Education as a Social Good for Economic Growth in Hawaii

Tam Bang Vu¹, Calvin Luscombe², Shaun McKim³

Abstract
In this paper, we use data on secondary school graduates per worker in Hawaii as a proxy for social good and human capital to examine its effect on economic growth in Hawaii. The aggregate-data analysis shows that Hawaiian secondary graduates affect the economic growth positively. We then analyze the individual effects of public versus private schools and find that both public and private school graduates affect economic growth positively. Surprisingly, the effect of public school graduates is stronger than that of private school graduates. This might be due to the special characteristics of Hawaiian economy that rely heavily on low-skill services in the tourism sector and strongly implies education role as a social good.

JEL classification: O47, E23

Keywords: social good, public schools, private schools, secondary school graduates

1. Introduction
The importance of capital in fostering economic growth is emphasized in economics. The Original Solow model, modified by the endogenous growth model, is extended to allow for human capital and is labeled “new-growth model.” This model was originally developed to study the effect of research and development on output in a closed economy and has been further modified to allow for secondary school enrollment as a proxy of investment in human capital. Research using across-nation data shows that school enrollment has a positive affect on productivity growth. Our paper is unique in that very few papers use the number of graduates, a stock variable as oppose to the number of students enrolled, a flow variable, as found in the literature, and is thus a better measure of human capital. Even less used are state level data in private versus public schools, the stronger representative of education as a social good, to investigate their different effects as in our research.

The remainder of this paper is organized as follows: Section Two discusses existing literature, Section Three introduces the theoretical model and data issue, Section Four analyzes the empirical methodology and the estimated results. Section Five concludes.

2. Existing Literature

➢ Theoretical Literature

There is plenty of theoretical literature on human capital and productivity growth. The neoclassical model on this subject is the Solow (1957) growth model, where labor productivity, defined as output per worker, depends solely on capital per worker. Lucas (1998), Romer (1990), and Aghion and Howitt (1992) extended this Solow model in the so-called “new growth” theory. It was originally developed to study the effect of research and development on output growth in a closed economy; it is further modified by Kremer (1993) for productivity growth in a closed economy and by Barro et al. (1995) for an open economy.

¹College of Business and Economics, University of Hawaii-Hilo, 200 W Kawili Street, CoBE, Hilo, Hawaii 96720
² Department of Economics, Boston University
³ CVS Headquarters

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Bils and Klenow (2000) write an influential paper on the possible two-way causality between economic growth and education. They develop a dynamic optimization model in which a firm’s output depends on capital, labor and, the stock of human capital, where the stock of human capital is equal to the aggregate product of the number of workers in the firm and their level of human capital. The consumer maximizes his utility subject to the constraint that his wage is at least as great as his sum of life time consumption and his expenditures on education at an early age. They show that the optimal quantity of school enrollments depends positively on the total factor productivity of a country. Concerning the effect of schooling on economic growth, they show that human capital only has a very weak effect on growth of GDP per capita and GDP per worker.

In Thirlwall (2006) and Lynn (2003) books on economic development they argue that an increase in per capita income fosters the willingness to invest further in education. Hence, there is a self perpetuating positive feedback cycle of economic or productivity growth and human capital, where education increases productivity growth, which in turn increases school enrollments as per capita income rises. Thirwall also points out that social investment in education often yields lower returns, as measured by per capita income, than private investment. This inspires us to add private total expenditures to our econometric model.

Empirical Literature

Though many “new growth” models are developed for productivity defined as GDP per worker, most empirical studies have focused on GDP per capita instead of productivity. Barro (1991) is the pioneer in the new growth approach. He uses cross sectional data for 98 countries, single equation estimation, and ratios of primary and secondary enrollments to population. His results show that education has a positive effect on GDP per capita. Levine and Renelt (1992), Mankiw et al. (1992), Barro and Lee (1993), Levine and Zervos (1993), and Kremer (1993), all confirm Barro’s results in their slightly modified models using single equation estimations.

Knowles and Owen (1995) find that when life expectancy and based-period output per capita is added to the model the effect of human capital on growth is not statistically significant. Caselli et al. (1996) even show that the secondary school enrollment ratio affects economic growth negatively. On the contrary, Temple (1999) finds that several outliers cause the observed weak effect of human capital on growth. After removing these outliers he finds the effect of this secondary school enrollment ratio is positive. Hojo (2003) points out that while education might not affect per capita output directly, it can do so indirectly through an increase in productivity.

Papers investigating the effect of economic growth on human capital accumulation are scarce. Behrman and Knowles (1999) find that children in higher income families receive more education than those in lower income families. A careful observation of the historical data from the United Nation and the World Bank also reveals that countries with higher productivity levels tend to have higher rates of school enrollments. Thirwall (2006) and Lynn (2003) development theory arguments are supported by this particular paper and the corresponding data.

Bils and Klenow (2000) also carry out empirical studies to examine the effect of productivity on school enrollment in their paper. They use single equation and OLS regressions on a dataset with 85 observations. They find a positive effect of productivity on school enrollment. Though they express their concerns on the possible simultaneity problems they also show that with a cross sectional dataset it is very difficult to find appropriate instruments for the endogenous variables. Kumar (2003) is the single author who attempted the simultaneous equation estimation using 2SLS approach. As discussed earlier, he finds that the effect of productivity on the school enrollments is negative.

None of these papers investigate the different effects of public schools, a stronger representative of education as a social good, versus private schools using state data. In the following section we introduce our model and data issues.
3. Model and Data Issue

We use an augmented Cobb-Douglas production function similar to a "new growth" model:

\[ y_t = D + \beta h_t + \sum_{j=1}^{n} \gamma_j C_{jt} + e_t \]

(1)

where \( D \) is the shift parameter, \( y \) is either growth of real output per worker (henceforth called productivity) or growth of real income per person (henceforth called per capita income), and \( h \) is human capital, of which we use secondary school graduates per worker as a proxy. Subscript \( t \) is time index, \( e \) is the error term, and \( C \) is a vector of control variables such as exports, imports, foreign direct investment (FDI), population, and tourism.

The data set on education contains numbers of private school and public school graduates in the State of Hawaii from 1969 to 2011. This data is too short to take a 4 to 5 year average, so we carry out the estimation using the original yearly data and hence utilizing Newey-West (1987) estimations to control for autocorrelation and heteroskedasticity problems. Data for several control variables are only available for later periods, so we have an unbalanced data set.

4. Methodology and Results

The initial regressions and Granger causality tests do not show a significant two-way relationship between human capital and productivity growth. Hence, we study the effect of human capital on growth of output per worker using single equation estimations. We first tested for heteroskedasticity using the White test and find a p-value of 0.0366, indicating a heteroskedasticity problem. Similarly, testing for autocorrelation yielded for AR(1) yields p-value = 0.000, AR(2) yields p-value = 0.034 and AR(3) yields p-value = 0.385.

Several preliminary tests are performed on the model. The first is the endogeneity of the explanatory variables. To avoid the problem of singularity in the original Hausman test, the modified Hausman test is used. The theoretical justification of this test is illustrated in the following discussion and Figure 1.

Figure 1 Diagram for the Modified Hausman Test

When variable \( X_i \) is regressed on a vector of all exogenous variables \( X_j \), \( X_j = [x_1, x_2, \ldots, x_{j-1}, x_{j+1}, \ldots, x_n] \), the part of \( X_i \) explained by these variables would be partialed out. The
rest of \( X_i \) is explained by the residual from the estimation, \( V_i \). This \( V_i \) is then added to the regression of the original equation. If the t statistics for the coefficient of \( V_i \) is statistically insignificant, then \( V_i \) is not correlated with the dependent variable, so \( V_i \) and \( X_i \) are not correlated with the error term of the structural equation. Alternative tests for the explanatory variables in the model are performed, and the results show that we do not have endogeneity problem, so 2SLS approach is not needed, and Newey-West estimations are used to obtain correct standard errors for the coefficients and subsequent tests.

We use the modified Akaike information criterion procedure with a correction for finite sample sizes (AICc) introduced by Hurvich & Tsai (1989) to determine numbers of lags for the Newey-West estimations. The original AIC proposed by Akaike (1980) is defined as:

\[
AIC = 2k - 2\ln(ML),
\]

where \( k \) is the number of estimated coefficients for the model and \( ML \) is the maximized value of its likelihood function. Alternative numbers of lagged values are tried on the model and the one with the lowest AIC is chosen. The AICc is the modified AIC and is defined as

\[
AICc = AIC + \frac{2k(k+1)}{n-k-1},
\]

where \( n \) denotes the sample size. Since our sample size is small, the AICc is more appropriate than the original AIC. After several rounds of trying, we find that a model with two lagged values is the best for our Newey-West estimations.

We then carry out multicolinearity tests, using the variance inflation factors (VIF) approach. Theoretically, when an independent variable, \( X_i \), is regressed on \( k \) other independent variables, the covariance matrix is:

\[
\text{Cov} \hat{\beta}_i = \sigma^2(X'M_k X_i)^{-1}.
\]

The inverse of this correlation matrix is used in detecting multicolinearity. The diagonal elements of this matrix are called VIF, and are given by:

\[
VIF_i = \frac{1}{1 - R_{ik}^2},
\]

where \( R_{ik}^2 \) is the \( R^2 \) from regressing \( X_i \) on \( k \) other variables. Classical OLS only requires no perfect multicolinearity. When there is perfect multicolinearity, this \( R^2 \) equals to one, and VIF approaches infinity. Kennedy (2009) recommends that we eliminate any variable with VIF greater than ten. The test reveals no multicolinearity, so we keep all original variables.

Finally we perform the Ramsey RESET (Regression Specification Error Test) for omitted variables. The theoretical basis is simple: when a relevant variable is omitted from a model, the disturbance term of the false model incorporates the influence of the omitted variable. If a set of variables, \( X \), can be used as a proxy for the unknown omitted variable, a specification error tests can be carried out by examining \( X \)'s relationship to the error term. The Ramsey RESET often uses the squares, cubes, and fourth powers of the explanatory variables as the proxy for potentially omitted effects. Although a significant value of RESET could mean either non-linearity or an omitted variable, an insignificant value is commonly interpreted as an absence of misspecification or omitted variables. The test gives the p-value for the F statistics as 0.6453. Hence, the model probably has no important omitted variable.

Table 1 shows the results from the Newey-West estimation for aggregate effect of human capital on economic growth. We find a statistically significant and positive effect of secondary school graduates on growth of productivity.
Table 1: Aggregate Effect of Human Capital on Productivity Growth

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>St. Error</th>
<th>t-stat</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Capital</td>
<td>22.5642***</td>
<td>7.2132</td>
<td>3.04</td>
<td>0.005</td>
</tr>
<tr>
<td>Population</td>
<td>0.1785***</td>
<td>0.02807</td>
<td>6.36</td>
<td>0.000</td>
</tr>
<tr>
<td>Exports</td>
<td>0.0243**</td>
<td>0.0121</td>
<td>2.01</td>
<td>0.049</td>
</tr>
<tr>
<td>Imports</td>
<td>0.0647</td>
<td>0.4892</td>
<td>1.28</td>
<td>0.244</td>
</tr>
<tr>
<td>FDI</td>
<td>0.0014*</td>
<td>0.0072</td>
<td>1.79</td>
<td>0.085</td>
</tr>
<tr>
<td>Tourism</td>
<td>0.9757**</td>
<td>0.4171</td>
<td>2.201</td>
<td>0.026</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.1034***</td>
<td>0.45961</td>
<td>-4.77</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: ***, **, and * denotes 1%, 5%, and 10% statistically significant, respectively.

We then examine the individual effects of private versus public school graduates on economic growth. The results show that both public and private school graduates affect productivity growth positively. The most interesting finding is that public school graduates have a stronger effect on productivity growth than private school graduates. The possible explanation could be that private schools emphasize theoretical education to send students to top universities in the nation. This approach will produce great students and scholars but not necessarily great workers, especially those for low-skill services in tourism sector. Public schools teach more applied knowledge and practical skills which directly affect labor productivity once they leave school and join the labor force, either as part-time workers while attending college or as full-time workers.

Table 2: Public versus Private Schools and Productivity Growth

<table>
<thead>
<tr>
<th>Variable</th>
<th>Public School Graduates</th>
<th>Private School Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Capital</td>
<td>43.4145***</td>
<td>37.4962***</td>
</tr>
<tr>
<td>Per capita income</td>
<td>1.2778***</td>
<td>1.1502***</td>
</tr>
<tr>
<td>Imports</td>
<td>-0.0397***</td>
<td>-0.0239**</td>
</tr>
<tr>
<td>Exports</td>
<td>0.0547**</td>
<td>0.0436**</td>
</tr>
<tr>
<td>Tourism</td>
<td>0.0257***</td>
<td>0.0218***</td>
</tr>
<tr>
<td>FDI</td>
<td>0.0436**</td>
<td>0.0352**</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.9305*</td>
<td>-0.6089</td>
</tr>
</tbody>
</table>

Note: ***, **, and * denotes 1%, 5%, and 10% statistically significant, respectively.

Another possible explanation is that there is a relatively fixed number of skilled jobs in Hawaii, so many of the private school graduates may leave the islands to further their higher education and, rather than return to a tight labor market, they may continue to work elsewhere, thus not affecting Hawaii's GDP. This is especially true for our research period when Hawaii had a tight labor market with the average rate of unemployment hovering around 5% until 2009.

Next we considered the different effects of public schools, the stronger representative of a social good, versus private schools on per capita income. The results for public school versus private school graduates, which are shown in Table 3, are similar to those in Table 2, except that the magnitudes of the effects are smaller than those on productivity growth.
### Table 3: Effect of Human Capital on the Growth of Per Capita Income

<table>
<thead>
<tr>
<th>Variable</th>
<th>Public School Graduates</th>
<th>Private School Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>p-value</td>
</tr>
<tr>
<td>Human Capital</td>
<td>32.2455**</td>
<td>.039</td>
</tr>
<tr>
<td>Productivity</td>
<td>.3252**</td>
<td>.000</td>
</tr>
<tr>
<td>Imports</td>
<td>.4367</td>
<td>.184</td>
</tr>
<tr>
<td>Exports</td>
<td>.3652**</td>
<td>.045</td>
</tr>
<tr>
<td>Tourism</td>
<td>.0055</td>
<td>.214</td>
</tr>
<tr>
<td>FDI</td>
<td>.0033**</td>
<td>.043</td>
</tr>
<tr>
<td>Constant</td>
<td>.8881*</td>
<td>.082</td>
</tr>
</tbody>
</table>

Note: ***, ** and * denote 1%, 5%, and 10% statistically significant, respectively.

Additionally, the effect of tourism is no longer significant. This implies that Hawaiian tourism can increase per capita income only indirectly through an increase in labor productivity. This finding is consistent with Hojo (2003). We also found that tourism, FDI, and exports all have positive and significant effects on the growths of productivity and per capita income, but the effects of imports are either negative or insignificant. This can be easily explained. While exports can increase output per worker or per capita income, imports might not, where in the equation for national income accounts, imports are entered with a negative sign whereas exports are entered with positive sign.

5. Conclusion

Using the ratio of secondary school graduates for public and private schools to employment as a proxy of human capital we discovered that human capital has a positive and significant effect on output per worker and per capita income in Hawaii. We also find that public school graduates affect productivity and per capita income more than their private school counterparts. This implies that obtaining education from private schools is not necessarily better than that from public education in Hawaii if one intends on staying in Hawaii. If a secondary school student wishes to work in Hawaii after finishing a college degree, entering a public school might be a better choice than a private school. Only when a student wishes to go to graduate school or leave Hawaii, enrolling in a private school might be worth the expenses. The results strongly support the role of education as a social good in economic development.

We also noticed that tourism only has a positive and significant effect on output-per worker. Further studies should be carried out once more data becomes available, such as income from tourist spending, or a larger sample size.

References


Thirlwall, A.P., 2006. Growth and Development with Special Reference to Developing Economies, Palgrave Macmillan, N.Y.