Department of Economics

Evaluating the Macroeconomic Impact of IMF Programs in Sudan

by Muayad Ismail

Discussion Paper No. 2020-21

Department of Economics
University of Reading
Whiteknights
Reading
RG6 6AA
United Kingdom

www.reading.ac.uk

Evaluating the Macroeconomic Impact of IMF Programs in Sudan

Muayad Ismail [1]

October 5, 2020

Abstract

This paper applies a combination of quantitative techniques, namely the Generalized Evaluation Estimator (GEE) and Synthetic Control Method (SCM), to assess the impact of IMF programs implemented in Sudan on the performance of real GDP growth, inflation, and the current account balance. The two applied methods provide empirical evidence that IMF programs in Sudan were effective in reducing inflation during program periods, albeit with short-lived effects thereafter. However, conclusions drawn by the two approaches are divergent regarding the effects of IMF programs on GDP growth and the current account balance. While the GEE approach fails to detect any significant effects of Fund programs on growth and the current account balance for the entire sample period, the SCM concludes that the effects on growth (current account) have been positive (negative). Further, the GEE approach finds positive and significant effects of IMF programs on GDP growth when the analysis is restricted to cover IMF Staff Monitored Program (SMP) periods only. Notwithstanding these positive effects, the analysis indicates that deliberately keeping inflation rates very low during SMP program periods could have possibly constrained higher rates of GDP growth during the same periods.

JEL Classification: F33, E65
Keywords: IMF Programs, Generalized Evaluation Estimator, Synthetic Control, Stand-By Arrangements, Staff Monitored Programs

[1] **Author's Email:** m.h.m.ismail@pgr.reading.ac.uk - Department of Economics, University of Reading.
[2] The author wishes to thank James Reade and Joo Young Jeon for their valuable comments and guidance throughout the research project. He also would like to thank Tim Willems and Hisham Osman for their insightful discussions and advice.

1 Introduction

The effectiveness of programs mandated by the International Monetary Fund (IMF) has been subjected to intensive research. Particularly, economists have been debating for years whether IMF programs consistently produce positive economic outcomes or can do more harm than good. Nevertheless, it is difficult to find a conclusive answer to this seemingly evolving question. This is due, in part, to the fact that constructing adequate counterfactual to the policies adopted by a country absent IMF programs is proven technically challenging. At the same time, it is difficult to disentangle effects induced by IMF programs on economic performance and those driven by other exogenous factors. That said, this paper attempts to address these technical challenges in an effort to find a plausibly coherent conclusion on whether the relatively large number of IMF programs implemented in Sudan have been effective in achieving their desired macroeconomic outcomes.

For Sudan, finding out whether IMF programs are good or bad for the economy is becoming particularly important. This is not only because about 40 percent of the years since Sudan's independence in 1956 were covered by IMF programs, but also the successful implementation of an IMF staff Monitored Program (SMP) remains one of the technical requirements of granting Sudan external debt relief under the Heavily Indebted Poor Countries (HIPC) initiative. More importantly, securing external debt relief under the HIPC initiative is potentially the only way to restore debt sustainability and bring the Sudanese economy back on a sustainable path. In this context, a technically sound and objective evaluation of the impact of IMF programs in Sudan is considered extremely important for the Sudanese government to decide on future engagement with the IMF.

The first IMF program implemented in Sudan dated back to FY1966/67 and was prompted, at the time, by a balance of payments (BOP) crisis that pressured the Sudanese government to resort to the IMF for financial assistance. Since that year until now, about 25 years of the country's life time were mandated by various Fund programs covering a spectrum of macroeconomic objectives, targets, and structural benchmarks.

As part of IMF programs implemented in Sudan, a total of 11 years covering the period between 1960s to 1980s, were ordinarily accompanied with both policy advice and financial assistance. However, the Fund's financial assistance to Sudan came to a halt in mid-1980, when the Sudanese government accumulated arrears and failed to repay the IMF's overdue financial obligations. In 1987, the relationship between Sudan and the IMF entered a historically serious phase when the IMF declared Sudan ineligible to Fund resources given the lingering accumulation of arrears. This escalation continued with Sudan being declared non-cooperative in 1990 and its voting rights subsequently suspended in 1993. This notwithstanding, in 1997, the relationship began to reel back with the Sudanese authorities and IMF agreeing on a Staff Monitored Program (SMP) that aimed primarily to restore macroeconomic stability. The

implementation of sound macroeconomic policies under four consecutive SMPs between 1997-2000 contributed to stabilizing the economy and improving the relationship between Sudan and the Fund, leading to restoration of Sudan's voting rights in 2000. Since the reinstatement of its voting rights, Sudan implemented about 10 more SMPs.

This paper intends to fill the gap in the literature on studies that objectively assess the macroeconomic feasibility of IMF programs implemented in Sudan. To this effect, the study adopts a combination of quantitative techniques, namely the Generalized Evaluation Estimator (GEE) and Synthetic Control Method (SCM) that effectively address the problem of constructing the counterfactual while accounting for external environment effects. Adopting such a combination of GEE and SCM techniques is considered a major research contribution since there have been no attempts to use a similar approach in the existing literature.

The two methods employed in the study provide empirical evidences that Fund programs implemented in Sudan helped contain inflation during program periods. However, this positive impact on inflation is found to be short-lived. At the same time, the two approaches provide different conclusions regarding the impact of IMF programs on real GDP growth and the current account balance. Particularly, while GDP growth is found to be strengthened during program periods by the SCM method, the GEE approach fails to detect any significant effects from IMF programs on the performance of real GDP growth, except for SMP-type programs. Similarly, the SCM approach points to a large negative impact of Fund programs on the current account balance as a percent of GDP. However, the GEE model concludes that effects of IMF programs implemented in Sudan on the current account balance were insignificant for the whole sample period.

This paper is organized as follows, section two reviews literature on impact evaluation of IMF programs. Section three provides a historical overview of IMF programs implemented in Sudan since 1960 while section four undertakes a descriptive analysis of key historical trends under IMF programs implemented in Sudan. Section five outlines the methodology employed in this paper to assess the feasibility of IMF programs and section six presents the main findings of the study based on the GEE and SCM approaches. Section seven concludes.

2 Literature Review

The impact of IMF programs on macroeconomic performance has been subjected to an intense debate for several years. This has culminated in several studies that aim to evaluate the economic feasibility of IMF programs and whether they have succeeded in achieving their intended objectives. However, while most of these studies provide a holistic analysis of IMF program issues at synthesized country levels, they are limited in terms of their deep coverage

of individual country issues. Therefore, this study intends to bridge this gap through providing a more profound coverage of specific country issues pertaining to Sudan.

The increasing importance of the role of the IMF and the expansion of its mandate and influence during the past decades have spurred the interest in assessing the impact of Fund programs. This interest has recently moved beyond focusing on the economic impact of IMF programs to scrutinize social and political effects of these programs. At the same, different methodologies have been used to evaluate such an impact. Hence, literature on IMF programs have produced mixed results depending largely on the area of focus, methodology used, time period, and geographical representation and income levels of countries under study.

The first study by Reichmann and Stillson (1978) adopts the before-after approach[1] to evaluate a et of macroeconomic outcomes of 79 IMF-supported programs across a diversified group of countries. They conclude that while IMF programs are broadly neutral to the balance of payment and economic growth, they have mixed effects on inflation depending on whether the specific programs are accompanied with exchange rate devaluations. Connors (1979) employs a similar methodology that yields congruent results regarding the effects of Fund programs. Killick and Bird (1984) compare the macroeconomic performance of 24 countries before and after implementing Fund programs using non-parametric statistical tests. Contrary to the previous studies they conclude that the balance of payment and the current account balance deteriorated during post-program period. Assessing Fund programs implemented in 22 African economies, Zulu and Nsouli (1985) find that growth rates have been lower in post-program periods than in pre-program periods.

Despite its simplicity, the before-after approach is, however, criticized for the inability to distinguish between program and non-program determinants of the macroeconomic performance. To overcome this shortcoming, Donovan (1981), (1982) control for non-program determinants by estimating the performance of program countries in the absence of IMF programs using the observed performance of non-program non-oil developing countries. He concludes that Fund programs are effective in improving the external position and reducing inflation while their impact on growth remains insignificant. Applying a similar methodology Gylfason (1987) and Pastor (1987) replicate the same results, with the exception the effect of IMF programs on inflation is found negligible.

Most of the early studies on IMF programs have been criticized on econometric grounds. Particularly, the before-after approach falls short of accounting for exogenous factors that could affect the economic performance independently from Fund programs. At the same time, the standard control group approach tends to overlook pre-existing economic conditions in program countries, which gives rise to the problem of adverse selection bias. Goldstein and Montiel (1986) address these shortcomings by controlling for differences between initial economic conditions

[1]The before-after evaluation method involves testing for significant differences between the means of the targeted variables before and after the program period.

using a policy reaction function that approximates counterfactual policies following a non-random selection of program countries. Their approach is known as the Generalized Evaluation Estimator (GEE) or modified control group approach. Dicks-Mireaux, et al. (2000) apply an improved version of the GEE model on 61 developing countries undergone IMF structural adjustment programs and conclude that Fund programs have positive impact on growth and external debt while their effect on inflation remains insignificant.

Using a dynamic version of the Heckman Selection Model, Przeworski and Vreeland (2000) find that IMF programs have negative contemporaneous impact on economic growth. Particularly, growth in countries undertaking Fund programs can improve only after they leave the program. This result has been confirmed by Atoyan and Conway (2006) who employ a combination of instrumental variable and matching techniques on a group of transition and developing countries participated in Fund programs. They also find that IMF programs positively affect the current account and fiscal performance.

Newiak and Willems (2017) employ the Synthetic Control Method (SCM) to evaluate the Policy Support Instrument recently introduced by the IMF on the economic performance of seven low-income African countries. They conclude that while IMF programs were effective in reducing inflation and increasing growth, they did not appear to influence foreign direct investment.

A number of studies focus on the political aspects of IMF programs in developing countries and provide evidence that IMF financial assistance is driven by political factors. These studies include Barro and Lee (2002); Thacker (1999); Harrigan, et al. (2006); and Reynaud and Vauday (2008). Further, research also focuses on social and distributional effects of Fund programs, including Easterly (2003); Garuda (2000); Lang (2016); and Forster et al. (2019). These studies, however, produce divergent conclusions on the social impact of IMF programs.

Notwithstanding these plethora of studies on assessing Fund programs in general, there have been limited number of studies that particularly focus on evaluating the impact of IMF programs implemented in Sudan. In this context, using a combination of the before-after approach and an econometric model, Bannaga (2004) concludes that home-grown macroeconomic policies adopted by the Sudanese authorities were more effective than policies pursued under IMF programs in Sudan. Abdelrahman (1998) argues that Fund programs implemented in Sudan in early 1980s helped improve the productivity of the agricultural sector, the mainstay of the economy at the time. These productivity gains, however, had been unsustainable and faded over time. Concurrently, O'Brien (1985) stresses that the 1970s Fund programs aimed at enhancing Sudan's export production had negatively affected the purchasing power, particularly for urban populations, who had become increasingly vulnerable to drought-induced famines.

This study primarily focuses on assessing the macroeconomic impact of IMF programs implemented in Sudan during the period 1960 to 2017. Importantly, focusing on a single country

will help deepen the analysis while providing scope for ensuring parameters' stability relative to multiple-country studies. Particularly, cross-country studies usually experience parameters' instability due to possible institutional and structural differences among countries under study, specifically low income and developing countries. At the same time, a major contribution of this study is that it applies a combination of two robust quantitative techniques, namely GEE and SCM, which has not been combinedly adopted in the existing literature.

3 History of IMF Programs in Sudan

The Sudanese economy has been largely vulnerable to exogenous shocks, including those precipitated by severe droughts, political tensions, civil wars, and commodity price shocks, with significant implications for growth, productivity, and social development. Since its independence in 1956 until 1999, the economy depended largely on agricultural production and commodity exports before the production and exportation of oil in late 1990s. The over-reliance on the agricultural sector exposed the economy to agricultural and climate related stocks that were transmitted to fiscal and monetary sectors given the lack of economic and policy buffers.

The vulnerability of the economy to exogenous shocks was particularly evident in the precarious balance of payment (BOP) situation in late 1966, which prompted Sudan to resort to the IMF for BOP assistance for the first time. In line with the program agreement at the time, Sudan implemented three successive Fund stabilization programs from late 1966-1969. Although these programs were generally helpful in improving the country's external and fiscal positions during first two years, fiscal deficits widened significantly during the third year of the stand-by arrangement on account of a substantial increase in the public wage bill with significant implications for fiscal finances and overall economic performance (International Monetary Fund, 1972).

Although the early experience with Fund programs in Sudan was broadly fruitful, these programs did not address the root causes of economic vulnerabilities in Sudan, including limited economic diversification and over-dependence on the agriculture. As a result, the Sudanese economy witnessed further substantial contractions during 1970s and 1980s. Particularly, in 1972 marketing difficulties for cotton, the main export in Sudan at the time, weighed heavily on economic growth and deepened external and fiscal imbalances. To address elevated internal and external imbalances, the government resorted to another stand-by arrangement from the Fund for the period 1972-73 (International Monetary Fund, 1972). As part of the conditionality of these arrangements, the government expenditures and credit growth were markedly restrained, which had crippled economic growth with possibly negative effects on socio-economic indicators.

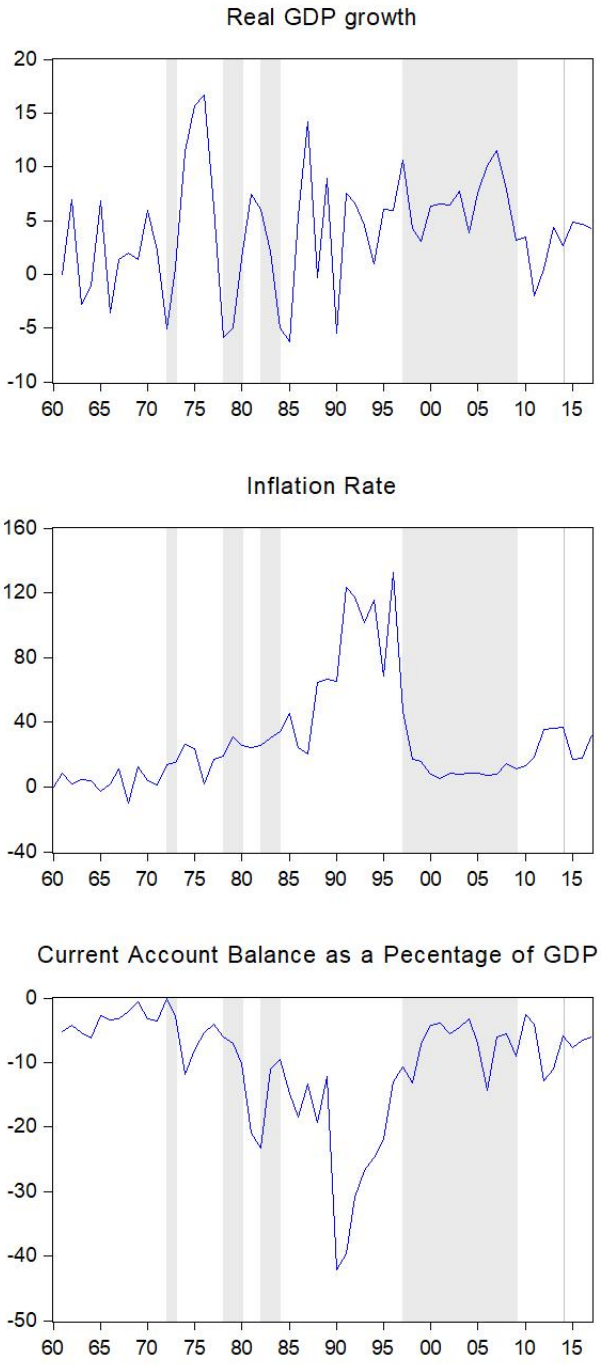
Further, the next IMF's stand-by arrangements to Sudan took place in 1978-80 and aimed

primarily to strengthen growth, stabilize high inflation, and improve the balance of payment following years of economic deterioration driven largely by cotton supply shocks. However, these arrangements did not achieve the intended economic outcomes on the back of adverse developments in international markets and structural capacity constraints (International Monetary Fund, 1982). These series of Fund programs in Sudan were particularly important because they witnessed the abundance of the long-established fixed exchange rate regime and adoption of a flexible regime based the Fund's advice in 1978.

The main objective of the subsequent IMF stand-by arrangements in 1982-84 was to strengthen the balance of payment position through encouraging exports and curbing imports while re-channelling remittances of the Sudanese working abroad to official foreign exchange markets away from the parallel markets for exchange rates. These arrangements were broadly successful in attaining their main objective, particularly it helped to narrow the current account deficit in 1983. However, economic growth and the current account deficit subsequently deteriorated in 1984 following the severe droughts that hit Sudan during that year. Interestingly, the year 1984 marked the last arrangement with financial assistance from the Fund as Sudan continued to accumulate arrears to the Fund and other international financial institutions (IFIs) since that year. According to the IMF's lending into arrears policy (LIA), the Fund cannot lend to Sudan provided that it accumulates arrears to the IMF and other IFIs.

Although the Fund cannot lend to Sudan, the LIA policy allows the Fund to provide technical assistance and engage in non-financing programs, such as Staff Monitored Programs (SMPs). That said, the Sudanese government successfully implemented thirteen SMPs during the period 1997-2009. These SMPs broadly targeted stabilizing inflation, improving the external sector position, and supporting growth with various degree of emphasis on each objective during the program period. Looking at data, we find that GDP growth, inflation rates, and the current account balance generally improved during the SMP periods in line with the envisaged program objectives, as indicated in Figure 1. The successful implementation of SMPs, however, did not resolve Sudan's long overdue debt relief issue, which was blocked by the presence of Sudan in the US list of State Sponsors of Terrorism since 1993 (International Monetary Fund, 2017). In 2014, the Sudanese government implemented another SMP that prioritized stabilizing the economy after the secession of South Sudan in 2011. Nevertheless, the program had not been completed due the non-observance of a prior action on exchange rate devaluation despite the satisfactory performance in almost all other performance criteria and structural benchmarks.

Figure 1: Real GDP Growth, Inflation, and the Current Account Balance in Sudan[2]



4 Descriptive Analysis of Trends under IMF Programs

This section focuses on analyzing the trends of the key macroeconomic variables commonly targeted under IMF programs in Sudan as well as the main policy variables used to achieve

[2]For the rest of the figures in the paper, gray shaded areas correspond to IMF program periods.

these targets. In line with the previous studies on evaluating Fund programs, key targeted variables examined in this paper are GDP growth, inflation, and the current account balance. Focusing on these particular macroeconomic variables helps compare the study's findings with the outcomes of the existing literature. In the same vein, the main policy instruments considered in this section are exchange rate, budget balance, and growth of the money supply, which are found to be the most commonly policy tools used to achieve objectives under IMF programs implemented in Sudan. The methodology section will, however, provide further details on policy instruments employed by the Sudanese authorities absent Fund programs.

The next subsection provides brief information on the main sources of data used in the study while the subsequent subsections delve into the analysis of general trends of key macroeconomic variables under Fund programs.

4.1 Sources of Data

The time-series data on key macroeconomic indicators in Sudan from 1960-2017 is derived from the IMF World Economic Outlook (WEO) Database. Other data sources include the World Bank Development Indicators Data-bank, Government of Sudan's official reports, and Archives of the IMF Executive Board, which are used to complement the data collected from the WEO database. In addition, panel data on developing countries used to construct the synthetic control group is obtained from the World Bank Development Indicators Data-bank.

4.2 Exchange Rate

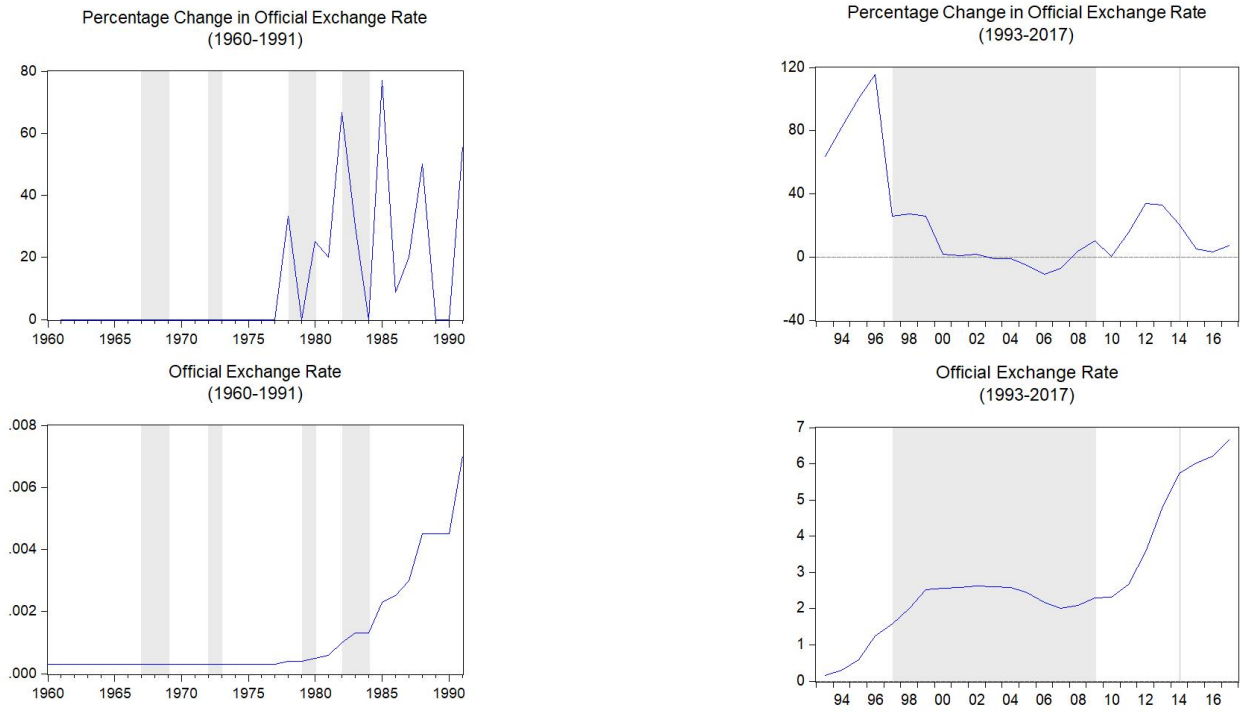
Figure 2 below shows that IMF program periods in Sudan witnessed a number of exchange rate devaluations. The study uses the 25 percent threshold applied by Franke and Rose (1996) to single out exchange rate devaluation episodes in Sudan during the study period. To this end, the paper identifies about 8 devaluations that took place during IMF programs between 1960 and 2017. Interestingly, the first ever devaluation of the Sudanese pound against the U.S. dollar implemented in June 1978 was inspired by an IMF program that primarily aimed at restructuring the cost in the agricultural sector, pursuing fiscal consolidation, tightening monetary policy, and limiting external borrowing. Particularly, the adjustment of the exchange rate was one of the requirements of the credit tranche purchase of the 1978/79 IMF program (International Monetary Fund, 1979). Subsequently, exchange rate devaluations continued at different magnitudes in the following Fund programs, particularly in the context of IMF stand-by arrangement during 1980s.

In this connection, using a vector auto-regressive (VAR) analysis, the study finds that exchange rate devaluations tend to cause a persistent increase in inflation and reduction in real

GDP growth that washes out over the medium term as indicated in impulse response analysis in Appendix 6. This result confirms the high economic cost of exchange rate devaluations in developing countries proved by Frankel (2005). However, this finding alone cannot be used as a presumption that IMF programs implemented in Sudan have been harmful to the economy given that about 10 exchange rate devaluations also took place during non-program periods. Accordingly, a more inclusive approach is needed to evaluate the overall macroeconomic impact of Fund programs. To this effect, the study applies a combination of quantitative technique to provide a more comprehensive evaluation of the effectiveness of Fund programs, which will be further illustrated in the methodology section of the study.

Figure 2 below depicts developments in official exchange rates in Sudan between 1960-2017.

Figure 2: Exchange Rate Developments (1960 - 2017)

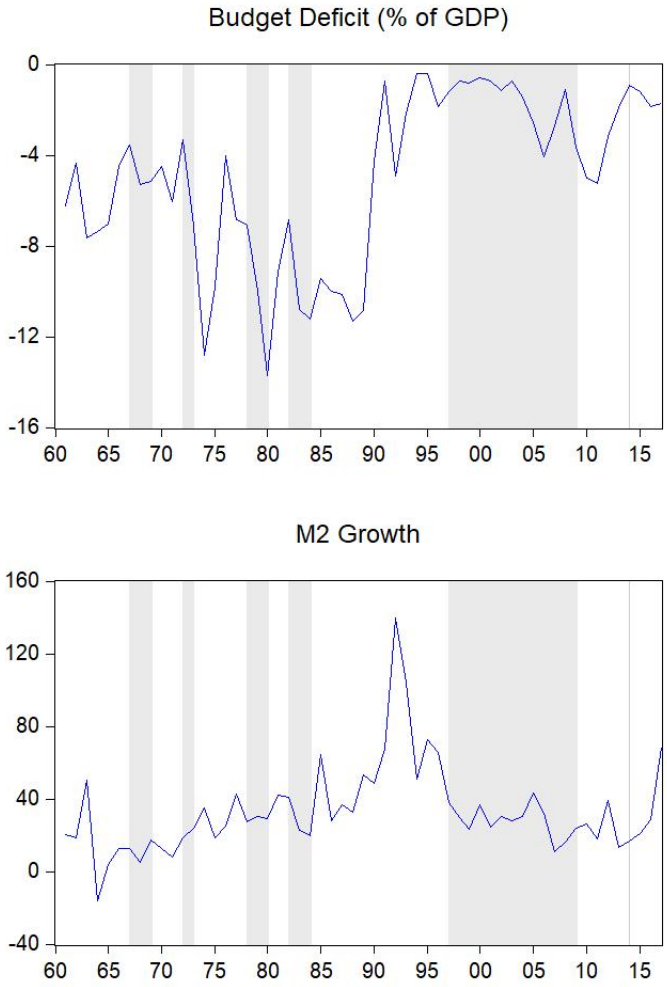


4.3 Budget Deficit and Money Supply

In addition to exchange rate devaluations, the most commonly used policy measures under Fund programs are found to be fiscal consolidation and tightening monetary aggregates, (Bird, 1996) and (Forster, et al., 2019). Looking at the data, we find that the growth of the money supply was relatively tamed during IMF programs relative to non-program period. In parallel, the budget deficit as percentage of GDP showed notable improvement reflecting consolidation efforts during IMF programs relative to non-program periods, as indicated by Figure 3.

In this respect, the average growth of the money supply was 25.3 percent during Fund program periods between 1960-2017 compared to 32.4 percent during non-program periods. Using T-Test for equality of means, the study finds that the mean of the growth in the money supply under Fund programs is significantly lower than the average growth during non-program periods. In the same way, the average budget deficit as percentage of GDP during program periods was 4.3 percent compared to 5.5 during non-program periods. However, the difference between the means of the budget deficit during program and non-program periods was insignificant.

Figure 3: Developments of the Budget Deficit and Monetary Growth in Sudan



4.4 GDP Growth, Inflation, and the Current Account Balance

Table 1: Average GDP Growth, Inflation, and the Current Account Balance during IMF Program and Non-Program Periods

Sample	No. of Obs.	IMF Program	GDP Growth		Inflation		Current Account Balance (% of GDP)	
			Program	Post Program	Program	Post Program	Program	Post Program
Full Sample	32	Non-Program	4.4	3.8	38.6	38.1	-12.9	-12.5
	25	Program	3.4	1.4	16.5**	21.8	-7.0**	-7.5**
	57	**Total**	**4**	**4**	**28.9**	**28.4**	**-10.3**	**-10.3**
Stand-By Arrangement	32	Non-Program	4.4	3.7	38.6	39.3	-12.9	-12.5
	11	Program	-0.5**	1.9	19	21.8	-6.9*	-8.6
	43	**Total**	**3.1**	**3.1**	**33.6**	**34.8**	**-11.3**	**-11.5**
SMP	32	Non-Program	4.4	3.8	38.6	39.3	-12.9	-12.5
	14	Program	6.5	6.2	14.5**	10.7**	-7.2*	-6.7*
	46	**Total**	**5**	**4.6**	**31.3**	**30.6**	**-11.1**	**-10.7**
Stand-By vs. SMP	11	Stand-By	-0.5	1.5	19	21.8	-6.9	-8.6
	14	SMP	6.5***	6.2	14.5	10.7**	-7.2	-6.7
	25	**Total**	**3.4**	**4.1**	**16.5**	**15.6**	**-7**	**-7.5**

* ** *** denote that using T-Test, the mean during Fund programs is significantly different than the mean during non-program periods at 0.1, 0.05, and 0.01, respectively.

As indicated in the results of the T-Test for equality of the means in Table 1, the average of the inflation rates and current account deficits were significantly lower during IMF programs in Sudan than in non-program periods for the entire sample of the study. Conversely, IMF program periods exhibited a weaker GDP growth on average relative to non-program periods. However, the difference between average GDP growth rates during program and non-program periods was insignificant. Comparing the economic performance during post program periods and non-program periods yielded similar results for real GDP growth and the current account deficit. On the other hand, although post-program inflation was lower than non-program inflation, the difference between the two rates was insignificant.

Interestingly, real GDP growth during stand-by IMF arrangements was significantly lower than growth rates during SMP periods. However, the difference between the means of GDP

growth during post stand-by arrangements and SMPs was insignificant. Equally important, the average inflation rate was significantly lower during both SMPs and post SMPs than in stand-by and post stand-by Fund arrangements. Further, while the average current account deficit post program periods was significantly narrower than during non-program periods, the analysis failed to detect any significant differences between the performance of the current account during stand-by arrangements and SMP programs.

Based on the results of the T-Test for equality of means, IMF programs appeared to have a significant positive impact on inflation and the current account balance for the entire sample. The effect of Fund programs on GDP growth though positive, it was insignificant. Nevertheless, the performance of real GDP growth under SMPs was significantly better than under IMF stand-by arrangements. At the same time, average inflation and the current account deficit were lower during post-SMPs compared to post stand-by arrangement.

Although the tests for equality of means provide good insights about the impact of Fund programs on growth, inflation, and the current account, they do not take into consideration the performance of these macroeconomic variables in the absence of IMF programs or what is known as the counterfactual. Particularly, they do not account for changes in the economic performance for reasons other than Fund programs by assuming that external environment remains constant (Khan, 1988), (Bird, 1996), (Ul Haque and Khan, 1998). Therefore, the next section explores other quantitative methods, namely the Generalized Evaluation Estimator (GEE) and Synthetic Control Method (SCM), to further evaluate the impact of Fund programs on the Sudanese economy. These methods are considered superior to the tests for equality of the means as they take into consideration the effects of the external environment.

5 Methodology

This paper adopts two approaches to quantitatively evaluate the macroeconomic impact of IMF programs implemented in Sudan during the period 1960-2017. These two methods are the Generalized Evaluation Estimator (GEE) and Synthetic Control Method (SCM). Adopting more than one method would help compare results while providing more scope to solidify the final outcomes of the research, particularly in cases where the two approaches produce comparable results.

5.1 Generalized Evaluation Estimator (GEE)

The GEE approach employed in this paper draws on the model developed by Goldstein and Montiel (1986), which originally adapts techniques used for evaluating effectiveness of labor

training. It also builds on subsequent developments by Dicks-Mireaux, Mecagni, and Schadler (2000). This method is basically geared towards assessing whether Fund programs implemented in Sudan during the research period had been successful in improving macroeconomic performance. Specifically, it measures the impact of Fund programs on the outcomes of three macroeconomic variables, economic growth, the current account balance, and inflation using time-series data covering the period from 1960 to 2017. These three variables exemplify the main macroeconomic objectives targeted by IMF programs. For most Fund program periods, stabilizing the economy, improving the external position, and boosting economic growth were among the main aspirations. While the selection of these three variables facilitates comparisons with earlier studies, the availability of relatively long time-series data for these particular variables is considered an additional advantage that merits their selection.

The GEE model assumes that the performance of the targeted macroeconomic variables is a function of four components, namely (i) changes in macroeconomic policies that would be adopted in the absence of an IMF program or counterfactual, (ii) changes in the external environment that influence the outcomes of the targeted variables (iii) the impact of IMF programs implemented during the program periods, and (iv) an unobservable shocks component.

The general equation of the GEE model can be written as follows:

$$Y_{it} = \alpha_{0i} + \alpha_{ik} x_{kt} + \beta_{ih} g_{ht} + \alpha_i^{IMF} d_i + \theta_i S_i + \epsilon_{it} \tag{1}$$

Where Y_{it} is the ith target variable at time t, including real GDP growth, inflation, and the current account balance as a percentage of GDP. x_{kt} denotes a vector of k-elements policy variables that would be pursued by the Sudanese authorities during non-program years. g_{ht} is an h-element vector of exogenous variables that accounts for the effects of the external environment on the targeted variables. Export market growth could potentially be the best measure used to capture the effects of the external environment. However, due to the unavailability of data on Sudanese export market growth, the study uses the terms of trade as a single exogenous variable to instill the spillovers from the external environment into the model. The impact of IMF programs is captured by the dummy variable d_i that is set to be one during IMF-program periods and zero otherwise. In this context, the model assumes that the IMF dummy variable captures the direct effect of Fund programs on the targeted macroeconomic variables and indirect effects that may influence the macroeconomic performance such as improvement in the investment sentiment as a result of engagement with the IMF. Further, ϵ_{it} is unserially correlated error term, while α_{0i}, $\beta_{ih} g_{ht}$ and θ_i are vectors of fixed parameters. S_i is a dummy variable that takes the value 1 during the secession of South Sudan and 0 otherwise. The inclusion of this variable is grounded on the substantial impact of the secession on the Sudanese economy due to the loss of more than 70 percent of oil production, 90 percent foreign export proceeds, and more than 50 percent of government revenues. In addition, the study includes

a dummy variable in the inflation equation to account for potential structural break in the year 1996 that witnessed an unprecedentedly high inflation rate due to the extremely high depreciation in the exchange rate.

The vector of policy variables incorporates counterfactuals to the policies adopted during IMF program periods. In essence, the model assumes that the Sudanese authorities systematically adjust policy instruments in the current period in reaction to disequilibrium or deviation in the target variable from its desired value in the previous period. This policy reaction function could be written as follows:

$$\Delta x_{kt} = \delta_{ki}(y_{it}^{d} - y_{it-1}) + \omega_{it} \tag{2}$$

The vector of policy variables Δx_{kt} consists of growth in the money supply, the budget deficit as a percentage of GDP, and nominal effective exchange rate. These represent the major policy instruments used by the authorities to achieve the desired macroeconomic outcomes of the targeted variables. δ_{ki} is a parameter that indicates the degree of adjustment of policy variables to deviation in the target variable in the previous period. For instance, a positive deviation of actual inflation from target in the previous period would induce the authorities to tighten monetary policy and pursue fiscal consolidation in the current period to bring inflation down to the targeted level. The component Δx_{kt} underpins an important assumption that captures the policy norm in the absence of Fund programs and provides a good estimate of program counterfactual. Further, ω_{it} is an error term that is assumed to be uncorrelated with ϵ_{it}.

Substituting equation (2) in equation (1) and assuming that the desired macroeconomic outcomes y_{it}^{d} is constant overtime, we derive the following GEE model representation:

$$\Delta y_{it} = \alpha_{0i} - (\alpha_{ik}\delta_{ki} + 1)y_{it-1} + \alpha_{ik}x_{kt-1} + \beta_{ih}g_{ht} + \alpha_{i}^{IMF}d_i + \theta_i S_i + (\epsilon_{it} + \alpha_{ik}\omega_{it}) \tag{3}$$

Equation (3) represents the basic form of the GEE model applied in this paper. It is important to note that the GEE model is not a structural macroeconomic model. Instead, its validity hinges on a set of restrictive assumptions. These assumptions include the perseverance of the policy objective function over the study period regardless of changes in economic and political conditions. Another underlying assumption is that the policy reaction function is captured by the lagged target variables in the model while inertial effects of the lagged target variables are not considered in the model. At the same time, the stochastic terms ϵ_{it} and ω_{it} are assumed to be uncorrelated and all shocks are neutralized after one period to avoid understating the positive impact of Fund programs after a negative exogenous shock to the

Sudanese economy.

The inclusion of the lagged target variables renders the model capable of capturing the selection of IMF programs that is usually grounded on the balance of payment needs, given that the vector of the lagged target variables includes values of the main macroeconomic variables in the previous period. Therefore, it is important to assume that the program selection is random to separate IMF program and non-program determinants of the changes in target variables. This could be done by imposing the restrictive assumption that Δx_{kt} and $\Delta \epsilon_{it}$ are uncorrelated.

5.2 Synthetic Control Method (SCM)

The Synthetic Control Method (SCM) applied in this paper to evaluate the macroeconomic performance of IMF programs in Sudan is based on the original SCM developed by Abadie and Gardeazabal (2003) to assess the impact of the conflict in the Basque region during the 1960s on GDP per capita. It also draws from Abadie, Diamond, and Hainmueller (2010) extension to the SCM to estimate the effect of the Tobacco Control Program implemented in California in 1988 on tobacco sales. The analogy between assessing the impact of the 1960s conflict in the Basque region, the Tobacco Control Program, and the feasibility of IMF programs inspires the application of the same methodology to evaluate the impact of Fund programs on the Sudanese economy.

Against this background, the SCM applied in this paper assumes that we have $J+1$ number of observations, where $i = 1, 2, \cdots, J+1$ denotes the number of countries in our sample. Since we are interested in evaluating the effectiveness of Fund programs in Sudan only, we assume that Sudan is country $i = 1$ that implemented an IMF program or "treatment" at time T_0.

Now we want to compare the performance of the Sudanese economy with other peer countries that did not undertake Fund programs or in this case "treatment". To this effect, we form a controlled pool of countries that remains untreated over the study period. In our case, the untreated or could also be referred to as "synthetic group" consists of all developing countries that did not implement any IMF programs during the sample period.

The effect of IMF programs on the treated country, Sudan, could then be estimated using the following equation:

$$e_{1t} = Y_{1t}^{I} - Y_{1t}^{N}, t \geq T_0 \tag{4}$$

Where Y_{1t}^{I} represents the outcome variable understudy during which the intervention takes

place. In this case, the outcome variables during Fund program periods are real GDP growth, inflation, and the current account balance as a percentage of GDP. Y_{1t}^N denotes the outcome variable in the absence of intervention, and e_{1t} is an estimate of the impact of Fund program on the outcome variable Y. Since Y_{1t}^N is an unobserved counterfactual, the study employs the SCM to estimate a counterfactual from the controlled group of developing countries that did not undergo any treatment or IMF programs. Hence, the counterfactual outcome variable absent intervention could be estimated using the following equation:

$$Y_{1t}^I = \beta_t + Z_i\delta_t + {}_t\mu_i + \epsilon_{it},\ t \geq T_0 \tag{5}$$

Where β_t is a common factor that has an identical impact on all treated and untreated countries, Z_i represents a vector of covariates or predictors that are used to estimate the outcome variable for the synthetic group of countries. δ_t represents a set of unknown parameters, and y_t is a vector that consists of unobserved factors. μ_i denotes factor loadings, and ϵ_{it} is the error term that is assumed to have zero means for all countries. Equation (2) is then used to estimate a linear combination of the counterfactual of the realized outcome variable for the synthetically controlled group of countries. This could be estimated by the following equation:

$$\hat{Y}_{1t}^N = \Sigma_{i=2}^{J+1}\omega_i Y_{it},\ t \geq T_0 \tag{6}$$

ω_i denotes weights assigned in a manner that ensures the outcome variable of the synthetic control countries closely matches specific features of the treated country prior to the program period. This could be achieved through selecting a vector of weights ω^* that minimizes the difference between the vector X_1 that contains average values of variables of the treated country, Sudan, prior to IMF program periods and the vector X_0 consisting of the same variables of the control countries, using the following equation:

$$min_w \left\| X_1 - X_0 \right\| v = \sqrt{(X_1 - X_0)' V (X_1 - X_0)} \tag{7}$$

In Equation (7) above, the positive and semi-definite matrix V is elected to minimize the mean squared error of the outcome variable during the pre-intervention period. At the same time, Equation (7) is subject to the following two restrictions to ensure that weights are positive and do not exceed one.

$$\begin{aligned} \omega_i^* \geq 0,\ \forall\, i = 2, \cdots, J+1 \\ \Sigma_{i=2}^{J+1}\omega_i^* = 1 \end{aligned} \tag{8}$$

To assess the effects of IMF programs on the macroeconomic performance of the treated country, Sudan, we need to assign the weights and estimate the counterfactual for the post intervention period using the following equation:

$$\hat{e}_{1t} = Y_{1t}^{I} - \hat{Y}_{1t}^{N},\ t \geq T_0 \tag{9}$$

To evaluate the effectiveness of IMF programs implemented in Sudan using the Synthetic Control Method, our analysis focuses on three main macroeconomic variables, namely real GDP per capita, inflation, and the current account.

The pre-program period from 1985-1996 is selected as time predicting period or "synthetic control optimization period". At the same time, the period from 1997 onward is consider as the "treated period", including 13 successive Fund programs from 1997 to 2009 and one program that took place in 2014. In this context, it is important to note that the SCM approach used in this paper attempts to assess the impact of the 14 IMF staff monitored programs implemented between 1997 to 2014 as data is only sufficiently available for this group of Fund programs. On the other hand, available data is not sufficient to generate a meaningful SCM model to evaluate IMF programs implemented during 1960s, 1970s and early 1980s. This is due to the fact that the SCM requires data across a spectrum of macroeconomic and development variables for relatively large number of countries which is hardly available. Therefore, we focus our analysis on the IMF staff monitored programs that constitute a considerable proportion of Fund programs implemented in Sudan.

Against this background, the synthetic group of countries consists of 31 developing countries that did not undergo any Fund programs during the sample period from 1985 -2017. Data on the macroeconomic variables for these countries has been collected from two sources, namely IMF World Economic Outlook Database and World Bank Development Indicators. The final SCM models are developed using a selected group of countries out of the entire developing countries population due to the unavailability of data points for some of the countries. This is understandable given the relatively long time horizon and large number of developing countries used to construct the synthetic control group.

With respect to the real GDP per capita equation, the predictors chosen in the study are inspired by the work done by Barro and Sala-i-Martin (1995) and Abadie and Gardeazabal (2003). These predictors include the gross fixed formation as a share of GDP, economic openness, population density, the share of agricultural to the GDP, the share of industry to the GDP. Variables correspond to secondary and tertiary school enrolment rates and institutional capacity have been dropped due to unavailability of data.

The predictors used in the inflation equation are selected based on the approach adopted by

Gosh, Ostry, and Tsangarides (2010). These include trade openness, real GDP growth, fiscal balance as a percentage of GDP, growth of the money supply, and change in the exchange rate. The data on consumer price index (CPI) is rebased in a way that all countries would have a CPI of 100 in 1997, which corresponds to the beginning of the first Fund program in our sample period.

The covariates used to predict the current account balance in this paper are trade openness, real GDP growth, fiscal balance, real interest rate, real exchange rate, and inflation rate. This approach broadly follows the model adopted by Khan and Knight (1983) that chooses these variables as main determinants of the current account balance in developing countries.

6 Key Results

This section provides an overview of the main findings on the impact of Fund programs on the performance of real GDP growth, inflation, and the current account balance using the Generalized Evaluation Estimator (GEE) and Synthetic Control Method (SCM).

6.1 Results of the Generalized Evaluation Estimator (GEE) Model

Before estimating the GEE model, the study applies the Augmented Dickey Fuller (ADF) test to check whether all variables incorporated in the estimation are stationary over the study period. In addition, the KPSS test is also used to further corroborate the results obtained by the ADF test. Particularly, the KPSS test effectively addresses the common failure of standard unit root tests, including the ADF, to reject the null hypothesis of non-stationarity by testing the null hypothesis of stationarity against the alternative of a unit root (Kwiatkowski, et al., 1992). Applying both tests combinedly, the study concludes that all variables are stationary at the level, as indicated by Appendix 8.

Table 2: Results of the Generalized Evaluation Estimator (GEE) Model

Target/ Dependent Variable	GDP Growth		Inflation		Current Account Balance (% of GDP)	
	Program[1]	Post Program	Program	Post Program[1]	Program[1]	Post Program[1]
Constant	5.129*** [2.89]	6.992*** [2.42]	0.788 [0.10]	-1.661 [-0.20]	1.408 [0.63]	1.412 [0.62]
Lagged Real GDP Growth	0.024 [0.12]	0.040 [0.22]	0.291 [0.47]	-0.173 [-0.18]	-0.108 [-0.46]	-0.055 [-0.26]
Lagged Inflation	-0.028 [-0.56]	-0.038 [-0.98]	0.362*** [2.88]	0.374** [2.23]	-0.111** [2.09]	-0.110* [-1.998]
Lagged Current Account Deficit to GDP Ratio	-0.157 [-1.23]	-0.137 [-1.13]	-1.80*** [-4.65]	-1.761*** [-3.93]	0.396** [2.37]	0.390** [2.26]
Lagged Percentage Change M2 Growth	-0.033 [-0.68]	-0.036 [-0.70]	0.144 [0.86]	0.177 [0.91]	-0.149** [-2.59]	-0.153** [-2.65]
Lagged Budget Deficit to GDP Ratio	0.320 [1.26]	0.364* [1.87]	-0.142 [-0.21]	-0.469 [-0.68]	0.793*** [3.04]	0.821*** [2.98]
Lagged Percentage Change in Nominal Effective Exchange Rate	-0.054 [-0.91]	-0.056 [-1.07]	0.257 [1.46]	0.306 [1.64]	-0.257*** [-3.01]	-0.262*** [-3.06]
Current Percentage Change in Terms of Trade	0.077* [2.05]	0.082** [1.15]	0.002 [0.01]	0.022 [0.15]	0.086 [1.17]	0.083 [1.13]
IMF Program Dummy	0.626 [0.28]	-1.349 [-0.67]	-14.081** [-2.23]	-8.363 [-1.09]	1.600 [0.92]	1.215 [0.66]
Secession of South Sudan Dummy	-4.827** [-2.21]	-6.265** [-1.63]	12.537 [1.07]	13.087 [1.19]	-2.402 [-0.49]	-2.251 [-0.46]
Inflation 1996 Dummy	-	-	68.606*** [4.30]	73.863*** [11.48]	-	-
R-Squared	0.25	0.26	0.89	0.88	0.81	0.81
Probability of Serial Correlation LM Test	0.45	0.79	0.064	0.23	0.18	0.14
Probability of Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.040	0.052	0.37	0.049	0.018	0.012

* ** *** denote that using T-Test, the mean during Fund programs is significantly different than the mean during non-program periods at 0.1, 0.05, and 0.01 respectively.

1/ t-statistic and standard errors are estimated using White heteroskedasticity consistent standard errors and covariance.

As indicated by the GEE estimation results depicted in Table 2, IMF programs implemented by the Sudanese authorities helped reduce inflation during program periods. This is evidenced by the negative coefficient of the IMF dummy variable in the inflation equation, which is significant at 5 percent significance level. In the same inflation model, the current account balance is found to have a significant negative effect on inflation at 1 percent significance level. This could be explained by the result derived by Ferrero, et al. (2008) who find that exchange rate depreciation triggered by widening the current account deficit could amplify inflation. The 1996 inflation dummy is found to be large and significant in line with initial assumptions. It is important to note that the inflation model passes robustness checks, given that it has a relatively high explanatory power with R-squared at 81 percent, and it is free of serial correlation and heteroskedasticity problems. That said, Fund programs appear to have somewhat short-lived effects on inflation given that the post-program IMF dummy variable has a smaller and insignificant coefficient.

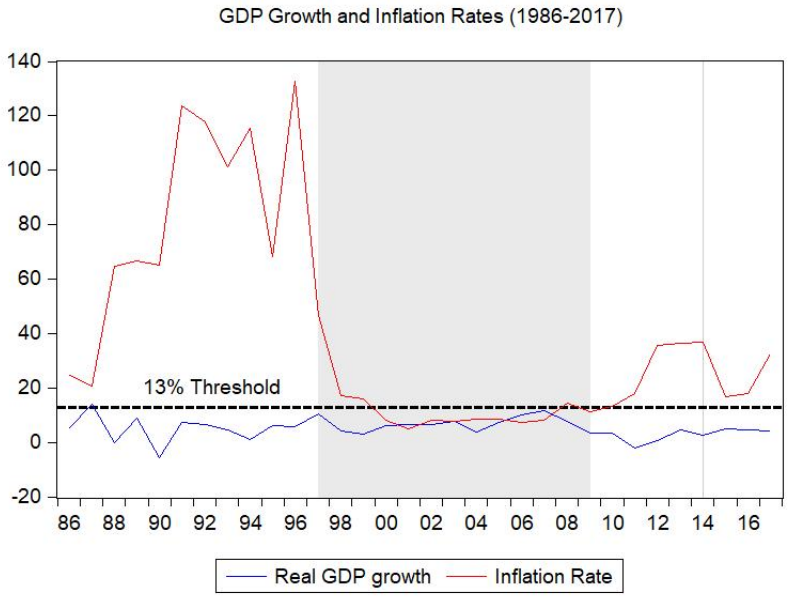
The GEE model fails to detect any significant effects of IMF programs on GDP growth nor the current account balance. In this connection, the IMF dummy variable is found to be insignificant in the GDP growth equation. Nevertheless, shocks to terms of trade have positive impact on growth and the secession of South Sudan appears to have a significant negative impact on growth. While the growth equation is free of serial correlation, the White's (1980) consistent standard errors and covariance are used overcome the heteroskedasticity problem encountered in the growth equation.

With respect to the current account balance, the IMF dummy variable is found to be insignificant, indicating that IMF programs implemented in Sudan did not have significant impact on improving the current account position during program or post program periods. However, the current account balance is found to have been affected by other domestic factors, including the lagged current account balance, lagged inflation, monetary growth, the budget deficit, and the real effective exchange rate. In contrary, external factors represented by the terms of trade appear to be insignificant. While the current account single equation model satisfies robust checks of serial correlation, WhiteâĂŹs (1980) consistent standard errors and covariance are used to overcome the heteroskedasticity problem.

In addition, the study employs the GEE approach to assess the impact of SMP type Fund programs on the Sudanese economy. To this effect, the analysis is restricted to the period 1986-2017, excluding the effects of stand-by Fund arrangements implemented before this sample period. This is important given that the last stand-by arrangement in Sudan was in 1984. Accordingly, the analysis yields similar results with respect to the positive impact of IMF SMPs on reducing inflation and insignificant effects on the current account balance. However, the IMF term in the real growth equation appears to be positive and significant at 10 percent significance level as indicated by Appendix 9. Notwithstanding the positive effect of SMP type programs on GDP growth, the overemphasis on reducing inflation sought under SMPs could

have somewhat constrained growth during the same period. Particularly, the study finds that inflation rates during most of the SMP time periods had persistently been kept below the 13 percent threshold estimated by Christoffersen and Doyle (1998), below which reducing inflation would have negative effects on growth. The potential trade-offs between containing the inflation and boosting growth could be illustrated in Figure 4.

Figure 4: Potential Trade-offs between GDP Growth and Inflation

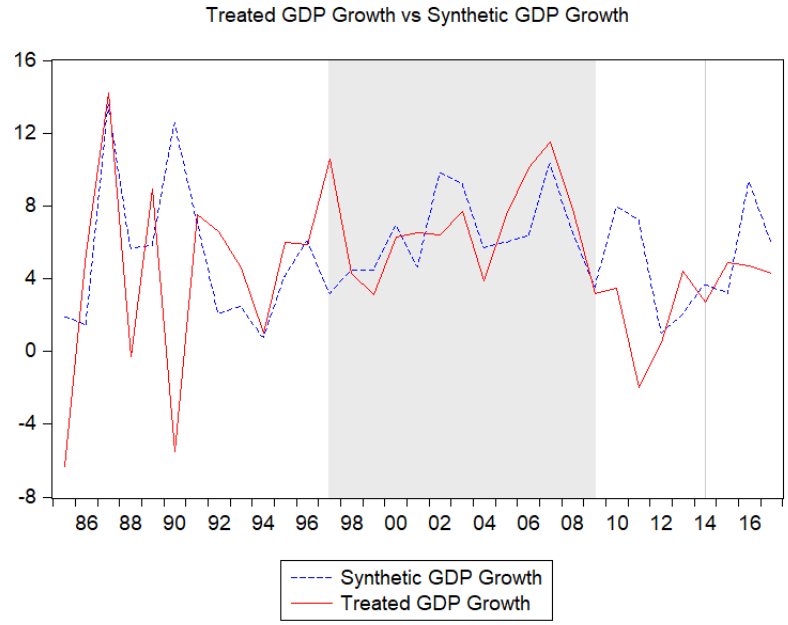


6.2 Results of the Synthetic Control Method (SCM)

Table 3: Average Treated versus Synthetic Macroeconomic Performance During IMF Program Periods

Target Variable	Treated/ Actual	Synthetic	Program Effect
Real GDP Growth	6.5	5.3	+1.2
Inflation	14	15.5	-1.5
Current Account Balance as Percent of GDP	-7.2	11.4	-18.6

Figure 5: Treated versus Synthetic GDP Growth



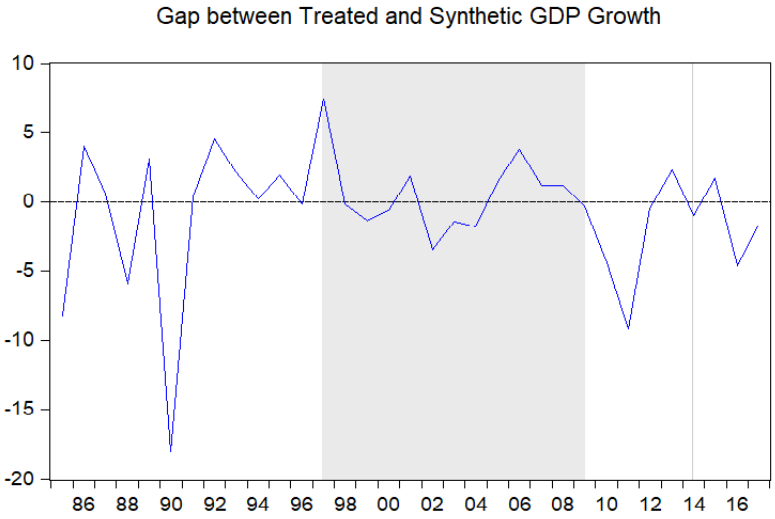


Figure 6: Treated versus Synthetic Inflation

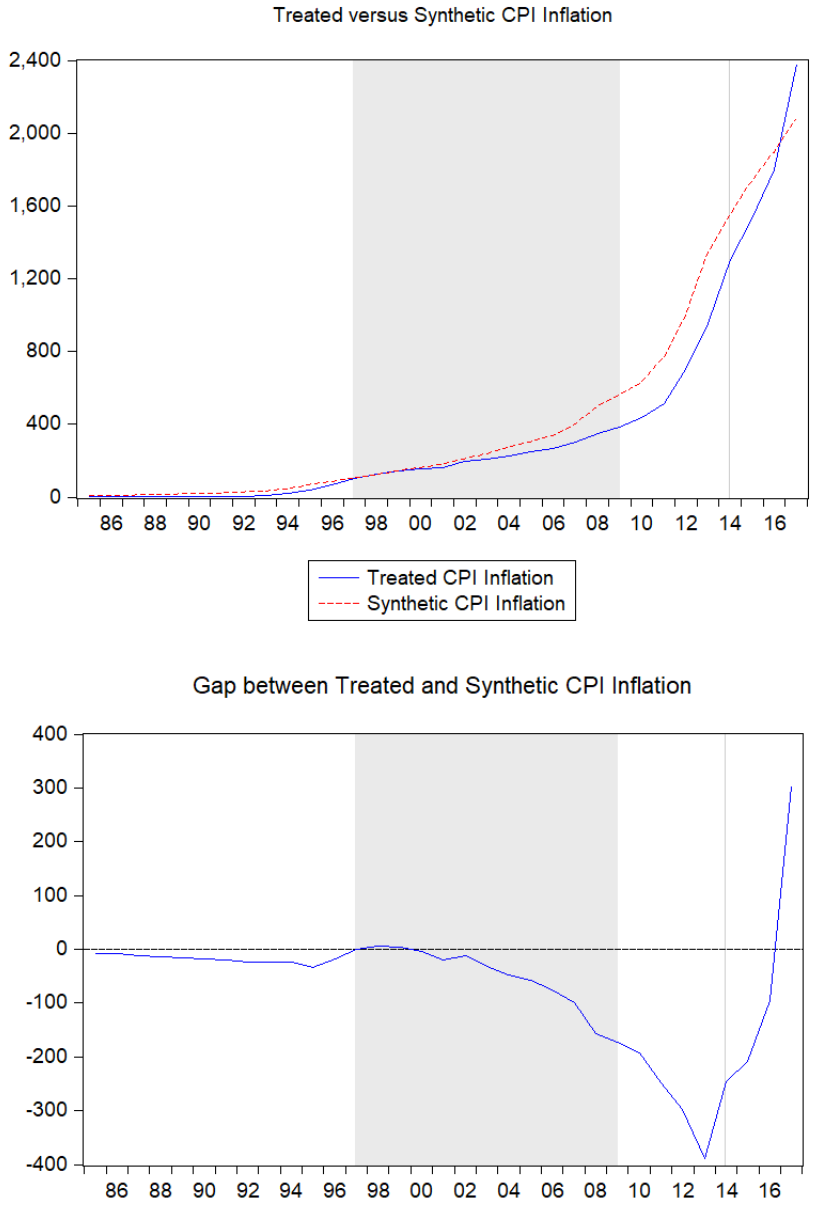
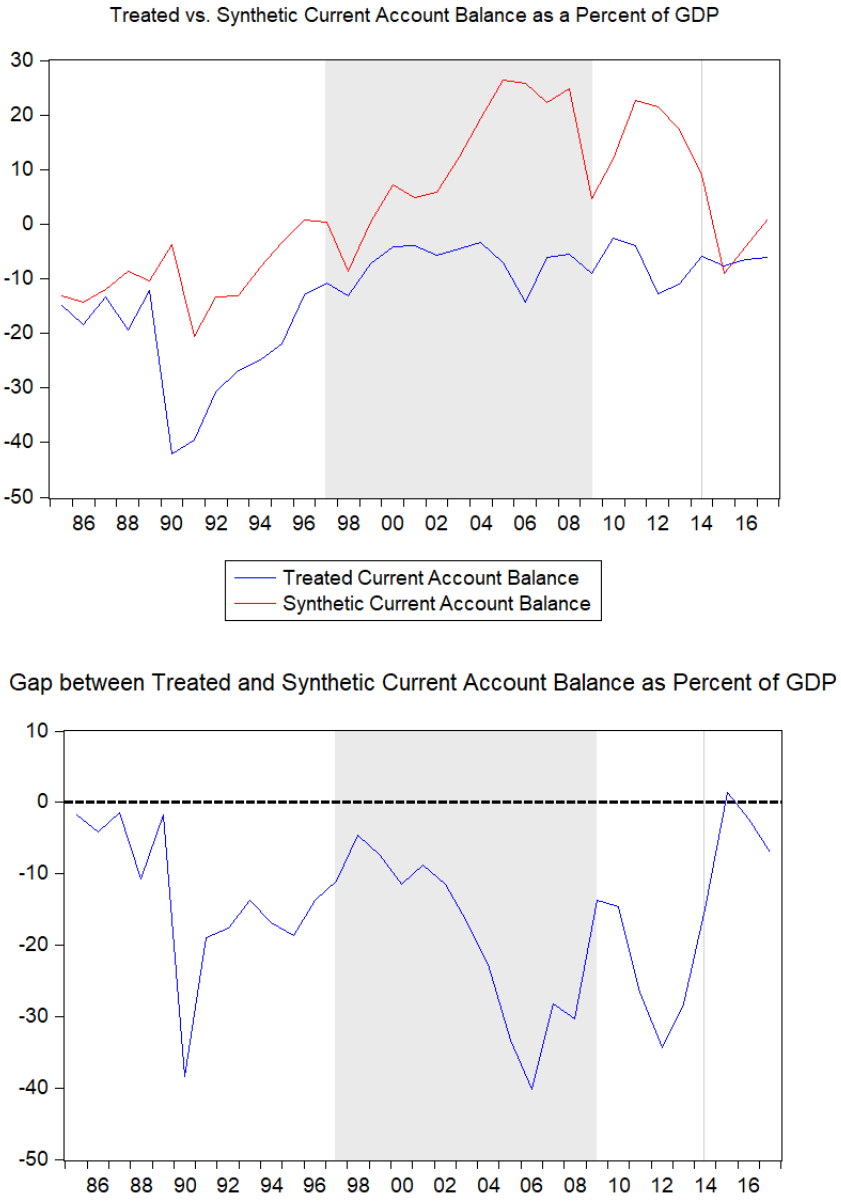


Figure 7: Treated versus Synthetic Current Account as Percent of GDP



As indicated by Table 3 and Figures 4, 5 and 6, using the Synthetic Control Method, the average inflation rate during IMF programs is found to be lower than the average inflation rate of the synthetically controlled group by 1.5 percent. This gap exceeds 3 percent when we exclude the year 2014 where the IMF program had not been completed. Notwithstanding this, the gap between the CPI inflation in Sudan and synthetic group turns negative after 2012, potentially driven by the secession of South Sudan and its aftermath macroeconomic stability.

By the same token, average real GDP growth during program periods is found to be larger than average growth of the synthetic group by 1.2 percent. The contraction in output activity in the post-secession appears to contribute to the slowdown in actual GDP growth after 2011. Nevertheless, growth showed signs of recovery after 2012, with the gap between treated and

synthetic growth closing, before widening again around 2016.

Contrarily to the GEE model, IMF programs is found to have negative impact on the current account balance using the SCM. This is reflected in the negative gap between the average current account as percent of GDP during program period and the synthetic current account balance. However, this gap appears to shrink in 2009 and 2015, which coincided with significant drop in commodity prices during these years, affecting external positions of many developing countries in the synthetically controlled group.

7 Conclusion and Policy Implications

This study applies the Generalized Evaluation Estimator (GEE) and Synthetic Control Method (SCM) to assess the impact of IMF programs on the Sudanese economy. These two approaches broadly address most of the shortcomings associated with other methodologies used to evaluate the effectiveness of Fund programs, including overlooking the effects of the external environment, inadequate construction of counterfactual, and control of reverse causality.

The analysis suggests that IMF programs implemented in Sudan during 1960-2017 were effective in reducing inflation. In this context, the two approaches applied in the study support this finding, albeit with different magnitude. On the other hand, the methods used provide divergent conclusions with respect to the impact of Fund programs on the performance of real GDP growth and the current account balance as a percent of GDP. While the GEE fails to capture any significant effects of IMF program on growth and the current account, the SCM finds that Fund programs had positive and negative effects on growth and the current account balance, respectively.

In addition, the impact of IMF programs on GDP growth is found to be positive and significant when the sample period of the GEE model is restricted to resemble that of the SCM. This essentially indicates that SMP type Fund programs had been effective in supporting growth during program periods. However, deliberately keeping inflation rates very low for most of the SMP periods could have constrained growth. Particularly, the study finds that inflation rates had been kept below 13 percent, a threshold estimated by Christoffersen and Doyle (1998), below which reducing inflation would have negative effects on growth.

The study also singles out a number of exchange rate devaluations with different magnitudes taken place during Fund program periods. These devaluation episodes are found to have negative impact on GDP growth with potential distributional and welfare implications.

Against this background, the study concludes that implementing Fund programs remains an effective strategy to reduce high inflation rates and eventually restore macroeconomic stability.

However, the authorities, in countries with large developmental needs such as Sudan, should be mindful of potential growth loss that could result from keeping inflation rates very low during IMF program periods. At the same time, it is important to note that exchange rate devaluations sought under Fund programs should be properly sequenced to mitigate negative distributional and welfare impacts. Particularly, strengthening social safety nets and enhancing social transfers prior to exchange rate devaluation would be crucial to ameliorate negative effects. Finally, more needs to be done to improve the external position, particularly the current account balance, under Fund programs. This underscores the importance of pressing ahead with structural reforms aimed at addressing structural bottlenecks to competitiveness and improving the business environment with a view to creating a lasting effect on the external sector position.

8 References

Abadie, A., Diamond, A. and Hainmueller, J., 2010. Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. Journal of the American Statistical Association, 105(490), pp. 493-505.

Abadie, A. and Gardeazabal, J., 2003. The Economic Costs of Conflict: Case Study of the Basque Country. American Economic Review, 93(1), pp. 113-132.

Abdelrahman, A. A., 1998. The Implementation and Results of IMF/World Bank-Supported Agricultural Reforms: The Case of Sudan's Gezira Scheme. Northeast African Studies, 5(2), pp. 95-115.

Agenor, P.-R., 2004. Macroeconomic Adjustment and The Poor: Analytical Issues and Cross-Country Evidence. Journal of Economic Surveys, 18(3).

Atoyan, R. and Conway, P., 2006. Evaluating the Impact of IMF Programs: A Comparison of Matching and Instrumental-Variable Estimators. Review of International Organizations, 1(2), pp. 99-124.

Bannaga, A., 2004. Adjustment Policies and the Current Account Balance: Empirical Evidence from Sudan. IDPM Development Economics and Public Policy Working Paper Series, 8.

Barro, R. J. and Lee, J.-W., 2002. IMF Programs: Who IS Chosen and What Are The Effects?. National Bureau of Economic Research, 8951.

Bird, G., 1996. The International Monetary Fund and Developing Countries: A Review of the Evidence and Policy Options. International Organization, 50(3), pp. 477-511.

Connors, T., 1979. The Apparent Effects of Recent IMF Stabilization Programs. International Finance Discussion Paper, 135.

Christoffersen, P. and Doyle, P., 2000. From inflation to growth. Economics of Transition, 8(2), pp. 421-451.

Dicks-Mireaux, L., Mecagni, M. and Schadler, S., 2000. Evaluating the Effect of IMF Lending to Low-Income Countries. Journal of Development Economics, 61, p. 495-526.

Donovan, D., 1981. Real Responses Associated with Exchange Rate Action in Selected Upper Credit Tranche Stabilization Programs. IMF Staff Papers, 28(4), pp. 698-727.

Donovan, D., 1982. Macroeconomic Performance and Adjustment under Fund-Supported Programs: The Experience of the Seventies. IMF Staff Papers, 29(2), pp. 171-203.

Dreher, A. and Walter, S., 2010. Does the IMF Help or Hurt? The Effect of IMF programs on the likelihood and outcome of currency crises. World Development, 38(1), pp. 1-18.

Easterly, W., 2003. IMF and World Bank Structural Adjustment Programs and Poverty. In: Managing Currency Crises in Emerging Markets. s.l.:National Bureau of Economic Research, pp. 361-392.

Ferrero, A., Gertler, M. and Svensson, L. E., 2008. Current Account Dynamics and Monetary Policy. Federal Reserve Bank of San Francisco Working Paper Series, 26.

Forster, T. et al., 2019. How structural adjustment programs affect inequality: A disaggregated analysis of IMF conditionality, 1980-2014. Social Science Research.

Franke, J. and Rose, A., 1996. Currency Crashes in Emerging Markets: An Empirical Treatment. Journal of International Economics, 41(3), pp. 351-368.

Frankel, J., 2005. Contractionary Currency Crashes in Developing Countries. NBER Working Paper Series, 11508.

Garuda, G., 2000. The Distributional Effects of IMF Programs: A Cross-Country Analysis. World Development, 28(6), pp. 1031-1051.

Goldstein, M. and Montiel, P., 1986. Evaluating Fund Stabilization Programs with Multicountry Data: Some Methodological Pitfalls. IMF Staff Papers, 33(2), pp. 304-344.

Guitian, M., 1981. Fund Conditionality: Evolution of Principles and Practices. Pamphlet Series, Volume 38.

Gylfason, T., 1987. Credit Policy and Economic Activity in Developing Countries with IMF Stabilization Programs. Princeton Studies in International Finance, Volume 60.

Harrigan, J., Wang, C. and EL-Said, H., 2006. The Economic and Political Determinants of IMF and World Bank Lending in the Middle East and North Africa. World Development, 34(2), p. 247-270.

International Monetary Fund, 1972. Sudan - Request for Stand-By Arrangement, Washington D.C.: International Monetary Fund.

International Monetary Fund, 1972. Sudan - Review and and Consultation Under the Stand-By Arrangement, Washington D.C.: International Monetary Fund.

International Monetary Fund, 1979. Sudan - Use of Fund Resources under Extended Fund Facility, Washington D.C.: International Monetary Fund.

International Monetary Fund, 1982. Sudan - Staff Report for the 1982 Article IV Consultation, Washington D.C.: International Monetary Fund.

International Monetary Fund, 2017. Sudan - Staff Report for the 2017 Article IV Consultation, Washington D.C.: International Monetary Fund.

Khan, M. S., 1988. The Macroeconomic Effects of Fund-Supported Adjustment Programs: An Empirical Assessment. IMF Working Paper, 113.

Khan, M. S. and Knight, M. D., 1983. Determinants of Current Account Balances of Non-Oil Developing Countries in the 1970s: An Empirical Analysis. IMF Staff Papers , 30(4), pp. 819-842.

Khan, M.S. and Ssnhadji, A.S., 2001. Threshold effects in the relationship between inflation and growth. IMF Staff papers, 48(1), pp.1-21.

Killick, T. and Bird, G., 1984. The Quest for Economic Stabilization: The IMF and the Third World. New York: St. Martin's Press.

Lang, V. F., 2016. The Economics of the Democratic Deficit: The Effect of IMF Programs on Inequality. Discussion Paper Series, 716.

O'Brien, J., 1985. Sowing the Seeds of Famine: The Political Economy of Food Deficits in Sudan. Review of African Political Economy, 33, pp. 23-32.

Pastor, M., 1987. The Effects of IMF Programs in the Third World: Debate and Evidence from Latin America. World Development, 15(2), pp. 249-262.

Przeworski, A. and Vreeland, J. R., 2000. The Effect of IMF Programs on Economic Growth. Journal of Development Economics, 62, p. 385-421.

Reichmann, T. and Stillson, R., 1978. Experience with Programs of Balance of Payments Adjustment: Stand-By Arrangements in the Higher Tranches, 1963-72. IMF Staff Papers, 25(2), pp. 293-309.

Reynaud, J. and Vauday, J., 2008. IMF Lending and Geopolitics. ECB Working Paper Series, 965.

Thacker, S. C., 1999. The High Politics of IMF Lending. World Politics, 52, pp. 38-75.

Ul Haque, N. and Khan, M. S., 1998. Do IMF Supported Programs Work? A Survey of the

Cross-Country Empirical Evidence. IMF Working Paper, Volume 169.

White, H., 1980. A Heteroschedasticity-consistent Covariance Matrix Estimator and a Direct Test for Heteroschedasticity. Econometrica, 48, pp. 817-838.

Zulu, J. and Nsouli, S., 1985. Adjustment Programs in Africa: The Recent Experience. IMF Occasional Papers, Volume 34.

Appendices

Appendix 1: Test for Equality of Means of Real GDP Growth

Categorized by values of IMF Dummy Variable
Sample (adjusted): 1961 2017
Included observations: 57 after adjustments

Method	df	Value	Probability
t-test	55	0.673251	0.5036
Satterthwaite-Welch t-test*	54.20349	0.684259	0.4967
Anova F-test	(1, 55)	0.453267	0.5036
Welch F-test*	(1, 54.2035)	0.468211	0.4967

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	12.69335	12.69335
Within	55	1540.226	28.00410
Total	56	1552.919	27.73070

Category Statistics

IMFD	Count	Mean	Std. Dev.	Std. Err. of Mean
0	32	4.375000	5.578819	0.986205
1	25	3.424000	4.896451	0.979290
All	57	3.957895	5.265994	0.697498

Appendix 2: Test for Equality of Means of Inflation

Categorized by values of IMF Dummy Variable
Sample (adjusted): 1961 2017
Included observations: 57 after adjustments

Method	df	Value	Probability
t-test	55	2.640195	0.0108
Satterthwaite-Welch t-test*	38.15842	2.929082	0.0057
Anova F-test	(1, 55)	6.970630	0.0108
Welch F-test*	(1, 38.1584)	8.579520	0.0057

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	6856.738	6856.738
Within	55	54101.37	983.6613
Total	56	60958.11	1088.538

Category Statistics

IMFD	Count	Mean	Std. Dev.	Std. Err. of Mean
0	32	38.57500	40.34104	7.131355
1	25	16.47200	12.33557	2.467114
All	57	28.88070	32.99299	4.370029

Appendix 3: Test for Equality of Means of the Current Account Balance as Percent of GDP

Categorized by values of IMF Dummy Variable
Sample (adjusted): 1961 2017
Included observations: 57 after adjustments

Method	df	Value	Probability
t-test	55	-2.521479	0.0146
Satterthwaite-Welch t-test*	46.07949	-2.732410	0.0089
Anova F-test	(1, 55)	6.357855	0.0146
Welch F-test*	(1, 46.0795)	7.466067	0.0089

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	476.0354	476.0354
Within	55	4118.047	74.87358
Total	56	4594.082	82.03719

Category Statistics

IMFD	Count	Mean	Std. Dev.	Std. Err. of Mean
0	32	-12.87188	10.66106	1.884627
1	25	-7.048000	4.977627	0.995525
All	57	-10.31754	9.057438	1.199687

Appendix 4: Test for Equality of Means of M2 Growth

Categorized by values of IMFD
Sample (adjusted): 1961 2017
Included observations: 57 after adjustments

Method	df	Value	Probability
t-test	55	2.178274	0.0337
Satterthwaite-Welch t-test*	38.28715	2.415714	0.0206
Anova F-test	(1, 55)	4.744878	0.0337
Welch F-test*	(1, 38.2871)	5.835673	0.0206

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	2687.135	2687.135
Within	55	31147.78	566.3233
Total	56	33834.92	604.1950

Category Statistics

IMFD	Count	Mean	Std. Dev.	Std. Err. of Mean
0	32	39.15185	30.58987	5.407576
1	25	25.31500	9.442459	1.888492
All	57	33.08305	24.58038	3.255751

Appendix 5: Test for Equality of Means of Budget Deficit as Percentage of GDP

Categorized by values of IMFD
Sample (adjusted): 1961 2017
Included observations: 57 after adjustments

Method	df	Value	Probability
t-test	55	-1.282743	0.2050
Satterthwaite-Welch t-test*	49.52420	-1.269692	0.2101
Anova F-test	(1, 55)	1.645429	0.2050
Welch F-test*	(1, 49.5242)	1.612117	0.2101

*Test allows for unequal cell variances

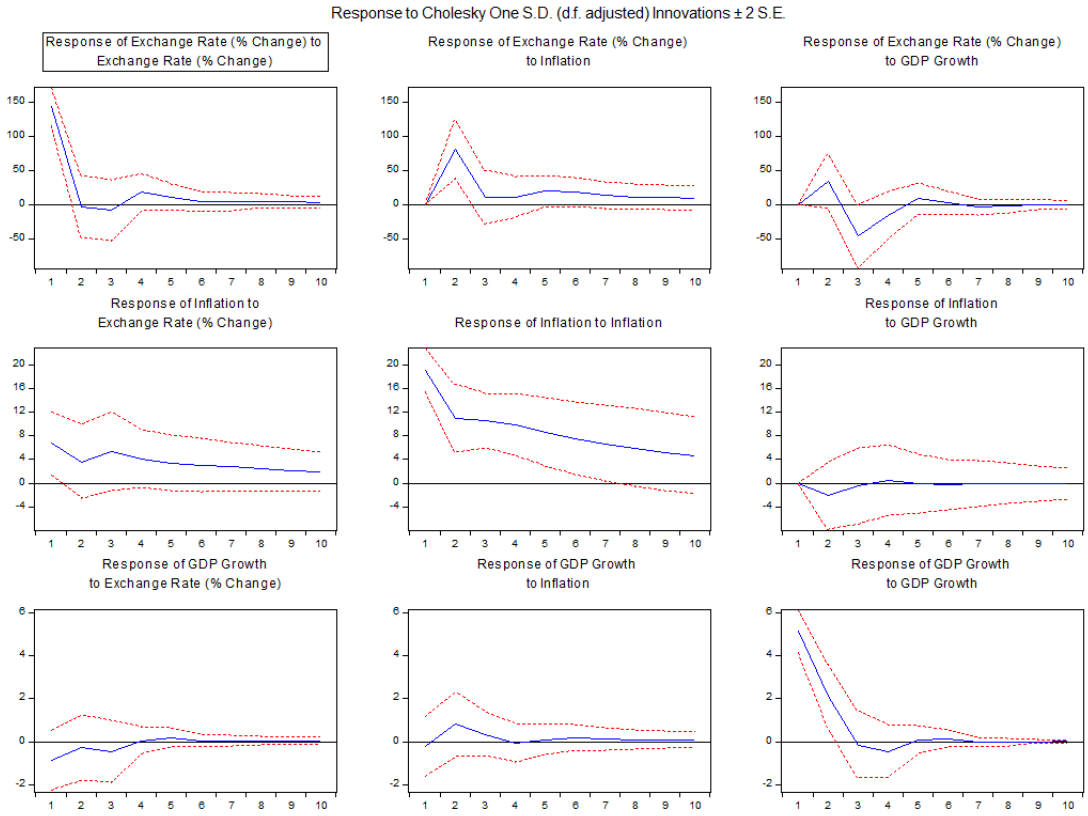
Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	22.35861	22.35861
Within	55	747.3575	13.58832
Total	56	769.7161	13.74493

Category Statistics

IMFD	Count	Mean	Std. Dev.	Std. Err. of Mean
0	32	-5.524755	3.550837	0.627705
1	25	-4.262593	3.854088	0.770818
All	57	-4.971175	3.707416	0.491059

Appendix 6: Impulse Responses of the VAR for Real GDP Growth, Inflation, and Exchange Rate Devaluation



Appendix 7: Mathematical Derivation of the GEE Model

The key GEE model equation can be written as follows:

$$Y_{it} = \alpha_{0i} + \alpha_{ik}x_{kt} + \beta_{ih}g_{ht} + \alpha_i^{IMF}d_i + \theta_i S_i + \epsilon_{it} \tag{10}$$

The vector of policy variables that incorporates counterfactuals to the policies adopted during IMF program periods assuming systematic adjustment of policy instruments in the current period in reaction to disequilibrium or deviation in the target variable from its desired value in the previous period. This policy reaction function could be written as follows:

$$\Delta x_{kt} = \delta_{ki}(y_{it}^d - y_{it-1}) + \omega_{it} \tag{11}$$

$$x_{kt} = \delta_{ki}(y_{it}^d - y_{it-1}) + \omega_{it} + x_{kt-1} \tag{12}$$

Substituting equation 12 in equation 10 and subsuming y_{it}^d in the constant as we assume that the desired macroeconomic outcomes is constant overtime, we get the following GEE model representation.

$$Y_{it} = \alpha_{0i} + \alpha_{ik}[-\delta_{ki}y_{it-1} + \omega_{it} + x_{kt-1}] + +\beta_{ih}g_{ht} + \alpha_i^{IMF}d_i + \theta_i S_i + \epsilon_{it} \tag{13}$$

Subtracting y_{it-1} from both sides of equation (13):

$$\Delta y_{it} = \alpha_{0i} - (\alpha_{ik}\delta_{ki} + 1)y_{it-1} - y_{it-1} + \alpha_{ik}x_{kt-1} + \beta_{ih}g_{ht} + \alpha_i^{IMF}d_i + \theta_i S_i + (\epsilon_{it} + \alpha_{ik}\omega_{it}) \tag{14}$$

Further simplifying equation (14) we get the final representation of the GEE model

$$\Delta y_{it} = \alpha_{0i} - (\alpha_{ik}\delta_{ki} + 1)y_{it-1} + \alpha_{ik}x_{kt-1} + \beta_{ih}g_{ht} + \alpha_i^{IMF}d_i + \theta_i S_i + (\epsilon_{it} + \alpha_{ik}\omega_{it}) \tag{15}$$

Appendix 8: Stationarity Tests for Key Macroeconomic Variables

Variable	Test	critical values			Test Statistic	P-Value
		1%	5%	10%		
GDP Growth	ADF	-3.55747	-2.91657	-2.59612	-5.49796	0.000
	KPSS	0.739	0.463	0.347	0.260585	
Inflation	ADF	-3.55267	-2.91452	-2.59503	-2.50785	0.1191
	KPSS	0.739	0.463	0.347	0.1966	
Current Account (% of GDP)	ADF	-3.55267	-2.91452	-2.59503	-2.62093	0.0948
	KPSS	0.739	0.463	0.347	0.199801	
Budget Deficit to GDP Ratio	ADF	-3.55747	-2.91657	-2.59612	-1.36006	0.595
	KPSS	0.739	0.463	0.347	0.51352	
M2 Growth	ADF	-3.55267	-2.91452	-2.59503	-3.5482	0.0101
	KPSS	0.739	0.463	0.347	0.23502	
Percentage Change in Nominal Effective Exchange Rate	ADF	-3.55267	-2.91452	-2.59503	-4.26523	0.0012
	KPSS	0.739	0.463	0.347	0.218802	
Percentage Change in Terms of Trade	ADF	-3.62678	-2.94584	-2.61153	-5.7932	0.000
	KPSS	0.739	0.463	0.347	0.128985	

Appendix 9: Results of the General GEE Model for IMF Staff Monitored Program

Target/ Dependent Variable	GDP Growth		Inflation		Current Account Balance (% of GDP)	
	Program	Post Program	Program	Post Program	Program/2	Post Program/2
Constant	4.094*	4.572	1.074	7.904	1.713	2.029
	[1.75]	[1.66]	[0.90]	[0.60]	[0.65]	[0.82]
Lagged Real GDP Growth	-0.167	-0.118	1.179	1.021	0.011	0.0198
	[-0.96]	[-0.67]	[1.33]	[1.21]	[0.06]	[0.10]
Lagged Inflation	-0.0201	-0.008	0.145	0.008	-0.12	-0.120
	-[0.59]	[-0.20]	[0.83]	[0.04]	[-2.56]	[-2.72]
Lagged Current Account Deficit to GDP Ratio	-0.180	-0.151	-2.339***	-2.413***	0.39*	0.401*
	[-1.57]	[-1.29]	[-4.00]	[-4.30]	[2.42]	[2.35]
Lagged Percentage Change M2 Growth	-0.051	-0.061	0.182	0.263	-0.150	-0.150
	[-1.17]	[-1.34]	[0.82]	[1.20]	[-2.02]	[-1.93]
Lagged Budget Deficit to GDP Ratio	-0.048	-0.004	1.001	1.325	0.945	0.966
	[-0.21]	[-0.02]	[0.87]	[1.14]	[3.62]	[3.82]
Lagged Nominal Effective Exchange Rate	-0.06	-0.066	-0.017	0.039	-0.276	-0.276
	[-1.23]	[-1.29]	[-0.07]	[0.16]	[-2.39]	[-2.34]
Current Percentage Change in Terms of Trade	0.0496	0.061	-0.024	-0.080	0.113	0.114
	[0.80]	[0.95]	[-0.08]	[-0.26]	[1.07]	[1.13]
IMF Program Dummy	3.443*	2.596	-20.26**	-25.909**	0.337	-0.042
	[1.81]	[1.14]	[-2.10]	[-2.39]	[0.15]	[-0.02]
Secession of South Sudan Dummy	-5.13	-5.459	16.141	12.239	-2.289	-2.483
	[-1.62]	[-1.62]	[01.00]	[0.76]	[-0.82]	[-0.88]
R-Squared	0.38	0.33	0.84	0.85	0.82	0.82
Probability of Serial Correlation LM Test	0.70	0.78	0.49	0.52	0.049	0.047
Probability of Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.23	0.28	0.47	0.68	0.016	0.0198

* ** *** denote that using T-Test, the mean during Fund programs is significantly different than the mean during non-program periods at 0.1, 0.05, and 0.01 respectively.

1/ t-statistic and standard errors are estimated using White heteroskedasticity consistent standard errors and covariance.

2/ t-statistic and standard errors are estimated using Newey-West consistent standard errors and covariance.

Appendix 10: Synthetic Controls for GDP Growth, Inflation, and the Current Account Balance

Covariate	Weight		
	Current Account	Inflation	GDP Growth
Gross fixed capital formation (% of GDP)			0.02
Openness	0.313	0.031	0.085
Population density (people per sq. km of land area)			0.041
Agriculture, forestry, and fishing, value added (% of GDP)			0.058
Industry (including construction), value added (% of GDP)			0
Real GDP Growth	0.074	0.004	
Budget Balance (% of GDP)	0.118	0.052	
Broad Money Growth		0.004	
Change in Exchange Rate		0.012	
Real interest rate (%)	0.106		
Average Inflation Rate	0.05		
Change in Real Effective Exchange Rate	0.08		
Dependent Variable (1986)	0.147	0.266	0.11
Dependent Variable (1991)	0.086	0.541	0.004
Dependent Variable (1996)	0.027	0.91	682
Synthetic Control Countries			
The Bahamas	0	0	0
Bahrain	0	0	0
Bhutan	0.02	0	0.518
Botswana			0
Eswatini	0	0	0
Fiji	0	0	0.164
Iran		1	0.305
Saudi Arabia	0.98	0	0.013
St. Lucia	0	0	0
Tonga			0.001
Vanuatu	0	0	0