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Abstract
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Keywords
effects, differential, growth, have, economic, capital, health, does, ERA2015

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Does Health Capital have Differential Effects on Economic Growth?

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Abstract: Investigating the impact of health capital disaggregated by gender on economic growth in a sample of 210 countries over the 1990-2008 period, this study suggests that the influence of health capital across countries cannot be generalised. Results for the full sample indicate that health capital does not have a robust and significant effect on economic growth unless through their interactions with health expenditure and education. The results disaggregated by income group reveal that health capital has a positive robust influence on economic growth in high and upper middle income economies. In low and low middle income economies, health capital gains statistical significance only through their interaction with education and health expenditure. Increased fertility rates act to reduce the influence of health capital on economic growth.

Keywords: health capital, life expectancy, survival rate, economic growth, panel data.

JEL Codes: O11, O15, O57

1 Introduction

The importance of health in a country's economic growth has been well documented in the literature: Barro (1996), Bloom et al. (2003, 2000), Bhargava et al. (2001), Knowles and Owen (1995), McDonald and Roberts (2002). Caselli et al. (1996) however, find that the significance of the health capital variable disappears with the use of system GMM. Whether health directly influences economic growth or whether it acts as a proxy for omitted variables is a question that has been raised by Barro and Sala-i-Martin (1995). Given that the influence of health on economic growth is unclear, this study attempts to further investigate this issue using panel data for 210 countries covering the 1990-2008 period. The present study divides the stock of human capital into two components, education capital and health capital. The focus of this study however, is on the influence of health capital on economic growth. This study departs from the literature in two ways: 1) the present study disaggregates the stock of health capital by gender and investigates its influence on economic growth, 2) given the heterogeneity of the group of countries in the sample, the estimation is also carried out by grouping the countries by income (using the World Bank classification). The central argument of the study is that the impact of health capital on economic growth depends on the level of development of the economy.

2 The Model and Data

The study uses panel data covering 210 countries over the 1990-2008 period. Both OLS and system GMM are used to test the model. OLS is applied to equation (1) and system GMM to both equations (1) and (2).

$$y_{it} = \gamma y_{it-1} + X_{it}\beta + \mu_i + \eta_t + u_{it} \qquad (1)$$

$$\Delta y_{it} = \gamma \Delta y_{it-1} + \beta \Delta X_{it} + \Delta \eta_t + \Delta u_{it} \qquad (2)$$

where y_{it} is GDP per capita for country i in period t. All control variables are captured by the vector X_{it}. μ_i is a country specific effect and $\eta_{t,}$ a fixed time effect. u_i is a random error term that captures all other variables. Although both education and health capital are disaggregated by gender, the main explanatory variables of interest rate are the health capital variables as measured by life expectancy and the survival rate to 65 years. In addition to the investment ratio, education capital and health capital, the study also extends the model to incorporate monetary and fiscal policy as proxied by the ratio of M2 to GDP, and ratio of government expenditure to GDP, and trade to GDP to capture the degree of openness of an economy. The fertility rate is added as an additional control variable as increases in the fertility rate can reduce the growth rate (see Barro 1996). As the fertility rate can act to reduce the influence of health capital on economic growth, interactions terms are added for female life expectancy/survival rates x the fertility rate. Similarly as health expenditure and education can act to increase the influence of health capital on economic growth, interaction terms are incorporated for male and female life expectancy/survival rates and health expenditure per capita and male and female life expectancy/survival rates male and female enrolment ratios. All variables are converted into natural logarithmic form for empirical estimation.

3 Empirical Results

The OLS results are reported in Table 1. Column (1) estimates the model with the initial level of GDP per capita, the investment ratio and female and male enrolment ratios as independent variables. Colum (2) adds the female and male life expectancy variables to the model. The policy variables are incorporated into the model in column (3) and the openness variable in column (4). Evidence suggests that fertility can fall as a country grows, affecting in particular female primary education and health status (Barro 1996, Schultz 1989). Therefore column (5) incorporates the fertility rate and an interaction term for the fertility rate x female life expectancy. An increase in life expectancy increases the ability to invest in education (Barro 1996). Similarly an increase in health expenditure increases life expectancy. Accordingly Column (6) estimates the model with interaction terms for female and male life expectancy x female and male enrolment ratios and female and male life expectancy x health expenditure per capita.

[Table 1, about here]

The results for the full sample reported in Table 1 suggest no convergence among the economies. This is reasonable considering the economies are heterogenous comprising countries at various income levels. The coefficients on the investment and male and female enrolment ratios are statistically significant. The coefficient on the female enrolment ratio in column (1) for example suggests that a 1% increase in the female enrolment ratio leads to a 0.05% increase in economic growth. The coefficient on female life expectancy is statistically significant in columns (2) and (6), and male life expectancy in columns (3), (5) and (6). The coefficient on female life expectancy in column (6) indicates that each additional year of life expectancy increases the growth rate by 0.29%. Note that the statistical significance of the life expectancy variables are not robust. All the life expectancy variables gain statistical significance only in column (6) when life expectancy is interacted with health expenditure per capita and education. The results suggest that the marginal effect of both male and female life expectancy on economic growth is increased when enrolment is high. Similarly, the interaction terms on life expectancy both male and female x health expenditure per capita is positive and significant suggesting that the effect of life expectancy on economic growth is increased when health expenditure per capita is increased. In column (5), the interaction term for female life expectancy x fertility rate is negative and significant suggesting that the effect of female life expectancy on economic growth is reduced when the fertility rate is high.

Money supply is statistically significant in columns (3) and (6) while government expenditure is not statistically significant. Trade is statistically significant in column (6).

[Table 2, about here]

The results for the full sample using GMM estimation is reported in Table 2. The results are similar to the OLS results. The male and female education capital variables are statistically significant in all columns. The female health capital variables gain statistical significance in columns (4) and (6) and the male health capital variable in columns (5) and (6). The coefficient on male life expectancy in column (5) suggests that each additional year of life expectancy increases the growth rate by 0.05%. The results in column (6) again suggest that the marginal effect of both male and female life expectancy on economic growth is increased when enrolment is high and health expenditure per capita are high, and the results in column (5) indicate that the marginal effect of female life expectancy on economic growth is reduced when the fertility rate is high. The fertility rate has a negative impact on economic growth as expected. Money supply is statistically significant in all columns and government expenditure is not statistically significant. The lagged dependent variable is statistically significant in columns (5) and (5). There is not much persistency in the growth rate which is reasonable considering the countries are at different levels of development. Therefore Table 3 estimates the model by disaggregating the countries by income group.

[Table 3, about here]

Table 3 reports results for the model disaggregated by income group. The results are interesting. The investment ratio, enrolment ratios and life expectancy, both male and female, trade and the interaction terms on life expectancy x enrolment ratios both male and female and the interaction terms on life expectancy x health expenditure per capita are statistically significant for the high and upper middle income economies. Note that for the high and upper middle income groups, life expectancy has a robust and significant influence on economic growth. In the low income and low middle income economies, the male enrolment ratio, and interaction terms on life expectancy x enrolment and life expectancy x health expenditure per capita are statistically significant. Female enrolment does not significantly influence economic growth in the low and low middle income economies possibly due to the fact that female enrolment ratios are not high enough to positively influence economic growth in these countries. Life expectancy for both males and females in these two groups of countries have a positive and significant influence on economic growth only when interacted with education and health expenditure. Again this is perhaps due to the fact that life expectancy is not high enough to positively impact upon economic growth unless through their interactions with other variables. The fertility rate has a negative significant impact on economic growth in the low income and low middle income economies. The fertility rate acts to reduce the impact of life expectancy on economic growth in the upper and lower middle income and low income economies.

Finally the survival rate, is used as proxy for health capital to ensure that the results are robust to the measure of health capital. Table 4 reports results for the model disaggregated by income group, using the survival rate to 65 years as proxy for health capital. Once again, the investment ratio, enrolment ratios and survival rates, both male and female, trade and the interaction terms on the survival rate x enrolment ratios both male and female and survival rate x health expenditure per capita are statistically significant for the high and upper middle income economies. For the low income and low middle income economies, the male enrolment ratio is statistically significant. Survival rates for both males and females in these two groups of countries gain significance only when interacted with education and health expenditure. The fertility rate has a significant negative impact on economic growth in the low and low middle income economies, while the interaction of survival rates with the fertility rate reduces the effect of the survival rate on economic growth.

[Table 4, about here]

4 Conclusions

This study examines the influence of health capital disaggregated by gender on economic growth. The results for the full sample suggest that life expectancy does not have a robust influence on economic growth unless interacted with education and health expenditure per capita. Increased education and health expenditure cause health capital to significantly and positively influence economic growth. The estimates for the countries divided by income group indicate that both health and education capital positively and significantly influence economic growth in the high income and upper middle income economies. In the low income and low middle income economies, the male enrolment ratio positively affects economic growth but not the female enrolment ratio. This can perhaps be explained by the fact that the female human capital stock is not sufficiently well developed to positively impact upon growth. Similarly health capital positively influences economic growth only through its influence on education and health expenditure in these economies. The policy implications stemming from this study are that skill levels and education opportunities for females should be increased to promote growth. In addition, both men and women should be encouraged to seek health services in these countries. The accessibility and affordability of health services should be increased and the population be educated to maximize the effects of health expenditure and education on the health capital stock and therefore on economic growth

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Table 1: OLS Estimation

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Initial GDP per Capita	0.011 (0.105)*	0.010 (0.006)	0.018 (0.010)	0.020 (0.010)	0.052 (0.012)***	-0.002 (0.005)
Investment Ratio	0.067 (0.109)*	0.070 (0.027)*	0.104 (0.027)**	0.092 (0.036)*	0.129 (0.056)***	0.042 (0.006)***
Enrolment Ratio female	0.051 (0.011)***	0.047 (0.010)**	0.095 (0.014)***	0.088 (0.016)***	0.056 (0.021)***	0.053 (0.034)*
Enrolment Ratio male	0.018 (0.010)**	0.017 (0.006)***	0.026 (0.013)**	0.022 (0.013)*	0.087 (0.037)*	0.070 (0.035)**
Life Expectancy Female	-	0.010 (0.002)**	0.132 (0.184)	0.134 (0.205)	0.091 (0.231)	0.294 (0.170)**
Life Expectancy Male	-	0.071 (0.186)	0.073 (0.149)**	0.089 (0.048)	0.061 (0.032)**	0.181 (0.025)***
Money supply	-	-	0.015 (0.010)*	0.019 (0.012)	0.036 (0.024)	0.024 (0.007)***
Government Expenditure	-	-	0.008 (0.015)	0.007 (0.016)	0.003 (0.025)	0.005 (0.024)
Trade	-	-	-	0.039 (0.043)	0.065 (0.080)	0.006 (0.003)*
Fertility Rate	-	-	-	-	-0.268 (0.110)***	-
Life Expectancy Female* Fertility Rate	-	-	-	-	-0.163 (0.087)**	-
Life Expectancy Female* Enrolment Ratio Female	-	-	-	-	-	0.137 (0.060)**
Life Expectancy Male* Enrolment Ratio Male	-	-	-	-	-	0.111 (0.045)***
Life Expectancy Female*Health Exp per capita	-	-	-	-	-	0.134 (0.047)**
Life Expectancy Male*Health Exp per capita	-	-	-	-	-	0.136 (0.046)**
Constant	0.583 (0.009)***	0.709 (0.300)*	0.528 (0.198)*	0.585 (0.266)	0.204 (0.431)	0.661 (0.483)
R^2	0.33	0.34	0.34	0.41	0.52	0.58
Observations	2081	2047	1174	1156	794	515

Note: Robust standard errors clustered by region reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels

Table 2: System GMM Estimation

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Investment Ratio	0.034 (0.011)***	0.029 (0.010)***	0.015 (0.012)	0.018 (0.010)**	0.025 (0.010)***	0.042 (0.006)***
Enrolment Ratio female	0.014 (0.007)**	0.015 (0.008)**	0.064 (0.033)**	0.043 (0.024)**	0.065 (0.015)***	0.051 (0.025)**
Enrolment Ratio male	0.018 (0.009)**	0.015 (0.007)**	0.078 (0.043)*	0.062 (0.037)*	0.045 (0.021)*	0.178 (0.111)**
Life Expectancy Female	-	0.029 (0.039)	0.032 (0.030)	0.021 (0.010)**	0.025 (0.010)	0.039 (0.024)*
Life Expectancy Male	-	0.083 (0.238)	0.029 (0.034)	0.032 (0.020)	0.045 (0.024)**	0.023 (0.013)*
Money supply	-	-	0.036 (0.013)***	0.037 (0.012)***	0.047 (0.007)***	0.114 (0.034)***
Government Expenditure	-	-	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.002 (0.003)
Trade	-	-	-	0.043 (0.020)**	0.046 (0.012)***	0.028 (0.025)
Fertility Rate	-	-	-	-	-0.406 (0.105)***	-
Lagged Dependent Variable	0.003 (0.003)	0.003 (0.003)	0.007 (0.005)	0.007 (0.005)	0.265 (0.072)***	0.211 (0.071)***
Life Expectancy Female* Fertility Rate	-	-	-	-	-0.460 (0.210)**	-
Life Expectancy Female* Enrolment Ratio Female	-	-	-	-	-	0.212 (0.120)**
Life Expectancy Male* Enrolment Ratio Male	-	-	-	-	-	0.222 (0.121)**
Life Expectancy Female*Health Exp per capita	-	-	-	-	-	0.275 (0.154)**
Life Expectancy Male*Health Exp per capita	-	-	-	-	-	0.279 (0.106)***
Constant	0.100 (0.063)	0.005 (0.375)	0.224 (0.367)	0.385 (0.376)	0.352 (0.124)**	0.380 (0.283)
Sargan Test for over-identifying restriction: p value	0.20	0.14	0.12	0.21	0.21	0.13
2^{nd} Order Autocorrelation: p value	0.14	0.24	0.15	0.13	0.24	0.21
Observations	2116	2081	1211	1192	746	558

Note: Robust standard errors reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels

Table 3: System GMM Estimation by Income Group

Independent Variables	(1) HI	(2) UMI	(3) LMI	(4) LI
Investment Ratio	0.067 (0.021)***	0.041 (0.017)**	0.016 (0.019)	0.032 (0.043)
Enrolment Ratio female	0.225 (0.123)**	0.170 (0.051)***	0.216 (0.212)	0.421 (0.817)
Enrolment Ratio male	0.212 (0.122)**	0.242 (0.104)***	0.122 (0.061)**	0.308 (0.126)***
Life Expectancy Female	0.274 (0.121)***	0.203 (0.110)***	0.157 (0.142)	0.178 (0.197)
Life Expectancy Male	0.390 (0.106)***	0.226 (0.118)**	0.611 (0.712)	0.021 (0.176)
Money supply	0.037 (0.048)	0.072 (0.038)*	0.022 (0.040)	0.058 (0.042)
Government Expenditure	0.003 (0.005)	0.001 (0.003)	0.005 (0.004)	0.014 (0.004)***
Trade	0.052 (0.028)**	0.042 (0.021)**	0.056 (0.039)	0.027 (0.047)
Fertility Rate	0.021 (0.159)	0.036 (0.025)	-0.047 (0.025)**	-0.056 (0.031)**
Lagged Dependent Variable	0.418 (0.228)*	0.179 (0.092)**	0.149 (0.090)*	0.218 (0.120)*
Life Expectancy Female*Fertility Rate	-0.013 (0.015)	-0.016 (0.010)*	-0.019 (0.009)**	-0.034 (0.016)**
Life Expectancy Female* Enrolment Ratio Female	0.046 (0.009)***	0.139 (0.065)**	0.201 (0.104)**	0.150 (0.090)**
Life Expectancy Male* Enrolment Ratio Male	0.185 (0.050)*	0.164 (0.090)**	0.159 (0.102)*	0.155 (0.100)*
Life Expectancy Female*Health Exp per capita Female	0.286 (0.120)***	0.220 (0.143)*	0.242 (0.159)*	0.240 (0.156)*
Life Expectancy Male*Health Exp per capita Male	0.282 (0.126)**	0.250 (0.175)*	0.228 (0.121)**	0.253 (0.121)**
Constant	0.052 (0.379)	0.015 (0.214)	0.045 (0.035)	0.101 (0.320)
Sargan Test: p value	0.13	0.15	0.14	0.16
2^{nd} Order Autocorrelation: p value	0.20	0.20	0.21	0.24
Observations	76	183	96	83

Note: Robust standard errors reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels

Table 4: Survival rates used as proxy for life expectancy.

Independent Variables	(1) HI	(2) UMI	(3) LMI	(4) LI
Investment Ratio	0.210 (0.115)*	0.018 (0.010)**	0.038 (0.048)	0.012 (0.041)
Enrolment Ratio female	0.239 (0.148)**	0.181 (0.041)***	0.024 (0.412)	0.002 (0.002)
Enrolment Ratio male	0.204 (0.135)*	0.263 (0.135)**	0.222 (0.113)**	0.057 (0.036)*
Survival Rate Female	0.256 (0.116)**	0.173 (0.042)***	0.211 (0.216)	0.178 (0.197)
Survival Rate Male	0.289 (0.113)***	0.231 (0.120)**	0.083 (0.552)	0.132 (0.176)
Money supply	0.074 (0.076)	0.001 (0.018)	0.001 (0.025)	0.045 (0.016)***
Government Expenditure	0.022 (0.025)	0.002 (0.002)	0.001 (0.002)	0.003 (0.001)***
Trade	0.129 (0.044)***	0.019 (0.010)**	0.030 (0.051)	0.020 (0.032)
Fertility Rate	0.024 (0.025)	0.015 (0.010)	-0.019 (0.009)**	-0.029 (0.014)**
Lagged Dependent Variable	0.301 (0.183)*	0.138 (0.060)**	0.356 (0.184)**	0.271 (0.164)*
Survival Rate Female* Fertility Rate	-0.016 (0.021)	-0.014 (0.006)***	-0.027 (0.016)*	-0.034 (0.018)**
Survival Rate Female* Enrolment Ratio Female	0.263 (0.149)*	0.210 (0.123)*	0.233 (0.152)*	0.124 (0.081)**
Survival Rate Male* Enrolment Ratio Male	0.128 (0.062)***	0.280 (0.144)**	0.234 (0.148)*	0.186 (0.117)*
Survival Rate Female*Health Exp per capita	0.192 (0.101)**	0.133 (0.087)*	0.213 (0.119)**	0.135 (0.053)***
Survival Rate Male*Health Exp per capita	0.182 (0.116)*	0.163 (0.112)*	0.216 (0.121)**	0.266 (0.169)*
Constant	0.090 (0.126)	0.315 (0.214)	0.021 (0.015)	0.112 (0.220)
Sargan Test for over-identifying restriction: p value	0.23	0.13	0.14	0.13
2nd Order Autocorrelation: p value	0.14	0.22	0.14	0.25
Observations	33	183	96	57

Note: Robust standard errors reported in parenthesis. *, **, *** Significant at the 10%, 5% and 1% levels