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Explaining Long-Run Growth in South Africa And OECD Countries: Implications for the Rest of SADC Countries

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Abstract

This paper tests a "generalised" version of Thirlwall's balance-of-payments (BOP) constrained growth model by examining the existence of a long-run relation between the output growth rates of OECD countries, South Africa and the rest of the Southern African Development Community (RSADC). Although the policy implications of the study are not mutually exclusive, they can be viewed from the individual perspectives of OECD, South Africa and RSADC. First, OECD is BOP constrained with respect to middle-income countries (MIC) represented by South Africa and low-income countries (LIC) represented by RSADC. OECD will grow faster by providing MIC and LIC greater access to their markets to maintain the demand for their products buoyant. Second, South Africa is only BOP constrained with respect to OECD. The message to South Africa's policy makers is plain: high rates of growth will be the result of an improvement in the structural demand features of South Africa's exports to OECD. Third, RSADC is only BOP constrained with respect to South Africa. Growth-promoting policies in South Africa may have a high and positive impact on the whole SADC region. Policy-makers in RSADC, however, should reduce their dependence on South Africa by improving the structural demand features of their exports to OECD.

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EXPLAINING LONG-RUN GROWTH IN SOUTH AFRICA AND OECD COUNTRIES: IMPLICATIONS FOR THE REST OF SADC COUNTRIES

Executive Summary

In Thirlwall's (1979) seminal paper the idea was advanced and empirically verified that for a large group of countries the rate of growth of output is balance-of- payments (BOP) constrained because this sets the limit to the growth of demand to which supply can adapt (Thirlwall and Hussein, 1982: 498). The main essence of "Thirlwall's law" is that in an open economy expenditure cannot grow faster than income growth without creating a current account deficit on the balance of payments. A current account deficit cannot be sustained through an indefinite inflow of capital, because deficits above a certain percentage of GDP trigger negative signals to the international community that force countries to adjust (McCombie and Thirlwall, 1997). For a given rate of growth of exports, the brunt of the adjustment falls on a reduction in income growth to restore balance of payments equilibrium. An open economy's real economic growth rate is therefore determined by export growth for a given income elasticity of the demand for imports. The rate of growth of exports, in turn, is mainly a function of "world" income or "world" demand.

The main objective of this paper is to test the BOP growth model by examining the existence of a stable and positive long-run relation between the output growth rates of a group of high-income countries (OECD), a middle-income country {South Africa (SA)} and a group of low-income countries {the rest of the Southern African

Development Community (RSADC)[1]}[2].

[1] The Southern African Development Community is a multilateral economic co-operation scheme that includes fourteen countries from the Southern African Region: Angola, Botswana, Congo (Democratic Republic), Lesotho, Malawi, Mauritius Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

[2] The classification of countries into different income groups is mainly based on per capita income levels (World Development Report, 2000/2001). However, note that Botswana, Mauritius and Seychelles recored higher per capita income levels than South Africa in 1999. Nonetheless, these countries are still regarded as low-income countries based on their low levels of GDP compared to South Africa. In 1999 South Africa's level of GDP constituted 72% of SADC.

Thirlwall's BOP constrained growth model is a specific case involving a bilateral trade relationship between one country and the "rest of the world". In this paper the specific case is generalised into a multilateral trade relation between an individual country (South Africa) and blocks of countries (OECD and RSADC). One of the main findings of the paper is that the policy implications of the "generalised" BOP growth model present a different perspective compared to the "specific" BOP model.

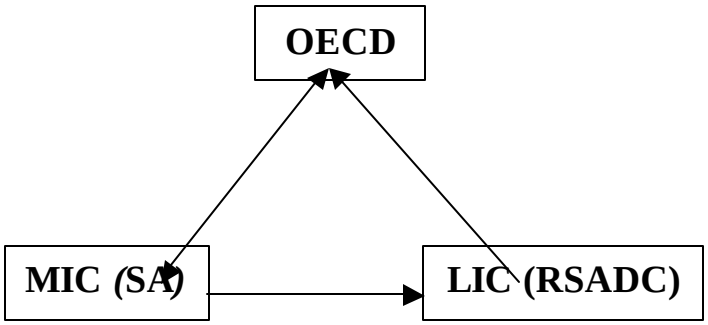
Although the policy implications are not mutually exclusive, they may be viewed from the different perspectives of OECD, SA and RSADC, respectively:

1. OECD growth is BOP constrained with respect to middle-income countries (MIC) represented by South Africa and low-income countries (LIC) represented by RSADC. OECD countries may not necessarily benefit by focusing on the usual policy implication of a BOP constrained economy: i.e. improving the structural demand features of OECD exports such as quality, design, product differentiation and delivery service. OECD countries are major suppliers of capital and intermediate goods, which play a crucial role in the growth and development process of MIC and LIC. These goods are "first" choice goods from the viewpoints of MIC and LIC. OECD will therefore benefit by keeping its sources of demand buoyant. The main policy implication for OECD may be to grant MIC and LIC greater access to their markets, because high rates of growth in these countries constitute important sources of demand for OECD.
2. South Africa is BOP constrained with respect to OECD. The message to policy-makers is plain: South Africa must make its goods more attractive abroad by improving the structural demand characteristics of its export goods.
3. RSADC is BOP constrained with respect to South Africa. From the viewpoint of policy makers in South Africa this is an important result. Growth-promoting policies in South Africa will have a significant and positive impact on RSADC growth. The long-run results indicate that a one percent increase in South Africa's growth will on average lead to a 1.76 percent increase in RSADC growth. From the perspective of RSADC, however, policy-makers should reduce their dependence on South Africa by improving the structural demand features of their exports to OECD countries.

Figure 4 presents a summary of the main findings of the paper.

Figure 4

A Summary of the BOP Constrained Growth Models



The results are strongly consistent with the BOP constrained growth model. The positive long-run growth relations stress the mutual interdependence of the world economy, where one country's (or block of countries) growth rate depends on others. Figure 4 shows that irrespective of which country's (or block of countries) growth rate is shocked, the growth process will become self-perpetuating.

EXPLAINING LONG-RUN GROWTH IN SOUTH AFRICA AND OECD COUNTRIES: IMPLICATIONS FOR THE REST OF SADC COUNTRIES

1. Introduction

In Thirlwall's (1979) seminal paper the idea was advanced and empirically verified that for a large group of countries the rate of growth of output is balance-of- payments (BOP) constrained because this sets the limit to the growth of demand to which supply can adapt (Thirlwall and Hussein, 1982: 498). The main essence of "Thirlwall's law" is that in an open economy expenditure cannot grow faster than income growth without creating a current account deficit on the balance of payments. A current account deficit cannot be sustained through an indefinite inflow of capital, because deficits above a certain percentage of GDP trigger negative signals to the international community that force countries to adjust (McCombie and Thirlwall, 1997). For a given rate of growth of exports, the brunt of the adjustment falls on a reduction in income growth to restore balance of payments equilibrium. An open economy's real economic growth rate is therefore determined by export growth for a given income elasticity of the demand for imports. The rate of growth of exports, in turn, is mainly a function of "world" income or "world" demand.

The main objective of this paper is to test the BOP growth model by examining the existence of a stable and positive long-run relation between the output growth rates of a

group of high-income countries (OECD), a middle-income country {South Africa (SA)} and a group of low-income countries {the rest of the Southern African Development

Community (RSADC)[3]}[4]. In this context, the paper makes several contributions.

First, Thirlwall's BOP constrained growth model is a specific case involving a bilateral trade relationship between one country and the "rest of the world". In this paper the specific case is generalised into a multilateral trade relation between an individual country (South Africa) and blocks of countries (OECD and RSADC). One of the main findings of the paper is that the policy implications of the "generalised" BOP growth model present a different perspective compared to the "specific" BOP model. Second, since all the output growth rate variables in this paper are stationary {I(0)}, the econometric methodology employed departs from standard cointegration techniques such as the Johansen procedure which tests whether non-stationary variables {I(1)} cointegrate to from an I(0) process. The methodology draws on recent advances in time series econometric techniques to show that policy inferences from all the *long-run growth rate* equations are rigorous as well as methodologically consistent.

The policy suggestions of the paper are particularly useful to promote growth in regions or continents where one country (South Africa) dominates other countries

[3] The Southern African Development Community is a multilateral economic co-operation scheme that includes fourteen countries from the Southern African Region: Angola, Botswana, Congo (Democratic Republic), Lesotho, Malawi, Mauritius Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

[4] The classification of countries into different income groups is mainly based on per capita income levels (World Development Report, 2000/2001). However, note that Botswana, Mauritius and Seychelles recored higher per capita income levels than South Africa in 1999. Nonetheless, these countries are still regarded as low-income countries based on their low levels of GDP compared to South Africa. In 1999 South Africa's level of GDP constituted 72% of SADC.

(RSADC) in terms of economic size. The results also indicate that if OECD countries grant middle-income- and low-income countries greater access to their market, the growth benefits are mutually inclusive.

The rest of the paper is organised as follows. Section 2 discusses the theoretical propositions of the BOP model and Section 3 the main features of the data. Section 4 presents the econometric methodology and Section 5 the empirical results. Section 6 concludes with policy implications.

2. Thirlwall's BOP Constrained Growth Model: A Generalised Version

Following Thirlwall (1979 & 1999), South Africa's current account of the balance of payments, measured in its own domestic currency, may be written as:

$$P_x X = P_f ME \tag{1}$$

P_x measures the average price of exports in domestic currency; X the quantity of real exports; P_f the average foreign price of imports; M the quantity of real imports; and E is the nominal exchange rate in units of domestic currency per unit of foreign currency.

By taking logarithms of equation (1) and expressing the result in *growth rates* we obtain the current account equilibrium of a *growing* economy:

$$(p_x + x) = (p_f + m + e) \tag{2}$$

The export and import demand functions expressed in *growth rates* are given by

$$x = \eta(p_x - pf - e) + \pi_1(y^{OECD}) + \pi_2(y^{RSADC}) \tag{3}$$

and

$$m = \psi(p_f + e - p_x) + \pi_1(y^{SA}), \tag{4}$$

where y^{OECD} is the output growth rate of OECD which proxies a part of "world" income or "world" demand; y^{RSADC} is the output growth rate of the rest of the Southern African

Development Community (RSADC) which proxies a part of "world" income or "world" demand; η is the price elasticity of the demand for exports (< 0); ε_1 and ε_2 are the income elasticities of the demand for South Africa's exports (> 0); ψ is the price elasticity of the demand for imports (< 0); y^{SA} is the growth rate of South Africa's (SA) domestic income; and π_1 is the income elasticity of South Africa's demand for imports (> 0).

Substituting (3) and (4) into (2) yields:

$$p_x + \eta(p_x - p_f - e) + \varepsilon_1(y^{OECD}) + \varepsilon_2(y^{RSADC}) = p_f + \psi(p_f + e - p_x) + \pi_1(y^{SA}) + e \qquad (5)$$

Solving for y^{SA} we obtain the growth rate of domestic income consistent with current account equilibrium (y^{SA*}):

$$y^{SA*} = \frac{(1+\eta+\psi)(p_X - p_f - e) + \varepsilon_1(y^{OECD}) + \varepsilon_2(y^{RSADC})}{\pi_1} \qquad (6)$$

If it is assumed that relative prices in international trade are constant ($p_x - p_f - e = 0$) based on the assumptions that prices are fixed in oligopolistic markets and/or that price reductions by one country can easily be matched by foreign competitors (Thirlwall, 1986), then equation (6) reduces to:

$$y^{SA*} = \frac{\varepsilon_1(y^{OECD})}{\pi_1} + \frac{\varepsilon_2(y^{RSADC})}{\pi_1}, \qquad (7)$$

or, equivalently:

$$y^{SA*} = \frac{x}{\pi_1} \qquad (8)$$

Equation (8) is known as "Thirlwall's law" and states that South Africa's long-run output growth rate is determined by the growth rate of exports for a given income

elasticity of the demand for imports. Equations (7) and (8) show that one country's output growth rate depends on the growth rate of other countries or blocks of countries (y^{OECD} and y^{RSADC}).

Equations (7) and (8) have a clear policy implication: for a given income elasticity of the demand for imports, non-price factors such as the structural demand characteristics of export goods will be the dominant determinants of South Africa's long-run output growth rate.

By following the same procedure as above, the output growth rates of RSADC and OECD consistent with current account equilibrium can be written as:

$$y^{RSADC*} = \frac{\pi_3(y^{OECD})}{\pi_2} + \frac{\pi_4(y^{SA})}{\pi_2} \tag{9}$$

and

$$y^{OECD*} = \frac{\pi_5(y^{SA}_{MIC})}{\pi_3} + \frac{\pi_6(y^{RSADC}_{LIC})}{\pi_3} \tag{10}$$

Equations (9) and (10) have the same interpretation as equation (7). The long-run output growth rates of RSADC and OECD are determined by the income elasticities of exports, for a given income elasticity of imports. Equation (10), however, may be regarded as a "world" growth rate equation. Equation (10) states that the long-run growth rate of OECD is BOP constrained with respect to the output growth rates of middle-income countries represented by South Africa (y^{SA}_{MIC}); and low-income countries represented by RSADC (y^{RSADC}_{LIC}).

Equation (10) is subject to several assumptions. Since the analysis is concerned with *growth rates* and not *levels* of output, it is possible to use the output growth rates of

individual countries or blocks of countries to represent larger blocks of countries. South Africa and RSADC are too small to affect the growth rate of OECD directly. However, if South Africa's trade structure reflects that of a typical middle-income country and RSADC's trade structure that of a low-income country, then equation (10) may be regarded as a "world" equation. Table 1 records the imports of middle-income countries (MIC) and low-income countries (LIC) as a percentage of the exports of high-income countries (HIC) and selected OECD countries.

Table 1

Imports of MIC and LIC as a percentage of Exports of HIC and Selected OECD Countries, 1998

(1)		(2)		(3)		(4)	
MIC/HIC	LIC/HIC	MIC/USA	LIC/USA	MIC/UK	LIC/UK	MIC/Germany	LIC/Germany
26.2	4.7	145.2	26.1	364.1	65.44	217.6	39.1

Source: World Development Report (2000/2001)

Column 1 shows that the MIC/HIC ratio is not negligible at around 26 percent, but the LIC/HIC ratio of 4.7 percent is small. Columns 2-4 show that the imports of MIC and LIC as a percentage of the exports of selected OECD countries are high in most cases. One of the main theoretical propositions of the BOP growth model is that the world economy is mutually interdependent; one country or block of countries' growth rate depends on others. So, if the growth rates of MIC and LIC only affect the growth rates of a few OECD countries, this may spread to other OECD countries which increases the average growth rate of OECD as a whole. Overall, the magnitudes of the ratios in Table 1

suggest that the imports of MIC and LIC may affect the exports of OECD, which, in turn, affects the output growth rate of OECD.

It is not unrealistic to assume that the growth rates of MIC and LIC affect OECD growth. OECD countries are major suppliers of capital and intermediate goods, which play a crucial role in the growth and development process of MIC and LIC. Nonetheless, OECD growth will still depend on the demand (income growth) for capital and intermediate goods from MIC and LIC.

Empirical applications of the BOP growth model usually focus on equation (8)[5]. This is a specific case involving a bilateral trade relationship between one country and the "rest of the world". In this paper the focus is on equations (7), (9) and (10). These equations represent a more general case of a multilateral trade relation between an individual country and blocks of countries. The policy implications of equations (7), (9) and (10) may also differ from those of an individual economy that is BOP constrained with respect to the "rest of the world".

2. Data Analysis

Figure 1 plots the real gross domestic product (GDP) growth rates of OECD, SA and RSADC over the period 1981-1998. The data are obtained from International Financial Statistics and World Development Indicators.

[5] For extensive surveys of the empirical literature see McCombie (1997) and McCombie and Thirlwall (1997).

The output growth rates in Figure 1 display several important features. First, there is a positive relation between the output growth rates. Second, there may be several outliers with respect to SA and RSADC. South Africa's growth rate was visibly slower than the rest in 1983 and 1985. Slower growth over these two years may be attributed to the sharp real exchange rate depreciation in 1983 and the immediate repayment of foreign debt in 1985. RSADC on the other hand, grows faster than the rest in 1987 and 1996. Third, all the output growth rates appear to be stationary {I(0)} in Figure 1. Phillips and Perron's (1988) semi-parametric correction to the Dickey-Fuller (DF) test in Table 2 confirms that all the growth rate variables are I(0) at the 5% significance level.

Figure 1

Real Gross Domestic Product (GDP) Growth Rates

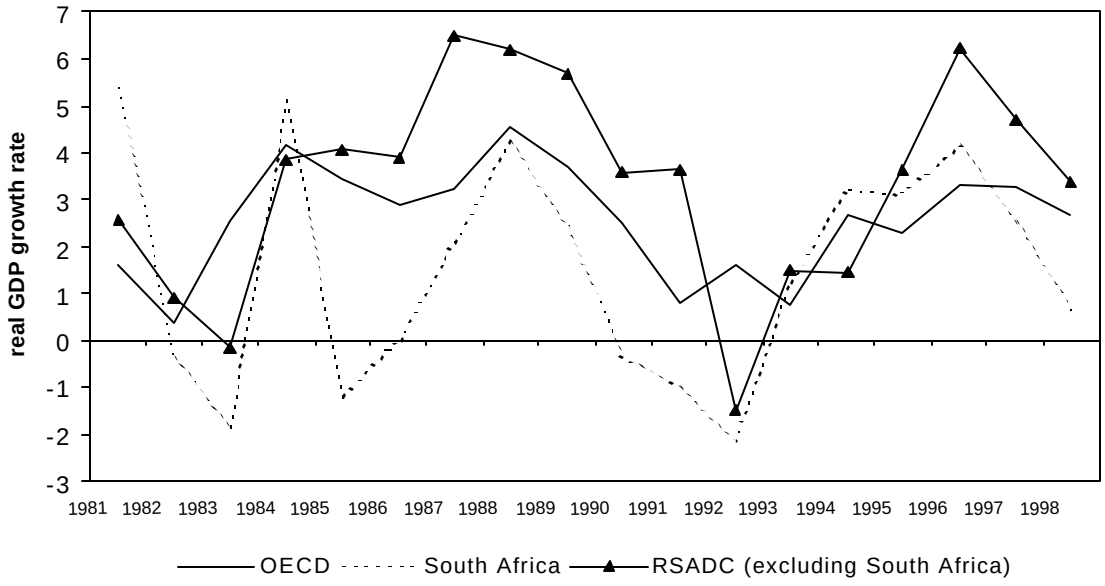


Table 2

Phillip-Perron (1988) Unit Root Tests

Variables	Phillips-Perron Tests
OECD	-3.80**
SA	-3.70**
RSADC	-3.74**

Notes:
1. The 95% critical value of Dickey and Fuller (1979) is -3.08. ** denotes significance at the 5% level.
2. The Phillips-Perron tests contain intercepts and no trends.
3. Phillips and Perron's (1988) semi-parametric correction to the DF test is based on Bartlett weights with a truncation lag of one.

3. Econometric Methodology

To test the BOP growth model for South Africa, OECD and RSADC, equations (7), (9) and (10) are transformed into unrestricted error correction models (UECM) derived from Auto Regressive Distributed Lag (ARDL) models of order one:

$$Dy^{SA} = b_0 + \jmath_1 Dy^{OECD} + \phi_2 Dy^{RSADC} + \phi_3 D^{SA} + \phi_4 D^{RSADC} + \delta_1 y^{SA}_{t-1} + \delta_2 y^{OECD}_{t-1} + \delta_3 y^{RSADC}_{t-1} + \varepsilon_{t2},$$

$$\phi_1 > 0;\ \phi_2 > 0;\ \phi_3 < 0;\ \phi_4 < 0;\ \delta_1 < 0;\ \delta_2 > 0;\ \delta_3 > 0 \qquad (11)$$

$$Dy^{RSADC} = c_0 + J_1 Dy^{OECD} + J_2 Dy^{SA} + J_3 D^{SA} + J_4 D^{RSADC} + l_1 y^{RSADC}_{t-1} + l_2 y^{OECD}_{t-1} + l_3 y^{SA}_{t-1} + \varepsilon_{t3},$$

$$J_1 > 0;\ J_2 > 0;\ J_3 > 0;\ J_4 > 0;\ l_1 < 0;\ l_2 > 0;\ l_3 > 0, \qquad (12)$$

$$Dy^{OECD} = a_0 + b_1 Dy^{SA} + b_2 Dy^{RSADC} + b_3 D^{SA} + b_4 D^{RSADC} + \alpha_1 y^{OECD}_{t-1} + \alpha_2 y^{SA}_{t-1} + \alpha_3 y^{RSADC}_{t-1} + \varepsilon_{t1},$$

$$b_1 > 0;\ b_2 > 0;\ b_3 > 0;\ b_4 < 0;\ \alpha_1 < 0;\ \alpha_2 > 0;\ \alpha_3 > 0 \qquad (13)$$

where D^{SA} is a short-run dummy variable that captures SA's slower growth rate relative to the others (see Figure 1) with values of unity in 1983 and 1985 and zero otherwise; D^{RSADC} is a short-run dummy variable that captures the faster growth of RSADC relative to the others (see Figure 1) with values of unity in 1987 and 1996 and zero otherwise; and a_0, b_0 and c_0 are intercept terms. Variables in differences (Δ) represent the short-run part of the models and variables in levels the long-run part of the models.

The long-run multipliers of equation (11) can be obtained by dividing δ_2 and δ_3 through by the absolute value of the error correction coefficient (δ_1):

$$y^{SA} = \sigma_1 y^{OECD} + \sigma_2 y^{RSADC}, \tag{14}$$

where $\sigma_1 = \frac{\theta_1}{\pi_1}$ and $\sigma_2 = \frac{\theta_2}{\pi_1}$.

The long-run multipliers of equation (12) can be obtained by dividing λ_2 and λ_3 through by the absolute value of the error correction coefficient (λ_1).

$$y^{RSADC} = \sigma_3 y^{OECD} + \sigma_4 y^{SA}, \tag{15}$$

where $\sigma_3 = \frac{\theta_3}{\pi_2}$ and $\sigma_4 = \frac{\theta_4}{\pi_2}$.

The long-run multipliers of equation (13) can be obtained by dividing α_2 and α_3 through by the absolute value of the error correction coefficient (α_1):

$$y^{OECD} = \sigma_5 y^{SA} + \sigma_6 y^{RSADC}, \tag{16}$$

where $\sigma_5 = \frac{\theta_5}{\pi_3}$ and $\sigma_6 = \frac{\theta_6}{\pi_3}$.

The magnitudes of the long-run coefficients in equations (14), (15) and (16) are determined by the income elasticity of the demand for exports divided by the income elasticity of the demand for imports.

The choice of ARDL models, or UECM's, which are simply re-parameterizations of ARDL's, is based on several advantages. First, Pesaran and Shin (1999) have shown that ARDL models yield consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I(1) or I(0).

Similarly, Inder (1993) shows that the omission of dynamics in static equations may be detrimental to the performance of the estimator in finite samples, and alternatively proposes the UECM which includes dynamics in the estimation of the short-run and long-run coefficients. Second, Pesaran (1997) and Inder (1993) have separately shown that the inclusion of dynamics may correct for the endogeneity bias of the regressors in ARDL's and UECM's, respectively. However, for the analysis to be rigorous and methodologically consistent, we follow Inder (1993) and apply Phillips and Hansen's (1990) Fully Modified OLS estimator to all the UECM's (FUECM's). Phillip and Hansen's (1990) semi-parametric corrections have the advantages of asymptotic optimality and an asymptotic distribution free of nuisance parameters (Inder, 1993:59).

4. Empirical Results

The UECM's and FUECM's are estimated over the period 1981-1998 using annual observations. Wars, political instability and civil strife in several individual RSADC countries are various factors, among others, that make it difficult to obtain reliable data for all the RSADC countries before 1980. For some applications long-run may imply a matter of months, for others 15 years, or for some a long time span of several decades (Hakkio and Rush, 1991; Maddala and Kim, 1998). Moreover, it is well known that the power of tests for long-run relations is not improved by increasing the frequency of the data. It is the length of the time series that matters not the frequency of observations (Shiller and Perron, 1985 ; Campbell and Perron, 1991). In a more general context, it is worth noting that it is up to the researcher to weigh up the advantages of using a very long time series against the disadvantages of increasing the probability of introducing

more unknown structural breaks into the analysis. Structural breaks inadvertently affect the power of unit root tests and long-run tests and may also lead to the predictive failure of error correction models (Clements and Hendry, 1997; Maddala and Kim, 1998).

4(i) Results for UECM's and FUECM's

The results for the parsimonious representations of the UECM's in equations (11) – (13) and their corresponding FUECM's are reported in Table 3. The semi-parametric corrections of the UECM's are based on a Bartlett lag window with a truncation lag of two. The F-tests and t-tests for the individual significance of the coefficients in the UECM's and FUECM's, respectively, support the model reduction process. None of the redundant regressor coefficients is significantly different from zero at the 10% level, while all the retained regressor coefficients are highly significant. The results are not reported for the individual significance of the intercept terms which were statistically insignificant in all the UECM's and FUECM's. The F-tests for the overall significance of the retained and redundant regressor coefficients of the UECM's provide further support of the model reduction process.

The following observations can be made. The error correction coefficients of all the UECM's and FUECM's are highly significant and correctly signed. All the models therefore represent a long-run equilibrium relationship. With one notable exception in columns 3(a) and 3(b), it is apparent that the magnitudes of the coefficients obtained from all the other UECM's and the FUECM's are very close. Suitable transformations of the

variables are performed to obtain more orthogonal model specifications (Hendry, 1995). When the coefficients of two variables yield equal magnitudes and opposite signs, the effect is captured as a differential in Table 3.

Table 3

Unrestricted Error Correction Models (UECM) and Fully Modified Unrestricted Error Correction Models (FUECM)

Dependent Variable	1(a) Δy^{OECD}_{UECM}	1(b) Δy^{OECD}_{FUECM}	2(a) Δy^{SA}_{UECM}	2(b) Δy^{SA}_{FUECM}	3(a) Δy^{RSADC}_{UECM}	3(b) Δy^{RSADC}_{FUECM}	3(c) $\Delta y^{RSADC(UECM)}_{REL}$
Δy^{OECD}	–	–	1.34*** (18.31)	1.26*** (39.13)	–	–	–
Δy^{SA}	–	–	–	–	–	–	–
Δy^{RSADC}	-0.30*** (-4.75)	-0.37*** (-11.28)	0.64*** (16.07)	0.66*** (45.03)	–	–	–
$(\Delta y^{SA} - D^{RSADC}_{t-1})$	0.74*** (14.51)	0.80*** (26.46)	–	–	–	–	–
$\Delta(y^{SA} - y^{OECD})$	–	–	–	–	1.04*** (16.17)	1.22*** (27.21)	–
y^{OECD}_{t-1}	-0.59*** (-7.46)	-0.59*** (-12.17)	0.49*** (12.91)	0.43*** (11.15)	F(1,11) = 0.66	t-test: 1.32	F(1,12) = 1.26
y^{SA}_{t-1}	0.48*** (8.94)	0.49*** (18.50)	-0.64 (-16.89)	-0.61*** (-35.95)	0.74*** (10.78)	0.71*** (20.11)	0.71*** (13.45)
y^{RSADC}_{t-1}	0.22*** (3.65)	0.22*** (7.30)	F(1,10) = 2.35	t-test: 1.83	-0.41*** (-10.25)	-0.25*** (-6.87)	-0.40*** (-10.51)
D^{SA}	3.16*** (14.14)	3.32*** (23.39)	-4.18*** (-16.79)	-4.17*** (-45.83)	3.63*** (9.19)	4.91*** (16.72)	3.46*** (10.69)
D^{RSADC}	–	–	-1.29*** (-4.77)	-1.38*** (-14.32)	2.06*** (5.94)	2.17*** (12.87)	2.13*** (6.47)

Table Continued (next page)

Table 3 Continued

Dependent Variable	1(a) Δy_{UECM}^{OECD}	1(b) Δy_{FUECM}^{OECD}	2(a) Δy_{UECM}^{SA}	2(b) Δy_{FUECM}^{SA}	3(a) Δy_{UECM}^{RSADC}	3(b) Δy_{FUECM}^{RSADC}	3(c) $\Delta y_{REL}^{RSADC(UECM)}$
Diagnostic Tests							
R^2 (adjusted)	0.95		0.99		0.96		0.95
F_{ret}	F(5,11) = 70.87***		F(5,11) = 336.46***		F(4,12) = 100.05***		F(3, 13) = 128.50
F_{red}	F(1,10) = 1.10		F(2,9) = 1.16		F(2, 10) = 2.36		F(2,11) = 2.90
LM^{ar}: $\chi^2(1)$	0.00		0.12		0.78		0.00
LM^{arch}: $\chi^2(1)$	0.02		2.22		2.88		1.48
$RESET^{ff}$	0.07		2.16		7.00***		0.30
N: $\chi^2(2)$	0.08		1.05		0.15		0.34
H: $\chi^2(1)$	0.75		0.00		2.65		0.001
Forecast: $\chi^2(6)$	0.78		8.22		6.08		3.77
Chow: F(6,5)	0.06		1.18		0.64		0.43

Notes:

1. Figures in parentheses ( ) are t-statistics. *** denotes significance at the 1% level ** at the 5% level.
2. R^2 is the coefficient of determination; F_{ret} is a F-test for the joint significance of the retained regressors; F_{red} is a F-test for the joint significance of the redundant regressors; LM^{ar} is a Lagrange Multiplier test for first order serial correlation; LM^{arch} is a Lagrange Multiplier test for auto regressive conditional heteroscedasticity; $RESET^{ff}$ is Ramsey's Reset test for functional form misspecification; N is a test for normality; H is a heteroscedasticity test statistic; *Forecast* tests whether the models suffer from predictive failure during 1993-1998; and *Chow* tests whether the models are structurally stable between the sub-periods 1982-1992 and 1993-1998.

The short-run coefficient of Δy^{RSADC} is negative in columns 1(a) and 1(b) and contradicts our *a priori* expectations, although it needs to be stressed that the BOP model is a theory of *long-run growth rates*. The long-run effect (y_{t-1}^{RSADC}) in columns 1(a) and 1(b) is positive and consistent with the BOP theory. In the short-run, the negative relation may reflect a delayed growth-effect between high-income OECD countries and low-income RSADC countries.

With one exception the UECM's in Table 3 pass all the diagnostic tests. The diagnostic tests show that the UECM in column 3(a) suffers from functional form misspecification. There also appears to be a large difference between the magnitudes of the coefficients of the UECM in column 3(a) and the FUECM in column 3(b). A Wald test showed that the coefficient of $\Delta(y^{SA} - y^{OECD})$ in column 3(a) is insignificantly different from unity (not reported here). A unit coefficient allows us to write (without any loss of information) the dependent variable as $\Delta y_{REL}^{RSADC} = \Delta y^{RSADC} - [\Delta(y^{SA} - y^{OECD})]$. The results for the UECM are given in columns 3(c). Two important results emerge. First, the magnitudes of the coefficients are very close in columns 3(a) and 3(c). Second, the UECM in column 3(c) now passes functional form specification. The results suggest that if there were any simultaneity problems in column 3(a), this is effectively addressed in column 3(c), where $\Delta(y^{SA} - y^{OECD})$ is endogenised.

Overall, the results in Table 3 indicate that all the UECM's are well determined, addresses the endogeneity problem, and passes a battery of diagnostic tests. In addition, the Chow tests for structurally stable equations between the sub-periods 1982-1992 and 1993-1998; and the overall forecast test for the period 1993-1998 in Table 3; show that

all the UECM's are structurally stable and produce good out-of-sample forecasts. None of the tests are significant at any reasonable level.

Figures 2(a) – (d) report the one-step ahead forecasts for all the UECM's in Table 3 over the period 1993-1998. All the forecasts are scaled by their 95 percent confidence bar intervals based on Hendry (1995). Figures 2(a) – (d) show how well the forecasts trace the actual values of all the UECM's. Constancy is easily accepted for all the UECM's, with every actual value falling well within the 95% confidence intervals of the individual forecasts. It is interesting to note that although the UECM in column 3(a) of Table 3 suffers from functional form misspecification, it produces satisfactory forecasts in Figure 2(c). Note that the forecasts in Figure 2 imply that the short-run and long-run coefficients of the UECM's are constant and structurally stable.

4(ii) Long-run Solutions of UECM's and FUECM's

The long-run solutions of the UECM's and FUECM's together with the long-run tests based on Pesaran *et. al.* (2001) are reported in Table 4. The long-run test is a standard F-test for the joint significance of the long-run coefficients in equations (11) - (13). Since this statistic has a non-standard distribution, Pesaran *et. al.* (2001) provide critical value bounds for a set of purely I(0) variables and purely I(1) variables.

Figure 2

One-Step Ahead Forecasts, 1993-1998

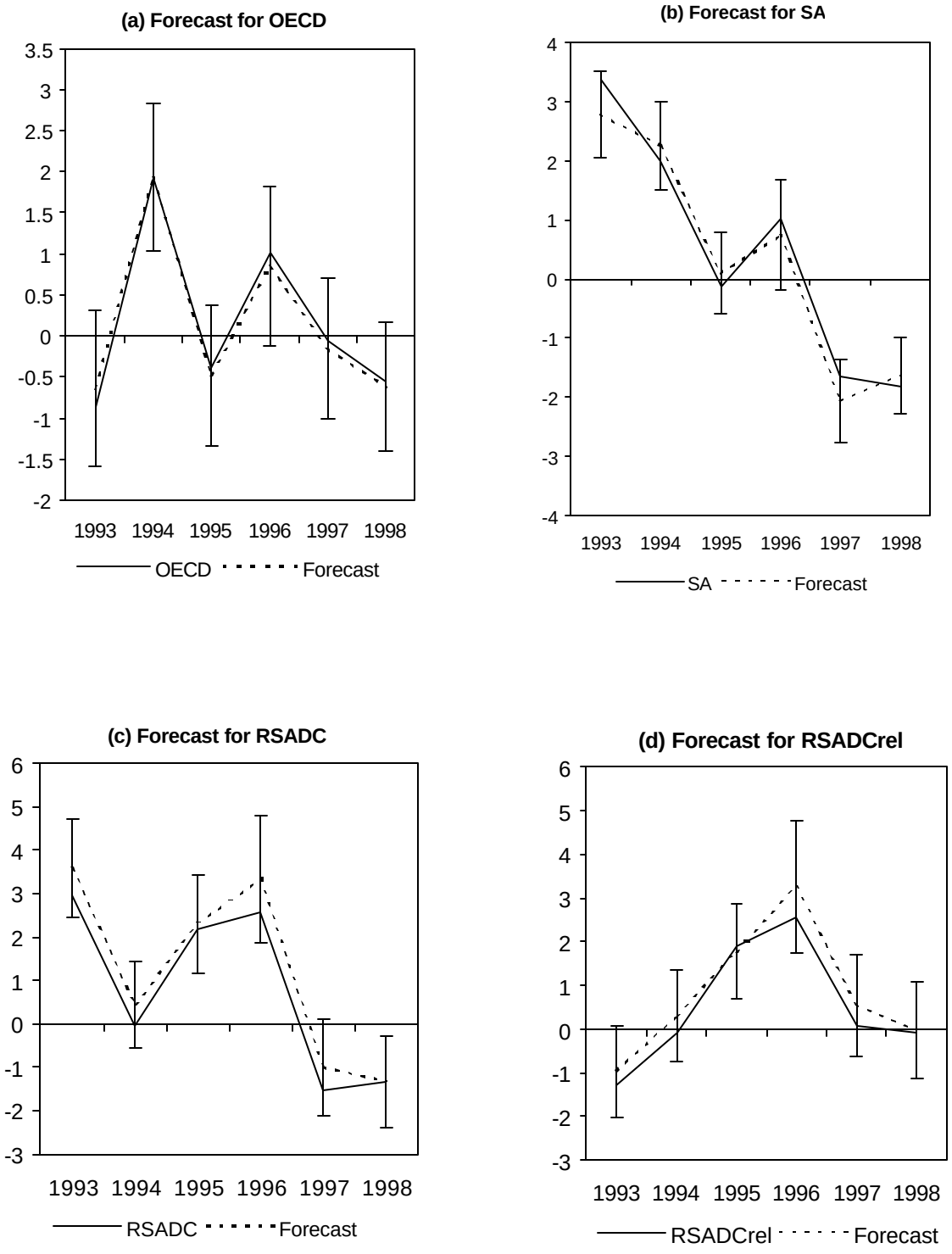


Table 4

Long-run Solutions of UECM's and FUECM's and Long-run Tests

Dependent Variable	1(a) y^{OECD}_{UECM}	1(b) y^{OECD}_{FUECM}	2(a) y^{SA}_{UECM}	2(b) y^{SA}_{FUECM}	3(a) y^{RSADC}_{UECM}	3(b) y^{RSADC}_{FUECM}	3(c) $y^{RSADC(UECM)}_{REL}$
y^{OECD}	–	–	0.76*** (15.11)	0.70*** (13.28)	insignificant	insignificant	insignificant
y^{SA}	0.80*** (5.48)	0.83*** (9.41)	–	–	1.81*** (12.51)	2.79*** (7.17)	1.76*** (13.91)
y^{RSADC}	0.38*** (6.15)	0.37*** (9.80)	insignificant	insignificant	–	–	–
Long-run Tests							
F-test	50.03***		151.43***		67.33***		92.74***
99% CV: I(0)	**3.88**		**4.81**		**4.81**		**4.81**
99% CV: I(1)	**5.30**		**6.02**		**6.02**		**6.02**
Final result	$OECD \Leftarrow SA, RSADC$		$SA \Leftarrow OECD$		$RSADC \Leftarrow SA$		$RSADC_{rel} \Leftarrow$ SA

Notes:

1. Figures in parentheses ( ) are t-statistics. *** denotes significance at the 1% level and ** at the 5% level.
2. Based on the general-to-specific methodology employed earlier, time trends and intercepts yielded insignificant results in al the UECM's. The 99% critical values (CV) in Table 3 are therefore consistent with the option of no intercept and no trend given in Pesaran *et.al*. (2001). The 99% critical values correspond to the I(0) and I(1) bounds in Pesaran *et. al*. (2001). Although the Phillips-Perron unit root tests indicate that all the variables are I(0) unit root tests are always subject to some degree of uncertainty. The critical values are also reported for I(1) variables which present a stricter tests than those for purely I(0) variables.

The magnitudes of the long-run coefficients derived from the UECM's and FUECM's are fairly close, except for those in column 3. Since the underlying UECM from which the long-run solution in column 3(c) was derived yielded good out-of-sample forecasts (Figure 2) and passed all the diagnostic tests (Table 3), the long-run interpretation will focus on the results in column 3(c). The Pesaran *et. al.* (2001) procedure resoundingly rejects the null hypothesis of no long-run relation in each equation based on the 99 percent critical values for I(0) and I(1) variables.

The BOP growth rates are obtained from the long-run models in Table 4 by substituting for the average growth rates of OECD, South Africa and RSADC in columns 1(b), 2(b) and 3(c), respectively[6]. From example, South Africa and RSADC's recorded average growth rates of 1.67 and 2.63 percent, respectively[7]. When these values are substituted for in column 1(b) of Table 4, OECD's BOP constrained growth rate is 2.35 percent {=(1.67 x 0.83) + (2.63 x 0.37)}. The BOP growth rates and the actual average growth rates are reported in Table 5.

Table 5

Testing the BOP Growth Model, 1981-1998

	Actual Growth rate (y)	BOP Growth rate (y^*)	Difference ($y - y^*$)	Wald test: χ^2: (1)
y^{OECD}	2.52	2.35	0.17	0.96 [0.32]
y^{SA}	1.67	1.76	-0.09	0.70 [0.40]
y^{RSADC}	2.63	2.93	0.30	2.32 [0.12]

[6] Although the long-run coefficients of the UECM's and FUECM's are close in magnitude, there is nevertheless a difference. To correct for any endogeneity bias the FUECM's in column 1(b) and 2(b) are used to derive the BOP growth rates for OECD and South Africa. In column 3(c) all the variables are endogenised, so these results are used to calculate the BOP growth rate for RSADC.

[7] South Africa and RSADC's average growth rates exclude the outliers identified in the previous sections.

The results in Table 5 strongly support the contention that the output growth rates of OECD, South Africa and RSADC are BOP constrained. The Wald tests (probability values in parentheses) show that the difference between the actual growth rates and the BOP growth rates is not significantly different from zero.

4(iii) Simulations based on the Generalized Impulse Response Analysis

Simulations present a useful exercise to supplement the long-run results derived from single equation UECM's. A systems approach by construction overcomes endogeneity problems and is not confined to a single long-run relation.

The simulations are based on the generalized impulse response (GIR) analysis described by Pesaran and Shin (1998). Unlike the traditional orthogonalized impulse response analysis, the GIR has the advantage that it is invariant to the ordering of the variables in the Vector Auto Regressive (VAR) model. The analysis is based on a VAR model of order one that includes the output growth rates of OECD, South Africa and RSADC[8]. A likelihood ratio test was performed to test the joint significance of the deterministic components in the VAR (not reported). Based on the results, the deterministic components include the two dummy variables D^{SA} and D^{RSADC}. The intercept terms were jointly insignificantly different from zero and therefore excluded from the deterministic components of the VAR.

[8] Given the low frequency of the data we start with a VAR of order one. The choice of an order one VAR is strongly supported by the diagnostic tests of all the single equation VAR's. The VAR's pass diagnostic tests such as first order serial correlation, heteroscedasticity and normality. Analogous system diagnostic tests of Hendry (1995) yielded similar results. All these results are available from the author.

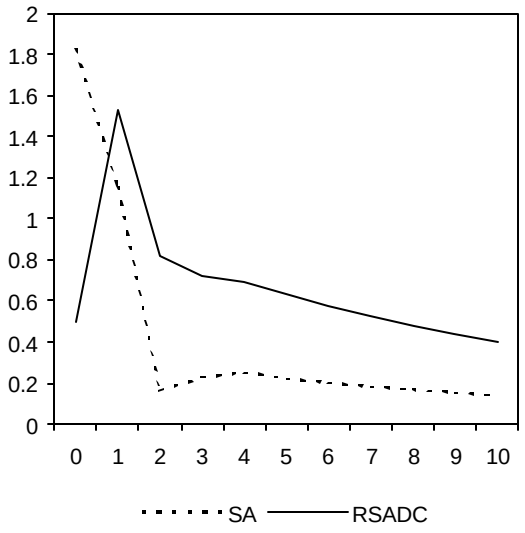
Figures 3(a) – (c) report the generalized impulse responses with respect to a one standard error shock to the three growth rate variables over a time horizon of ten years. The GIR's display several features that are strongly consistent with the UECM's in the previous section. First, all the growth rates react in a positive way to a one standard error shock and also display a high degree of persistence irrespective of which growth rate variable is shocked. Second, the impulse response of South Africa is very similar irrespective of whether OECD growth is shocked in Figure 3(a) or RSADC growth in Figure 3(c). Similarly, the impulse response of RSADC is virtually the same irrespective of whether OECD growth is shocked in Figure 3(a), or South Africa's growth in Figure 3(b). By contrast, OECD growth displays markedly different responses depending on whether South Africa's growth is shocked in Figure 3(b) or RSADC growth in Figure 3(c).

A possible reason why OECD growth displays different responses can be found in Table 4 of the previous section. The long-run results in columns 1(a) and 1(b) of Table 4 show that OECD growth is BOP constrained with respect to middle-income countries (MIC) represented by South Africa and also low-income countries (LIC) represented by RSADC growth. The impulse response of OECD growth will therefore react in different ways depending on whether the initial shock comes from MIC growth or LIC growth. On the other hand, South Africa's growth and RSADC growth will respond in virtually the same way irrespective of whether the initial shock comes from different sources. The answer again lies in Table 4. South Africa's growth is only BOP constrained with respect to OECD growth and RSADC growth is only BOP constrained with respect to South Africa's growth. For example, if we shock RSADC growth in Figure 3(c), South Africa's

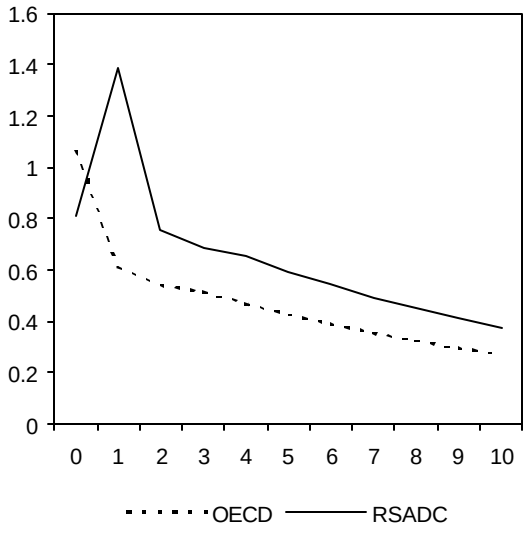
Figure 3

Generalised Impulse Response Analysis

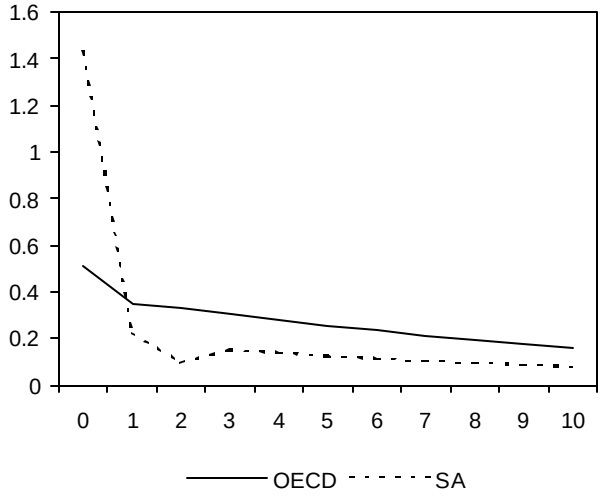
(a) Shock to OECD growth



(b) Shock to SA growth



(c) Shock to RSADC growth



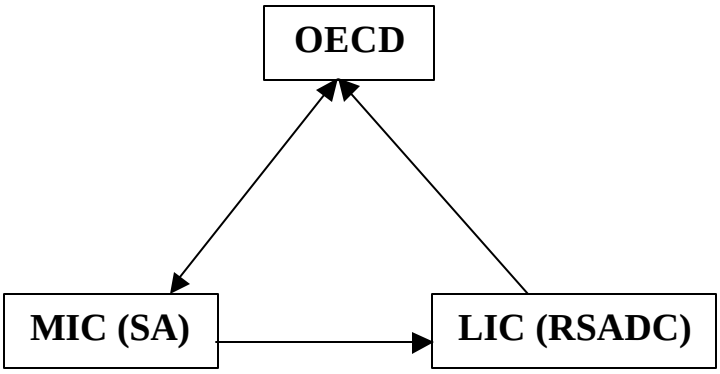
growth does not respond directly to the initial shock, but indirectly through LIC (RSADC) impact on OECD growth. The impulse response of South Africa's growth will therefore be the same in Figure 3(c) compared to Figure 3(a) where the initial shock comes from OECD growth.

Figure 3(b) shows that OECD growth is more responsive to a shock from MIC (South Africa) than a shock from LIC (RSADC). South Africa's growth rate in Figures 3(a) and 3(c) shows a large repsonse over the first two years, but thereafter seems to stabilise at a lower level. This seems to be consistent with the results in Table 3 column 2(b) and Table 4 column 2(b) respectively, which report a high short-run elasticity of 1.26 with respect to OECD growth and a much smaller long-run elasticity of 0.70. RSADC growth shows a large impulse repsonse in Figure 3(b) with respect to South Africa's growth. The long-run results of RSADC in Table 4 column 3(c) records a large elasticity of 1.76 with respect to South Africa's growth.

Figure 4 presents a summary of the main findings of the paper. The results are strongly consistent with the BOP constrained growth model. The positive long-run growth relations stress the mutual interdependence of the world economy, where one country's (or block of countries) growth rate depends on others. Figure 4 shows that irrespective of which country's (or block of countries) growth rate is shocked first, the growth process will become self-perpetuating.

Figure 4

A Summary of the BOP Constrained Growth Models



5. Conclusions and Policy Implications

This paper tests a "generalised" version of Thirlwall's balance-of-payments (BOP) constrained growth model by examining the existence of a stable and positive long-run relation between the output growth rates of OECD, South Africa and the rest of the Southern African Development Community (RSADC) over the period 1981-1998. The policy implications present a different perspective compared to the "specific" BOP growth model where an individual country is BOP constrained with respect to the "rest of the world".

Although the policy implications are not mutually exclusive, they may be viewed from the different perspectives of OECD, SA and RSADC, respectively:

4. OECD growth is BOP constrained with respect to middle-income countries (MIC) represented by South Africa and low-income countries (LIC) represented by RSADC. OECD countries may not necessarily benefit by focusing on the usual policy implication of a BOP constrained economy: i.e. improving the structural demand

features of OECD exports such as quality, design, product differentiation and delivery service. OECD countries are major suppliers of capital and intermediate goods, which play a crucial role in the growth and development process of MIC and LIC. These goods are "first" choice goods from the viewpoints of MIC and LIC. OECD will therefore benefit by keeping its sources of demand buoyant. The main policy implication for OECD may be to grant MIC and LIC greater access to their markets, because high rates of growth in these countries constitute important sources of demand for OECD.

5. South Africa is BOP constrained with respect to OECD. The message to policy-makers is plain: South Africa must make its goods more attractive abroad by improving the structural demand characteristics of its export goods.
6. RSADC is BOP constrained with respect to South Africa. From the viewpoint of policy makers in South Africa this is an important result. Growth-promoting policies in South Africa will have a significant and positive impact on RSADC growth. The long-run results indicate that a one percent increase in South Africa's growth will on average lead to a 1.76 percent increase in RSADC growth. From the perspective of RSADC, however, policy-makers should reduce their dependence on South Africa by improving the structural demand features of their exports to OECD countries.

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