or education qualifications), potential experience and its squared and public vs. private sector employment, while in certain specifications dummy variables for place of employment are included (Phnom Penh and other urban areas). The dependent variable is the hourly wage, obtained using the information on hours worked.

Initially OLS estimates are obtained. Subsequently, acknowledging that it is problematic to interpret the estimated return to schooling as the causal effect of education on earnings due to the inability to control for ability as well as selection into schooling on the basis on unobservable gains to schooling in the labor market, Instrumental Variable (IV) estimates using a combination of instruments are derived and compared to OLS estimates.

Table 2 presents the mean hourly wage for those in wage employment by earnings (hourly wage) quantile and education qualification. As expected, the higher the education level, the higher the wage. University degree holders earn on average 1.8 times more than those with upper secondary qualifications and those with upper secondary education earn 1.25 times more than those with lower secondary education and 1.4 times those with primary education; on the other hand, the earnings of those with no education are indistinguishable to that of those with incomplete primary education. Finally, within each education level, earnings differences by quantile exhibit a similar pattern, whereby the slope of the quantile-earnings curve becomes steeper beyond the 75<sup>th</sup> quantile and even more beyond the 90<sup>th</sup> quantile.

Comparison of mean hourly wages by earnings quantile and education level between 1997 and 2004 (Tables 2 and 3), results in some notable observations. Looking at the mean hourly wage (last column), the overall wage as well as wages across the earnings distribution have changed significantly between 1997 and 2004. Significant increases in mean earnings are



observed especially for workers with higher education qualifications (especially university education), across all earnings quantiles.

**Table 2: Mean hourly wage (Riel) by quantile and school level (%) - Wage Employment – 2004**

Quantile/hourly wage	No school	Incomplete Primary	Primary	Lower Secondary	Upper Secondary	University	Mean
0-Q10	231.4	264.1	276.4	280.1	304.2	239.0	<b>275.0</b>
Q10-Q25	530.7	521.3	542.7	549.3	558.8	594.1	<b>545.3</b>
Q25-Q50	786.3	812.3	796.6	788.7	794.5	822.6	<b>798.5</b>
Q50-Q75	1,139	1,149	1,149	1,162	1,160	1,089	<b>1,150</b>
Q75-Q90	1,754	1,872	1,949	1,821	2,031	2,094	<b>1,934</b>
Q90-Q99	5,486	4,375	4,976	5,015	5,017	5,733	<b>5,140</b>
Mean	<b>1,094</b>	<b>1,139</b>	<b>1,274</b>	<b>1,404</b>	<b>1,760</b>	<b>3,183</b>	<b>1,535</b>
N*	154	610	873	786	713	275	3,437

Source: Socioeconomic Survey of Households 2003-05

\* Excludes observations for those with wages > the 99<sup>th</sup> percentile.

**Table 3: Mean hourly wage (Riel) by quantile and school level (%) - Wage Employment – 1997**

Quantile/hourly wage	No school	Incomplete Primary	Primary	Lower Secondary	Upper Secondary	University	Mean
0-Q10	124.1	138.5	139.9	145.2	151.8	135.0**	<b>139.7</b>
Q10-Q25	228.3	216.4	224.2	223.4	218.0	220.7	<b>222.0</b>
Q25-Q50	316.1	315.6	309.0	311.2	302.7	315.9	<b>309.8</b>
Q50-Q75	534.0	513.9	503.9	515.1	526.4	460.9	<b>513.2</b>
Q75-Q90	840.6	893.5	861.4	868.8	842.0	1,006	<b>870.7</b>
Q90-Q99	1,639	1,937	2,131	2,355	2,125	2,445	<b>2,121</b>
Mean	<b>542.5</b>	<b>778.2</b>	<b>584.8</b>	<b>587.1</b>	<b>754.9</b>	<b>1082</b>	<b>664</b>
N*	176	302	438	395	284	70	1,675

Source: Socioeconomic Survey of Households 1997

\* Excludes observations for those with wages > the 99<sup>th</sup> percentile.

\*\* Less than 5 obs.

OLS estimates of the wage premium associated with one additional year of schooling in Cambodia in 2003 seem low, at 6.5 and 6.2 percent for men and women respectively, based on the Mincerian specification with basic additional controls (Table 4). However, wage premiums have increased drastically between 1997 and 2003, with the return to one additional year of schooling doubling for men and quadrupling for women.

Including years of schooling squared in the specification (Table 5), suggests a convex relationship between earnings and years of schooling; however, it does not change the estimate of the wage premium. Including parents' years of schooling in the specification decreases the male estimate only slightly, to 5.2%. However, there is considerable heterogeneity with respect to parents' education. Those with more educated parents experience lower gains compared to those with less educated parents (2.9 vs. 5.2 percent), that is those from a more disadvantaged background benefit more from education.

**Table 4: OLS: Returns to Schooling – Employed for Wages, 22-65 years in 2003-4**

Variable	<u>Males</u>		<u>Females</u>	
	2003-4	1997	2003-4	1997
Years of schooling	0.065 (11.0)	0.031 (4.9)	0.062 (7.7)	0.015 (1.2)
Experience	0.017 (2.4)	0.022 (2.6)	0.025 (2.5)	-0.010 (0.8)
Experience <sup>2</sup>	-0.0002 (1.6)	-0.0004 (2.3)	-0.0005 (2.2)	0.0001 (0.5)
Married	0.043 (0.8)	0.135 (2.1)	-0.079 (1.6)	0.139 (1.9)
Phnom Penh	0.247 (5.9)	0.081 (1.7)	0.194 (3.6)	0.067 (0.7)
Other Urban	0.188 (3.9)	-0.027 (0.5)	0.104 (1.6)	-0.053 (0.5)
Public sector	-0.781 (19.1)	-0.768 (17.1)	-0.560 (9.4)	-0.385 (4.5)
Constant	6.37 (64.8)	5.89 (51.3)	6.40 (49.2)	6.17 (31.4)
R <sup>2</sup> adj.	0.242	0.191	0.146	0.046
N	1,825	1,261	911	400

Note: t-values in parentheses.

**Table 5: OLS: Regression Results<sup>a</sup> with Quadratic Years of Schooling and Family Background Variables-Men Employed for Wages, 22-65 years in 2003-4**

Variable	(1)	(2)	(3)
Years of schooling	-0.004 (0.2)	-0.026 (1.1)	-0.017 (1.0)
Years of schooling squared	0.0039 (4.3)	0.0052 (3.0)	0.0051 (4.2)
Experience	0.026 (3.8)	0.023 (3.3)	0.026 (3.8)
Experience <sup>2</sup>	-0.0004 (3.5)	-0.0004 (3.0)	-0.0004 (3.5)
Married	0.045 (0.8)	0.023 (0.4)	0.052 (0.9)
Phnom Penh	0.222 (5.3)	0.201 (4.7)	0.219 (5.2)
Other Urban	0.159 (3.4)	0.140 (3.0)	0.156 (3.4)
Public	-866 (21.5)	-0.868 (21.5)	-0.870 (21.5)
Father years of schooling	-	0.028 (1.4)	
Mother years of schooling	-	-0.001 (0.1)	
Father years*years of schooling	-	-0.0024 (1.2)	
Mother years*years of schooling	-	0.0015 (1.2)	
Parent low sec. or higher (At least one parent)	-	-	0.241 (1.6)
Parent low sec. or higher* years of schooling	-	-	-0.023 (1.5)
Constant	6.64 (67.0)	6.67 (62.6)	6.64 (63.8)
R <sup>2</sup> adj.	0.281	0.284	0.282
N	1,901	1,901	1,901

a. Results reported are for an identical sample with non-missing information on family background variables

**Table 6: OLS: Annualized Returns to Education Qualifications by Gender- Employed for Wages, 22-65 years in 2003-4**

Dependent Variable: log of hourly wage	Males		Females <sup>1</sup>	
	2003-04	1997	2003-04	1997
Primary*	0.072	0.012	0.046	0.001
(vs < primary)	(4.0)	(0.7)	(2.3)	(0.0)
Lower secondary	0.066	0.038	0.052	0.008
(vs primary)	(7.3)	(2.4)	(4.1)	(0.2)
Upper secondary	0.047	0.027	0.074	-0.015
(vs Lower sec.)	(8.7)	(3.1)	(5.8)	(0.1)
University	0.095	0.072	0.121	0.001
(vs upper sec.)	(10.6)	(4.1)	(7.0)	(0.1)
Experience	0.019	0.023	0.027	-0.016
	(2.6)	(2.6)	(2.6)	(1.2)
Experience Squared	-0.0002	-0.0004	-0.0006	0.0002
	(1.8)	(2.5)	(2.5)	(0.8)
Married	0.052	0.125	-0.090	0.135
	(1.0)	(2.0)	(1.8)	(1.8)
Phnom Penh	0.229	0.083	0.179	0.104
	(5.4)	(1.7)	(3.2)	(1.1)
Other Urban	0.179	-0.014	0.114	-0.036
	(3.7)	(0.3)	(1.7)	(0.4)
Public sector	-0.791	-0.747	-0.556	-0.342
	(19.2)	(16.7)	(9.2)	(3.9)
Constant	6.57	6.02	6.64	6.31
	(74.9)	(55.4)	(57.7)	(33.7)
R <sup>2</sup> adj.	0.244	0.189	0.144	0.036
N	1,825	1,261	911	400

\* three years of forgone earnings were assigned to primary education.

Note: t-values refer to comparisons with no schooling.

In 2003-4, the highest premiums are observed for university education (10% for men and 12% for women). The major changes between 1997 and 2003-4 are that the returns have increased for all education levels; in the case of women, while in 1997 the return to education and experience were non-existent, by 2003 women enjoyed returns similar to those of men. The increase in the R-sq of the regression (especially in the case of women) suggests that the human capital model became increasingly relevant in the labor market of Cambodia.

<sup>1</sup> Self-selection issues (using Heckman's procedure) are not explored in the estimation of the wage function for women, mainly because of the very high labour force participation of women in Cambodia, as well as because of the difficulty in finding relevant controls for the first stage regression.

While average educational attainment of workers in wage employment in the public sector (9.3 years for males and 9.4 years for females) exceeds that of the private sector (8 years for males and 6.5 for females), the wage premium for one additional year of schooling from OLS regressions in the private sector is about twice that in the public sector (estimated at 11.0% vs. 4.7% for men and 8.8% vs. 4.6% for women). Furthermore, the average return to one additional year of potential labor market experience is higher in the private sector (3.5 % vs. 2.3% for men and 1.5% vs. an insignificant 0.8% for women (Table 7). This raises questions about the reasons for the self-selection of more educated workers in the public sector in Cambodia.

The above findings are not unique to Cambodia. For example, Hyder (2007) finds that in Pakistan: "...a year of education yields a greater increase in wages in the private sector than the public sector, despite more educated workers being in the public sector". He also finds that in Pakistan there is a different reward system in the private sector (where the earnings gap is small), compared to the private sector, and that these findings perhaps reflect the scarcity of educated people in the private sector.

**Table 7: OLS: Returns to Schooling by Sector and Gender – Employed for Wages, 22-65 years, in 2003-4**

Variable	Public Sector	Public Sector	Private Sector	Private Sector
	Males	Females	Males	Females
Years of schooling	0.047 (8.3)	0.046 (4.0)	0.110 (13.2)	0.088 (11.3)
Experience	0.023 (3.5)	0.008 (0.6)	0.035 (3.4)	0.015 (1.6)
Exp. squared	-0.0004 (3.6)	-0.0002 (0.6)	-0.0004 (1.9)	-0.0000 (0.1)
Constant	5.90 (52.5)	6.22 (29.8)	5.96 (40.5)	6.31 (49.1)
R <sup>2</sup> adj.	0.061	0.036	0.188	0.162
N	1,476	451	759	746

Note: t-values in parentheses.

**Table 8: Returns to Schooling with Correction for Selection\* by Sector and Gender – Employed for Wages, 22-65 years in 2003-4**

Variable	Public Sector	Public Sector	Private Sector	Private Sector
	Males	Females	Males	Females
Years of schooling	0.087 (13.2)	0.090 (3.7)	0.134 (10.4)	0.073 (5.7)
Experience	0.056 (7.7)	0.031 (1.8)	0.058 (4.4)	0.004 (0.4)
Exp. squared	-0.0006 (4.8)	-0.0002 (0.8)	-0.0005 (2.4)	0.0000 (0.1)
Constant	4.73 (34.4)	5.13 (11.0)	5.72 (32.4)	6.42 (43.4)
Selection term	0.645 (16.8)	0.386 (2.7)	-0.362 (2.9)	0.132 (1.5)
Wald Chi <sup>2</sup>	187.4	23.7	143.7	66.4
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]
Chi <sup>2</sup> for rho=0	50.6	2.93	6.23	2.52
[p-value]	[0.000]	[0.085]	[0.012]	[0.112]
N	2,400	1,247	2,259	1,211
Uncensored	1,476	451	759	746

Note: t-values in parentheses. \* The regressors used in the first stage are: age, agesq years of schooling, marital status Phnom Penh residence and other urban residence. All regressors were statistically significant.

The picture changes substantially once the assumption that the location of individuals in the public and private sectors is the outcome of a random process. Given the observations

outlined in this paragraph, selectivity seems to be biasing the estimates in the OLS regressions. In Table 8, selectivity corrected estimates are given using Heckman's correction. The estimates of the wage premium are now substantially different. For men, one additional year of schooling still increases earnings more in the private sector (by about 13.4% in the private sector compared to 8.7% in the public sector), but the discrepancy is now smaller. On the other hand, for women, one additional year of schooling increases earnings by nearly 9% in the public sector, compared to only about 7.3% in the private sector. Furthermore, now the return to one additional year of potential labor market experience is significantly higher in the public sector, for both men and women.  $\chi^2$  tests for the hypothesis that  $\rho=0$  are generally rejected. Therefore, selectivity correction is justified. These results may be of some help in explaining why workers in Cambodia are attracted to the public sector. However, there are other reasons also that may result in a self selection of workers in the private sector.

Those with more schooling but of lower ability/skills may be attracted to the sector which is less risky in terms of earnings (small spread of earnings), provides more job security, arguably less demanding work conditions, etc. On the other hand, the private sector attracts those with higher ability (including non-cognitive ability) who have more appetite for risk, as well as those with no schooling/low schooling who cannot enter the public sector. As a result, in the private sector there may be a group with less than average formal schooling but more diverse in terms of ability/skills. This leads to a more wide distribution of earnings.

Before getting into endogeneity issues and IV estimation, I use a siblings sample and family fixed effects estimation. When there is reason to believe that the most important unobservables are at the household level, the appropriate strategy would be to use household fixed effects estimation (for a discussion, see Altonji and Dunn 1996). An analysis of siblings may help alleviate the endogeneity bias associated with returns to education estimates. The

assumption is that if one eliminates the part of unobserved heterogeneity which is common to members of the same family, the endogeneity problem is reduced. On the other hand, fixed effects estimation does not deal with measurement error which can bias downward the estimates of the return to schooling. In this case, family fixed effects estimation reduced the estimate of the wage premium associated with one additional year of schooling by about 10% compared to the OLS estimate (Table 9).

**Table 9: OLS and Family Fixed Effects: Regression Results-Male Siblings**

Variable	OLS			Family fixed effects		
	1	2	3	1	2	3
Years of schooling	0.070 (5.8)	-0.010 (0.3)	-0.011 (0.3)	0.061 (4.8)	-0.015 (0.4)	-0.014 (0.4)
Years of schooling squared	-	0.0044 (2.2)	0.043 (2.2)	-	0.0042 (2.1)	0.0042 (2.2)
Experience	-0.085 (2.8)	-0.052 (1.6)	-0.052 (1.6)	-0.099 (3.2)	-0.070 (2.1)	-0.070 (2.1)
Experience <sup>2</sup>	0.004 (2.9)	0.0023 (1.5)	0.0022 (1.5)	0.004 (3.2)	0.0028 (1.8)	0.0029 (1.9)
Married	-0.224 (1.9)	-0.231 (2.0)	-0.232 (2.0)	-0.203 (1.7)	-0.211 (1.9)	-0.209 (1.8)
Public	-0.805 (10.2)	-0.818 (10.5)	-0.820 (10.5)	-0.737 (9.1)	-0.752 (9.3)	-0.749 (9.2)
Father low sec. or higher* years of schooling	-	-	0.0020 (0.3)	-	-	-0.0024 (0.4)
Constant	6.98 (29.9)	7.15 (29.3)	7.16 (29.1)	7.14 (29.8)	7.31 (19.1)	7.30 (28.9)
R <sup>2</sup> adj./ R <sup>2</sup> within	0.353	0.362	0.360	0.343	0.353	0.353
F-test (Homo. Returns) (p-value)	-	-	-	1.60 (0.055)	1.59 (0.058)	1.59 (0.059)
N	306	306	306	306	306	306

Note: t-values in parentheses.



### Instrumental Variables (IV) Estimates

In addressing endogeneity<sup>2</sup> in the estimation of the effect of earnings on wages, multivariate methods involving instrumental variables estimation<sup>3</sup> will be used.

Consider the model:

$\log w_i = \beta S_i + X_i \gamma + u_i$ , along with the schooling equation:

$$S_i = Z_i \alpha + \varepsilon_i$$

where the  $Z$  vector contains variables that are not contained in  $X$ . If  $S_i$  is not exogenous, the two error terms will be correlated and the OLS estimates will be biased. This is typically because one or more relevant variables which influence both schooling and earnings are omitted from vector  $X$ . Such variables can relate to observed and unobserved ability (motivation being a frequently mentioned example). Using the schooling equation, predicted schooling enters the earnings equation in place of actual schooling. While predicted schooling is correlated with actual schooling, it should not be correlated with the error term in the earnings equation, and the estimate of the effect of schooling on wages arising from this approach can be considered unbiased.

In the case of the Cambodian data at hand, one can use information on smoking at an early age and spouse's education. The Socioeconomic Survey of Households 2003-04 contains all the necessary information for a detailed examination of returns to education in Cambodia.

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<sup>2</sup> There are 2 potential endogeneity problems. One is the *ability bias* resulting from correlation between unobserved ability and observed schooling; the second is the *self-selection* – individuals with higher expected returns to education may decide to acquire more education. Another, different but potentially important problem is the presence of *measurement errors* (reporting errors) in the earnings or education variables. Such measurement errors, especially in reported education, results in attenuation bias in the estimates of the returns to education. Instrumental variables estimation is also used to address this problem.

<sup>3</sup> One needs to be aware that neither the OLS nor the IV estimation results in a unbiased and consistent estimator of the mean return to education in the presence of heterogeneity and selection and that the OLS and IV methods do not identify the causal effect of education (see discussion at the end of this section).

The rationale for using smoking as an instrument is given in Evans and Montgomery (1994) where it is argued that smoking is indicative of strong particular time preference: that is, high discount rates so that individuals who smoke show that they place considerable weight on satisfying current wants at the expense of the future. Smoking at age 16 is not correlated with current earnings but is correlated with educational choices. From the scarce past empirical evidence using smoking as instrument (for an overview, see Harmon, Oosterbeek and Walker 2000), we observe larger estimated returns from the IV estimation than from OLS estimation. The element of this body of work that seems most noticeable is the often very large returns obtained when current smoking (instead of early smoking) is used (estimates of around 20 percent), compared with the more modest increases when early smoking is used. For reasons already mentioned in this paragraph, there may be some violation of the strict rules for the validity of the instrument when using current smoking, in that some correlation with current earnings is quite likely. Therefore, I'll be using smoking by the age of 16 instead of current smoking behavior.

Spouse's education has been suggested as a possible valid instrument by Trostel, Walker, and Wooley (2002) who explored the independence of wife's education from husband's earnings and its interaction with husband's education (for another application, see also Arabsheibani and Mussurov 2006). These studies relied on the assortative nature of marriage, as married couples share common interests and behavioral traits, and they usually share a common level of schooling (Pencavel, 1998). On average, Trostel *et. al.* (2002) obtain IV estimates using spouse's education to instrument for schooling which are over 20% higher than the corresponding OLS estimates, suggesting that conventional OLS estimates may be biased downwards. Arabsheibani and Mussurov (2006) also find that spouse's education is a

valid instrument and that the conventional OLS estimates which do not control for endogeneity bias, may underestimate the true rates of return.

In Table 10 I present the IV estimates. Age and age squared is used instead of experience and its squared to avoid further endogeneity issues. OLS estimates using the same specification are also given for comparison purposes. Using the combination of these 2 instruments<sup>4</sup>, the wage premium from the IV regression is about 50% higher, compared to the OLS estimate. The over-identification test, using the (albeit not particularly strong) Hansen statistic, is satisfied. Estimation by sector of employment (Table 11) resulted in higher IV estimates in private sector employment. While the IV and OLS estimates (5.5% and 4.8% respectively) of the wage premium in the public sector are statistically equal based on the Wu-Hausman test, in the private sector the IV estimate is nearly double the OLS estimate (17.1% vs. 9.6%). In both cases the p-value associated with Hansen's test are very high.

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<sup>4</sup> First stage regression results show that smoking by age 16 is a much weaker instrument compared to spouse's education. Consequently, the IV estimates are mostly driven by spouse's education.

**Table 10: Returns to Schooling from IV – Males Employed for Wages, 22-65 years in 2003-4**

Variable	OLS	OLS	IV <sup>a</sup> :	IV <sup>a</sup> :
Years of schooling	0.065 (14.1)	0.055 (11.1)	0.096 (8.6)	0.083 (6.4)
Age	0.057 (4.8)	0.048 (3.6)	0.062 (4.8)	0.051 (3.5)
Age squared	-0.0006 (4.4)	-0.0006 (3.5)	-0.0007 (4.3)	-0.0006 (3.3)
Married	-	0.021 (0.4)	-	0.050 (0.8)
Phnom Penh	-	0.249 (6.0)	-	0.161 (2.9)
Other Urban	-	0.161 (3.5)	-	0.139 (3.0)
Public	-0.912 (22.8)	-0.867 (21.3)	-0.954 (20.3)	-0.919 (18.2)
Constant	5.69 (24.6)	5.83 (24.0)	5.32 (19.5)	5.55 (19.0)
R <sup>2</sup> adj./ centered R <sup>2</sup>	0.263	0.276	0.247	0.267
N	1,902	1,902	1,902	1,902
<b>First Stage:</b>				
Shea's partial R <sup>2</sup>	-		0.225	0.180
F-value			275.4	207.7
(p-value)			[0.000]	[0.000]
<b>Over-identification Test:</b>				
Hansen's J-statistic	-	-	0.005	0.011
(p-value)			[0.944]	[0.915]
<b>Endogeneity Test:</b>				
Wu-Hausman F-test	-		13.18	7.34
(p-value)			[0.000]	[0.007]

Note: t-values in parentheses; estimates are for an identical sample with non-missing information on the 2 instruments used.

a: Instruments: Smoked by age 16 and Spouse's education.

**Table 11: Returns to Schooling from IV in Public vs. Private Sector – Males Employed for Wages, 22-65 years in 2003-4**

Variable	Public				Private			
	OLS	IV <sup>a</sup> :	OLS	IV <sup>a</sup> :	OLS	IV <sup>a</sup> :	OLS	IV <sup>a</sup> :
Years of schooling	0.048 (8.8)	0.055 (4.4)	0.041 (7.0)	0.044 (3.0)	0.096 (11.3)	0.171 (9.6)	0.078 (8.7)	0.152 (6.3)
Age	0.037 (2.5)	0.039 (2.4)	0.036 (2.2)	0.037 (2.1)	0.064 (2.8)	0.065 (2.7)	0.052 (2.1)	0.050 (1.9)
Age squared	-0.0004 (2.5)	-0.0005 (2.4)	-0.0004 (2.2)	-0.0004 (2.1)	-0.0007 (2.2)	-0.0006 (1.9)	-0.0006 (1.8)	-0.0005 (1.5)
Married	-	-	-0.043 (0.5)	-0.043 (0.5)	-	-	0.046 (0.5)	0.151 (1.6)
Phnom Penh	-	-	0.157 (3.2)	0.149 (2.3)	-	-	0.420 (5.5)	0.169 (1.6)
Other Urban	-	-	0.101 (1.9)	0.100 (1.9)	-	-	0.293 (3.1)	0.159 (1.6)
Constant	5.41 (17.2)	5.30 (13.5)	5.46 (16.8)	5.42 (13.2)	5.22 (12.7)	4.50 (9.8)	5.41 (12.7)	4.82 (10.2)
R <sup>2</sup> adj./ centered R <sup>2</sup>	0.060	0.061	0.071	0.071	0.190	0.087	0.228	0.148
N	1,302	1,302	1,302	1,302	600	600	600	600
<b>First Stage:</b>								
Shea's partial R <sup>2</sup>	-	0.212	-	0.172	-	0.255	-	0.201
F-value		174.5		134.7		101.9		74.5
(p-value)		(0.000)		[0.000]		(0.000)		[0.000]
<b>Over-identification Test:</b>								
Hansen's J-statistic	-	0.001 (0.978)	-	0.015 (0.902)	-	0.060 (0.439)	-	0.045 (0.504)
<b>Endogeneity Test:</b>								
Wu-Hausman F-test	-	0.44 (0.507)	-	0.41 (0.839)	-	28.44 (0.000)	-	21.22 (0.000)

t-values in parentheses.

a: Instruments: Smoked by age 16 and Spouse's Education

Instrumental Variables estimates, therefore, exceed OLS estimates and in the case of men in the private sector the differences are large. Similar evidence has been emerging with regularity in the empirical literature for some time. The intuitive rationale for using IV to correct for omitted ability bias goes hand in hand with the expectation that  $\beta_{IV} < \beta_{OLS}$ . This is what one expects in a constant coefficient model, where  $\beta$  ("the" effect of schooling) is unique, but not necessarily in the presence of heterogeneity in returns. As noted as far back as Griliches (1977) and more recently in Card (2001), a persistent finding is the opposite:  $\beta_{IV} > \beta_{OLS}$ . The most

obvious possible explanation would be a large (classical) measurement error which results in a downward bias of the OLS coefficient. This would not be a convincing explanation in the case of, say, the USA since schooling is relatively well measured. On the other hand, the measurement error may be large in the case of Cambodia and this may have something to do with our results.

However, it is more likely that our findings, which are representative of those summarized in the literature, would benefit from other explanations put forward to explain the empirical regularity of such findings. The suggestion by Card (2001) is that with heterogeneity in the returns to schooling,  $\beta$  is a random variable correlated with schooling. While OLS estimates of the average return are upward biased, IV estimate the return to schooling for individuals at the margin; then to the extent that IV estimates exceed the corresponding OLS estimates, the individuals at the margin have higher returns than the average individual. Heckman *et. al.* (2005) point out that implicit in Card's argument is the assumption that it is not possible for the average individual to have a higher return than the marginal individual and still find that that  $\beta_{IV} > \beta_{OLS}$ .

Recent theoretical and empirical analyses (for example, Carneiro and Heckman, 2002; Carneiro, Heckman and Vytlačil, 2005) drawing from earlier work by Willis and Rosen (1979) have added more wisdom on the interpretation of IV estimates, with the realization that in a model with heterogeneous returns, intuitions about ability bias are not as simple as previously thought. They show that a more likely possibility is that  $\beta_{IV} > \beta_{OLS}$  not because the marginal student has a higher return than the average student, but because the unobserved abilities of those who acquire more schooling and those who do not are negatively correlated. They show empirically using USA data, that the marginal return is below the average for college goers while simultaneously,  $\beta_{IV} > \beta_{OLS}$ . Heckman *et. al.* (2005) use the following example for

illustration: if individuals who acquire more schooling become teachers and those who do not become plumbers, then the latter are better plumbers than the average teacher would be if he became a plumber. Here, unlike the Griliches (1977) model in which the most able go to school, there can be multiple abilities which can be arbitrarily correlated.

What can one make of the size of the returns to schooling in Cambodia, as a function of the relative demand and supply of skills? The returns to one additional year of schooling is significant in the private sector (high dropout, repetition rates and other quality of schooling issues notwithstanding), especially for men. This means that there is a relative shortage of skills in the private sector and a contributing factor may be the public sector's attraction of more educated workers (for relatively modest monetary rewards, but possibly attractive non-monetary premiums). On the other hand, overall, the return to schooling in Cambodia continues to stay at levels below those for countries at comparable levels of development.

Finally, based on the return to education level estimates, the highest premiums seem to be for university education. However, between 1997 and 2003, excess demand in the labor market basically due to insufficient demand, resulted in an increase in the return to education across the board for both men and women. Despite this increase, by 2003 the supply of skills is adequate, except perhaps in the private sector. Improving school quality could be the immediate target of policies for education expansion.

Cambodia has yet to embark on a path to high growth. The labor market manifestation of this is the modest increase in demand for skilled labor, in the presence of insignificant growth in the corresponding supply in the 1997-2003 period. Any plan for Cambodia's expansion of the pool of skilled labor, must be combined with the creation of new sources of growth in the economy. This is important because recent significant increases in primary and secondary school enrollments will eventually increase the supply of skilled workers in the

labor market. Cambodia's approach could be similar to other countries in Asia (especially SE Asia), starting with policies nurturing an attractive environment for FDI and infusion of technology, skills intensive industries etc., with the establishment of industrial zones near border areas.



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