Social Security and Fertility Rates in sub-Saharan African Countries

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Abstract

The decline in fertility since the 1950s in most developed countries has been attributed to the increased availability of social security for the elderly. As from the mid 1970s, many economists have focused attention on the effects of fertility on economic variables, especially models of endogenous growth, where human capital is no longer considered exogenous as in the classical models. This paper investigates whether the introduction of social security programs may have had an impact on fertility in sub-Saharan Africa (SSA). The results show that to a large extent, low coverage and replacement rates may prevent many families in SSA countries from regarding social security as a perfect substitute for having more children in an optimal retirement portfolio. Current social security programs do not reduce fertility in sub-Saharan countries with the result that per capita investment in human capital continues to be low. The results of the model tested in this study, using a panel data analysis and bootstrapping, show that social security in fact affects fertility positively. These results suggest that policymakers in SSA countries urgently need to rethink the structure and effectiveness of existing retirement programs if they want these programs to have the desired effects. Rethinking the new structure, the growing informal sector and agrarian societies have to be considered as well.

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Key Words: social security, fertility, sub-Saharan countries, bootstrapping

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1. Introduction

According to Becker and Barro (1990) the establishment of retirement schemes offers one of the most important explanations for the declining rates of fertility in developed countries since the 1950s. The latter in turn appears to be one of three determinants of the economic growth path (Ehrlich and Lui, 1998).

Since the 1930s, fertility rates in developing countries, particularly sub-Saharan African (SSA) countries have exceeded those of developed countries. In addition to the high levels of fertility, many young people immigrate towards urban areas in search of work and improved living conditions. All of this impact on dependency ratios and replacement of income for the aged, especially where the security of an extended family system is eroded by the poverty and migration patterns.

This study analyses the impact of existing retirement programs in SSA countries on fertility. The objective is to identify a set of possible policies that can be used to influence fertility rates through which retirement schemes can positively impact on economic growth and human capital formation. We analyse the effects of social security on fertility in fourteen SSA countries. The rest of the paper is structured as follows: section 2 deals with the theoretical background, section 3 specifies the model to be tested, section 4 discusses the results of the model and section 5 concludes with some policy recommendations.

2. Theoretical background

The effects of social security on fertility and on saving and economic growth have been researched extensively. However, the results of the research are somehow mixed. This section explores the theoretical framework of the effects of social security on fertility in SSA countries based on the Boldrin, De Nardi and Jones (2005) model. This model initially assumes a PAYG system as is the case in most of the SSA countries, with agent i born in period $t-1$ maximizing the following utility function:

$$U_{t-1} = u(c_t^m) + \varsigma u(c_t^o) + \beta u(C_{t+1}^o) \quad (1)$$

Subject to the following constraints:

$$d_t^i + s_t + c_t^m + a_t n_t \leq (1-\tau_t) w_t (1 - b_t n_t) \quad (2)$$

$$c_t^o \leq d_t^i + \sum_{j \neq i, j=1}^{j=n_{t-1}} d_t^j + (1-\xi) R_t x_t + T_t^o \quad (3)$$

$$c_{t+1}^o \leq \sum_{j=1}^{j=n_t} d_{t+1}^j + (1-\xi) R_{t+1} x_{t+1} + T_{t+1}^o \quad (4)$$

$$x_{t+1} \leq \xi R_t x_t / n_{t-1} + s_t \quad (5)$$

where: T_t^o is the benefit payment to retirees; τ_t is the social security tax rate; c_t^m is the consumption of a middle-age person (in the authors' terminology) in period t; c_t^o is the consumption of a retiree; s_t are savings; n_t is the number of children; d_t^i is the level of support the agent *i* gives to his/her parents; x_t is the amount of capital stock each retiree controls in period t; w_t is the wage rate; R_t is the gross return on capital in period t. If it is assumed that the retirement benefit received when old T_t^o equals its contributions at any point in time and if taxes levied are: $(1-\tau_t) w_t (1 - b_t n_t)$; then $T_t^o = n_{t-1} \tau_t w_t (1 - b_t n_t)$ and rewriting the budget constraint (2) we get:

$$d_t^i + s_t + c_t^m + \theta_t(\tau) n_t \leq (1-\tau_t) w_t \quad (6)$$

The argument behind equilibrium equations (1-5) is that a representative agent *i* chooses the level of donation *d* to his parents so as to maximise his utility function (1). In the safe family social insurance setup (with no default) as in Ehrlich and Lui (1998), the optimisation problem implies that the elderly receive optimal transfers for consumption from their offspring. In this environment the introduction of social security will affect the choice of the number of children (*n*) and saving (*s*). The need for support from children decreases with improved social security, thereby reducing the level of donations required. But this reduction will depend on the level of compensation parents expect to receive from their children.

If social security benefits grow faster than the level of donation (*d*) received from children, parents will tend to reduce the number of children and increase investment in them, since the level of compensation or donation expected from children to parents may be correlated to the level of human capital accumulated. This reflects the choice regarding the number of children and quality referred to in the Ehrlich and Lui (1998) model, which implies that parents become more concerned about the quality of their children's education. In this model the level of support (compensation or donation) is related to the level of investment in human capital. A higher social security tax rate will initially increase the rate of return on the number of children relative to investment in human capital, because the added tax burden increases the ratio of emotional benefits relative to material compensation or donation from the children.

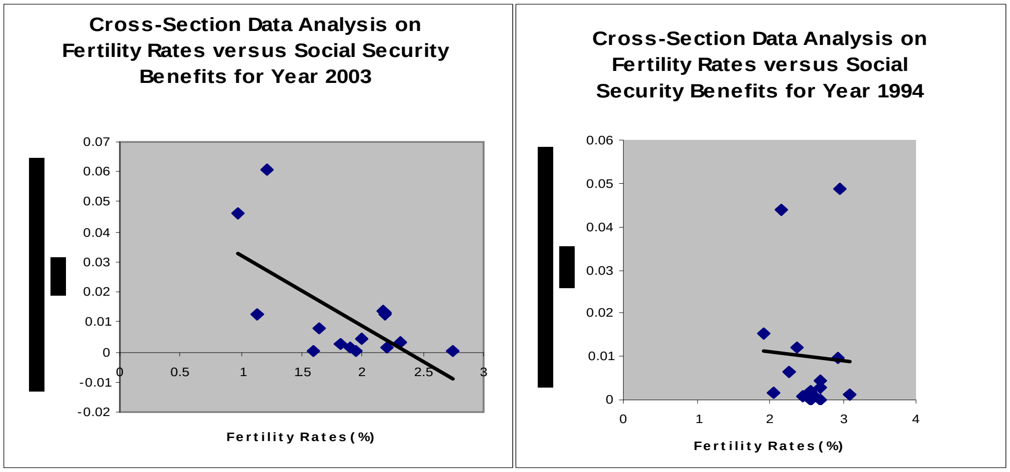
In SSA countries where families are still strongly connected by dynastic family structures as in Becker and Barro (1988), also known as the safe family insurance setup with no default as in Ehrlich and Lui (1998), social security may also negatively affect fertility, inducing parents to pay more attention to the quality of life rather than the number of their children.

However, the quality of education, lack of job opportunities, poverty and many other exogenous factors may constrain the performance of social security programs in these countries. This means that fertility rates fall much slower than in other regions in the world as parents still rely heavily on children as an important source of provision during retirement. Furthermore, the weaknesses of and highly imperfect financial markets[3] also hinder access to financial services to many African families, most of them living in rural areas. Boldrin, De Nardi and Jones (2005) argue that the development of financial markets reduces the value of within-family support during old age and, therefore, causes a decrease

[3] See also section 3.5.3 in Chapter 3.

in fertility rates. As seen in many empirical studies a negative relationship is expected between social security and fertility (see Figure 1 beloww). However, the relationship is not as strong as in some other regions in the world because the weak financial markets would induce parents to choose other forms of retirement.

Figure 1



In Figure 1 fertility rates versus social security benefits to GDP ratio in SSA countries are presented. It can be seen that in 1994 the relationship between social security and retirement benefits was weaker than in 2003. This simply implies that as individuals perceive social security as an important source of consumption, children become of less importance. Furthermore, having more children is constrained as individuals begin to understand the costs of rearing and educating them. Therefore, this Figure shows that the number of children decline as individuals incorporate social security in their life time expenditure decisions and with time more individuals become aware of the importance of the children-social security substation effect. This is shown by the gradient of the stepper line graph in 2003 compared to that in the 1994 graph.

In many sub-Saharan African countries, children form part of the production function of a dynastic family or safe family insurance structure. They assist in breeding animals (mainly looked after by young boys) and crop farming and many other home tasks (predominantly the young girls). Even if parents are concerned about the education of their children, the great distances between schools and homes is a real constraint to the quality of children's education.

3. The Model

While retirement funds have shown adverse implications on economic growth in various economies, a number of studies empirically show that contributions to retirement funds are related to fertility (see Zhang and Zhang, 2004 and Ehrlich and Kim, 2005). These results are consistent with the notion that retirement programs reduce fertility rates per woman and therefore increase investment in human capital per child[4]. Thus, two different model specifications from Zhang and Zhang (2004) and Ehrlich and Kim (2005) were combined to get the specification below. This specification allows the investigation of the effects of social security on fertility rates in sub-Saharan Africa, by applying a fixed effect one way error component model:

$$LnF_{it} = \beta_{1it} LnRBen_{jt} + \beta_{2it} LnRGC_{it} + \beta_{3it} GPC_{it} + \beta_{4it} RNX_{it} + LnSEC_{it} + u_{it} \quad (7)$$

Where: ➔ $u_{it} = \mu_i + \varepsilon_{it}$ is the error term component, with vectors of country specific fixed effects (μ_i) error component and ε_{it} is the usual white noise error.

LnF is the fertility rate and all other variables are as specified earlier.
β is the vector of the coefficients with $\beta_1<0$, $\beta_2>0$, $\beta_3<0$, and $\beta_4>0$
LnRBen is the social security benefit payment to GDP ratio;
LnRGC is the government consumption to GDP ratio;
GPC is the growth rate of the economy;
RNX net exports of the country *i* and
LnSEC secondary school enrolment

In this model the hypothesis to be tested is: retirement funds reduce fertility rates in the SSA countries. The outcome is considered against the background of the evaluation of the reforms in social security programs as proposed by the World Bank Report (1994).

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[4] In the case of many dynastic families in SSA countries the expected reduction of fertility may not increase (at least in the initial phase of growth of social security programs) investment in human capital because of low income per capita that tend to slow the reduction of fertility rates.

This research comprises fourteen sub-Saharan African countries for which at least ten years consistently reported data on retirement benefit payment were available.

The World Bank development indicators provide a comprehensive data base on countries' investment and government consumption, surplus/deficit and net exports as a share of GDP, growth rates, etc. However, given the fact that no significant number of observations on fertility rates in many (all) sub-Saharan African countries exists, population growth is used as a proxy of net fertility, calculated as the gross fertility rate minus the mortality rate. Other sources of data, such as country statistics of the IMF, were used to complement the required statistical information.

4. Empirical Results

This section empirically investigates the effects of social security on fertility. Unlike in the case of the growth of per capita GDP, where empirical results of the effects of social security have shown adverse results, fertility studies have consistently shown that social security negatively affects fertility. In other words, the existence and increase in social security systems in a society tend to reduce the importance of children as a means of old age security (Becker and Barro, 1988; Ehrlich and Lui, 1991). But as argued by Becker, Murphy and Tamura (1990), families with limited human capital tend to have large families and invest little in each member. Developing countries in Africa tend to fall within this category with poor levels of investment in human capital. In this case the growth in social security taxes tends to reduce fertility only temporarily even if the children do not support their parents (Becker and Barro, 1988).

The question is how long it takes before inverting the sign? The answer surely depends on the dynamics within each specific country (given the increase in regional policy coordination through regional blocks of development). Table 4.1 shows the results of the empirical investigation into the effects of social security on fertility (using population growth as a proxy of fertility net of mortality) in 14 sub-Saharan African countries.

The results presented in Table 4.1, column two (labelled model 1), indicate that social security in African countries included in the model do not reduce fertility as has been the case for developed countries. In fact, our results show that social security benefit payments have a positive impact on fertility. The growth in total government expenditure (RGC) seems to impact negatively on fertility in the SADC countries model.

Table 4.1: Dependent Variable **–** *LnF*

Variables (Regressors)	Coefficients (First order asymptotic)		
	Model 1 (All countries)	**Model 2 (SADC)**	**Model 3 (West Africa)**
LnRBen	0.0466	0.0969	0.0343
	(0.0383)	(0.0897)	(0.0291)
LnRGC	-0.0475	0.2740	-0.1070*
	(0.0958)	(0.3094)	(0.06380
LnSEC	-0.2559**	-0.3259	-0.0920
	(0.1177)	(0.4198)	(0.0797)
GPC	0.5940	1.0740	0.8034
	(0.5201)	(0.9852)	(0.5248)
RNX	-1.1730***	-1.5701***	-0.6603***
	(0.2577)	(0.5341)	(0.2293)
Fixed Effects			
BENIN	1.7458***		1.1042***
	(0.4843)		(0.2976)
CAMEROON	1.7922***		1.0573***
	(0.5133)		(0.3184)
ETHIOPIA	1.5460***		
	(0.4277)		
GHANA	1.7142***		0.9900***
	(0.5236)		(0.3301)
IVORY COST	1.9937***		1.2522***
	(0.5112)		(0.3172)
KENYA	1.9366***		
	(0.5652)		
LESOTHO	0.5445	1.1520	
	(0.5247)	(1.1520)	
MALI	1.4899***		0.9777***
	(0.3966)		(0.2481)

MOZAMBIQUE	1.1844***	2.2345*	
	(0.4013)	(1.3208)	
NIGERIA	1.9978***		1.2058***
	(0.5109)		(0.3193)
SOUTH AFRICA	1.5066**	2.5100	
	0.5948	(2.0693)	
SENEGAL	2.0868***		1.3345***
	(0.5286)		(0.3372)
ZAMBIA	1.6615***	2.8146	
	(0.5015)	(1.7068)	
ZIMBABWE	1.5306***	2.5104	
	(0.5181)	(1.7970)	
R^2 = 0.6644		R^2 = 0.5089	R^2 = 0.6129
R^2-*Adj* = 0.6145		R^2-*Adj* = 0.3984	R^2-*Adj* = 0.5395
F-stat = 13.3092		*F-stat* = 4.6061	*F-stat* = 8.3477
p(F-stat) = 0.0000		*p(F-stat)* = 0.0003	*p(F-stat)* = 0.000

(Standard errors in parenthesis)

*** Significant at 1% level; ** Significant at 5% level and * Significant at 10% level

Our findings, although not statistically significant, are similar to those of the theoretical model by Boldrin, De Nardi and Jones (2005)[5]. The positive relationship between social security and fertility is also in line with the arguments of Becker, Murphy and Tamura (1990) that families with limited resources tend to choose large families and invest less on each family member, which is a characteristic of SSA countries.

However, the results contradict those of Ehrlich and Lui (1998) who find that social security is likely to reduce fertility in the early stage of development and only at a more advanced stage reduces economic growth while little effect on fertility and private savings is expected. The argument put forward in this study is based on the fact that most of the developing countries are consumers of technology developed in advanced western countries. However, due to unequal development and often deficient infrastructure, some

[5] The authors' general hypothesis is that "since children are perceived by parents as a component of their optimal retirement portfolio, any social or institutional change that affects the economic value of other components of the retirement portfolio will have a first order impact on fertility choices". This implies that general perception of how social security affects the old age portfolio is fundamental for the decision of how many children to have. The result above shows that the majority of the African population has not yet perceived social security as substitute of children in their optimal retirement portfolio.

technology is used effectively while other is used inadequately, causing confusion. This is important if one intends to analyse the actual structure and/or the performance of the economies of developing countries, in particular those in SSA region in either policy to be considered.

Another important caveat to the results is the low coverage rates of retirement programs. Low coverage rates especially in the case of families living in rural areas result in such families giving more weight to having children in their retirement portfolios. In many countries where land belongs to individuals or families, land bequests are another important motive for having more children, a kind of Becker and Barro (1988) case where parents are altruistic toward children.

Secondary school enrolment as a control variable has a negative sign and is statistically significant implying that as individuals get more educated, they tend to have smaller families since their opportunity to get formal employment increases. With formal employment they get access to formal social security programs

Net exports are fundamental for these countries as one of the control variables, since the increase in the net exports implies increase in country's or household (particularly rural household) income with the possibility to reduce the weight of children in the retirement portfolio of a household. Therefore, an increase in the net exports will decrease the desire of children and possibly an increase in investment in human capital will occur. This variable has negative sign and it is statistically significant at one per cent.

Becker and Barro (1988) argue that an increase in government transfers in an economy tend to reduce fertility. This argument is based on the fact that individuals behave opportunistically (moral hazard) by assuming that government will take care of them in their old age or following a hazardous event that may occur during their lifetimes. The coefficient of government consumption in the model is negative but not statistically significant at the conventional levels. This result implies that government consumption has little or no impact on fertility rates in sub-Saharan countries, although it has the desired sign, which may reflect a weakness in government policy in this regard.

Another control variable included in the model is the growth of per capita GDP, which has a positive correlation with fertility but is not statistically significant at the conventional levels. This is in contrast with the results by both the Ehrlich and Kim (2005) and Zhang and Zhang (2004) studies in panel and cross-section analysis. These studies found a negative relationship between growth of per capita income and fertility, which implies that fertility declines with a growth in per capita income. The influences on growth of per capita GDP on fertility in these countries may be even more complex than one would consider. These influences may range from low per capita income to the unequal distribution of income which leaves the majority of the population exposed to only informal (or traditional) social security systems. In this case the growth in per capita income may not be accompanied by a reduction in fertility rates, at least during the early stages of development.

The results, in column two (Table 4.1), show that all countries have specific effects that affect fertility rates positively and all are statistically significant at one per cent, with the exception of South Africa in which case specific factors are significant only at five per cent and Lesotho whose specific factors are not significant at conventional levels.

4.1 Testing for the Validity of the Model 1

Model 1 of this section was estimated using fixed effects Least Square Dummy Variable procedure, allowing for the testing of fixed effects and homogeneity of the coefficients in the model. It is also tested for the validity of exogeneity of variables included in the model.

The test for fixed effects is the test for the validity of the null hypothesis of no individual effects against the alternative that individual effects exist, that is:

$H_O : \mu_1 = \mu_2 = \mu_3 = ... = \mu_{14} = 0$ ➔ No individual effects

$H_A : \mu_1 \neq \mu_2 \neq \mu_3 \neq .... \neq \mu_{14} \neq 0$ ➔ Individual effects exist

The test of fixed effects is an *F-test* and is distributed as an *F-statistic* with [(N-1), (NT-N-K)] degrees of freedom. Where N is the number of cross-sections, T a time dimension and K the number of coefficients estimated. The result of the test is $F_{(13,121)} = 6.5758$ which rejects the null of no individual effects (or common intercept). The results indicate that there are specific factors affecting fertility in SSA countries included in the model.

The next step is to test whether countries have a common slope coefficient, in other words testing for homogeneity of the slope coefficient. This is a test of the null of equality of all coefficients, that is:

$H_O : \delta_1 = \delta_2 = \delta_3 = ... = \delta_{14} = \delta$ ➔ All coefficients are equal and therefore one slope for all cross-sections

$H_A : \delta_1 \neq \delta_2 \neq \delta_3 \neq .... \neq \delta_{14} \neq \delta$ ➔ Not all coefficients are equal and therefore each cross-section has its own coefficient; in other word coefficients are not poolable.

The test for homogeneity of coefficients is an *F-test* and it is distributed as an *F-statistic* with [(N-1)K, (N(T-K))] degrees of freedom, where N, T and K are read as previously defined. The test rejects the null of poolability of coefficients at the five per cent level of significance in the full sample represented by Model 1.

The Houseman test is used to test for exogeneity of the variables in Model 1, which is distributed as Chi-square with K degrees of Freedom ($\chi^2(K)$). The null hypothesis to be tested is $H_o : E(\varepsilon_{it} / \mathrm{X}_{it}) = 0$, which implies exogeneity of the variables in the model or no correlation between individual effects and exogenous variables. The result of the test is $m = 25.7260$, which is greater than the critical value of $\chi^2(5)$ thus rejecting the null hypothesis at one per cent level of significance, meaning that not all variables included in the model are exogenous.

The result of the test for serial correlation indicates no evidence of serial correlation. It is based on an LM test distributed as Chi-square with one degree of freedom (χ_1^2) under the null hypothesis of no serial correlation. The result based on the RSS is equal to 5.7916, which is less than the critical value of χ_1^2 thus resulting in the failure to reject the null at one per cent level of significance.

4.2 Testing for the validity of the alternative models (regional grouping)

Given the rejection of the poolability of the coefficient in the full sample and given the limited time-series data, the countries were divided into regional blocks of economic development and/or according to their location. The assumption is that with the growing importance of regional blocks, policy coordination is more likely and therefore social security programs as well as other development programs are likely to cross borders[6]. In this regard at the regional level countries tend to be more homogenous than at continental level.

The results of the estimation and using LSDV are also presented in Table 4.1 Model 2 (column 3) shows the results of the estimation for the Southern African (SADC) countries. The coefficient of social security is positive but not statistically significant, implying that in the SADC region, although social security is positively related to fertility, its effect is not significantly different from zero. In other words, social security in the SADC countries included in this study has no effect on fertility. This result may be supported by the fact that social security in many countries of the region is only available to a small proportion of the population. Thus, the majority of the populations in this area is still exposed to only traditional social security systems, where children play an important role in the choice of an optimal retirement portfolio.

Two of the four control variables (secondary school enrolment and net exports) have the correct signs. Secondary school enrolment has a negative sign and is not statistically significant at the conventional level. This result differs from that of Ehrlich and Kim (2005) who found a positive and significant relationship between fertility and the number

[6] An example of this is the SADC charter (2003) which envisages policy coordination of social security programs, especially those policies regarding old age in the region.

of years of schooling. The reason for such a negative relationship could be that the population becomes exposed to formal social security programs.

The specific effects are positive for all countries but not statistically significant at the conventional levels, except for Mozambique which is significant at ten per cent level.

Testing for validity of the null hypothesis of no individual effects against the alternative gives the following result: $F_{(4,40)} = 69.6458$, which rejects the null. Thus, country specific characteristics play an important role in fertility in the countries included in this model to the extent that the countries in the model are not poolable.

No serial correlation has been detected with the calculated LM value distributed as Chi-square with one degree of freedom (χ_1^2). The value of the LM statistic is less than the critical value, resulting in the acceptance of the null of no serial correlation at five per cent.

In Model 3 (column 4), for West African countries, the estimates from LSDV indicate that social security is positively related to fertility, as in the full and SADC samples, and it is not statistically significant.

All control variables contain the expected signs and only government consumption and net exports are significant at ten and one per cent respectively, with the exception of the growth in per capita GDP which has the unexpected sign but which is not statistically significant at the conventional levels. As in the other two regions, fixed effects are positive and statistically significant at one per cent level, indicating that specific factors play a significant role in the behaviour of fertility rates in West African countries. The test for fixed effects of Model 4 rejects the null hypothesis of no individual effects. The result of the *F-test* implies that there are country specific factors affecting fertility in the West African region.

No serial correlation could be detected with LM test equal to 3.9507 distributed as a Chi-square with one degree of freedom (χ_1^2). The calculated LM value is less than the critical value, resulting in acceptance of the null hypothesis of no serial correlation at one per cent level of significance.

4.3 Bootstrapping

The reliance on normal asymptotic assumptions may be misleading in the context of a small sample, in particular short time-series in panel data. Mooney and Duval (1993) and Judson and Owen (1996) suggest that bootstrapping constitutes an important instrument to rely on when constructing empirical distribution functions (EDF), since bootstrap is based on the available data. Therefore, many recent studies and tests have been relying more heavily on second order asymptotic properties like bootstrapping to reduce the size of the distortions relative to alternative methods (Kim, 2005). Although Kim claimed this advantage in regressions with autocorrelated errors, bootstrapping can be extremely useful under data that are not normally distributed and particularly small sample panel data, by allowing the construction of an empirical distribution function, especially under the false null hypothesis[7].

In this section only the results of regional LSDV regressions are bootstrapped. This is important for the validation of the results of the regressions presented in section 4.2. The results of bootstrapping are presented in Tables 4.1a and 4.1b in the Appendices.

Table 4.1a shows that social security is positively related to fertility in SADC countries but not statistically significant at conventional levels. However, it is significant at 12.7 per cent, which is much lower than the level of significance given in the LSDV regression. These results show a significant improvement in the power of the test. This result implies that the reliance on the LSDV results based on assumptions of normality may lead to inappropriate conclusions. Therefore, re-enforcing the idea that bootstrapping may improve the statistical power of the test.

[7] For the advantages of using bootstrapping in the regression models, see also Giersbergen and Kiviet (2002) and Bun and Kiviet (2001).

Two of the four control variables have the correct signs. Secondary school enrolment has the correct and expected sign and it implies that as people become more educated, children become less weighted in the old age portfolio.

All control variables have improved their levels of significance. For example, the government consumption to GDP ratio could be significant only at 38.12 per cent under LSDV estimation but with bootstrapping it is now significant at 12.7 per cent.

Secondary school enrolment improved from 44.22 per cent to just 19.7 per cent (the probability of accepting the null). Also, while with the LSDV procedure the growth in per capita GDP is significant at 28.22 per cent it now declines to the true level of significance is 16.3 per cent. Similar improvements can be observed in other variables.

Countries specific effects are significant at 2.52, 3.20 and 6.1 per cent for Zambia, Zimbabwe and South Africa, respectively. Countries specific effects for Lesotho and Mozambique are only significant at 37.8 and 11.6 per cent, respectively. These results are quite different from the LSDV results.

In Table 4.1b the bootstrapping simulations of the LSDV for West African countries are presented. The Table shows that social security is positively related to fertility as in the case of the SADC countries and full sample regressions but it is not statistically significant at conventional levels. The level of significance given by the second order asymptotic results is 28 per cent against the 24.32 per cent of the first order asymptotic, which shows a reduction in the probability of committing type I error. By bootstrapping the social security coefficient the level of significance exceeds that of the significance shown in the first order asymptotic equation. The calculated bias suggests that the magnitude of the social security coefficient is not biased, which is important for policy simulations.

The results on the control variables show that only secondary school enrolment and net exports are statistically significant at one per cent levels of significance. All other variables remained not statistically significant within the conventional levels. These results indicate that the combination of bootstrapping and the LSDV techniques improves the quality of the results obtained. The results of fixed effects are all significant at one per cent level after bootstrapping, confirming the results from the LSDV regression

5. Conclusion

The results from this study show that there is a positive relationship between social security benefit payments and fertility in the full sample of fourteen sub-Saharan countries. However, the coefficient is not statistically significant at the conventional levels. The results suggest that lower weights are allocated to social security in the optimal retirement portfolio of the majority of African families compared to components like children, as provision for retirement. No misspecification and serial correlation were detected and the poolability of both coefficients and cross-sections was rejected thereby validating the estimated models. An important result in this model is that as they receive more education, individuals tend to attach less weight to children in their retirement portfolio. The reason being that the probability of being involved in some formal social security system increases and therefore, children as a means of old age security, are no longer the only option.

Reference:

Barro, R. J. 1974. Are government bonds net wealth? *Journal of Political Economy*, vol. 82(6), Nov/Dec: 1095-1117.

Becker, G. S. and Barro, R. J. 1986. A Reformulation of the Economic Theory of Fertility. Mimeo, University of Chicago, August.

Becker, G. S. and Barro, R. J. 1988. A REFORMULATION OF THE ECONOMIC THEORY OF FERTILITY. *Quarterly Journal of Economics*, Vol. CIII(1), February: 1-25.

Becker, G. S., Murphy, K. M. and Tamura, R. 1990. Human Capital, Fertility and Economic Growth. *Journal of Political Economy*, vol. 98(5): S_{12}-S_{37}

Boldrin, M., De Nardi, M. and Jones, L. E. 2005. Fertility and Social Security. *Research Department Staff Report 359*, Federal Reserve Bank of Minneapolis.

Bun, M.J.G. and Kiviet, J.F. 2001. The accuracy of inference in small samples of dynamic panel data models: Simulation evidence and empirical results, *Tinbergen Institute Discussion Paper*, TI 2001-006/4.

Ehrlich, I. and Lui, F. T. 1998. Social Security, the Family and Economic Growth. *Economic Enquiry*, vol. 36(3), July: 390-409.

________ and Kim, J. 2005. Social security, demographic trends, and economic growth: Theory and evidence from the international experience. *NBER Working Paper No 11121*.

Giersbergen, N. P. A. and Kiviet, J. F. 2002. How to implement the bootstrapping in static or stable dynamic regression models: test statistic versus confidence interval region approach. *Journal of Econometrics*, vol. 108: 133-156.

Judson, R.A. and Owen, A.L. 1999. Estimating dynamic panel data models: A guide for macroeconomists, *Economics Letters*, vol. 65: 9-15

Mooney, C. Z. and Duval, D. D. 1993. *Bootstrapping: A nonparametric approach to statistical inference*. Sage University Paper.

United Nations. 2006. Human Development Report.

World Bank. 2003. World Development Indicators, CD-ROM

Zhang, J. 1995. Social security and endogenous growth, *Journal of Public Economics*, vol. 58: 185-213.

Zhang, I. and Zhang, J. 2004. How does social security affect economic growth? Evidence from cross-country data. *Journal of Population Economics*, vol. 17: 473-500

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Appendices

Table 4.1a: Dependent Variable – L*nF*

Regressors	**First Order Asymptotic Results (LSDV)**	**No of Replications: 10000**		**Confidence Interval**		**Level of Significance**
	Model 2 (SADC)	**Second Order Asymptotic Results (Bootstrap)**	**Bias**	**LCI**	**UCI**	
LnRBen	0.0969 (0.0897)	0.0958	-0.0011	0.00015	0.1882	Fail to reject the null at 10%[12.7%][1]
LnRGC	0.2740 (0.3094)	0.2734	-0.0006	0.00023	0.5581	Fail to reject the null at 10%[12.6%][1]
lnSEC	-0.3259 (0.4198)	-0.3224	0.0035	-0.6428	-0.0002	Fail to reject the null at 10% [19.7%][1]
GPC	1.0740 (0.9852)	1.0729	-0.0011	0.0008	2.1195	Fail to reject the null at 10% [16.3%][1]
RNX	-1.5701*** (0.5341)	-1.5704	-0.0003	-2.4342	-0.7037	Significant at 1%
Fixed Effects						
LESOTHO	1.1520 (1.8279)	1.1337	-0.0183	0.0034	2.2684	Fail to reject the null at 10% [37.8%][2]
MOZAMBIQUE	2.2345 (1.3208)	2.2199	-0.0146	0.0014	4.3221	Fail to reject the null at 10% [11.6%][2]
SOUTH AFRICA	2.5100 (2.0693)	2.4909	-0.0191	0.0093	4.7181	Significant at 6.1%
ZAMBIA	2.8146 (1.7068)	2.7951	-0.0195	0.0056	5.3389	Significant at 2.52%
ZIMBABWE	2.5104 (1.7970)	2.4930	-0.0174	0.0079	4.7640	Significant at 3.20%

(Standard errors in parenthesis)

*** Significant at 1% level

[1] The variables are not significant at 10 per cent but significant at 12.6, 12.7, 16.3 and 19.7 per cent levels of significance, respectively. Specific effects for Mozambique and Lesotho are only significant at 11.6% and 37.8%, respectively.

Table 4.1b: Dependent Variable - *LnF*

Regressors	**First Order Asymptotic Results (LSDV)**	**No of Replications: 10000**		**Confidence Interval**		**Level of Significance**
	Model 4 (West Africa)	**Second Order Asymptotic Results (Bootstrap)**	**Bias**	**LCI**	**UCI**	
LnRBen	0.0343 (0.0291)	0.0344		0.0001	0.0683	Fail to reject the null at 10% [28%][1]
LnRGC	-0.1070* (0.06380	-0.1071		-0.2208	-0.0001	Fail to reject the null at 10% [13.8%][1]
lnSEC	-0.0920 (0.0797)	-0.0917		-0.1727	-0.01224	Significant at 1%
GPC	0.8034 (0.5248)	0.8049		0.0003	1.6138	Fail to reject the null at 10% [22.7%][1]
RNX	-0.6603*** (0.2293)	-0.6614		-1.2488	0.1222	Significant at 1%
Fixed Effects						
BENIN	1.1042*** (0.2976)	1.1037		0.4445	1.6787	Significant at 1%
CAMEROON	1.0573*** (0.3184)	1.0570		0.4105	1.6267	Significant at 1%
GHANA	0.9900 (0.3301)	0.9893		0.3328	1.5665	Significant at 1%
IVORY COST	1.2522 (0.3172)	1.2519		0.6018	1.8159	Significant at 1%
MALI	0.9777 (0.2481)	0.9772		0.2443	1.6370	Significant at 1%
NIGERIA	1.2058 (0.3193)	1.2055		0.4727	1.8481	Significant at 1%
SENEGAL	1.3345 (0.3372)	1.3348		0.5270	2.0523	Significant at 1%

(Standard errors in parenthesis)

*** Significant at 1% level and * Significant at 10% level

[1] The variables are not significant at 10 per cent but significant at 28, 13.8 and 18.7 per cent level of significance, respectively.