



# **The Export-Output Relationship in South Africa: An Empirical Investigation**

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# The Export-Output Relationship in South Africa: An Empirical Investigation

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## Abstract

This study re-investigates the empirical relationship between exports and economic growth in South Africa using econometric techniques of co-integration and Granger causality over the period 1970Q1-2012Q4. The Johansen approach of co-integration shows that exports and GDP evolved together overtime, though deviations from the steady state might happen in the short-run. Furthermore, Granger causality based on a Vector Error Correction model (VECM) reveals the existence of short and long run bi-directional causality between export and GDP growth. Similarly, Granger causality based on an augmented vector auto-regression (VAR) model confirms that export Granger causes GDP and vice versa. Overall, the empirical findings of this study support the validity of export-led growth and growth-driven export hypotheses in the case of South Africa. The main policy implication of these results is that a speedy and sound execution of government's plans aimed at stimulating and diversifying production for export will contribute to the improvement of growth and employment prospects.

**Key words:** Export-led growth, Granger causality, South Africa

## 1 Introduction

The relationship between export expansion and economic performance has received an enormous attention in the literature of development economics. This was mainly due to the waning of the strategy of industrialization through import substitution (ISI) in favour of an export-oriented industrialization strategy (Salvatore, 2011: 380).

Most arguments in favour of an outward-oriented strategy emphasize trade openness by claiming that countries that increase their participation in international trade achieve long term economic growth faster than countries that are less open to global trade (see for example World Bank, 1993; Dollar and

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Kraay, 2005; and Pugel, 2007). These arguments are often buttressed by the East Asian miracle where the nexus between export and economic growth was evidenced between 1965 and the 1990s. The surge of exports that the Asian Tigers (Hong Kong, South Korea, Singapore, and Taiwan) experienced during that period is often seen as a key factor that explained their rapid economic performance (Weiss, 2005: 2-3).

Following the experience of East Asian countries, many developing countries have shifted their development strategies from inward looking (ISI) to outward looking strategies. In South Africa, this shift has initially been suggested in the post-apartheid government macroeconomic strategy, namely the Growth Employment and Redistribution Macroeconomic Strategy (GEAR)<sup>1</sup>. Roberts (2000: 270) points out that the policy swing was seen in GEAR as an important step that could result in an export-led growth (ELG).

Apart from GEAR, a number of other policy documents such as Trade and Industrial Policy, the New Growth Path (NGP) and the National Development Plan (NDP) have also alluded to the prominent role that export could play in driving economic growth. For instance, in the NDP it is noted that the rise of exports and competitiveness is crucial to increasing growth and employment in South Africa (RSA, 2011: 12).

Against this backdrop, the main objective of this paper is to investigate the empirical relationship between exports and economic growth in order to establish whether the hypothesis of ELG is valid for South Africa. This study contributes to the scanty empirical literature that exists on the topic in the case of South Africa. Moreover, the study attempts to clarify the channel through which export growth is expected to affect output growth. Lastly, contrary to previous South African studies, this study makes use of an empirical framework based on an augmented production function which controls for variables such as export and import.

The structure of the study is as follows: section II covers a review of the literature and theoretical background. Section III presents the empirical model, the methodological approach and data; section IV discusses the results; and the last section concludes.

## **2 Review of the literature and theoretical background**

This section begins by outlining trade policy in South Africa given the arguments that trade reforms lead to more trade which in turn contributes to economic growth. This is followed by an overview of a few empirical studies that have investigated the export-output relationship both internationally and in South Africa. The last part of this section presents a brief discussion of the benefits of export expansion as well as the channels via which export is expected to drive

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<sup>1</sup>In GEAR it is stated that: "...sustained growth on a higher plan requires a transformation towards a competitive outward-oriented economy" (RSA, 1996:3).

output growth.

## 2.1 Review of South Africa's trade reforms

In South Africa, the initial phase of trade reforms dates back to the 1970s when the Apartheid government decided to introduce market oriented policies together with import protection in order to diversify the export sector away from gold dependency. The first direct form of export incentives announced in 1972, was a tax allowance for export related marketing expenditures (Rangasamy, 2009: 604).

Subsequently, during the late 1980s and early 1990s, export subsidies and incentive schemes were strengthened so as to ease the burden on exporters. This was first evidenced by the introduction of the General Export Incentive Scheme (GEIS). The main aim of the GEIS was to provide a tax-free subsidy to exporters with the objective of fostering higher value added exports (Jonsson & Subramanian, 2001: 200; Cassim et al, 2004: 9).

Following the election of a new democratic government in 1994, a major shift in policies occurred; which led to a further intensification of liberal trade policies. This has made the South African trade regime considerably liberalized. For example, the new government announced a tariff liberalization program that went beyond its commitments to the World Trade Organization (WTO) in the Uruguay Round (Subramanian & Jonsson, 2001: 201). Furthermore, various bilateral and regional trade agreements were envisaged following the resurgence of South Africa on the global arena.

However, the recent government's approach to trade policy is to use tariffs strategically in line with current developments in the global trade. In response to these developments, a strategic framework for trade policy was launched in 2009 whereby government intends to use trade policies to boost economic growth, diversify export production, create employment and alleviate poverty. These objectives are less likely to be achieved with uniform tariff liberalization. Thus a selective (sector by sector) and flexible use of tariffs is needed to ensure that the economy is not locked into the production and export of primary commodities over the long run (see Department of Trade and Industry: South African Trade Policy and Strategic Framework 2009; Industrial Policy Action Plan 2013).

## 2.2 Empirical literature

Empirical studies have used both cross-sectional data and time-series data to examine the export-growth relationship. Cross sectional and panel data has been used in earlier studies; whereas time series observations are often employed in recent studies. Earlier studies have largely supported an ELG hypothesis as they have found statistically positive correlations between export expansion and economic performance (see studies conducted, among others, by Balassa 1978; Findlay 1984; Ram 1985; Fosu 1990 and Dodaro 1991).

These earlier studies are criticized due to a number of limitations including the assumption that countries have the same economic structure, technol-

ogy and production function. Moreover, the approach of rank correlation and Ordinary Least Square (OLS) used in these studies do not account for issues of causality nor capture dynamics behaviour between variables. Consequently cross-sectional analysis do not fully depict long run relationships such as exports and economic growth (Oskooee and Economidou, 2009: 179; Shirazi and Abdul, 2005: 474).

Current studies attempt to address these limitations by making use of time series data and by applying techniques such as co-integration analysis and Granger causality. However, these studies have reached mixed conclusions as in some cases the hypothesis of ELG is rejected while in other cases this hypothesis is found to be valid. This is mainly due to variables included (or omitted) in the model, methods used or periods covered.

The international literature of time series studies is abundant. A succinct review of selected studies includes the following: Henriques and Sardorsky (1996) test the ELG hypothesis in the case of Canada using annual data for the period 1870-1991. Based on the Johansen's procedure and Granger causality test, the study finds that export does not Granger cause growth, neither the opposite.

Ghatak and Price (1997) investigate the validity of the hypothesis for India during the period 1960-1992 by applying co-integration and error-correction techniques on both aggregated and disaggregated export data. For aggregate export, findings indicate that GDP growth causes export expansion. On the other hand, when considering the composition of export, the results show that export of machinery and transport equipment causes output growth; whereas traditional manufactured exports have little impact on growth.

Medina-Smith (2001) tests the ELG hypothesis for Costa Rica for the period 1950-1997. The author applies the techniques of Johansen's co-integration and Engle-Granger causality by making use of an augmented Cobb-Douglas production function. The findings of this study suggest that changes in exports explain both short and long run changes in economic growth; hence supporting the validity of an ELG hypothesis.

Herzer et al (2006) examine, through increases in Total Factor Productivity (TFP), the role of manufacturing and primary exports in Chili's economic growth for the period 1960-2001. Using the Johansen multivariate co-integration techniques, the study finds that exports have a significant impact on output growth. However, the impact of primary exports is less significant than the role of manufactured exports.

Tang and Lai (2011) re-investigate the hypothesis of ELG in the Asian four little dragons. Using co-integration and rolling causality techniques, the authors find evidence of ELG in all four countries in trivariate models. However, in bivariate models, the ELG is valid only for Hong Kong and Singapore. Moreover, the authors verify the stability of ELG by applying rolling regression based on Modified Wald tests. Their results suggest that the ELG hypothesis is unstable in all four countries.

In South Africa, few studies have explored the ELG hypothesis. The list includes: Ukpolo (1998) who investigates the export-led growth premise for the period 1964-1993 using co-integration and Granger causality techniques. The

author finds evidence that economic growth Granger causes exports; hence no validity of the ELG hypothesis. On the other hand, Rangasamy (2009) makes use of the same methodological approach for the period 1960Q1-2007Q3 and finds evidence of a unidirectional Granger causation running from exports to output. This entails that export growth contributes to economic growth. Likewise, Ziramba (2011) tests the hypothesis of export-led growth using the component of exports for the period 1960Q1- 2008Q3. The scholar applies the bounds test approach to co-integration and the Toda-Yamamoto Granger causality procedure. Findings from the latter technique show that only merchandise exports lead to GDP growth; while the former technique reveals the existence of a long run relationship among the composition of exports and GDP.

### 2.3 The export-growth nexus

The export-led growth strategy suggests that promoting and increasing the production for exports is crucial to driving economic growth (Felipe, 2003:3). This strategy is based on the idea that export driven policies contribute to economic performance. The proximate rationale behind the important role of export can be associated with direct and indirect benefits that accrue to exporting. These benefits can affect output through different channels which include the following:

i) As a component of aggregate demand, export expansion adds directly to aggregate output thereby boosting domestic output. Because export-oriented production is not limited by the small size of the local market, exports allow a country to access a sizable foreign demand for local exportable. From this perspective, exports growth provides a demand incentive that triggers high levels of domestic production, investments (mostly Foreign Direct Investments), profits, savings and growth (Ibarra 2010: 443; Weiss 2005: 9 and Ye Lim et al 2010: 1).

ii) A thriving export sector generates foreign exchange earnings. With the availability of foreign exchange earnings as a result of increase in exports, developing countries can afford to service their foreign debts (Jin, 2002:64). Furthermore, these earnings could facilitate the import of foreign intermediate and capital goods. There are static and dynamic gains in importing capital equipment. Static gains can accrue to both consumers and producers in the form of access to cheaper imports. On the other hand, the economy stands to benefit dynamic gains from capital goods imports in the form of higher productivity in the domestic economy. This is due to higher technology embodied in capital goods (Ghatak and Price, 1997: 539; Weiss, 2005: 9).

iii) Export expansion is expected to enhance specialization in sectors where a country enjoys comparative advantages. According to trade theory, specialisation improves efficiency in the allocation and utilisation of resources (Salvatore, 2011: 35). In other words, specialisation allows the reallocation of resources from the relatively inefficient non-tradable sectors to the more efficient tradable sectors (Mahadevan, 2007: 1071).

iv) Export expansion can lead to the realization of economies of scale. The role of exports in improving total factor productivity (TFP) growth results in reduced average production costs in the long run. According to the endogenous

growth theory, the concept of TFP encompasses a range of externalities, such as increasing returns to scale, Research and Development (R&D), combination of physical and human capital accumulation, learning, training, incentive to compete, improvements in product quality, distribution and marketing (De Melo and Robinson 1990: 2-8; He & Zhang 2008: 20).

As far as the association between trade and growth is concerned, De Melo and Robinson (1990: 2-8) argue that one possible channel of formalising this relationship is to construct a model that incorporate these externalities (dynamic gains from trade); that is, a model of endogenous growth. Salvatore (2011: 367) points out that the theoretical contribution of the new growth theory is the clarification of the channels via which trade is supposed to lead to higher growth in the long run. For instance, the model describes how an endogenously determined technological change generates externalities that compensate for any tendency to diminishing returns to capital accumulation.

Similarly, Grossman and Helpman (1990) investigate the mechanism through which international exchanges may improve long run growth by constructing a model of endogenous innovation and human capital formation (or endogenous technological progress). This model attempts to provide an understanding of the link between trade openness and long run economic performance. It basically argues that innovation, R&D or technological spillovers that sustain long run growth will benefit the local economy via international exchanges.

### 3 Empirical model, econometric methodology and data

#### 3.1 Empirical model

Considering the assumption that export expansion contribute to long run growth via increases in TFP, it can be argued that improvements in TFP spill over from the export sector to the rest of the economy, thereby leading to increasing returns in production (Salvatore, 2011: 366). Based on this assumption and following Herzer et al (2006), the basis of the empirical model is a production function denoted as follows:

$$Y = Af(K, L) \tag{1}$$

Where Y, A, K and L represent *TFP*, *output (GDP)*, *capital stock (GFCF)* and *labour* respectively. Because A is assumed to capture the dynamic gains from exporting as well as importing (e.g. import of technology-embodied capital goods), A can be modelled as  $A = f(X, M)$  where X and M denote *exports* and *imports* respectively<sup>2</sup>

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<sup>2</sup>It can be argued that A or TFP is affected by exports, via for example better access to production blue-prints, foreign technology through foreign direct investments (FDI are a key source of technology transfer and exporting firms tend to have a higher foreign ownership), improved allocative efficiency, exit of relatively inefficient firms, etc.

By replacing  $A = F(X, M)$  into equation (1) and taking logarithms, the linear form of the model is given by:

$$\log Y_t = \alpha + \beta \log K_t + \gamma \log L_t + \delta \log X_t + \theta \log M + \epsilon_t \quad (2)$$

Where  $\alpha$  is a constant,  $\epsilon_t$  is the stochastic error term which is assumed to measure the impact of all other explanatory factors;  $\beta$ ,  $\gamma$ ,  $\delta$ , and  $\theta$  are coefficients of the independent variables. The coefficients  $\delta$  and  $\theta$  are assumed to measure the effect of export and import on TFP, while the coefficients  $\beta$  and  $\gamma$  are elasticities.

From the aggregate demand identity, a positive influence of exports on GDP is arithmetically obvious because exports are a component of GDP. In order to have an estimate of GDP that does not include the positive influence of exports resulting from national account identity, it is parsimonious to separate this influence from the economic impact of exports on output. Hence, following Ghatak and Price, and Herzer et al (2006), a measure of net GDP is calculated by subtracting export from GDP as follows: GDP net of Exports or  $YN = Y - X$ . Replacing Y by YN, equation (2) becomes:

$$\log YN_t = \alpha + \beta \log K_t + \gamma \log L_t + \delta \log X_t + \theta \log M + \epsilon_t \quad (3)$$

In what follows, the econometric procedures pertaining to the estimation of equation (3) are explained; thereafter the empirical analysis is carried out in section IV.

### 3.2 Methodology

The study makes use of the Johansen co-integration procedure as well as Granger causality techniques. The reason for using the Johansen approach of co-integration is to account for the long-run behavioural causal relationships that might emerge between export and output growth (Awokuse, 2003: 129). In other words, this procedure is useful in revealing the existence of a long run co-integrating relationship between exports and GDP. Furthermore, the value of this approach is that it determines a system of variables endogenously; hence avoiding the issue of normalizing the co-integrating relation on one of the variables (Herzer et al, 2006: 314)

The application of the co-integration technique requires some prior testing of the series. The first step consists of verifying the time series 'order of integration. This step involves the use of unit roots tests to check for stationarity. Second, if the series are found to be of the same order of integration, the Johansen's (1998) multivariate test for co-integration will be performed. Third, in the event that a co-integration relationship is found among the variables an Error Correction Model (ECM) will be estimated to account for short- run dynamics in the system as well as the long -run equilibrium mechanisms. Fourth, Granger causality based on the ECM is performed to ascertain the direction of dynamic relationships. The reason for using Granger causality is to establish whether the ELG hypothesis is valid in the case of South Africa. In addition to the ECM



based Granger causality, an augmented VAR based Granger causality test (the Toda Yamamoto procedure) is also used to cross check the results.

### 3.3 Data

Apart from the employment data, the data source of this study is the South African Reserve Bank (SARB) quarterly bulletins. This data is expressed in constant prices (2005) and covers the period extending from 1970Q1 to 2012Q4. The employment data is obtained from Statistics South Africa (P0211 - Quarterly Labour Force Survey 2008Q1-2012Q4) and from Hodge (2009) who constructed annual employment series from 1946 to 2007.

Given the difficulties of obtaining reliable quarterly data for export sectors such as agriculture, manufacturing and mining; the present analysis is restricted to aggregate exports. On the other hand, employment data (1970-2007) obtained from Hodge was interpolated by applying the quadratic match average function (Eviews, 2009) in order to obtain quarterly values

## 4 Empirical investigation

This section covers the discussion about the empirical results. It first presents the visual representation of the variables; which is followed by the analysis of time series properties. Thereafter, the tests for co-integration are carried out followed by the testing of the null of Granger non-causality using the VECM and Toda Yamamoto technique.

### 4.1 Preliminary investigation of the data

Before analyzing time series properties, a preliminary visual analysis of the data can be insightful. Gujarati & Porter (2009:749) argue that a graphical representation of the series provides a primary clue of the expected nature of the series with regard to the inclusion or not of a trend, a constant or both in the model. This analysis is done by using time graphs of all the variables. These variables include GDP net of exports (denoted GDPnet), GFCF (proxy for Capital input), Labour, total Exports and Imports. Figure 1.1 shows a graphical representation of these variables for the period 1970Q1-2012Q4.

The GDP net series displays an upward linear trend for the period under review; while the GFCF series depicts considerable swings around an almost horizontal trend from the 1970s through the 2000s. The level of Capital stock has increased since 2001 owing to an acceleration of both public and private sector investments. However, GFCF has declined in 2009 due to the global recession before a mild rebound from 2011. The fluctuations in the employment series exhibit a rough upward trend followed by a decline in the mid-1990s; thereafter the upward trend in employment is almost steady owing to a relatively robust growth registered in the economy for most of the 2000s. However, the 2008 recession induced an increase in unemployment. Exports and Import series

show virtually similar patterns in that they fluctuated around a horizontal trend from 1970 to the late 1980s; thereafter they increased monotonically, except for a decline around 2009 due to the global recession.

## 4.2 Analysis of time series properties

A look at figure 1 reveals that all series exhibit a time trend. This is evidence that the series are non-stationary; which means that they may have unit roots. This study employs the Augmented Dickey Fuller (ADF) and Philip Peron (PP) unit root tests to verify stationarity.

Table 1 shows the results of PP and ADF unit root tests. Irrespective of the inclusion of a constant or a linear trend in the test regressions, the results indicate that all series are non-stationary in their levels, but stationary in their first differences. Since all variables are non-stationary in their levels and integrated of the same order in their first difference, co-integration tests can be performed.

## 4.3 Co-integration tests

The test for co-integration uses the Johansen procedure. This approach leads to the estimation of the number of co-integrating relations among the variables in the system. It is based on the estimation of a VAR(p) model which can be expressed as follows:

$$Y_t = \mu + \sum_{k=1}^p \Pi_k Y_{t-k} + \varepsilon_t \quad (4)$$

Where  $Y_t$  is the  $k$  vector of non-stationary I(1) variables,  $\mu$  denotes the vector of constants,  $\Pi_k$  represents the coefficient matrix,  $p$  is the lag length and  $\varepsilon_t$  denoted the vector of innovations. Since the vector of variables is assumed to be I(1), letting  $\Delta Y_t = Y_t - Y_{t-1}$  is an attempt to reach stationarity; thus the first difference notation of equation (1) which is reformulated in a VECM is as follows:

$$\Delta Y_t = \mu + \sum_{k=1}^{p-1} \Gamma_k \Delta Y_{t-k} + \Pi Y_{t-1} + \varepsilon_t \quad (5)$$

Where  $\Pi$  and  $\Gamma_k$  are coefficient matrices and the rank  $r$  of matrix  $\Pi$  will determine the co-integrating rank or the number of co-integrating relations. Equation (5) denotes an uneven degree of integration because some variables such as  $\Delta Y_t$  and  $\Delta Y_{t-k}$  are I(0) and other like  $Y_{t-1}$  are I(1). For the purpose of running a co-integration test, it is parsimonious that all variables on the left and the right hand side of equation (5) have the same degree of integration.

Therefore, if the rank  $r$  of matrix  $\Pi$  equals zero that is if  $r = 0$ ,  $\Pi=0$ . But if  $r > 0$ , the parameters of  $\Pi$  will be such that  $\Pi Y_{t-1}$  is stationary. In the case where  $r = 0$ ;  $\Pi = 0$ , there is no co-integration. But in the event that  $r > 0$ , there will be  $r$  possible linear combinations of the vector  $Y_t$ . This means that there will be  $r < k$  co-integrating relations. If  $0 < r < k$ ,  $\Pi$  has a reduced rank

matrix which can be separated into two matrices  $\alpha$  and  $\beta$  with rank  $r$  such as that:

$$\Pi Y_{t-1} = \alpha\beta'Y_{t-1} \quad (6)$$

Where  $\beta'Y_{t-1}$  is the co-integrating relations; the property of the vector  $\beta$  is such that  $\beta Y_t$  is stationary even if  $Y_t$  itself is non-stationary. The  $\alpha$  term contains the coefficients of the error correction vector; these coefficients measure the speed of adjustment toward equilibrium.

Within the Johansen framework, the formal tests for co-integration use the trace and maximum eigenvalue statistics. The trace statistic is a test of the null hypothesis that there are at most  $r$  co-integrating vectors against the alternative hypothesis of  $k$  co-integrating vectors. The maximum eigenvalue statistic tests the null hypothesis of the existence of  $r$  co-integrating relations against the alternative hypothesis of  $r + 1$  co-integrating vectors. (Maddala and Kim, 1998: 211-212). These two tests are presented below:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^n \ln(1 - \lambda_i), \text{ and} \quad (7)$$

$$\lambda_{max}(r, r + 1) = -T \sum \ln(1 - \lambda_{r+1}) \quad (8)$$

In both tests  $T$  represents the number of observations and  $\lambda_i$  are the smallest values of the coefficient matrix  $\Pi$  or the determinant equation. The decision rule is such that the null hypothesis of zero co-integration vectors is rejected in favour of the alternative hypothesis of  $r$  co-integrating vectors if the likelihood ratio is greater than the critical values.

Table 2 contains the results of the Johansen co-integration test based on VAR(5). The selection of lag 5 was based on three selection criteria models, namely the Akaike Information criteria (AIC), Schwarz information criterion (SC) and Hannan-Quinn (HQ) information criteria. Moreover, a VAR residual serial autocorrelation test indicated that residuals are white noise for a maximum lag length of five for each variable (LM test:  $\chi^2=24$ ; p-value=0.52).

The Johansen test reported in Table 2 compares the Trace and Maximum-Eigen statistics with their critical values at 5% level of significance. Both statistics reject the null hypothesis of no co-integration; hence the conclusion that there exists a unique co-integrating relation between the variables at 5% level of significance. The presence of co-integration suggests causality between variables at least in one direction.

#### 4.4 Granger causality test based on a VECM

Having found a unique co-integrating relation among the variables, Granger causality can be conducted in order to establish the direction of causality and thereby determining whether the hypothesis of ELG is valid. Following Engle and Granger (1987), a VECM representation is used for this purpose. A VECM allows for capturing long run dynamics via the Error Correction Term (ECT).

Besides revealing long-run relationships, short run dynamic effects are also inferred from the VECM by imposing restrictions on lagged differenced terms, that is, through the testing (Wald test) of lagged differenced terms of independent variables. The VECM representation with five variables can be expressed as follows:

$$\begin{aligned} \Delta \log YN &= \mu_1 + \sum_{k=1}^p [\beta_{1k} \Delta \log YN_{t-k} + \delta_{1k} \Delta \log K_{t-k} + \varphi_{1k} \Delta \log L_{t-k} \\ &\quad + \alpha_{1k} \Delta \log X_{t-k} + \sigma_{1k} \Delta \log M_{t-k}] + \lambda_1 ECT_{-1} + \varepsilon_1 \end{aligned} \quad (9)$$

$$\begin{aligned} \Delta \log K &= \mu_2 + \sum_{k=1}^p [\beta_{2k} \Delta \log YN_{t-k} + \delta_{2k} \Delta \log K_{t-k} + \varphi_{2k} \Delta \log L_{t-k} \\ &\quad + \alpha_{2k} \Delta \log X_{t-k} + \sigma_{2k} \Delta \log M_{t-k}] + \lambda_2 ECT_{-1} + \varepsilon_2 \end{aligned} \quad (10)$$

$$\begin{aligned} \Delta \log L &= \mu_3 + \sum_{k=1}^p [\beta_{3k} \Delta \log YN_{t-k} + \delta_{3k} \Delta \log K_{t-k} + \varphi_{3k} \Delta \log L_{t-k} \\ &\quad + \alpha_{3k} \Delta \log X_{t-k} + \sigma_{3k} \Delta \log M_{t-k}] + \lambda_3 ECT_{-1} + \varepsilon_3 \end{aligned} \quad (11)$$

$$\begin{aligned} \Delta \log X &= \mu_4 + \sum_{k=1}^p [\beta_{4k} \Delta \log YN_{t-k} + \delta_{4k} \Delta \log K_{t-k} + \varphi_{4k} \Delta \log L_{t-k} \\ &\quad + \alpha_{4k} \Delta \log X_{t-k} + \sigma_{4k} \Delta \log M_{t-k}] + \lambda_4 ECT_{-1} + \varepsilon_4 \end{aligned} \quad (12)$$

$$\begin{aligned} \Delta \log M &= \mu_5 + \sum_{k=1}^p [\beta_{5k} \Delta \log YN_{t-k} + \delta_{5k} \Delta \log K_{t-k} + \varphi_{5k} \Delta \log L_{t-k} \\ &\quad + \alpha_{5k} \Delta \log X_{t-k} + \sigma_{5k} \Delta \log M_{t-k}] + \lambda_5 ECT_{-1} + \varepsilon_5 \end{aligned} \quad (13)$$

Where  $p$  is the lag order;  $\beta_i$ ,  $\delta_i$ ,  $\varphi_i$ ,  $\alpha_i$  and  $\sigma_i$  are coefficients of lagged differenced endogenous variables; and  $ECT_{-1}$  is the one period lag value of the ECT. The ECT coefficient  $\lambda$  is assumed to measure the speed of adjustment toward long run equilibrium. This coefficient is expected to be negative for the long run relationship to be restored.

The results reported in table 3 can be interpreted as follows:

i) The coefficients  $\lambda$  of the error correction term (ECT) are statistically significant in GDP, export and import equations. This result reveals the existence of long run Granger causality from exports and imports to economic growth; as well as from economic growth to exports and imports. It therefore shows that there exists a bi-directional causation between exports and GDP in the long run. This implies that export growth Granger causes GDP growth via channels such as increased productivity gains in the tradable sector. Similarly, this finding suggests that output growth Granger causes export growth through an overall economic performance which creates economies of scale leading to costs reduction and high productive capacity.

ii) The ECT coefficient in the output equation is negative (-0.13) as expected. This finding indicates that the system converges toward a long run steady state.

Moreover, the value of the ECT term could be interpreted as representing a 13% adjustment back towards long run equilibrium after a shock. This is a relatively slow adjustment toward equilibrium.

iii) The lagged differenced coefficients of GDP and export are significant in the export and GDP equations respectively. This entails that short run dynamic effects run from exports to GDP and vice versa. Similar to the long-run feedback effects, this finding provides further support for a bi-directional Granger causality between export and GDP. In other words, the evidence not only supports the export-led growth hypothesis; but also the notion that output growth leads to export expansion.

#### 4.5 Toda-Yamamoto Granger causality test

Contrary to the VECM representation, the Toda-Yamamoto (T-Y) causality procedure does not depend on the prior existence of co-integrating relations among the variables. For this reason, this procedure is most likely to improve the power of Granger causality than other Granger causality techniques (Awokuse, 2003:130).

The Toda-Yamamoto approach suggests the use of a modified Wald test for restrictions on the coefficients of a  $VAR(k)$  in levels. This VAR model is then augmented (over-fitted) with an extra lag denoted d-max, which represents the maximum order of integration of the variables, so that the order of the VAR becomes  $p = k + d$ . The parameters of the last d-max lagged vectors are not included in the Wald test; only the first k parameter matrices are included. By using an over-fitted VAR such as  $VAR(k + d)$ , this approach ensures that Wald test statistics have their usual asymptotic chi-square distribution under the null hypothesis (Toda and Yamamoto, 1995: 245-246).

The Toda-Yamamoto procedure can be illustrated by constructing a VAR model with two variables, namely output Y and export X, as follows:

$$\begin{aligned} \log Y_t = & \alpha_0 + \sum_{i=1}^p \alpha_{1i} \log Y_{t-i} + \sum_{j=p+1}^{d \max} \alpha_{2j} \log Y_{t-j} + \sum_{i=1}^p \beta_{1i} \log X_{t-i} \\ & + \sum_{j=p+1}^{d \max} \beta_{2j} \log X_{t-j} + \epsilon_{1t} \end{aligned} \quad (14)$$

$$\begin{aligned} \log X_t = & \mu_0 + \sum_{i=1}^p \mu_{1i} \log X_{t-i} + \sum_{j=p+1}^{d \max} \mu_{2j} \log X_{t-j} + \sum_{i=1}^p \varphi_{1i} \log Y_{t-i} \\ & + \sum_{j=p+1}^{d \max} \varphi_{2j} \log Y_{t-j} + \epsilon_{2t} \end{aligned} \quad (15)$$

From equations (14) and (15), one can then test the hypothesis that the parameters of only the first p lagged values of X are zero in Y; and vice versa. Hence, the null hypothesis  $H_0$  that:  $\beta_{11} = \beta_{12} = \dots = \beta_{1p} = 0$  against the alternative  $H_A$  that: not  $H_0$ , is a test that export (X) does not Granger cause

GDP(Y). Likewise, testing  $H_0: \varphi_{11} = \varphi_{12} = \dots = \varphi_{1p} = 0$  against the  $H_A$  that  $\varphi_{11} = \varphi_{12} = \dots = \varphi_{1p} \neq 0$  is the test that output does not Granger cause export. In either case, the rejection of the null hypothesis implies a rejection of non-causality, which entails the existence of Granger causality.

Table 4 reports causality results using the Toda-Yamamoto procedure. This procedure estimates long run Granger causality since it is based on an augmented VAR object in level. The optimal lag order in the VAR was found to be five ( $k=5$ ); this was increased by one extra lag ( $dmax=1$ ) since the order of integration is one. Hence, Wald tests were applied to the first  $k$  coefficients of VAR(5+1); rejection (significance) of the null infers Granger causality from regressors to dependent variables.

The second column of table 4 shows that capital stock, employment, export and import Granger cause output since their coefficients are significant. On the other hand, column 5 indicates that output, capital stock and imports Granger cause exports. Considering the export-output nexus in particular, the results suggest the existence of bi-directional Granger causality between export and output in the long run, which corroborates the above findings. Table 5 summarizes the results of the two approaches.

## 5 Conclusion and recommendations

The relationship between export and economic growth has received a particular interest in international and development economics. Indeed, the experience of Asia Tigers has led to the abandonment by many developing countries of ISI policies in preference for an outward-oriented strategy. South Africa has also in some way resorted to this strategy given the policy priority that exports expansion continues to receive in government programs.

This study re- investigates the empirical relationship between exports and economic growth in South Africa using econometric techniques of co-integration and Granger causality over the period 1970Q1-2012Q4. The Johansen approach of co-integration suggests that exports and GDP move together in the long-run, though deviations from the steady state might happen in the short-run. Furthermore, Granger causality based on a Vector Error Correction model reveal the existence of short and long run bi-directional causality between export and GDP growth. Similarly, Granger causality based on an augmented vector auto-regression model confirms that export Granger causes GDP in the long run and vice versa. Overall, the empirical findings of this study support the validity of export-led growth and growth-driven export hypothesizes in the case of South Africa. These conclusions are in line with previous studies' findings which have either found a unidirectional causality from export to GDP (Rangasamy, 2009 and Zimbara, 2011) or from GDP to Export (Ukpolo, 1998).

With reference to the export-growth nexus, the implications for policy include boosting measures which aim not only at stimulating production for exports, but also at diversifying the content and the destination of exports. In this respect, a number of government policy programs relating to export promotion

initiatives appear to be on the right track. However, a successful execution of these measures in tandem with other policies (demand-led initiatives) is needed in order to boost growth and employment prospects in South Africa.

With respect to employment creation, the manufactured sector has a substantial potential to drive economic growth and employment creation. Also manufacturing has become crucial to the government 'strategy of export diversification. Further studies that dig into the role of the major components of manufactured exports in driving growth and employment will be informative with regard to policy direction.

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**Table 1: PP and ADF unit root tests, 1970Q1-2012Q4**

Variables	PP t-statistic			ADF t-statistic		
	Critical values (1)	Level	First differences	Critical values (1)	Level	First differences
LogGdpnet(YN)	-2.88*	1.58*	-23*	-2.88*	1.89*	-3.76*
	-3.44**	-0.94**	-24.66**	-3.44**	2.27**	-5.41**
LogCapital(K)	-2.88*	-0.95*	-13.79*	-2.88*	0.42*	-3.94*
	-3.44**	-0.4**	-13.89**	-3.44**	-0.52**	-4.2**
LogLabour(L)	-2.88*	0.47*	-9.11*	-2.88*	0.35*	-9.12*
	-3.44**	-1.05**	-9.16**	-3.44**	-1.15**	-9.20**
LogExports(X)	-2.88*	-0.32*	-20.28*	-2.88*	-0.17*	-6.86*
	-3.44**	-3.2**	-20.4**	-3.44**	2.31**	-6.88**
LogImports(M)	-2.88*	0.65*	-13.68*	-2.88*	1.11*	-4.96*
	-3.44**	-1.38**	-13.96**	-3.44**	-0.92**	-5.35**

Notes: 1. (1) Critical values @ 5% are from MacKinnon (1996) and are the same in level or in first differences

2. \* denotes the inclusion of a constant and \*\* denotes the inclusion in test regression of a constant plus time trend

3. The lag order in both tests was selected automatically. The PP tests used the Newey-West Bandwidth, whereas the ADF tests used the Schwarz information criterion (SIC) which selected lag length from a maximum of 13 lags

Source: Own calculations

**Table 2: Johansen Co-integration tests; 1970Q1-2012Q4**  
**Variables included in the unrestricted VAR(5): logYN, logK, logL, logX, logM**

N0 of co-integrating vectors		Trace Statistic	Max-Eigen Statistic
Null	Alternative		
r=0	r=1	88.9(69.8)*	48.8(33.9)*
r≤ 1	r=2	40.1(47.9)	20.9(27.6)
r≤ 2	r=3	19.3(29.8)	11.6(21.1)
r≤ 3	r= 4	7.7(15.5)	7.6(14.3)

Notes: figures in parentheses are critical values @ 5% level. These values are derived from MacKinnon-Haug-Michelis (1999) p-values, \* indicate rejection of  $H_0$  at 5% significant level; the model include unrestricted intercepts.

**Table 3: Granger causality test based on VECM (9)-(13); 1970Q1-2012Q4**

Regressors	Coefficients of lagged dependent variables				
	$\Delta \log YN$	$\Delta \log K$	$\Delta \log L$	$\Delta \log X$	$\Delta \log M$
ECT(-1)	-0.13 [-6.45]*	0.005 [0.14]	0.006 [0.40]	0.234 [4.45]*	-0.146 [2.06]*
$\Delta \log YN(-4)$	-	30.97 (0.000)*	3.56 (0.468)	12.6 (0.013)*	10.83 (0.029)*
$\Delta \log K(-4)$	17.87 (0.001)*	-	1.83 (0.768)	10.63 (0.031)*	6.77 (0.147)
$\Delta \log L(-4)$	3.07 (0.546)	3.1 (0.542)	-	11.12 (0.025)*	6.99 (0.136)
$\Delta \log X(-4)$	37.56 (0.000)*	15.62 (0.003)*	4.64 (0.327)	-	6.72 (0.152)
$\Delta \log M(-4)$	25.63 (0.000)*	4.03 (0.402)	2.94 (0.568)	8.37 (0.079)	-

Notes: Values in square brackets are *t*-statistics for ECT coefficients. Values in parentheses are *p*-values of reported Wald statistics for lagged differenced coefficients. \* indicate significance at 5% level.

**Table 4: Granger causality test based on the Toda-Yamamoto approach**

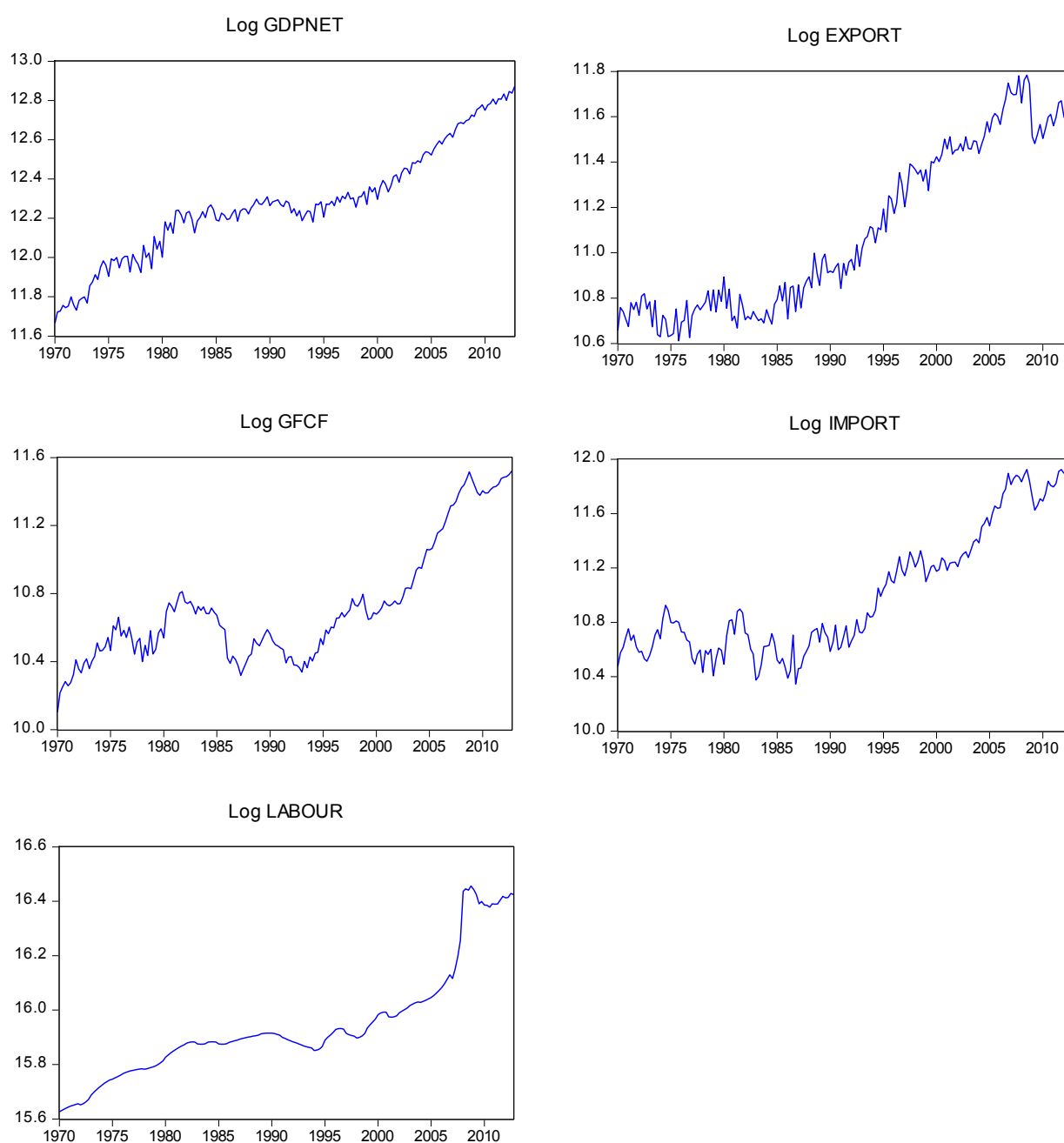
Regressors	Dependent variables				
	$\log YN$	$\log K$	$\log L$	$\log X$	$\log M$
$\log YN$	-	1.29 (0.255)	2.07 (0.150)	12.74 (0.000)*	0.03 (0.857)
$\log K$	4.93 (0.027)*	-	1.91 (0.167)	12.54 (0.000)*	0.2 (0.658)
$\log L$	4.94 (0.036)*	3.55 (0.060)	-	0.04 (0.842)	0.42 (0.515)
$\log X$	14.67 (0.000)*	0.01 (0.908)	1.42 (0.233)	-	5.66 (0.017)*
$\log M$	5.85 (0.016)*	6.44 (0.011)*	1.57 (0.996)	14.45 (0.000)*	-

Note: A VAR(6) was estimated using the Seemingly Unrelated Regressions estimator. Reported values are Wald statistics with *p*-values in parentheses. \* indicate significance at 5% level.

**Table 5: Summary of Granger causality tests**

	Direction of Causality	Equation	Chi-square (Wald tests)	t-statistics ECT	Conclusion
<b>Long run causality: T-Y</b>	EXP→GDP	(14)	14.67	-	Yes
	GDP→EXP	(15)	12.74	-	Yes
<b>Long run causality: ECM</b>	EXP→GDP	(9)	-	6.45	Yes
	GDP→EXP	(12)	-	4.45	Yes
<b>Short run dynamics: ECM</b>	EXP→GDP	(9)	37.56		Yes
	GDP→EXP	(12)	12.60		Yes

**Figure 1: Log of Gdpnet, Export, GFCF, Import and Labour: 1970Q1-2012Q4**



Source: SARB, online statistical query