Inflation Targeting and Inflation Performance in Africa: Evidence Using a Synthetic Control Approach

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Bringing Rigour and Evidence to Economic Policy Making in Africa

Inflation Targeting and Inflation Performance in Africa: Evidence Using a Synthetic Control Approach

By

Ablam Estel Apeti

EconomiX-CNRS, University of Paris Nanterre, Paris, France

And

Bao-We-Wal Bambe

German Development Institute/Deutsches Institut für Entwicklungspolitik (DIE), Tulpenfeld 6, 53113 Bonn, Germany

Université Clermont Auvergne, Université d'Orléans, LEO, 45067, Orléans, France

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Abstract

Since the 1990s, inflation targeting (IT) has been adopted by a growing number of developing countries, including in Africa, where South Africa, Ghana, and Uganda have implemented the monetary framework to promote macroeconomic stability. Despite extensive literature on the topic, little is known about the impact of IT on the performance of African economies. We fill this gap by applying the synthetic control method over the period 1990-2020 to estimate the IT effect from a counterfactual situation based on a comparison group. We find robust evidence that the IT framework has not significantly reduced inflation in any of the three countries. We then explore the underlying mechanisms and argue that weak Central bank independence and the frequent supply shocks to which African economies are exposed make it difficult for Central banks to achieve their inflation targets.

Keywords: Inflation Targeting; Inflation Performance; African Countries; Synthetic Control; Monetary Policy Credibility

JEL Classification: E4, E5, E6

1. Introduction

Many Sub-Saharan African economies have experienced structurally high inflation rates (Bleaney and Francisco, 2016). While regional inflation over the period spanning 2000 to 2022 averaged around 11%, countries such as Angola, Sudan, the Democratic Republic of Congo, South Sudan, and Zimbabwe reported much higher rates, ranging from 45% to 80%. Regional inflation surged during the COVID-19 pandemic due to supply chain disruptions (Nsafoah et al., 2024), reaching 23% in 2020, compared with a pre-pandemic average (2010-19) of 8.5% before declining. High and volatile inflation worsens household living standards and causes economic uncertainty, resulting in significant adverse repercussions for the global economy. Among the tools designed to promote macroeconomic stability, inflation-targeting (IT) regimes have become very popular in emerging market economies. In Africa, South Africa was the first to adopt IT, in 2000, followed by Ghana (2007), and Uganda (2011). The IT regime remains of interest in Sub-Saharan Africa, with Zambia, Mauritania, Burundi, and Angola planning to move towards an explicit IT framework shortly.

The growing interest in the IT framework is mainly due to its ability to anchor inflation expectations, thus fostering greater monetary policy credibility (Bernanke and Mishkin, 1997; Walsh, 2009; Bordo and Siklos, 2014). To make the target credible, the central bank explicitly announces that low and stable inflation is its main objective, and reinforces its communication policy, for example, through quarterly or half-yearly inflation reports (Svensson, 2010; Bernanke et al., 2018). Aside from a few exceptions (e.g., see Levin et al., 2004; Brito and Bystedt, 2010; Ardakani et al., 2018), a large body of literature focusing on developing countries shows that a monetary framework geared towards price stability, such as IT, significantly contributes to improving the performance of developing countries by reducing inflation and its volatility, interest rate and exchange rate, or output volatility (Lin and Ye, 2009; Vega and Winkelried, 2005; Lin, 2010; Fratzscher et al., 2020; Arsić et al., 2022). Another stream of the literature examining the side effects induced by the IT framework provides evidence that by constraining seigniorage, IT also helps promote fiscal discipline (e.g., see Lucotte, 2012; Minea and Tapsoba, 2014; Combes et al., 2018; Ogrokhina and Rodriguez, 2018; Minea et al., 2021; Apeti et al., 2023).

Although many studies have analyzed the impact of IT on economic performance in developing countries, very few papers have focused specifically on African economies. Most papers in the literature focus on large country samples, with often very heterogeneous economic,

structural, and institutional features. Consequently, this paper fills the gap in the literature by examining the IT effect on inflation performance, focusing on the three African countries that have adopted the monetary framework. This issue is more relevant as numerous countries in the region have been experiencing particularly high inflation rates for several decades, with significant repercussions for their economies. In addition, as mentioned above, an explicit IT framework is of interest for many Central banks in the region, which plan to move towards this monetary regime in the coming years. Identifying the IT-induced effect is challenging, as a counterfactual model is needed to distinguish the genuine impact of the policy from other trajectories that would have occurred without the reform. To overcome this, we rely on the synthetic control method (SCM), developed by Abadie and Gardeazabal (2003) and extended by Abadie et al. (2010), which estimates the effect of the policy by simulating a counterfactual situation of the treated country, based on a comparison group. This approach offers a suitable analytical framework for a few treated units —which is the case in this study, and does not rely on the parallel trend assumption before policy implementation, as required by the difference-in-difference methods. Moreover, the SCM can handle endogeneity due to (time-varying) omitted bias (Billmeier and Nannicini, 2013).

Our results suggest that the IT framework has not significantly reduced inflation in Africa. These findings are robust to a range of econometric tests, including alternative specifications and donor pools, and placebo tests, when considering inflation volatility, or when using the synthetic difference-in-differences (SDID) estimator proposed by Arkhangelsky et al. (2021), which combines the traditional SCM with the difference-in-differences approach. We further attempt to understand the potential mechanisms underlying the results. Specifically, based on Lee (2011), we compare the institutional environment, captured by central bank independence, between African IT countries and other developing countries where IT has been successful; i.e., those where inflation decreased following IT adoption. We find that there has been a significant improvement in central bank independence following the post-IT period in other developing countries where the monetary framework has been successful, while there was a lack of progress after IT adoption in the case of South Africa and a deterioration in Ghana and Uganda.

The remainder of the paper is organized as follows. The following section reviews the literature on IT and discusses the implementation of the monetary framework in each country of interest. Section 3 reports some stylized facts. Section 4 presents our empirical methodology. The main

results are discussed in Section 5. Section 6 analyses the sensitivity of our findings. Section 7 explores the underlying mechanisms. The last section concludes.

2. Background

The literature dealing with monetary policy delegation establishes that a discretionary regime leads to an inflation bias, because the central bank tends to make inflation surprises to support economic activity, given the society's inflation and employment preferences. Inflation biases weaken the credibility of monetary policy and can increase the cost of dis-inflation (Kydland and Prescott, 1977). To remedy this, Rogoff (1985) suggests choosing a more conservative central banker to give more weight to the inflation objective, while Walsh (1995) proposes an inflation contract to the central bank. The strategy suggested by Walsh (1995) is formally equivalent to IT, recommended by Svensson (1995). The IT framework involves the explicit announcement by the central bank of a quantitative inflation target and the willingness of the monetary authorities to meet that target, for instance through increased central bank transparency to promote greater monetary policy credibility (Bernanke and Mishkin, 1997; Walsh, 2009; Bordo and Siklos, 2014). Indeed, credibility is a key factor in monetary policy, as it influences public expectations and facilitates the conduct of monetary policy, implying, among other things, a low effort by the central bank to achieve the announced target (Kydland and Prescott, 1977). If the inflation targets are perceived as credible by the public, they should strongly anchor their expectations and may shape actual inflation.[1]

Numerous studies focusing on emerging economies provide evidence that by strongly anchoring public expectations, the IT framework enhances macroeconomic stability; i.e., the reduction in inflation and its volatility, interest rates, the exchange rate, and output volatility (Minella et al., 2003; Calderón et al., 2004; Vega and Winkelried, 2005; Rose, 2007; Gonçalves and Salles, 2008; Lin and Ye, 2009; Lin, 2010; López-Villavicencio and Pourroy, 2019; Fratzscher et al., 2020; Arsić et al., 2022). Some exceptions include Levin et al. (2004); Brito and Bystedt (2010); or Ardakani et al. (2018) who find no significant differences in inflation performance between IT countries and the others. Similarly, Lee (2011) finds that not all emerging countries that have adopted IT have experienced positive

[1] As mentioned earlier, monetary policy credibility in an IT framework Is enhanced by the central bank's communication strategy, particularly through regular reports and forward-looking inflation assessments (Mishkin, 2000; Svensson, 2010; Bernanke et al., 2018).

benefits. The literature provides some scarce evidence for Sub-Saharan African countries, with studies focusing on South Africa. For instance, using recursive VARs and the rolling window VARs, Burger and Marinkov (2008) find some success in South Africa's IT framework, particularly when compared with inflation levels in the 1990s, but consider this success to be mixed as inflation levels remain far from the official target range. Kaseeram and Contogiannis (2011) find somewhat similar results using GARCH and GARCH-M models. Lastly, another body of literature finds that by constraining seigniorage, IT leads the government to greater fiscal discipline by increasing its efforts to mobilize tax revenues, reducing fiscal waste, promoting fiscal and financial reforms, or improving the quality of fiscal institutions (Lucotte, 2012; Minea and Tapsoba, 2014; Combes et al., 2018; Bernanke et al., 1999; Brash et al., 2000; Minea et al., 2021; Apeti et al., 2023).

IT in Africa

Today, around 40 countries have an IT policy, and almost half are emerging economies. In Africa, the monetary regime was introduced in the 2000s and has been formally adopted by three countries to date. This section discusses in detail the IT framework in the three countries of interest; that is, the context of its implementation, the targets set, and the central bank's communication strategies to anchor inflation expectations more effectively.

South Africa

In February 2000, the South African Reserve Bank (SARB) officially introduced the IT framework to achieve low and stable inflation. Following countries such as Brazil, Korea, Israel, Peru, and Thailand, the target in South Africa is determined by the government in consultation with the Reserve Bank.[2] However, the primary objective of the Bank is to "protect the value of the South African currency" (Jonsson, 1999), and the tools to be applied to achieve this objective are at the discretion of the SARB. The SARB must therefore exercise its functions independently and "without fear", as stipulated in Section 224(2) of the constitution (Van der Merwe, 2004). In other words, although the government is involved in setting the inflation target, the central bank must be able to pursue the inflation

[2] In Spain, Sweden, Mexico, And Poland, the inflation target is set and announced by the central bank. In Australia, Canada, Colombia, And New Zealand, the target is set jointly by the government and the central bank. Finally, the UK is one of the few countries, if not the only one, where the target is set only by the government (Van Der Merwe, 2004).

objective without constraints on its use of monetary policy instruments. The SARB is the main body responsible for achieving the inflation target.[3]

The SARB has specified its target in terms of the consumer price index, over a range of 3% to 6%, and aims to achieve it continuously every month. Since IT was adopted, the SARB has intensified its efforts to communicate and clarify its monetary policy to the public. For instance, the Minister of Finance announces the level of the target, then the central bank publishes monetary policy statements and press releases, and live television broadcasts, six times a year to better inform the public on monetary policy issues (Van der Merwe, 2004). Since IT was introduced, the SARB has become more accountable for its actions to strengthen the credibility of its monetary policy. The central bank governor is then required to submit an annual report on the implementation of monetary policy to the Minister of Finance. Lastly, the use of social networks (e.g., LinkedIn, Facebook, Twitter) is part of the tools the SARB has deployed to strengthen its communication to strongly anchor inflation expectations (Masciandaro et al., 2022).

Ghana

In 2007, Ghana became the second African country to formally implement IT in the quest for greater price stability, the main objective of the Bank of Ghana (see Section 3 of the Bank of Ghana Act 2002, Act 612). As for South Africa, the medium-term inflation target is set jointly by the government and the central bank, while the latter is required to deploy its policy tools to achieve the target.[4] The Bank of Ghana was granted operational independence in the conduct of monetary policy, and a monetary policy committee is responsible for the formulation of the central bank's policy (Bleaney et al., 2020). The central bank is the main body responsible for achieving the target and is required to submit a full report on its line of policy action to parliament twice a year.

The bank's inflation target is 8%, with a symmetric band of 2%. To enhance its transparency and successfully anchor inflation expectations within the target range, the Bank of Ghana publishes a monthly report detailing its policy and summarizing several macroeconomic indicators. These reports are written in English, the official language of the country, and are accessible through the bank's website.[5] Regular press briefings, which are transcribed and published on the bank's website, are organized by the

[3] Https://Www.Resbank.Co.Za/En/Home/What-We-Do/Monetary-Policy
[4] Https://Www.Bog.Gov.Gh/Monetary-Policy/Our-Monetary-Policy-Framework/
[5] Https://Www.Bog.Gov.Gh/Monetary_Policy_Rpts/

Governor to explain in detail the interest rate decision and any other monetary policy measures taken. Finally, other communication tools such as social media or advertisements in different local languages of the country have been widely adopted in recent years to disseminate information materials related to the bank's policy to reach a wider audience.

Uganda

Uganda formally introduced the IT framework in July 2011. Price stability has been the primary objective of the Bank of Uganda (BOU) since the 1990s. The 1995 Constitution of Uganda conferred operational independence on the central bank, allowing it to pursue an independent policy. The Constitution states that: "In performing its functions, the Bank of Uganda shall conform to this Constitution but shall not be subject to the direction or control of any person or authority." Consequently, the BOU is required to implement its monetary policy freely, without being influenced by the government. However, as a public institution, the Bank is accountable to Parliament and must listen to the views of legislators, who represent the public.[6]

The BOU's average inflation target is 5% over a two- to three-year period. The Bank's main objectives are communicated regularly through monthly statements, accessible on the Bank's website, to influence inflation expectations and convince the public of the credibility of monetary policy. Moreover, a press briefing is given by the Governor after each Monetary Policy Committee meeting to further explain the monetary policy decisions taken and the IT framework. The Governor's speeches are also published on the Bank's website (Brownbridge and Kasekende, 2018). Since IT adoption, the BOU has strengthened its communication strategy in the serious local and foreign media, which regularly report on press briefings. Reports on the interest rate decision are sometimes relayed in specialized international media, such as Reuters, Bloomberg, or MSBC Africa (Brownbridge and Kasekende, 2018).

3. Stylized Facts

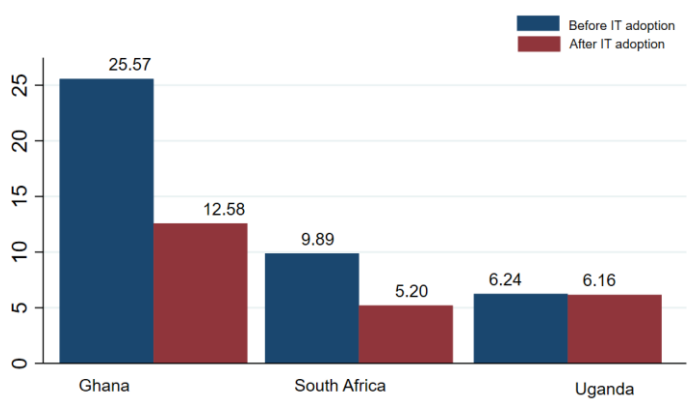
This section provides some stylized facts about average inflation rates per year and their evolution across the three countries during the period from 1990 to 2020. Figure 1 displays the average evolution of inflation rates in

[6] Https://Www.Bis.Org/Review/R181018h.Pdf

each of the three countries, before and after IT adoption. There has been a decline in the average inflation rate in all the countries. However, the drop was particularly pronounced for Ghana and South Africa. Indeed, Ghana's average inflation rate fell from 25.57% before IT adoption to 12.58% after IT adoption, and South Africa's average inflation rate fell from 9.89% to 5.20%. In other words, the average inflation was almost halved in both countries after IT adoption. However, the pattern is more mixed for Uganda, which reports an average inflation rate almost similar to its level before IT adoption, with a negligible difference (0.08 percentage points). Nevertheless, Uganda is on target at 5%.

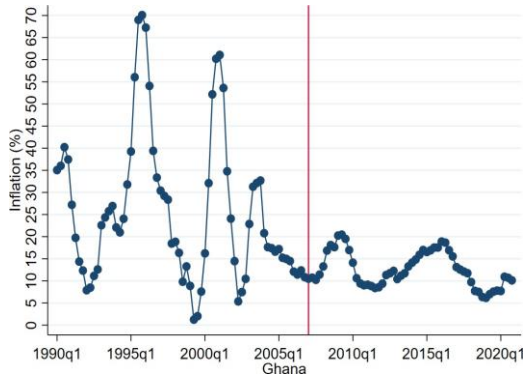
Figure 2 displays the inflation trend in each country over 1990-2020, based on quarterly data. Inflation has been declining in Ghana (Figure 2a), particularly since 2003; i.e., four years before the formal adoption of the monetary regime, with an overall downward trend until the end of the study period. Uganda (Figure 2c) records a peak in inflation that almost overlaps with the timing of formal IT adoption, followed by a strong downward trend until the end of the study period. The case of South Africa is quite mixed (Figure 2b), with, however, a general downward trend. Moreover, Figure 2 shows high variability in inflation in all three countries, reflecting high economic uncertainties, but with relatively lower amplitude in Ghana and Uganda after IT introduction.

Figure 1: Average inflation rates before and after IT adoption (1990-2020)

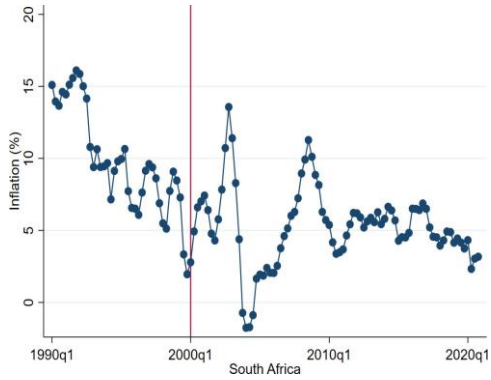


Notes: This figure reports the average inflation trends in Ghana, South Africa, and Uganda, before and after IT adoption. We refer to the adoption dates declared by the central bank of each country (soft or informal IT); that is, 2007 for Ghana, 2000 for South Africa, and 2011 for Uganda. These dates also correspond to those reported by academics (full-fledged or hard IT).

Figure 2: Inflation trends from 1990 to 2020

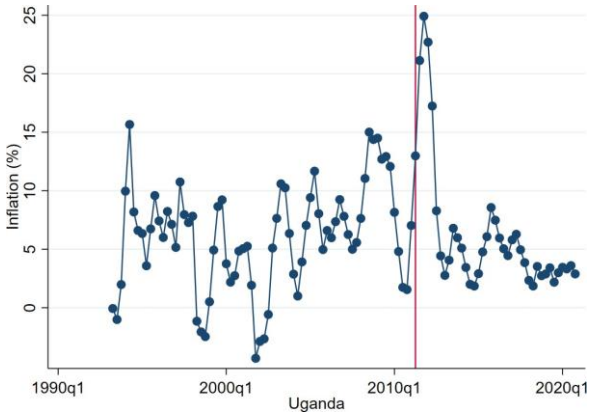


(a) Ghana



(

b) South Africa



(c) Uganda

Notes: These figures display inflation trends in Ghana, South Africa, and Uganda. The vertical red line denotes the IT adoption date for each country.

4. Methodology

The study aims to estimate the IT effect on inflation in Ghana, South Africa, and Uganda. A simple approach would be to compare the trends in outcomes for each country before and after policy adoption. However, such an approach would suffer from a counterfactual problem, since it is not possible to observe how the country would have evolved if it had not adopted the reform. To overcome this problem, the literature has proposed an approach to assess the impact of the implementation of economic programmes, the synthetic control method (SCM), developed by Abadie and Gardeazabal (2003) and extended by Abadie et al. (2010). A few studies in the literature have used the SCM using macroeconomic variables (e.g., see Lee, 2011; Billmeier and Nannicini, 2013; Cavallo et al., 2013; Campos et al., 2022). The SCM makes it possible to estimate the counterfactual situation of a treated unit; that is, one that has been exposed to a treatment, from a weighted average of potential controls that best meet the characteristics of the treated unit before the measure, called the synthetic control. In other words, the synthetic control neutralizes the influence of other factors on the treated unit, thus representing an almost perfect mirror of the latter; that is, the counterfactual we desire. The treatment effect for each treated unit is therefore the difference in outcomes between that unit and its synthetic control (Abadie and Gardeazabal, 2003; Abadie et al., 2010).

Assume that Y^1_{it} is the outcome indicator for the treated unit *i* at time *t*, and there are *J* potential control units, indexed j = *{2,....; J* +1*}*. X^1_{it} and X^0_{it} are a set of pretreatment characteristics for the treated unit and the potential controls, respectively. The treatment effect at time *t* for the treated unit *i* can be written as follows:

$$\delta_{it} = Y^1_{it} - \sum_{j\varepsilon J} W_j Y^0_{it} \quad (1)$$

where W_j is a set of non-negative weights whose sum is 1 and which minimizes the distance, before the treatment, between the treated unit and the potential controls. In other words, we choose weights to minimize the following distance:

$$||X_1 - X_0 W||V = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \quad (2)$$

where *V* is a positive-definite diagonal matrix. Several methods can be used to determine *W* and *V*. We follow Abadie et al. (2010) and choose *W* and *V* such that they minimize the RMSPE (Root Mean Square Prediction

Error) of the outcome variable for the periods before the treatment.[7]

Specification of the Synthetic Controls

Potential control group

The implementation of the SCM requires the selection of potential control units. As discussed by Abadie and Gardeazabal (2003), the effectiveness of the method depends in particular on the choice of the potential control countries whose characteristics are plausibly similar to those of the treated unit. The restriction of potential control countries ("the donor pool") by their socio-economic characteristics most similar to the treated unit thus avoids interpolation bias and improves the robustness of the results (Abadie et al., 2015). To construct the synthetic group, we include all developing countries with available data over the study period and exclude those that have adopted an IT regime. In total, we consider 43 potential control countries. We restrict the donor pool to African countries in robustness checks.

Main variables

The dependent variable, baseline inflation, is measured by the annual change in the consumer price index. In Equation 1, the treatment year (IT adoption date) is captured by a dummy equal to 1 from the policy adoption date, and zero otherwise. From the existing literature (e.g., see Sargent and Wallace, 1981; Romer, 1993; Edwards, 1993; Barro, 1995; Reinhart and Rogoff, 2011), we include the following covariates: annual GDP growth, public debt, domestic credit to the private sector (as a proxy for financial development), trade openness, the exchange rate regime, and the level of the outcome variable over the four years before the treatment to account for differences in volatility across countries before IT adoption. We further discuss the rationale for the choice of these variables.

GDP growth: While inflation is an important factor in the evolution of economic growth, the inverse relationship can also prevail. For example, Barro (1995) argued that when there is an exogenous slowdown in the growth rate, monetary authorities may react with expansionary policies, which can generate high inflation.

Public debt: According to the unpleasant monetarist arithmetic theory (Sargent and Wallace, 1981), by worsening fiscal solvency, high debt levels can lead the government to pressure the central bank to finance its deficits through money creation, which can trigger strong inflationary pressures.

[7] In other words, the RMSPE is a measure of the magnitude of the difference between the observed indicator for the treated unit and the selected synthetic unit. See Abadie et al. (2010) for a more detailed technical discussion of the SCM.

Financial development: Sound financial development limits the risk of monetization through the sharing of seigniorage power between the central bank and commercial banks (Minea et al., 2021) and can promote tax revenue collection (Nnyanzi et al., 2018; Gnangnon, 2021; Apeti and Edoh, 2023), thus reducing debt financing through money creation or seigniorage. We then expect sound financial development to reduce inflation.

Trade openness: Romer (1993) and Lane (1997) find that greater openness is associated with lower inflation. The reasoning is as follows: In the absence of an independent or credible monetary authority, the government is incentivized to generate inflation surprises to make output gains. However, a more open country has less to gain from generating inflation surprises due to the deterioration of the terms of trade. Thus, by reducing the net marginal benefit of an inflation surprise, trade openness acts as a brake on the gains from inflation surprises. Moreover, by fostering competition, trade openness may reduce the ability of monopoly firms to impose inflationary price increases.

Exchange rate regime: Although a flexible exchange rate regime may allow greater scope for reaction to exogenous shocks, and therefore greater inflation stability, empirical studies have shown that fixed exchange rates are associated with significantly better inflation performance, in level and variability (e.g., see Edwards, 1993; Ghosh et al.,1996; Bleaney and Greenaway, 2001).[8]

Inflation, GDP growth, trade openness (measured as the sum of exports and imports as a share of GDP), and financial development (approximated by domestic credit to the private sector as a share of GDP) are extracted from the World Bank's WDI (World Development Indicators) dataset. The exchange rate regime variable is from Ilzetzki et al. (2019)'s classification that varies within 15 categories, where a low (high) value indicates a fixed (flexible) regime. Public debt is extracted from Kose et al. (2022).

5. Main Findings

First, we apply the algorithm to create a synthetic control for South Africa, obtaining a control composed of 1.3% Albania, 61.0% Morocco, 4.7% Myanmar, 30.4% Sierra Leone, and 2.6% Sudan. Therefore, the

[8] Ghosh et al. (1996) discuss two potential channels linking the fixed exchange rate regime to inflation. The discipline effect stipulates that the political costs of abandoning the peg induce tighter policies, while according to the confidence effect, strong confidence leads to a greater willingness to hold domestic currency rather than foreign currencies.

constructed synthetic South Africa is a weighted average of the latter countries. Ghana's counterfactual outcome is composed of Costa Rica (51.7%), Myanmar (9.2%), and Nigeria (39.0%). Uganda's synthetic outcome is derived primarily from Bangladesh (44.4%), Botswana (30.1%), Burkina Faso (22.7%), and Kenya (2.8%). Table 1 shows the pre-IT values of the indicator variables for the actual and the synthetic treated country. Overall, the synthetic control mimics the treated country throughout the pre-IT period. Figure 3 plots the real and synthetic South Africa, Ghana, and Uganda, both in the pre-IT period we used to construct the control and in the post-IT period where the control serves as a counterfactual. The difference in the evolution of inflation over the post-IT period between the treated country and the control provides insight into the IT effect on inflation. The analysis shows that after IT adoption, the inflation outcomes of the treated countries and their synthetics converge for the three countries. These representations, therefore, suggest that the IT framework has not significantly reduced inflation in South Africa, Ghana, and Uganda, compared to non-IT countries. The results for South Africa corroborate those of Lee (2011) who, using synthetic control methods over the period 1993-2006, found no significant impact of IT on inflation.

Table 1: Predictor comparison

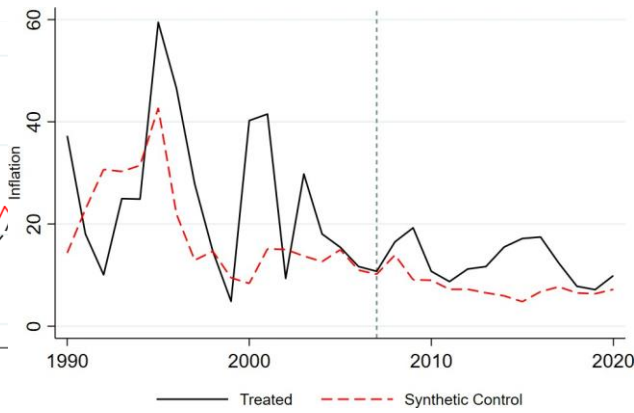
South Africa			**Ghana**			**Uganda**		
Covariates	Treated	Synthetic	Covariates	Treated	Synthetic	Covariates	Treated	Synthetic
Inflation (1999)	5.18	4.73	Inflation (2006)	11.68	10.98	Inflation (2010)	3.98	5.64
Inflation (1998)	6.88	8.01	Inflation (2005)	15.44	14.96	Inflation (2009)	13.02	5.67
Inflation (1997)	8.598	6.69	Inflation (2004)	18.05	12.63	Inflation (2008)	12.05	10.93
Inflation (1996)	7.35	9.21	Inflation (2003)	29.77	13.72	Inflation (2007)	6.14	6.40
GDP growth	1.39	1.58	GDP growth	4.59	5.03	GDP growth	6.95	4.85
Public	38.	77.8	Public	43.	48.9	Public	36.	26.3

debt	47	7	debt	64	7	debt	83	1
Exchange rate regime	13.50	11.64	Exchange rate regime	10.82	9.39	Exchange rate regime	10.57	5.88
Financial development	100.95	54.24	Financial development	9.12	28.95	Financial development	13.15	19.24
Trade openness	39.05	49.01	Trade openness	77.17	61.82	Trade openness	36.23	50.98
RMSPE		2.04			15.73			2.85

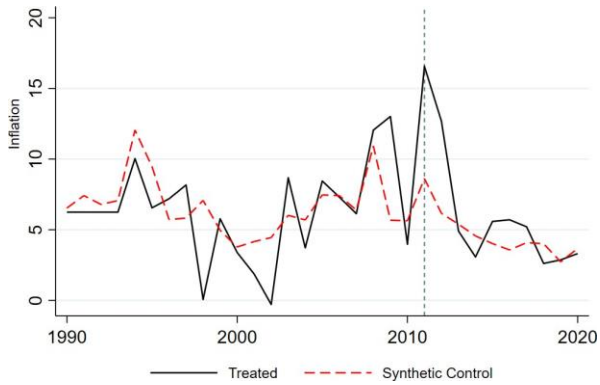
Notes: This table displays the pre-IT values of the control variables for the actual and the synthetic treated country. The dependent variable is inflation, measured by the annual change in the consumer price index.

Figure 3: Inflation trends: Treated country versus synthetic control

(a) South Africa



(b) Ghana



(c) Uganda

Notes: The solid line represents observed inflation. The dotted line represents the synthetic control. The vertical dotted line indicates the IT adoption date.

6. Robustness

Alternative Specifications

As a first robustness test, we slightly changed our specification by replacing GDP growth with the output gap.[9] We have restricted the main model to a series of relevant controls, as the inclusion of a larger number of variables exposes us to multicollinearity problems. The second robustness test consists in augmenting our main specification by including a few additional control variables. The literature has examined the role of institutions in inflation. For instance, Acemoglu et al. (2008) find that inflation and central bank independence are negatively associated with medium levels of institutional quality, but that the relationship is ambiguous for low levels of institutional quality. The underlying mechanism is that the effect of reforms may depend on the constraints imposed by the existing political economy factors.[10] Other studies have pointed out that in developing countries—generally characterized by weak institutions and where the central bank is under the direct control of the government—inflation tax represents an important financial resource for public expenditure (Huang and Wei, 2006; Minea et al., 2021). Therefore, we augment our baseline model by including corruption control and central bank independence.[11] Finally, since African countries are often affected by international shocks, they may have greater challenges in controlling inflation. In addition, the increasing prevalence of climate shocks may induce supply shocks, exerting pressure on inflationary dynamics in the region. Therefore, we further include terms of trade and climate shocks among the covariates of the baseline model to capture some cost shocks.[12] The results reported in Sub-figures (a) and (b) of Figure B1 and Sub-figure (a) (Figure B2), respectively, support the main findings.

Alternative Donor Pools

[9] The output gap is computed by extracting potential output from observed real GDP, using the Hodrick-Prescott (HP) filter.

[10] We further discuss this point in Section 7.

[11] The corruption control variable is extracted from the International Country Risk Guide (ICRG) dataset. Central bank independence is captured by a composite index from Romelli (2022).

[12] The terms of trade variable Is from the World Bank's WDI database. The climate shocks variable is extracted from the IMF Climate Change Indicators Dashboard and captures annual changes in mean surface temperature, in degrees celsius, by country, using temperatures between 1951 and 1980 as a baseline.

The potential control group includes some countries having a fixed exchange rate regime, which therefore implicitly have an inflation target. Consequently, from the potential control group, we exclude countries belonging to a monetary union or dollarized countries, and those with a *de facto* fixed exchange rate or currency boards. Second, we restrict our group of potential controls to African countries to ensure common support between the treated and comparison countries according to geographical, structural, and institutional factors. The new findings are reported in Sub-figures (b) (Figure B2) and (a) (Figure B3), respectively. The results hold.

Placebo Test

According to the literature, some countries have operated under informal or soft IT for several years before formally implementing hard IT. The distinction between the two types of regime results from the reaction of the central bank following an inflation deviation from the target. Indeed, the central bank's response to an inflation deviation from the target under a soft IT regime is slower than under a hard IT regime. Soft IT refers to the date reported by the central bank itself, while hard IT refers to the date reported by researchers, which is considered the confirmed date from which the central bank operates under the IT regime.

Although the reported year for soft and hard IT is the same in the three countries of interest according to our data, the preconditions for adopting the monetary framework were set in place well before its formal implementation, two, three, or four years before. The length of the transition period depends, among other things, on the time required for the Central bank to incorporate the key elements, including preconditions, to ensure greater effectiveness of formal IT. From the foregoing, we assume that the adoption of key elements before the formal announcement of the IT policy may induce an anticipation effect that may affect public expectations regarding inflation. Therefore, we conduct a temporal Placebo test to determine whether the treatment effect induced changes in inflation before the formal adoption date. Specifically, we assume that IT has been adopted three years before its initial date for each treated country, and then replicate our main results. Sub-figure (b) (Figure B3) suggests that potential IT anticipation or setting the preconditions for the adoption of a formal IT regime did not have a significant effect on inflation in the three countries. Moreover, the results are consistent with previous findings. Finally, it is also likely that there will be a delayed effect, as it takes time for unions, employers, and others to incorporate an inflation target into their negotiations or expectations. Therefore, in Sub-figure (a) (Figure B4), we test the hypothesis of a delayed effect of the monetary framework, considering that it was implemented three years

after its true adoption date. The results remain unchanged.

Inflation Volatility

As yet another robustness check, we examine the IT effect on several measures of volatility. First, we estimate inflation volatility from the Hodrick-Prescott (HP) filter, since this approach does not rely a priori on any assumption regarding the presence and nature of the trend in the series.[13] Second, following Di Giovanni and Levchenko (2012) and Garriga and Rodriguez (2023), among others, we measure inflation volatility as the standard deviation of a 12-month rolling window of the monthly inflation rate, to account for all the transitory variations. Third, following Pritchett (2000), Lensink and Morrissey (2006), Apeti (2023), and Garriga and Rodriguez (2023), we use the standard deviation of the residual from an inflation regression on a linear trend. Fourth, we consider extreme levels of volatility; that is the 75^{th}, 90^{th}, and 95^{th} volatility percentiles. Lastly, we consider quarterly data when computing inflation volatility. Although the pre-treatment fits are poor, the results indicate neither a significant decrease nor a significant increase in inflation volatility following IT adoption in any of the three countries of interest (the results are not reported but are available on request).

Synthetic Difference in Differences

The primary estimation method is based on the traditional synthetic control method (SCM) developed by Abadie and Gardeazabal (2003). The SCM has been widely used in the economics literature, given its ability to find a good combination of control units that match as closely as possible the outcome behaviour of the unit of interest during the pre-treatment period. Since then, the econometric literature has proposed several developments of the SCM, including some extensions that can provide statistical inferences (Abadie, 2021). Most recently, Arkhangelsky et al. (2021) proposed a new extension of the SCM, combining the traditional SCM with the difference-in-differences approach: the synthetic difference-in-differences (SDID). In contrast to the SCM, which includes only time-fixed effects, the SDID also considers unit-fixed effects. This makes it possible to better account for time-invariant unobserved individual characteristics that might explain differences in outcome levels between treated and control units. Second, the SDID provides statistical inference, allowing us to quantify the average effect induced by the treatment, which is not possible in the case of the traditional SCM. Third, by assigning

[13] The results hold when we exclude values at the end of the sample from the HP filter, as the latter may be very different from those in the middle.

greater weights to years near the end of the pre-treatment period, the SDID reduces the impact of past shocks in constructing counterfactuals (Campos et al., 2022). Third, with this new method, in addition to quantifying the treatment effect for the treated unit, it is also possible to quantify the average treatment effect in the case of multiple treated units, as in the case of the difference-in-differences estimator or the propensity score matching methods. Lastly, although the SDID is an interesting method, it has a few shortcomings. For example, it requires a highly balanced panel, and the average treatment effect for multiple treated units ideally assumes that the treatment year is identical for all treated units.

The new results from the baseline model and using the SDID are reported in Table 2. Although the average treatment effect is negative, it is not statistically significant. The conclusions remain similar when we look at the effect for each of the treated units, reinforcing our previous results.

Table 2: Synthetic difference in differences

	Multiple Treated	South Africa	Ghana	Uganda
Treatment effect	-2.011	-8.579	3.579	3.956
	(24.151)	(31.174)	(24.022)	(28.417)

Notes: This table reports the IT effects on inflation, using the synthetic difference-in-differences (SDID) estimator. First, we estimate the average effect for the three treated countries (Multiple Treated), then we report the results for each of the three countries. Standard errors are in parentheses. For all estimates, there is no statistically significant effect at the 10% threshold.

7. Underlying Mechanisms

There is a follow-up question. Why did the IT framework fail to significantly reduce inflation in Africa? This section examines to what extent institutional quality, in particular central bank independence, might explain the main results. Institutions, notably central bank independence, are a key precondition for successful monetary reforms (see, among others, Acemoglu et al., 2008; Agénor and da Silva, 2019). Acemoglu et al. (2008) argue that the relationship between inflation and central bank independence could be ambiguous for low and high levels of institutional quality. The underlying mechanism is that in economies where politicians

are unconstrained and unaccountable to citizens, distortionary policies are more likely to be implemented. As a result, such reforms are adopted in societies where political constraints are weak. However, in the latter economies, policy reforms may be ineffective, as the underlying political economy problems are often not altered by these reforms. The authors find some evidence consistent with the idea that central bank reforms have reduced inflation in societies with intermediate constraints and have had no or little effect in countries with high and low levels of constraints. From the foregoing, we can assume that a monetary reform such as IT, which is supposed to constrain seigniorage revenues for the government, is likely to succeed only when the essential institutional preconditions are met, with sound central bank independence.

In a study focusing on emerging economies, Lee (2011) finds that the inflation rate decreased in Colombia, the Czech Republic, Hungary, and Poland in the post-IT period. Based on this, we first examine the institutional differences between the two groups of countries; that is, the IT countries in our sample and those identified by Lee (2011) where the introduction of the monetary framework has been successful.[14] The intuition is to test whether central bank independence, a key element of a successful IT policy, improved after the adoption of the monetary regime. Our comparison list includes only emerging countries, based on the IMF classification.[15] We approximate central bank independence by the Romelli (2022) Governor and Central Bank Board indicator, which can range from 0 to 1 (higher values indicate greater central bank independence).[16]

We estimate simple Pearson correlations to capture the relationship between the Romelli (2022) central bank independence index and inflation. Not surprisingly, we find a negative and significant correlation between central bank independence and inflation, with a magnitude of 27%. Next, Figure 4 shows that, on average, in other developing countries where IT has been successful, the central bank has greater independence compared to African IT countries, with a significant difference (all the p-

[14] The inflation target in Poland Is 2.5% with a symmetric band for deviations of +/-1 percentage point in the medium term. Colombia has specified its target over a range of 2 to 4%. The target in Hungary is 3% with a symmetric band for deviations of +/-1 percentage point. Source: Jahan and Sarwat (2012).

[15] Based on the IMF classification, we exclude the Czech Republic from our analysis.

[16] The index considers a central bank to be more independent from the government when: i) The executive branch has little or no legal authority in appointing the governor and other board members.

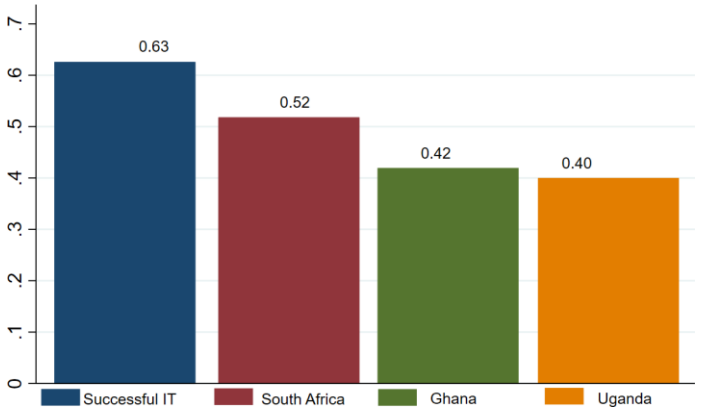
ii) The term of office exceeds the electoral cycle; iii) Reappointment is limited; iv) Dismissal is based on objective grounds; and v) Parallel activities of management bodies are limited.

values are below the 1% threshold) ranging from 0.11 to 0.23 points. Third, Figure 5 reports the average change in central bank independence in the two groups of countries, before and after IT adoption. As shown in sub-figure (a) (Figure 5), central bank independence has significantly improved after IT adoption in developing countries where the monetary regime has been successful (t = -4.91; p-value: 0.00).[17] In contrast, the institutional environment remained almost unchanged in South Africa and Uganda, while it declined significantly in Ghana (t = 4.95; p-value: 0.00). In other words, in contrast to African economies, the post-reform effort to increase central bank independence seems to be more important in other countries where IT has been successful.[18]

[17] Results are similar when we consider central bank independence for each country.

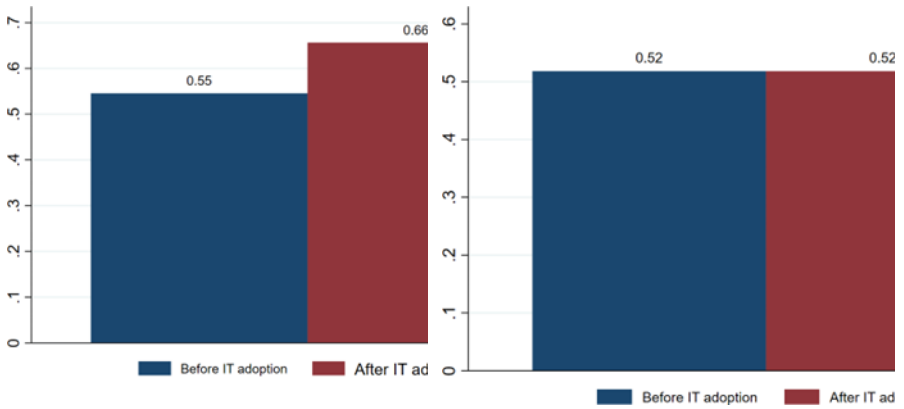
[18] We find similar conclusions when we replicate the analysis by comparing the three African IT countries with their synthetic controls: African countries did not significantly improve their institutional environment after the adoption of the monetary regime, compared to their counterfactuals.

Figure 4: Central bank independence: African IT countries versus successful other developing IT countries (average over the period 1990-2020)



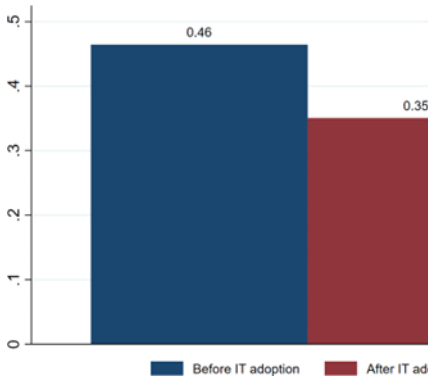
Notes: This figure displays the average Central bank independence trends in African IT countries and other developing countries in Lee (2011) where the IT framework has been successful in reducing inflation (Colombia, Hungary, and Poland). The Central bank independence index is from Romelli (2022). Higher values reflect greater Central bank independence.

Figure 5: Central bank independence: African IT countries versus successful other developing IT countries, before and after IT adoption (average over 1990-2020)

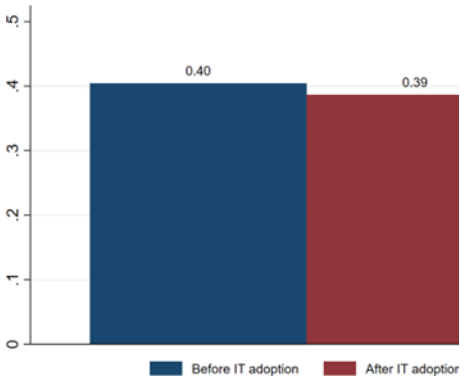


(a) Central bank independence in successful IT countries

(b) Central bank independence in South Africa



(c) Central bank independence in Ghana



(d) Central bank independence in Uganda

Notes: This figure displays the average rates of Central bank independence in African IT countries and other developing countries in Lee (2011) where the IT framework has been successful in reducing inflation (Colombia, Hungary, and Poland), before and after IT adoption. The Central bank independence index is from Romelli (2022), higher values reflect greater Central bank independence.

8. Conclusion

Summary: Reforms are often presented to improve economic performance. Among monetary reforms, the inflation targeting (IT) framework has been adopted by a growing number of emerging economies to promote macroeconomic stability. Since the early 2000s, three African countries have been formally operating under IT: Ghana, South Africa, and Uganda. So far, the literature has often examined the IT effects using large panels of developing countries, sometimes with very heterogeneous economic, institutional and structural features. In this paper, we examine the IT effect on inflation performance, focusing on African economies. This issue is particularly relevant since most countries in the region have been experiencing high inflation rates for several decades, with some of them planning to move towards an explicit IT framework shortly. The empirical approach uses the synthetic control method from 1990-2020, which estimates the counterfactual situation of the IT countries based on a similar comparison group. We find robust evidence that the IT framework has neither reduced nor increased inflation in the three countries of interest. We further examine some underlying mechanisms, drawing attention to the importance of central bank independence. A comparative study suggests that, in contrast to African IT countries, other developing countries where the monetary framework has been successful have experienced a significant improvement in central bank independence post-IT period.

Discussion: Do these results imply that the IT policy has been a failure in African economies? Our conclusions deserve some nuances. First, it is likely that without the IT regime, these countries could have faced record inflation rates. Second, the experience of the three countries seems young, except for South Africa, compared to the three comparison countries that implemented the regime in the late 2000s (Colombia in 1999, Hungary in 2000, and Poland in 1998) and where IT has been successful. Therefore, this calls for a degree of caution in interpreting the results. Third, the findings do not necessarily imply that monetary reforms such as IT are doomed to fail in African countries. In contrast, our recommendation is that special attention should be paid to the institutional context when implementing economic reforms. Consequently, improving central bank independence, not only in setting the inflation target but also in the choice and manipulation of policy instruments, may define another path to inflation control and stability in African IT countries. Last but not least, weather-related supply shocks (given the predominance of the agricultural sector) and import and export price shocks are major determinants of inflation in

Sub-Saharan Africa (Agénor and da Silva, 2019; Klomp, 2020; McKibbin et al., 2020; Mukherjee and Ouattara, 2021; Thang et al., 2022). Unlike demand shocks, supply shocks tend to lead to higher inflation while adversely affecting output. In this case, a central bank —even while pursuing an IT policy— might hesitate to tighten monetary policy, as this could exacerbate the decline in output and thus worsen social costs. Such hesitation is all the greater if its independence is more formal than real. In short, supply shocks will make it difficult for central banks to achieve their inflation targets, more so as their independence is weak. To this end, it seems important for monetary authorities to be equipped with a framework that can account for the effects of climate shocks or terms-of-trade shocks in their objective function and forecasting exercises, to limit inconsistency issues when facing such shocks. More generally, we advocate a strengthened monetary framework to support the IT regime in African countries, which may account for supply shocks while facilitating greater independence for monetary authorities.

Limits: It would have been interesting to consider other measures of inflation, such as core inflation, which excludes certain components of the consumer price index such as food and energy, which are temporarily highly volatile. Ha et al. (2023) provide data on core inflation, but with very limited availability for African countries, including those in our sample. Some data is provided by the Central banks of the countries concerned, for more recent years, while our study extends from 1990 to 2020. We hope this aspect will be addressed in future research, to distinguish between the effects resulting from the conduct of monetary policy and those stemming from external factors.

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Appendix

Appendix A: Data

Table A1: List of variables and their sources

Variables	Nature	Sources
1. Treatment variable		
Inflation targeting	Dummy	Rose (2007); Jahan and Sarwat (2012); Ciżkowicz-Pękała et al. (2019)
2. Outcome variables		
Inflation	Continuous	WDI, World Bank
Inflation volatility	Continuous	Authors, from WDI, using the Hodrick-Prescott (HP) filter
3. Covariates		
GDP p growth	Continuous	WDI, World Bank
Domestic credit to private sector	Continuous	WDI, World Bank
Trade openness	Continuous	WDI, World Bank
Public debt	Continuous	Kose et al. (2022)
Fixed exchange rate	Continuous	Authors' calculations based on Ilzetzki et al. (2019)
4. Additional controls		
Output gap	Continuous	Authors, from WDI, by extracting potential output from observed real GDP
Corruption control	Index ranging from 0 to 6	Country Risk Guide (ICRG)
Central bank independence	Index ranging from 0 to 1	Romelli (2022)
Terms of trade	Continuous	WDI, World Bank
Climate shocks	Continuous	Food and Agriculture Organization of the United Nations (FAO)

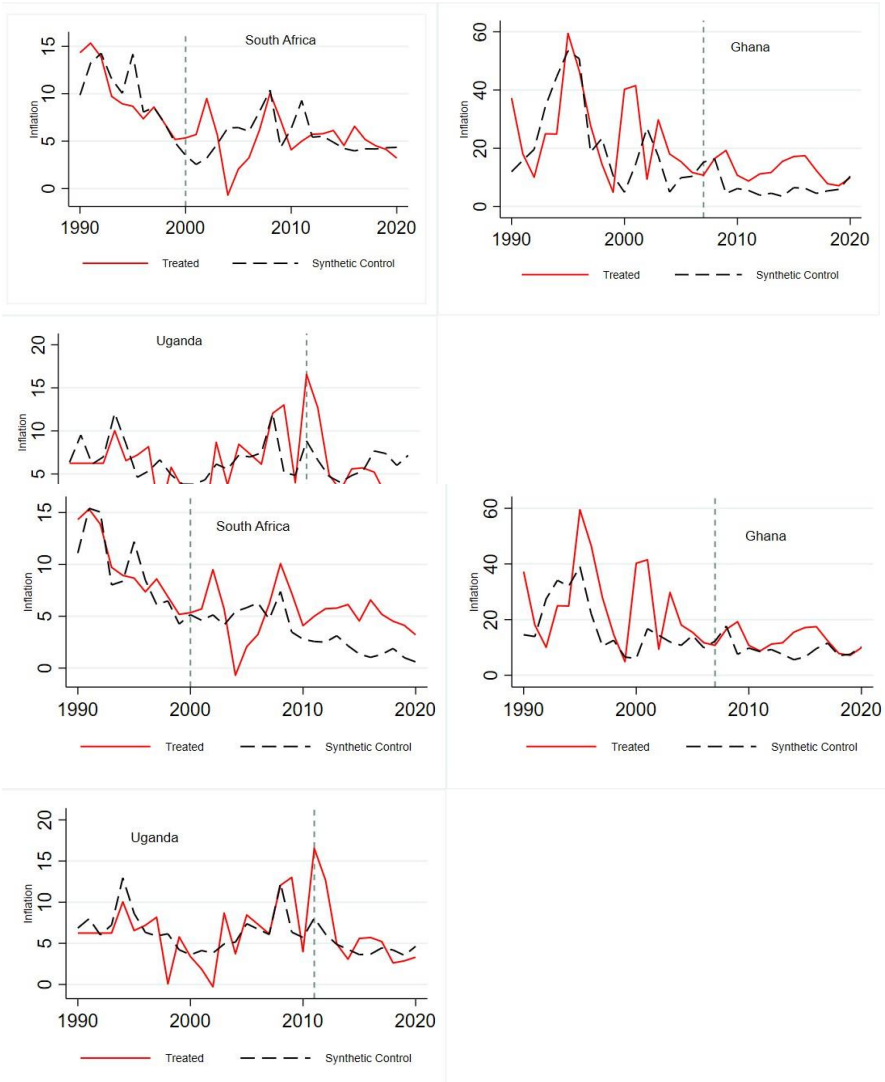
Table A2: Inflation targeting countries

Country	Soft IT	Hard IT	Inflation Target (%)
Ghana	2007	2007	8 ±2
South Africa	2000	2000	[3-6]
Uganda	2011	2011	5

Appendix B: Robustness

Figure B1: Inflation trends: Treated country versus synthetic control

(a) Including output gap

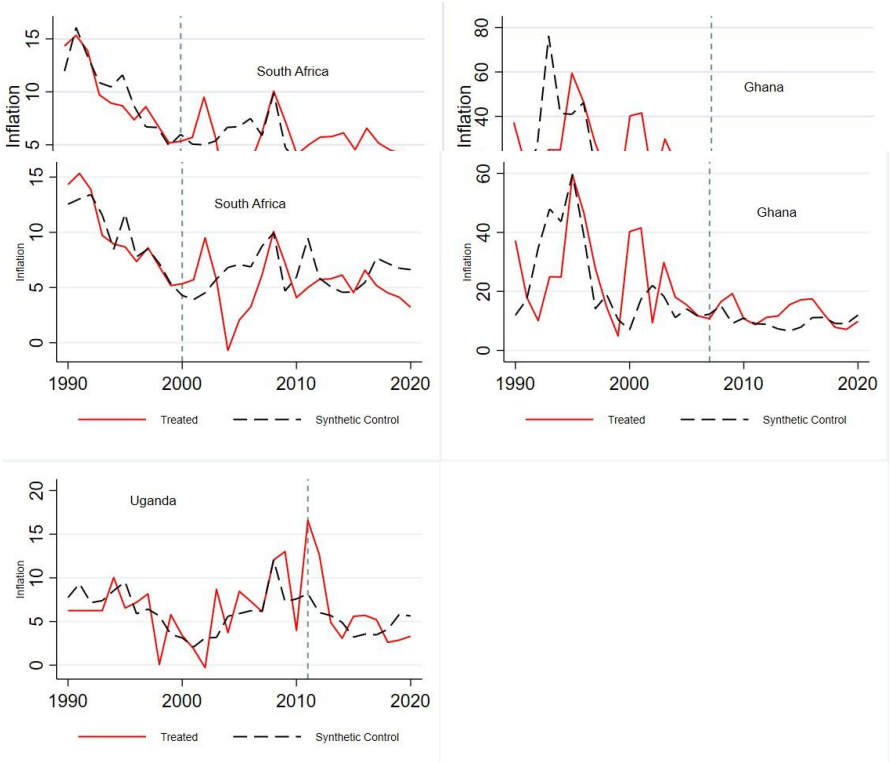


replicate our main model by replacing GDP growth with the output gap. In Sub-figure (b), we augment our baseline model by including corruption control and

Central bank independence. The solid line represents observed inflation. The dotted line represents the synthetic control. The vertical dotted line indicates the IT adoption date.

Figure B2: Inflation trends: Treated country versus synthetic control

(a) Including terms of trade and climate shocks



Notes: This figure displays the robustness of our results. In Sub-figure (a), we augment our baseline model by including terms of trade. In Sub-figure (b), we exclude from the potential control group countries belonging to a monetary union or dollarized countries, and those with a *de facto* fixed exchange rate or currency boards. The solid line represents observed inflation. The dotted line represents the synthetic control. The vertical dotted line indicates the IT adoption date.

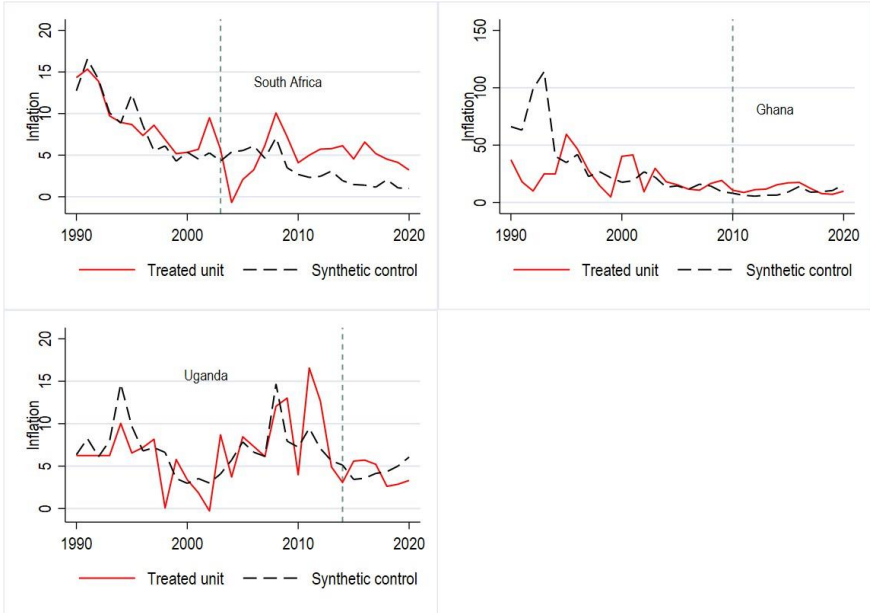
Figure B3: Inflation trends: Treated country versus synthetic control

(a) Restricting the donor pool to Africa

Notes: This figure displays the robustness of our results. In Sub-figure (a), we restrict our group of potential controls to African countries. In Sub-figure (b), we assume that IT has been adopted three years before its initial date for each treated country. The solid line represents observed inflation. The dotted line represents the synthetic control. The vertical dotted line indicates the IT adoption date.

Figure B4: Inflation trends: Treated country versus synthetic control

(a) Is there a delayed effect?



Notes: This figure displays the robustness of our results. We test the hypothesis of a delayed effect of the monetary framework, considering that it was implemented three years after its true adoption date. The solid line represents observed inflation. The dotted line represents the synthetic control. The vertical dotted line indicates the IT adoption date.

Mission

To strengthen local capacity for conducting independent,
rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

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Contact Us
African Economic Research Consortium
Consortium pour la Recherche Economique en Afrique
Middle East Bank Towers,
3rd Floor, Jakaya Kikwete Road
Nairobi 00200, Kenya
Tel: +254 (0) 20 273 4150
communications@aercafrica.org