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Education for Growth: The Premium on Education and Work Experience in Singapore

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EDUCATION FOR GROWTH: THE PREMIUM ON EDUCATION AND WORK EXPERIENCE IN SINGAPORE*

BY

**AUDREY LOW
SAM OULIARIS
EDWARD ROBINSON
WONG YUET MEI**

**ECONOMIC POLICY DEPARTMENT
MONETARY AUTHORITY OF SINGAPORE**

AND

**MANPOWER RESEARCH AND STATISTICS DEPARTMENT
MINISTRY OF MANPOWER**

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ABSTRACT

This paper examines the education premium in Singapore. Using a large dataset drawn from the 2000 Survey on Educational Qualifications, we estimate the premium on various levels of education. The average number of years of schooling among the employed was estimated to be 10.1 years, which suggests a general increase in educational attainment when compared to earlier studies. The proportion of degree holders among the labour force has also risen from less than 5% in the early 1980s to more than 17%, currently.

Our econometric work, which makes use of the standard Mincerian human capital earnings equation, confirms a relatively high premium on higher education in Singapore. On average, a worker who invests in an additional year of education is expected to increase his earnings by 13.2%. This estimate of the premium on education falls within the range of 10-13% estimated in earlier studies done on some of the Asian countries. In addition, there is evidence of a positive “interaction” effect between education and work experience, implying that the wages of more educated workers increase at a faster rate than those of the less educated, as work experience increases. The results indicating a strong premium on post-secondary education and beyond imply that it is rational for individuals to invest in education.

The standard Mincerian equation was also estimated separately for subgroups of data, segregated by industry and occupation types. We find that, in general, the premiums on education and work experience tend to be higher among the industries with a higher proportion of higher skilled workers (such as the financial intermediation industry), as well as among white-collar jobs (such as professionals and managers).

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1. INTRODUCTION

1. Modern societies have been increasing their investment in developing their human capital resources. For example, expenditure on educational institutions among the OECD countries as a percentage of GDP has risen from 4.8% in 1988 to 5.6% in 1999¹. Human capital development is a high priority of both the state and the individual. A highly skilled and educated workforce tends to be more productive and thus earn higher wages. Moreover, the richer and more advanced countries tend to be characterized by higher levels of literacy and educational attainment. The increasing significance of human capital in the modern economy is also observed by Nobel Laureate Gary Becker (2002), "Technology may be the driver of a modern economy, especially of its high-tech sector, but human capital is certainly the fuel".

2. Human capital is particularly vital in a small economy like Singapore, especially since it has no natural resources. While Singapore ranks top in terms of the strong linkage between pay and productivity (Global Competitiveness Report 2001-2002), it unfortunately does not fare as well in other indicators of human capital development. For example, Singapore is ranked 39th in terms of illiteracy rate (World Competitiveness Yearbook, 2002), 23rd in terms of labour productivity, 22nd and 28th in terms of secondary school and tertiary education enrolment, respectively.

3. This study examines the relationship between wages and skill levels, measured in terms of the number of years of schooling and work experience. In addition to providing a comparison of the relative premiums of human capital across countries, we estimate the human capital premium in Singapore, specifically in terms of the premiums on education and work experience, by applying the Mincerian wage equation to a survey data of the employed labour force in 2000. We also examine the premiums at various levels of educational attainment and work experience, as well as across various industry and occupational groups.

¹ "Education at a Glance – OECD Indicators", Centre for Educational Research and Innovation, Indicators of Education Systems, 1992 and 2002 Editions.

4. This paper is structured as follows. In the following section, we describe some stylised facts derived from the cross-sectional dataset. We then proceed to introduce the empirical methodology and apply it to the data in Section 3, where we discuss the empirical findings. Section 4 concludes.

2. CHARACTERISTICS OF THE WORKFORCE

2.1. PRELIMINARIES

5. The cross-sectional data used in this study was obtained from the 2000 Survey on Educational Qualifications, conducted by the Central Provident Fund Board for the Ministry of Manpower. The survey covered establishments in the private sector, with at least 25 employees, stratified by industry². After removing incomplete records and restricting the sample age group to 15-64 years, the data sample consisted of 156,366 employed workers³, of which 53% were males. The average age of a male worker was 39.9 years, while that of a female worker was 36.7 years, implying an overall sample mean of about 38.4 years.

6. The average number of years of schooling for both males and females was 10.1 years. This number is higher than that reported in previous studies, which found the average number of years of schooling to be 9.5 in 1998 (Sakellariou, 2001) and 8.5 in 1974 (Liu and Wong, 1981). We infer that the average level of education received by a Singaporean worker has been increasing over the years. Indeed, a reflection of this trend is that the proportion of degree holders in the workforce has risen from less than 5% in the early 1980s to more than 17% in 2002⁴.

7. Chart 1 shows the industry⁵ profile of the workers sampled. The majority of the workers were from the services-related industries (74.3%) while the manufacturing and construction sectors comprised 21.0% and 4.4% of the sample, respectively.

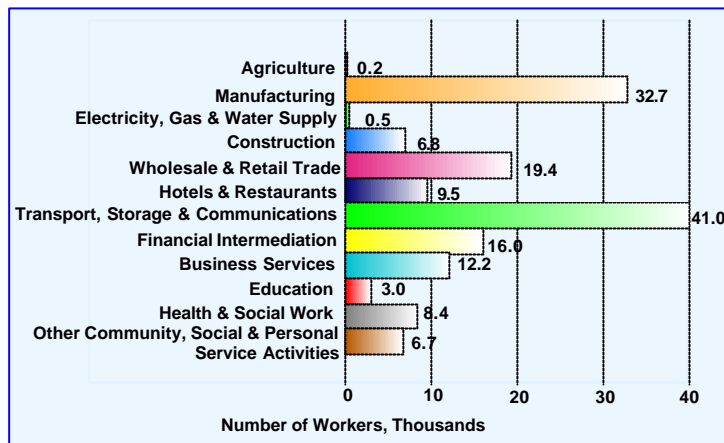
² The sample only includes CPF contributors. The following types of CPF contributors were excluded for the tabulation of monthly gross wages: apprentices / trainees; temporary workers; part-time workers; piece rated workers; and workers who worked part month in the month of June 2000.

³ The original dataset had a total of 163,207 observations.

⁴ Report on Labour Force in Singapore, Ministry of Manpower.

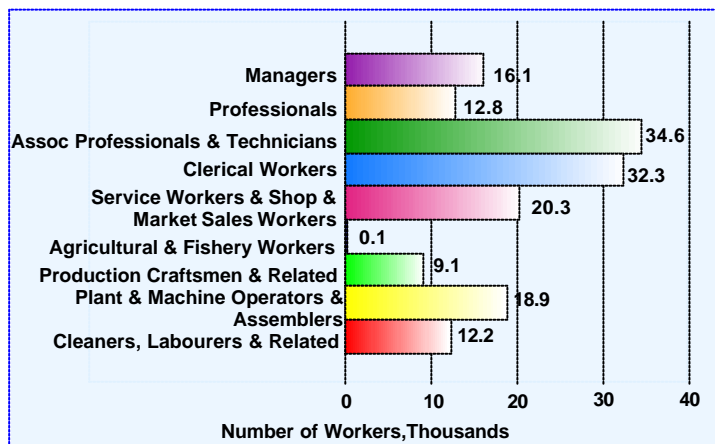
⁵ The industry groups are based upon the Singapore Standard Industrial Classification Code.

**Chart 1
Disaggregation by Industry, 2000**



8. A disaggregation of workers by occupation type⁶ is shown in Chart 2. The two most common occupational groups were associate professionals and technicians, and clerical workers.

**Chart 2
Disaggregation by Occupation, 2000**



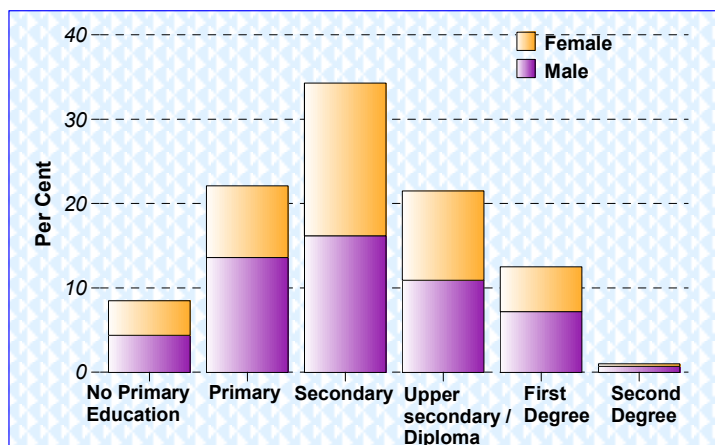
2.2 PROFILE OF SUBGROUPS, BROKEN DOWN BY EDUCATIONAL ATTAINMENT

9. Chart 3 shows the profile of workers by educational attainment. Approximately 8.5% of the workers in the sample did not attain primary level education, while 22.2% and 34.3% received primary and secondary

⁶ The occupational groups are based on the Singapore Standard Occupational Classification Code.

education, respectively. Another 21.6% were upper secondary or diploma holders. University graduates comprised 12.5% of the sample, while 1.0% attained a second degree (e.g., Masters degree).

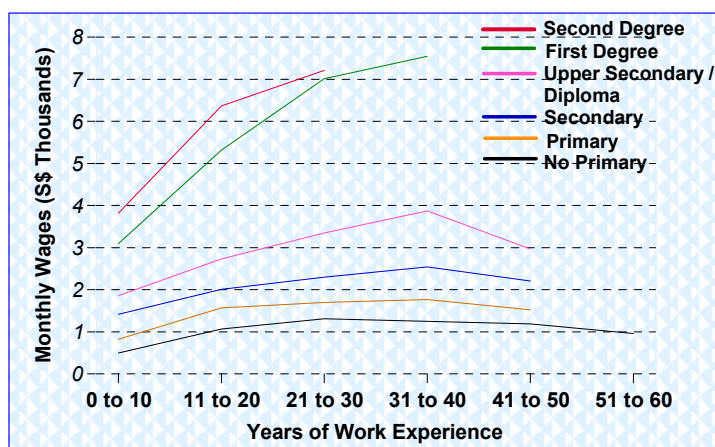
Chart 3
Percentage of Workers By Educational Attainment, 2000



* The values are presented in Table A1.1 of Annex 1.

10. We find that wage profiles vary considerably among workers with different levels of educational attainment (see Chart 4). The median (or “middle”) wage was used rather than the mean wage, since the former is less sensitive to extreme values, making it a better measure in distributions such as wages, which tend to be highly skewed by a relatively small number of high income earners at the top end.

Chart 4
(Median) Monthly Wage Profiles of Worker by Educational Attainment, 2000



* The values are presented in Table A1.2 of Annex 1.

11. As can be seen from Chart 4, wages increased monotonically with the level of educational attainment. A first-degree holder earned approximately six times that of a worker who did not have primary level education. (See Table A1.3 of Annex 1 for a comparison between the wages of first-degree holders to that of workers with lower educational qualifications.) This premium on higher education also increased with work experience (i.e., the longer a highly educated worker was in the workforce, the higher his wage would be relative to his less educated counterpart), reflected in the steeper slope of the wage profiles for degree holders than those for less educated workers. Wages have a tendency to increase with work experience, as a worker gains more skills and knowledge of the job, thus enabling him to become more productive. This positive correlation is sometimes reinforced by the seniority-based wage system in some companies. The rise in wages with work experience is more pronounced among higher skilled workers than the blue-collar and lower skilled workers. In the case of manual jobs, wages typically peak at an earlier age, as age may become a hindrance to the worker's performance. (This explains the inverted "U-shaped" wage profiles of the less educated workers, peaking at around 31-40 years of work experience.) This is unlike the situation for higher-skilled workers (e.g. managers and professionals) where wages continue to rise with experience (even after they reach 50).

2.3 SUMMARY

12. To summarise, the main findings from the data are:
- (i) Wages increased monotonically with the level of educational attainment.
 - (ii) Wages increased with work experience, as workers typically acquire more skills and knowledge of the job with time, thus enabling them to become more productive. The rise in wages with work experience is more pronounced among the higher skilled workers than the blue-collar and lower skilled workers.
 - (iii) The wage profiles of the less educated workers followed an inverted "U-shape", peaking at around 31-40 years of work experience.

3. EMPIRICAL METHODOLOGY AND FINDINGS

13. In order to formalise the findings reported in the previous section, we now apply some fairly standard econometric tools to assess the relevance of the Mincerian human capital earnings equation (see below) using our dataset.

3.1. STANDARD MINCERIAN EQUATION

14. The standard Mincerian human capital earnings equation, as developed by Jacob Mincer in 1974, is a log-linear earnings-education relation that measures the returns to human capital. The Mincerian equation estimates the change in earnings using “educational attainment” and “work experience” as explanatory variables. In empirical work, a quadratic term in work experience is often added into the model to capture possible non-linear returns to work experience such as returns to on-the-job training. The standard Mincerian wage equation may be represented as follows:

$$\ln(W_i) = \beta_0 + \beta_1 * S_i + \beta_2 * X_i + \beta_3 * X_i^2 + \varepsilon_i \quad (1)$$

where $\ln(W_i)$ is the natural log of the wage of individual i , S_i is the number of years of schooling, X_i refers to the number of years of work experience, and ε_i is a disturbance term. The parameter β_1 is thus interpreted as the conditional rate of return, on average, to investment in schooling. It should be positive, as wages tend to increase with the number of years of schooling. The coefficient β_2 should also be positive, as work experience should add value to the productivity of the worker, and hence result in higher wages. The expected sign on β_3 is negative, as the return to work experience usually increases at a decreasing rate. Subsequently, after many years of work experience, the return to work experience becomes negative and then falls at an increasing rate. This behaviour implies an inverted “U-shaped” wage profile like that found in the data (as described in the previous section).

15. As the number of years of work experience was not directly available from the data, it was inferred by subtracting five years from the difference between the age of the person and the number of years of

schooling. The corresponding assumptions made here are that people begin schooling at age six, and commence work immediately once they finish school. Details of the various categories of educational attainment as well as the respective years of schooling assigned to each category can be found in Annex 2. The results of estimating equation (1) using the OLS method are⁷:

Table 1
Results of Standard Mincerian Equation

Dependent Variable: ln(wages)				
R-squared	0.4296			
S.E. of regression	0.5420			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	5.4434	0.0076	715.92	0.0000
GENDER	0.3206	0.0027	119.65	0.0000
SCHOOL	0.1315	0.0005	277.58	0.0000
EXPERIENCE	0.0521	0.0004	131.50	0.0000
(EXPERIENCE) ²	-0.0007	0.0000	-88.19	0.0000

16. The model suggests that the pay-off for an additional year of schooling is around 13.2%. In other words, a worker who invested in an additional year of education is expected to increase his earnings by 13.2%, on average. This figure is comparable to previous estimates obtained by Sakellariou (13.1%) using 1998 data.

17. The empirical results confirm that earnings eventually fall with experience ($\beta_2 > 0$, $\beta_3 < 0$). Thus, wages increase with an additional year of work experience, though at a decreasing rate.

18. The analysis of the data in Section 2 (Para. 11) suggested the existence of “interaction” effects between educational attainment and work experience, as returns to work experience seemed to be augmented by educational attainment. We therefore tested for such “interaction” effects through the inclusion of two “interaction” terms (among the schooling and experience variables) in equation (1), arriving at the equation (2) as follows:

$$\ln(W_i) = \beta_0 + \beta_1 * \text{gender}_i + \beta_2 * S_i + \beta_3 * X_i + \beta_4 * X_i^2 + \beta_5 * (S_i * X_i) + \beta_6 * (S_i * X_i^2) + \varepsilon_i \quad (2)$$

⁷ Also, we have included a gender indicator variable (1 if male, 0 if female). Observations with wages that fall outside of the 0.5th-99.5th percentile range of the distribution have been removed, for two reasons: (i) to base our analysis on a more representative sample; and (ii) enhance the robustness of our parameter estimates, in view of the well-known sensitivity of the OLS method to outliers.

19. The results of estimating equation (2) are shown in Table 2 below. The coefficients of the “interaction” terms, β_5 and β_6 , are significant and of the correct sign. The coefficient of the first “interaction” term, β_5 , is significant and slightly positive (0.0009). This suggests that the premium on work experience is dependent on educational attainment, and similarly, the premium on educational attainment is dependent on work experience. These “interaction” effects between educational attainment and work experience will be explored further in Section 3.3, when we consider further extensions to the Mincerian equation.

Table 2
Results of Standard Mincerian Equation (with “Interaction” Terms)

Dependent Variable: $\ln(\text{wages})$				
R-squared	0.4594			
S.E. of regression	0.5101			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	4.8581	0.0164	296.60	0.0000
GENDER	0.3245	0.0026	124.30	0.0000
SCHOOL	0.1617	0.0013	128.27	0.0000
EXPERIENCE	0.0752	0.0012	63.87	0.0000
(EXPERIENCE) ²	-0.0007	0.0000	-39.19	0.0000
SCHOOL*EXPERIENCE	0.0009	0.0001	9.35	0.0000
SCHOOL*(EXPERIENCE) ²	-0.0001	0.0000	-43.57	0.0000

20. Table 3 summarises the results of studies on returns to education done with similar earnings data from other countries. Higher returns to education tend to be estimated for countries at an early stage of development and relatively low average education levels, while lower returns tend to be estimated for more developed countries with relatively high average education levels⁸. Estimates of the returns to education for most countries average between 5% and 15% (i.e., each additional year of schooling can be expected to boost the average wages of a worker between 5-15%).

21. Previous studies have found that the returns to education tend to be lower for the more developed countries. Estimates of the average rate of returns to education for Asian countries average around 10-13%. In this regard, Singapore’s relatively high “return to education” estimate – considering its advanced stage of development and per-capita income – in

⁸ Sakellariou C. (2003). See also Hall R. (2002) for an interesting discussion of the contribution of education to individual earnings in various countries.

part suggests the greater application of complementary machines and equipment in Singapore's production process. In addition, the technological developments in the context of rapid structural change, in the recent past, may have favoured the higher educated workers. These would have supported the returns to education in Singapore.

Table 3
Returns to Education in Selected Countries

Country / Sample period	Returns to Each Additional Year of Schooling	Study
Australia	5.1% (males); 5.2% (females)	Trostel, Walker & Woolley (2001)
China / 2000	6.4%	Brau and Rozelle (2002)
Great Britain	12.7% (males); 13.0% (females)	Trostel, Walker & Woolley (2001)
Hong Kong / 1981	6.1%	Psacharopoulos (1994)
Indonesia / 1995	6.8%	Duflo (2001)
Italy / 1995	4.8%	Brunello (2000)
Japan	7.5% (males); 9.4% (females)	Trostel, Walker & Woolley (2001)
Korea / 1986	13.5%	Ryoo, Nam & Carnoy (1993)
Malaysia / 1988-89	11.3%	Schafgans (2000)
Philippines	11.3% (males); 19.2% (females)	Trostel, Walker & Woolley (2001)
Singapore / 1998	13.1%	Sakellariou (2001)
Taiwan	8.0%	Liu, Hammitt & Lin (2000)
Thailand / 1989	11.5%	Patrinos (1995)
United Kingdom / 1995	5.5% (males); 9.7% (females)	Chevalier & Walker (1999)
United States	7.4% (males); 9.6% (females)	Trostel, Walker & Woolley (2001)
Regions		
Sub-Saharan Africa	11.7%	Psacharopoulos & Patrinos (2002)
Asia	9.9%	
Latin America / Carribean	12.0%	

3.2. QUALIFICATION

22. Some limitations of the methodology used in the various studies should be noted. First, the returns to education may vary across various educational attainments and types of educational institutions. As such, the returns to education estimates above should be understood as estimates of the mean returns. These returns may also vary across time, subject to

various economic conditions and education policy developments. A related point concerns the interpretation of the coefficient on the schooling variable. As noted above, this variable is defined as the number of years of schooling of each individual worker. Ideally, this should be augmented with data on the successful attainment of various educational qualifications, such as the PSLE, 'O' and 'A' Levels, etc, which unfortunately is not easily extractable. We have tried to address this issue by also reporting the results of returns to various stages of educational qualifications in the modified Mincerian equation, reported in Section 3.3 below.

23. Second, the estimates are not directly comparable with each other as education systems differ across countries.

24. Third, there exist biases and errors in the schooling estimates. Measurement errors, which occur when the educational attainment is not observed precisely or reported accurately, have a tendency to result in a downward bias in the return estimates, i.e., actual returns are higher. Card (1995) reviewed the US dataset and concluded that measurement errors do exist in the self-reported years of schooling. Corrected returns to education range from 10-15%.

25. Fourth, there are additional factors that influence returns to education such as ability bias, family background and quality of schooling. It is important to distinguish the returns to an individual's schooling or work experience from the returns from such additional factors. Individuals, with better abilities, better family background, and better schooling are likely to have higher income generating capacities. They are also likely to be the ones who choose higher education. Thus, it has been a concern that workers who have had more education tend to possess certain characteristics, which, on their own, would bring about higher wages. The returns to education would then be overstated if these characteristics were unaccounted for.

26. Some papers have attempted to control for these other characteristics. While some introduced control factors such as scores on standardized aptitude or IQ tests to take account of differences in inherent ability, others selectively used data where such characteristics have already been accounted for.

27. However, on balance, there is little evidence that omitted variables might be correlated with earnings and education. Indeed, Welch (1975) and Griliches (1977) concluded the addition of such variables would not necessarily generate superior estimates of the return to schooling. Indeed, Griliches (1977) claims that “the implied net bias is either nil or negative” once measurement error in education is accounted for, as the inclusion of variables that are correlated with a worker’s schooling may increase the measurement error bias, despite reducing the omitted variable bias. Angrist and Krueger (1991) are of the same view, as they suggested that the upward bias in the return to schooling is generally of about the same order of magnitude as the downward bias due to measurement error in schooling.

3.3. MODIFIED MINCERIAN EQUATION

28. In the Mincerian model used earlier (i.e., equation (1)), both the schooling and experience coefficients are aggregate measures. However, the returns to education might vary depending on the level of education attained, and the wages of workers might vary with the years of work experience. For example, wages tend to increase more with work experience, the more educated the worker is. Thus, it would be useful to disaggregate the explanatory variables in the Mincerian equation, namely years of schooling (S_i) and years of work experience (X_i), into further subcategories to gain more insight from the data. The following revised Mincer’s equation⁹ was arrived at:

$$\ln(W_i) = \beta_0 + \beta_1 * \text{gender}_i + \beta_2 * \text{primary}_i + \beta_3 * \text{secondary}_i + \beta_4 * \text{upper secondary/ diploma}_i + \beta_5 * \text{first degree}_i + \beta_6 * \text{second degree}_i + \beta_7 * \text{1-10yrs}_i + \beta_8 * \text{11-20yrs}_i + \beta_9 * \text{21-30yrs}_i + \beta_{10} * \text{31-40yrs}_i + \beta_{11} * \text{>40yrs}_i + \varepsilon_i \quad (3)$$

29. The estimation results in Table 4 show that the returns to an additional year of schooling at the secondary, upper secondary/diploma or first degree levels, were about 15-17%, with the highest returns accruing to

⁹ Note that the education and work experience breakdowns are accumulative and reflect the number of years of education or work experience that the individual i had in each specific category. For example, a worker with secondary school education and 10 years of work experience would have primary=6, secondary=4, upper secondary/diploma=0, first degree=0, second degree=0, 1-10yrs=10, 11-20yrs=0, 21-30yrs=0, 31-40yrs=0, >40yrs=0.

individuals with a first degree¹⁰. The returns to an additional year of schooling at the primary level was minimal, at 1.2% while the returns to an additional year of schooling at the second degree level (e.g., Master/Doctorate) was about 5.0%.

Table 4
Results of Modified Mincerian Equation

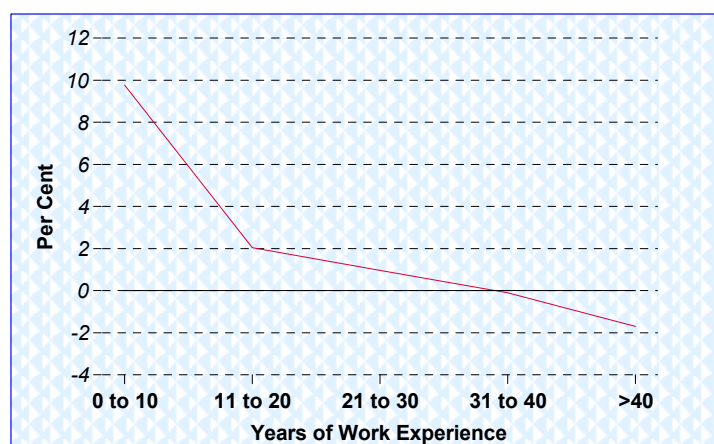
Dependent Variable: ln(wages)
R-squared 0.4786
S.E. of regression 0.5010

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	5.6396	0.0106	534.35	0.0000
GENDER	0.3228	0.0026	125.23	0.0000
PRIMARY	0.0122	0.0015	8.17	0.0000
SECONDARY	0.1523	0.0012	123.18	0.0000
UPPER SECONDARY/DIPLOMA	0.1626	0.0014	120.26	0.0000
FIRST DEGREE	0.1683	0.0011	156.15	0.0000
SECOND DEGREE	0.0500	0.0078	6.41	0.0000
0-10 YEARS	0.0977	0.0008	119.67	0.0000
11-20 YEARS	0.0204	0.0005	38.71	0.0000
21-30 YEARS	0.0097	0.0005	17.85	0.0000
31-40 YEARS	-0.0009	0.0007	-1.23	0.2179
>40 YEARS	-0.0169	0.0010	-17.98	0.0000

30. As for an additional year of work experience, the estimated returns were greatest during the first ten years of work experience (9.8%) and slowly declined to negative values after about 31-40 years of work experience. (Chart 5)

¹⁰ A recent study entitled Education at a Glance 2002, conducted by the Organisation for Economic Cooperation and Development, looks at the rate of return from all sectors of education across 32 countries. The study found that graduates in Britain enjoyed the highest rate of return at 17%, compared with 7% in Italy and Japan and between 10% and 15% in the US, France, the Netherlands, Sweden and Denmark. The OECD average is 11.8%. Thus, returns to higher education (first degree) in Singapore comes in strong at 17%, comparable to that in Britain.

**Chart 5
Returns to Work Experience**



31. Harmon and Walker (1999) suggested that the ability to estimate returns for specific subgroups (i.e., grouping by different levels of educational attainment) is informative, especially since policy changes are often directed at particular types of education. We therefore ran separate regressions on various groups of workers, categorised according to their level of educational attainment. A summary of the results is presented in Table 5.

**Table 5
Summary of Regression Coefficients of Workers with Different Educational Attainment**

Educational attainment	School coefficient	Experience coefficient	(Experience) ² coefficient
No Primary and Primary	0.0539	0.0557	-0.0008
Secondary and Upper Secondary / Diploma	0.1725	0.0837	-0.0015
First Degree and Second Degree	0.0801	0.0894	-0.0016

32. We have also disaggregated the years of work experience for the various groups of workers into further subcategories. The results of these regressions can be found in Tables A1.4-A1.6 of Annex 1.

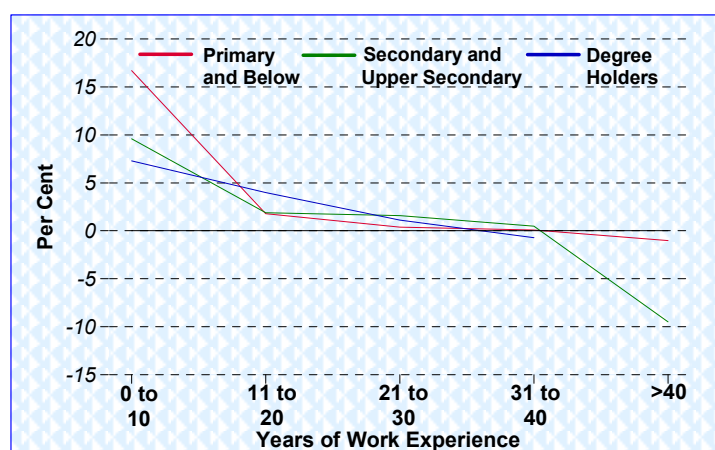
33. The returns to an additional year of schooling were largest for the group with secondary, post secondary & diploma education. While a degree definitely augmented income, the extra income from an additional year of schooling was proportionately less.

34. The results also suggest that a less educated worker has lower returns to work experience vis-à-vis a more educated worker. The returns to

experience of a worker with primary and below level of educational attainment were 5.6%, whereas those of a degree holder were 8.9%. This is not surprising, considering the propensity of the less educated to hold more manual jobs where age becomes an impediment. This is unlike the case of the higher end jobs, which are typically held by the more educated, where a premium is accorded for the knowledge gained through longer working experience.

35. The rates of returns at various levels of work experience for each subgroup were obtained by disaggregating the experience variable into deciles, as shown in Chart 6.

Chart 6
Returns to Work Experience (by Educational Attainment)



* The exact values are presented in Table A1.7 of Annex 1.

36. The rates of return to initial work experience (0-10 years) were the highest among the less educated workers. This can be explained in terms of the comparatively low wages earned by the less educated workers. However, as can be seen from Chart 6, the returns to work experience of the less educated workers declined the quickest (steepest slope), especially during the first twenty years of work experience. Thus, wages of more educated workers increased at a faster rate than those of less educated workers, and especially so for the first twenty years of work experience. Our results confirm previous stylised results that the relative wages of more educated workers to less educated workers tended to increase along with work experience, for the first few decades of work experience. Additional years of work experience do not add as much value to the worker, in terms of rendering them more productive and getting paid higher wages.

3.4. DISAGGREGATION BY INDUSTRY AND OCCUPATION TYPES

37. For completeness, the standard Mincerian equation was also estimated separately for subgroups of the data, segregated by industry and occupation types. The main results are reported below¹¹.

3.4.1 Disaggregation by Industry Type

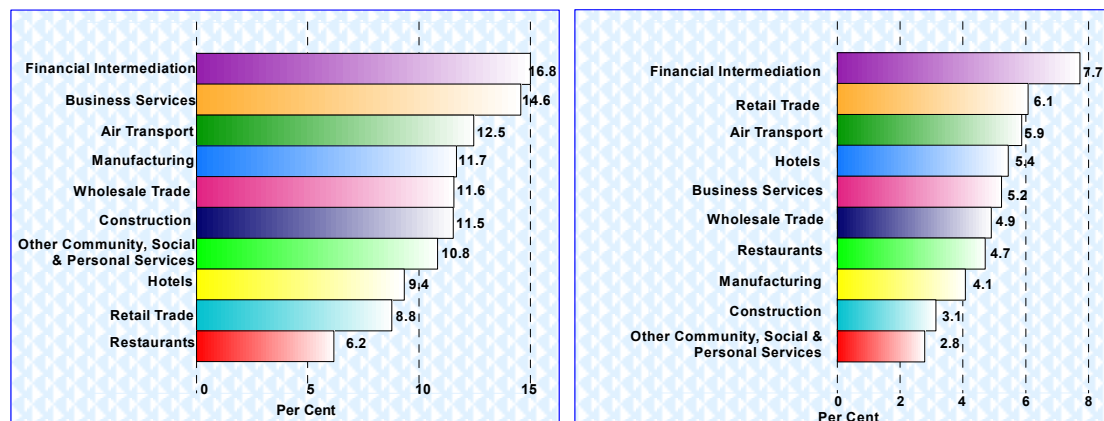
38. Chart 7a shows the coefficient of the schooling variable for the various subgroups, disaggregated by industry types. The premium on education was higher than average in the financial intermediation (16.8%) and business services industries (14.6%). Workers in the retail trade and restaurant industries had the lowest premium on education, at 8.8% and 6.2% respectively.

39. Chart 7b compares the coefficients of the work experience variable across the various industries. The work experience coefficient varied quite markedly among the industries. Workers in the financial intermediation sector had the highest premium on work experience (7.7%), followed by those in the retail trade (6.1%), air transport (5.9%) and hotel (5.4%) industries. Indeed, workers in these industries tend to be white-collared workers who are generally better educated, and hence would command a higher premium on work experience. Another possible explanation for the higher premium in such industries could be the existence of seniority-based wage systems implemented by the larger and more established firms.

40. Workers in the industries associated with more manual work activities, such as the manufacturing and construction industries, tend to have lower premium on work experience, at 4.1% and 3.1% respectively. Age and work experience tend to play a more minor role in increasing the workers' productivity in such industries.

¹¹ Observations with wages that fall outside of the 0.5th-99.5th percentile range of the distribution have been removed. Also, industry and occupational groups which had less than 500 observations were excluded from the regressions.

Chart 7
Disaggregation by Industry
(a) Premium on Education **(b) Premium on Work Experience**

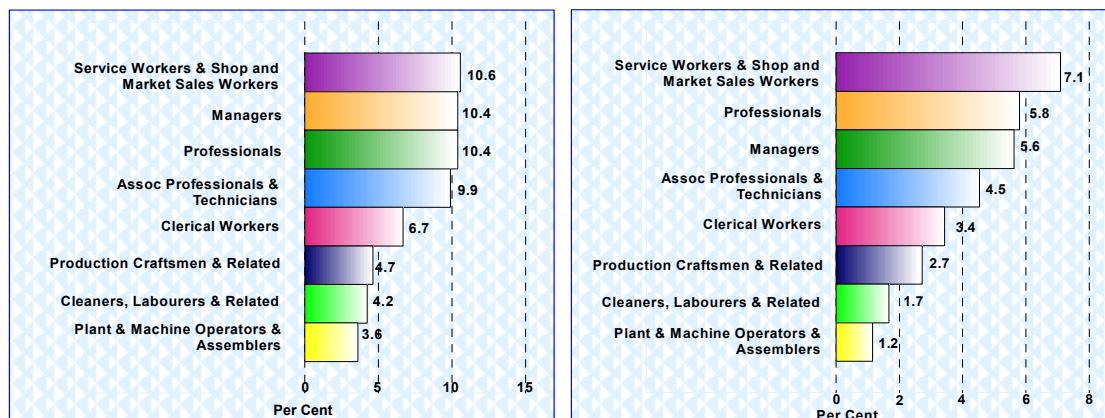


3.4.2 Disaggregation by Occupation Type

41. Chart 8a shows the premium on education among the workers in the various subgroups, disaggregated by occupation type. The premium was highest among the higher skilled workers such as the service workers (10.6%), managers (10.4%) and professionals (10.4%). The lower skilled occupations such as the cleaners and labourers, and the plant and machine operators and assemblers commanded the lowest premium on education, at 4.2% and 3.6% respectively.

42. Chart 8b compares the coefficients of the work experience variable across occupations. The premium on work experience was lower among lower skilled jobs such as the plant and machines operators and assemblers (1.2%) and the cleaners and labourers (1.7%). The premium on work experience was higher among the higher skilled occupations such as professionals (5.8%) and managers (5.6%). It is surprising, though, that service workers and shop and market sales workers had the highest premium on work experience (7.1%). One possible explanation is that while the commencing wages of such jobs are lower than the market average, such commission-based jobs can see significant rise in wages alongside growth in clientele, which is correlated to work experience.

Chart 8
Disaggregation by Occupation
(a) Premium on Education **(b) Premium on Work Experience**



3.5. SUMMARY

43. To summarise, the main empirical findings from the Mincerian equations are as follows:

- (i) A worker who invests in an additional year of education is expected to increase his wage by 13.2%, on average.
- (ii) The returns to secondary, upper secondary/diploma or first degree qualifications were about 15-17%, with the highest returns accruing to individuals with a first degree. The returns to primary level education were minimal, at 1.5%, while the returns to a second degree qualification were about 5.0%.
- (iii) The returns due to an additional year of work experience were greatest during the first ten years of work experience (9.8%) and slowly declined to that of negative values after about 31-40 years of work experience.
- (iv) A less educated worker had lower returns to work experience vis-à-vis a more educated worker.
- (v) Wages of more educated workers increased at a faster rate than those of less educated workers, for the first 20 years of work experience.
- (vi) The premiums on education and work experience tend to be higher among the industries with a higher proportion of higher skilled workers such as the financial intermediation

industry, as well as among the white-collar jobs such as professionals and managers.

4. CONCLUSION

44. The premium on human capital in Singapore is comparable to other developed countries, and suggests strong evidence of a substantial pay-off to education. In particular, we find that wages increased monotonically with the level of educational attainment, at all levels of work experience. Furthermore, the returns to an additional year of schooling increased as the individual progresses through the education ranks to obtain a first degree.

45. In terms of work experience, the returns to an additional year of work were positive during the first thirty years of work experience, but became negative after this. In other words, wages for an individual generally peak after about thirty years of work experience.

46. The results point to a high premium on university education in Singapore. Moreover, the returns to work experience decreased at a slower pace for more educated workers. As Singapore restructures itself and shifts from a technology-oriented society to a knowledge-based info hub, there will be increasing demand for high skilled workers. The premium on investing in higher education should encourage and provide greater incentives for individuals to pursue such qualifications.

47. The focus of this study is on the returns to formal education using data for 2000. As this study uses a single-year data, and as 2000 is a recovery period, one has to be cautious in generalizing the results to all time periods since they might not reflect the long-term trends of the economy. For example, the trend of an increasing supply of university graduates may impact the returns to education in Singapore in time to come. Hence, while this study provides a useful baseline, it is important to continue to monitor the returns to education over time. In addition, with the increasing emphasis on continuous employment training (CET), it would be useful to explore the returns to such investment in future studies.

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ANNEX 1: DATA TABLES AND REGRESSION RESULTS

Table A1.1
Percentage of Workers by Educational Attainment, 2000

Education Attainment	Male	Female	Total
No Primary Education	4.4	4.1	8.5
Primary	13.6	8.5	22.2
Secondary	16.2	18.1	34.3
Upper secondary / Diploma	10.9	10.6	21.6
First degree	7.2	5.3	12.5
Second degree	0.7	0.3	1.0

Table A1.2
(Median) Monthly Wages (\$ thousands) of Workers
by Educational Attainment, 2000

Education Attainment	Years of Work Experience					
	0 to 10	11 to 20	21 to 30	31 to 40	41 to 50	51 to 60
No Primary	0.50	1.07	1.31	1.25	1.19	0.96
Primary	0.82	1.57	1.70	1.77	1.52	
Secondary	1.42	2.01	2.30	2.54	2.21	
Upper Secondary / Diploma	1.86	2.73	3.35	3.87	2.97	
First Degree	3.10	5.32	7.01	7.55		
Second Degree	3.82	6.37	7.21			

Table A1.3
Ratio of Wages of Workers with a First Degree to Wages of Workers
With Lower Levels of Educational Attainment

Ratio of Wages of First Degree Holders to Wages of Workers with the following Educational Attainment:	Years of Work Experience			
	0 to 10	11 to 20	21 to 30	31 to 40
Upper Secondary / Diploma	1.67	1.95	2.09	1.95
Secondary	2.18	2.65	3.04	2.98
Primary	3.80	3.38	4.12	4.27
No Primary	6.20	4.98	5.37	6.04

Table A1.4
Workers with Primary and Below Educational Attainment

Dependent Variable: ln(wages)

R-squared 0.2753

S.E. of regression 0.5723

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	4.7351	0.0352	134.44	0.0000
GENDER	0.5173	0.0054	96.16	0.0000
SCHOOL	0.0562	0.0012	47.30	0.0000
0-10 YEARS	0.1673	0.0041	40.81	0.0000
11-20 YEARS	0.0183	0.0017	10.55	0.0000
21-30 YEARS	0.0038	0.0011	3.49	0.0005
31-40 YEARS	0.0012	0.0010	1.26	0.2080
>40 YEARS	-0.0103	0.0011	-9.39	0.0000

Table A1.5
Workers with Secondary or Upper Secondary/Diploma Educational Attainment

Dependent Variable: ln(wages)

R-squared 0.3032

S.E. of regression 0.5274

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	4.6779	0.0195	240.50	0.0000
GENDER	0.2729	0.0036	75.71	0.0000
SCHOOL	0.1676	0.0015	115.39	0.0000
0-10 YEARS	0.0960	0.0011	84.09	0.0000
11-20 YEARS	0.0185	0.0007	27.68	0.0000
21-30 YEARS	0.0155	0.0008	20.32	0.0000
31-40 YEARS	0.0049	0.0014	3.48	0.0005
>40 YEARS	-0.0946	0.0063	-15.09	0.0000

Table A1.6
Workers with First Degree or Second Degree Educational Attainment

Dependent Variable: ln(wages)

R-squared 0.3614

S.E. of regression 0.4903

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	6.2297	0.1203	51.78	0.0000
GENDER	0.2315	0.0069	33.53	0.0000
SCHOOL	0.0809	0.0075	10.81	0.0000
0-10 YEARS	0.0732	0.0015	48.90	0.0000
11-20 YEARS	0.0403	0.0014	29.67	0.0000
21-30 YEARS	0.0105	0.0023	4.50	0.0000
31-40 YEARS	-0.0072	0.0069	-1.04	0.2970

Table A1.7
Returns (%) to Work Experience (By Educational Attainment)

Experience	Secondary and Upper		
	Primary and Below	Secondary	Degree Holders
0 to 10	16.7	9.6	7.3
11 to 20	1.8	1.9	4.0
21 to 30	0.4	1.6	1.1
31 to 40	0.1	0.5	-0.7
>40	-1.0	-9.5	

ANNEX 2: BREAKDOWN OF THE SCHOOLING VARIABLE BASED ON HIGHEST EDUCATIONAL QUALIFICATION ATTAINED

Highest Educational Qualification Obtained	Primary	Secondary	Upper secondary / Diploma	First degree	Second degree
No formal Qualification / Lower Primary					
▪ Never attended School	0	0	0	0	0
▪ Primary education without PSLE/PSPE	3	0	0	0	0
▪ BEST 1-3 Cert	3	0	0	0	0
Primary					
▪ PSLE/PSPE/Equivalent	6	0	0	0	0
▪ BEST 4 cert	6	0	0	0	0
Lower Secondary					
▪ Secondary Sch without GCE 'O'/'N' Level Pass	6	2	0	0	0
▪ WISE 1-3 cert	6	2	0	0	0
▪ Basic Vocational certs/ITE Basic Vocational Training	6	2	0	0	0
Secondary					
▪ At least 1 GCE 'N' Level Pass or credit	6	4	0	0	0
▪ At least 1 GCE 'O' Level Pass or credit	6	4	0	0	0
▪ Cert of Competency/Artisan Cert/Artisan Trade Cert	6	4	0	0	0
▪ Technical Cert at NTC Gr 3/Equivalent	6	4	0	0	0
▪ Cert in Service Skills for Healthcare and Retailing/Cert in Enrolled Nurse	6	4	0	0	0
▪ Cert issued by non-educational institutions eg. Trade Assoc, Govt Ministries, Stats Boards etc	6	4	0	0	0
Upper Secondary: General					
▪ At least 1 GCE 'A' Level pass/Higher Sch Cert	6	4	2	0	0
▪ Other qualifications of equivalent std	6	4	2	0	0
Upper Secondary: Vocational					
▪ Cert in Office Skills/Cert in Computer Operation	6	4	2	0	0
▪ Cert in Business Skills/Cert in Business Studies	6	4	2	0	0
▪ NTC Gr 2	6	4	2	0	0
▪ NTC Gr 1	6	4	2	0	0

Highest Educational Qualification Obtained	Primary	Secondary	Upper secondary / Diploma	First degree	Second degree
<ul style="list-style-type: none"> ▪ Industrial Tech Cert ▪ Cert in Service Skills eg. For Travel Services/SHATEC ▪ Other advanced Cert/SIM cert/City & Guild cert/Teachers Training Cert/ACCA Level 1/LCCI Lower & Intermediate 	6 6 6	4 4 4	2 2 2	0 0 0	0 0 0
Polytechnic Diploma <ul style="list-style-type: none"> ▪ Polytechnic Dip ▪ Polytechnic Adv Dip ▪ Polytechnic Post-Dip Cert ▪ Dip in Applied Arts ▪ Dip in Nursing/Midwife ▪ Dip issued by Professional & Commercial Inst. Eg. AAT, ICSA, LCCI, CEHA, CDAF, City Guild ▪ Other dip of equiv std issued by Non-tertiary eg. Trade Assoc, Govt Ministries, Stats Boards etc 	6 6 6 6 6 6 6	4 4 4 4 4 4 4	3 3 3 3 3 3 3	0 0 0 0 0 0 0	0 0 0 0 0 0 0
Professional Qualification and Other Diploma <ul style="list-style-type: none"> ▪ Qualification Awarded by Professional Bodies (entry requirement not nec degree eg. ACCA level 3, CIMA, ICAEW, ACII, AII, BCS) ▪ National Inst of Education (NIE) dip ▪ Qualification Awarded by Professional Bodies (qualifying members must have a degree) eg. CPA, Chartered Mech Engrg, FIA, CFA ▪ Other qualification/SIM Dip 	6 6 6 6 6	4 4 4 4 4	3 3 3 3 3	0 0 4 0 0	0 0 0 0 0
University First Degree <ul style="list-style-type: none"> ▪ University (1st Degree & Honours) or equiv/Degree from Foreign U 	6	4	2	4	0
University Post Graduate Diploma/Degree <ul style="list-style-type: none"> ▪ Postgraduate Dip/NIE Postgraduate Dip ▪ Master ▪ Doctorate 	6 6 6	4 4 4	2 2 2	4 4 4	1 1.5 3