Education and economic growth in Cape and Natal colonies: learning from history

Biyase, Mduduzi

University of Johannesburg

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Mduduzi Biyase[‡‡] and Frederich Kirsten[§§]

Abstract

This paper uses archival data from colonial South Africa over the 1859–1910 period to investigate the impact of education on economic growth. The analysis applies fixed effect to account for unobserved colony-level heterogeneity and minimise the omitted variable bias. It also employs fixed effects two-stage least squares (FE-2SLS) estimator to account for a possible endogeneity bias due to reverse causation between economic growth and education or other forms of endogeneity problem. The results suggest that levels of education (proxied by spending on education) have a robust positive impact on economic growth. Results are robust to addressing the potential reverse causality of education influencing economic growth and using alternative measures of education (proxied by enrolment rate).

***Keyword*:** FE-2SLS; colonies; education; South Africa, growth and fixed effect

JEL classification: O47, I21, I25

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[‡‡] Lecturer at the university of Johannesburg, South Africa, mbiyase@uj.ac.za
[§§] Lecturer at the university of Johannesburg, South Africa, fkirsten@uj.ac.za

1 Introduction

This paper investigates the role played by education in South African economic growth over the period 1859 to 1910. The increase in economic growth in any country hinges on a number of broad factors such as geography (Sachs and Warner, 1997; Bloom and Sachs, 1998; Gallup et al., 1998; Diamond, 1999; Sachs, 2001; institutions (e.g., Acemoglu, Johnson, & Robinson, 2001; Hall & Jones, 1999; Dollar & Kraay 2004; North, 1989; Rodrik, Subramanian, & Trebbi, 2004; Glaeser, La Porta, Lopez-de Silanes, & Shleifer, 2004), human capital (Glaeser et al. (2004) and Djankov et al. (2003) and natural endowment Matsuyama (1992); Engerman and Sokoloff (2004); Sachs and Warner (1995), Isham, Woolcock , Pritchett and Busby (2005); Ding and Field (2004); Alpha and Ding (2016); Jalloh (2013).

While education is seen as one the most important determinants of economic development (Crafts 1995; DeLong et al. 2003; Galor and Weil 2000; Galor and Moav 2002), empirical analysis linking education and economic growth have not yielded consistent results. Barro (1991), Mankiw, Romer, and Weil (1992), and Easterly and Rebelo (1993) all find a positive association between human capital investment and economic growth; while others have found the opposite, Islam (1995) and Caselli, Esquire, and Lefort (1996) – find a negative relationship between economic growth and measures of human capital. These contradictory results may be partly due to specification of a growth model, definitions of human capital and time period of analysis. This paper contributes and improves upon the existing literature by disentangling the influence of human capital in South African economic growth during the colonial period 1859 to 1910.

Directed by the empirical and theoretical literature, this paper incorporates the effects of education on economic growth in keeping with the specifications of a growth model by important scholars, notably Barro, 1998, Barro and Sala-i-Martin 1995, Mankiw et al 1992 and others). It also extend these specifications to include different measures of education: spending on education and student enrolment separately.

The paper proceeds as follows. In section two we review the existing empirical literature on the education or human capital and economic growth. Section three then, discusses the methods and describe the dataset used in this paper. Section 4 provides evidence on the effect

of education or human capital on economic growth in the Natal and Cape colonies. The last section provides some concluding remarks.

2 Literature review

A huge body of theoretical and empirical literature has analysed the relationship between education[4] and economic growth. The theoretical basis of human capital-economic growth relationship is entrenched in the endogenous growth and the extended neoclassical growth theories (see Lucas (1988), Romer (1990), Aghion and Howitt (1998)). According to these theories education can be seen as a process that increase the innovative capacity of the economy, and the new knowledge on new technologies, products, and processes promotes growth (Hanushek et al 2010).

Empirically, a variety of studies have investigated the human capital-economic growth nexus. The findings are however inconclusive due to problems with human capital proxies, different data sets and econometrics techniques used. Following the classical contributions by Barro (1991, 1997) and Mankiw et al. (1992), many studies have found positive effects on education on growth (see Barro and Sala-i-Martin (1995);Toya et al (2010); Cohen and Soto (2007); Cai (1999); Lin (2003); Grundey and Sarvutytė (2007); and Castelló-Climent and Hidalgo-Cabrillana (2012); Lee et al (1994) Mingat and Tan (1996); Mc Mahon (1998); Gyimah, Paddison and Mitiku (2006); Chi (2008); Zhang and Zhuang (2011); Pegkas (2014); Tallman & Wang (1994)). Extensive reviews of the literature are found in Topel (1999), Temple (2001); Krueger and Lindahl (1998) and Sianesi and Van Reenen (2003).

In their work, Barro (1997, 1999) and Barro Sala-i-Martin (1995) examined the relationship between education (education measured as the average years of secondary education of the adult population) and economic growth and found a positive and statistically significant relationship between male education and income growth, but not for female education or primary education for both genders.

[4] The literature has suggested several measures of education. Education quantity is measured by schooling enrolment ratios (Mankiw, Romer and Weil 1992, Barro 1991, Levine and Renelt 1992), the average years of schooling (Hanushek and Woessmann 2007, Krueger and Lindhal 2001), adult literacy rate (Durlauf and Johnson 1995, Romer 1990) and education spending (Baladacci et al 2008.).

Gyimah-Brempong et al (2006) covering the period 1960–2000, investigated the effect of education or human capital on economic growth in African countries, using a modified neoclassical growth equation, and a dynamic panel estimator. The study suggest that all levels of education human capital, including higher education human capital, have positive and statistically significant effect on the growth rate of per capita income in African counties. Specifically, they found growth elasticity of higher education human capital to be in the region of 0.09 – twice as large as the growth impact of physical capital investment.

In contrast, some studies (see Islam (1995), Caselli, Esquivel and Lefort (1996); Benhabib & Spiegel (1994); Pritchett (1996); Bils & Klenow (1998) and Self & Grabowski (2004) do not find education to be significant factor in the growth models. A study by Delgado, Henderson and Parmeter (2013) investigate the impact of education on economic growth, using five leading educational attainment databases and nonparametric econometric techniques that are robust to functional form misspecification, and employing a various robustness checks addressing concerns over both data structure and measurement. The results suggests that education enters insignificantly in explaining economic growth.

The authors provide three possible reasons for their results. First, they acknowledge that the use of the nonparametric techniques does not in itself warrant unbiased and consistent estimates. It may suffer from potential omitted variable bias. Secondly they argue that inadequate, incomplete and poor data quality from developing countries may contaminate the regression estimates – distort the estimates due to measurement error. Thirdly, "years of schooling derived from enrolment rates and census data may in fact provide poor proxies for the stock of human capital within a particular nation". Delgado, Henderson and Parmeter (2013:16).

In their influential paper Benhabib & Spiegel (1994) used cross-country estimates of physical and human capital stocks and estimated the growth accounting regressions implied by a Cobb Douglas aggregate production function. The results indicate that human capital growth is not statistically related to economic growth. Such counterintuitive results should not be taken at face value because they are subject to various specification problems, poor data quality and deficiencies in the human capital data.

Fourie and von Fintel (2014) is the only paper to empirically investigate the effect of colonial education on growth in South Africa. In their paper entitled, "Settler skills and colonial development" these authors find that "settler capabilities — specific skills acquired in the land of origin — matter in colonial development and should be considered an important element — together with environmental conditions and resource endowments in the destination region — in explaining why countries follow different development paths". In a sense our paper builds on Fourie and von Fintel (2014) work. Our work is different from theirs in many ways: while they use only one measure of education, we use various measures of education (spending on education and student enrolment). Moreover, we use several approaches to account for specific effects, time effects and potential endogeneity bias. Finally, while the data used in their paper covers the period 1700 to 1773, the data used in this paper is for the period 1859-1910.

3 Data and methodology

This study employs various data sources (Bluebooks, De Zwart 2011, Statistical yearbook of the colony of Natal and Malherbe) in its investigation of the impact of education on economic growth in Natal and Cape colonies. In addition to the dependent variables (economic growth), we use several control variables in our econometric analysis. We use as independent variables several factors identified in the literature as important determinants: inflation, savings, trade openness, number of scholars on roll, natural resources, population and government expenditure on education. A detailed description of all variables used is presented in Table 1 below.

Table 1: Variables used in the regression

CAPE COLONY		
VARIABLE	DESCRIPTION	SOURCE
EDUC	Nominal Government Expenditure	Bluebooks
POP	Population	Blue books
INFL	Bare bones basket CPI%	De Zwart 2011
SAVINGS	Nominal total savings as used by Greyling and Verhoef (2017)	Blue Books
NATURAL RESOURCES	Proxied by export of natural resources	Blue Books
OPEN	Trade openness (calculated)	Blue Books
ENROL	Number of scholars on roll	Blue Books
NATAL COLONY		
EDUC	Education expenditure by state	Malherbe
POP	Population	Statistical yearbook of the colony of Natal
INFL	Bare bones basket CPI%	De Zwart 2011

SAVINGS	Nominal total savings as used by Greyling and verhoef (2017)	Statistical yearbook of the colony of Natal
NATURAL RESOURCES	Proxied by export of natural resources	Statistical yearbook of the colony of Natal
OPEN	Trade openness (calculated)	Statistical yearbook of the colony of Natal
ENROL	Total pupils	Malherbe

Directed by the empirical literature, especially Barro, 1998, Barro and Sala-i-Martin 1995, Mankiw et al 1992 and others, we employ a standard empirical neoclassical growth specification, modified to incorporate the effect of human capital. Thus, we specify a growth equation of the following general form:

$$Y_{1it} = \psi_{1i} + \delta_{1t} + \beta_{11}Pop + \beta_{12}EDU + \sum_{m=8}^{m} \beta_{13}\left(\Psi_{1it}\right) + \mu_{1it} \quad (1)$$

$$Y_{2it} = \psi_{2i} + \delta_{2t} + \beta_{21}\,Pop + \beta_{22}ENROL + \sum_{m=8}^{m} \beta_{23}\left(\Psi_{2it}\right) + \mu_{2it} \quad (2)$$

Where the dependent variable (Y) is the growth rate of real GDP per capita, $\psi\ and\ \delta$ and denote the country-specific effect and time-specific effect, respectively; Pop value of total population: counts all residents regardless of legal status or citizenship--except for refugees not permanent, EDU is the amount of government spending on education and $ENROL$ is the number of enrolled pupils. Ψ consists of control variables such as trade openness – expressed as the sum of total imports and exports in relation to GDP, and inflation rate and μ is the error term.

To estimate the above equations, we employ the fixed effects models. The standard fixed effect has an obvious advantage over the random effect model in that it accounts for the unobserved heterogeneity which might be correlated with observed independent variables. Moreover, our choice of fixed effect, as opposed to the random effects model is supported by the results of Hausman-type specification test (reported at the bottom of tables 1 to 3). While the fixed effect model passes the Hausman test and has a number of other advantages (mitigates endogeneity bias due to omitted variable) it does not account for endogeneity caused by reverse causality. One of the empirical concerns in this field is the possible endogeneity which could arise due reverse causality (economic growth might influence education). So while we have hypothesised a direct effect stemming from education to economic growth, we acknowledge that the reverse is also possible. Our preferred choice of estimator to deal with the possibility

of endogeneity is fixed effects two-stage least squares (FE-2SLS) estimator. We account for endogeneity issue by using the lagged value of education as an instrument.

4 Empirical results

Figure 1 displays the correlation between economic growth and spending on education in both Cape and Natal colonies. What emerges from figure 1 is that there is a neat positive relationship between spending on education and economic growth in Cape. Figure 2 compares the different education levels in Cape and Natal colonies. What stands out is the substantial difference between spending on education in the Cape and Natal. However the scatter plots can only be viewed as a suggestive relationship between spending on education and economic growth. The following section will empirically inspect the robustness of the scatter plots.

Figure 1: Education and growth in Cape and Natal colonies, 1859-1910

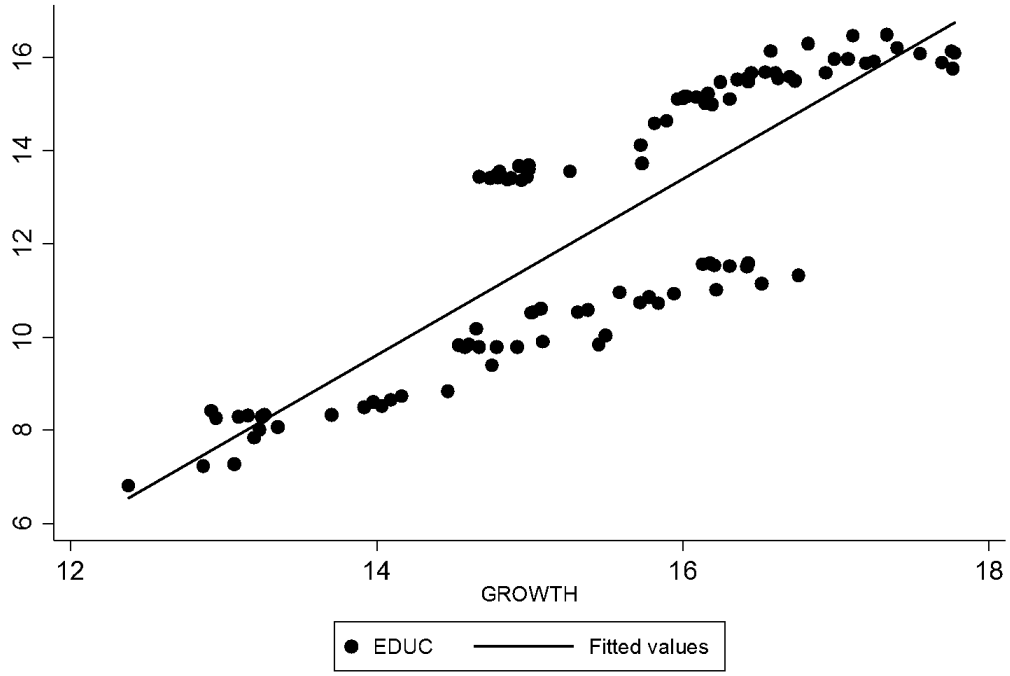
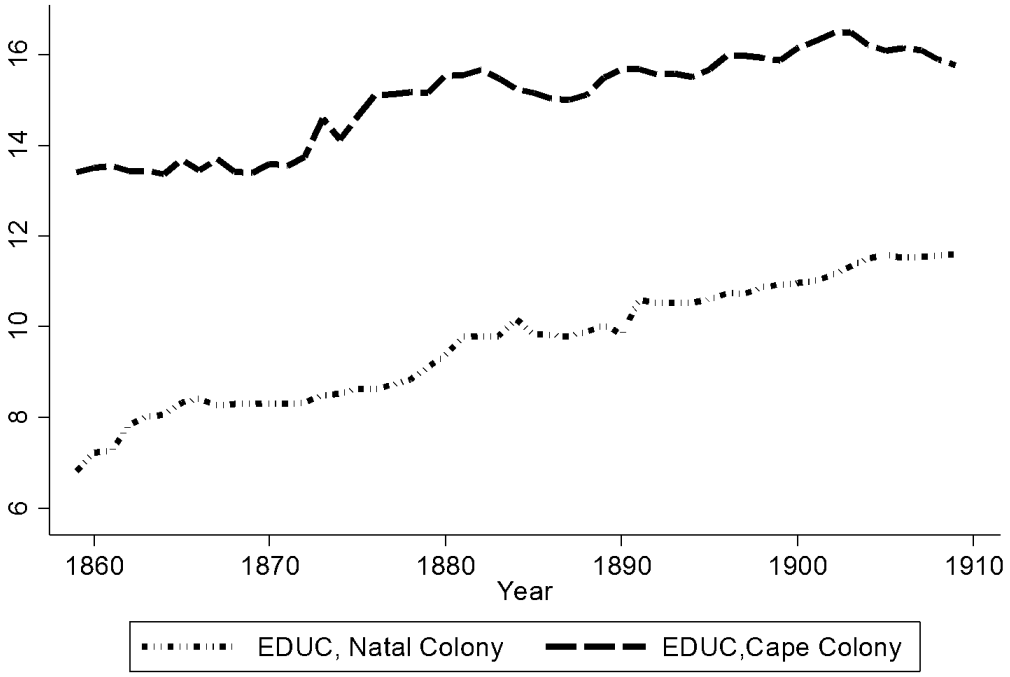


Figure 2: Education by colony, 1860-1910



We start of by estimating a fixed effect model which is reported in Table 1. Column two of table 1 includes our variable of interest (education), while the rest of the columns incorporate a host of variables in a step wise fashion to check robustness of the model. Column 3 adds population, column 4 inflation, column 5 savings, column 6 natural resource and column 7 trade openness. The choice of these controls is determined by data availability and standard control variable used in the literature. The fixed effect estimates, suggest that there is a positive relationship between education and growth and the coefficient is fairly stable across specifications. More specifically, FE-(1) indicates that education is significant ($\beta = 0.8615673$, $p < 0.05$) and has a positive impact on the economic growth, consistent with findings of Barro (1997, 1999), Barro Sala-i-Martin (1995) and Gyimah-Brempong et al (2006).

The FE-(2) reveals a positive and statistically significant effect of population on economic

Table 1 Fixed effects estimates of the effects of education spending on economic growth. 1865-1909

Economic Growth	FE(1)	FE(2)	FE(3)	FE(4)	FE(5)
EDUC	0.8615673*** [0.027]	0.4188395*** [0.069]	0.367005*** [0.088]	0.3858834*** [0.083]	0.5989921*** [0.088]
POP		0.9243769*** [0.135]	0.9917125*** [0.170]	1.023647*** [0.159]	0.4206837** [0.201]
INFL			-0.0247018 [0.224]	-0.0266772 [0.021]	-0.0209461 [0.017]
SAVINGS				-6.52E-08* [2.33e-08]	-9.65E-08*** [2.11e-08]
NATURAL RES					2.19E-08*** [5.50e-09]
OPEN					-0.2199842 [0.183]
Hausman test (RE vs FE)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Poolability test [1], p-val:	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Heteroscedasticity Test[2]	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-sq: within	0.7658	0.6542	0.6433	0.6543	0.5932

growth. Historically, population has always been one of the important determinant of aggregate income. As Hagen (1958:7-8) puts it, "From the beginning of the Christian era to 1650, the average rate of growth of world population was in the neighborhood of 1/20 of one percent per year. It then began to rise, first in Western Europe, but during the last half of in the nineteenth century/the peasant societies, which were then colonial, The modal rate in peasant societies between 1900 and World War II was probably between .5 and one percent per year. Historical evidence indicates rather clearly that the level of per capita income increase in such societies had not risen before the rise in the population growth rate. There is also historical evidence that the increased rate of population growth has resulted specifically from gradual introduction of improved medical and health practices under colonial administrations."

The control for macroeconomic performance (inflation) has an expected negative sign but statistically insignificant and this result holds up quite well when adding other plausible explanatory variables. Natural resources present positive and significant estimates on economic growth, in line with many studies in developing countries which have found that discovery of natural resources favourably affects the rate of economic growth.

We performed an additional robustness check on the impact of education on growth. Specifically, we use an alternative measure of education, namely, enrolment rates. Tables 2 show the estimation results. Clearly, our earlier finding on the impact of education on growth is robust to this alternative measure of education. Specifically, in the alternative version of baseline model (equation 1), the alternative measure of education are statistically significant and very similar to the estimates for equation 1. Estimates of the effects of the other control variables are also consistent with the baseline variables. The estimated coefficients for the population, inflation, and natural resources are significant and have the expected sign. For example, the estimated coefficient of population and natural resources is always positive, significant and almost equal in terms of magnitudes.

Table 2 Fixed effects estimates of the effects of school enrolment on economic growth. 1865-1909

Economic Growth	FE(1)	FE(2)	FE(3)	FE(4)	FE(5)
ENROLMENT	1.398024***	0.5065832**	0.5825652***	0.5482771***	0.6058422***
	[0.046]	[0.182]	[0.196]	[0.192]	[0.184]
POP		1.119711***	0.9900388***	1.077222***	0.9813199***
		[0.221]	[0.241]	[0.239]	[0.250]
INFL			-0.0289362	-0.0309439	-0.0199288
			[0.024]	[0.023]	[0.022]
SAVINGS				-4.90e-08*	-4.28e-08*
				[2.63e-08]	[2.53e-08]
NATURAL RES					1.61E-09
					[5.58e-09]
OPEN					-0.6764506***
					[0.225]
Hausman test (RE vs FE)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Poolability test [1], p-val:	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Heteroscedasticity Test[2]	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-sq: within	0.8654	0.7562	0.6543	0.6543	0.7654

Notes: clustered standard errors are reported in parentheses with ***, ** and *, denoting significance at the 1%, 5% and 10% levels, respectively.

Table 2 is replicated for different population groups (Native and Europeans), to further establish the robustness and origin of this result. The results are presented in Table 3. The effects are not similar across the different groups. The results show that there is a large gap between European and Native enrolments impact on economic growth. Specifically, European enrolment contributed significantly more to economic growth in Cape and Natal than the Native enrolled students.

Table 3 Fixed effects estimates of the effects of school enrolment by race on economic growth. 1865-1909

Economic Growth	FE(1) EU_ENR	FE(2) NAT_ENR
ENROLMENT	1.219477***	0.1468978
	[0.414]	[0.0.263]
POP	-2.287739**	0.3081608
	[1.042]	[0.815]
INFL	0.0164246***	-0.0020235
	[0.002]	[0.005]
Savings	-0.026831**	-0.1039279
	[0.011]	[0.167]
NATURAL RES	4.71e-08***	2.89e-08***
	[7.45e-09]	[3.74e-09]
OPEN	1.066842***	0.447098***
	[0.260]	[0125]
Hausman test (RE vs FE)	(0.000)	(0.000)
Poolability test [1], p-val:	(0.000)	(0.000)
Heteroscedasticity Test[2]	(0.000)	(0.000)
R-sq: within	0.9824	0.9753

Notes: clustered standard errors are reported in parentheses with ***, **, and *, denoting significance at the 1%, 5%, and 10% levels, respectively.

To ensure that our findings in Table 1 are not biased due to the endogeneity issue and the measurement error problem, we re-estimate equation (1) using the fixed effects two-stage least squares estimates with an instrument as discussed earlier. We also perform various specification test to check for serial correlation and to check if the instruments use are valid i.e. not correlated with the error term respectively. We found that there exists no serial correlation and that the Cragg-Donald F-test rules out the concern of weak instruments (above the value of 10, see bottom of Table 4). We also run an endogeneity test to check if we need to use fixed effects two-stage least squares regression or if a fixed effect model will suffice. The results indicate that a fixed effects two-stage least squares model is in fact the model we need to use.

The fixed effects two-stage least squares estimator suggest that education positively influences economic growth at a 1% significance level, a result which we observed in the fixed effects estimation. This coefficient also have slightly higher magnitudes which shows that there is a positive and strong relationship between education and economic growth. As regards the effects of explanatory variables on growth, the FE-2SLS results (which accounts for endogeneity among the variables) appear to be similar to the results of the fixed effect estimates. Specifically, coefficients for population and natural resource, remain an important determinant of economic growth — enters positively and significantly in all specifications.

Table 4 Fixed Effect-IV estimates of the effects of education on economic growth, 1859 to 1910

GROWTH	FE-IV(1)	FE-IV(2)	FE-IV(3)	FE-IV(4)	FE-IV(5)	FE-IV(6)
EDU	1.472621***	.5643439	.515126***	.7115636***	.6858056 ***	.4632592
	[.258138]	[.3344353]	[.1053016]	[.1515548]	[.1353052]	[.503961]
NATURAL RES		.3906241***	.7401909***	.5879936***	.6042968***	.5772213***
		[.1153616]	[.0344259]	[.0528953]	[.054251]	[.037590]
SAV			.1747973***	.0973754***	.1123653***	.1358173***
			[.034402]	[.0237232]	[.0324543]	[.0468458]
OPEN				-.8812423**	.7902229**	.5371785
				[.3073919]	[.2750515]	.657039
INFL					.1631461	.0840716
					[.1710418]	[.2226876]
POP						.3567823
						[.7184098]
Time dummies?	Yes	Yes	Yes	Yes	Yes	Yes
Colony dummies?	Yes	Yes	Yes	Yes	Yes	Yes
Chi-sq(1) Pval=	0.0011	0.0223	0.0001	0.0341	0.0341	0.0001
Cragg-Donald Wald F statistic	52.51	10.3	10.97	19.23	16.23	17.23

Notes: clustered standard errors are reported in parentheses with ***, **, and *, denoting significance at the 1%, 5%, and 10% levels, respectively.

Conclusion

This paper investigated the empirical relationship between spending on education and economic growth for Cape and Natal colonies for the period 1859 to 1909. We implemented a fixed effect estimator to account for unobserved heterogeneity. While the endogeneity bias was accounted for using a FE-2SLS estimator. Our analysis yields two important results. (1) The results suggest that levels of education (proxied by spending on education) have a robust positive impact on economic growth. The results are robust to addressing the potential reverse causality of education influencing economic growth and using alternative measures of education (proxied by enrolment rate).

(2) We find that the effect of education is significantly higher for Europeans compared to natives groups. These results highlight the importance of distinguishing between race groups to get a more comprehensive picture of the relationship between education and growth. The latter finding can be attributed to the gaps in school quality that historically existed between Native and European students. Unsurprisingly the current education policy in South Africa is still trying to close the gap caused by educational systems inherited from colonial rule. As van

der Berg et al (2011) put it “a far more resilient legacy from the past has been the low quality of education within the historically disadvantaged parts of the school system”. But if history has taught us anything it’s that any biased educational policy that is not inclusive to all would lead to large educational gaps that can be persistent and destructive to the development of a country.

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