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REAL EXCHANGE RATE UNDERVALUATION AND POVERTY REDUCTION IN SOUTH AFRICA: DOES THE NATURE OF PRODUCTIVITY GROWTH MATTER?

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Abstract

While an undervalued exchange rate has gained prominence in the last three decades as a correlate of economic growth and poverty alleviation, South Africa's experience is less encouraging as the depreciation of the Rand against the United States dollar barely coincided with poverty reduction. Against this background, this paper sought to examine the impact of real exchange rate undervaluation on poverty reduction in South Africa. It also investigated how the nature of productivity growth influenced the impact of real exchange rate undervaluation on poverty reduction. Using annual time series data observed between 1995 and 2020, evidence from binary regressions and a Balassa-Samuelson adjusted undervaluation measure suggests that an undervalued exchange rate could have potentially lifted people out of poverty had it been accompanied by within-sector productivity growth of at least 2.5% annually. The South African economy fell short of this threshold level between 1995 and 2020 as annual within-sector productivity growth averaged 2.2%. Furthermore, evidence shows that South Africa went through a structural change that shifted employment in the wrong direction. Low-skilled workers appear to have moved from primary and secondary to tertiary sectors, a process that shrank overall productivity growth.

Keywords: Undervaluation, Poverty, Structural change, Productivity growth, South Africa

JEL Classifications: O10, O40, E58

1. Introduction

In Rodrik (2008), an undervalued real exchange rate is viewed as a fundamental factor that stimulates economic growth by reallocating capital from the non-tradable sector towards the tradable sector. This prediction is, to a large extent, consistent with China's experience since the early 1990s. China had an illustrious three decades on the back of a deliberately undervalued

Renminbi lifting in the process over 800 million people out of poverty. This experience and the predicted underlying theoretical mechanism of Rodrik (2008) are encouraging in the context of global poverty eradication efforts, it raises an important question, if an undervalued real exchange rate is capable of lifting people out of poverty as we saw in China, why has South Africa, whose real exchange rate has been mostly weaker, hardly recorded as much success?

Since the 2008-2009 Global Financial Crisis, South Africa's real value of the Rand has been weaker against the dollar within the auspices of an inflation targeting framework (Buthelezi, 2023). Khomo and Aziakpono (2020) particularly show that the Rand was largely undervalued in the past three decades. Yet economic growth has been modest at best barely averaging above 1% annually between 2009 and 2020 according to Quantec data. Poverty measured at the international poverty lines of $1.90 and $3.20 per person per day (2011 PPP) is in fact estimated to have increased from 16.6% and 35% in 2011 to 18.9 percent and 37.6 percent in 2015, respectively (Statistics South Africa, 2015). By 2020, approximately 55.5 percent (30.3 million people) are believed to live in poverty at the national upper poverty line while a total of 13.8 million people (25 percent) was estimated to experience food poverty (World Bank, 2023). The latter statistic means that the number of people in South Africa estimated to have been subjected to food poverty in 2020 was twice the combined population of Botswana and Lesotho. Reconciled with Rodrik's (2008) theory and China's experience, these disturbing figures imply two possibilities. Firstly, the real exchange rate's poverty reducing effects may not be an empirical regularity. Secondly, undervaluation's poverty reducing effects may be an empirical regularity that is conditional on country-specific circumstances.

Leaning towards the latter, this paper considers the possibility of South Africa's unique circumstances that may have dampened or at least neutralized the real exchange rate's poverty reducing potential. To this effect, it considers the path and nature of South Africa's structural change and how it may have influenced the relationship between undervaluation and poverty reduction. To the best of our knowledge, this is the first empirical attempt to link undervaluation with poverty while accommodating the nature of productivity and structural change.

Influential research relevant to our study is: Elbadawi (2015) who estimates the impact of real exchange rate undervaluation on poverty in Sub-Saharan Africa. Underpinning his empirical work is the argument that a weaker exchange rate may generate offsetting supply-side effects which, in the presence of downward price rigidity, may facilitate a reallocation of investment from non-tradable sectors and a concomitant decrease in the real wage. In developing countries where the urban poor are both producers and consumers of non-tradables, a real exchange rate undervaluation may generate economywide poverty increase. His empirical analysis concluded that poverty reduces poverty if the degree of undervaluation is less than 50 percent.

In this paper, we consider the moderating role of productivity growth building on literature highlighting the importance of productivity growth as a mediating factor that spurs growth and reduces poverty. We aim to unravel the extent to which the nature of productivity growth influences the impact of exchange rate undervaluation. Our analysis uses annual time series data observed between 1995 and 2020. Different from previous studies, we create a binary indicator that picks years associated with poverty reduction. We then use a measure of undervaluation that is adjusted for the Balassa-Samuelson effect using the dynamic ordinary least squares method. In line with McMillan *et al.* (2014), we decompose total labor productivity growth into two parts namely the component capturing productivity growth within economic sectors i.e., through capital accumulation and technological change and the second part capturing labor reallocation across sectors, i.e., from low-productivity sectors to high-productivity sectors.

Results from binary regressions indicate that structural change and the nature of productivity growth matter. An undervalued real exchange rate facilitates a reduction in poverty if accompanied by (i) productivity growth above 2.5% annually and (ii) structural change that places low-skilled workers into tradable sectors. The evidence shows that South Africa generated an averaged productivity growth below the estimated threshold and went through a structural change process that dragged overall productivity growth through moving low-skilled workers from tradable sectors towards the service sector.

The rest of the paper is organized as follows. Section 2 sets the foundation by providing a review of empirical literature. Section three then outlines the methodology of the study. Results are presented and discussed in section 4. Section 5 provides concluding remarks and recommendations.

2. Literature review

The mechanism through which undervaluation affects poverty is complicated and less clear cut. In the main, the complexity arises because the exchange rate itself is endogenous and responsive to broad macroeconomic policies, the majority of which affect poverty. On the one hand, classical economists tend to regard exchange rate fluctuations as a balance of payments adjustment process with no real effects on the economy. This view, to some extent, holds credibility as a depreciation of the local currency in most cases simply reflects capital flowing out of the country on account of slow economic growth, negative economic developments, or interest rate differentials.

Notwithstanding the above classical view of the exchange rate, neoclassical economists view the exchange rate as a relative price of tradable to non-tradable goods capable of facilitating two poverty-reducing growth processes. The first process is the structural change effect which holds ancestry in dual economy model of Lewis (1954). Through this process, poverty decreases with the shifting of workers from low productivity sectors (typically agriculture) to high productivity sectors such as manufacturing, and modern industries. In this sense, the real exchange rate could influence poverty through raising wages in the high productivity sector, a channel which is plausible in developing countries where the majority of the poor depend on wage income. The second process is the within-sector productivity effect which arises from the accumulation of economic fundamentals such as human capital, physical capital, and modern technologies. A notion noteworthy is that these two processes are more complementary than they are competing, as it is possible for an economy to pursue structural transformation while concurrently accumulating factors within-sectors.

Underpinning the above processes, there is an expected positive effect of factor incomes and growth on poverty (Bhagwati, and Srinivasan, 2002; Dollar and Kraay, 2002; Ravallion, and Datt, 2002; Perera, and Lee, 2013; Banerjee *et al.* 2015; Fosu, 2015; Balasubramanian *et al.* 2023; Kouadio and Gakpa, 2022). However, in investigating the factors underpinning the slow pace of poverty reduction between the mid-1980s and the mid-2000s in Brazil, Ferreira *et al.* (2010) found that economic growth has played a negligible role in Brazil's poverty reduction. This link, although non-consensual in broad a sense, has provided a useful starting point for the exchange rate-poverty discussion which unfortunately remains shrouded by controversies. In Kuokštis *et al.* (2022) for example, an appreciation of the real exchange rate is argued to facilitate an increase in the real remuneration of unskilled labor in tradable goods. This channel essentially means a real depreciation of the real exchange rate can be detrimental to poverty through lowering the real remuneration of unskilled workers involved in tradable sectors. Contrary to this view however is the possibility raised by Elbadawi (2015) that a depreciated exchange rate can in fact raise incomes of exporting farmers and rural households whose ability to escape poverty very much depends on farm proceeds. The same sentiments were also echoed by Gnangnon (2021). The theoretical intuition underpinning this argument is that exports become more competitive on global markets if the local currency is weaker.

While the above point makes Elbadawi's (2015) point plausible, it ignores the negative supply side effects that weaker exchange rates may facilitate which likely undermine efforts to reduce poverty. A weaker currency facilitates imported inflation through altering the cost structure of producers particularly in developing countries where firms rely heavily on imported intermediate inputs. With a weaker currency and assuming a high pass-through effect, imported inflation that a depreciated exchange rate facilitates likely erodes the real purchasing power of an average person elevating their chances of getting poorer. Interestingly while intuitive, this mechanism is less obvious as it depends on the input structure of firms and the degree of factor substitution (Andersen 2023). With a higher degree of input substitution in countries that initially rely on imported capital, it can be argued that a weaker exchange rate, by increasing the user cost of

imported capital, may incentivize firms to switch from capital-intensive production to low-skill intensive production, ultimately benefiting poor people.

From an empirical point of view, the results on the real exchange rate and poverty link have been unsurprisingly mixed. In Elbadawi (2015) and Gnangnon (2021), for instance, evidence points to a negative but non-monotonic association between real exchange rate undervaluation and poverty in panel of countries. In Apergis and Cooray (2018), focus is placed on the asymmetric effect of real exchange rate changes on poverty through the remittance channel for a panel of 99 countries, spanning the period 1980–2015. Reliant on a threshold partial adjustment modelling approach, the results documented find the real exchange rate depreciations exerting a stronger positive effect on poverty through remittances. In an earlier paper and applying a similar technique albeit in a single country framework, Apergis (2015) and Andersen (2023) found that real depreciations increased poverty in China. The argument raised in support of this finding was the high costs of imported raw materials which real depreciations induce. This argument parallels however the conclusion reached in Diallo (2007) where, in a panel of countries, a real exchange rate depreciation is found to benefit poor people. It also contradicts the poverty reducing effects of exchange rate depreciation observed in Omojimite and Oriavwote (2012) for Nigeria based on a Vector Error Correction model (VECM). In addition to the linear effect, Omojimite and Oriavwote (2012) find real depreciation more effective as a poverty reducing intervention if accompanied by strong institutions and the accumulation of human capital.

While Omojimite and Oriavwote (2012) and Adeleye (2024) emphasize the importance of robust institutions and human capital in fostering the effect of real exchange rate on poverty reduction, Farhani *et al.* (2023) recently consider remittances as a key channel through which the real exchange rate affects poverty in the context of Maghreb countries. Using an asymmetrical estimation approach similar to that applied in Apergis and Cooray (2018), they find real exchange rate depreciations having a larger positive effect on poverty through remittances. Their findings therefore support the conclusion of Omojimite and Oriavwote (2012) but contradict that of Apergis (2015). Interestingly, having applied the same approach, Karimi, and Heshmati Dayari (2021) reach a different conclusion. Their analysis does not find a significant association between a real exchange rate depreciation and poverty reduction both in the short and the long run. Since the studies applied the same technique, the contradiction in findings therefore suggests that the way real exchange rates affect poverty is contextual and very much depends on country-specific features.

Methodologically, there is a possibility that the handling of endogeneity could be partly influential in the contradiction of findings. This is primarily because real exchange rates by their nature respond to many other macroeconomic factors which in most cases affect poverty but are not always specified explicitly in the poverty reduction function. Cognizant of this methodological caveat, Gnangnon (2021) uses a two-step GMM approach in the context of 90 developing countries albeit focusing on exchange rate pressure as opposed to usual exchange rate dynamics and finds exchange rate pressure influencing poverty positively. An earlier African study by Hojman (1996) sought to establish how real exchange rate depreciation affects the poor and came to four important conclusions. Firstly, real exchange rate reforms have re-distributional effects that tend to favor the poor. Secondly, a devaluation eliminates implicit taxes on exporters which consequently erodes rents that are normally beneficial to the political elite in government. Thirdly, because the poor are more heavily concentrated in the production of tradables than the nonpoor such as agriculture, a real devaluation is likely to benefit the poor. Finally, because the poor tend to consume a larger share of home-produced and non- tradable goods, the resulting expenditure switching effects may benefit farm products supplied by the poor.

The above review of conflicting conclusions is summarized in the recent work of Rezazadeh and Ghasemnejad (2020) who found the effect of real exchange rate dynamics on poverty inconsistent. The current study joins this discussion by considering the moderating effects of productivity sources, a focus which acknowledges the possibility of real exchange rate dynamics having effects that are contextual and depend on country-specific experiences. In this sense, this paper suspects that the nature and composition of South Africa's productivity growth over the last three decades may have shaped the way the country's real exchange rate affected

poverty reduction. To this effect, the paper decomposes productivity growth into two respective components namely within-sector productivity growth and structural change arising from the relocation of workers across sectors. Unlike previous studies, the paper proceeds to test the empirical possibility of these two sources of productivity growth serving as moderating factors. This consideration is intuitive on the following grounds; Firstly, higher within-sector productivity growth tends to go hand in hand with higher remuneration in the spirit of Leibenstein (1966). Given the direct connection between higher remuneration and poverty therefore and the connection between real exchange rates and real remuneration, higher within-sector productivity growth is likely to shape the way an undervalued exchange rate relates with poverty. Secondly, if undervaluation influences poverty through facilitating the reallocation of resources from low-productivity sectors to high-productivity sectors which consequently generates growth and increases average incomes, the poverty-reducing effects of an undervalued exchange rate are therefore more likely to show up in countries where the pace of structural change is higher.

3. Data and methodology

The methodology of the paper consists of three steps. The first step in section 3.2 provides a measure of structural change. The second step, section 3.3, provides the measure of real exchange rate undervaluation. The third and final step in section 3.4 links poverty with real exchange rate undervaluation and structural change components.

3.1. Data description

The analysis uses annual time series data observed between 1995 and 2020 guided by data availability. Key variables used in the estimation process are sectoral employment, sectoral output, the nominal exchange rate measured as the number of local currency units per United States dollar, real gross domestic product per capital (2015=100), the purchasing power parity conversion factor and the number of people living under the international poverty datum line set by the World Bank at $1.90 per capita per day (PPP 2011=100). Data on the real gross domestic product per capital, the nominal exchange rate and the purchasing power parity conversion factor were sourced from the World Bank under the World Development Indicators (WDI).

3.2. Structural change

Following McMillan *et al.* (2014), we decompose total labor productivity growth into two parts. The first part captures productivity growth arising from within economic sectors through capital accumulation, technological change, or reduction of misallocation across plants. The second part captures labor reallocation across sectors, from low-productivity sectors to high-productivity sectors, increasing overall labor productivity in the economy. This decomposition takes the following form which is Equation (1).

$$\Delta Y_t = \sum_{i=n} \theta_{i,t-k}\, \Delta y_{i,t} + \sum_{i=n} y_{i,t}\, \Delta \theta_{i,t}, \tag{1}$$

where Δ is a first difference operator capturing changes in productivity or employment shares between $t-k$ and t, Y_t and $y_{i,t}$ are economy-wide and sectoral labour productivity levels, respectively, and $\theta_{i,t}$ denotes the share of employment in sector i. The first term $\sum_{i=n} \theta_{i,t-k}\, \Delta y_{i,t}$ in Equation (1) is the weighted sum of productivity growth within individual sectors, where the weights are the employment share of each sector at the beginning of each period. This is essentially the ‘‘within” component of productivity growth. The second term captures the productivity effect of labor re-allocations across different sectors. This is referred to as the ‘‘structural change” term. When changes in employment shares are positively correlated with productivity levels, this term will be positive, and structural change will increase economy-wide productivity growth. The opposite is true if changes in employment shares are negatively

correlated with productivity levels. The term will be negative and structural change will decrease economy-wide productivity growth. We consider data on three broad sectors namely primary, secondary, and tertiary sectors.

3.3. Real exchange rate undervaluation

It is important to note that although much discussion on related studies in literature has centered on real exchange rate depreciation, there is a marked distinction between a real exchange rate undervaluation and a real exchange rate depreciation (Fidora *et al.* 2021). The latter simply reflects a loss in local currency value in relation to the foreign currency. The former is more than just a depreciation insofar as it relates to some equilibrium value. This distinction therefore means, although undervaluation can be facilitated by a currency depreciation, it is possible to have a currency depreciation that does not amount to an undervaluation. In this study, the focus is on exchange rate undervaluation as opposed to mere exchange rate depreciations that have received much scholarly attention in literature.

There are three main approaches to measuring real exchange rate undervaluation and these are the purchasing power parity, the black-market premium approach, and the equilibrium model-based approach (Edwards, 1989; Toulaboe, 2011). In this analysis, a PPP-related measure of real exchange rate undervaluation suggested by Rodrik (2008) is applied. The argument raised by Rodrik (2008) is that undervaluation measured this way may facilitate growth and reduce poverty through expanding the tradable sector. Hence, following his measure allows one to draw testable hypotheses that can be used to indirectly validate or refute his broader claim. Measurement of Rodrik's (2008) undervaluation proceeds in three steps. First, it defines the real exchange rate (RER) as follows in the form of Equation (2).

$$\ln(RER)_t = \ln\left(\frac{XRAT}{PPP}\right)_t \tag{2}$$

where *ln* denotes natural logarithm, t is a time notation (from 1995 to 2021), XRAT denotes the amount of Rands per US$ and PPP is the purchasing power parity conversation factor. The Balassa-Samuelson effect in which productivity tends to rise faster in tradable sectors relative to non-tradable sectors is then, in the second step, controlled for through regressing the RER on real gross domestic product per capita. In this specification, the analysis adds a dummy variable that takes the value 0 from 1995 to 1999 and 1 from 2000 onwards to capture South Africa's inflation targeting which may have plausibly affected real exchange rate dynamics as the Central Bank shifted from a managed float to a flexible exchange rate system. The equation takes the form of Equation (3).

$$\ln(RER)_t = \theta_0 + \theta_1 \ln GDPPC_t + \delta D + \varepsilon_t \tag{3}$$

where θ_0 is an intercept, θ_1 is a slope, GDPPC is real gross domestic product per capita (2015=100), and ε is a stochastic error term that is independent and identically distributed. To estimate the value of θ_1, we consider three caveats. First is the possibility that lnRER and lnGDPPC could be potentially non-stationary processes which likely makes θ_1 spurious if estimated through the ordinary least squares method. Second is the possibility of lnRER and lnGDPPC being functions of third factors nested in the error term which biases θ_1. Third is the possibility of serial correlation in ε which distorts statistical inference. To address these three issues, we estimated Equation (2) using the dynamic ordinary least squares (DOLS) which, in comparison to its competing counterparts, bears desirable small sample properties. The DOLS method addresses endogeneity through leads and lags of first differenced endogenous regressors and deals with serial correlation in a feasible generalised least squares fashion. Having estimated Equation (2) with the DOLS method, undervaluation is then defined as Equation (4).

$$\ln UNDERVAL_{it} = \ln(RER)_t - \ln(\widehat{RER})_t \quad (4)$$

An increase in $\ln UNDERVAL_{it}$ denotes an increase in undervaluation. The next section relates the structural components and the real exchange rate undervaluation measure computed in sections 3.2 and 3.3, respectively, with poverty reduction.

3.4. Undervaluation and poverty reduction

Because we are interested in poverty reduction, the next step is to consider a regression equation in which undervaluation is a regressor. To achieve this, we follow Elbadawi (2015) approach of linking poverty with real exchange rate undervaluation. Our point of divergence is that we convert our dependent variable into a binary variable that takes the value 1 for years in which the number of people below the poverty datum line decreased. The starting point is therefore to express the poverty headcount in terms of changes, which provides us Equation (5).

$$POV\_C_t = \frac{POV_t - POV_{t-1}}{POV_{t-1}} \quad (5)$$

From Equation (5), the binary variable can then be defined as Equation (6),

$$y_t^* = \begin{cases} 1 & \text{if} \quad POV\_C_t < 0 \\ & . \\ 0 & \text{if} \quad POV\_C_t \geq 0 \end{cases} \quad (6)$$

The estimated model then takes the following final form which is Equation (7).

$$y_t^* = \alpha_0 + \alpha_1 \ln UNDERVAL_t + \alpha_2 WSPG_t + \alpha_3 SCPG_t + \alpha_4(\ln UNDERVAL_t \times WSPG_t) + \alpha_5(\ln UNDERVAL_t \times SCPG_t) + \mu_t \quad (7)$$

where y_t^* and lnUNDERVAL are as defined before, $\alpha_0, \ldots, \alpha_5$ are unknown parameters to be estimated, $WSPG$ denotes within-sector productivity growth which from Equation (1) is captured by $\sum_{i=n} \theta_{i,t-k} \Delta y_{i,t}$, $SCPG$ represents structural change productivity growth which, from Equation (1) is captured by $\sum_{i=n} y_{i,t} \Delta \theta_{i,t}$ and μ_t is an error term. With this specification, we are assuming that poverty reduction is essentially a function of the real exchange rate undervaluation, within-sector productivity growth, structural change productivity growth and the interaction between the real exchange rate undervaluation and each component of productivity growth. Inclusion of the two interaction terms was backed by tests for variable inclusion.

From a methodological point of view, Equation (5) could be criticized on grounds of being too parsimonious given the multiplicity of factors affecting poverty reduction. Our argument here is that the majority of economic fundamentals omitted here are in fact potential channels through which productivity growth affects poverty reduction. Their exclusion therefore allows us to capture the full effects of productivity growth. Post estimation, we are interested in probing three main aspects. First is the partial derivative of Equation (5) w.r.t within-sector productivity growth gives us Equation (8).

$$\partial y_t^* / WSPG_t = \alpha_2 + \alpha_4(\ln UNDERVAL_t) \quad (8)$$

which says within-sector productivity growth affects poverty reduction through α_2 plus α_4 times the level of real exchange rate undervaluation. Second is Equation (9).

$$\partial y_t^* / SCPG_t = \alpha_2 + \alpha_5(\ln UNDERVAL_t) \quad (9)$$

which says structural change productivity growth affects poverty reduction through α_2 plus α_5 times the level of real exchange rate undervaluation. Third is, $H_o: \alpha_2 = \alpha_3 = 0$ versus $H_a: \alpha_2 \neq \alpha_3 \neq 0$ which tests whether the within-sector productivity growth and structural change productivity growth have statistically homogenous effects on poverty reduction. Rejection of the null hypothesis at the 10% maximum level of significance would be taken as evidence that the two sources of productivity growth have statistically heterogenous effects on poverty reduction.

4. Findings and discussion

The starting step involved testing for stationarity in the process of estimating the Balassa-Samuelson effect. To achieve this, three tests were considered for robustness purposes and the results are presented in Table 1 evidently, lnRER and lnGDPPC all contain a single unit root which prompted testing for possible co-integration.

Table 1. Stationarity test results

	ADF		**PP**		**Break-Point Tests**		
	Levels	Δ	**Levels**	Δ	**Levels**	Δ	
lnRER	2.533	3.622**	2.041	3.227**	2.726	4.312*	I(1)
lnGDPPC	1.455	3.551**	1.944	3.763**	1.622	4.413*	I(1)

Note: *, ***, *** denotes p<0.1, p<0.05 & p<0.01, respectively. Figures in the table are test statistics.

Two commonly tests for cointegration are the Engel Granger approach and Johansen method. Because the former is a relatively weak test (Sephton, and Larsen, 1991) while the latter is heavily asymptotic and less reliable in small sample sizes (Kremers *et al.* 1992), the analysis relied on the Park Added Variables test for cointegration and the Hansen method. In both approaches, the null hypothesis is of no cointegration. The probability values are too high to reject these null hypotheses hence the conclusion was that lnRER and lnGDDPC are cointegrated.

Table 2. Cointegration test results

Cointegration Test - Park Added Variables Ho: Series are cointegrated			
	Value	**Df**	**Probability**
Chi-square	2.0690	2	0.3554

Cointegration Test - Hansen Parameter Instability Ho: Series are cointegrated				
Lc statistic	Stochastic Trends (m)	Deterministic Trends (k)	Excluded Trends (p2)	Prob.*
0.067068	1	0	0	> 0.2

On the back of results in Table 2, the DOLS estimator was then used to estimate Equation (2). The results presented in Table 3 show a θ_1 of – 1.86, which is statistically significant at a 1 percent level. This indicates a strong Balassa-Samuelson effect in which a percentage increase in per capita income is associated with a 1.86 percent appreciation of the real exchange rate. The table also shows that the Balassa-Samuelson effect explained about 58% variation in South Africa real exchange rate between 1995 and 2020. The IT dummy is positive statistically significant at 5% suggesting that the real exchange rate was, on average, more undervalued post the implementation of inflation targeting.

Diagnostic tests associated with Table 3 are presented in Tables A1, A2, and A3 and Figures A1 and A2 in the Appendix. The model is correctly specified and has homoscedastic and normally distributed residuals which is encouraging. Real exchange rate undervaluation (lnUNDERVAL) was then defined as the difference between lnRER and the predicted values from Table 3 Figure 1 shows the evolution of this generated series. Looking at this graph, South Africa's

real exchange rate was undervalued nearly 50% of the time between 1995 and 2020 with the most sustained undervaluation lasting five years.

Table 3. lnRER and the Balassa-Samuelson Effect

Dependent Variable: LNRER				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
lnGDPPC	-1.8825	0.4721	-3.9875	0.0010
C	16.7039	3.9925	4.1838	0.0006
IT	0.3913	0.1551	2.5230	0.0219
R-squared	0.5844	Mean dependent var		0.7234
Adjusted R-squared	0.4622	S.D. dependent var		0.1847
S.E. of regression	0.1354	Sum squared resid		0.3119
Long-run variance	0.0264			

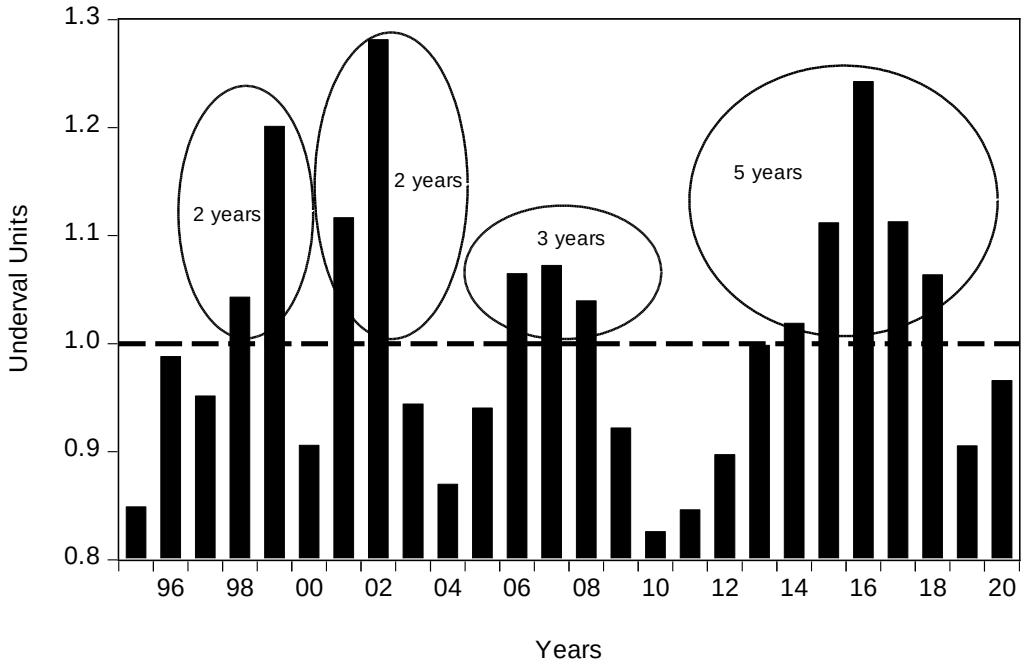

Figure 1. Real exchange rate undervaluation in South Africa 1995 – 2021
Source: Authors' Computation

The next step was to compute South Africa's total productivity growth and its respective components. Figure 2 displays these measures. A visual look at the graph shows an interesting pattern in which South Africa's productivity growth was largely undermined by structural change. For the best part of the period, South Africa recorded marginal within-sector productivity growth which, by implication, arises from the accumulation of factors within-sectors. Structural change productivity growth or productivity growth arising from the movement of factors across sectors appears to have had a surprisingly negative effect on overall productivity growth. While this latter pattern appears surprising at first glance, it is interestingly consistent with Rodrik's (2018) work in which he finds structural change having had a negative effect on productivity growth in a broad range of sub-Saharan countries. He describes this pattern as structural change in which labor and economic resources moved in the 'wrong direction.' In other words, Rodrik (2018) attributes the negative productivity effect of structural change that sub-Saharan Africa went through a structural change process in which labor moved from high productivity sectors to low productivity sectors. Figure 2 validates this proposition in the context of South Africa.

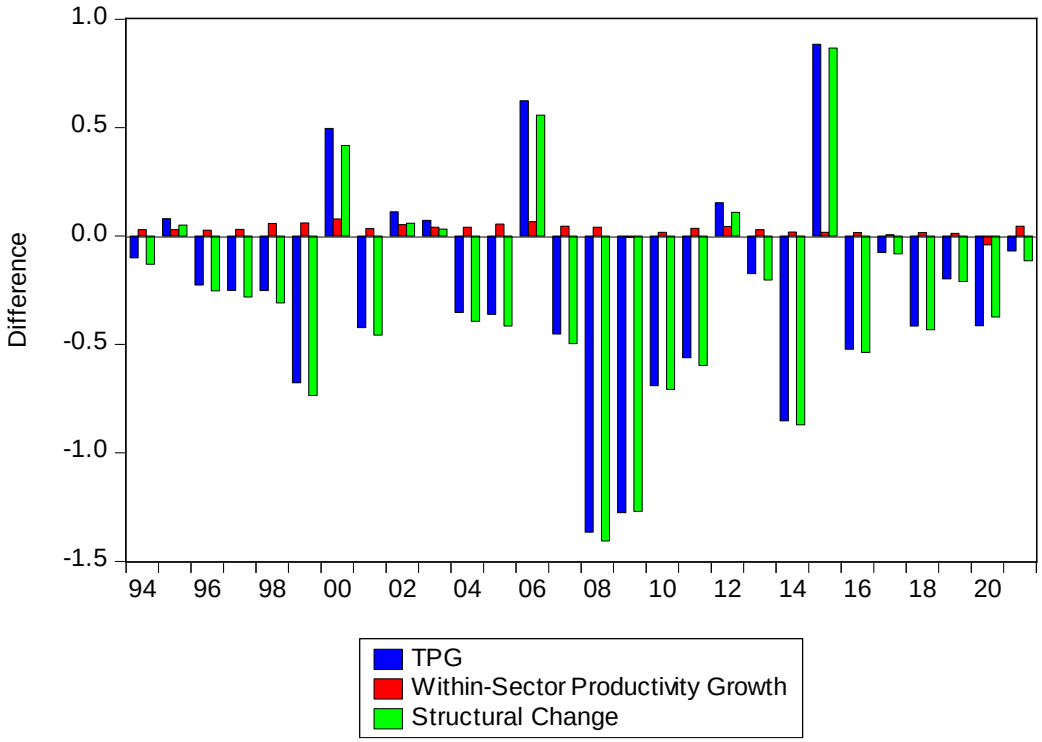

Figure 2. Within-sector and across sector productivity growth
Source: Authors' computation

In Figure 3, changes in the number of people living below the poverty datum line are displayed. The grey sections of the graph represent years in which the number declined. In other words, the grey areas indicate years in which South Africa experienced a reduction in poverty. From a visual inspection, much success was recorded and sustained between 2003 and 2008, a period which largely coincided with the Growth, Employment and Redistribution (GEAR) strategy and the Accelerated and Shared Growth Initiative for South Africa (AsgiSA).[1]

Table 4 presents summary statistics, and it shows that on average, the number of people living below the poverty datum line decreased about 54% of the time. The real exchange rate of the Rand was undervalued by, on average, 1.6%. Within-sector productivity growth averaged 2.2% annually while structural change productivity growth averaged –30.5%. All three continuous variables, real exchange rate undervaluation (lnUNDERVAL), within-sector productivity growth (WSPG) and structural change productivity growth (SCPG) have Jarque-Bera statistics below 6 and corresponding probability values below 0.1. This confirms that real exchange rate undervaluation (lnUNDERVAL), within-sector productivity growth (WSPG) and structural change productivity growth (SCPG) are normally distributed. The standard deviations show that structural change productivity growth had the highest variability followed by real exchange rate undervaluation and within-sector productivity growth, respectively. The outcome variable y* has a maximum and minimum value of 1 and 0, respectively, which is expected as it is, by construction, binary.

[1] GEAR was implemented in 1996 to stimulate faster economic growth which was required to provide resources to meet social investment need. AsgiSA was prepared during 2005 and launched in February 2006. Its objectives were to introduce policies, programmes and interventions that would allow the South African economy to grow enough to halve poverty and unemployment between 2004 and 2014.

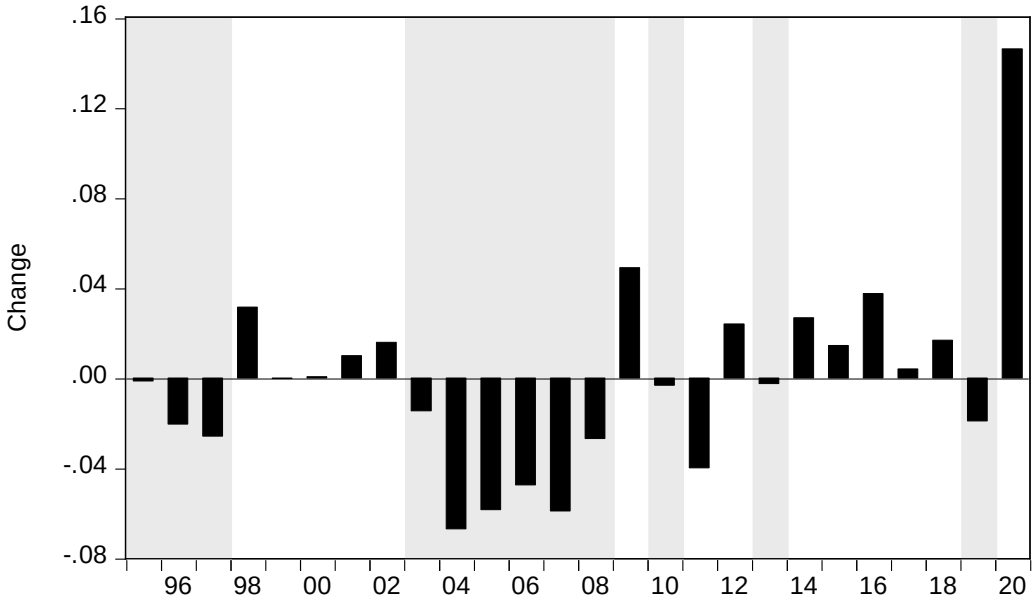

Figure 3. Poverty dynamics in South Africa 1995 – 2021
Source: Authors' computation

Table 4. Summary statistics

	y*	lnUNDERVAL	WSPG	SCPG
Mean	0.5385	1.0169	0.0216	-0.3053
Median	1.0000	0.9932	0.0225	-0.3410
Maximum	1.0000	1.2814	0.0788	0.8670
Minimum	0.0000	0.8260	-0.0401	-1.4065
Std. Dev.	0.5084	0.1220	0.0247	0.5022
Skewness	-0.1543	0.5430	-0.6882	0.0763
Kurtosis	1.0238	2.5924	4.2231	3.4689
Jarque-Bera	4.3339	1.4578	3.6730	0.2634
Probability	0.1145	0.4824	0.1594	0.8766
Sum	14.000	26.1792	0.8229	-7.9382
Sum Sq. Dev.	6.4615	0.3720	0.0152	6.3039
Observations	26	26	26	26

Having converted the above poverty dynamics into a binary variable, taking the value 1 for years with grey areas and 0 otherwise, the analysis proceeds with results from a logit model estimated through the maximum likelihood technique with Huber-White covariance method to guide against potential autocorrelation and heteroscedasticity. Three regression variants were estimated. In variant (1) of Table 5, lnUNDERVAL is included along with the two components of productivity growth. Variant (2) interacts lnUNDERVAL with the within-sector productivity growth component (WSPG). The third regression variant in addition to lnUNDERVAL and WSPG adds the interaction between lnUNDERVAL and the structural change productivity growth (SCPG) component. Interestingly, lnUNDERVAL enters negatively and significantly at 5% level in variant (1). This suggests that the likelihood of lifting people out of poverty decreases with lnUNDERVAL. The probability of lifting people out of poverty falls by roughly 0.01 in response to a percentage increase in the real exchange rate undervaluation. While this result seems surprising given Rodrik's (2008) view that undervaluation fosters growth and China's experience since the early-1990s, it is consistent with the recent work of Seraj *et al.* (2023) which finds real exchange rate undervaluation detrimental to economic growth in South Africa. If one is to assume that real exchange rate undervaluation affects poverty through its effect on growth, then a negative effect of undervaluation on poverty documented here could plausibly be a validation of their results.

A word of caution here is that variant (1) contains the two respective components of productivity growth. The significance of the lnUNDERVAL variable against this background confirms therefore that the two components of productivity growth included here are not the sole channels through which an undervalued real exchange rate affects poverty reduction. In this case given the exchange rate pass through effect argument raised earlier in section 2 and the results observed in Maduku and Kaseeram (2018), the negative sign could reflect the detrimental effect of an undervalued exchange rate that operates through imported inflation which ultimately erodes the real value of incomes and throw an average person into poverty.

The two productivity growth components have revealing results. The within-sector productivity has a positive sign which is statistically significant at the 10% level of significance. From the results, a percentage point increase in the within-sector productivity growth, which mainly arises from the accumulation of fundamentals within-sectors, increases the likelihood of lifting people out of poverty by 0.042 holding constant real exchange rate undervaluation and the productivity growth emanating from structural change. Interestingly, the structural change productivity growth component enters with a negative and statistically insignificant sign. The negative sign suggests that the structural change productivity component potentially undermines efforts to lift people out of poverty while the insignificance of the coefficient in fact indicates that this component did not impact poverty reduction at all during the sampling period. Variant two comes with two important observations. First is that while lnUNDERVAL retains its significantly negative sign, its interaction with WSPG turns out to be positive and statistically significant at the 1% level. This provides indications that within-sector productivity growth cushions out the negative effect of real exchange rate undervaluation on poverty reduction. In fact, algebraically, the result in variant (2) suggests that a real exchange rate undervaluation can increase the likelihood of lifting people out of poverty if accompanied by an annual within-sector productivity growth above 2.5%. This result, looking at Figure 2 presented earlier, implicitly implies that the real exchange rate undervaluation's potential to lift people out of poverty in South Africa may have been undermined by the weak within-sector productivity growth. Higher within sector productivity growth could have therefore led to a different outcome. The second observation is that the structural change productivity growth component remains statistically insignificant which remains hardly surprising given Figure 2 which provided indications of a structural change process that largely moved workers in the wrong direction. In variant (3), the interaction term between lnUNDERVAL and SCPG enters negatively and significantly while that of lnUNDERVAL and WSPG enters positively and significantly at 1% level.

Table 5. Undervaluation, productivity growth components and poverty

Dep = y*	**Model (1)**	**Model (2)**	**Model (3)**
lnUNDERVAL	–0.0092**	–0.0345**	–0.0442**
	(0.0046)	(0.0175)	(0.0174)
SCPG	–0.0011	–0.0009	–0.0007
	(0.0011)	(0.0012)	(0.0011)
WSPG	0.0423*	0.0552*	0.0542**
	(0.0251)	(0.0302)	(0.0220)
WSPG × lnUNDERVAL		0.0846***	0.0554***
		(0.0004)	(0.0126)
SCPG × lnUNDERVAL			–0.0118
			(0.0141)
C	-1.5624	-2.3035	–2.3058
	(1.1540)	(1.5301)	(1.1283)
McFadden R-squared	0.2357	0.3415	0.3554
LR statistic	8.4621	12.256	12.7570
Prob (LR statistic)	0.0374	0.0155	0.0258
Observations	26	26	26

Note: *, **, *** denote p<0.1, p<0.05, p<0.01, respectively.

The results can be discussed in the context of Figures 2, 4, and 5. From Figure 2, South Africa experienced a productivity growth reducing type of structural change during the sampling

period. As Rodrik (2008) posits, productivity growth that is accompanied by the shrinking of a sector's share of employment may have a negative effect on economy-wide growth if the displaced labor ends up in activities with lower productivity. Figure 4 suggests that workers displaced in primary sectors (agriculture and mining) and secondary sectors (manufacturing) ended up in the tertiary sector where they may not have been as productive. In comparison to primary and secondary sectors, the demand for skilled workers is relatively high in the tertiary sector. If workers with limited to moderate skills switch from primary and secondary sectors to services therefore, overall productivity growth may decline which ultimately undermines efforts to lift people out of poverty.

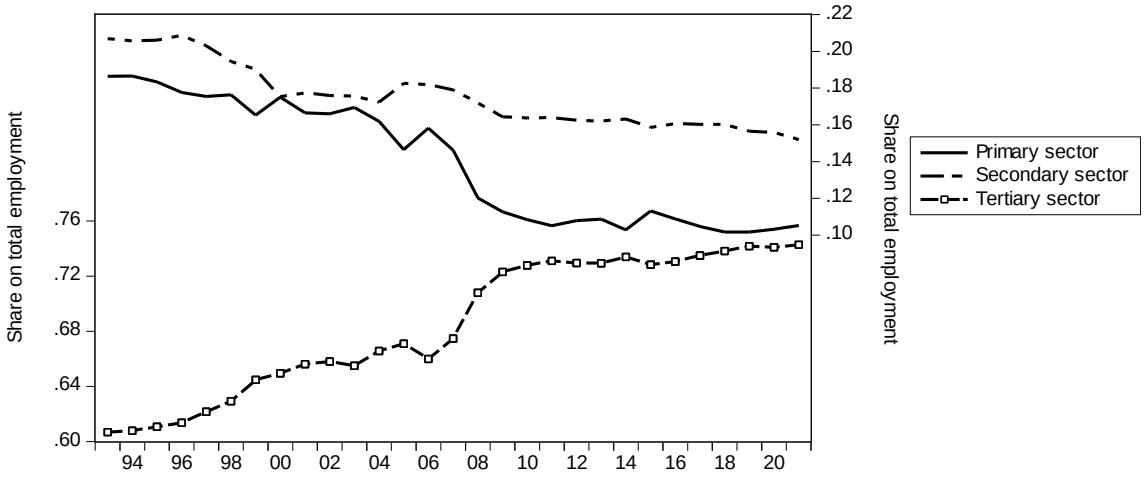

Figure 4. Sectoral employment shares 1995 – 2021
Source: Authors' computation using data from Quantec

From Figure 5, one observes indications that low-skilled workers displaced in primary and secondary sectors may have landed in the tertiary sector. This provides additional support to the claim that South Africa's structural change process is one that appears to have moved workers in the wrong direction. The argument here is that low-skilled are likely to be more productive if placed in sectors that demand low skills (primary and secondary sectors). If low-skilled workers end up in skill-demanding sectors as Figure 5 suggests, overall productivity growth suffers.

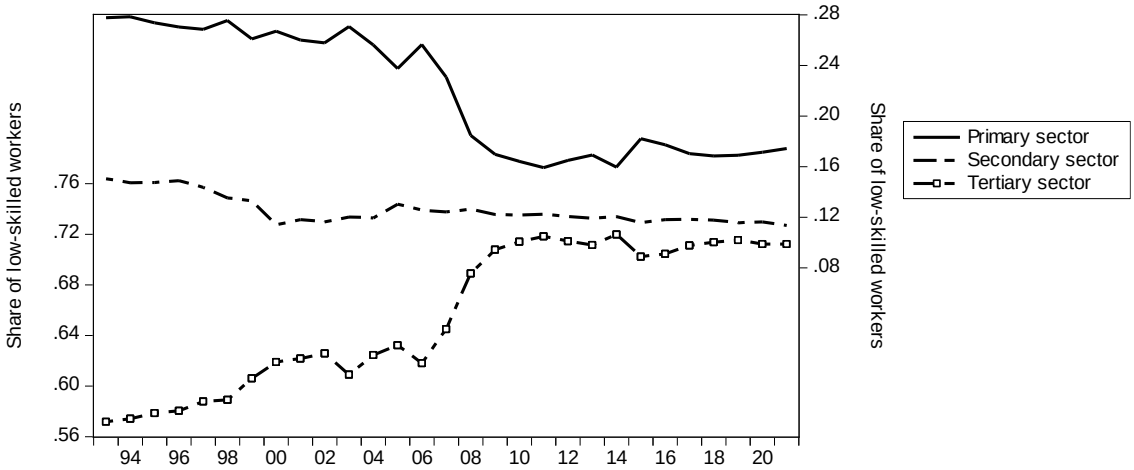

Figure 5. Employment shares of low-skilled workers
Source: Authors' computation using data from Quantec

Lastly, a potential argument could be that the insignificance of SCPG in Table 5 may not necessarily mean that structural change undermines efforts to lift people out of poverty but rather suggests that its effect on poverty reduction may not be significantly different from that of within-sector productivity growth. Table 6 And Table 7 dismiss this claim. The claim, if true, should technically be supported by at least two observations. One is that the correlation coefficient between these two components of productivity must be positive and very close to one. The second observation is that the two coefficients must not be statistically different. Table 6 presents the pairwise correlation matrix for the two productivity growth components. Evidently, the correlation coefficient is quite small for one to suspect the level of collinearity would reverse the true sign on structural change productivity growth in Table 5.

Table 6. Pairwise correlation matrix

	WSPG	SCPG
WSPG	1	0.2750
SCPG	0.2750	1

According to results in Table 7, on the other hand rejects the null hypothesis that $\boldsymbol{\alpha_2 = \alpha_3}$ as the probability value is less than the maximum 10% level of significance. This essentially means the within-sector productivity growth component and the structural change productivity component have heterogenous effects on poverty reduction. In other words, the claim that WSPG and SCPG may have a homogenous effect on poverty reduction (which would support the insignificance of the latter in Table 5) is not supported by the statistical test results presented in Table 7.

Table 7. Wald test results on $\boldsymbol{H_o: \alpha_2 = \alpha_3 = 0}$

Test Statistic	Value	Df	Probability
F-statistic	3.0258	(2, 20)	0.0711
Chi-square	6.0516	2	0.0485
Null Hypothesis: C(2)=C(3)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		0.0542	0.0220
C(3)		-0.0007	0.0011

Note: Restrictions are linear in coefficients.

Therefore, considered together, Table 6 and Table 7 make it less likely that the two sources of productivity growth have uniform effects on poverty reduction. They are statistically different and what appears to generate the lifting of poor people out of poverty is the within-sector productivity component as opposed to the structural change process. Residuals from the estimated logit models were subjected to a normality test. Results in Figures A3 and A4 in the Appendix B confirm that the model passed this diagnostic check.

In closing, it worth mentioning that the negative effect of lnUNDERVAL should be interpreted with caution. On the one hand as we argue in the paper, this could mean that South Africa as a small open economy, its devalued currency could not yield the anticipated poverty reducing effects. That could be as a result of the imported inflation channel since South African industries import majority of their inputs. If a signification portion of inputs in industries are imported, that may affect the competitiveness of South Africa's imports on the World market. Hence, the failure of devalued South African Rand to have a huge poverty reducing muscle.

5. Conclusion

While an undervalued real exchange rate is increasingly becoming regarded as a positive correlate of growth and economic development looking at China's experience, South Africa's own experience is hardly supportive of this viewpoint as a mostly depreciated Rand barely coincided

with a significant lifting of people out of poverty. Evidence presented in this paper suggests that an undervalued real exchange rate potentially lifts people out of poverty if the economy generates within-sector productivity growth that exceeds 2.5% annually. The South African economy fell short of this threshold level as within-sector productivity growth averaged 2.2% annually. Evidence has further shown, and worrisomely so, that South Africa went through the kind of structural change that shifted employment in the wrong direction. Low-skilled workers appear to have been reallocated from primary and secondary to tertiary sectors, a process that shrank overall productivity growth. In conclusion therefore, the analysis has shown that the real exchange rate can potentially increase the likelihood of lifting people out of poverty as we saw in China, but its effect ought to be complemented by robust within-sector productivity growth (achievable through the accumulation of economic fundamentals within-sectors) and structural change that moves workers from low productivity sectors to high productivity sectors and not the other way round. Given the above, it is the recommendation of this paper that, South African authorities may have to prioritize and encourage within-sector productivity growth to make South African exports competitive. Competitive South African exports have a high poverty reducing effect even with a depreciating Rand as proven in this paper. Also, to reduce poverty, primary and secondary sectors may have to be reprioritized as employment creation centers for low skilled workers. The prioritization of the tertiary and service sector is unrealistic for the South African economy given the abundance of no and low skilled workers in the country.

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Appendix

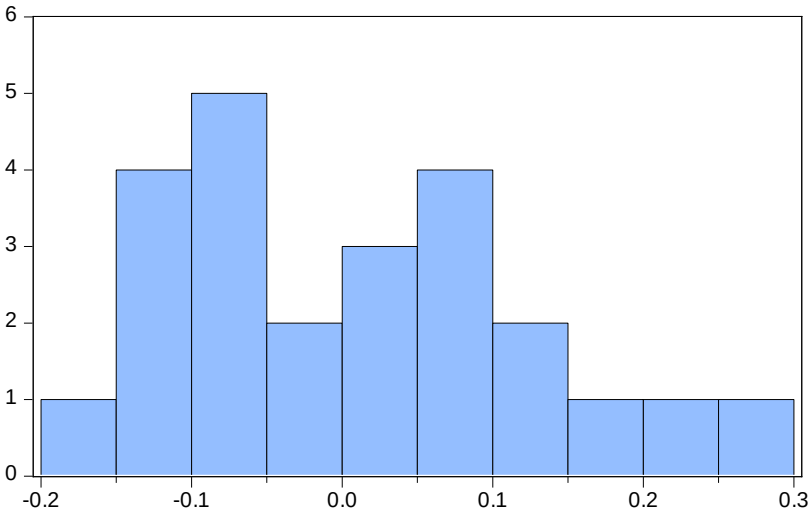

Figure A1. Diagnostic Check on Serial Correlation

Table A1. Observations

Date: 06/03/23 Time: 19:29
Sample: 1995 2020
Included observations: 24

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. | . |	. | . |	1	-0.041	-0.041	0.0464	0.830
. *| . |	. *| . |	2	-0.121	-0.123	0.4631	0.793
. *| . |	.**| . |	3	-0.198	-0.213	1.6336	0.652
.**| . |	.**| . |	4	-0.268	-0.327	3.8748	0.423
. | . |	. | . |	5	0.062	-0.064	4.0000	0.549
. *| . |	.**| . |	6	-0.131	-0.317	4.5947	0.597
. |* . |	. | . |	7	0.191	-0.011	5.9373	0.547
. | . |	. *| . |	8	0.002	-0.202	5.9374	0.654
. | . |	. | . |	9	0.062	-0.034	6.0954	0.730
. | . |	. *| . |	10	0.003	-0.151	6.0959	0.807
. *| . |	. *| . |	11	-0.124	-0.132	6.8374	0.812
. | . |	.**| . |	12	-0.010	-0.205	6.8430	0.868

*Probabilities may not be valid for this equation specification.

Table A2. Diagnostic check on homoscedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.367044	Prob. F(1,24)	0.2538
Obs*R-squared	1.401154	Prob. Chi-Square(1)	0.2365
Scaled explained SS	1.159522	Prob. Chi-Square(1)	0.2816

Table A3. Diagnostic check on model specification

Ramsey RESET Test			
	Value	**df**	**Probability**
t-statistic	1.120894	23	0.2739
F-statistic	1.256403	(1, 23)	0.2739
Likelihood ratio	1.382846	1	0.2396

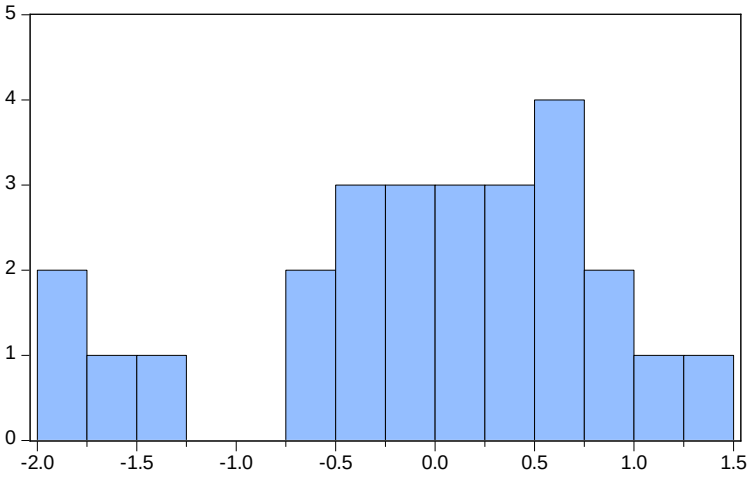

Figure A2. Variant (1)

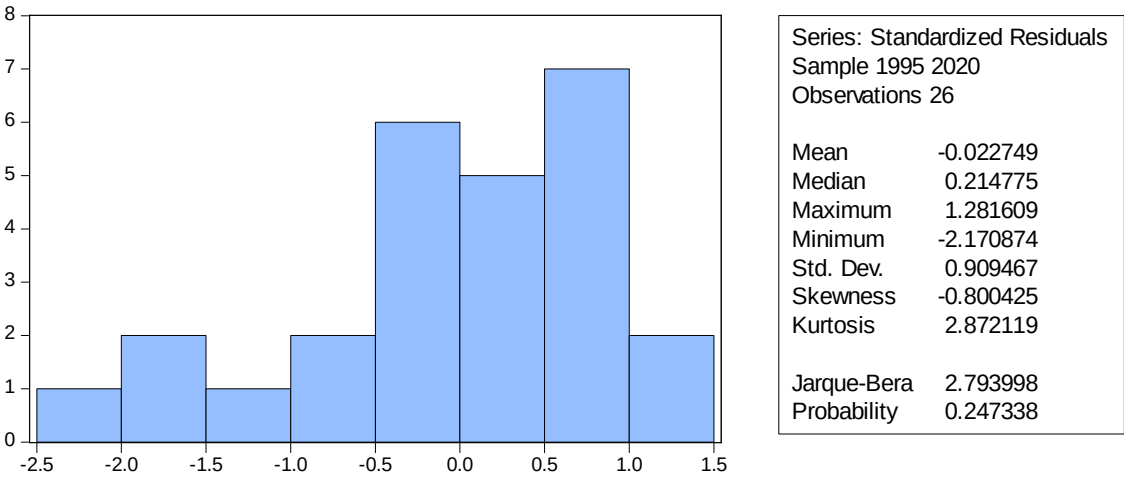

Figure A3. Variant (2)

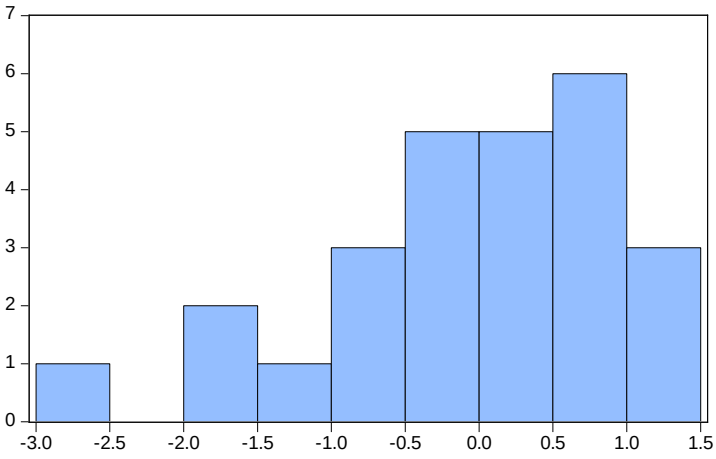

Figure A4. Variant (3)