Primary Education and Fertility Rates in Southern Africa: Evidence from Before the Demographic Transition

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Abstract

I investigate whether primary school completion has played any role on total fertility rates in all fifteen countries of the Southern African Development Community (SADC) between 1980 and 2009. The evidence, based on panel time-series analysis (I use the Pooled OLS, Fixed Effects and Fixed Effects with Instrumental Variables estimators in order to deal with heterogeneity and endogeneity in thin panels), suggests that primary education has indeed reduced fertility rates in the SADC, or that the community is already trading-off quantity for quality of children. The results are important because lower fertility, caused by education, implies more capital per worker, higher productivity and therefore higher growth rates, and also because—in accordance to the unified growth theory—they suggest that the SADC, like other regions in the past, is experiencing its own transition from the Malthusian regime into sustained growth.

Keywords: Education, fertility, Africa, panel time-series.

JEL Classification: I20, J13, O55.

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1 Introduction

Africa is known for its recent political independence from European rule, for a number of political regime changes taking place particularly during the cold war, for civil and military conflicts, and for poor macroeconomic performance. More recently though, the continent has seen some economic structural changes and reforms being implemented, which combined with a certain degree of political stability, have been matched by better economic performance, Bates, Coatsworth and Williamson (2007).

Bearing the above in mind, I investigate the role of primary school completion rates in determining total fertility rates in the Southern African Development Community (SADC), a community of countries that advocates the importance of democracy and integration as tools for development and which includes a diverse set of countries, eg with Angola and Mozambique presenting positive growth rates since the 1990s and with some double figures from 2004 onwards, with Botswana and Mauritius presenting positive growth for the whole period investigated, with South Africa presenting positive growth, although modest, since the end of the Apartheid regime in 1994, and with a country like Zimbabwe which has presented negative growth rates since 1999. More specifically, I use data from all fifteen SADC countries between 1980 and 2009, and panel time-series analysis to study whether education played any role on fertility in the region.

For the above I rely on unified growth theory models (Galor and Weil 1999, Galor and Weil 2000, and Galor and Moav 2002) to better understand and contextualise the recent development of the southern African region. The underlining theory divides the process of development of an economy into three regimes. Firstly, the Malthusian regime in which increases in income—usually coming from external shocks, eg the Black Death in 14^{th}-century Europe—have the effect of increasing fertility rates. After some time though, given the "preventive checks", this natural economy converges back to its original equilibrium, ie shocks have no long-run effects on income per capita, only on population density, Ashraf and Galor (2013). Secondly, there is the Post-Malthusian regime in which income increases and some industrialisation takes place, without too much human capital though. In addition, during this transitional period, life expectancy as well as fertility tend to increase. Lastly, during the sustained growth regime, technological

progress and industrialisation take off, demand for educated workers who can operate particular production technologies increases and in fact human capital takes a central role in the production process, fertility rates see a reduction and eventually the demographic transition takes place.

The evidence I report suggests that, firstly, primary education completion rates have been a robust determinant of total fertility rates in the community. Essentially, because of higher demand for skilled people who can operate basic technologies in services and industry, education is associated with lower fertility in a region that has not yet gone through its own demographic transition, Murphy (2010). Secondly, the rise in life expectancy that the region has been experiencing in the last decades is accompanied by higher fertility rates, Galor (2012). Thirdly, the agricultural sector of those economies is associated with higher fertility rates, Becker, Cinnirella and Woessmann (2010). Fourthly, there is some evidence that economic globalisation reduces fertility, Soares (2007). Lastly, there is evidence suggesting that income increases lower fertility in the community, Becker (1960). All in all, the evidence—particularly the role of education and income in reducing fertility, and the effect that life expectancy has on fertility—indicates that the SADC have already escaped the Malthusian regime.

The importance of acquiring a better understanding of the role of education on fertility rates in the SADC is threefold: firstly, lower fertility implies more capital per worker, higher productivity and higher growth rates; secondly, lower fertility caused by education implies that the modern sector of those economies is already demanding people with some human capital who can work in services and industry. Thirdly, the take off into the sustained growth regime, usually caused by a shock, requires a critical level of human capital, so that the virtuous circle between human capital and technological progress can take place, Galor and Moav (2002). Given the overall evidence, and bearing in mind the numerous factors that might have delayed Africa's own demographic transition in the past, eg colonialism, it is hard not to emphasize the importance of understanding the interplay between education and fertility in a community which is transitioning from the Malthusian regime into more sustained growth.

The empirical literature on the role of education on fertility has mostly studied the European trade-off between quantity and quality of children taking place in the 19^{th} century. Firstly though, Drèze and Murthi (2001) use

Indian data, at district level between 1981 and 1991, to report that female education reduces fertility rates. Secondly, Dribe (2008) uses Swedish data from 1880 to 1930 at county and national level to report that the number of teachers per 100 children (aged between 7 and 14) reduces fertility rates. Thirdly, Murphy (2010) uses French departmental-level data between 1876 and 1896 to report that female literacy reduced fertility in France. Fourthly, Becker, Cinnirella and Woessmann (2010, 2012 and 2013) use data from Prussian counties in the 19^{th} century to report that school enrolment and female education reduced the child-woman ratio at the time. Similarly, but with contemporaneous African data, Bittencourt (2014) presents evidence that secondary education reduces fertility in a panel of southern African countries.

In essence, the empirical evidence, mostly covering European countries in a time period which they had not yet experienced their own demographic transition, just like Africa now, suggests that education was already playing an important role in lowering total fertility rates. Hence, this paper is a natural development of the previous literature on the subject. I conduct a case study of an important club of African developing countries that attempts to pinpoint in more detail the effects of primary completion rates on total fertility. I do that by taking advantage of the unified growth theory and panel time-series analysis which allow us to put the evidence into context and also to deal with particular econometric issues in thin panels, heterogeneity and endogeneity, which enables me to provide—to the best of my knowledge, for the first time—informative and contextual estimates so that our knowledge of an idiosyncratic, and diverse within, southern Africa is furthered.

2 The Data and Methodology

The dataset covers the period between 1980 and 2009, and fifteen sub-Saharan African countries, which are all members of the SADC, namely Angola, Botswana, the Democratic Republic of the Congo, Lesotho, Madagascar, Mozambique, Mauritius, Malawi, Namibia, South Africa, Swaziland, Seychelles, Tanzania, Zambia and Zimbabwe, and these countries accounted for approximately 52% of the total GDP in sub-Saharan Africa in 2009.

The variable proxying for total fertility, $FERTIL$, is the number of children per woman—or the number of children that would be born to each

woman with age-specific fertility rates—and the data are from the United Nations. For education I use primary school completion as percentage of the relevant age group, $EDUC$, and the data are provided by the World Bank. It is expected that education leads to more investment in the quality than in the quantity of offspring, or that higher primary completion rates reduce total fertility rates because of demand for basic skills for use in services and industry even before a region's demographic transition takes place, Becker, Cinnirella and Woessmann (2013).

The choice of control variables follows the underlining theory. First, I account for life expectancy, $EXPECT$, which is life expectancy in terms of number of years at birth. The data come from the United Nations Population Division and it is predicted that an increase in life expectancy leads to an increase in fertility, particularly in developing countries where uncertainty regarding survival of offspring is still high, Galor (2012). Moreover, I make use of the importance in percentage terms of the agricultural sector on the respective GDPs of those countries, $AGRIC$, and the data are from the World Development Indicators provided by the World Bank. It is predicted that more agrarian societies tend to favour quantity instead of quality of children because of non-complementarities between agricultural and non-skilled goods, and lower fertility, Becker, Cinnirella and Woessmann (2010).

Furthermore, I use the gross fixed capital formation to GDP, INV, as a proxy for industrialisation and the data are from the World Bank. It is predicted that industrialisation is associated with lower total fertility rates because of complementarities between industrialised-skilled goods and lower fertility, Galor and Moav (2006), and also because of higher relative wages for women in services and industry which tend to reduce fertility, Galor and Weil (1996). I also use a variable for economic globalisation, $GLOBAL$, provided by Dreher (2006) which takes into account trade to GDP and also, eg foreign direct and portfolio investment, and import barriers. It is expected that globalisation, at least in non-industrialised developing countries trading with developed countries, might negatively affect education because developing countries specialise in non-skilled agricultural goods which do not require human capital, Galor and Mountford (2008). Lastly, I control for income per capita, GDP, and the data come from the World Development Indicators. It is expected that higher income in societies that have already escaped the Malthusian stagnation, because of higher opportunity costs of having

children when income increases and by the substitution effect, leads to a decline in fertility, Becker (1960).

Figure One shows the averaged-data on fertility and education in the sample, and the take from this eye-ball exercise is that during the whole period fertility rates in the SADC have been decreasing over time, ie from roughly six children per woman in 1980 to approximately four in 2009. Moreover, primary education has been on the rise throughout the period, from roughly 60% of the corresponding population age group in 1980 to approximately 80% in 2009. In the third panel I plot the OLS regression line between primary completion and total fertility rates (the data are now in logs), and the plot shows that there is already an economic relationship between higher primary completion rates and lower fertility taking place in the community.

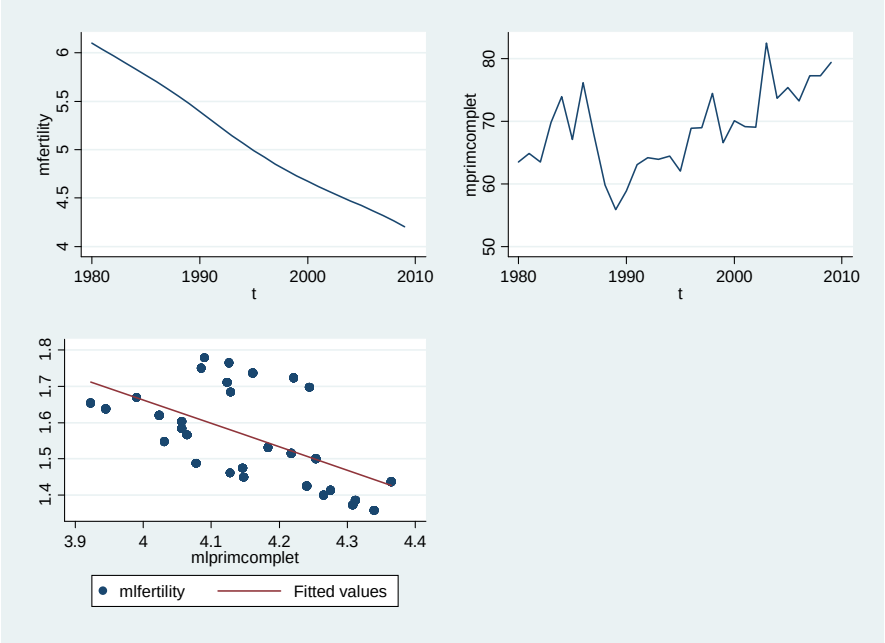

Figure 1: Fertility rates, primary education and the OLS regression line between education and fertility, SADC, 1980-2009. Sources: United Nations and World Development Indicators.

Table One presents the correlation matrix of the variables used for the analysis. Initially, the two main variables of interest, fertility rates and primary education confirm the above eye-ball evidence and present a negative

and statistically significant correlation with each other. In addition, life expectancy presents a negative and significant correlation to fertility, which suggests that an increase in life expectancy might reduce uncertainty about survival of offspring, reduce the costs of investment in human capital and reduce fertility, Soares (2005) and Doepke (2005).

Furthermore, the ratio of the agricultural sector to GDP presents a positive correlation with fertility and fixed capital formation presents the expected negative correlation with fertility. Contrary to expectation, the negative correlation between globalisation and fertility is probably capturing the role of openness, eg via the spreading of better health technologies and information, in lowering fertility, Soares (2007). Finally, income per capita displays a negative correlation with fertility, which indicates that the substitution effect is already at work in the community.

Table 1: The Correlation Matrix: SADC, 1980-2009.

	FERTIL	EDUC	EXPECT	AGRIC	INV	GLOBAL	GDP
FERTIL	1						
EDUC	-0.657*	1					
EXPECT	-0.663*	0.602*	1				
AGRIC	0.709*	-0.731*	-0.491*	1			
INV	-0.282*	0.289*	0.388*	-0.311*	1		
GLOBAL	-0.384*	0.405*	0.133*	-0.663*	0.288*	1	
GDP	-0.234*	0.076	0.158*	-0.231*	0.265*	0.237*	1

Sources: United Nations, World Development Indicators and Dreher (2006). * represents significance at the 5% level.

The empirical strategy, given that I have a $T > N$ dataset, $T = 30$ and $N = 15$, is based on panel time-series analysis. Panel time-series allows me to deal with important econometric issues in relatively thin panels—heterogeneity and endogeneity—and also to specifically further our knowledge of sub-Saharan Africa without having to incur in the removal of African countries (or use of dummies) that often takes place in large cross-sectional and panel data analyses.

Firstly, although some of the variables are either ratios or indices and hence bounded within closed intervals, I evoke Phillips and Moon (1999) result which suggests that the issue of spurious regressions is less of a problem in panels because of the averaging taking place in panel estimators which

reduces the noise coming from such regressions.

Secondly, the issues of statistical endogeneity and heterogeneity of intercepts are dealt with by the one-way Fixed Effects (FE) with robust standard errors estimator, which provides consistent estimates when $T \to \infty$, Smith and Fuertes (2010), and Achen (2001). Essentially, although these countries shared some political and economic transitions in their recent history, which makes the homogeneity of slopes a plausible assumption, the FE estimator also accounts for the fact that some of these countries do present different characteristics in terms of economic and political development, eg Botswana, Mauritius and South Africa are relatively richer and more politically stable than most other countries in the community, and these country differences are picked up by the heterogeneous intercepts of the FE estimator.

Thirdly, some would argue that reverse causality is a possibility, or that lower fertility leads to higher education, Becker, Cinnirella and Woessmann (2010). Therefore I use the Fixed Effects with Instrumental Variables (FE-IV) estimator, which provides estimates that are asymptotically consistent and efficient as $T \to \infty$, Arellano (2003).

In terms of instruments used, with the assumption ($E(educ_{it-1}v_{it} = 0)$) in mind, firstly I make use of the lag of education as a baseline identifying instrument for contemporaneous primary education. It is expected, because of education's persistence over time, a positive effect of lagged education on contemporaneous primary completion. Secondly, I use the normalised, so that it ranges from zero to one, polity2 variable (POL) from the Polity IV files to account for the external democratic shock coming with the end of the cold war in the 1990s that the region saw taking place back then and which continues to the day, Bates, Block, Fayad and Hoeffler (2013).

Figure 3 shows the above-mentioned external instrumental variable series which illustrates the shift to more democratic institutions taking place in 1990 in the region, which coincides with the end of the ideological conflict between the West and the former USSR. It is expected that democracy should play a positive role on education, by better governance and more efficient allocation of resources towards public goods, in this case education, Tavares and Wacziarg (2001) and Murtin and Wacziarg (2013), and the OLS regression line in the second panel of Figure 3 points towards a positive economic relationship taking place between both variables in the community.

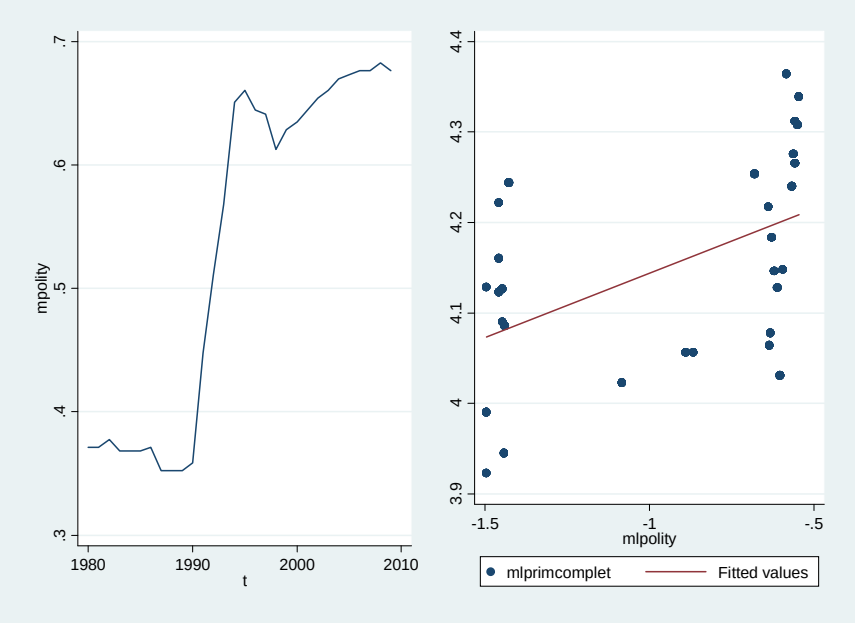

Figure 2: Democracy and the OLS regression line between democracy and primary education, SADC, 1980-2009. Sources: Polity IV and World Development Indicators.

Therefore I estimate equations with different pooled estimators, the baseline Pooled OLS (POLS), which assumes homogeneity of intercepts and slopes, the FE and FE-IV estimators, so that different econometric issues are dealt with and reliable estimates provided. The one-way FE estimated equation is as follows,

$$FERTIL_{it} = \alpha_i + \beta EDUC_{it-1} + \beta EXPECT_{it} + \gamma AGRIC_{it} + \delta INV_{it} + \epsilon GLOBAL_{it} + \varepsilon GDP_{it} + \upsilon_{it} \quad (1)$$

where $FERTIL$ is the number of children per woman, $EDUC$ is primary completion rates, $EXPECT$ is life expectancy at birth, $AGRIC$ is the share of the agricultural sector to GDP, INV is the share of gross fixed capital formation to GDP, $GLOBAL$ is economic globalisation and GDP is income per capita. All variables are in logs.

3 Results and Discussion

In Table Two I report the baseline POLS (first panel) and then the robust FE estimates (lower panel). Most POLS and all FE primary education estimates are negative and statistically significant against fertility rates. For instance, the FE estimate in column five suggests that for each percentage point increase in primary education, there will be a .13 percentage point reduction in fertility in the community, a result which is consistent with the previous efforts which use data from other regions before their own demographic transition, Murphy (2010).

About the controls, the agricultural sector is associated with significantly higher fertility rates, which highlights the role of non-complementarities between unskilled-agricultural goods and lower fertility in the community, Becker, Cinnirella and Woessmann (2010). In addition, income per capita reduces fertility rates in the community, which indicates that the substitution effect is dominating the income effect in the community, Becker (1960).

Furthermore, the proxy for life expectancy, when using the FE estimator, presents positive and significant estimates on fertility, which suggests that an increase in life expectancy reduces the costs of child rearing, which combined with uncertainty about survival of offspring, increases fertility in those developing countries, Galor (2012). Lastly, in this instance fixed capital formation does not present clear-cut effects on fertility or does the proxy for economic globalisation.

Table 2: Pooled OLS and Fixed Effects Estimates of Education on Fertility, 1980-2009.

FERTIL	POLS (1)	POLS (2)	POLS (3)	POLS (4)	POLS (5)	POLS (6)
EDUC	-.619 (-14.72)	-.373 (-8.15)	-.076 (-1.53)	-.077 (-1.54)	-.085 (-1.64)	-.097 (-1.85)
EXPECT		-1.10 (-9.06)	-.904 (-8.69)	-.883 (-8.16)	-.919 (-7.51)	-.890 (-7.23)
AGRIC			.237 (10.62)	.236 (10.49)	.265 (9.28)	.262 (9.22)
INV				-.022 (-0.71)	-.035 (-1.01)	-.027 (-0.78)
GLOBAL					.119 (1.68)	.140 (1.96)
GDP						-.004 (-1.71)
F test	216.58	181.12	213.53	159.97	90.23	76.29
R^2	0.43	0.56	0.70	0.70	0.65	0.65
FERTIL	FE (1)	FE (2)	FE (3)	FE (4)	FE (5)	FE (6)
EDUC	-.226 (-2.35)	-.233 (-2.63)	-.131 (-3.38)	-.131 (-4.22)	-.130 (-3.99)	-.045 (-1.79)
EXPECT		.958 (2.77)	.415 (1.97)	.549 (3.02)	.681 (4.08)	.619 (6.11)
AGRIC			.302 (11.74)	.298 (11.76)	.243 (8.39)	.047 (1.04)
INV				-.075 (-2.24)	-.052 (-1.57)	-.023 (-1.63)
GLOBAL					-.178 (-2.27)	-.077 (-0.91)
GDP						-.250 (-3.82)
F test	5.54	5.51	61.31	58.28	46.99	610.66
F* test	72.07	76.15	134.12	146.93	187.66	365.84
R^2	0.43	0.09	0.50	0.47	0.32	0.06

T-ratios in parentheses. Number of observations: $NT = 450$. $FERTIL$ is child per woman, $EDUC$ is primary school completion, $EXPECT$ is life expectancy at birth, $AGRIC$ is agriculture ratio to GDP, INV is the gross fixed capital formation ratio to GDP, $GLOBAL$ is economic globalisation and GDP is income per capita. POLS is the Pooled OLS and FE the Fixed Effects estimators.

In Table Three I report the FE-IV estimates. In the first panel I instrument primary education with its own lag, $EDUC_{-2}$, and in the second I use democracy, POL, as the identifying instrument for primary completion rates. Firstly, all $EDUC$ estimates are negative and statistically significant against total fertility rates. For example, using column five, second panel, the $EDUC$ estimate suggests that for each percentage point increase in primary education, there will be a reduction in .46 percentage points in total fertility.

Secondly, life expectancy confirms its positive and significant role on fertility as well as the share of the agricultural sector to GDP with positive

and significant estimates. On the other hand, fixed capital formation and income per capita present negative and significant estimates on fertility, which firstly points to the importance of demand for human capital from services and industry and the role of complementarities between skilled goods, higher relative wages for women and lower fertility, Galor and Moav (2006) and Galor and Weil (1996); and secondly because of higher opportunity costs and of the substitution effect taking place in the region, Becker (1960). Lastly, economic globalisation presents negative and mostly significant estimates on fertility, which suggests that openness can reduce fertility, by the spreading of health technologies, flows of knowledge and values across the developing world, Soares (2007).

Moreover, in the first-stage regressions our identifying instruments display the expected signs against primary education, ie lagged education through its persistent effect on itself and democracy by its better governance effect, Stasavage (2005), positively determine education. Furthermore, the t-stats of our identifying instruments are all significantly different from zero as well as the F-tests for overall significance, which minimise the issue of weak instruments in the regressions.

Table 3: Fixed Effects with Instrumental Variables Estimates of Education on Fertility, 1980-2009.

FERTIL	FE-IV (1)	FE-IV (2)	FE-IV (3)	FE-IV (4)	FE-IV (5)	FE-IV (6)
EDUC	-.267 (-4.48)	-.249 (-5.05)	-.149 (-4.35)	-.143 (-4.32)	-.140 (-4.50)	-.060 (-2.49)
EXPECT		1.02 (9.98)	.399 (5.35)	.523 (6.72)	.650 (8.30)	.588 (10.36)
AGRIC			.310 (16.99)	.307 (17.45)	.256 (12.76)	.056 (2.68)
INV				-.073 (-4.22)	-.055 (-2.97)	-.034 (-2.54)
GLOBAL					-.144 (-3.78)	-.033 (-1.16)
GDP						-.255 (-12.70)
F* test	60.65	75.36	152.16	165.88	199.73	391.48
R^2	0.45	0.08	0.50	0.47	0.34	0.05
IV	$EDUC_{-2}$	$EDUC_{-2}$	$EDUC_{-2}$	$EDUC_{-2}$	$EDUC_{-2}$	$EDUC_{-2}$
	.884 (23.28)	.886 (23.44)	.872 (22.38)	.873 (22.36)	.875 (21.97)	.846 (20.86)
F test	541.78	275.12	194.88	145.89	112.73	98.48
FERTIL	FE-IV (1)	FE-IV (2)	FE-IV (3)	FE-IV (4)	FE-IV (5)	FE-IV (6)
EDUC	-1.04 (-4.02)	-1.03 (-4.18)	-.694 (-4.12)	-.614 (-4.20)	-.462 (-4.11)	-.314 (-2.06)
EXPECT		.843 (4.71)	.523 (3.56)	.655 (4.68)	.707 (6.19)	.657 (6.70)
AGRIC			.191 (4.44)	.196 (5.19)	.170 (5.26)	.105 (3.20)
INV				-.083 (-3.27)	-.059 (-2.61)	-.043 (-2.24)
GLOBAL					-.159 (-3.52)	-.121 (-3.15)
GDP						-.111 (-1.80)
F* test	27.59	24.37	41.90	53.78	91.24	163.31
R^2	0.45	0.28	0.51	0.50	0.38	0.14
IV	POL	POL	POL	POL	POL	POL
	.071 (4.18)	.071 (4.18)	.068 (4.20)	.071 (4.28)	.080 (4.19)	.048 (2.41)
F test	17.49	8.86	13.69	10.45	7.35	9.36

T-ratios in parentheses. Number of observations: $NT = 450$. $FERTIL$ is child per woman, $EDUC$ is primary school completion, $EXPECT$ is life expectancy at birth, $AGRIC$ is agriculture ratio to GDP, INV is the gross fixed capital formation ratio to GDP, $GLOBAL$ is economic globalisation and GDP is income per capita. FE-IV is the Fixed Effects with Instrumental Variable estimator and the instruments are the lag of contemporaneous primary education $EDUC_{-2}$ and democracy POL.

In a nutshell, primary completion rates have been reducing fertility rates in the SADC, which confirm previous efforts using European historical data from countries which had not yet experienced their own demographic transition, Dribe (2008) and Murphy (2010). Moreover, the results suggest that

the community is experiencing the trade-off between quantity and quality of children, which is an important ingredient of the transition from the Malthusian regime to sustained growth, Becker, Cinnirella and Woessmann (2010), and also that the modern sector of those countries is already demanding people with some human capital who can operate particular production technologies in services and industry, a factor which leads to lower fertility, Galor (2011).

Furthermore, lower fertility rates are important because they can have a positive effect on capital per worker, productivity, on the much needed economic growth and on the composition of the population, Galor (2012). Equally important, Galor and Moav (2002) predict that those already with human capital, even during the Malthusian regime, have higher survival rates and at some point in time, when there is enough human capital in place and usually after a shock, eg the implementation of democratic institutions, a virtuous circle is created between human capital and technological progress, and sustained growth might take place. All in all, it cannot be emphasized enough the importance of having a certain stock of human capital in place in a community like the SADC.

In addition, life expectancy is a variable displaying consistent results, ie positive effects on total fertility rates, results which are in line with the evidence presented by Galor (2012) who suggests that in 18^{th}- and 19^{th}-centuries England, increases in life expectancy were associated with increases in fertility as well as with Dribe (2008) who suggests the same for the Swedish case. The results about the role of agriculture on fertility rates confirm the prediction that agrarian, and unskilled, goods and quality offspring are not complementary to each other, Becker, Cinnirella and Woessmann (2010). On the contrary, fixed capital, with the caveat that the SADC is not a Solow region and its industrial sector is still small, is reducing fertility rates in the community by skill complementarities and increases in relative wages for women in particular sectors, Galor and Moav (2006) and Galor and Weil (1996).

Income per capita presents results which confirm that the community is not in a Malthusian regime in which higher income would increase fertility. In fact, the evidence indicates that the substitution effect, by higher opportunity costs of having children, is already dominating the income effect in the community, Becker (1960). Furthermore, the economic globalisation

estimates—although negative and mostly significant in the FE and FE-IV regressions, indicate that openness, by eg easier access to health technologies, foreign direct investment and flows of knowledge, can induce lower fertility, Soares (2007)—have to be taken with caution since not all of them are statistically significant. Bearing the above in mind, the globalisation results are in line with some of the objectives of the SADC, ie integration and development. Finally, about the instrumental variables, the first-stage regressions results of the positive effects of democracy on primary education confirm that democracy increases efficiency in terms of public spending on education, Stasavage (2005), and they also bode well with some of the broad developmental objectives of the SADC.

All in all, the above are important characteristics that other, now developed, countries displayed in their own past, Galor (2005), and that the SADC is already displaying, ie the trade-off between quantity and quality of children caused by education and the income substitution effect. Thus, it is fair to say that this community of countries (some of which have been growing fast, others which have been growing consistently, in the last twenty years or so, eg Angola, Botswana, Mauritius, Mozambique and South Africa) are not in the Malthusian stagnation or on a sustained growth regime. Therefore, it is plausible that those countries are going through the Post-Malthusian regime of development.

4 Conclusion

Using a dataset covering the period between 1980 and 2009, I have investigated the role of primary completion rates in determining total fertility in the SADC. The results suggest that education has had a negative and significant effect on fertility in the region. In fact, education proved to be a robust determinant of reduced fertility, which also highlights its indirect role in determining prosperity in the community by higher capital per worker, increased productivity and economic growth.

In addition, although Bates, Coatsworth and Williamson (2007) argue that Africa right after its independence in the 1960s has shown similar characteristics that Latin America had right after its own independence in the 19^{th} century, eg political instability, conflict and economic stagnation, and Acemoglu, Johnson and Robinson (2001) highlight the importance of ex-

tractive institutions being implemented in Africa during its colonial period, factors that might have delayed Africa's own demographic transition, the evidence suggests that southern Africa has escaped the worst of a Malthusian stagnation and is already showing characteristics of a region in transition. In fact, Young (2012) argues that sub-Saharan Africa has witnessed since the mid 1990s a considerable increase in consumption of vital durables such as housing, schooling and health, which is on par with other developing regions.

However, we also have to bear in mind that Galor and Moav (2002) argue that for sustainable growth to take place a higher proportion of educated "quality type" people combined with technological progress must be in place when a shock, eg democratisation, happens, so that failed takeoffs are minimised. To put it another way, Nelson and Phelps (1966) argue that educated people are innovators and also adaptable to technological change, which reinforces the role of education on fertility and sustained development in a globalised world.

A Appendix

I report extra regressions in which female labour force participation (FEM) is included as an extra control variable and also where I use both instruments, lagged education and democracy, together. Female labour force participation is the percentage of female to total female population who are older than fifteen years old and the data are from the International Labour Organisation. The results are consistent with the ones reported above, however FEM does not present clear-cut effects on fertility.

Table 4: Fixed Effects with Instrumental Variables Estimates of Education on Fertility, 1980-2009.

FERTIL	FE-IV (1)	FE-IV (2)	FE-IV (3)	FE-IV (4)	FE-IV (5)	FE-IV (6)	FE-IV (7)
EDUC	-.297 (-5.46)	-.280 (-5.93)	-.169 (-5.43)	-.161 (-5.46)	-.153 (-5.64)	-.147 (-4.85)	-.092 (-3.93)
EXPECT		.864 (8.04)	.233 (3.18)	.370 (4.82)	.496 (6.59)	.497 (6.08)	.522 (8.48)
AGRIC			.309 (17.85)	.303 (18.23)	.253 (13.60)	.234 (12.04)	.044 (1.90)
INV				-.072 (-4.44)	-.056 (-3.27)	-.039 (-2.22)	-.021 (-1.56)
GLOBAL					-.135 (-3.98)	-.153 (-4.25)	-.052 (-1.84)
FEM						-.004 (-0.04)	.022 (0.23)
GDP							-.240 (-10.53)
F* test	69.89	72.24	160.86	178.36	226.46	235.19	408.45
R^2	0.46	0.01	0.56	0.53	0.40	0.36	0.06
IV							
$EDUC_{-2}$	.846 (21.15)	.849 (21.38)	.832 (20.29)	.833 (20.35)	.844 (19.86)	.797 (16.64)	.794 (16.54)
POL	.034 (3.29)	.035 (3.37)	.031 (3.06)	.032 (3.20)	.026 (2.35)	.029 (2.30)	.024 (1.79)
F test	273.01	186.60	148.33	119.61	93.13	53.10	46.46
Sargan	0.00	0.00	0.00	0.00	0.00	0.00	0.00

T-ratios in parentheses. Number of observations: $NT = 450$. $FERTIL$ is child per woman, $EDUC$ is primary school completion, $EXPECT$ is life expectancy at birth, $AGRIC$ is agriculture ratio to GDP, INV is the gross fixed capital formation ratio to GDP, $GLOBAL$ is economic globalisation, FEM is female labour force participation and GDP is income per capita. FE-IV is the Fixed Effects with Instrumental Variable estimator and the instruments are the lag of contemporaneous primary education $EDUC_{-2}$ and democracy POL.

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