The current issue and full text archive of this journal is available on Emerald Insight at:
www.emeraldinsight.com/2040-0705.htm

Received 17 June 2017
Revised 28 January 2018
Accepted 15 June 2018

Real exchange rate undervaluation and sectoral growth in South Africa

Brian Tavonga Mazorodze
University of Zululand, KwaDlangezwa, South Africa, and
Dev D. Tewari
Faculty of Commerce Administration and Law, University of Zululand, KwaDlangezwa, South Africa

Abstract

Purpose – The purpose of this paper is to establish the empirical link between real exchange rate (RER) undervaluation and sectoral growth in South Africa between 1984 and 2014.

Design/methodology/approach – The study employs a dynamic panel data approach estimated by the system generalised method of moments technique in a bid to control for endogeneity.

Findings – The authors find a significant positive impact of undervaluation on sectoral growth which increases with capital accumulation. Also, the authors confirm that undervaluation promotes sectoral growth up to a point where further increases in undervaluation retards growth.

Practical implications – The results confirm the importance of policies that keep the domestic currency weaker to foster sectoral growth.

Originality/value – The originality of this paper lies in establishing the impact of exchange rate undervaluation on growth at a sector level in the context of South Africa using a dynamic panel data approach.

Keywords Real exchange rate undervaluation, Sectoral growth, System GMM

Paper type Research paper

Introduction

The ongoing economic slowdown in South Africa against a backdrop of a weakening currency[1] has once again underscored the need for examining carefully how currency depreciation affects economic growth. This recent experience is quite contrary to the idea of undervaluation-led growth and consequently raises questions on currency depreciation as a precondition of the growth process as claimed in the work of Rodrik (2008). Although recent years have seen an explosion of studies addressing this issue, much of the empirical effort (Rodrik, 2008; Béreau *et al.*, 2009; Elbadawi *et al.*, 2012; Couharde and Sallenave, 2013) has focussed on overall economic growth. Sectoral effects of exchange movements have not received a fair share of scholarly attention and where such empirical studies have been conducted, the results have largely been inconclusive (see Brixiová and Ncube, 2014).

Why results are so inconclusive is not obvious but in large part reflects three methodological issues. The first is that the majority of studies (Razin and Collins, 1997; Di Nino *et al.*, 2011; Ghura and Grennes, 1993; Haddad and Pancaro, 2010; Eichengreen, 2007; Dubas, 2012; Béreau *et al.*, 2009, 2012; Couharde and Sallenave, 2013) have focussed mainly on overall growth, an approach which assumes homogeneity of sectors. However, it is widely acknowledged that sectors respond differently to appreciation and depreciation of

© Brian Tavonga Mazorodze and Dev D. Tewari. Published by Emerald Publishing Limited. This article is published under the Creative Commons Attribution (CC BY 4.0) licence. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this licence may be seen at http://creativecommons.org/licences/by/4.0/legalcode

African Journal of Economic and Management Studies
Vol. 9 No. 4, 2018
pp. 462-476
Emerald Publishing Limited
2040-0705
DOI 10.1108/AJEMS-06-2017-0132

the exchange rate depending on the degree of sector tradability (Ngandu, 2008). Failure to capture such heterogeneity of sectoral responses, in turn, surfaces the problem of aggregation bias and consequently, the inferences drawn from such analyses may be misleading. Second, the few available sector-specific studies (Njindan, 2017; Masunda, 2011; Berka *et al.*, 2014; Bhorat *et al.*, 2014; Brixiová and Ncube, 2014) in exception of Vaz and Baer (2014) rarely adequately address endogeneity of the real exchange rate (RER). Third, most of the sectoral studies have mainly focussed on the contemporaneous effect of exchange rate undervaluation on sectoral growth: an approach which does not accommodate the delayed effects of undervaluation.

Taking the above limitations into account, we contribute to the ongoing debate of exchange rates and economic growth by using a sectoral approach to shed light on the effects of exchange rate undervaluation on growth of six sectors in South Africa. The sectors considered are agriculture, mining, manufacturing, tourism, financial and the personal services sector for the period spanning 1985 through 2014. Previous studies on exchange rate undervaluation in the context of South Africa are Bhorat *et al.* (2014), Zwedala (2013), Elbadawi *et al.* (2012), Sibanda *et al.* (2013), Mpofu (2013), Ngandu (2008) and Njindan (2017). Our study differs in that it uses a system GMM estimator and a dynamic panel data approach at a sectoral level with a sample that consists of both goods and service sectors. This means that unlike previous work, we are better able to deal with endogeneity issues based on a sample with more sectoral diversity.

The rest of the paper unfolds as follows: literature review (which covers both theoretical and empirical review), methodology (which provides data description and specifies the empirical models), empirical results and policy implications.

Literature review

A number of explanations have been proposed in the literature as to how the RER affects economic growth. These explanations focus particularly on the deviation of the actual RER from an ideal exchange rate which is conceptually termed "misalignment". Generally, misalignment takes two forms, overvaluation and undervaluation and these two may have distinct effects on economic growth. For Ebaidalla (2014), exchange rate overvaluation and undervaluation capture the consequences of distortionary monetary and exchange rate policies on the allocation of resources between exporting sectors and import competing sectors. It affects sectoral growth through a number of channels. First, an overvalued exchange rate results in a loss in economic competitiveness of export and import competing sectors within an economy. Since the RER is a relative price, its overvaluation would make it difficult to sell in a foreign market and this can compromise the growth of tradable sectors which mainly produce for the foreign market (Razin and Collins, 1997).

For sectors that produce homogenous products which are standard, market power is non-existent and this leads to a reduction of profit margins as a result of an overvalued RER (Abida, 2011). For industrial sectors, an overvalued exchange rate is deleterious due to forward and backward linkages that exist across sectors (Dubas, 2009). In this regard, overvaluation effects on tradable sectors like agriculture will be spread to other sectors through the spillover mechanism. Service sectors (finance, insurance, real estate and communication) are also impacted by an overvalued exchange rate with services that are reliant on the tourism industry likely to suffer mostly (Dubas, 2009). If an economy can market itself as a potential destination worth visiting like South Africa, then tourism may become a source of export of revenue. When the local currency is overvalued, tourism may be hard-hit as an overvalued exchange rate makes the country an undesirable destination and this later causes service sectors to lose out.

In general, however, the goods markets are severely affected by an overvalued exchange rate. Both export and import competing sectors lose out financially in terms of profit. As a result, current and future investment is likely to be affected leading to a decline in growth of the sectors concerned (Toulaboe, 2006). RER overvaluation can impact both domestic and foreign investment in tradable sectors of the economy (Razin and Collins, 1997).

While overvaluation is argued to generally retard growth, undervaluation is believed to promote economic growth and Mbaye (2012) emphasises the capital accumulation hypothesis as a channel through which the exchange rate undervaluation affects growth. Levy-Yeyati and Sturzenegger (2003) argue that an undervalued RER can increase savings through a number of channels. In particular, an undervalued RER implies that firms are paying low wages in real terms and this lowers costs of production so that firms in sectors can invest more.

Another theoretical proposition that has been used to link exchange rate undervaluation to growth is that of export-led growth. This hypothesis holds that expansion of exports is a key to growth and an undervalued RER encourages exports in tradable sectors such as agriculture, mining and manufacturing (Rodrik, 2008). Advocates of export-led growth argue that increased exports are an engine of growth (Giles and Williams, 2000). Other scholars, Aizenman and Lee (2010), Benigno *et al.* (2015) and McLeod and Mileva (2011) in particular argue the presence of learning by doing effects external to the individual firm in the traded goods sector which means that a weak RER would be needed to support the production of tradables. Rodrik (2008) on the other hand raises the idea that a real undervaluation fosters growth by incentivising production of tradable goods which are generally characterised by market distortions and institutional weaknesses. This argument forms the theoretical basis of our analysis as we intend to empirically establish the link between a real undervaluation and sectoral growth in the context of South Africa.

At an empirical level, an earlier study by Dollar (1992) shows that overvaluation harms growth, whereas Razin and Collins (1997) and Aguirre and Calderón (2005) confirm that large overvaluation and undervaluation hurt growth, while modest undervaluation enhances growth. Similarly, Hausmann *et al.* (2005) demonstrate that rapid growth accelerations are often associated with RER depreciations.

Vaz and Baer (2014) analyse the impact of RER undervaluation on manufacturing sectors in Latin America. From a panel data set covering 39 countries and 22 manufacturing sectors (two-digit) for the period 1995–2008, they confirm a positive and significant impact of undervaluation on the manufacturing sector. A similar result is confirmed in a recent study by Njindan (2017) for particular sectors, who empirically tests the impact of a real undervaluation on South Africa's agriculture, industry and services sectors. Results from ordinary least squares and generalised method of moments techniques based on annual time series data for the period 1962–2014 show that RER undervaluation correlates positively and significantly with agriculture and industry but correlates negatively with services. Interestingly, Rodrik (2008) documents a negative relationship between undervaluation and the agriculture sector.

While Njindan (2017) documents a positive impact of undervaluation on agriculture and industry, Masunda (2011) reports a negative and significant impact of undervaluation on Zimbabwe's agriculture, manufacturing and mining sectors using the feasible generalised least squares approach in the context of Zimbabwe for the period spanning 1980–2003. Brixiová and Ncube (2014) in the context of Zimbabwe focussing on three sectors agriculture, mining and manufacturing conclude that overvalued exchange rates have contributed to economic collapse of sectoral growth in Zimbabwe but they do not find a robust positive link between undervaluation and sectoral growth.

Béreau *et al.* (2009) and Couharde and Sallenave (2013) use panel smooth transition regressions (PSTR) and find non-linear effects of RER misalignment on growth. Habib *et al.* (2017) analyse the impact of RER on economic growth based on a panel data set of over 150 countries in the post-Bretton Woods period. Unlike previous literature, they use external instruments (global capital flows interacted with individual countries financial openness and the growth rate of official reserves) to deal with possible reverse causality from growth to the RER. They find that a real depreciation significantly raises annual real GDP growth only in the context of developing countries and for pegs.

Haddad and Pancaro (2010) focus on the link between RER undervaluation, exports and growth in the case of developing countries. They show that a RER raises economic growth but the effect is relevant for low income countries and only in the medium run. Levy-Yeyati and Sturzenegger (2007) show that undervaluation facilitates growth through the expansion of savings while Korinek and Servén (2010) provides evidence that undervaluation raises growth through learning by doing externalities in the tradable sectors.

In the South African context, Elbadawi *et al.* (2012) using the generalised method of moments (GMM) and 77 countries including South Africa for the period 1970–2004 conclude that overvaluation is detrimental on economic growth and the effect is more severe in countries with a fragile financial system. Recently, a similar finding is confirmed in Iyke and Odhiambo (2015) using panel data techniques on 15 Sub-Saharan countries that include South Africa over a 40-year period. The authors relied on the within estimators and the GMM techniques and confirm a positive relationship between two measures of real undervaluation and economic growth while the converse relationship is confirmed between RER overvaluation and economic growth.

Di Nino *et al.* (2011) provide evidence of a positive correlation between undervaluation and economic growth based on a panel data set spanning the period 1861–2011. They additionally show that undervaluation supported growth through raising the volume of exports from high-productivity sectors in Italy during the 1861–2011 period. Kappler *et al.* (2013) on the other hand find that the effects on output are limited between 1960 and 2008. Glüzmann *et al.* (2012) conclude that undervaluation does not have a significant influence on the tradable sector, but tends to promote domestic savings and investment. Similarly, Nouira and Sekkat (2012) do not find any evidence that undervaluation promotes economic growth when overvaluation episodes are excluded from the analysis.

Country specific studies for South Africa are very scant. Among them is a study by Sibanda *et al.* (2013) which applies the Johansen and Julius test for cointegration and the vector error correction model on data observed at quarterly intervals from 1990:01 to 2010:04 and reveal a negative effect of misalignment on economic growth. Zwedala (2013) on the other hand uses the behavioural equilibrium approach to measure RER misalignment and the vector error correction model to establish its growth effects. For the period 1985–2011, the results show that RER misalignment stimulates economic growth if it comes in form of undervaluation. Bhorat *et al.* (2014) estimate sectoral employment effects of exchange rate fluctuations in South Africa using annual data observed from 1975 to 2009. They focus on non-agricultural sectors and methodologically rely on a regression model similar to the one employed by Chen and Dao (2011). Their findings indicate an inverse relationship between RER appreciation and employment in tradable sectors.

Özyurt (2013) conducts a similar analysis but focuses on the service sector in a panel setup consisting of 66 countries (including South Africa) for the period stretching from 1983 to 2007. The results confirm that currency undervaluation, per capita income and productivity have a significant influence on expansion of services. Mpofu (2013) using an autoregressive distributed lag bounds testing procedure finds a positive impact of RER undervaluation on employment in South Africa's manufacturing sector. A similar result is confirmed in Ngandu (2008) using a computable general equilibrium model.

From the above reviewed literature, it apparent that the impact of undervaluation remains inconclusive from both theoretical and empirical standpoints. In light of this unsettled debate, we contribute mainly by conducting a dynamic panel data approach at a sectoral level in order to address aggregation bias that may have confounded the results obtained in earlier studies taking into account that most of them were performed at an aggregated level.

Methodology

Data description

Our empirical analysis is based on six sectors, namely, agriculture, mining, manufacturing, tourism, financial and the personal service sector. The analysis is spanning the periods 1985–2014. The starting period allows us to focus on the period where South Africa was operating a flexible exchange rate policy post the breakdown of the Bretton Woods system of pegged rates. The Bretton Woods system collapsed in 1973 but South Africa continued to operate a pegged rate regime until the early 1980s. Selection of the ending period on the other hand is based on data availability. Following Rodrik (2008), data are converted into five-year averages in order to remove cyclical effects. This transformation yields six non-overlapping five-year windows (1985–1989, 1990–1994, 1995–1999, 2000–2004, 2005–2009 and 2010–2014). This implies six observations per sector. The final panel property of the data is, therefore, $T=6$, $N=6$. The data sources are World Development Indicators (WDI), South Africa Statistics, PENN World Tables version 9.0 and QUANTEC.

Empirical model

We calculate RER undervaluation following an approach documented in Rodrik (2008). With this approach, the undervaluation index is essentially a measure of domestic price level that is adjusted for the Balassa–Samuelson effect and is constructed in three steps. The first step involves calculation of the RER through the purchasing power parity (PPP) conversion factor; the second step regresses the computed RER on per capita GDP to control for the Balassa–Samuelson effect. In this study, the Stock and Watson (1993) dynamic ordinary least squares estimation technique was used to estimate the RER and per capita GDP model in a bid to address endogeneity issues. This estimation technique uses leads and lags of first differenced regressors in addressing endogeneity. We used 1 lead and 1 lag selected automatically by the Schwarz Information Criteria. The third step measures undervaluation as the difference between the actual RER and the value of the RER predicted in the second step. Whenever the undervaluation index exceeds 1, the currency is considered undervalued. The steps are as follows:

$$\ln RER_t = \ln\left(XRAT_t/PPP_t\right), \tag{1}$$

where *XRAT* and *PPP* denote the exchange rate and the purchasing power parity, respectively expressed as national currency units per US dollar. In order to control for the Balassa–Samuelson effect, In RER_t is then regressed against gross domestic product per capita:

$$\ln RER_t = \lambda + \delta \cdot \mathrm{lnGDPpc}_t + \varepsilon_t, \tag{2}$$

Undervaluation is then defined as the deviation of the actual RER, from the Balassa–Samuelson adjusted rate as follows:

$$\ln UNDERVAL_t = \ln RER_t - \ln \widehat{RER}_t, \tag{3}$$

where $\ln \widehat{RER}_t$ is the predicted value of the RER; a value of UNDERVAL above unity indicates an undervalued currency which makes goods produced domestically relatively cheaper in terms of the dollar. On the other hand, a value of UNDERVAL that is less than unity will signify an overvaluation of the local currency in dollar terms. When transformed in logarithmic form as we do in our regression analysis, we find a mean of 0.007 and a standard deviation of 0.038. The mean statistic of lnUNDERVAL suggests an UNDERVAL (antilog) average value of roughly 1.02 and since it is above unity, then the currency was on average undervalued.

In the next step, we need a model that specifies how our measure RER undervaluation (lnUNDERVAL) measured in Equation (3) affects sectoral growth. In this regard, we consider a Solow-type sectoral conditional convergence growth theoretical model which controls for lnUNDERVAL, initial income and sector-specific factors. According to this sectoral conditional convergence model, a sector that starts off poor is predicted to grow faster and catch up with richer sectors and it takes the following form:

$$\hat{y}_j = \beta\left(\ln y^*\left(\Theta_j\right) - \ln y_i\right) + \varepsilon_j. \tag{4}$$

This model has also been used in related studies such as Vaz and Baer (2014) and Karadam (2014), where $\hat{y}_j$ denotes the growth rate in sector j, Θ_j is a vector of sector-specific factors that govern the long-run steady state, β is the rate of convergence and ε_j is a random error term. What enters Θ_j are called growth fundamentals which are essentially a set of factors that tell us where each sector is heading in the long run. While this set of fundamentals is large in principle, only key sector-specific factors, labour and capital plus the exchange rate undervaluation are considered as conditioning variables for the purpose of this discussion. Empirically following the works of Vaz and Baer (2014) and Karadam (2014), the measure of undervaluation generated from Equation (3) is then used as the main regressor in this sectoral conditional convergence equation in order to appreciate how it affects sectoral growth:

$$\ln Y_{it} = \lambda + \delta \cdot \ln Y_{it-5} + \omega \cdot \ln UNDERVAL_t + \varphi \cdot \ln \chi_{it} + \mu_i + \eta_t + \varepsilon_{it}, \tag{5}$$
$$i = 1, 2, \ldots, 6 \; t = 1, 2, 3, \ldots, 6$$

From Equation (5), the dependent variable is sectoral growth which is a change in the average annual growth of a five-year non-overlapping window. Differentiating Equation (5) with respect to In *UNDERVAL* yields the slope coefficient of interest, ω, which governs how undervaluation of the local currency interacts with sectoral growth. Symbol χ is a 2×1 vector of explanatory variables which includes employment and capital formation in each sector, φ is a 2×1 vector of slope coefficients and $\ln Y_{it-5}$ represents initial income which is proxied, in this case, by the natural logarithm of output in each sector at the start of every five-year non-overlapping period. The convergence term, δ, being negative or positive would be taken to reflect conditional convergence or divergence of sectoral growth, respectively that is conditioned on employment in each sector, capital formation plus a measure of exchange rate undervaluation. Lastly, μ_i and η_t absorb sector and time fixed effects, respectively, while ε_{it} is the error term with usual properties $\varepsilon_{it} \sim \text{iid}(0, \sigma^2)$.

Capital, proxied by gross fixed capital formation, enters the regression model as a regressor with an expected positive sign. The theoretical argument behind this *a priori* expectation is that investment adds up to the available capital stock within the sector necessitating an increase in capital stock that is corresponded by an increase in sectoral growth. Labour is captured by employment in each sector. From standard growth theory, a positive sign is *a priori* expected.

Estimation

Equation (5) can conventionally be estimated using either the pooled least squares, fixed effects or the random effects. In our case; however, an appropriate estimation approach must be able to account for endogeneity that is likely to emanate from two important sources. The first is the Nickell–Hurwicz bias due to the initial income variable $\mathbf{lnY_{it-5}}$ in Equation (5). This bias confounds every dynamic model estimated by one-way fixed effects techniques in the presence of finite $\mathbf{T}$. Nickell (1981) shows that the fixed effects estimator will carry a bias of $\mathbf{O}(1/\mathbf{T})$ in a dynamic model setup and that this bias can be severe in small $\mathbf{T}$. For panels with $\mathbf{T}$ around 30, the bias could be as high as 20 per cent of the true value

(Judson and Owen, 1999). The limit of $\hat{\boldsymbol{\rho}}-\boldsymbol{\rho}$ as $\mathbf{N}\rightarrow\infty$ will approximately be $-(1+\boldsymbol{\rho})/(\mathbf{T}-1)$ (Nickell, 1981). In our case for ρ and $\mathbf{T}=6$, the bias will be −0.30. The same problem is present even in the one-way random effects (Baum *et al.*, 2012). The $\mathbf{u_i}$ error component will enter every $\mathbf{y_{it}}$ value by assumption so that the lagged term of the dependent variable will be dependent on the composite error process. The second source of endogeneity emanates from third variables that jointly affect the RER and sectoral growth.

To address these kinds of endogeneity in literature, the natural response is to use instrumental variable regressions. The two-stage and three-stage least squares are immediate examples. The logic behind these techniques is embedded in finding an instrument which is a variable correlated with the endogenous regressor (the RER in this particular case) but uncorrelated with the error term. In our case, the challenge of using these approaches lies in finding a variable that is correlated with the RER without plausibly having an independent effect on sectoral growth. Most of the variables that affect growth are the same variables that affect the RER and therefore finding a suitable instrument is an empirical challenge.

The solution suggested in empirical panel data studies is to take advantage of lagged values of the variables as instruments in the GMM framework proposed by Arellano and Bond (1991). This is the approach used in this study and it is preferred because of its ability to pin down endogeneity issues using internal instruments. A close alternative estimator that addresses endogeneity problems of this type is the Anderson and Hsiao (AH) technique. Arellano and Bond (1991) argue, however, that the AH estimator although consistent fails to absorb all the potential conditions of orthogonality into account. A further advantage of the GMM estimator is embedded in their consistency even in the presence of non-stationary panels (Binder *et al.*, 2005). Technically, the GMM estimators are based on differencing regressions and/or instruments in order to account for unobserved effects and using lagged dependent and independent variables as instruments. The GMM approaches are based on a dynamic model of the following sort where we treat all regressors as endogenous:

$$\ln Y_{it} = \lambda+\alpha\cdot \ln Y_{it-1}+\delta\cdot \ln Y_{it-5}+\omega\cdot \ln UNDERVAL_t+\varphi\cdot \ln \chi_{it}+\varepsilon_{it}. \tag{6}$$

By incorporating the lagged term of the dependent variable, Equation (6) can be viewed as a partial adjustment model where $\alpha-1$ is the partial adjustment mechanism. The use of sector-level data, however, brings to the forefront the issue of heterogeneity of sectors which has to be properly addressed even in a dynamic setting (Cameron and Trivedi, 2005). This unobserved heterogeneity is removed by first differencing Equation 96) so that we have:

$$\Delta \ln Y_{it} = \lambda+\alpha\cdot\Delta \ln Y_{it-1}+\delta\cdot\Delta \ln Y_{it-5}+\omega\cdot\Delta \ln UNDERVAL_t+\varphi\cdot\Delta \ln \chi_{it}+\Delta\varepsilon_{it}, \tag{7}$$

where Δ denotes the first difference operator. First differencing our specification this way wipes away sector-specific effects but requires instrumentation to control for endogeneity of the regressors and the correlation between the new error term $(\varepsilon_{it}-\varepsilon_{it-1})$ and the lagged dependent variable. In a panel data setup, initial values of regressors and the lagged response variable are capitalised as instruments and this constitutes the difference GMM estimator. Blundell and Bond (1998) show, however, that the difference GMM estimator is exposed to weak instruments in cases where the covariates are persistent over a period of time. The presence of weak instruments further distorts both the small sample and asymptotic performance of the difference estimator. A solution of this problem of weak instruments proposed by Blundell and Bond (1998) and Arellano and Bover (1995) requires using a system GMM which combines the first differenced equations with the equation in which the level regressors are instrumented by their first differenced terms. Blundell and Bond (1998) through Monte Carlo simulation conclude that the system GMM estimator is relatively more efficient as compared to the first difference estimator. For this reason, we use the Blundell and Bond system GMM as the baseline estimator.

The Blundell and Bond system GMM can be estimated using one step or two step. The one-step system GMM estimator employs a variance covariance matrix while the two-step system GMM estimator capitalises on the residual values generated from the first estimation step for variance covariance matrix, $\hat{\Omega}_i = \hat{\varepsilon}_i\hat{\varepsilon}_i'$, which is utilised in the second estimation stage. Both the one-step and two-step estimators can be performed with heteroscedasticity corrected standard errors. The two-step system GMM estimator is considered to be relatively more efficient as compared to the one-step estimator with a heteroscedastic error-structure. Nonetheless when the size of n (cross-sectional members, sectors in this particular case) is small relative to the number of instruments used, the standard errors from the two-step system GMM estimator will be downward biased (Blundell and Bond, 1998). The bias on the standard errors will later compromise and distort statistical inferences on the parameters of our explanatory variables. In such a case where n is smaller than the number of instruments, the one-step system GMM estimator will be relatively more reliable (Blundell and Bond, 1998). In the present case, we have only six sectors and, therefore, the issue just mentioned above is very relevant if more lags are used as instruments. Mindful of this fact, the one-step system GMM estimator is employed. It is critical to test validity of two assumptions that underpin success of the system GMM estimator. The first diagnostic test is the Sargan test for over-identifying restrictions and the second is the Arellano and Bond test for AR (2) autocorrelation.

Results and discussion

Table I presents summary statistics of the data. From our results, the mean of ln UNDERVAL is 0.007 which implies an average UNDERVAL of roughly 1.02 (i.e. the antilog of 0.007). Since the average of UNDERVAL (antilog of lnUNDERVAL) is above unity, it means that the domestic currency was on average undervalued. On the other hand, the average growth of a five-year period for a typical sector between 1985 and 2014 was 2.7 per cent. Each variable is bringing 30 observations into the sample emanating from six non-overlapping five-year averages. We performed a multicolinearity check using a simple pairwise correlation matrix. The results in Table II indicate correlation

	Mean	SD	Skewness	Kurtosis	Obs.
Sectoral growth	0.027	0.022	0.130	2.467	30
Initial income	5.622	0.327	−0.667	2.929	30
ln capital	5.736	0.337	−0.631	2.476	30
ln labour	5.189	0.262	0.325	1.749	30
ln UNDERVAL	0.007	0.038	−0.455	1.430	30

Table I. Summary statistics (1985–2014)

	Growth	Initial income	lnCapital	lnlabour	lnUNDERVAL
Growth	1				
Initial income	0.02	1			
lnCapital	0.31	0.45	1		
lnlabour	0.35	0.26	0.11	1	
lnUNDERVAL	0.34	−0.09	−0.02	−0.01	1

Table II. Pairwise correlation matrix coefficients of less than 0.5; hence, we could safely proceed to estimate our regression models without any serious concern of multicolinearity.

Table III reports econometric estimates. As is customary in literature, we have estimated several regression variants so that we can evaluate the sensitivity of our estimates to alternative estimation techniques. We report results from four estimation techniques although our main baseline results are those from the system GMM technique. The joint significance test of time effects turned out to be statistically insignificant, hence we excluded time dummies in all our specifications to avoid unnecessary model overfitting.

The initial income coefficient is negative and statistically significant in our baseline regression which is the evidence of sectoral conditional convergence. Sector-specific input factors, labour and capital, all enter with expected positive signs predicted by economic theory. Labour turns out to be positive as one would expect but the effect is only statistically significant in two out of four cases. In the system GMM case, a percentage increase in labour is accompanied by a 0.029 per cent increase in subsequent sectoral growth but the impact is significant at the margin. The marginal significance of labour might stem from the fact that by measurement, our labour variable is capturing the quantity not the quality of labour. The coefficient of capital on the other hand is positive and significant at 5 per cent level. Holding constant all other explanatory variables, a percentage increase in capital translates into a 0.041 per cent increase in sectoral growth on impact. The coefficient of capital is quite larger and more relevant when compared to that of labour and this means that capital accumulation has had a stronger effect on sectoral growth than employment in South Africa between 1984 and 2014.

Turning to the variable of main inquiry, we find a positive and significant impact of lnUNDERVAL and sectoral growth across all the four variants. In the baseline specification, a percentage increase in lnUNDERVAL is estimated to raise the mean annual growth of a five-year period by 0.177 per cent on impact. This is consistent with the results reported in recent literature such as Rodrik (2008), Vaz and Baer (2014), Berka *et al.* (2014), Iyke and Odhiambo (2015) and Özyurt, (2013), Di Nino *et al.* (2011), Zwedala (2013), Elbadawi *et al.* (2012), Korinek and Servén (2010) and Habib *et al.* (2017) who all document a positive and significant correlation between a real undervaluation and growth. In the baseline specification which is variant (1), the size of the undervaluation effect lies within the range of 0.15 to 0.17 reported in Njindan (2017).

	Dependent variable = five-year average sectoral growth			
	(1) System GMM	(2) Fixed effects	(3) Random effects	(4) Pooled
Growth (t−1)	0.169 (0.178)			
Initial income	−0.019** (0.009)	−0.016 (0.050)	−0.012 (0.020)	−0.015 (0.013)
Initial lnUNDERVAL	0.177*** (0.061)	0.208** (0.093)	0.204** (0.086)	0.201* (0.098)
Initial lnCapital	0.041** (0.019)	0.064 (0.040)	0.041* (0.022)	0.032** (0.014)
Initial lnLabour	0.029* (0.017)	0.046 (0.132)	0.025 (0.021)	0.025** (0.012)
Constant	−0.293 (0.129)	−0.547 (0.603)	−0.307 (0.169)	−0.234 (0.106)
AR(1)	0.0460			
AR(2)	0.7346			
Sargan test	0.7367			
p-value	0.0000	0.1154	0.0307	0.0247
Time dummies	No	No	No	No
Observations	30	30	30	30

Notes: Figures shown in parentheses are standard errors. Note that we have 30 observations as we have converted data into five-year averages and used initial rather than contemporary values to wipe off cyclical effects and partially tackle causality issues, respectively. *,**,***Denote $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively

Table III. lnUNDERVAL and sectoral growth in South Africa

Under alternative estimation techniques, the effect of an increase in lnUNDERVAL on sectoral growth is much more positive albeit with weak statistical significance. The larger effect of undervaluation in alternative estimators could represent an upward bias mentioned by Rodrik (2008) that results from omitted time-variant variables that may affect both RER undervaluation and growth. Notwithstanding this upward bias, the size of the coefficient is consistent with the 0.181–0.209 range reported in Njindan (2017). Since our sample consists of both tradable goods and service sectors, one can make the argument that undervaluation in South Africa has created an environment that is conducive to sectoral growth. A RER undervaluation makes domestically produced goods cheaper which means that tradable goods sectors such as agriculture, mining and manufacturing are likely to experience an export-led growth. These sectors are not constrained by domestic demand. On the other hand, the positive impact of undervaluation in Table III means that service sectors such as tourism benefit from tourists' arrival when the currency is undervalued as they can stay longer while spending less.

A customary practice in literature is to test the sensitivity of regression estimates to changes in the estimation techniques and variable measurement. As shown in Table III, changing the estimation technique does not significantly alter the association between undervaluation and sectoral growth. It is important to note, however, that Woodford (2009) criticises the Balassa–Samuelson effect adjusted measure of undervaluation. He argues that by construction, this variable suffers from measurement error which could exaggerate the association between undervaluation and growth. This measurement error arises from regressing the RER on income per capita in a bid to control for the Balassa–Samuelson effect. Table IV presents estimates with an undervaluation measure that is not adjusted for the Balassa–Samuelson effect.

The results from fixed and random effects are not very encouraging in the sense of their having a considerable number of insignificant variables although undervaluation still enters with the consistent positive sign. Undervaluation only enters significantly in the baseline estimator otherwise the coefficient is not significantly different from zero in a statistical sense in alternative estimation techniques despite having the correct sign. These findings reiterate the importance of controlling for endogeneity of third variables nested in the error term. A noteworthy result from this robustness check is the substantial decrease in the size of the undervaluation coefficient. The Balassa–Samuelson effect adjusted measure of undervaluation in Table III produced a 0.177 which is not only sizeable but also highly significant as compared to the 0.015 documented in Table IV when using the unadjusted measure which is significant at 5 per cent. This result corroborates Woodford's (2009) argument that Rodrik's (2008) measure adjusted for the Balassa–Samuelson effect exaggerates the association between undervaluation and growth.

	Dependent variable = sectoral growth			
	(1) System GMM	(2) Fixed effects	(3) Random effects	(4) Pooled
Growth (t−1)	−0.025 (0.142)			
Initial income	−0.011*** (0.003)	−0.006 (0.022)	−0.009 (0.008)	−0.008 (0.006)
Initial lnUNDERVAL	0.015** (0.006)	0.026 (0.024)	0.015 (0.019)	0.014 (0.019)
Initial lnCapital	0.015** (0.006)	−0.034 (0.057)	0.009 (0.008)	0.009* (0.005)
Initial lnLabour	0.016*** (0.003)	0.030 (0.021)	0.015* (0.009)	0.014** (0.006)
Constant	−0.114 (0.038)	0.050 (0.237)	−0.088 (0.066)	−0.086 (0.044)
AR(1)	0.0314			
AR(2)	0.4850			
Sargan test	0.5290			
p-value	0.0000	0.6216	0.3098	0.0582
Time dummies	No	No	No	No

Notes: Figures in parentheses are standard errors. *,**,***Denote $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively

Table IV. Estimates of the unadjusted undervaluation measure

The next exercise is to test whether or not the impact of undervaluation on sectoral growth is non-linear. Some studies (Béreau *et al.*, 2012; Aflouk and Mazier, 2011) show that undervaluation correlates with growth in a non-linear fashion implying presence of a turning point in the way undervaluation affects growth. To test this prediction, we add in the model a quadratic term of undervaluation and observe its behaviour in terms of both the sign and statistical significance. The impact of undervaluation will be non-linear if the effect of the linear term is positive while that of the non-linear term is significantly negative. The results of this exercise are reported in Table V.

With respect to the baseline regression model estimated by the system GMM approach, the linear term of undervaluation remains positively and significantly signed. In the case of fixed, random and pooled least squares techniques, the coefficient on the variable capturing the linear effect of undervaluation is positively signed but the effect is not statistically significant. The reason could be that the linear effect of undervaluation is estimated less precisely (given higher standard errors) under alternative estimation techniques as compared to the system GMM which controls for endogeneity. Turning to the quadratic term of undervaluation, the results from the baseline model are supportive of a non-linear (inverted U-shaped) relation between undervaluation and sectoral growth. The non-linear term is negative and statistically significant in the system GMM framework suggesting that increasing undervaluation will raise growth up to a certain turning point where further undervaluation of the local currency negatively affects growth. This result lends support to Béreau *et al.* (2009) and Couharde and Sallenave (2013) who find a positive effect of small to moderate undervaluations on growth while large undervaluations hurt growth.

We also experimented by adding concurrently two interaction terms in the model undervaluation and sectoral employment and undervaluation and capital stock in each sector. This experiment simply uses capital stock and the number of workers employed in each sector as moderator variables governing how undervaluation interacts with sectoral growth. For brevity sake, the results of this robustness exercise are attached in Appendix. The result emerging from this experiment is quite insightful in that only the latter interaction enters with a significant positive sign. What this implies is that undervaluation has a more relevant and sizeable effect in sectors that accumulate more capital stock as opposed to those that employ more labour.

We checked for cross-sectional dependence in the residuals, heteroscedasticity and model specification. The results are not reported here for brevity sake but we found no evidence of

	Dependent variable = sectoral growth			
	(1) System GMM	(2) Fixed effects	(3) Random effects	(4) Pooled
Growth (t–1)	−0.049 (0.137)			
Initial income	−0.008*** (0.003)	0.115 (0.025)	−0.005 (0.009)	−0.007 (0.007)
Initial lnUNDERVAL	0.027*** (0.009)	0.022 (0.024)	0.026 (0.021)	0.027 (0.019)
Initial lnUNDERVAL^2	−0.032** (0.012)	−0.040 (0.027)	−0.030 (0.020)	−0.029* (0.014)
Initial lnCapital	0.014** (0.006)	−0.004 (0.061)	0.008 (0.008)	0.009*** (0.005)
Initial lnLabour	0.016*** (0.004)	0.020 (0.022)	0.014 (0.009)	0.013** (0.005)
Constant	−0.130 (0.044)	−0.153 (0.275)	−0.102 (0.066)	−0.029 (0.041)
AR(1)	0.0310			
AR(2)	0.3827			
Sargan test	0.5842			
p-value	0.0000	0.4520	0.2152	0.0069
Time dummies	No	No	No	No

Notes: Figures shown in parentheses are standard errors. *,**,***Denote $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively

Table V.
Nonlinearities of undervaluation and sectoral growth

cross-sectional dependence in residuals, heteroscedasticity and model misspecification. Also from Table III, the test for autocorrelation of second order as well as the Sargan test clearly suggests that our instruments in the system GMM estimation technique are relevant and valid.

Conclusion

We have provided empirical evidence on the impact of undervaluation on sectoral growth in South Africa. Between 1984 and 2014 using a sample of six sectors, namely, manufacturing, agriculture, mining, finance, tourism and personal services, we find that undervaluation has a positive impact on sectoral growth. In particular, a percentage increase in undervaluation is estimated to raise sectoral growth in the range of 0.177–0.208 per cent. Based on this result, we conclude that policies that keep the currency weaker are imperatively important in promoting the growth of goods and service sectors in a developing economy like South Africa. Future studies can explore the non-linear effects of exchange rate undervaluation using the PSTR. This would enhance our understanding further on the threshold effects of undervaluation on growth at a sectoral level.

Note

1. According to the 2016 South African Reserve Bank Quarterly Bulletin, the South African rand depreciated sharply against most major currencies in the fourth quarter of 2015 as both global and domestic developments negatively affected the currency. Whereas the weighted average exchange rate of the rand increased, on balance, marginally by 0.2 per cent in October 2015, it declined by 2.1 per cent and 8.3 per cent in November and December, respectively. On balance, the nominal effective exchange rate of the rand declined by 10.0 per cent in the fourth quarter of 2015 compared with a decline of 9.0 per cent in the third quarter. The weighted exchange rate of the rand declined by no less than 19.7 per cent from 31 December 2014 to 31 December 2015, the sharpest fall since the 23.5 per cent decline in 2008.

References

Abida, Z. (2011), "Real exchange rate misalignment and economic growth: an empirical study for the Maghreb countries", *Zagreb International Review of Economics and Business*, Vol. 14 No. 2, pp. 87-105.

Aflouk, N. and Mazier, J. (2011), "Exchange rate misalignments and economic growth non-linear models-based study", working paper, CEPN – Centre d'Économie de l'Université Paris-Nord.

Aguirre, A. and Calderón, C. (2005), "Real exchange rate misalignments and economic performance", Documentos de Trabajo, Banco Central de Chile, Santiago, Región Metropolitana, Chile, pp. 1-49.

Aizenman, J. and Lee, J. (2010), "Real exchange rate, mercantilism and the learning by doing externality", *Pacific Economic Review*, Vol. 15 No. 3, pp. 324-335.

Arellano, M. and Bond, S. (1991), "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations", *The Review of Economic Studies*, Vol. 58 No. 2, pp. 277-297.

Arellano, M. and Bover, O. (1995), "Another look at the instrumental variable estimation of error-components models", *Journal of Econometrics*, Vol. 68 No. 1, pp. 29-51.

Baum, A., Poplawski-Ribeiro, M. and Weber, A. (2012), "Fiscal multipliers and the state of the economy (No. 12-286)" International Monetary Fund, Washington, DC.

Benigno, G., Converse, N. and Fornaro, L. (2015), "Large capital inflows, sectoral allocation, and economic performance", *Journal of International Money and Finance*, Vol. 55, pp. 60-87.

Béreau, S., Villavicencio, A.L. and Mignon, V. (2009), "Nonlinear adjustment of the real exchange rate towards its equilibrium value: a panel smooth transition error correction modelling", *Economic Modelling*, Vol. 27 No. 1, pp. 404-416.

Béreau, S., Villavicencio, A.L. and Mignon, V. (2012), "Currency misalignments and growth: a new look using nonlinear panel data methods", *Applied Economics*, Vol. 44 No. 27, pp. 3503-3511.

Berka, M., Devereux, M.B. and Engel, C. (2014), "Real exchange rates and sectoral productivity in the eurozone (No. w20510)", National Bureau of Economic Research.

Bhorat, H., Tian, N. and Ellyne, M. (2014), "The real exchange rate and sectoral employment in South Africa (No. 201404)" Development Policy Research Unit Working Paper, Capetown.

Binder, M., Hsiao, C. and Pesaran, M.H. (2005), "Estimation and inference in short panel vector autoregressions with unit roots and cointegration", *Econometric Theory*, Vol. 21 No. 4, pp. 795-837.

Blundell, R. and Bond, S. (1998), "Initial conditions and moment restrictions in dynamic panel data models", *Journal of econometrics*, Vol. 87 No. 1, pp. 115-143.

Brixiová, Z. and Ncube, M. (2014), "The real exchange rate and growth in Zimbabwe: does the currency regime matter?", African Development Bank Working Paper No. 210, Tunis.

Cameron, A.C. and Trivedi, P.K. (2005), *Microeconometrics: Methods and Applications*, Cambridge University Press, Cambridge.

Chen, R. and Dao, M. (2011), "The real exchange rate and employment in China", IMF working papers, pp. 1-50.

Couharde, C. and Sallenave, A. (2013), "How do currency misalignments' threshold affect economic growth?", *Journal of Macroeconomics*, Vol. 36 No. 1, pp. 106-120.

Di Nino, V., Eichengreen, B. and Sbracia, M. (2011), "Real exchange rates, trade, and growth: Italy 1861–2011", Bank of Italy Economic History working paper.

Dollar, D. (1992), "Outward-oriented developing economies really do grow more rapidly: evidence from 95 LDCs, 1976-1985", *Economic Development and Cultural Change*, Vol. 40 No. 3, pp. 523-544.

Dubas, J. (2012), "Exchange rate misalignment and economic growth", *Southwestern Economic Review*, Vol. 39 No. 1, pp. 121-137.

Dubas, J.M. (2009), "The importance of the exchange rate regime in limiting misalignment", *World Development*, Vol. 37 No. 10, pp. 1612-1622.

Ebaidalla, E.M. (2014), "Real exchange rate misalignment and economic performance in Sudan", *African Review of Economics and Finance*, Vol. 6 No. 2, pp. 115-140.

Eichengreen, B. (2007), "The real exchange rate and economic growth", *Social and Economic Studies*, Vol. 56 No. 4, pp. 7-20.

Elbadawi, I.A., Kaltani, L. and Soto, R. (2012), "Aid, real exchange rate misalignment, and economic growth in Sub-Saharan Africa", *World Development*, Vol. 40 No. 4, pp. 681-700.

Ghura, D. and Grennes, T.J. (1993), "The real exchange rate and macroeconomic performance in Sub-Saharan Africa", *Journal of Development Economics*, Vol. 42 No. 1, pp. 155-174.

Giles, A.J. and Williams, C.L. (2000), "Export-led growth: a survey of the empirical literature and some non-causality results. Part 1", *The Journal of International Trade & Economic Development*, Vol. 9 No. 3, pp. 261-337.

Glüzmann, P.A., Levy-Yeyati, E. and Sturzenegger, F. (2012), "Exchange rate undervaluation and economic growth: Díaz Alejandro (1965) revisited", *Economics Letters*, Vol. 117 No. 3, pp. 666-672.

Habib, M.M., Mileva, E. and Stracca, L. (2017), "The real exchange rate and economic growth: revisiting the case using external instruments", *Journal of International Money and Finance*, Vol. 73 No. 1, pp. 386-398.

Haddad, M. and Pancaro, C. (2010), "Can real exchange rate undervaluation boost exports and growth in developing countries? Yes, but not for long", Economic Premise, No. 20, World Bank, Washington, DC.

Hausmann, R., Pritchett, L. and Rodrik, D. (2005), "Growth accelerations", *Journal of Economic Growth*, Vol. 10 No. 4, pp. 303-329.

Iyke, B.N. and Odhiambo, N.M. (2015), "Real exchange misalignments and economic growth in Sub-Saharan Africa: panel data evidence", *Biennial Conference of the Economic Society of South Africa*, *Capetown*, pp. 2-4.

Judson, R.A. and Owen, A.L. (1999), "Estimating dynamic panel data models: a guide for macroeconomists", *Economics Letters*, Vol. 65 No. 1, pp. 9-15.

Kappler, M., Reisen, H., Schularick, M. and Turkisch, E. (2013), "The macroeconomic effects of large exchange rate appreciations", *Open Economies Review*, Vol. 24 No. 3, pp. 471-494.

Karadam, D.Y. (2014), *The Real Exchange Rate and Economic Growth*, Middle East Technical University, Ankara.

Korinek, A. and Servén, L. (2010), "Real exchange rate undervaluation: static losses, dynamic gains", World Bank Policy Research Working Paper No. 5250, Washington, DC.

Levy-Yeyati, E. and Sturzenegger, F. (2003), "To float or to fix: evidence on the impact of exchange rate regimes on growth", *The American Economic Review*, Vol. 93 No. 4, pp. 1173-1193.

Levy-Yeyati, E. and Sturzenegger, F. (2007), "Fear of floating in reverse: exchange rate policy in the 2000s", *LAMES-LACEA Annual Meetings*.

McLeod, D. and Mileva, E. (2011), "Real exchange rates and productivity growth", No. 2011-04, Department of Economics, Fordham University, New York, NY.

Masunda, S. (2011), "Real exchange rate misalignment and sectoral output in Zimbabwe", *International Journal of Research and Economics*, Vol. 2 No. 4, pp. 59-74.

Mbaye, S. (2012), "Real exchange rate undervaluation and growth: is there a total factor productivity growth channel?", Working Papers No. 201211, CERDI.

Mpofu, T.R. (2013), "Real exchange rate volatility and employment growth in South Africa", *The Case of Manufacturing! ECCE-USB Conference, Capetown*.

Ngandu, S. (2008), "Exchange rates and employment", *South African Journal of Economics*, Vol. 76 No. S2, pp. 5-21.

Nickell, S. (1981), "Biases in dynamic models with fixed effects", *Econometrica: Journal of the Econometric Society*, pp. 1417-1426.

Njindan, I.B. (2017), "Exchange rate undervaluation and sectoral performance of the South African economy", *Journal of Economic Studies*, Vol. 44 No. 4, pp. 636-649.

Nouira, R. and Sekkat, K. (2012), "Desperately seeking the positive impact of undervaluation on growth", *Journal of Macroeconomics*, Vol. 34 No. 2, pp. 537-552.

Özyurt, S. (2013), "Currency undervaluation and economic rebalancing towards services: is China an exception?", *China & World Economy*, Vol. 21 No. 1, pp. 47-63.

Razin, O. and Collins, S.M. (1997), *Real Exchange Rate Misalignments and Growth*, National Bureau of Economic Research, New York, NY.

Rodrik, D. (2008), "The real exchange rate and economic growth", *Brookings Papers on Economic Activity*, Vol. 2008 No. 2, pp. 365-412.

Sibanda, K., Ncwadi, R. and Mlambo, C. (2013), "Investigating the impacts of real exchange rates on economic growth: a case study of South Africa", *Mediterranean Journal of Social Sciences*, Vol. 4 No. 13, p. 261.

Stock, J.H. and Watson, M.W. (1993), "A simple estimator of cointegrating vectors in higher order integrated systems", *Econometrica: Journal of the Econometric Society*, pp. 783-820.

Toulaboe, D. (2006), "Real exchange rate misalignment and economic growth in developing countries", *Southwestern Economic Review*, Vol. 33 No. 1, pp. 57-74.

Vaz, P.H. and Baer, W. (2014), "Real exchange rate and manufacturing growth in Latin America", *Latin American Economic Review*, Vol. 23 No. 1, p. 2.

Woodford, M. (2009), "Is an undervalued currency the key to economic growth?", Department of Economics Discussion Paper No. 0809-13.

Zwedala, S. (2013), *The Effect of Real Exchange Rate Misalignment on Economic Growth in South Africa*, North-West University, Potchefstroom.

Appendix. Blundell and Bond system GMM one-step estimates (interactions)

```
System dynamic panel-data estimation        Number of obs        =        30
Group variable: id                          Number of groups     =         6
Time variable: window
                                            Obs per group:    min =         5
                                                              avg =         5
                                                              max =         5

Number of instruments =     39              Wald chi2(5)         =    224.53
                                            Prob > chi2          =    0.0000
One-step results
```

growth	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
growth						
L1.	.2511466	.1385744	1.81	0.070	-.0204542	.5227475
initial	-.0207969	.0066457	-3.13	0.002	-.0338222	-.0077716
lnunderval_5	-3.407024	1.511896	-2.25	0.024	-6.370285	-.4437625
lncapital_5	.0359796	.0154287	2.33	0.020	.00574	.0662192
lnlabour_5	.0222969	.0155418	1.43	0.151	-.0081644	.0527583
lnUNDERVAL_lnlabour	.1344641	.1215316	1.11	0.269	-.1037334	.3726617
lnUNDERVAL_lncapital	.4506451	.2105402	2.14	0.032	.0379939	.8632963
_cons	-.2122781	.094295	-2.25	0.024	-.3970929	-.0274632

Arellano-Bond test for zero autocorrelation in first-differenced errors

Order	z	Prob > z
1	-1.9808	0.0476
2	-.87234	0.3830

H0: no autocorrelation

```
Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid

        chi2(31)      =  21.16601
        Prob > chi2   =    0.9075
```

Corresponding author
Brian Tavonga Mazorodze can be contacted at: brianmazorodze@gmail.com

For instructions on how to order reprints of this article, please visit our website:
www.emeraldgrouppublishing.com/licensing/reprints.htm
Or contact us for further details: **permissions@emeraldinsight.com**