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EDUCATION AND ECONOMIC GROWTH IN CAPE AND NATAL COLONIES: LEARNING FROM HISTORY[1]

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ABSTRACT

Although the relationship between colonial education and economic growth are topics of growing interest, few studies have examined the influence colonial education on economic growth in South Africa. This paper uses archival data (derived from Bluebooks, De Zwart 2011, Statistical yearbook of the colony of Natal and Malherbe (1925)) from colonial South Africa over the 1859–1910 period to study the extent to which economic growth is influenced by education. The analysis applies fixed effect to account for unobserved colony-level heterogeneity and minimise the omitted variable bias. It also employs certain methods (such as Fixed effects two-stage least squares (FE-2SLS) procedure)) that account for a possible endogeneity bias caused by reverse causation between the dependent variable (growth) and our variable of interest (education). Our analysis yields two important results. First, 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 between education and economic growth and using alternative measures of education (proxied by enrolment rate). Secondly, the impact of education on economic growth appear to vary from one population group to another. Specifically, the effect of education on economic growth is found to be significantly higher for Europeans compared to natives groups, adding a more nuanced understanding of the relationship between education and growth in the South African context. The estimated coefficients of control variables such as 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. Thus our results suggest that there is a need to think about how available resources could be used more efficiently to guarantee quality education for all and proposes that policy interventions in the historically disadvantaged schools and universities might have important implications to stimulate economic growth. This does not mean that historically advantaged schools must be ignored as 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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INTRODUCTION

This study examines the role played by education in 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; and 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); and Jalloh (2013). While education has been identified as one of the key determining factor of economic development (DeLong et al. 2003; Galor and Moav 2002; Galor and Weil 2000 and Crafts 1995), empirical analysis linking education and economic growth has not yielded consistent results. Barro (1991), Mankiw, Romer, and Weil (1992), and Easterly and Rebelo (1993) all find a positive relationship 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 the 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 is structured as follows. Section 2 looks at the existing empirical literature on the effect of education or human capital on economic growth. Section 3 discusses both the methods and the dataset employed in this paper. Section 4 present the results on the effect of education or human capital on economic growth in the Natal and Cape colonies. The last section provides some concluding remarks.

LITERATURE REVIEW

A huge body of theoretical and empirical literature has analysed the relationship between education[2] 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). Various strands of contemporary growth theories have emerged that try to shed further light on why developing countries are not able to perform as expected -- attaining a better equilibrium. An example of these theories is coordination failure. According to this theory poor performance in developing countries is due to coordination failure (among

complementary industries) which in turn leads "the market to an outcome (equilibrium) inferior to a potential situation where resources would be correctly allocated and all agents would be better off" (Glavan 2007:2). The notion of coordination failure is not entirely new. Some studies trace it back to Rosenstein-Rodan (1943), in a seminal article entitled "Problems of Industrialization of Eastern and South-eastern Europe". Other scholars such as Graham and Temple (2005) trace it back to Malthus.

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 datasets 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.

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 countries. 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 could be affected by 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) studied the effect that human capital has on economic activity. Their results suggest 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 Fintels' (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.

DATA AND METHODOLOGY

This study employs various data sources (Bluebooks, De Zwart 2011, Statistical yearbook of the colony of Natal and Malherbe (1925)) in its investigation of the impact of education on economic growth in Natal and Cape colonies. Apart from the dependent variable, this paper employs a number of explanatory variables. It uses as explanatory factors identified in the literature as important determinants: inflation, savings, trade openness, number of scholars on roll, population, and government expenditure on education natural resources. The latter variable (natural resources) deserves some attention. Growth studies have attempted to explain the degree to which initial conditions may have been favourable to the region's growth (see Rodrik, 1995; Booth, 1997; Temple, 1997). Thus, following Sachs and Warner (1997) an attempt is made in this study to acknowledge the importance of initial conditions (such as natural resources) in these two colonies and the impact that these conditions might have had on growth differentials. Specifically, our fixed effect model explicitly contain such initial conditions. Acknowledging the importance of initial conditions is as Temple (1998: 311) accurately puts it "… an attempt to arrive at a more complete explanation of the growth difference" between regions, countries or regions. Previous studies have incorporated different kinds of initial conditions, including geography and trade specialisation (Temple, 1998); ethnic diversity (Easterly and Levine, 1997) and geography and resource endowments (Sachs and Warner, 1997). 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	Blue books
POP	Population	Blue books
INFL	Bare bones basket CPI%	De Zwart (2011)
SAVINGS	Nominal total savings as used by Greyling and Verhoef (20157)	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 (1925)
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 (1925)

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:

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

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

To estimate the above equations, we employ the fixed effects (FE) models. The reason for choosing the FE model over the random effect model is because it accounts for the unobserved heterogeneity which might be correlated with observed independent variables. Moreover, our choice of FE model, as opposed to the random effects model is supported by the results of Hausman-type specification test (reported at the bottom of tables 2 to 4). Although the FE model is supported by the Hausman test and mitigates endogeneity problem attributable to omitted variable bias, it ignores simultaneity bias or reverse causation. Simultaneity bias (i.e. feedback relationship between economic growth and education) is regarded as an important empirical concern in this field. We attempt to account for simultaneity bias or reverse causation by using fixed effects two-stage least

squares (FE-2SLS) estimator. Specifically, we use the lagged value of education as an instrument for education.

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. Thus, in what follows we empirically inspect the robustness of these scatter plots.

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

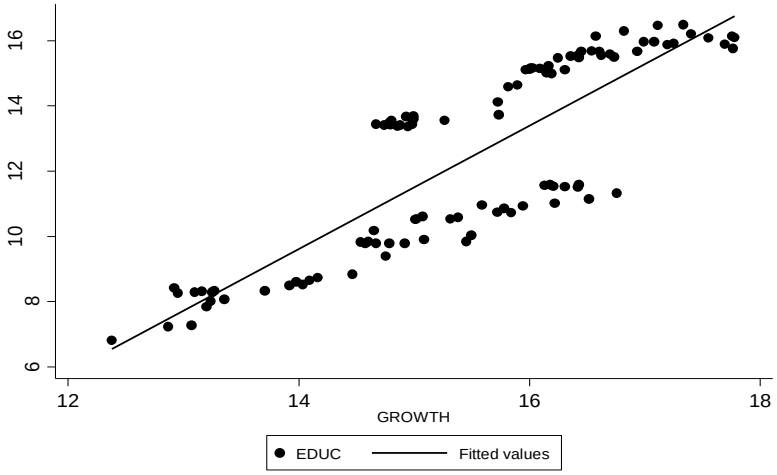

Figure 2: Education by colony, 1860-1910

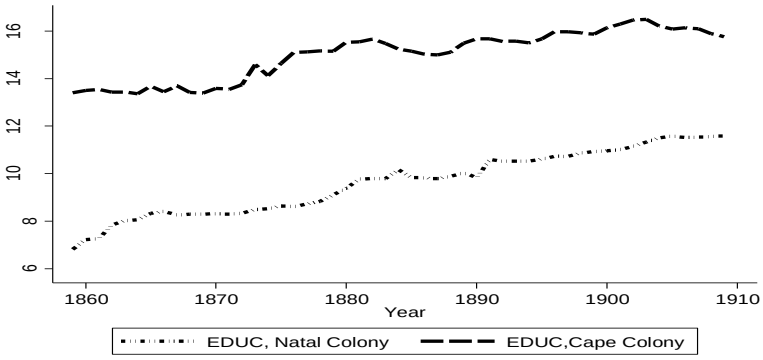

TABLE 2: FIXED EFFECTS ESTIMATES OF THE EFFECTS OF EDUCATION SPENDING ON ECONOMIC GROWTH. 1865-1909

Economic Growth	FE(1)	FE(2)	FE(3)	FE(4)	FE(5)
EDUC	0.8615673***	0.4188395***	0.367005***	0.3858834***	0.5989921***
	[0.027]	[0.069]	[0.088]	[0.083]	[0.088]
POP		0.9243769***	0.9917125***	1.023647***	0.4206837**
		[0.135]	[0.170]	[0.159]	[0.201]
INFL			-0.0247018	-0.0266772	-0.0209461
			[0.224]	[0.021]	[0.017]
SAVINGS				-6.52E-08*	-9.65E-08***
				[2.33e-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

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

We start of by estimating a fixed effect model which is reported in Table 2. Column two of table 2 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);Gyimah-Brempong et al (2006) and Biyase and Zwane (2016).

The FE-(2) reveals a positive and statistically significant effect of population on economic 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 3 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 3: FIXED EFFECTS ESTIMATES OF THE EFFECTS OF SCHOOL NROLMENT 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 3 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 4. 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 4: 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 mitigate simultaneity bias, we estimate equation (1) using the fixed effects two-stage least squares estimates with an instrument as discussed earlier. We also test for serial correlation and instrument validity. The results of the serial correlation test rules out the possibility of serial correlation and the Cragg-Donald F-test rules out the concern of weak instruments (above the value of 10, see bottom of Table 5). We also performed an endogeneity test to establish whether there is a need to employ the FE-2SLS regression or if a FE model will be adequate. As expected, the result appear to be in favour of two-stage least squares model.

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. Concerning the influence of the control variables on growth, the FE-2SLS estimates (accounting for simultaneity bias) appear to be similar to the fixed effect estimates. For example, population and natural resource, still positively and significantly affect growth in all specifications.

TABLE 5: FIXED EFFECT-IVESTIMATES OF THE EFFECTS OF EDUCATION O 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.*

CONCLUDING REMARKS

We investigated the effect that spending on education has on economic growth for Cape and Natal colonies for the period 1859 to 1909. We implemented a fixed effect estimator to deal with unobserved heterogeneity. Whereas the simultaneity bias was controlled for by employing a FE-2SLS estimator. The 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. Although one cannot directly compare the current education policies with the colonial education policies, there is evidence to suggest that the latter policies are a persistent series (see Magee, Verhoef and Greyling (2016); Verhoef and Greyling (2015); Acemoglu, Johnson and Robinson (2001) and Fourie and Von Vintel (2010). That is, the long term persistence of colonial policies have shaped

current economic structures. 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.

ENDNOTES

[1] An earlier version of this paper has been presented in a seminar at the University of Stellenbosch in South Africa, 28 March 2018. We thank Johan Fourie, Dieter von Fintel and other participants for their insightful comments and suggestions. We also thank Lorain Greyling and Grietjie Verhoef for kindly sharing the data which they have collected from various sources. We also acknowledge the helpful comments of Norman Bromberger and Grietjie Verhoef on the earlier version of this paper.

[2] 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.).

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