Chapter 6: Empirical Results

This chapter presents the empirical results of the models outlined in the previous chapter. The chapter is divided into three sections. The first section presents the results of the model estimation of saving, with the investment/GDP ratio a proxy for saving. It is estimated as a fixed effect model for the fourteen countries included in the study divided into regions (economic blocks), to analyse the heterogeneity of these economic blocks in terms of their level of economic development. The second section presents the results of the growth model for all fourteen countries divided according to their blocks of economic development. The third section presents the results from the fertility model, where population growth is used as a proxy for net fertility rates (comprising the number of births per woman excluding infant mortality). That is the net number of children that present rearing and educational expenses to their parents, but could also possibly provide secured retirement to their parents.

6.1 The Saving Model

This section presents the results of the effect of social security on saving using a combination of models available in the literature. The proxy used for saving is the investment/GDP ratio. The assumption is that any current additional period investment is a reflection of expected future national saving[30]. The proxy is needed given the lack (deficiency) of data on saving for the countries under consideration. Thus, investment is assumed to be a close substitute to saving. The section starts by analysing the characteristics of the data through testing for the presence of unit root followed by the presentation and discussion of the results.

[30] This flows from the national income identity consideration. Because of this identity any investment beyond the level of saving is equivalent to debt, which will require future saving for repayment.

6.1.1 Unit root testing

As outlined earlier this study analyses a panel of fourteen countries with seven variables, namely: investment, social security benefit payments, government consumption, government deficit as a proxy of government saving (dissaving), net exports, inflation and the growth of per capita GDP over a period of ten years from 1994 to 2003. All variables appear as a ratio to GDP with the exception of the growth of per capita GDP and inflation.

Based on Levin, Lin and Chu T* and the Breitung t-statistic, the common unit root test for growth of per capita GDP is significant at one and five per cent, respectively. This result implies that the growth of per capita GDP across countries is non-stationary. Im, Pesaran and Shin W-statistic, ADF-Fisher Chi-square and PP-Fisher Chi-square unit root tests (assume individual unit root process) show that the growth in per capita GDP across countries has unit root process (I(1)), which means that it is non-stationary. However, the unit root hypothesis is rejected at one per cent based on Hadri Z-statistic test. Thus, the variable per capita GDP has a unit root process at five per cent with individual effects and a linear trend.

The test of the null hypothesis of unit root for inflation is significant at one per cent for both tests based on Levin, Lin and Chu t* and the Breitung t-statistic, with no intercept and no trend. This result implies that inflation across countries has unit root process, that is, it is non-stationary for all countries when considered together. The test for unit root based on ADF-Fisher Chi-square and PP-Chi-square, assuming individual unit root process, with no intercept and no trend is significant at one per cent, that is, inflation is non-stationary.

The Breitung t-statistic test of unit root on the benefit/GDP ratio in natural logarithms rejects the null at ten per cent level of significance with no intercept and no trend. The unit root test based on Levin, Lin and Chu t* fails to reject the null at five per cent level of significance with no intercept and no trends. The unit root test based on ADF-Fisher Chi-square and PP-Chi-square fails to reject the null with no intercept and no trend at 10 per cent level of significance. Therefore, it can be concluded that the variable benefit/GDP ratio in natural logs is stationary across countries.

The result of the unit root test on the variable investment/GDP ratio in natural logarithms indicates unit root process with individual effects. It also has a linear trend at one per cent based on Levin, Lin and Chu t* test and at five per cent based on the Breitung t-statistic test. However, the Hadri Z-statistic test fails to reject the null of no unit root at one per cent, implying that the investment/GDP ratio is stationary. These are contradictory results in terms of the validity of the test for unit root. The test for unit root based on the Im, Pesaran and Shin W-statistic, based on the assumption that each cross-section has unit root process, confirms unit root with individual effects and a linear trend at five per cent. The unit root test based on ADF-Fisher Chi-square and PP-Fisher Chi-square show unit root with individual effects and a linear trend at one per cent. Thus, the investment/GDP ratio is non-stationary (has unit root).

The result from Levin, Lin and Chu t* statistic, testing for unit root in the case of the government consumption/GDP ratio in natural logarithms, shows that the government consumption/GDP ratio has unit root with individual effects and a linear trend at one per cent level of significance. The Breitung t-statistic test on the other hand rejects the null of unit root at ten per cent. This rejection implies that the natural logarithm of the government consumption/GDP ratio is stationary. The Hadri Z-statistic fails to reject the null of no unit root, suggesting stationarity of this variable. Unit root test based on Im, Pesaran and Shin W-statistic and ADF–Fisher Chi-square also rejects the null of unit root with individual effects and an individual linear trend.

Another variable included in this model is government deficit (as a proxy of government saving or dissaving) to GDP ratio in levels. In this case the unit root test based on Levin, Lin and Chu t* statistic fails to reject the null of unit root with individual effects at one per cent level of significance and the Breitung t-statistics at five per cent. The Hadri Z-statistic also fails to reject the null of no unit root. Unit root tests based on the Im, Pesaran and Shin W-statistic, ADF–Fisher Chi-square and PP-Fisher Chi-square fail to reject the null of unit root. Therefore, it can be concluded that the government deficit/GDP ratio is a non-stationary variable, in other words it has unit root process.

Finally, net exports are included in the model. The Levin, Lin and Chu t* test for unit root on this variable (represented as a ratio to GDP) fails to reject the null of unit root at one per cent but the Breitung t-test rejects the null at conventional ten per cent. The Hadri Z-statistic fails to reject the null of no unit root. The Im, Pesaran and Shin W-statistic unit root test fails to reject the null of unit root at five per cent level of significance; while ADF–Fisher Chi-square and PP-Fisher Chi-square tests also fail to reject the null of unit root process at one per cent level of significance.

6.1.2 The results of the model

The basic model is estimated using the Least Square Dummy Variable (LSDV) estimation procedure and the results are presented in Table 6.1 column 2 (labelled Model 1). This model estimates the full sample, which includes 14 SSA countries.

The results of Model 1 (in column 2) show that social security crowds-out saving in the group of sub-Saharan African countries included in this study. The result confirms the effects of social security financed by a pay-as-you-go system on national saving in the life cycle models. There are two fundamental channels through which these effects occur: (i) the financing of implicit debt and (ii) the reduction of personal saving. The results of the coefficients from Model 1 have the expected signs according to various other theoretical models, with the exception of government consumption which has the wrong (positive) sign but is not statistically significant.

The coefficient for social security found in this study is similar to that of Ehrlich and Kim (2005) in their endogenous-growth model, where social security taxes to finance benefit payments are foreseen to have a negative effect on saving. However, Zhang and Zhang (2004) in a model where they investigate how social security interacts with growth and growth determinants, find that social security has a positive effect on saving. Cigno, *et al.* (2003) in a time-series analysis also found positive effects on saving, which contradicts the results found in this study and that of Ehrlich and Kim (2005) and Ehrlich and Zhong (1998).

Table 6.1: Dependent variable - *LnRinv* (full and regional samples)

Variables (Regressors)	Coefficients (First-order Asymptotic)		
	Model 1 (All Countries)	**Model 2 (SADC)**	**Model 3 (West Africa)**
LnRBen	-0.0062	0.0322	-0.0558
	(0.0330)	(0.0712)	(0.0336)
GPC	2.3448***	2.5371***	1.1126*
	(0.4812)	(0.8453)	(0.6392)
RNX	-0.5609**	-0.7988*	-0.6034**
	(0.2217)	(0.4368)	(0.2950)
LnRGC	0.0895	-0.2951	0.3846***
	(0.0813)	(0.2452)	(0.0776)
RDef	-0.7412*	-0.7411	-0.7901*
	(0.3789)	(0.7535)	(0.4670)
INFL	-0.0009***	-0.0008*	-0.0021**
	(0.0003)	(0.0004)	(0.0009)
Fixed Effects			
BENIN	-1.7116***		-1.3088***
	(0.2360)		(0.2053)
CAMEROON	-1.6757***		-1.3121***
	(0.2668)		(0.2364)
ETHIOPIA	-1.8878***		
	(0.2005)		
GHANA	-1.4450***		-1.1251***
	(0.2210)		(0.1996)
IVORY COST	-1.9600***		-1.6167***
	(0.2601)		(0.2279)
KENYA	-1.8122***		
	(0.3157)		
LESOTHO	-1.1194***	-1.6256***	
	(0.2103)	(0.4341)	
MALI	-1.5538***		-1.2953***
	(0.1686)		(0.1458)
MOZAMBIQUE	-1.2805***	-2.0523***	
	(0.2220)	(0.5865)	
NIGERIA	-1.3628***		-0.9634***
	(0.1986)		(0.1757)
SOUTH AFRICA	-1.7419***	-2.2666***	
	(0.1552)	(0.4201)	
SENEGAL	-1.5273***		-1.2911***

	(0.3222)		(0.2916)
ZAMBIA	-1.7253***	-2.2832***	
	(0.2325)	(0.5764)	
ZIMBABWE	-1.7446***	-2.2846***	
	(0.1804)	(0.3534)	
R^2 = 0.8632		R^2 = 0.8697	R^2 = 0.8817
R^2-*Adj* = 0.8416		R^2-*Adj* = 0.8363	R^2-*Adj* = 0.8567
F-stat = 39.8861		*F-stat* = 26.027	*F-stat* = 35.3866
p(F-stat) = 0.0000		*p(F-stat)* = 0.000	*p(F-stat)* = 0.000

(Standard errors in parenthesis)

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

Note: for explanation of abbreviations see Chapter 5.

The results in Model 1 (see also the discussion in Chapter 4) indicate that large government deficits and the way they are financed have important negative effects on the economy's performance via a reduction in aggregate saving. Therefore, large social security expenditures accompanied by an increased dependence ratio and inflation, reduce national saving. Cesaratto (2003) indicated that the way private saving responds to government borrowing determines national saving, which can remain unchanged or even decrease. In developing countries and in particular sub-Saharan countries where saving rates are very low, government deficits are large and labour productivity low, borrowing to finance social security will aggravate the negative effect of PAYG systems. Therefore, the results in Model 1 regarding the effects of social security on saving in SSA are similar to the Cesaratto (2003) findings in that large government deficits tend to reduce public saving. National saving also tended to decrease, which adds to depressing the productivity of these countries.

In the case of SSA countries, the drop in national saving can be attributed to the reduction in personal saving, inflation and the deteriorating terms of trade and some other exogenous factors such as low labour productivity. As can be seen from Model 1 inflation has a negative sign and it is statistically significant at one per cent. Some may argue that inflation will induce precautionary saving but if individuals adjust their marginal propensity to consume, inflation will reduce saving as implied by the above result. The Government deficit also has a negative sign but is not statistically significant at the conventional levels. This is acceptable since governments tend to borrow more or raise taxes to finance deficits on their budgets.

Borrowing to finance retirement programs not only affects national saving in models where bequests are operative and the economy is growing at steady-state rates. If the assumption of steady-state growth is relaxed, which is the case in SSA countries with economic growth rates below the growth rates of the labour force, national saving declines. Taxes to finance retirement programs, under conditions of low productivity and low levels of economic activity, also affect private saving and thus national saving negatively, given the fact that government saving is also negative.

The growth in per capita income leads to an increase in saving in these economies. This result is acceptable and supported by both the theoretical claims. From a Keynesian perspective where individuals consume a fixed portion of their disposable income, growth in per capita GDP in real terms, *ceteris paribus*, will increase aggregated saving. In an economy where bequests are operative as in the Barro (1974) and latter Backer and Barro (1988) models the growth in per capita GDP will also lead to an increase in saving due to bequest motives and through investment in human capital as discussed in Section 6.3 below.

Model 1 suggests that specific factors that affect national saving exist in all countries. Some of these factors are institutionally important for the mobilisation of saving for retirement from rural areas where the majority of the population lives and the informal sector is also increasingly important. Other exogenous factors like instability and natural disasters lower productivity, especially in the agricultural sector, which inhibits growth in the industrial sector.

6.1.3 Testing for the validity of Model 1

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

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

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

$H_A : \mu_1 \neq \mu_2 \neq \mu_3 \neq .... \neq \mu_{14} \neq 0$ ➔ There are individual effects

The test for fixed effects is an *F-test* and it is distributed as an *F-statistic* with [(N-1), (NT-N-K)] degrees of freedom: Where N is a number of cross-sections, T time dimension and K the number of coefficients estimated. The result of the test is $F_{(13,120)} = 16.4883$, which rejects the null of no individual effects (or common intercept) in favour of the existence of individual effects at the five per cent level of significance. This result suggests that certain of the SSA countries have different factors that affect saving behaviour, justifying therefore, the fixed effects model, rather than pooling all countries together.

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 to test whether the null of all coefficients is equal as opposed to all slope coefficients not being equal, 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

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

The test for homogeneity of coefficients is an *F-test* and is distributed as an *F-statistic* with [(N-1)K, (N(T-K))] degrees of freedom. Where N, T and K are read as defined previously. The result of the test is $F_{78,56} = 11.8025$, which also rejects the null of poolability of coefficients at the five per cent level of significance in the full sample represented by Model 1.

Exogeneity of the variables in the Model 1 are also tested for through the Hausman test which is distributed as Chi-square with K degree of freedom ($\chi^2(K)$). The null hypothesis to be tested is $H_o : E(\varepsilon_{it} / X_{it}) = 0$ which implies no misspecification in the model or correlation between individual effects and exogenous variables. The result of the test is $m = 6.8008$, which is less than the critical value of $\chi^2(6)$ and therefore fails to reject the null hypothesis at the one per cent level of significance, in other words no misspecification is detected.

The result of the test for serial correlation indicates no evidence of serial correlation. It is based on the LM test which is distributed as Chi-square with one degree of freedom (χ_1^2) under the null hypothesis of no serial correlation. The calculated LM test based on the RSS is equal to 4.6937, which is less than the critical value of χ_1^2 leading to failure of rejecting the null at one per cent level of significance.

6.1.4 Testing for the validity of 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. 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[31]. In this regard, at regional level, countries tend to be more homogenous than considered at the continental level.

The results of the estimation from this exercise and using LSDV are also presented in Table 6.1. Model 2 (column 3) shows the results of the estimation for Southern African (SADC) countries. The coefficient of social security is positive but not statistically significant at conventional levels, implying that in the SADC region social security tends to crowd-in (or increase) saving but its effect is not significantly different from zero. This result is similar to the results found by Zhang and Zhang (2004).

All other variables have the expected signs but both government consumption and deficits are not significant at the conventional levels of significance. However, inflation and net exports have a negative impact on saving and both are statistically significant at ten per cent levels. Per capita GDP is also significant but only at one per cent level. The cross-sections effects are negative and are all statistically significant at one per cent.

We test the null hypothesis of no individual effects against the alternative that individual effects exist. The result of the test is $F_{(4,39)} = 3.5257$ which marginally rejects the null at five per cent level of significance. This result implies that countries do have different factors that affect their saving behaviour, justifying, therefore, a fixed effects model rather than pooling the countries all together.

The relevant test does not reveal the existence of serial correlation under the null of no serial correlation. The result of the calculated LM value is equal to 3.4525 and is distributed as Chi-square with one degree of freedom (χ_1^2). The value of the LM statistic is less than the critical value, leading to the acceptance of the null of no serial correlation at five per cent.

In another regional grouping of West African countries in Model 3 (column 4), the estimates from LSDV indicate that social security has a negative effect on saving and it is not statistically significant at the conventional levels of significance. This again confirms the validity of the life cycle hypothesis that social security financed by pay-as-you-go crowds-out saving.

All variables contain the expected signs with the exception of government consumption which has the wrong (positive) sign and is significant at one per cent. Net exports and inflation affect saving negatively and are statistically significant at one per cent. These results show that countries with high inflation save less than those with low inflation rates. Also countries exporting less than they import tend to have lower saving rates. Growth in per capita GDP increases national saving but is not statistically significant in this model.

[31] An example of this is the SADC charter (2003) which envisages policy coordination in the social security

As in the other two regions, the fixed effects are statistically significant at one per cent, indicating that there are individual effects influencing the behaviour of saving in these countries. Therefore, the estimation of the fixed effect LSDV model seems to be justifiable.

Tested for fixed effects, Model 3 rejects the null hypothesis of no individual effects. The result of the test is given as $F_{6,57} = 24.8614$ which rejects the null, implying that there are fixed effects in the model at five per cent level of significance.

The test for serial correlation shows no evidence of serial correlation. The LM test is equal to 4.5386 which is distributed as Chi-square with one degree of freedom (χ_1^2). The calculated LM value is less than the critical value, leading to the acceptance of the null hypothesis of no serial correlation.

6.1.5 Bootstrapping results

The reliance on asymptotic normal distribution assumptions may be misleading in the context of the small sample, in particular the short time span of the series in the panel data. Mooney and Duval (1993) and Judson and Owen (1996) suggest that bootstrapping constitutes an important instrument to rely on in the construction of the empirical distribution function (EDF), since it is based on data at hand. 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 auto-correlated errors, by allowing the construction of empirical distribution function, especially under the false null hypothesis[32] bootstrapping can be extremely useful in the case of data that are not normally distributed and particularly small sample panel data.

programs, especially those policies regarding the old age in the region.

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

In this study the advantages of bootstrapping were employed to construct an empirical distribution function based on the available data and to determine the magnitude of the coefficients bias. However, in this exercise only models grouped at regional level (labelled Model 2 and 3) will be bootstrapped. Due to few cross-sections (only two, Kenya and Ethiopia) that do not allow for enough heterogeneity, the countries in the East African region will not be analysed separately.

Bootstrapping in this study was based on unrestricted residual resampling, where an equal number of cross-section equations is constructed on the basis of the first-order coefficient results. The unrestricted residuals are calculated in e-views 5 for the purpose of resampling. The argument behind the use of unrestricted residuals is based on the fact that unrestricted residuals "ensure that the EDF $\hat{F}_{\varepsilon}$ converges to the population distribution F_{ε} in a suitable metric even when the null hypothesis is false" (see Giersbergen and Kiviet, 2002). The results of bootstrapping based on unrestricted residuals seem to perform better than block resampling, especially in the absence of serial correlation. In fact, the use of block bootstrapping has frequently been employed in bootstrapping time series data to reduce possible effects of serial correlation in the results of the bootstrapped coefficients. However, it has also been shown (see the above authors) that using unrestricted residuals delivers good results, especially in small time series data, as is the case in this study.

The results of bootstrap are stored in two matrices created for this purpose with one used to store bootstrapped coefficients and the other to store bootstrapped fixed effects, from which empirical distribution functions are determined. The use of 10000 replications is justified due to the fact that this number of replications seemed to be sufficiently large to be used to compare with the results of the first-order asymptotic tests based on normality assumptions.

In tables 6.2 and 6.3 below, the first-order asymptotic theory approximation results are presented jointly with the second order asymptotic results (bootstrapping results), the bias of the coefficients, the confidence interval and the level of significance. The confidence intervals are based on bootstrapping results and rather than relying on conventional levels of significance (1%, 5% and 10%) the study extended these levels of confidence to determine the most accurate levels based on used data.

From the bootstrapping results it is possible to see that some of the variables that were not significant at a conventional level of significance are now significant and others that were at certain level of significance, for example 10 per cent, after bootstrapping are now significant at lower levels of significance. This is important in terms of a comparison of the results based on normality assumptions and those based on the characteristics of the sample in hand. Normality assumes asymptotic properties that many macroeconomic variables do not possess.

The variable benefit/GDP ratio which was not significant for the SADC and West African countries first-order asymptotic theory approximation regression, still does not remain significant for the SADC countries even after bootstrapping. However, in West African countries it becomes significant at 10 per cent. These results show that relying on normal asymptotic properties may result in incorrect policy inferences. However, parametric bootstrapping as used in this study can be a powerful instrument for validity of parameters that are used for policy simulation[33]. This is evident in the case of West Africa where one could have rejected the effects of social security on saving at ten and one per cent respectively. In the case of SADC countries the coefficient of social security is not significant even at 35 per cent, but it has a positive sign leading to different policy implications compared to those for West Africa.

Other coefficients follow the same distributional pattern. Another advantage of bootstrapping is the fact that the researcher is no longer bound to strict levels of significance and is able to detect significance even at intermediate levels. For example, the deficit/GDP ratio which was only significant at ten per cent, is now significant at the six per cent level of significance after conducting the simulation. In SADC countries the coefficient of this variable indicated significance only at about 30 per cent but after

[33] See annexure 3 and 4 for the distribution of the EDF of the coefficients of the variables in the models based on the data at hand.

bootstrapping simulation, significance showed at 15 per cent, a significant improvement in terms of the power of the test.

Next we address the policy implications that social security has on saving in African countries. In general social security has a negative effect on saving for West African countries. It is statistically significant at ten and one per cent respectively, with the exception of SADC countries where it shows that social security has a positive effect on saving but is not statistically significant. In the case of West African countries the suggestion is that reforms are important but they should be implemented with caution as suggested by Orszig and Stiglitz (1999) and many others. In the SADC countries the reforms should be directed at the improvement of management of the portfolio and diversification to increase the effects of social security on saving.

The results also show that a deficit in the current account balance (exports less imports), government consumption (except for West Africa) and government deficits have a negative effect on saving. However, government consumption, the current account balance and government deficits are only significant for West Africa. In the SADC countries only the current account balance is significant. The final results show that inflation crowds-out savings and is significant at one per cent for all regions.

In the group of countries included in the sample there are negative country specific factors that affect saving. This is of extreme importance in view of policy decisions with regard to saving behaviour in the presence of social security programs.

Some of these factors could be low productivity that limits an individual's income and therefore, consumption and saving. Low productivity in many SSA countries can result from labour force deficiencies such as lack of skills, natural disasters, instability and other exogenous factors that affect the level of production and saving, which can turn into a vicious circle if proper policy measures are not taken timeously.

Table 6.2: Dependent variable - *LnRinv* (SADC sample)

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	0.0322 (0.0712)	0.0322	0.000 (0.00%)	-0.0778	0.1589	Fails to reject the null at 10%
GPC	2.5371*** (0.8453)	2.5517	0.0146 (0.60%)	0.3869	4.6784	Significant at 1%
RNX	-0.7988* (0.4368)	-0.8004	-0.0016 (0.20%)	-1.4682	-0.1042	Significant at 1%
LnRGC	-0.2951 (0.2452)	-0.2921	0.0030 (1.00%)	-0.5859	-0.0012	Fails to reject the null at 10% [26%][1]
RDef	-0.7411 (0.7535)	-0.7523	-0.0112 (1.51%)	-1.5556	-0.0058	Fails to reject the null at 10% [15%][1]
INFL	-0.0008* (0.0004)	-0.0008	0.0000 (0.00%)	-0.0014	-0.0001	Significant at 1%
Fixed Effects						
LESOTHO	-1.6256*** (0.4341)	-1.6234	0.0022 (0.14%)	-3.0613	-0.1068	Significant at 1%
MOZAMBIQUE	-2.0523*** (0.5865)	-2.0466	0.0057 (0.28%)	-3.4562	-0.6341	Significant at 1%
SOUTH AFRICA	-2.2666*** (0.4201)	-2.2622	0.0044 (0.19%)	-3.4978	-0.9961	Significant at 1%
ZAMBIA	-2.2832*** (0.5764)	-2.2778	0.0054 (0.24%)	-3.6759	-0.8652	Significant at 1%
ZIMBABWE	-2.2846*** (0.3534)	-2.2816	0.0030 (0.13%)	-3.4804	-1.4066	Significant at 1%

(Standard errors in parenthesis)

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

[1] The variables are not significant at 10 per cent but significant at 26 and 15 per cent level of significance, respectively

Table 6.3: Dependent variable - *LnRinv* (West Africa sample)

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	-0.0558 (0.0336)	-0.0564	-0.0006 (1.08%)	-0.1143	-0.0004	Significant at 10%
GPC	1.1126* (0.6392)	1.1118	-0.0008 (0.07%)	0.05510	2.2139	Significant at 5%
RNX	-0.6034** (0.2950)	-0.6027	-0.0007 (0.12%)	-1.1312	-0.1200	Significant at 5%
LnRGC	0.3846*** (0.0776)	0.3854	0.0008 (0.21%)	0.2125	0.5567	Significant at 5%
RDef	-0.7901* (0.4670)	-0.7891	-0.0010 (0.13%)	-1.5866	-0.0151	Significant at 6%
INFL	-0.0021** (0.0009)	-0.0021	0.0000 (0.00%)	-0.0040	-0.0003	Significant at 1%
Fixed Effects						
CAMEROON	-1.3121*** (0.2364)	-1.3100	0.0021 (0.16%)	-1.3100	-0.7550	Significant at 1%
GHANA	-1.1251*** (0.1996)	-1.1259	-0.0008 (0.07%)	-1.3138	-0.7436	Significant at 1%
BENIN	-1.3088*** (0.2053)	-1.3138	-0.0050 (0.38%)	-1.7508	-0.5100	Significant at 1%
IVORY COST	-1.6167*** (0.2279)	-1.6188	-0.0021 (0.13%)	-2.2343	-1.0361	Significant at 1%
NIGERIA	-0.9634*** (0.1757)	-0.9640	-0.0006 (0.06%)	-1.9995	-0.6253	Significant at 1%
SENEGAL	-1.2911*** (0.2916)	-1.2962	0.0051 (0.40%)	-1.6658	-0.2901	Significant at 1%
MALI	-1.2953*** (0.1458)	-1.2940	0.0013 (0.10%)	-2.1080	-0.5454	Significant at 1%

(Standard errors in parenthesis)

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

6.2 An Example of Country Specificity – The Case of South Africa

6.2.1 Introduction and model

Using Feldstein's (1974) specification an attempt was made to quantify the extent to which retirement benefits in South Africa affected personal saving between 1970 and 2003. Consumption is estimated as a function of disposable labour-income and pension and provident benefits (both official and privately administered):

$$\text{ConsPC} = f(Y_d\text{PC}, Y_d\text{PC}(-1), \text{TBENPC})$$

where ConsPC is real per capita consumption, Y_dPC is real per capita disposable labour income and TBENPC is real per capita total pension and provident fund benefits.

6.2.2 Data and empirical results

All data used in this study have been obtained from *South African Reserve Bank (SARB) Quarterly Bulletin* and data on population numbers were sourced from the publication *World Development Indicators (2005)*, comprising a range of 34 years.

We conducted unit root tests on all variables in the model. The results of the Augmented Dickey-Fuller and KPSS tests show that all variables (in natural logarithms and in levels) are I(0) except the interacted unemployment variable, consumption per capita and both total and privately administered pension benefits, which are I(1). The results show that almost all household labour disposable income in South Africa is spent on consumption (0.98).

In the case of total payouts from retirement funds both privately and officially administered (Regression 1 in Table 6.4) the marginal propensity to consume amounts to about 0.06, which is more than double the coefficient (0.028) for the US as estimated by Feldstein (1995), and is statistically significant. These results suggest that such benefits have a significant impact on consumption in South Africa and the way in which they are taxed will strongly impact on saving via consumption during the life cycle of an individual.

Regression 1 is re-estimated in Regression 2 (see Table 6.4) by substituting total benefits paid, by the benefits paid by pension and provident funds privately administered (TPAPPPC). In this regression the marginal propensity to consume now increases to 0.11, which is almost double the marginal propensity to consume as measured in Regression 1 and is statistically significant. The results show that for each rand paid as benefit by a privately administered pension fund, 11 cents will be spent on consumption.

Table 6.4: Dependent Variable - Per Capita Consumption (ConsPC) – Feldstein (1974, 1995) Specification

Variables	Regression 1	Regression 2
YdPC	0.984 (0.1798)	0.931 (0.1595)
YdPC(-1)	0.445 (0.1518)	0.401 (0.1360)
TBENPC	0.055 (0.0063)	
TPAPPPC		0.112 (0.0111)

(Standard errors in parenthesis)

The approach is that a tax on benefits reduces the expected benefits (returns) on such investment and depending on the level of taxation, individuals will seek other forms of savings, like buying property or investing in assets other than pension and provident funds. Thus, the tax treatment given to pension funds in South Africa can have adverse effects on saving for retirement through the pension funds, depending on how individuals perceive their benefits during retirement.

Estimating the coefficients based on the Feldstein model, the effects of pension and provident fund benefits paid on consumption and savings were estimated for 1996 (one year after the Katz Commission and Smith Committee) and again in 2003, eight years thereafter.

The results of these calculations show that total benefits received from pension funds led to increased consumption of R1.56 billion in 1996, and R2.79 billion in 2003, implying a reduction in saving of the same amount. During 1996, contributions to retirement funds amounted to a R25.8 billion reduction in consumption and a R420 million reduction in saving. The corresponding amounts were R40 billion in consumption and R651 million in discretionary savings in 2003.

The combined effect on saving of benefits received from and contributions to pension and provident funds during 1996 were R1.98 billion and in 2003 it increased to R3.441 billion. This implies that household potential discretionary saving was reduced by 4.0 per cent in 1996 and by 6.92 per cent in 2003. These results are comparable to findings from studies for other countries. The decline in household saving in South Africa is also supported by time-series analyses done by Aron and Muellbauer (2000) and Prinsloo (1994, 2002).

The results, in Regression 2 show that discretionary household saving, when only administered funds are considered, is crowded out more than when private and public funds are combined. When the results from Regression 2 (shown in the fifth row of Table 6.4) are applied to the monetary values of privately administered funds, it shows that consumption increased by R2.0 billion in 1996 and by R3.6 billion in 2003. By repeating the exercise for privately administered funds we find that the combined effects on saving was R3.0 million and R5.2 billion for 1996 and 2003 respectively, which implies a reduction in potential saving of 5.3 per cent for 1996 and 10.1 per cent for 2003 (worse than when privately and officially administered schemes are combined).

These results indicate the dominant effect of pension and provident funds privately administered. Not being able to separate pension from provident funds, may lead to a serious bias in the analysis due to the fact that provident funds may have a different impact on saving and consumption in the life cycle of individuals.

Ehrlich and Kim (2005) analysed the effects of different retirement schemes and found that provident funds provide a better retirement deal to the aged than social security financed payroll taxes. However, in the South African case where contributions are capped as a percentage of remuneration, its effects are likely to be similar to those of social security in other countries. Both programs lower disposable labour-income, which is at the centre of household decision-making during their lifetime earnings. In South Africa, however, it is not possible to separate the effects of provident from pension funds, since both are lumped together. However, these results could be regarded as directly comparable to the pure social security programs financed by payroll taxes in the US.

6.2.3 Conclusion regarding findings on the South African case

The results suggest that both in 1996 and 2003, social security (as represented by retirement benefits received) crowded out discretionary savings by 4.3 per cent and 7.5 per cent, respectively. These results are comparable with findings from studies in other countries.

The implication thereof is that policy change towards increased levels of social security contributions, could increase the crowding out of discretionary saving. In a life cycle hypothesis context individuals tend to maintain their consumption patterns during their life span. Thus, changes in the tax regime affecting the discounted value of retirement benefits will change savings in the opposite direction of the policy change.

6.3 Growth Model

This section analyses the effects of social security on the growth of per capita income. The results so far of the effect of social security on the growth of per capita income, have been inconclusive. Some were found to be positive while others were negative.

This section presents empirical results of the growth model. Fourteen sub-Saharan African countries are presented to verify the validity of the effect of social security on growth. The model uses the general specification on the effect of social security as frequently found in the literature. However, before the results of the model are presented, unit root tests of the variables included in the model are presented. The results of the model are followed by tests for their validity.

6.3.1 Unit root test

The study in this section analyses a panel of fourteen countries with seven variables, namely: secondary school enrolment, social security benefit payments, government consumption, openness (defined as exports plus imports divided by GDP), inflation and the growth of per capita GDP. All variables appear as ratios of GDP with the exception of the growth of per capita GDP, inflation and secondary school enrolment (defined as a percentage of gross enrolment).

The test of the null hypothesis that openness (in logarithmic forms) has unit root process is accepted by Levin, Lin and Chu T* test only. Breitung t-statistic test rejects the null and the null of no unit root based on Hadri Z-statistic is accepted. However, the null of unit root based on the Im, Pesaran and Shin W-statistic, ADF-Fisher Chi-square and PP-Fisher Chi-square tests that assumes individual unit root process, fails to reject the null in the case of the variable openness. Combining the unit root results based on tests assuming individual unit root process and those assuming common unit root process, it is concluded that the openness variable has unit root with intercept and trend.

The unit root test for growth of per capita GDP is significant at one and five per cent based on the Levin, Lin and Chu T* and Breitung t-statistic tests respectively. This result implies that the growth of per capita GDP across countries is non-stationary. The test for unit root based on Im, Pesaran and Shin W-statistic, ADF-Fisher Chi-square and PP-Fisher Chi-square tests concludes that the growth of per capita GDP across countries has unit root or is non-stationary. However, the unit root hypothesis is rejected at one per cent with the test based on Breitung t-statistic. Therefore, the variable GDP per capita can be regarded as having a unit root process at 5 per cent with individual effects and a linear trend.

The test of the null hypothesis that inflation is non-stationary is significant at one per cent for the Levin, Lin and Chu T* and Breitung t-statistic and with no intercept and no trend. This result implies that inflation across countries has unit root process, that is, it is non-stationary. The unit root tests based on ADF-Fisher Chi-square and PP-Chi-square, assuming individual unit root process with no intercept and no trend are significant at one per cent, that is, inflation has unit root or is non-stationary.
The tests for unit root for the remaining variables included in this model are presented in Section 6.1.1.

6.3.2 The results of the model

The basic model is estimated, as in the case of the saving model, using the Least Square Dummy Variable (LSDV) procedure and the results are presented in Table 6.4 column 2 (labelled Model 1).

These results show that social security impacts negatively on the growth of per capita GDP, but that it is not statistically significant. The non-significance of the social security coefficient may imply that social security in the sub-Saharan African countries included in the study is being neglected. Or it may imply that a larger part of the population are not members of the formal social security schemes, or poor data recording leads to conflicting results since this has been a problem in most developing countries and the SSA countries in particular. This phenomenon is of great concern in view of the effect of social security on the performance of these economies, especially poverty alleviation for the aged and growth in the informal sector. This result, however, corroborates with the Ehrlich and Zhong (1998) and Ehrlich and Kim (2005) results where they found a negative relationship between social security benefit payments and the growth in per capita GDP. However, the magnitude of the effect in the set of poor countries was significantly smaller or insignificant. This result contradicts that of Zhang and Zhang (2004), who found a positive relationship between social security and the growth in per capita GDP after they had controlled for the initial GDP. In this study the results remain essentially unchanged even after controlling for initial per capita GDP.

Regarding the results of the saving model (Section 6.1), they also confirm the results of the life-cycle models with regard to the effect of social security on the economy's performance. Investment will be negatively affected if social security reduces personal saving (except when national saving increases more than the drop in personal saving to compensate for the decrease in personal saving). Thus, following the transmission mechanism, the growth in per capita GDP will also be negatively affected. This is acceptable since the growth of an economy can only occur if there is investment, which according to the assumption in this study is equal to saving in the national identity income equation.

Therefore, reforming the existing social security systems in many SSA countries seems to be urgent. However, such reforms do not necessarily imply privatisation of the systems given the weaknesses regarding regulation and monitoring of the institutions.

Another interesting result, although not statistically significant, but also in line with the Ehrlich and Kim (2005) results, is that education attainment (represented here as secondary school enrolment) may negatively affect the growth in per capita GDP of the SSA countries. The inadequate quality of education, lack of job opportunities, high fertility rates and other exogenous factors like drought and instability affect the growth of GDP.

Table 6.5: Dependent variable - *GPC* (Full and regional samples)

Variables (Regressors)	Coefficients (First-order Asymptotic)		
	Model 1 (All Countries)	**Model 2 (SADC)**	**Model 3 (West Africa)**
LnRGC	-0.0073	-0.0037	-0.0081
	(0.0147)	(0.0449)	(0.0177)
LnRBen	-0.0056	-0.0029	-0.0051
	(0.0056)	(0.0132)	(0.0069)
INFL	-0.0001***	-0.0001	-0.0004*
	(0.0001)	(0.00008)	(0.0002)
LnOpen	-0.010	-0.0240	0.0108
	(0.0174)	(0.0335)	(0.0215)
LnSEC	-0.0290	-0.0670	-0.0138
	(0.0178)	(0.0676)	(0.0193)
LnRinv	0.0675***	0.0884***	0.0402*
	(0.0145)	(0.0253)	(0.0240)
Fixed Effects			
BENIN	0.0325		0.0371
	(0.0523)		(0.0618)
CAMEROON	0.0271		0.0244
	(0.0553)		(0.0639)
ETHIOPIA	0.0400		
	(0.0507)		
GHANA	0.0398		0.0321
	(0.0443)		(0.0486)
IVORY COST	0.0371		0.0147
	(0.0560)		(0.0662)

KENYA	0.0168		
	(0.0629)		
LESOTHO	0.0067	0.0008	
	(0.0353)	(0.0829)	
MALI	0.0227		0.0305
	(0.0459)		(0.0588)
MOZAMBIQUE	0.0230	-0.0359	
	(0.0530)	(0.1460)	
NIGERIA	0.0363		0.0233
	(0.0410)		(0.0444)
SOUTH AFRICA	0.0976**	0.1374	
	(0.0385)	(0.1161)	
SENEGAL	0.0101		0.0102
	(0.0632)		(0.0741)
ZAMBIA	0.0267	0.0274	
	(0.0496)	(0.1201)	
ZIMBABWE	0.0837**	0.1013	
	(0.0389)	(0.1023)	
R^2 = 0.4868		R^2 = 0.5406	R^2 = 0.3831
R^2-*Adj* = 0.4056		R^2-*Adj* = 0.4228	R^2-*Adj* = 0.2532
F-stat = 5.9912		*F-stat* = 4.5893	*F-stat* = 2.9500
p(F-stat) = 0.0000		*p(F-stat)* = 0.0003	*p(F-stat)* = 0.0030

(Standard errors in parenthesis)

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

These factors suggest that it is not educational output *per se* that increases the growth in per capita GDP, but the combination of educational output and other factors affecting the two variables, namely: GDP and population. Dependence ratios (which are high in many SSA countries) and the structure of the population, for example, also affect the growth in per capita GDP.

Openness has a negative sign but is not statistically significant. This result is important from a policy perspective, since a negative sign may imply that most of the SSA countries import more consumption goods than they export. It is normally not growth enhancing and thereby affects the growth of their economies negatively. However, the variable investment has a positive sign and is significant at one per cent, meaning that investment has an important effect on the growth of per capita GDP. Inflation has a negative sign and is statistically significant (though the magnitude is very small) supporting the theoretical claim that countries with higher inflation will have low GDP growth rates. With higher inflation individuals tend to save in foreign stable currencies which drain resources out of the country and/or durable goods (generally real estate) whose value grows with inflation. In the case of the majority of sub-Saharan African countries where the population is featured by a lack of resources for such shifts, the impact of inflation is more painful than in other parts of the world.

The results in Model 1 indicate that all countries have positive specific effects influencing the growth of per capita GDP, but almost all these specific factors are not significant except for South Africa and Zimbabwe, which are both significant at five per cent level of significance.

6.3.3 Testing for the validity of Model 1

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

The test for fixed effects, tests the validity of the null hypothesis that no individual effects exist against the alternative that they do 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 for 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 a number of cross-sections, T the time dimension and K the number of coefficients estimated. The result of the test is $F_{(13,120)} = 1.79$ which accepts the null of no individual effects (or common intercept) at five per cent level of significance. Therefore, there are no specific factors that affect the growth of the SSA countries included in the model.

The next step is to test whether the countries included have a common slope coefficient, in other words testing for homogeneity of the slope coefficient. This is to test whether the null of all coefficients is equal against the alternative that not all slope coefficients are, 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 words, coefficients are not poolable.

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

It also tests for exogeneity of the variable in Model 1 using the Houseman test which is distributed as Chi-square with K degrees of Freedom ($\chi^2(K)$). The null hypothesis to be tested is $H_o : E(\varepsilon_{it} / X_{it}) = 0$, which implies no misspecification in the model or no correlation between individual effects and exogenous variables. The result of the test is $m = 11.3604$, which is less than the critical value of $\chi^2(6)$ failing to rejects the null hypothesis at one per cent level of significance.

The result of the test for serial correlation shows no such evidence. It is based on the LM test distributed as Chi-square with one degree of freedom (χ_1^2) under the null hypothesis of no serial correlation. The calculated LM test based on the test of RSS is equal to 0.9079, which is less than the critical value of χ_1^2 resulting in failure to reject the null at one per cent level of significance.

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

In this section countries were again 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. Countries at regional level tend to be more homogenous than when considered at continental level.

The results of the estimation from this exercise and using LSDV are also presented in Table 6.4 above. Model 2 (column 3) shows the results of the estimation for the southern African (SADC) countries. The coefficient of social security is negative but not statistically significant, implying that in the SADC region, although social security is negatively related to the growth of per capita GDP, its effect is not significantly different from zero. In other words, social security within the group of SADC countries included in this study has no effect on the growth of per capita GDP. This result is similar to those found by Ehrlich and Zhong (1998) and Ehrlich and Kim (2005), with the only difference being their coefficients are statistically significant.

All control variables have the expected signs but are not significant at the conventional levels of significance with the exception of the investment/GDP ratio which is significant at one per cent. The specific effects are positive for all countries except for Mozambique, in whose case it is negative. For all countries the effects are not significant at conventional levels.

The result of the test for the validity of the null hypothesis of no individual effects against the alternative that individual effects exist is $F_{(4,39)} = 1.55$, which fails to reject the null. This result implies that countries' specifics play no role in the growth of the countries included in this model.

Serial correlation is rejected under the null hypothesis of no serial correlation. The calculated LM value is equal to 0.1811 and is 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 the West African countries in Model 3 (column 4) the estimates from LSDV indicate that social security has a negative effect on the growth of per capita GDP but is not statistically significant. This result is again similar to the results found by Ehrlich and Zhong (1998) and Ehrlich and Kim (2005), with the only difference that their coefficients are significant.

All control variables have the expected signs but they are not significant with the exception of inflation and the investment/GDP ratio which are both significant at ten per cent. The fixed effects, as in the other two regions, are positive but not statistically significant, indicating that specific effects play no role in the behaviour of the growth of per capita GDP. Tested for fixed effects, Model 4 failed to reject the null hypothesis of no individual effects. The result of the *F-test* is $F_{6,57} = 0.6713$ which implies that there are no country specific factors affecting the growth of per capita GDP in the West African region.

No evidence of serial correlation is revealed. The LM test is equal to 2.9001, which is distributed as Chi-square with one degree of freedom (χ_1^2). The calculated LM value is less than the critical value at five per cent, leading to the acceptance of the null hypothesis of no serial correlation.

6.3.5 The results of pooled models

Tests for poolability of the growth models in both full sample and regional groupings suggest that countries are poolable. Thus, the growth models were run in pooled format and the results are presented in the Table 6.5.

The results shown in Table 6.5 (Model 4) indicate that social security is positively related to the growth of per capita GDP, which is opposite to the results in the LSDV regression above. These results are, however, similar to the findings by Zhang and Zhang (2004) in their panel data analysis and Cigno *et al.* (2003) in a time-series regression. The differences in the results in the LSDV regression and least square pooled regression have important policy implications for social security in SSA countries. These policy implications will be discussed in the next chapter. For now it is important to note that social security has a positive sign although not statistically significant.

Table 6.6: Dependent variable - *GPC* (full and regional samples-pooled regressions)

Variables (Regressors)	**Coefficients (First-order asymptotic)**		
	Model 4 (All Countries)	**Model 5 (SADC)**	**Model 6 (West Africa)**
LnRGC	-0.0149*	-0.0429	-0.0077
	(0.0084)	(0.0334)	(0.0141)
LnRBen	0.0010	0.0060	-0.0022
	(0.0015)	(0.0062)	(0.0021)
INFL	-0.0001**	-0.0001	-0.0003**
	(0.00005)	(0.0001)	(0.0002)
LnOpen	-0.0197**	-0.0196	-0.0078
	(0.0084)	(0.0242)	(0.0103)
LnSEC	-0.0038	0.0026	-0.0067
	(0.0055)	(0.0142)	(0.0106)
LnRinv	0.0476***	0.0559***	0.0494***
	(0.0082)	(0.0167)	(0.0130)
Constant	0.0533***	0.0477	0.0550**
	(0.0162)	(0.0469)	(0.0217)
R^2 = 0.3882		R^2 = 0.4695	R^2 = 0.3396
R^2-*Adj* = 0.3606		R^2-*Adj* = 0.3955	R^2-*Adj* = 0.2767
F-stat = 514.0653		*F-stat* = 6.3421	*F-stat* = 5.3983
p(F-stat) = 0.0000		*p(F-stat)* = 0.0000	*p(F-stat)* = 0.0000

(Standard errors in parenthesis)

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

All control variables in the least square pooled regression have the same signs as in the LSDV. However, government consumption/GDP ratio and openness, which were not significant in the LSDV fixed effects regression, appear to be significant in the least square pooled regression. Secondary school enrolment is still insignificant at the conventional levels.

The test for serial correlation in the least square pooled regression based on the LM test shows no serial correlation. The result of the LM test is equal to 2.2172, which is distributed as χ_1^2 . This is less than the critical value at five per cent resulting in acceptance of the null of no serial correlation in the residuals. Testing for variable omission in the pooled model using Wald test and both tests: *F-test* and Likelihood ratio (LR), rejects the null that the series included in the model do not belong to the equation at the one per cent level. The Wald test is equivalent to the Houseman test for misspecification; therefore, the results show no misspecification in the equation.

In column 3 the results of the least square pooled Model 2 are presented as Model 5. These results show that social security is positively related to the growth of per capita GDP in SADC countries. However, it is not statistically significant at conventional levels. As in the case of the full sample, these results are similar to those of Zhang and Zhang (2004) and Cigno *et al.* (2003).

The results of the control variables in the least square pooled model are similar to those obtained in the LSDV regression with the exception of secondary school enrolment of which the sign has changed but which is still not statistically significant at the conventional levels.

The result of the test on serial correlation is given by the LM test, distributed as χ_1^2 . This LM test result is 0.2104, which accepts the null of no serial correlation in the residuals with the calculated value less than the critical value at five per cent. The result of the Wald test for omitted variables shows no misspecification of the model.

The pooled results for West Africa show that social security is negatively related to the growth of per capita GDP but not statistically significant. There is no significant difference between the least square pooled regression and LSDV regression results. Again this result may have important implications for retirement programs in these countries where generous social security programs are still common, despite high levels of poverty.

The results of the control variables are also basically unchanged from the results of the LSDV regression, with the exception of openness which has the opposite sign but is still not significant at conventional levels. The investment/GDP ratio and inflation which were only significant at ten percent in the LSDV regression are now significant at one and five per cent, respectively.

The LM test for the least square pooled regression shows no serial correlation, since the result of the LM test (2.8612) is less than the critical value at five per cent suggesting no serial correlation in the relevant residuals. The test for omitted variables or misspecification indicates that there are no omitted variables or misspecification in the model. This conclusion is supported by the results of the linear normalised restriction which reject the null that each of the variables is equal to zero for all variables included in the model.

6.3.6 Bootstrapping results

As was argued in Section 6.1.5, the reliance on normal asymptotic assumptions may be misleading in the context of a small sample, in particular short time-series in the panel data. Therefore, the use of bootstrapping reduces the size of distortions relative to the alternative methods and also helps to capture the properties of the data available, which is important when validating the results of the models.

In this section we bootstrap the results of the LSDV models as done in Section 6.1.5, that is, only the regional LSDV regressions are bootstrapped. This is important in order to be able to validate the results of the regressions. The advantages of this procedure were discussed in sections 5.3 and 6.1.4. The results of bootstrapping are presented in tables 6.6 and 6.7 below.

The results shown in Table 6.6 indicate that social security is negatively related to the growth of per capita GDP in SADC countries but not statistically significant at the conventional levels (significant only at 84,5 per cent, which is slightly higher than the level of significance given in the LSDV regression).

This answer implies that reliance on the LSDV results based on normality assumption, may lead to the wrong conclusions. Therefore, using bootstrapping may improve the quality of statistical power by allowing constructing confidence intervals (or tests) based on an empirical probability distribution function.

The results of estimated bootstrapping coefficients confirm the LSDV results since the computed standardised bias[34] are below the threshold of 28 per cent. This is important in validating the magnitude and signs of the estimated coefficients at the same time improving the power of the test. For example, social security is only significant at 84.5 per cent instead of 82.6 per cent in the LSDV test. In general it can be concluded that social security has no effect on the growth of per capita GDP in the SADC countries.

All the control variables have the correct signs with the exception of openness which has the opposite sign. Again bootstrapping improves the level of significance. For example, in the case of openness which was significant at 47.9 per cent, after bootstrapping the level of significance is 40.0 per cent and in the case of inflation which was significant at 18.7 per cent, after bootstrapping the level of significance is 22 per cent. These results reveal that if one relied on the assumptions of normality one could have taken the wrong decisions. For example, concluding that inflation is significant at 18.7 while the true level of significance is 22 per cent (the probability of committing type I error reduces). The same applies for the other results. Annexure 6 contains the distribution of bootstrapped coefficients based on 10,000 replications. This distribution shows that bootstrapping the results improves the distribution of the coefficients and therefore improves the confidence in the results obtained.

All the country specific effects are not significant confirming the early results from the LSDV regressions. Only South Africa has country specific effects significant at 40 per cent; while all other countries in the region have no significant specific effects even at 50 per cent. Again if one is to depend only on assumptions of normality the country specific effects in South Africa would be recorded at 24.4 per cent (higher probability of committing type I error) while in reality they are only significant at 40 per cent.

The use of bootstrapping improves the power of empirical tests either in dynamic or static models (Kim, 2005; Giersbergen and Kiviet, 2002 and Bun and Kiviet, 2004). This is even more important in the context of small data series which characterise many developing countries, in particular sub-Saharan countries.

Table 6.7 contains results from bootstrapping simulations of the LSDV West Africa. In this table it is shown that social security is negatively related to the growth in per capita GDP as in the case of the SADC countries. This result is similar to the results found by Ehrlich and Zhong (1998) and Ehrlich and Kim (2005). However, it is not statistically significant at conventional levels and is only significant at 35.6 per cent after bootstrapping. This level of significance is significantly different from the result found for SADC countries.

Bootstrapping the coefficient of social security shows that the true level of significance is far below the level of significance shown in the first order asymptotic equation. Bootstrapping significantly improves the power of the test especially in the small sample. The calculated bias suggests that the coefficient social security is not biased, again important for relying on the results of regression for policy simulations.

The results on the control variables show that only the inflation and investment ratios are statistically significant within the conventional levels of significance. All other variables are not statistically significant within the conventional levels although the results from bootstrapping show significant improvements in the power of the tests. For example, secondary school education which was significant at 47.8 per cent, after bootstrapping the LSDV result becomes significant at 18.7 per cent. Therefore, the combination of these

[34] The percentage standardized bias is calculated using $Bias(\hat{\beta}) = \left(\frac{\hat{\beta} - \hat{\beta}_b}{\sigma_{\hat{\beta}_b}} \right) x\ 100\%$ (see also Chapter 5 on methodology).

techniques improves the quality of the results and also improves the quality of information for policy simulations.

The results of country specific effects are not significant even after bootstrapping and the power of the test for some country specific effects has decreased, that is, increased the probability of accepting the false null hypothesis. For example, the power of the test has decreased by 17.14 per cent for Ghana and 19.06 per cent for Nigeria.

Table 6.7: Dependent variable - *GPC* (SADC sample)

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**	
LnRGC	-0.0037 (0.0449)	-0.0029	0.0008	-0.0776	0.0720	Fail to reject the null at 10%
LnRBen	-0.0029 (0.0132)	-0.0030	-0.0001	-0.0241	0.0185	Fail to reject the null at 10%
INFL	-0.0001 (0.0001)	-0.0001	0.0000	-0.0002	0.0001	Fail to reject the null at 10% [22%][1]
LnOpen	-0.0240 (0.0335)	-0.0244	-0.0004	-0.0713	0.0213	Fail to reject the null at 10% [40%][1]
LnSEC	-0.0670 (0.0676)	-0.0672	-0.0002	-0.1703	0.0334	Fail to reject the null at 10% [29.5%][1]
LnRinv	0.0884*** (0.0306)	0.0886	0.0002	0.0218	0.1589	Significant at 1%
Fixed Effects						
LESOTHO	0.0008 (0.0829)	0.0017	0.0009	-02291	0.2296	Fail to reject the null at 10%
MOZAMBIQUE	-0.0359 (0.1460)	-0.0346	0.0013	-0.3271	0.2586	Fail to reject the null at 10%
SOUTH AFRICA	0.1374 (0.1161)	0.1387	0.0013	-0.1269	0.4101	Fail to reject the null at 10% [40%][2]
ZAMBIA	0.0274 (0.1201)	0.0284	0.001	-0.1749	0.2335	Fail to reject the null at 10%
ZIMBABWE	0.1013 (0.1023)	0.1025	0.0012	-0.1015	0.3073	Fail to reject the null at 10%

(Standard errors in parenthesis)

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

[1] The variables are not significant at 10 per cent but significant at 22, 40 and 29.5 per cent level of significance, respectively. Specific effects for South Africa are only significant at 40% but for other countries are not, even at 40%

Table 6.8: Dependent variable - *GPC* (West Africa sample)

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	
LnRGC	-0.0081 (0.0177)	-0.0083	-0.0002	-0.0354	0.0168	Fail to reject the null at 10%
LnRBen	-0.0051 (0.0069)	-0.0051	0.0000	-0.0140	0.0037	Fail to reject the null at 10% [35.6%][1]
INFL	-0.0004* (0.0002)	-0.0004	0.0000	-0.0008	-0.00001	Significant at 4.1%
LnOpen	0.0138 (0.0215)	0.0110	-0.0028	-0.0178	0.0390	Fail to reject the null at 10%
LnSEC	-0.0138 (0.0193)	-0.0138	0.0000	-0.0306	0.0037	Fail to reject the null at 10% [18.7%][1]
LnRinv	0.0402* (0.0240)	0.0404	0.0002	0.0001	0.0819	Significant at 9.7%
Fixed Effects						
BENIN	0.0371 (0.0618)	0.0368	-0.0003	-0.0562	0.0965	Fail to reject the null at 10% [52.4%]
CAMEROON	0.0244 (0.0639)	0.0239	-0.0005	-0.0627	0.0798	Fail to reject the null at 10% [65%]
GHANA	0.0321 (0.0486)	0.0316	-0.0005	-0.0645	0.0929	Fail to reject the null at 10% [60%]
IVORY COST	0.0147 (0.0662)	0.0143	-0.0004	-0.0854	0.0783	Fail to reject the null at 10% [82.2%]
MALI	0.0305 (0.0588)	0.0303	-0.0002	-0.0668	0.0924	Fail to reject the null at 10% [61.6%]
NIGERIA	0.0233 (0.0444)	0.0230	-0.0003	-0.0765	0.0868	Fail to reject the null at 10% [71.7%]
SENEGAL	0.0102 (0.0741)	0.0095	-0.0007	-0.0925	0.0750	Fail to reject the null at 10% [88.8%]

(Standard errors in parenthesis) * Significant at 10% level [1] The variables are not significant at 10 per cent but significant at 35.6 and 18.7 per cent level of significance, respectively.

In general, bootstrapping has the advantage of constructing one's own empirical distribution function (or empirical tests), which allows for more accurate levels of significance with exact probability of committing a Type I error. Figures in annexures 5 and 6 show the distribution of the bootstrapped coefficients based on LSDV coefficients.

6.4 Model for Fertility

In this section the effect of social security on fertility is investigated. Unlike in the case of growth per capita GDP, where empirical results of the effects of social security show adverse results, empirical literature on fertility has consistently shown a negative relationship to social security. In other words, the existence and improvement of 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). However, as argued by Becker, Murphy and Tamura (1990) families with limited human capital tend to have large families and invest little in each member. This is generally the characteristic of developing countries and therefore, their human capital tends to be poor. Becker and Barro (1988) argue that an increase in social security taxes tends to only temporarily reduce fertility, even if the children do not support their parents.

All this supports the ideas that empirical analyses have secularly shown that the existence of social security negatively affects fertility, even if these effects are temporary. Thus, the question is how long it takes before reverting the sign? The answer will surely depend on the dynamics in each specific country or group of countries (given the increase in regional policy coordination through regional blocks of development). Table 7.8 shows the effects of social security on fertility in 14 sub-Saharan African countries (using population growth as a proxy for fertility net of mortality).

The results presented in Table 6.8, column 2 (labelled Model 1), indicate that social security in African countries included in the model does not reduce fertility as argued in the literature for developed countries. Such literature argues that social security reduces fertility and increases investment in human capital (see for example, Ehrlich and Lui, 1998). However, the results in this study have found adverse implications of social security on fertility. These results imply that children receive more weight in the optimal choice of the old age retirement portfolio of the majority of African families than other forms of retirement do. Therefore, fertility is important to consider when measuring retirement dependency in the typical African family.

This finding, although not statistically significant, is similar to that of the theoretical model by Boldrin, De Nardi and Jones (2005)[35]. 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 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.

It could be argued that low coverage rates, especially for those families living and working in rural areas cause them to be more vulnerable in old age. For this section of the population a large family weighs more in their old age portfolio than other possible components do. In some other countries with private ownership of land, land bequests are another important motive for having more children - a type of Barro (1974) and Becker and Barro (1988) model where parents are altruistic towards children.

[35] 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.

Table 6.9: Dependent variable - *LnF* (full and regional samples)

Variables	**Coefficients (First-order Asymptotic)**		
(Regressors)	**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

All control variables show interesting results with regard to secondary school enrolment and net exports. Secondary school education has a negative sign and is statistically significant implying that as individuals become more educated, they tend to want fewer children. The reason being that when formally employed they have the opportunity to be integrated into some formal social security systems. This result is important to understand the differences in fertility rates between SSA and developed countries. In most developed countries the level of literacy averages 96 per cent while in many SSA countries the literacy rate average below 54 per cent (HDR, 2006). Literacy plays an important role in the flow of information regarding the role of social security as substitute for children in the optimal retirement portfolio.

An increase in net exports results in an increase in the country's or a household's (particularly a rural one's) income which may reduce the weight of children as a choice of optimal retirement portfolio. Therefore, an increase in net exports will decrease the desire for many children and possibly increase investment in human capital. This variable has a negative sign and 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 2 (Table 6.8), show that all countries have specific effects that positively influence fertility rates. All these positive fixed effects are statistically significant at one per cent, with the exception of South Africa in whose case the specific factors are significant at only five per cent and Lesotho whose specific factors are not significant at conventional levels.

6.4.1 Testing for the validity of 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 exists, 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 $H_o : E(\varepsilon_{it} / X_{it}) = 0$, 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.

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

In this section countries were again divided into regional blocks of economic development and/or according to their location based on the reasons provided earlier in the analysis.

The results of the estimation and using LSDV are also presented in Table 6.8. 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. Again the result differs from that of Ehrlich and Kim (2005) who found a positive and significant relationship between fertility and the number 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 equal to 3.2848 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* is $F_{6,58} = 149.7945$ which 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.

6.4.3 Bootstrapping results

Bootstrapping is again used to reduce the size of the distortions relative to alternative methods helping to capture the properties of the data in the hand, which is fundamental in validating the results of the models in assessment.

In this section the results of the regional LSDV models (see 6.3.2) are bootstrapped as performed in previous sections. The results of bootstrapping are presented in tables 6.9 and 6.10 below.

Table 6.9 shows that social security is positively related to fertility in the 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 LSDV results based on assumptions of normality may lead to inappropriate conclusions.

Two of the four control variables have the expected signs. In the case of secondary school enrolment it implies that once people become more educated; children become less weighted in the old age portfolio.

There are significant gains in the power of the test with the bootstrapping and the level of significance of all control variables improved. For example, the government consumption to GDP ratio was significant only at 38.12 per cent with the LSDV estimation, but with bootstrapping the level of significance is 12.7 per cent.

Secondary school enrolment improved from 44.22 per cent to 19.7 per cent (the probability of committing a type I error reduces, that is the probability of rejecting the null while it is true). The results imply that if one is to rely on assumptions of normality the wrong decisions could be taken. For example, the growth in per capita GDP was significant at 28.22 per cent while the true level proves to be at 16.3 per cent.

Table 6.10: Dependent variable - *LnF* (SADC sample)

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.

In Annexure 7 the distribution of 10,000 replications of the bootstrapped coefficient are included based on LSDV regression results. Country specific effects are significant at 2.52, 3.20 and 6.1 per cent for Zambia, Zimbabwe and South Africa, respectively. Country 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. Again if one has to depend on the assumptions of normality it could have been concluded that country specific effects were not significant except for Mozambique, in which case effects were significant at ten per cent.

Table 6.11: Dependent variable - *LnF* (West Africa sample)

Regressors	First Order Asymptotic Results (LSDV)	No of Replications: 10000		Confidence Interval		Level of Significance
	Model 3 (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.

Table 6.10 contains another result from bootstrapping simulations of the LSDV for West African countries. The results show that social security is positively related to fertility as in the case of the SADC countries and the full sample regressions but 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 reduction in the probability of committing type I error.

The control variables results show that only secondary school enrolment and net exports are statistically significant at one per cent levels of significance. All other variables remain statistically insignificant within the conventional levels. Annexure 8 contains the distributions of the bootstrapped coefficients.

The results of fixed effects are all significant at one per cent level after bootstrapping, confirming the results from the LSDV regression.

6.5 Main Insights and Concluding Remarks

In this chapter the empirical effects of social security on saving, growth in per capita GDP and fertility were analysed. The results of the estimation of the saving model (with investment as a proxy for saving) suggest that social security crowds-out saving in the full sample and West African models except for the SADC model, where social security crowds-in saving. However, the coefficients are not significant at the conventional levels of significance. These results suggest that in SADC countries, reforms in social security may be more directed at the development of institutions that mobilise savings for retirement. In other regions, more fundamental reforms will have to be considered. The tests on the results accept fixed effects models in both full and regional samples. No serial correlation and misspecification were detected in the analysis of the saving model. However, the hypothesis of poolability of cross-sections in these models was rejected thereby justifying the estimation of fixed effects models, as outlined.

In the second section, per capita GDP growth was estimated and the results indicate that social security negatively affects growth in per capita GDP. This was found in the full sample, SADC and West Africa models in both LSDV and least square pooled models.

These results are not statistically significant at the conventional levels for all models considered (full sample and regional grouping). The results also suggest that the role of social security in the performance of the economy is still undervalued. Therefore, policies that emphasise the important role of social security in the performance of these economies are necessary. In both LSDV and pooled least square models, no serial correlation and misspecification were detected but the poolability of both coefficient and fixed effects, were accepted. In this case the ideal would have been to estimate individual (country) regressions but the lack of long time-series data prevented such an exercise.

In the third section the LSDV model of fertility was estimated with the social security coefficient positive and 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.

Bootstrapping was performed and it confirmed the results in all estimated models. The advantage of bootstrapping is that it improved the level of confidence of the models assessed since their validation is based on the data available. Various authors recommend the use of bootstrapping in small panel data rather than depending on the asymptotic normality assumptions, which may not hold in small sample data. This is confirmed in this study given the fact that the majority of the results obtained could have led to wrong conclusions. An example of this is: concluding that a coefficient is significant at a certain level of significance while it is actually not: for example, the variable secondary school enrolment for the West African region in the fertility regression was significant even at 10 per cent, but after bootstrapping it became significant at one per cent level.