رؤية قطر الوطنية
Qatar National Vision

استراتيجية التنمية الوطنية
National Development Strategy

الأمانة العامة للتخطيط التنموي
General Secretariat for Development Planning

An Educated Population in 2030:

Returns to Schooling in Qatar

Department of Social Development
General Secretariat for Development Planning

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The views, opinions and interpretations of data expressed in this publication are those of the Project Team and not necessarily those of the General Secretariat for Development Planning.

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Foreword

Qatar's education system is evolving rapidly in response to a series of reforms. The system comprises six years of primary schooling, followed by three years each at the preparatory and secondary levels (K-12). Primary and secondary education are delivered through two types of schools, overseen by the Supreme Education Council, government-funded Independent schools and private schools.

Beyond primary and secondary schooling, high quality education and training are provided at the tertiary level, including opportunities for life-long learning. Qatari high school graduates have an option of entering Qatar University, or one of six highly reputed international universities in Education City, or receiving technical or vocational training.

The QNV 2030 foresees a modern world-class education system that provides young people with opportunities to realise their full potential, and that meets the needs of a knowledge-economy. To achieve this latter goal, a range of advanced skills will be required and this poses many challenges to policy makers. For example, school curricula at all levels must be able to respond to the current and future needs of Qatar's labour market.

This publication has been prepared to reflect the technical analysis that underpins the policies and programmes of Qatar's first National Development Strategy (NDS), 2011-16. It details the rates of returns to schooling for Qatar, utilising national datasets collected by the Qatar Statistics Authority (QSA) through the 2006-7 Household Income and Expenditure Survey (HIES), and the 2006 and 2008 Labour Force Surveys (LFSs).

Experience and skills acquired through formal education have both a monetary and non-monetary impact on a person's life. Education has external benefits as it helps improve an individual's decision throughout life, in health, marriage, parenting and social responsibility. This report focuses on the monetary benefits of education, on the assumption that better education will lead to higher earnings. The findings are based on an application of the human capital earnings function (HCEF), a model commonly used by developed and developing countries.

The results of the study presented analyses that show the returns to schooling for men are higher than those for women. Higher education is economically more beneficial where the marginal rates of return for one more year of schooling at this level is significantly higher than the marginal return at primary and secondary schooling. The results further show that schooling raises the probability that a Qatari woman will work, and if they do work, higher levels of education will lead to increased incomes.

This report also contains an analysis of the 2006 and 2008 LFS data sets that identifies the *determinants of female labour force participation*. This analysis supports the identification of policies that will direct the country towards

achieving the QNV 2030's ambition of enhancing women's capacity in the economic spheres. The results show that education is a key determinant of participation, especially schooling at the secondary level and above. By raising income when employed, higher levels of schooling encourage more women to take up, or seek, employment.

The results of this study thus provide a quantitative case to justify an aggressive policy to encourage Qataris to continue participation in education beyond secondary schooling, and for government to raise public awareness of these benefits. The current low male continuation rates to higher education suggests, *inter alia*, that there may be a lack of awareness and knowledge of the potential economic returns to higher levels of schooling. They also show that promoting higher education for women will raise labour force participation rates. Policy and programmes to support women in the labour force should be considered as female education attainment levels continue to rise.

GSDP is committed to ensuring that the policies, programmes and projects for the NDS are evidence-based. I would like to thank HE Sheikh Hamad bin Jabor bin Jassim Al-Thani, President of QSA, for providing the HIES and LFS data to GSDP. I would also like to thank all members of the project team (listed on page v) for their tremendous efforts, commitment and professionalism in putting this publication together. I am confident that it will be of considerable value to those concerned with education and labour market issues, and that it will be a useful tool for policymakers in Qatar and beyond.

Ibrahim Ibrahim
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Introduction

Introduction

"Education is key in building a culture of peace, peace as a positive, responsible and conscious action for our present and future generations".

HH Sheikha Mozah bint Nasser Al Missned at the World Innovation Summit for Education-WISE, 2009

Qatar launched its long-term vision, the Qatar National Vision (QNV) 2030 in October 2008. The QNV 2030 aims to transform Qatar into a country that is capable of sustaining its own development and providing a high standard of living for current and future generations. It rests on four pillars: human, social, economic and environmental development that enunciate the principles that can guide the country onto a sustainable path of development. In support of the QNV 2030, 5-year medium-term National Development Plans will provide a feasible path towards the sustainable achievement of the QNV 2030 development goals.

The human development pillar aims to have in place by 2030 an educational system that will meet the needs of the Qatari society. It will ensure that curricula and training programmes are responsive to the labour market and ensure that opportunities are available to all Qatari citizens in addition to promoting and developing mind-sets for life-long learning.

Macroeconomic studies of economic growth increasingly emphasize the role played by education in explaining why some countries experience more favourable growth than others. Sianesi and Van Reenen (2003) review this evidence and conclude that, taken as a whole, a one-year increase in average education raises the level of a country's output per capita by between 3 per cent and 6 per cent. And tertiary education appears to be the most important level of education for growth in OECD countries. Of course it is always possible that countries with a more favourable growth performance are more able to afford to raise their schooling levels – the causal mechanism is the reverse. Nevertheless the importance of schooling in so many macro studies

of economic growth highlights the central role it plays in economic development.

In this monograph we use survey data to analyze the impact that schooling has on the incomes of Qatari men and women. We do this by estimating the *private rate of return to schooling*[1]: by how much will future incomes rise as a result of an additional year of formal education? When schooling choices are made by individuals, this will clearly be an important deciding factor.

The human capital theory states that schooling decisions can be analyzed in just the same way that investment decisions are more generally analyzed. The (investment) cost of an additional year's schooling will be thought worthwhile if it leads to a higher level of expected future earnings than would otherwise have been received. Education at all levels is freely available for Qataris, so the cost of a year's schooling is dominated by the income foregone, i.e. the *opportunity cost*. According to the standard theory, education is viewed as an investment, rather than a consumption activity. This may be thought a rather narrow view of the learning experience but there is now a substantial body of evidence to suggest that the human capital theory has identified the single most important issue in schooling choice.

The private return to schooling may not exhaust the benefits schooling will bring for the individual or the community within which he or she lives. Experiences and skills acquired in school and university reverberate throughout life, not just through higher earnings. Schooling may lead individuals to make better decisions about health, marriage and parenting. Indeed, in their recent NBER paper Oreopoulos and Salvanes (2009) have shown that such non-pecuniary returns are at least as large as the monetary returns that we focus on in this monograph.

[1] By 'private' we mean the return to schooling enjoyed by the individuals themselves rather than society at large. As we shall later argue, education may have additional social benefits not captured by the returns we report here.

There are also likely to be substantial *social* benefits to schooling. Education has important and significant 'spill-over' effects on other members of society. Blundell *et al* (2005) suggest a number of reasons why society may additionally benefit from schooling: 'spill-over effects from technical progress or knowledge accumulation, better public health, better parenting, lower crime, a better environment, wider political and community participation, greater social cohesion – all of which are in turn likely to feed back into economic growth' (p.122). These social benefits present a compelling case for government policy intervention. Decisions taken on the basis of the private returns alone will clearly lead to under-investment from the viewpoint of society at large. But in order to analyze how much policy intervention is required, a necessary first step will be to estimate the private returns. And this is our primary focus here.

The monograph is divided into 4 chapters for ease of reference. This introductory chapter also contains a brief description of the data records of Qatar Statistics Authority's (QSA) Household Income and Expenditure Survey (HIES), 2006/7[2] used to estimate the rates of return to education for Qatari men and women. In Chapter 2, we outline the findings derived based on the application of the HIES data using the 'human capital earnings function' (HCEF). Chapter 3 details a discussion on the impact of self-selection on the returns to schooling for women and also discusses the employment and labour force participation probabilities of Qatari females. The final Chapter summarises the main findings and implications for public policy.

Household Income and Expenditure Income Survey (HIES)

We begin by considering the educational attainment of Qatari men and women sampled in the *HIES* 2006/7 aged 25 years and above. The choice of this age range is to cover only those individuals who are likely to have

[2] Qatar Statistics Authority (2008).

completed their formal schooling.[3] The 3,442 individuals of this age in the *HIES* are evenly split across the sexes.

Table 1.1 sets out the distribution of these individuals by educational attainment. Close to a quarter of male Qataris sampled have secondary schooling and a quarter have university degrees. The figures are similar for females with fewer at secondary level (around a fifth) and over a third of Qatari females over 25 have university degrees.

Table 1.1 **Educational Attainment and Incomes[a] by Sex, Qatari Individuals Aged 25 and above, HIES 2006/7**

	Males		Females	
Educational Attainment	**Frequency (%)**	**Mean Income[b] (QR)**	**Frequency (%)**	**Mean Income[b] (QR)**
Illiterate	6.9	118,313	14.9	73,509
Read and Write	7.5	202,743	10.5	50,733
Primary	13.6	132,898	7.6	62,496
Preparatory	18.0	158,474	10.3	75,031
Secondary	22.7	148,812	18.0	81,950
Diploma	3.8	215,650	2.3	110,597
University	24.4	237,796	35.6	112,732
Postgraduate	3.1	302,068	0.8	183,241

Notes
a Weighted
b Employment and self-employment income of those working
Source of data: Computed from QSA's HIES, 2006/7

The table also shows the mean annual income from employment and self-employment[4] received by working individuals. These generally have the expected pattern, with mean incomes of individuals rising with their educational attainment and male incomes being significantly higher than those of females.[5]

[3] Any individuals over 25 who are still in education are also dropped from the sample. In the econometric work reported below we widen the sample to include individuals 18 and over, omitting all individuals classified as students in the survey.
[4] In this section income is defined as including both income from employment and income from self-employment. The term non-wage income will be used for other income sources (such as property income) for the individual or household.
[5] Sex differentials may not be solely due to discrimination in labour markets. Female workers may well be more inclined to choose employment with fewer hours.

The exception is the mean income of males with little or no schooling – 7 per cent of Qatari males over 25 years old can only read and write and yet, perhaps unusually, their mean income exceeds that of males with secondary schooling. This somewhat extreme case illustrates a more general problem with interpreting Table 1.1: the means cover individuals of different ages. Incomes vary with age (or more precisely with work experience) - generally forming an 'inverted U-shape' over the life cycle. It is also the case that older cohorts in the sample are likely to have received less formal schooling than younger cohorts. The sample of men in the survey with no schooling will contain a large number of older individuals whose incomes may be high through life-cycle (age) effects.

Table 1.2 **Educational Attainment and Incomes by Sex, Qatari Individuals Aged 25-34 Years, HIES 2006/7**

	Males		Females	
Educational Attainment	**Frequency (%)**	**Mean Income[b] (QR)**	**Frequency (%)**	**Mean Income[b] (QR)**
Illiterate	0.3	384,000	2.3	-
Read and Write	3.4	123,566	4.2	-
Primary	13.4	124,254	4.2	121,200
Preparatory	21.4	110,487	11.5	76,288
Secondary	34.8	116,751	27.5	82,595
Diploma	2.5	151,408	2.6	106,270
University	23.7	193,039	47.5	104,141
Postgraduate	0.7	232,517	0.4	185,705

Notes
a Weighted
b Employment and self-employment income of those working
Source of data: Computed from QSA's HIES, 2006/7

Table 1.3 **Educational Attainment and Incomes by Sex, Qatari Individuals Aged 35 Years and Over, HIES 2006/7**

	Males		Females	
Educational Attainment	**Frequency (%)**	**Mean Income[b] (QR)**	**Frequency (%)**	**Mean Income[b] (QR)**
Illiterate	10.5	93,581	22.0	73,509
Read and Write	9.7	224,425	14.1	50,733
Primary	13.8	138,710	9.5	58,568
Preparatory	16.2	190, 636	9.6	74,163
Secondary	16.2	197,100	12.7	80,791
Diploma	4.6	234,718	2.1	115,087
University	24.8	261,918	29.0	121,305
Postgraduate	4.4	308,747	1.0	182,635

Notes
a Weighted
b Employment and self-employment income of those working

Source of data: Computed from QSA's HIES, 2006/7

Tables 1.2 and 1.3 present attainment and mean incomes for individuals respectively aged 25-34 and 35 years and over. The overall weighted mean income of younger individuals is QR122,203 and that for the older cohort QR183,045 – the longer work experience raises mean incomes by 50 per cent. This suggests that the high mean income for males who can only read and write could be due to a life-cycle effect. Amongst the younger cohort with this lack of schooling, incomes are lower than others with a higher level of schooling.

Younger males have higher levels of schooling. Of older males in the sample, over 20 per cent were either illiterate or had just basic literacy, whereas the corresponding figure for the younger cohorts is less than 4 per cent. The percentage of younger males with secondary schooling is more than twice that of older males (35 per cent and 16 per cent respectively). Perhaps the most striking feature of the two tables is the stable proportion of males with university degrees – virtually unchanged at 24 per cent.

For females, the differences between attainment of younger and older cohorts are more pronounced. In our sample, 36 per cent of females aged 35 and

over were either illiterate or had basic literacy only. The corresponding figure for younger females is 6 per cent. Only 13 per cent of older females had only completed secondary schooling, increasing to 29 per cent for younger females. And perhaps more striking is the change in university attainment - 29 per cent of older women had university degrees, the corresponding figure for younger females being 48 per cent (Tables 1.2 and 1.3).

Younger males with secondary schooling earn QR116,751 on average. Those with university degrees on average receive income of QR193,039 – a 'gain' of 65 per cent. The parallel figures for females are QR82,595 and QR104,141 – a gain of 26 per cent (Table 1.2). Crudely interpreted, the monetary gain for males completing a university degree is more than twice that for females and yet the male progression to higher education is substantially lower than female progression.

2

The Returns to Schooling

Applying the Human Capital Earnings Function

The Returns to Schooling – Applying the Human Capital Earnings Function

The aim of this analysis is to estimate the monetary returns to schooling, an important influence on the schooling decision. There is a consensus emerging from studies of developed countries that the monetary returns to annual adult income from spending one year in college are in the range 7 to 12 per cent. The channels through which schooling raises income have also been the subject of recent research.

The classical 'human capital model'[6] assumes that schooling raises an individual's productivity through the acquisition of a 'one-dimensional skill'. The mechanisms that lead to higher incomes may be far more complex - schooling may raise the enjoyment of work, lead to improved health, and lead to goal-oriented motivation – all of which may raise the incomes of educated individuals. And even when these effects do not improve labour-market outcomes, they may be desirable in their own right, indicating the impact of education on the non-monetary aspects of an individual.

The basic Human Capital Earnings Function (HCEF) (Appendix I) is applied to the HIES's sample of adult individuals (age 18 and over). The original sample consists of 8,626 Qatari individuals, evenly split between males and females. The sample is reduced by 2,171 individuals without the educational status record (mainly children) and a further 1,727 individuals younger than 18 years. Of the remaining sample, 568 were removed as they are classified as students (with incomplete schooling information).

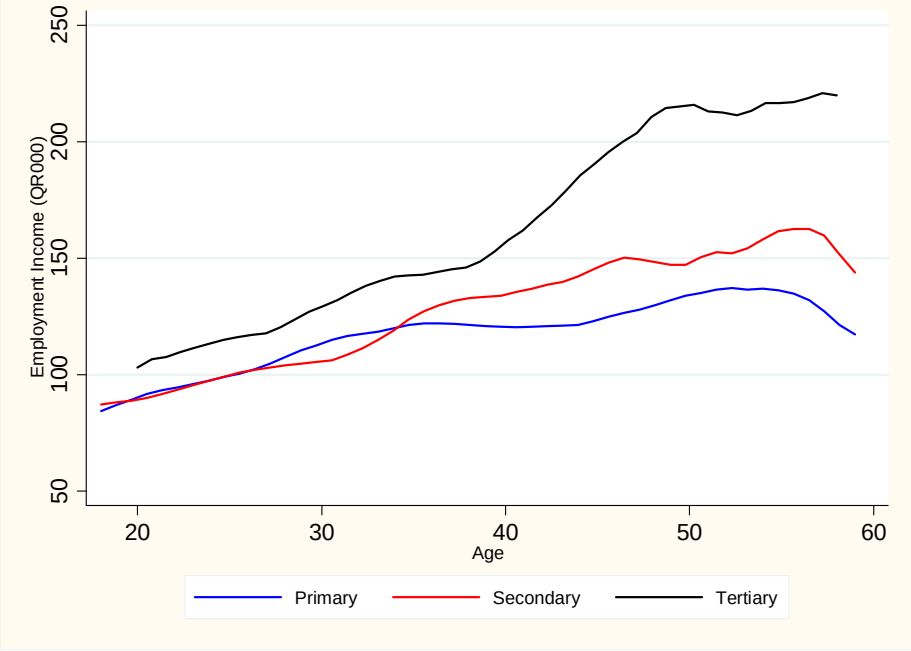
This leaves a sample of 4,160, evenly divided between men and women. Of the men, around 78 per cent had some income from employment (80 per cent had employment income and income from self employment). And of the females, 40 per cent had some employment income (very few females in the

[6] The pioneering contribution was Becker (1967).

sample received income from self-employment). The sample of wage-earners is 2,443[7], with twice as many male workers as females.

The use of annual earnings (as opposed to weekly or hourly rates of pay) may affect the estimated returns to schooling. In general individuals with higher schooling tend to work more and hence the measured return to schooling will be higher for annual earnings than for weekly or hourly earnings.[8]

Figure 2.1 **Age-Income Profiles, Qataris, HIES 2006/7**



Source of data: Computed from QSA's HIES, 2006/7

Figure 2.1 shows the fitted values of a kernel-weighted local polynomial regression of employment income against age for all adult individuals in the sample with positive incomes. The role of experience is clear, and the income

[7] If self-employment income is included in the income definition the sample is 2,512 – two-thirds of whom are males.

[8] Card (1999) reports that in the US labour market in the mid 1990s, two-thirds of the measured return to education observed in annual earnings is due to the effect of education on earnings per hour, the remainder being attributable to the effects on hours per week and weeks per year.

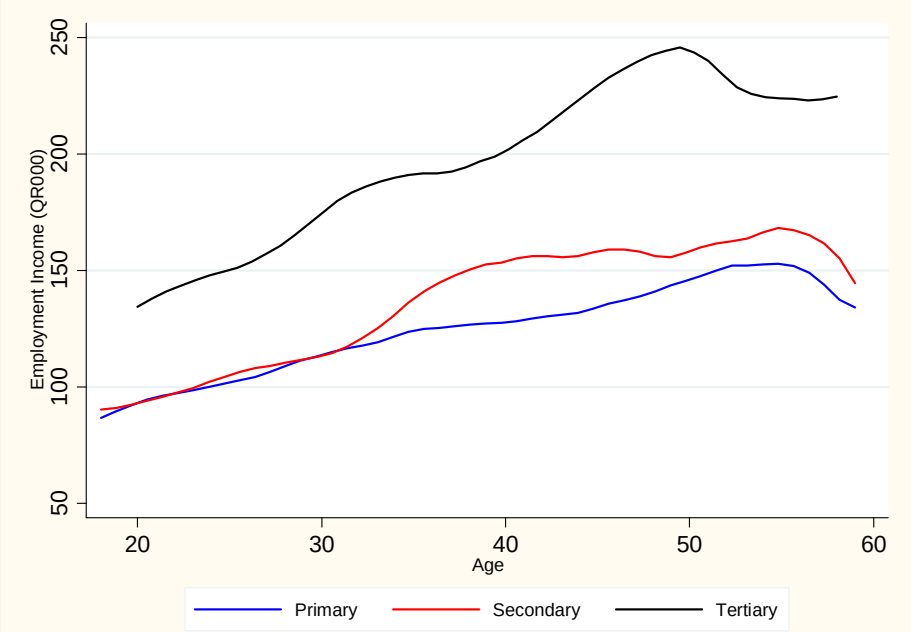
profiles tend to flatten and fall in later life.[9] They also show the schooling effect, though differences between the incomes of those with primary and secondary schooling only become apparent in individuals age 35 or over. The income-age profile of individuals with tertiary education lies every above the other two, substantially so in older cohorts.

The Qatari male and female profiles are graphed in Figures 2.2 and 2.3 respectively. That for males is similar to Figure 2.1 but in the case of females the income-age profiles for individuals with lower levels of schooling have an uncharacteristic pattern.

The life cycle pattern for females is undoubtedly influenced by child-rearing commitments and changes over time in family size will inevitably introduce unusual cohort effects in the observed profiles. Furthermore, the smaller sample size for working females may well lead to such unusual age-income patterns. The higher age-income profile for better-educated individuals is clear in all graphs, especially those with tertiary education.

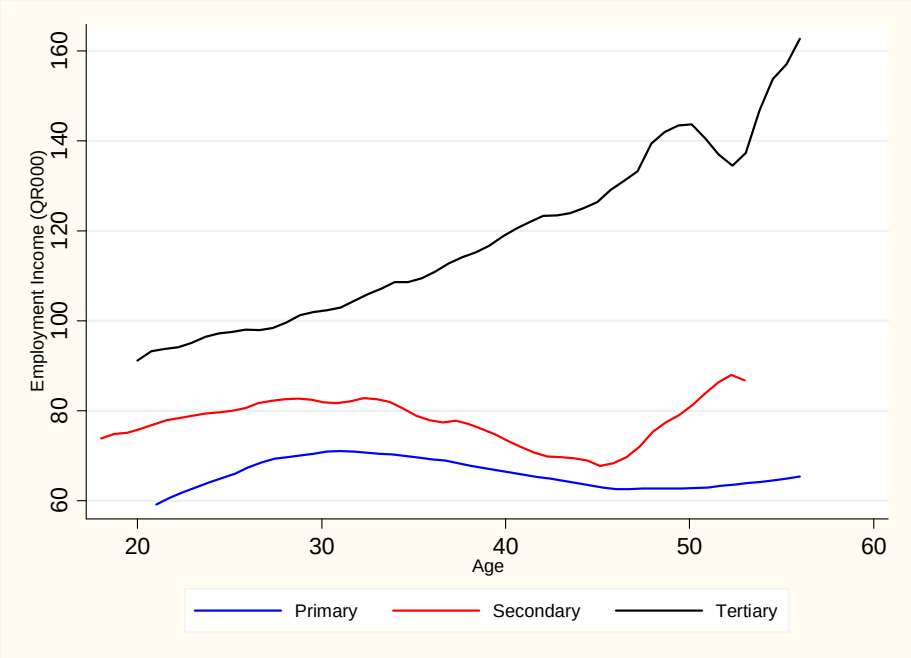
[9] Because we are analysing a sample at a single date, age will also be capturing cohort effects – i.e. effects due to year of birth influences on earning. Individuals aged 30 in 2006 may expect to earn more in 20 years time than individuals aged 50 in our sample.

Figure 2.2 **Age-Income Profiles, Qatari Males, HIES 2006/7**



Source of data: Computed from QSA's HIES, 2006/7

Figure 2.3 **Age-Income Profiles, Qatari Females, HIES 2006/7**



Source of data: Computed from QSA's HIES, 2006/7

To estimate the rates of return, the number of years of schooling (denoted by *S*) is used - illiterate individuals and those who can just read and write are assumed to have no formal schooling; individuals who have only completed primary education have 6 years of schooling; individuals with preparatory education (preparatory) have 9 years of schooling; individuals with secondary education have 12 years of schooling; those with diplomas have 14 years of schooling; graduates are assumed to have received 16 years of schooling and lastly postgraduates are assumed to have received 18 years of formal schooling. *E* (the number of years work experience) is defined as age minus years of schooling minus 5 years (the assumed year that schooling starts).[10]

Table 2.1 reports the estimated results using the sample of working adults. The variable y_i denotes the income received by individual *i* in the sample and the dependent variable is the logarithm of this income. Because the sample is not random, we used weighted least squares, where the weights are the sampling weights. Consider first the results in Panel A – those for the sample of all individuals. A number of features are fairly typical of empirical HCEF equations. First, adding experience and its square substantially raises the explanatory power of the model – both terms are statistically highly significant as one would expect.

Secondly the addition of the experience variables raises the estimated return to schooling – from 3 per cent to 4.5 per cent. This is because experience and schooling are inversely correlated – individuals with more schooling generally have less work experience. Thirdly the coefficients on E_i and E_i^2 have the expected pattern, with experience having a diminishing effect on income as it rises.

[10] For women this definition will exaggerate work experience because of spells of child rearing will reduce work experience. In some labour market surveys respondents are asked for details of their work experience explicitly. This information is not available in the *HIES.*

Differences are apparent between HCEF equation for males and females (Table 2.1). Note that both rates of return are higher than those derived from the full sample: 4.5 per cent in panel A rises to 6 per cent for males and 7.5 per cent for females. Taking into account their 95 per cent confidence intervals, the results suggest a rate of return to schooling of between 5 per cent and 7 per cent for men and between 6 per cent and 9 per cent for women.

Table 2.1 **HCEF Estimates for Working Individuals Aged 18 and over, HIES 2006/7**

A. All Individuals (Sample of 2,443)	
$\log(y_i) = \underset{(0.037)}{11.312} + \underset{(0.003)}{0.029}\, S_i + \varepsilon_i$	R^2=0.046
$\log(y_i) = \underset{(0..049)}{10.643} + \underset{(0.003)}{0.045}\, S_i + \underset{(0.003)}{0.041}\, E_i - \underset{(0.00007)}{0.0005}\, E_i^2 + \varepsilon_i$	R^2=0.197
B. Males (Sample of 1,615)	
$\log(y_i) = \underset{(0.043)}{11.266} + \underset{(0.004)}{0.046}\, S_i + \varepsilon_i$	R^2=0.120
$\log(y_i) = \underset{(0.053)}{10.556} + \underset{(0.004)}{0.059}\, S_i + \underset{(0.004)}{0.046}\, E_i - \underset{(0.00008)}{0.0006}\, E_i^2 + \varepsilon_i$	R^2=0.310
C. Females (Sample of 828)	
$\log(y_i) = \underset{(0.061)}{10.563} + \underset{(0.004)}{0.060}\, S_i + \varepsilon_i$	R^2=0.178
$\log(y_i) = \underset{(0.100)}{10.182} + \underset{(0.006)}{0.075}\, S_i + \underset{(0.005)}{0.012}\, E_i - \underset{(0.0001)}{0.00001} E_i^2 + \varepsilon_i$	R^2=0.224

Notes: Weighted least squares regressions. Robust standard errors in parenthesis.
Source of data: Computed from QSA's HIES, 2006/7

For females, work experience plays a very minor role and the square experience term is not statistically significant. The rate of return to one more year's work experience for a male with ten years in employment is 4 per cent but that for the equivalent female is just over 1 per cent.

HCEF equations estimated using a sample of younger individuals (those under 40) are shown in Table 2.2. The gender gap in the rates of return to schooling narrowed: for males under 40 the return is 6.4 per cent and for females, 6.8 per cent.[11]

Table 2.2 **HCEF Estimation for Working Individuals Aged 18-39, HIES 2006/7**

A. Males (Sample of 1,111)	
$\log(y_i) = \underset{(0.078)}{10.538} + \underset{(0.005)}{0.064}\,S_i + \underset{(0.004)}{0.038}\,E_i - \underset{(0.0003)}{0.0002}\,E_i^2 + \varepsilon_i$	R^2=0.232
B. Females (Sample of 653)	
$\log(y_i) = \underset{(0.132)}{10.246} + \underset{(0.008)}{0.068}\,S_i + \underset{(0.010)}{0.024}\,E_i - \underset{(0.0005)}{0.0006}\,E_i^2 + \varepsilon_i$	R^2=0.142

Notes: Weighted least squares regressions. Robust standard errors in parenthesis.
Source of data: Computed from QSA's HIES, 2006/7

Variable Rates of Return

It is possible to expand the basic HCEF model to allow for the rate of return to vary by level of schooling. This is achieved by replacing the schooling variable with education level dummy variables (See Appendix II).

The results are reported in Table 2.3 separately for males and females. For both sexes, the point estimates suggest higher marginal rates of return at higher levels of schooling.[12] At the post-secondary level, the rates are particularly high - females entering university can expect a return of around 10 per cent for each year of study when they eventually enter the labour market and the return at this level for men is slightly higher at around 11 per cent.

We perform a test to examine if the marginal rates of return are indeed different for various levels of school. For females the restrictions yielded a test

[11] As one might expect, for the younger sample, experience was generally less important.
[12] Appendix II explains the distinction between average and marginal rates of return. For example, the average return at university level averages the returns at each level up to and included university, The marginal return is the return to university schooling on its own.

statistic of $F(4,820) = 3.36$ (p-value 0.01). The same test in the model for males yields $F(4,1607) = 18.03$ (p-value 0.00).

For both sexes, at the 5 per cent confidence level we can reject the null hypothesis that the marginal returns to schooling are constant. However a test of the null hypothesis that the rates of return at primary, preparatory and secondary are equal to each other yields a test statistic of $F(2, 820) = 0.27$ (p-value = 0.76) for females, indicating no statistical difference in the returns at and below secondary level. For males the test statistic is $F(2,1607) = 4.25$ (p-value = 0.01), so these returns would appear to be statistically different from one another.

Table 2.3 **Variable Rates of Return, Working Individuals Aged 18 and Over, HIES 2006/7**

	Coefficient	Standard Error	*p*-value	Years Schooling	Rate of Return (%)	
					Average	Marginal
Females						
Experience	0.02	0.01	0.00			
Experience^2	0.00	0.00	0.05			
Primary	0.26	0.10	0.01	6	4.40	4.40
Preparatory	0.42	0.12	0.00	9	4.67	5.23
Secondary	0.49	0.12	0.00	12	4.04	2.15
Diploma	0.80	0.13	0.00	14	5.72	15.79
University	0.87	0.12	0.00	16	5.44	9.62
Constant	10.51	0.11	0.00			
Males						
Experience	0.05	0.00	0.00			
Experience^2	-0.00	0.00	0.00			
Primary	0.01	0.08	0.86	6	0.23	0.23
Preparatory	0.09	0.08	0.22	9	1.05	2.68
Secondary	0.24	0.08	0.00	12	2.01	4.90
Diploma	0.52	0.09	0.00	14	3.68	13.67
University	0.67	0.08	0.00	16	4.18	10.69
Constant	10.97	0.08	0.00			

Notes: Weighted least squares regressions; robust standard errors.
Source of data: Computed from QSA's HIES, 2006/7

The results for individuals younger than 40 are set out in Table 2.4. The tests for equality in the marginal returns are similar to those for the full sample: for females the test statistic is F(4,645) = 3.22 (p-value 0.01) and for males F(4,1103) = 12.07 (p-value 0.00). Again the null hypothesis of equal marginal returns is rejected at conventional confidence intervals.

The evidence for Qatar would suggest that the simple constant-rate-of-return HCEF model needs to be modified to allow for variations in the returns to schooling at different levels of education. The constant rate model exaggerates the returns to lower levels of schooling and understates that at tertiary level. For the younger sample of females the return from one year at university is 8.7 per cent compared with 11.4 per cent for men (Table 2.4).

Table 2.4 **Variable Rates of Return, Working Individuals Aged 18-39, HIES 2006/7**

	Coefficient	Standard Error	p-value	Years Schooling	Rates of Return (%)	
					Average	Marginal
Females						
Experience	0.03	0.01	0.01			
Experience^2	-0.00	0.00	0.06			
Primary	0.21	0.20	0.31	6	3.43	3.43
Preparatory	0.30	0.20	0.14	9	3.27	2.97
Secondary	0.26	0.19	0.17	12	2.19	-1.04
Diploma	0.54	0.19	0.01	14	3.87	13.94
University	0.61	0.19	0.00	16	3.82	8.70
Constant	10.71	0.17	0.00			
Males						
Experience	0.04	0.01	0.00			
Experience^2	0.00	0.00	0.12			
Primary	0.05	0.12	0.67	6	0.84	0.84
Preparatory	0.14	0.12	0.26	9	1.52	2.89
Secondary	0.26	0.12	0.03	12	2.14	3.99
Diploma	0.49	0.14	0.00	14	3.48	11.53
University	0.71	0.12	0.00	16	4.45	11.38
Constant	10.99	0.12	0.00			

Notes: Weighted least squares regressions; robust standard errors.
Source of data: Computed from QSA's HIES, 2006/7

In Table 2.5, the marginal rates of return derived using the full sample are repeated together with their robust standard errors and 95 per cent confidence intervals. This is to stress that the estimates reported in Table 2.3 have a sampling variation.

The marginal rate of return to tertiary education is estimated to be 9.6 per cent for females and the 95 per cent confidence interval is 7.7 per cent to 11.6 per cent. And for men the point estimate is 10.7 per cent with a confidence interval of 9.1 per cent to 12.3 per cent. The rates of return at lower levels of schooling are poorly determined for females, largely due to low sample observations. These results indicate that the null hypothesis that the marginal returns for females at primary, preparatory and secondary levels are the same can be rejected.

Table 2.5 **Marginal Rates of Return, Working Individuals Aged 18 and over, HIES 2006/7**

	Rate (%)	Standard Error	95% Confidence Interval	
Females				
Primary	4.40	1.71	1.04	7.76
Preparatory	5.23	4.01	-2.65	13.10
Secondary	2.15	2.82	-3.38	7.68
Diploma	15.79	3.99	7.95	23.63
University	9.62	0.99	7.68	11.55
Males				
Primary	0.23	1.30	-2.32	2.77
Preparatory	2.68	1.27	0.20	5.17
Secondary	4.90	1.01	2.93	6.88
Diploma	13.67	2.81	8.15	19.19
University	10.69	0.81	9.10	12.29

Notes: Based on estimates in Table 2.4
Source of data: Computed from QSA's HIES, 2006/7

Endogeneity

The HCEF model treats the years of schooling as exogenous but clearly individuals are likely to have *chosen* when to terminate their education – the years of schooling is endogenous. Some schooling may not involve choice; when schooling is legally compulsory there is no choice and when the level of compulsory schooling changes, the resulting change in schooling levels will be exogenous.

In the HIES sample the level of compulsory schooling appropriate for any individual will vary over his or her year of birth – for older individuals there may have been no compulsory schooling but as the law has changed over time, younger cohorts in the sample will have been obliged by law to complete a minimum level of schooling (currently 9 years).

Beyond the primary level, individuals (or their parents) choose whether they progress to higher levels of education. The endogeneity of their choice may bias the estimated rates of return. More particularly endogeneity will be a problem if the factors that affect the level of schooling also influence income. This implies that the number of years of schooling will be correlated with the model's error term. The weighted least squares estimation will produce biased estimates of the return to schooling.

If years of schooling are positively correlated with the equation error, this will bias the estimated rate of return to schooling *upwards*. In effect, the HCEF attribute higher income to schooling but it is possible that both higher income and schooling are both influenced by other personal characteristics discussed below.

The Ability Bias

The source of bias that has attracted most attention is the 'ability bias'. Individuals with more ability will tend to experience more years of formal schooling and they will also tend to earn more when they finish schooling, not

because of the schooling *per se* but because of their ability. In the HCEF equation schooling is assumed to raise earnings but in fact it may be ability that raises both earnings and schooling. For this reason ability potentially biases *upwards* the estimated return to schooling.[13]

Before discussing how one may attempt to correct for ability bias we first note that there are reasons to believe that returns to schooling may be biased *downwards* when using the Ordinary Least Square (OLS) regression. Griliches (1977) pointed out that when years of schooling are measured with error[14], the estimated income rate of return will be biased downwards. As the ability and measurement error biases are in different directions it is tempting to argue that OLS may yet deliver unbiased estimates of the returns to schooling.

However, research has shown that the ability bias is small. An interesting approach to measuring the impact of ability on the returns to schooling is to compare the incomes of twins whose schooling differs but who can be expected to have the same (inherited) ability. Ashenfelter and Rouse (1998) find that the OLS estimator yields only a slightly upward-biased estimate of the return to education. Following a review of this and other twin studies, David Card (1999) concludes that 'evidence from the latest studies of identical twins suggests a small upward "ability" bias - on the order of 10 per cent'.

Correcting for Ability Bias through Instrumental Variables

The standard way to correct for ability bias is through instrumental variable (IV) estimation. This exploits exogenous influences on the schooling decision which have a direct affect on income. Such exogenous variables can be used

[13] School test scores in the US have been found to be correlated with parental income. Some have argued that parental incomes are high because of ability and children do well in tests because ability is genetically inherited.
[14] Survey respondents may either have difficulty recalling when they left school or deliberately exaggerate their schooling to avoid embarrassment.

as instruments for schooling only if they are uncorrelated with the income equation's error term and, by implication, also uncorrelated with ability.

In efforts to remove ability bias researchers have been most ingenious in their choice of instrumental variables. Angrist and Krueger (1991) explore how an individual's date of birth may imply that some students reach school-leaving age after fewer months of compulsory education than others. Angrist and Krueger (1992) exploit the Vietnam-era draft lottery in the United States, which induced a change in educational participation.

Using the IV approach Angrist and Krueger (1991, 1992) also find that the ability bias is modest. Card (1995) uses proximity to schooling institutions as an instrument for schooling choice – individuals living close to the school or college are more likely to avail themselves of the facility than someone living further away. Card's IV estimates of the returns to schooling were actually substantially *larger* than those using OLS - a result confirmed by Harmon and Walker (1995) who exploit changes in compulsory schooling in the UK to identify exogenous changes in schooling.

Unfortunately, IV estimates are difficult to be precisely estimated (they have large standard errors) and the results are usually not significantly different from those obtained through an OLS regression. In Harmon and Walker's study using IV estimates which were more precisely estimated found the OLS estimates to be significantly lower than the IV alternatives. So if anything correcting for the endogeneity of the school choice appears to *raise* the returns to schooling.

The information provided in the HIES currently does not allow for the identification of appropriate variables that will serve as instrumental variables – variables that affect the level of schooling but not the incomes of those employed. Moreover schooling decisions were taken when individuals in the HIES were much younger and influences on schooling choice are unlikely to be recorded in the 2006/7 survey.

It would potentially be possible for the ability effect to be examined in Qatar by including additional question relating to school performance, such as grades achieved in maths in the HIES. However, a brief review of the evidence suggests that the use of HCEF or the Heckman procedure will give reliable estimates of the returns to schooling in Qatar.

3

Employment and Self-Selection

The Impact on the Returns to Schooling

Employment and Self-Selection – The Impact on the Returns to Schooling

Individuals in the sample that we are analysing will have observable and unobservable characteristics and both potentially influence schooling, the decision to work and income if employed. Observable characteristics include the individual's location, marital status, occupation and so on, and these are reported in the HIES.

However, there are other important behavioural characteristics which are not observed, including an individual's enthusiasm (or otherwise) for work, ambition, intelligence and so on. These and many other personal characteristics are unobserved, at least in the HIES. When we estimate the earnings equation our sample is self-selected – it consists of those individuals who have *chosen to work*.

Unobservable characteristics like enthusiasm for work, ambition or single-mindedness may make the individual more likely to work than someone else *with the same observable characteristics*. They may also mean this individual has more schooling and will enjoy a higher income if employed. The fact that our sample is self-selected may lead to a bias in the rate of return estimates.

It is possible to correct for sample selection bias using an approach by James Heckman (1979)[15] (See Appendix III). In the Heckman procedure, consider an unobservable characteristic 'taste for work' - a work-shy individual has little of it; a 'work-loving' individual has it in abundance. Heckman proposed a two-step procedure.

The first step is a probit-type equation that predicts whether or not an individual in the sample will work. This prediction can only be based on the *observable* characteristics of individuals in the sample: their age, marital status and so on. Work-shy individuals are likely to choose not to work and

[15] For this work Heckman received the Nobel Prize in Economics in 2000.

work-lovers *with the same observable characteristics* are more likely to work. The residuals in the probit model will reflect this.

If the residual is positive (an individual actually works when her observable characteristics suggest she might not) she is likely to have a taste for work. And if the residual is negative (the individual does not work when her observable characteristics suggest otherwise) it is more likely that we are dealing with a work-shy individual.

The residuals in the probit model will help reveal the individual's 'taste for work'. Positive residuals suggest a work-loving individual; negative ones suggest a work-shy individual. It is not difficult to imagine other unobservable characteristics which will affect the decision to work, the schooling choice and income if in work. The self-selection issue is conventionally raised and tested for females.

Self-Selection and the Return to Schooling of Qatari Females

For women, the decision to work is inevitably affected by the value of their time in 'non-market' (home-making) activities. In modelling the decision to work there are obvious observable characteristics that are relevant, such as her marital status and the number of children. Women may also differ in their *preferences* for home production and market activities. A strong personal preference for a professional career over home production will lead to a positive residual in the employment probit model, given the individual's observable characteristics. And women with these preferences may stay longer in school and earn more when in employment. The probit residuals potentially help to reveal these unobservable characteristics.

The results for females are reported in Table 3.1. The variables in the selection equation determining employment choice are:

Variable Name	Variable Description
Years of Schooling	Number of years of completed schooling
Doha	= 1 for individuals residing in Doha. Otherwise = 0.
Child	The number of children in the individual's household.
Married	= 1 for a married individual. Otherwise = 0.
HH Income	Income of other household members
Non-Wage Income	The individual's non-wage income
Internet-Using	= 1 for an internet-using individual. Otherwise = 0.

Women living in households with children can be expected to have high reservation wages and therefore choose not to work. The variable *'Child'* will be expected to have a negative effect on the probability of working. Similarly married women are less likely to be in employment.

Other income in the household will discourage women from working, as will any non-wage income she may receive. The expected signs on the coefficients on HH Income and Non-Wage Income are therefore both negative. It is likely that internet-using individuals are more likely to have a more favourable attitude to labour market activity and hence this variable is likely to have a positive effect on the probability of working. All these sign expectations are satisfied in the parameters reported in Table 3.1.

From the results reported in the lower panel of Table 3.1 it is clear that these characteristics have significant effects on the probability of working. The Wald test of zero correlation of residuals suggests that we cannot reject the null hypothesis that $\rho = 0$. Perhaps contrary to expectations, the error correlation is negative (-0.27): women who are more likely to work (given their observable characteristics) will earn less when in employment than other women with the same observable characteristics. The result is difficult to explain but is fairly typical of other similar studies.

Table 3.1 reports a Wald test of the null hypothesis that the rates of return to education are constant and independent of the level of schooling. The null hypothesis that the marginal rates of return are equal is rejected. However

from the second Wald test, the null hypothesis that the marginal rates of return at and below secondary level are equal cannot be rejected. Given this, we apply this restriction and re-estimate the rate of returns for females aged 18 and above.

Table 3.1 **Correcting for Self-Selection, Qatari Females Aged 18 and over, HIES 2006/7**

	Coefficient	Standard Error	*p*-value	Years Schooling	Marginal Return (%)
Income Equation					
Experience	0.019	0.01	0.00		
Experience^2	-0.00	0.00	0.05		
Primary	0.20	0.11	0.08	6	3.38
Preparatory	0.30	0.16	0.06	9	3.38
Secondary	0.34	0.18	0.06	12	1.15
Diploma	0.64	0.19	0.00	14	14.83
University	0.69	0.19	0.00	16	8.85
Constant	10.78	0.22	0.00		
Selection Equation					
Years of Schooling	0.15	0.01	0.00		
Doha	0.22	0.08	0.01		
Child	-0.05	0.02	0.00		
Married	-0.38	0.08	0.00		
HH Income	-0.00	0.00	0.00		
Non-Wage Income	-0.01	0.00	0.00		
Internet-Using	0.77	0.08	0.00		
Constant	-1.59	0.16	0.00		
ρ	-0.27	0.22			
σ_ε	0.40	0.03			
$\rho\sigma_\varepsilon$	-0.11	0.09			

Wald test of equality of all marginal rates of return:

χ^2_4 = 37.46, *p*-value = 0.00

Wald test of equal marginal returns to primary, preparatory and secondary level:

χ^2_2 = 0.52, *p*-value = 0.77

Notes: Weighted Maximum Likelihood; robust standard errors.
Source of data: Computed from QSA's HIES, 2006/7

Table 3.2 shows the estimates of the returns to schooling after imposing the restriction that the marginal rates of return at and below secondary level are equal to each other. Setting the marginal returns at these levels equal to each other implies restrictions to the ω coefficients in equation (2) detailed in Appendix II.

$$r_p = \frac{\omega_1}{6} = r_i = \frac{\omega_2 - \omega_1}{3} = r_s = \frac{\omega_3 - \omega_2}{3}$$

$$\Rightarrow \omega_2 = 1.5\,\omega_1 \text{ and } \omega_3 = 2\,\omega_1$$

To impose these restrictions we define a 'low-schooling' linear combination of the dummy variables:

$$LS_i = D_{i,1} + 1.5D_{i,2} + 2D_{i,3}$$

Replacing the three separate dummy variables in equation (2) with this linear combination will identify ω_1. And this parameter divided by 6 identifies the marginal rate of return at the three lowest levels of schooling. The point estimate of the returns to schooling at low levels is 2.5 per cent but it carries a high standard error so we cannot reject the null hypothesis of zero return to schooling at primary, preparatory and secondary levels. The rates of return at diploma and university levels are better determined (higher *t*-statistics).

Table 3.2 **Restricted Heckman Mode, Qatari Females Aged 18 and over, HIES 2006/7**

	Coefficient	Standard Error	*p*-value	Marginal Return (%)
Income Equation				
Experience	0.02	0.01	0.00	
Experience^2	-0.00	0.00	0.04	
Low Schooling	0.15	0.10	0.12	2.53 (1.61)
Diploma	0.60	0.20	0.00	14.59 (3.87)
University	0.65	0.20	0.00	8.71 (1.00)
Constant	10.76	0.23	0.00	
Selection Equation				
Years of Schooling	0.15	0.01	0.00	
Doha	0.22	0.08	0.01	
HH Size	-0.05	0.02	0.00	
Married	-0.37	0.08	0.00	
HH Income	-0.00	0.00	0.00	
Non-Wage Income	0.00	0.00	0.00	
Internet-Using	0.77	0.08	0.00	
Constant	-1.59	0.16	0.00	
ρ	-0.27	0.21		
σ_ε	0.40	0.03		
$\rho\sigma_\varepsilon$	-0.11	0.09		

Wald test of equality of all marginal rates of return:

χ^2_4 = 13.09, *p*-value = 0.00

Wald test ($\rho = 0$):

χ^2_1 = 1.48, *p*-value = 0.22

Notes: Weighted Maximum Likelihood; robust standard errors; (.) standard deviation
Source of data: Computed from QSA's HIES, 2006/7

The focus here is the sensitivity of the estimated returns to schooling to the inclusion of Heckman's sample selection term. Table 3.3 summarizes the marginal rates of returns for females before and after adjusting for self-selection.

Allowing for sample selection bias does reduce the marginal rates of return a little. The rate of return to one year of university education for women remains positive but is slightly lower at 8.7 per cent once we allow for sample selection

effects and with a standard deviation of 1 per cent we can be 95 per cent certain that the returns to one year of university lies between 7.7 per cent and 9.7 per cent for Qatari women.

Table 3.3 **Marginal Rates of Return, Qatari Females, HIES 2006/7**

	WLS	Heckman
Primary Preparatory Secondary	3.8	2.5
Diploma	15.8	14.6
University	9.6	8.7

Notes: WLS weighted least Squares
Source of data: Computed from QSA's HIES, 2006/7

Employment Probabilities of Qatari Females

The Heckman model can be used to make predictions about *employment probabilities* and incomes of different schooling levels. Table 3.4 provides some examples. The individual is assumed to be an internet-using married woman living in Doha. The woman's work experience, other family income in her household and her own non-wage income are set at their sample mean levels.

Schooling levels and the number of children at home affect the probability of employment selection. A Qatari woman with no schooling is less likely to be in employment even when there are no children in her household (an employment probability of only 6 per cent). With four children at home this probability falls to 4 per cent.

Schooling has a quantitatively important effect on employment probabilities. For example a woman with secondary schooling and 4 children at home has a 52 per cent probability of working. If this woman completed university education there would be a 74 per cent chance she would be in employment. And the final column states that if employed, this woman's additional schooling would raise her income from QR86,000 to QR122,000 (Table 3.4).

Table 3.4 **Employment Probabilities and Employment Income, Qatari Females, HIES 2006/7**

Schooling	Number of children					Income (QR)
	0	2	4	6	8	
None	0.06	0.05	0.04	0.03	0.03	63,646
Primary	0.26	0.23	0.20	0.17	0.14	74,061
Preparatory	0.42	0.38	0.34	0.30	0.27	79,892
Secondary	0.60	0.56	0.52	0.47	0.43	86,182
Diploma	0.71	0.67	0.63	0.59	0.55	115,379
University	0.80	0.77	0.74	0.70	0.66	122,103

Notes: based on estimates reported in Table 3.2
Source of data: Computed from QSA's HIES, 2006/7

In summary, additional schooling raises the probability that a Qatari female will work and also raises her income in employment. Both effects need to be considered when analysing the effects of schooling on labour market outcomes.

4

Determinants of Female Labour Force Participation

Determinants of Female Labour Force Participation

In the last Chapter, we recognized that for women, the decision to work is inevitably affected by the value of their time in 'non-market' (home-making) activities. Using the Heckman model to address self-selection issues, we estimated the employment probabilities for the female sample in the HIES.

A prominent feature of the development of women in Qatar is the increasing and progressive achievement of females in education, especially at higher levels. The QNV 2030 calls for the enhancement of women's capacities and the empowerment of women, enabling them to participate fully in the political and economic spheres, especially in decision-making roles.

Labour force participation rates for women in Qatar are increasing as discussed in the earlier sections. Increasing the labour force participation of women will help improve their relative economic positions and simultaneously increase the overall economic efficiency of the country. In this Chapter, we report the determinants of Qatari female labour force participation using the HIES.

In modeling the decision to work (or seek it) there are obvious observable characteristics that are relevant, such as her marital status and the number of children. In Table 4.1 sets out some important characteristics of Qatari female participation rates. Age is an obvious influence on participation given the likelihood of career interruptions though child-birth and child-rearing. The participation rates peak in the early 30s and decline thereafter. Participation rates also vary substantially by level of schooling. Around 80 per cent of women in the HIES sample with university education are active labour-market participants compared with around half for women with secondary schooling only.

Table 4.1	Labour Force Participation Rates, Qatari Females Age 18 and Over, HIES 2006/7		
Age Group	**Participation Rate (%)**	**Education Attainment**	**Participation Rate (%)**
Age less than 20	48.8		
Age 20-24	59.5	Illiterate	2.9
Age 25-29	59.4	Read and Write	6.2
Age 30-34	61.9	Primary	12.1
Age 35-39	55.7	Preparatory	16.4
Age 40-44	42.4	Secondary	49.8
Age 45-49	25.0	Diploma	66.4
Age 50-54	10.6	University	79.4
Age 55-59	3.7	Post-graduate	87.1
Age 60 and over	0.5		

Source of data: Computed from QSA's HIES, 2006/7

Multivariate Analysis

To identify the determinants of female labour force participation, we apply the logit model to the HIES data and define a binary variable P_i which takes the value 1 if the individual is participating (employed or unemployed) and 0 otherwise. In the logit model,

$$\Pr[P_i = 1 | X_i] = \frac{1}{1 + \exp(-\alpha - \beta X_i)}$$

and

$$\Pr[P_i = 0 | X_i] = 1 - \Pr[P_i = 1 | X_i]$$

$$= \frac{\exp(-\alpha - \beta X_i)}{1 + \exp(-\alpha - \beta X_i)}$$

where X_i are observable characteristics of individual *i* and α and β are parameters to be estimated.

The initial task is to identify the explanatory variables (X_i) that influence female labour-force participation decisions. The following *HIES* variables are likely to be important influences:

Variable Name	Variable Description
HH income	Income of other household members
Non-wage	Individual's non-wage income
Married	Marital status dummy
Internet	Internet-using dummy
Child	Number of children under 15 in household
Age	Woman's Age
Age^2	Age Squared
Doha	Doha dummy
Plus five educational attainment dummy variables	

Higher levels of the income of other household members and the woman's own non-wage income are expected to lower the likelihood that she will participate as they reduce the need for her to supplement household income. A married woman is less likely to participate than a single one as the value of her non-market time (home production) is potentially higher.

An internet-using individual is more likely to be in the labour force. More children living in the individual's household are likely to lower the probability of her participating. And by raising the expected income in employment, higher levels of formal schooling can, *ceteris paribus*, be expected to encourage women to join the labour force.

Each of these characteristics are assumed to have an *independent* effect on the probability of participating in the labour market. It is likely that participation will depend on the interactions of some of these variables: for example the effect of children on participation may depend on other household income – richer household may be able to fund child-care to facilitate labour force participation by the mother.

Alternatively, the effect of children on participation may be related to the presence or otherwise of extended family members who would act as child minders. A number of the potential interactions are examined but the evidence suggests that the regressors listed above only have *independent* effects of participation.

The results of the multivariate logit regression over a sample of 2,090 Qatari women in the HIES are reported in Table 4.2. The determinants of participation have the expected effects. The income of other household members, the individual's own non-wage income and the number of children in the household have depressing effects on participation probabilities. A married woman is also less likely to participate than one who is single. The non-linear effect of age on participation is picked up by the significance of both the *Age* and *Age-squared* variables and the negative coefficient on the latter. Higher levels of schooling encourage participation, especially at secondary level and above.

Table 4.2 **Determinants of Female Labour-Force Participation, Qatari Females 18 and over, HIES 2006/7**

Logistic regression		Number of observations	2090
		Wald $\chi^2(13)$	578.72
		Prob >χ^2	0
Log pseudo-likelihood	-748.002	Pseudo R^2	0.4788

Variable	Coefficient	Robust Standard Errors	*p*-value
Married	-1.885	0.175	0
HH income	-0.001	0.000	0
Non-wage	-0.014	0.003	0
Internet	1.381	0.163	0
Child	-0.106	0.031	0.001
Age	0.237	0.058	0
Age^2	-0.004	0.001	0
Primary	0.430	0.371	0.247
Preparatory	0.409	0.344	0.234
Secondary	1.652	0.297	0
Diploma	2.618	0.437	0
University	3.292	0.307	0
Doha	0.508	0.158	0.001
Constant	-3.907	0.993	0

Source of data: Computed from QSA's HIES, 2006/7

Education and Number of Children

For ease of interpreting the logit model's coefficients, their effects on females with different schooling levels and number of children in the households are computed as predicted participation probabilities or rates (Table 4.3). To compute these probabilities we assume that she is aged 37, married, living in Doha, is an internet user. Other assumptions and considerations include the income from other household members and her own non-wage income are at the sample mean levels of around QR500,000 per annum for the former and QR9,900for the latter.

Table 4.3 **Predicted Married Qatari Female Labour-Force Participation (%) By Education and Number of Children, HIES 2006/7**

Educational level	**Number of children in the household**				
	0	**2**	**4**	**6**	**8**
None	23.7	20.1	16.9	14.2	11.8
Primary	32.3	27.9	23.8	20.2	17.0
Preparatory	31.9	27.5	23.5	19.9	16.7
Secondary	61.8	56.7	51.5	46.2	41.1
Diploma	81.0	77.5	73.6	69.3	64.7
University	89.3	87.1	84.6	81.6	78.2

Notes: based on the logit regression in Table 3.1
Source of data: Computed from QSA's HIES, 2006/7

With no children present in the household, the logit model predicts that a married woman with secondary schooling (and the other characteristics described above) has a 62 per cent chance of being in the labour force. This falls to 52 per cent for a woman with four children. With four children in the household but with a university degree, the labour force participation probability rises to 85 per cent.

These calculations are repeated for an otherwise identical *single* woman and report the probabilities in Table 4.4. The change in marital status has a pronounced effect on participation: a married woman with secondary schooling and four children in the household has a 52 per cent chance of participating: this rises to 88 per cent for a single woman. Naturally the presence of children in the household will affect the participation decision of a

woman more acutely if the children were her own. We return to this issue below.

Table 4.4 **Predicted Single Qatari Female Labour-Force Participation (%) By Education and Number of Children, HIES 2006/7**

Educational level	Number of children in the household				
	0	2	4	6	8
None	67.2	62.4	57.3	52.1	46.8
Primary	75.9	71.8	67.3	62.5	57.5
Preparatory	75.5	71.4	66.9	62.1	57.0
Secondary	91.4	89.6	87.5	85.0	82.1
Diploma	96.6	95.8	94.8	93.7	92.3
University	98.2	97.8	97.3	96.7	95.9

Notes: based on the logit regression in Table 3.1
Source of data: Computed from QSA's HIES, 2006/7

Age of the Woman

The logit analysis also helps isolate the role played by age in the participation decision. The graphs in section 2 suggest that age is important but because age, education and other explanatory variables are likely to be correlated in the data, the logit analysis may give a better picture of their separate roles. The predicted probabilities are set out in Table 4.5. The individual characteristics are those assumed in Table 4.2 (except of course for age itself). And we assume that the woman has 3 children in the household, this being the rounded value of the sample weighted mean.

Table 4.5 **Predicted Married Qatari Female Labour-Force Participation (%) By Education and Age, HIES 2006/7**

Education level	Age				
	20	30	40	50	60
None					
None	19.3	28.1	23.1	9.9	1.8
Primary	19.0	27.7	22.8	9.7	1.8
Secondary	44.8	57.0	50.5	27.1	6.0
Diploma	68.1	77.7	72.9	49.4	14.3
University	80.7	87.2	84.0	65.7	24.7

Notes: based on the logit regression in Table 3.1
Source of data: Computed from QSA's HIES, 2006/7

The non-linear effect of age raises participation rates up to around age 30.[16] A 20-year old married woman has a 45 per cent probability of participating, falling to 27 per cent by 50. A key influence on the decision to work is the income of other household members.

A woman living on her own, a divorced or widowed woman with children or a woman married to a disabled husband is far more likely to seek employment than one in a household with one or more income-earners.

Other Household Member's Income

In Table 4.6 we present the predicted participation probabilities of a married woman with the characteristics assumed for Table 4.5 but aged 37 and with income from other members set at levels given in the table.

Table 4.6 **Predicted Married Qatari Female Labour-Force Participation (%) By Education and Other Household Income, HIES 2006/7**

Education level	Income from other household members QR(000)				
	200	300	400	500	600
None	26.11	23.34	20.79	18.45	16.32
Primary	35.19	31.88	28.74	25.80	23.06
Preparatory	34.73	31.44	28.33	25.41	22.70
Secondary	64.83	61.37	57.80	54.14	50.43
Diploma	82.89	80.68	78.26	75.63	72.79
University	90.48	89.12	87.60	85.89	83.99

Notes: based on the logit regression in Table 4.1
Source of data: Computed from QSA's HIES, 2006/7

The mean income of other household members in the sample is QR 500,000: the 25th percentile is QR305 and the 75th percentile is QR 618,000. A woman with secondary schooling, living in a household in which other members earn QR 200,000 a year has a 65 per cent chance of being in the labour force.

If household income were substantially higher, at around QR 600,000, the probability of a woman participating in the labour force would fall to 50 per

[16] The effect of age reaches its maximum at 31.5 years.

cent. Again we note that the predictions in Table 3.5 assume that the influence of other household income and education are independent, an assumption that is supported by the statistical insignificance of additional interactive terms in the logit model – other household income has the same effect on the participation probability at all levels of schooling.

Age of Children in the Household

To examine the impact of the ages of children in a household on a woman's labour force participation probability, the number of children in three age groups are included separately in the logistic regression - children in the household age less than 5; those age 5-9 and those age 10-14. The results are reported in Table 4.7.

Table 4.7 **Age of Child Effects on Labour-Force Participation of Adult Qatari Females, HIES 2006/7**

Logistic regression		Number of observations	2090
		Wald $\chi^2(15)$	575.52
		Prob >χ^2	0
Log pseudo-likelihood	-747.160	Pseudo R^2	0.479
Variable	**Coefficient**	**Robust Standard Errors**	***p*-value**
Married	-1.881	0.175	0
HH income	-0.001	0.000	0
Non-wage	-0.014	0.003	0
Internet	1.377	0.163	0
Children 0-4 years	-0.159	0.055	0.004
Children 5-9 years	-0.033	0.074	0.658
Children 10-14 years	-0.124	0.065	0.057
Age	0.231	0.058	0
Age^2	-0.004	0.001	0
Primary	0.407	0.374	0.276
Preparatory	0.394	0.344	0.251
Secondary	1.653	0.298	0
Diploma	2.627	0.438	0
University	3.296	0.308	0
Doha	0.503	0.158	0.00
Constant	-3.800	0.986	0.00

Source of data: Computed from QSA's HIES, 2006/7

More children in all three age groups lower the probability of participating, but the only statistically significant coefficient is that on the number of children age less than 5. The *p*-value on the coefficient on the number of children age 10-14 years is marginal (0.057) – older children have a significant effect at the 10 per cent confidence level.

Table 4.8 **Predicted Married Qatari Female Labour-Force Participation (%) By Education and Number Children by Age, HIES 2006/7**

Education	Number of children age 0-4				
	0	2	4	6	8
None	23.58	18.34	14.04	10.62	7.96
Primary	31.67	25.22	19.71	15.15	11.50
Preparatory	31.40	24.98	19.51	14.99	11.37
Secondary	61.71	53.97	46.04	38.30	31.12
Diploma	81.01	75.64	69.32	62.17	54.46
University	89.29	85.85	81.53	76.25	70.03
	Number of children age 5-9				
	0	2	4	6	8
None	23.58	22.42	21.30	20.22	19.18
Primary	31.67	30.27	28.90	27.57	26.28
Preparatory	31.40	30.00	28.64	27.32	26.04
Secondary	61.71	60.15	58.56	56.96	55.35
Diploma	81.01	79.98	78.91	77.80	76.64
University	89.29	88.64	87.97	87.25	86.51
	Number of children age 10-14				
	0	2	4	6	8
None	23.58	19.40	15.81	12.78	10.26
Primary	31.67	26.56	22.00	18.04	14.65
Preparatory	31.40	26.31	21.79	17.85	14.49
Secondary	61.71	55.70	49.51	43.34	37.37
Diploma	81.01	76.90	72.20	66.95	61.24
University	89.29	86.67	83.53	79.83	75.53

Notes: based on the logit regression in Table 3.6
Source of data: Computed from QSA's HIES, 2006/7

Based on these estimates in Table 4.7, the predicted participation rates are set out in Table 4.8. The individual's other characteristics are those assumed

in constructing Table 4.4, and in each panel the number of children in the other age groups are assumed to be zero.

Having additional young children (below 5 years) lowers the participation probability more than having older children while the presence of children age 10 to 14 years does have some effect. Additional children in the 5 to 9 age group has only a marginal effect on participation.

Own Child Effect

In the preceding section we allowed the total number of children *in the individual's household* to influence her participation behaviour. However if the analysis is restricted to the sample of women who are married to the head of house (or who, less commonly, are themselves heads of house), we are able to identify her own children in the household[17] and test whether participation of such women is affected by the number of her own children differently from those of others.[18] Table 4.9 has the results.[19]

As in the previous analysis, three age groups of the children are again considered - children under 5, those aged 5 to 9 and 10 to 4. The logit regression results are given in Table 4.9. The numbers of children in the three age groups have the expected effect on participation probability – they each lower it.

The coefficients on children aged 0 to 4 years and 5 to 9 years are not statistically significant (with respect *p*-values of 0.6 and 0.4). The coefficient on children age 10 to14 years is statistically significant, with a *p*-value of

[17] Around half the sample of adult females are heads of house or married to one.
[18] Children are again defined as those less than 15 years old. Over the sample the weighted mean number of own children was 2.4, and the mean number of other children present in the household was 0.5.
[19] Note that we still include the marital status dummy variable because some of the women in the sub-sample were unmarried heads of house – possibly divorced or widowed.

0.007. It is possible that when children are older there are fewer extended family members present to act as child minders[20].

Table 4.9 **Age of Own Child Effects on Labour-Force Participation of Head of Household or Spouse, HIES 2006/7**

Logistic regression		Number of observations	1088
		Wald $\chi^2(15)$	287.31
		Prob >χ^2	0
Log pseudo-likelihood	-410.823	Pseudo R^2	0.424

Variable	Coefficient	Robust Standard Errors	*p*-value
Married	-1.432	0.477	0.003
HH income	-0.003	0.000	0
Non-wage	-0.014	0.003	0
Internet	1.169	0.217	0
Children 0-4 years	-0.063	0.127	0.622
Children 5-9 years	-0.093	0.116	0.423
Children 10-14 years	-0.255	0.094	0.007
Age	0.411	0.130	0.002
Age^2	-0.006	0.002	0.001
Primary	0.607	0.497	0.222
Preparatory	0.470	0.473	0.320
Secondary	1.465	0.418	0
Diploma	2.292	0.594	0
University	3.277	0.416	0
Doha	0.452	0.216	0.037
Constant	-7.102	2.363	0.003

Source of data: Computed from QSA's HIES, 2006/7

Table 4.10 sets out the predicted participation rates for each of the three child age groups. For each set of probabilities, the numbers of children assumed for the other two age groups were zero. The analysis using the HIES data suggests that it is the presence of older children (10-14 years) that lowers the participation probability rather than the presence of children under 10.

This differs from the results reported for all females presented in Tables 4.7 and 4.8 above. For all females it was the youngest age group that impacted significantly on participation, though there too it was found that additional older children also reduced participation probabilities.

20 The number of other adults in the household made no significant contribution to the regression results.

Table 4.10 **Predicted Married Qatari Female Labour-Force Participation (%) By Education and Number of Own Children by Age, HIES 2006/7**

Education	Number of own children age 0-4				
	0	**2**	**4**	**6**	**8**
None	24.24	22.01	19.93	18.01	16.23
Primary	36.99	34.12	31.35	28.72	26.22
Preparatory	33.87	31.12	28.49	26.00	23.66
Secondary	58.07	54.98	51.86	48.72	45.60
Diploma	76.00	73.63	71.12	68.48	65.71
University	89.45	88.20	86.83	85.33	83.69
	Number of own children age 5-9				
	0	**2**	**4**	**6**	**8**
None	24.24	21.00	18.08	15.49	13.21
Primary	36.99	32.78	28.83	25.17	21.84
Preparatory	33.87	29.84	26.11	22.69	19.59
Secondary	58.07	53.49	48.86	44.24	39.72
Diploma	76.00	72.45	68.59	64.46	60.10
University	89.45	87.56	85.40	82.93	80.13
	Number of own children age 10-14				
	0	**2**	**4**	**6**	**8**
None	24.24	16.13	10.36	6.49	4.01
Primary	36.99	26.08	17.49	11.30	7.11
Preparatory	33.87	23.54	15.61	10.00	6.26
Secondary	58.07	45.42	33.34	23.11	15.30
Diploma	76.00	65.55	53.34	40.73	29.22
University	89.45	83.59	75.38	64.79	52.51

Notes: based on the logit regression in Table 4.3
Source of data: Computed from QSA's HIES, 2006/7

Summary

This Chapter reports the findings of an analysis of female labour force participation in Qatar through the use of QSA's HIES, 2006/7 data. Using logit regressions, we analysed the participation behaviour of (a) all adult females; and (b) women who were either heads of households or married to them. By using the second sub-sample we were able to identify which of the children in the household belonged to the woman concerned.

The main findings in this Chapter can be summarised as:

- The predicted labour force participation rate of married women is lower than that for single women.
- Income from other members of the household and the individual's own non-wage income significantly lower the likelihood of her participating.
- Age has an important (non-linear) effect on participation but we suspect this has more to do with year of birth than with age itself. Longitudinal data are required to disentangle age and cohort effects.
- Education is also an important determinant of participation, especially schooling at secondary level and above. By raising income when employed, higher levels of schooling encourage more women to take up or seek employment.
- The number of children in the household lowers participation rates. In the sample of all women, more young children in the household (those less than 5 years old) reduce the likelihood of participation
- In the smaller sample of heads of house (or their spouse), we find that the number of the woman's older children (aged 10-14) has the largest impact on her participation probability.

5

Implications for Policy

Implications for Policy

This monograph has examined the broad relationships between education and labour market outcomes in Qatar. Whilst recognizing that there are far wider benefits to schooling, both for the individual concerned and for society at large, our main aim has been to estimate the private return to schooling. Using the HIES 2006-7 dataset we sought to answer the question: by how much will the future incomes of Qatari men and women rise directly as a result of receiving an additional year of schooling? In the light of our findings, in this section we review possible policy options.

Although investment expenditure on education in Qatar has been rising in real terms its share in GDP is still low by international standards. In 2005 public spending on education accounted for 3.3 per cent of GDP in Qatar. In 2005 OECD countries were spending around 6 per cent of their GDP on education and, in the region, the GDP share of education spending in Saudi Arabia was 6.8 per cent. The increase in the school population has not yet been matched by investment in new primary and secondary schools and infrastructure; school facilities; poor usage of ICT in the classroom; science facilities limited; limited opportunities and usage of sports facilities.

On a broader level, the QNV 2030 envisages an increased participation of Qataris in the workforce. Current evidence indicates an increasing trend of labour force participation, particularly among the women. Qatari women have also made significant progress in their levels of educational attainment.

The results we have reported in this monograph suggest that the returns to post-secondary schooling are quite substantial: for men the return is around 11 to 14 per cent and for women slightly lower at 8 to 11 per cent. From our analysis of the returns to schooling there is every reason for government to engage in an aggressive policy to encourage the continuation of education beyond secondary schooling.

Before we address some specific areas of policy concern, we briefly outline some of the key features of the education system and the way it functions in Qatar:

- Schooling is Qatar is free. The private cost of post-secondary schooling is the income foregone during the period of schooling. Post-secondary schooling scholarships are offered to highly qualified students who want to progress to the tertiary level. The Higher Education Institute (HEI) administers a programme that offers such scholarships for study at home or abroad. The scholarships do come with some conditions, including past academic performance and the agreement of recipients to work in specific targeted areas. And scholarships from private companies are also used as part of their recruitment process. But again these will generally be offered only to the more capable students. So whilst education for Qataris is free, even at post-secondary level, additional financial support is only available for the more academically successful students.
- By law, Qatari children must currently complete nine years of schooling: from primary level (starting at age 6) up to the end of preparatory level or the age of 18, whichever comes earlier. Thus there is currently no *schooling choice* for nine years after the start of primary school. The key schooling decisions are (a) whether to complete secondary schooling; and (b) conditional on the completion of secondary schooling, whether to go on to some form of tertiary education (diploma, vocational education, university etc). The nine-year compulsory schooling rule was introduced in 2001.
- Of those individuals aged 20-24 in the HIES, 65 per cent of men and 83 per cent of women had completed secondary schooling. This cohort were aged 15-20 when compulsory schooling was introduced so, when they were progressing through the early stages of their education, they were free to drop out at any stage. Even so, only 7 per cent of women and 9 per cent of men (in this cohort) failed to complete preparatory

schooling. Of those who completed preparatory schooling, 89 per cent of women and 72 per cent of men progressed to the end of secondary level or beyond. The continuation rate to secondary schooling for women was significantly above that for men. Of course a number of individuals in this cohort were yet to complete their schooling at the time of the survey: some of those sampled with secondary schooling could well be part way through their tertiary education so observed continuation rates for this cohort beyond secondary level may give a misleading picture.

- Individuals aged 25 to 29 are most likely to have completed their schooling.[21] Of those in this cohort who had completed preparatory schooling, 87 per cent of women and 74 per cent of men continued to the secondary level. And of those that completed secondary schooling, 61 per cent of women and 34 per cent of men progressed to the tertiary level. This sex-differential in continuation rates is very marked. And naturally it raises important policy issues.

Male-Female Schooling Differentials

Whilst we find (using the HIES) that a greater proportion of females progress from the preparatory level to secondary education, the continuation rate differential is even more pronounced from secondary to tertiary levels. In the HIES 2006-7, of 100 women aged 25-29 who had completed preparatory schooling, 53 had progressed to the tertiary level. Of 100 men of the same age, only 25 had proceeded to the tertiary level – half the number females.

The continuation rates for other cohorts in the survey are set out in Table 5.1. For each of seven cohorts, the table presents the percentages of males and females who progress to some form of post-secondary schooling after completing the preparatory level. Note that the continuation rates for the 25-29 cohort are *below* those of older cohorts. The dip in the continuation rates of

[21] Only 3 per cent of men and women in this age range were still completing their formal schooling.

this youngest cohort in the table could be due to the fact that some in this group have yet to complete their schooling. However since only around 3 per cent of the cohort are described at 'Students', the dip in the continuation rates beyond secondary level would seem to a real one, rather than due to incomplete schooling experience. Fewer younger individuals of both sexes are progressing beyond secondary level compared with older cohorts in the HIES.

The differential male and female continuation rates are also evident in Table 5.1. Of course this feature is widely appreciated by government and other stake-holders in Qatar: it is certainly clearly evident in the HIES 2006-7 data we have analysed.

Table 5.1 **Progression to Post-Secondary Schooling Levels by Age Cohort and Sex, HIES 2006/7**

Percentage of students with Preparatory schooling who progress to post-secondary level.							
Age:	25-29	30-34	35-39	40-44	45-49	50-54	55-59
Female	53	61	62	62	58	40	44
Male	25	42	50	50	57	59	55

Source of data: Computed from QSA's HIES, 2006-7

Does our analysis of the returns to schooling shed any light on these differentials? It would appear not. If the HIES sample gives a reasonable picture of the additional income Qatari men and women can expect to earn by progressing beyond the secondary level, the return to each additional year of university education is higher for men than it is for women. For men the return is around 11 to 14 per cent and for women a shade lower at 8 to 11 per cent.

It is possible that the higher female continuation rates to post-secondary schooling will have had a depressing effect on the wage rates in labour markets where these females are typically predominant. And the same logic applies to the relatively high male rates of return, except the general

equilibrium effects are reversed. There is no reason to attribute low continuation rates of men to low expected future earnings. The HIES evidence suggests quite the reverse.

Imperfect Information

It is possible that Qatari men are not sufficiently well informed about the potential economic benefits of post-secondary education. The high returns to schooling are clear in the HIES but they may not be appreciated by children and their parents at the time schooling choices are made. And the low levels of schooling may themselves be partly responsible for poor schooling choices. As Oreopoulos and Salvanes (2009) have recently argued, the failure of many individuals to progress to higher levels of schooling may be due to their 'lack of the very same decision-making skills that more schooling would help improve'. There would then be a strong case for making the facts more widely known, perhaps by ensuring that students at preparatory and secondary levels are made fully aware of the benefits of additional schooling (for example through schools career counseling).

A subtle variation on imperfect information is also possible. Qatari men may well understand that higher incomes will be enjoyed *on average* by those with schooling beyond secondary level, but they may not believe this to be true in *their particular case*. In the US for example, Carneiro *et al* (2003) find substantial individual heterogeneity in the returns to college education. Students are aware that *on average* returns are high, but they are uncertain about the returns in their own case. This may well be the case in Qatar, but why it should be particularly true of males is unclear. In the UK, the government has adopted measures to prevent such heterogeneity in the rate of return from discouraging educational investment. Funds are made freely available to students and the repayment of the loans is made conditional on the individual receiving a sufficiently high income when they enter the labour market. If the additional schooling brings no income gain, the loan effectively becomes a government transfer. We return to this possibility below.

Schooling and Academic Success

Our focus has been on the number of years of schooling without taking into account the levels of achievement at the end of each schooling level. According to Stasz *et al* (2007): 'Traditionally males [in Qatar] are outnumbered by females in completing secondary school, twice as many males as females fail examinations and the school drop-out rate is three times higher for males than for females'.[22] The Evaluation Institute of the Supreme Education Council conducted three studies on the factors affecting educational outcomes in independent, semi-independent and private Arabic schools in Qatar. They report that, on average, boys do not perform better than girls in any subject.[23] The lack of academic success at the end of secondary schooling may well discourage continuation, even when places in higher education institutions are available to these students. Poor performance may lead young men to believe that the likely return to tertiary schooling *in their particular case* is not sufficient to warrant the income loss experienced over the period of additional schooling.

We noted above that scholarships are available for post-secondary education but they are generally only made available to highly qualified individuals. Emiri Scholarships (perhaps the most prestigious offered), National Scholarships and Employee Scholarships are available to academically successful students. And corporate scholarships are also available for capable students. It is unsurprising therefore that so many young men with a poor performance at secondary level are discouraged from progressing further.

Two policy options could be considered. In the first place the differential academic performance of boys and girls at secondary school needs to be investigated. Evidence from a number of countries indicates that girls often do outperform boys at this stage but perhaps not to quite the extent evident in Qatar. The problem would seem to be one of academic motivation at

[22] They cite evidence reported in Planning Council (2005).
[23] The surveys highlight are other reasons for poor academic performance, most notably parental background. But these do not explain the sex differential in performance.

secondary level. Secondly scholarships or additional loan finance could be more widely made available for post-secondary education. And the loans could offered under the conditional repayment scheme currently operated in the UK: repayment is only required if income earned subsequent to university rise above a threshold level.

Social and Private Returns to Schooling

Our focus in this monograph has been on the private returns to schooling, using income data reported in the *HIES* 2006-7. The benefits of formal education go far beyond the income gains that educated individuals can expect to enjoy as a result of their schooling. In the first place the individuals themselves will enjoy non-pecuniary benefits even with no the financial gains. In their recent NBER paper, Oreopoulos and Salvanes (2009) argue:

> *Experiences and skills acquired in school reverberate throughout life, not just through higher earnings. Schooling also affects the degree one enjoys work and the likelihood of being unemployed. It leads individuals to make better decisions about health, marriage, and parenting. It also improves patience, making individuals more goal-oriented and less likely to engage in risky behavior. Schooling improves trust and social interaction, and may offer substantial consumption value to some students.*

These additional benefits of education have social spill-over effects. For example if schooling leads to a healthier population, public health expenditures can be lower, releasing resources for other uses. For this reason the social return from an additional year's schooling will be substantially higher than the private returns we have reported here.

There are also likely to be *inter-generational* spill-over effects: the children of well-educated parents are more likely to progress to higher levels of education

themselves and to perform well when they do. Today's expenditure on schooling is likely to bring substantial benefits to future generations of Qataris.

Schooling and Female Labour-Force Participation

The labour-force participation of Qatari females is on a rising trend. Our analysis of the *HIES* data suggests that labour force participation is highest amongst more educated women. By promoting higher education for women, policies will raise the labour force participation rates and of course raise the incomes of these women when employed.

Extensions to Survey Design

The *HIES* has enabled us to estimate the rate of returns to schooling for Qatar. There are two ways to improve the accuracy of the estimates of the returns to schooling.

First, retrospective questions can be included in the survey questionnaire. For example, it would be helpful to obtain more accurate information about work experience. For women it would be useful to know how much their work-experience had been interrupted through child-bearing. And for men it would be useful to know whether their working lives have been regularly interrupted with spells of unemployment.

In addition to questions pertaining to the respondent's educational attainment, it would be useful to know of any other post-schooling training, whether specialised or *ad-hoc* and continuous on-the-job type training. Some studies on the returns to training have been able to compare the effectiveness of government-sponsored training with that provided by the private sector.

Secondly, much additional information can be gathered by using longitudinal (or panel) surveys, which would re-interview the same households and individuals over a number years. Data sets from a longitudinal survey have distinct advantages. For example, they can help enhance information on an

individual's post-schooling work experience and lead to more accurate estimates of the effects of schooling *per se*.

However, as longitudinal surveys can be expensive and relatively complex to manage, the option to include some retrospective questions in the annual Labour Force Survey should be seriously considered.

Concluding Comments

Using the *HIES* 2006-7, we find relatively high rates of return to post-secondary schooling: for men the return is around 11-14 per cent and for women, 8-11 per cent . The private rates of return to post-secondary schooling are therefore not responsible for the relatively low male continuation rates to post-secondary schooling. It is of course possible that when schooling choices are made, the individuals concerned (and their parents) may not be aware of the economic benefits of post-secondary schooling. Or they may be well informed about the average rates of return but may not believe these returns to apply to their own case. Relatively poor academic performance by boys at secondary level may well increase their uncertainty about the future benefits of higher education. Reducing the performance gap between the sexes will obviously help raise the post-secondary continuation rates of young Qatari men. And there is also a case for additional public financial support to encourage young men to consider post-secondary education as the most promising way to raise lifetime income.

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Appendix I
Human Capital Earnings Function

Our starting point is Jacob Mincer's (1974) human capital earnings function[24] (HCEF):

$$\log(y_i) = \alpha + \beta S_i + \gamma E_i + \delta E_i^2 + \varepsilon_i \qquad (1)$$

where y_i is individual *i*'s income, S_i is the number of years schooling; E_i is the number of years of post-school work experience; and ε_i is an error term reflecting other influences on income.

Note that the four parameters in equation (1) are assumed to be the same for every individual. Also note that schooling and experience have independent effects on earnings, so the influence of experience on income does not vary with the level of schooling. The coefficient β is the income rate of return to an additional year's schooling for those in employment since:

$$\frac{\partial \log(y_i)}{\partial S_i} = \beta$$

The left-hand side of this equation is the proportional change in income due to a marginal change (one-year) in schooling. So if β were estimated to be 0.05, this means that one more year of schooling would raise incomes by 5 per cent. Strictly speaking β is the rate of return to schooling only on the assumption that education is free and that students earn nothing while at school, both appropriate for the Qatari setting.

[24] Thirty years after his pioneering work, Mincer's model was given a fuller theoretical foundation by Card (2001). There are other theories of schooling, the most prominent of which is Spence's (1973) signalling model. Many analysts have argued that credentials (such as a high school diploma or college degree) matter more than years of schooling per se. This hypothesis has come to be known as the 'sheepskin effect' - the existence of wage premiums for fulfilling the final years of elementary school, high school or college (Card 1999).

The return to the individual is the income earned as a result of one more year's schooling expressed as a percentage of the opportunity cost of the schooling – the income foregone during the extra schooling.

There are two hypotheses embedded in equation (1) - first, that the correct measure of education is the number of years of completed formal education; and secondly, that each additional year of schooling has the same proportional effect on income, holding constant work experience. Assuming that these conditions are both satisfied, the coefficient β in equation (1) completely summarizes the effect of education in the labour market.

Mincer argued that learning and skill-acquisition were not limited to formal schooling and on-the-job learning was an important by-product of work experience. Individuals with more experience can be expected to be more productive and hence enjoy higher incomes.

Such post-schooling investments in human capital may explain why earnings form a typically inverted U-shape over the life cycle, the acquisition of new skills tapering off in the later years of life as planning horizons shrink. Mincer thus included work experience and its square in his human capital earnings function. The square term will capture the weakening effect of work experience over the life-cycle - older individuals have shorter planning horizons and the returns to further human capital investments inevitably decline.

To estimate (1) we need to settle on a definition of income that is relevant for the schooling decision – one that schooling can be expected to influence. Income in the analysis that follows is defined as wages and salaries from employment, as defined in Table A1 below. Robustness tests which added income from self employment (Table A1) had no effect on our main conclusions so we define income simply as income earned in employment.

Table A1 **Income Categories, HIES 2006/7**

	Income Source Code Name	Description
Wages and Salaries	inc_source_1	Basic Salary
	inc_source_2	Overtime
	inc_source_3	Seasonal payments
	inc_source_4	Allowances
	inc_source_5	Payment in kind
Self-Employment	inc_source_6	Net income from Trade
	inc_source_7	Net income from Services
	inc_source_8	Net income from Industry
	inc_source_9	Income in kind from Business

Appendix II
Human Capital Earnings Function – Variable Rate of Returns

To allow for variable rate of returns, the HCEF model can be expanded by replacing the schooling variable, S_i in Equation (1) above with a set of education level dummy variables.

$$\log(y_i) = \alpha + \sum_{j=1}^{5} \omega_j D_{j,i} + \gamma E_i + \delta E_i^2 + \varepsilon_i \qquad (2)$$

where $D_{j,i}$ are education level dummy variables; j = 1 refers to primary education, j = 2 to secondary etc; $D_{j,i} = 1$ if individual *i* has completed the *j*th level of education and $D_{j,i} = 0$ otherwise.

We assume that the rates of return *within* any schooling band are constant. To understand the interpretation of the parameters in equation (2) consider the income of someone who has completed primary schooling (six years):

$$\begin{aligned} y_6 &= y_0(1+r_p)^6 \\ \log(y_6) &= \log(y_0) + 6 \times \log(1+r_p) \\ &\approx \log(y_0) + 6 \times r_p \end{aligned}$$

where r_p is the return to one year of primary schooling; 6 refers to the number of years involved; and y_0 is the income of someone with no schooling.

The intercept in equation (2) identifies $\log(y_0)$ and ω_1 identifies $6 \times r_p$. So to identify the average and marginal rate of return at primary level (r_p) we simply divide the coefficient on the primary school dummy by 6. At preparatory (lower secondary) level, equation (2) allows the rate of return to change, but note that when they were at primary level individuals who have completed preparatory schooling earned a return of r_p. So the following is true of individuals who have completed secondary schooling:

$$y_9 = y_6 \times (1+r_i)^3$$

$$y_9 = y_0(1+r_p)^6 \times (1+r_i)^3$$

$$\log(y_9) = \log(y_0) + 6r_p + 3r_i$$

where r_i is the annual (marginal) rate of return to preparatory schooling.

We have already noted that ω_1 identifies $6r_p$. And ω_2 identifies $6r_p + 3r_i$. The average and marginal returns to schooling at preparatory level are therefore given by:

$$\text{Average}: r_i^A = \frac{\omega_2}{9} \quad \text{Marginal}: r_i = \frac{\omega_2 - \omega_1}{3}$$

Similar calculations will give the average and marginal rates of return at other schooling levels. We assume that individuals who progress beyond secondary schooling enter either diploma schooling or university, but not both. Hence the rate of return at secondary level and beyond are defined as:

$$\text{Average}: r_s^A = \frac{\omega_3}{12} \quad \text{Marginal}: r_s = \frac{\omega_3 - \omega_2}{3}$$

$$\text{Average}: r_d^A = \frac{\omega_4}{14} \quad \text{Marginal}: r_d = \frac{\omega_4 - \omega_3}{2}$$

$$\text{Average}: r_u^A = \frac{\omega_5}{16} \quad \text{Marginal}: r_u = \frac{\omega_5 - \omega_3}{4}$$

where the subscripts identify the schooling level (secondary, diploma and university).

Appendix III
The Heckman Model

Consider the following wage (*W*) or income equation that links income to a set of observable individual characteristics, *X* (which would include schooling):

$$W_i = \beta X_i + \varepsilon_i \qquad (3)$$

This is the income an individual with characteristics X_i can expect to receive when employed. Next consider a latent (unobservable) variable E_i^* defined as:

$$E_i^* = W_i - W_i^*$$

where W_i^* is individual *i*'s *reservation wage*. If the wage in employment W_i exceeds the reservation wage, individual *i* will choose to work. Otherwise she will not. Of course we do not observe the individual's W_i^* or therefore the value of E_i^*. But we do know her work-choice decision. Define a dichotomous variable E_i which takes the value 1 if $E_i^* > 0$ (i.e. if individual *i* chooses to work) and zero otherwise. Although we do not know the value of the latent variable E_i^* we may know what observable characteristics (*Z*) may influence it. For example the reservation wage for women is likely to reflect the value of their time at home and this will be affected by the number of her children. Women with many children will have a high reservation wage and are unlikely to work. These observable influences give rise to the following latent variable equation:

$$E_i^* = \gamma Z_i + u_i \qquad (4)$$

where the error term (*u*) reflects unobservable characteristics that also influence the individual's decision to work.

Heckman pointed out that the expected income of an individual with characteristics X_i conditional on her working $E_i = 1$ is:

$$E(W_i \mid E_i = 1, X_i) = \beta X_i + (\varepsilon_i \mid u_i > -\gamma Z_i) \qquad (5)$$

Intuitively this states that we may get some information about the value of ε_i from the fact that this individual has chosen to work. Assume that ε_i are normally distributed with variance σ_ε^2 and u_i has a standard normal distribution (mean zero and unit variance). Then if the correlation between ε_i and u_i is ρ, Heckman showed that equation (5) can be written:

$$E(W_i \mid E_i = 1, X_i) = \beta X_i + \rho\sigma_\varepsilon \left[\frac{\varphi(-\gamma Z_i)}{1 - \Phi(-\gamma Z)} \right]$$

where $\varphi(.)$ is the standard normal density and $\Phi(.)$ the standard normal cumulative density function. The term in square brackets is called the inverse Mills ratio. Heckman showed that we can help remove the sample selection bias by exploiting the correlation between the errors of the wage and employment choice (probit) equations.

The Heckman procedure thus requires two equations - one that links the income of those employed to their observable characteristics (*X*) and a second that identifies those characteristics that influence the decision to work (*Z*). Our (log) income equation can then be written:

$$\log(y_i) = \alpha + \sum_{j=1}^{5} \omega_j D_{j,i} + \gamma E_i + \delta E_i^2 + \rho\sigma_\varepsilon \left[\frac{\varphi(-\gamma Z_i)}{1 - \Phi(-\gamma Z_i)} \right] + \varepsilon_i \qquad (6)$$

Heckman suggested two possible approaches to estimating (6). The first is a two-step procedure that derives the inverse Mills ratio from a first-stage probit model for employment choice. This is then added to the income equation and its coefficient interpreted as an estimate of $\rho\sigma_\varepsilon$. The second approach is

maximum likelihood where the two equations are estimated jointly. We have reported results from the second approach.[25]

[25] Greene (2008) finds significant differences between the two-step and maximum likelihood procedures. Puhani (2002) recommends the use of the maximum likelihood method.