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# Exchange Rate Misalignment and Growth in Exports: Lessons from the 1994 CFA Franc Devaluation

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**Abstract**

On January 12th 1994, the members of the CFA Franc zone took a bold decision to devalue their currency by 50 %. Despite the significance of this macroeconomic event, the devaluation and its effects on export growth has been given surprisingly little attention. This paper tries to fill this gap in the literature by assessing the impact of the devaluation on export growth, using the synthetic control method (SCM). We find that across the zone, exports as a percentage of GDP were on average 5.03 percentage points higher compared to a synthetic control in the six years following the devaluation. We show that these effects are robust to a series of alternative specifications of the synthetic control method as well as to a set of robustness checks in space and time. However, there is some evidence of heterogeneous impacts within the CFA zone. Considering a different outcome measure, the results for export volumes suggest wide variation in country experience as well as a sluggish response to the devaluation. When exports are measured in dollar terms, rather than volumes, the analysis suggests that there was no significant change after devaluation for most countries but a slight contraction for a few. Our findings suggest exporters are slow to increase export volumes but are quick to raise export prices measured in CFA francs, giving rise to a high exchange-rate pass-through. Further analysis suggests that the change in misalignment of the CFA franc just before and after the devaluation is of a similar magnitude to the misalignment today, suggesting depegging the currency and letting it float freely may possibly yield similar results.

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# 1 Introduction

Following a period of almost two decades of low growth both in output and exports, and facing a seriously misaligned and overvalued exchange rate, the *Communauté Financière Africaine* (henceforth the CFA zone) decided to devalue their common currency, the CFA franc, by 50 % in January 1994. The CFA franc had been pegged to the French franc at a rate of 50 CFA to 1 French franc but following the devaluation the ratio was immediately changed to 100 to 1.

Despite the magnitude and importance of this macroeconomic event in African monetary history, the devaluation and its effects have until very recently been given surprisingly little attention in the empirical economic literature. Bouvet et al. (2022) is the first paper to empirically evaluate the GDP response to the devaluation. They find no positive statistically significant effect on GDP per capita following the devaluation. However, Bouvet et al. (2022) do not explore the failing mechanisms behind this result. As any output growth following the devaluation is most likely to come from the tradeable sectors, the aim of this paper is to estimate the causal effect of the devaluation on one of the key variables of this event: growth in exports. We do this by applying the synthetic control method (SCM).

We find that, across the zone, exports as a percentage of GDP increased by 6.29 percentage points in 1994 compared to the synthetic control. On average the gap remains throughout the post-treatment period (1994-1999) at 5.03 percentage points. For only four countries, however, do we see statistically significant effects measured with in-space placebo p-values in any of the post-treatment periods[1]. Chow tests, however, reveal the presence of a structural break in half of the sample.

The results for exports measured in volumes suggest high heterogeneity across the zone. In 1994, a (negative) gap emerges between many treated countries and their respective synthetic control. However, the average gap in the post-treatment period is positive i.e. the growth in export volumes of the treated outperform that of the synthetic control suggesting a sluggish supply response to the devaluation.

We also find that total exports measured in USD are slightly lower than the synthetic control in the post-treatment. Furthermore, with a gravity-based SCM, we conduct an analysis of exports to the zone's largest export partner, France which supports our results.

[1] This method of inference is similar to randomization inference. See Section 3.2

The combined results suggest that exporters in the CFA zone initially responded by not greatly decreasing prices measured in USD i.e. are quick to raise prices measured in CFA francs. In other words, the exchange-rate pass-through was close to 1 consistent with the CFA-zone exporters acting effectively as price takers. The supply-volume response, on the contrary, is sluggish and heterogeneous across countries suggesting that the tradeable sectors are slow to respond to relative prices.

Given the recent discussions on depegging the CFA franc from the euro, especially since the Macron-Outtara reform of 2019, these findings are important. Our calculations reveal that the change in exchange rate misalignment between 1993 and 1994 was 34.6 %, whereas recent estimates suggest the CFA franc is overvalued by between around 20 to 30 % (Zafar, 2021). Although, conditions have changed in the past thirty years, the experience of 1994 might suggest that depegging the currency and letting it float freely would possibly result in similar effects on growth in exports.

# 2 Background

## CFA

Created in 1945, the CFA franc is the name of two separate but effectively interchangeable currencies. The West African CFA franc is used in the the West Africa Monetary Union (WAEMU) which in 1994 included Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo. The Central African CFA franc is used in the Central African Economic Monetary Community (CEMAC) which included Cameroon, Central African Republic, Chad, the Republic of Congo, Equatorial Guinea and Gabon in 1994. Guinea-Bissau joined WAEMU in 1997.

The creation of these monetary unions dates back to the decolonisation of French colonial West and Central Africa. As such, the CFA franc is still today backed by the French Treasury with an unlimited convertibility guarantee. In return, the central banks of the CFA zone have to deposit some of their reserve assets at the French Treasury. (Kiendrebeogo and Minea, 2016)

With the French franc appreciating and commodity prices falling in the late 1980s, devaluing the CFA franc was seen as an increasingly attractive policy option. Under the coordination of the International Monetary Fund (IMF), policy makers in France and the CFA zone began planning on realigning the currency. The devaluation was accompanied by structural reforms including debt forgiveness, loans and efforts to broaden the tax base orchestrated by the IMF. (Tsangarides and van den Boogaerde, 2005)

### Hypothesis

Reinhart (1995) note that a currency devaluation will only yield an increase in real exports if a) the nominal devaluation translates into a real devaluation and b) if exports respond to relative prices. She further notes that most devaluations in developing countries translate into real devaluations as inflation is typically well contained. However, the response of trade flows to devaluations is typically of a very minor magnitude resulting in no significant increase in real exports.

CFA zone members largely specialise in the production and exportation of primary commodity goods. This has two implications for the responsiveness of the exports to relative prices. Firstly, the price of these largely undifferentiated commodities are determined by international markets where the CFA countries are price takers with very limited market power. Secondly, the supply of the primary commodities cannot easily be expanded unless large inventories are kept as production is typically constrained in the short run.

Given these theoretical conclusions, we hypothesise that whereas a real increase in the value of exports i.e. measured in a foreign currency is not to be expected, the export sectors are still likely to expand at least measured as a fraction of domestic output.

## 3 Empirical Strategy

The synthetic control method developed by Abadie and Gardeazabal (2003) is a relatively recent addition to the econometrician's tool box. It has been widely used for comparative case studies and for evaluation of isolated large-scale changes in policy such as the effect of Brexit on real output (Born et al., 2017), the effects of trade liberalisation on real output (Billmeier and Nannicini, 2013) and the effect of trade agreements in Latin America on trade flows (Hannan, 2017) to name a few studies.

The main idea is to let a matching algorithm estimate an outcome variable as a weighted linear combination of control units before the treatment. After the treatment has been implemented, these weights are used to create a counterfactual. The causal effect can then be interpreted as the difference between the outcome values of counterfactual to those of the treated unit in the post-treatment period. A main advantage of SCM is that it can account for time-variant confounding effects which is useful in our case as we are interested in the medium-term effects of the devaluation. (Hannan, 2017)

In the following section, we give a methodological outline of the method.

## 3.1 The Synthetic Control Method

Adopting the notation in Abadie (2021) and Abadie et al. (2015), suppose we observe a set of $J + 1$ countries: $j = 1, 2, ..., J + 1$. Assume the first country $j = 1$ is the treated unit. Assume further that the remaining countries $\{2, ...J + 1\}$ are untreated; these countries make up a 'donor pool' in the language of Abadie and Gardeazabal (2003). The untreated countries will be used to construct a synthetic counterfactual.

Further assume that our period of analysis spans $T$ years: $t = 1, 2, ..., T_0, ...T$. The first $T_0$ years occur before the treatment period, and these years form the basis for constructing the matching for the synthetic counterfactual i.e. the matching period. Then the years $t > T_0$ are the post-treatment period, allowing for inference of the causal treatment effect. In our case, $t > T_0$ is $1994, .., T$ as the treatment occurs in 1994.[2]

Let $Y_{it}$ be the outcome variable of interest for each country $i$ at time $t$. We further define $Y_{it}^N$ as the outcome for unit $j$ if it is not treated and $Y_{it}^T$ if it is treated. $Y_{it}^T = Y_{it}$ for $t > T_0$. The aim is to estimate $Y_{1t}^N$ for $t > T_0$, the counterfactual. To do this, a weighted average of the untreated units defines the synthetic control:

$$\hat{Y}_{it}^N = \sum_{j=2}^{J+1} w_j^* Y_{jt}$$

given the set of weights $\mathbf{W} = (w_2, ..., w_{J+1})$ where $w_j \geq 0$ [3] and $\sum_{j=2}^{J+1} w_j = 1$. The

[2] Confusingly, the post-treatment period is typically thought to include the treatment period.

[3] This assumption can be relaxed allowing extrapolation but this practice is avoided in our analysis.

treatment effect in the post-treatment period is thus:

$$\hat{\alpha}_{it} = Y_{1t}^T - \sum_{j=2}^{J+1} w_j^* Y_{jt}$$

For each unit $j$, further assume that we observe a vector $\mathbf{X}_j = X_{1j}, ..., X_{kj}$ of the values of the $m = 1, ..., k$ predictor variables that influence the path of the outcome variable. Let $\mathbf{X}_0$ denote the $(K \times J)$ matrix of these vectors for the untreated units $j = 2, .., J + 1$.

The weighting vector is chosen so that the synthetic control is as close as possible to the treated unit in terms of the vector of predictor variables $\mathbf{X}_j$. In other words, $\mathbf{W}$ is chosen to minimise:

$$||\mathbf{X}_1 - \mathbf{X}_0\mathbf{W}|| = \sum_{m=1}^{k} v_m (X_{1k} - \mathbf{X}_0\mathbf{W})^2$$

subject to the above-mentioned restrictions imposed on $\mathbf{W}$. The term $v_m$ is a weight that assigns a relative importance to each predictor variable $m$. This is known as the inner optimization.

The outer optimization (i.e., finding the optimal vector of weights $\mathbf{V} = v_1, ..., v_k$) can be solved in various ways. For instance, Abadie et al. (2010) choose $\mathbf{V}$ to minimise the mean squared prediction error (MSPE) in the pre-treatment period:

$$MSPE = \frac{1}{T_0} \sum_{t=1}^{T_0} (Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt})^2$$

However, we follow Bohn et al. (2014) and regress the outcome variable $Y_{jt}$ on each predictor variable $m$ in each pre-treatment time period $t \leq T_0$. This gives us a set of regression coefficients $\beta_{t,k} (m = 1, .., k)$. $v_k$ is then chosen as:

$$v_k = \frac{\sum_t \beta_{t,k}^2}{\sum_{m=1,...k} \sum_t \beta_{t,k}^2}$$

This implies that the larger the squared regression coefficient of the predictor variable $m$, the higher its relative importance $v_k$. (Kaul et al., 2015)

## 3.2 Inference

The recent literature has largely focused on various permutation methods to determine if results are robust when conducting SCM analysis. In the following sections, we present three methods of inference which are all employed in the analysis.

### Post to Pre Root Mean Sqaured Prediction Error

To measure robustness, Abadie et al. (2015) suggest analysing the ratio of the root mean squared prediction error (RMSPE) in the post-treatment period to the RMSPE in the pre-treatment period for country $j$:

$$\phi_j = \sqrt{\frac{\frac{1}{T-T_0}\sum_{t=T_0+t}^{T}(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt})^2}{\frac{1}{T_0}\sum_{t=1}^{T_0}(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt})^2}}$$

In this expression, the numerator is the average of the country specific RMSPEs over all post-treatment years; the denominator is the average RMSPE in the pre-treatment period. A large $\phi_j$ for a treated unit $j$ would indicate that a good pre-treatment fit is obtained but that the synthetic control does not provide a good post-treatment fit i.e. we observe a significant effect.

We can also calculate a p-value from this inferential exercise given by:

$$p - value = \frac{1}{J+1}\sum_{j=1}^{J+1} I(r_j - r_1)$$

where $I$ is an indicator function returning zero for negative values and one otherwise. (Quistorff and Galiani, 2017) This is equivalent to calculating the rank of the treated unit in the $\phi$-distribution and dividing by the total number of units.

It should be noted that this test turns out to be quite conservative in our case for two reasons. First, pre-treatment RMSPEs are typically relatively high for the treated countries. Second, the effects of the devaluation are sometimes relatively short-run, and the effects may be small in the latter half of the post-treatment period which gives rise to low country-specific average post-treatment RMSPEs.

### In-space placebo effects

Another way of determining the statistical significance of the effect is by generating a distribution of in-space placebo effects by iteratively estimating the model on each *untreated* unit in the donor pool, assuming the same time-frame, identification and treatment period. If the observed effects for the untreated units are similar to the effects for the treated units, we can conclude that the effects observed for the treated units most likely happened by chance. This test has the advantage of being non-parametric, and thus we do not need to make any assumptions regarding the distribution of the error terms. (Quistorff and Galiani, 2017)

In a similar fashion to the p-value calculated above, we can calculate the p-value of this inferential procedure as[4]:

$$p - value = \frac{\sum_{j \neq i} (I|\hat{\alpha}_{jt}| \geq |\hat{\alpha}_{1t}|}{J} \quad \forall \overleftarrow{s_j} < 2 * \overleftarrow{s_1}$$

where $\hat{\alpha}_{1t}$ is the estimated effect for unit 1 in the year $t$ in the post-treatment period. Indicator function $I$ returns zero for negative values and one otherwise.[5]

We follow Abadie et al. (2010) and do not include countries whose pre-treatment RMSPE, $\overleftarrow{s_j}$, is at least twice as large as that of the treated unit. This is because if a unit has a poor fit in the pre-treatment period and thus a high pre-treatment RMSPE, we would expect most of the effect estimated in the post-treatment period to be driven by chance and not driven by the treatment assignment. For this reason, placebo runs with high pre-treatment RMSPE would not give us additional insights about how rare the post-treatment effect is for a unit with a good pre-treatment fit. Doing this also partly solves the "scale effect problem"; this arises as a mechanical result when movements in the outcome variable differ in absolute magnitude between countries because some countries have higher values of the outcome variable. For instance, a 250 million dollar change in total exports for Mali constitutes a structural shift whereas for a country like India such a change could largely be considered noise. This scale effect can lead to very large p-values for our small treated CFA countries.

In contrast to the post to pre RMSPE p-value calculated in the previous section, this p-value is calculated for each year in the post-treatment year and is not a test

[4] We follow Cavallo et al. (2013) and do not add $\hat{\alpha}_{jt}$ to the comparison distribution

[5] Note that if treatment is randomized, this test is equivalent to the standard randomization inference test. (Abadie et al., 2015)

of the joint effect in the post-treatment period. This allows us to examine how the robustness of treatment effects vary in the post-treatment period, and thus to examine response functions of exports to the devaluation.

#### Chow test

Finally, if we assume the errors are normally distributed, we can run a Chow test to test for a structural break in the treatment period. In a setting with SCM, this method of inference has been used by Bove et al. (2014) when analysing the effects of civil war on real output.

# 4 Data

## 4.1 Donor pool and time horizon

#### Donor pool

We follow Billmeier and Nannicini (2013) and start with the largest sample possible, which results in 146 countries with complete annual data for all outcome and predictor variables between 1982 and 1999. This is our full sample dataset.

However, Abadie (2021) note that it is necessary to limit the donor pool to countries whose outcome and predictor variable values are similar. This is because averaging donors with large dissimilarities to obtain an appropriate match may lead to interpolation biases even if the matching produces a synthetic control that is close to the treated unit in the pre-treatment period. We therefore trim the full sample by excluding countries that were not classified as "developing" in the 1994 IMF World Economic Outlook report (IMF, 1994). We also exclude countries with a real GDP ten times higher than the largest economy in the CFA zone in 1994. Countries with exports as a percentage of GDP above 100 % are also excluded.

Abadie further notes that:

> "It is also important to eliminate from the donor pool any units that may have suffered large idiosyncratic shocks to the outcome of interest during the study

period, if it is judged that such shocks would not have affected the outcome of the unit of interest in the absence of the intervention."(Abadie, 2021, 409)[6]

Four developing countries stand out as having experienced very large structural changes in and around the treatment period. These are Madagascar, Zambia, the Philippines and Haiti which are therefore excluded.[7]

Lastly, we also exclude Comoros, Guinea-Bissau and Equatorial Guinea. The Comorian franc was pegged to the French franc at the time and similarly devalued on January 12th 1994 making it an invalid member of the donor pool. Guinea-Bissau joined the zone in 1997. Finally, Equatorial Guinea, although a member of the CFA Franc zone, is excluded as they saw their economy and export sector change fundamentally following a major discovery of oil in 1996.

Note that "trimming" the full sample in this way will not change the estimated synthetic control significantly. This is because we include predictor variables that forces the SCM algorithm to select similar countries and thus most of the countries excluded from the full sample would have received a zero weight anyways. However, as it is up to the researcher to restrict the donor pool to limit biases, there is a risk of p-hacking. We therefore conduct the same analysis with the full sample and only African countries as our donor pools. We report the mean treatment effect across countries of the four outcome variables in 1994 in Table 8 on page 35. Mean treatment effects calculated with the full sample are largely the same as in the trimmed sample. For the African sample, there is somewhat more variation due to improper pre-treatment fit, arising from a very small donor pool of typically less than 25 countries, but the overall conclusions remain the same. All in all, we conclude that the choice of donor pool is not what is driving our results.

[6]For instance, in a seminal paper by Abadie et al. (2010), studying the effects of California's tobacco control program, several US states are excluded from the donor pool as these also implemented similar policies in the post-treatment period.

[7]In 1993 the Zafy regime in Madagascar implemented a range of pro-market policies increasing exports substantially. In Zambia (the Chiluba government) and in the Philippines (the Ramos government) pursued similar policies around the same period. In 1996, Haiti implemented structural reforms encouraged by France. All of these structural changes result in very large increases in exports and exports as a percentage of GDP around the time of the CFA devaluation invalidating our causal estimation of the effect.

### Time horizon

The supply response to the devaluation both in terms of price setting and production as well as the demand response may be sluggish and take time to adjust. It is therefore of interest to have a sufficiently large post-treatment period to observe effects from the devaluation. However, the longer we extend the post-treatment period, the higher the risk that other policies interfere with the result. One such important interfering change in policy was the fixing of the French franc to the euro in 1999 and the subsequent increase in the real effective exchange rate of the CFA franc. For this reason, we limit our post-treatment analysis to exclude years beyond 1999.

In many papers using SCM, the pre-treatment period is largely determined by the data. As Ferman and Pinto (2016) note that bias decreases with the number of pre-treatment periods, we extend our pre-treatment period the longest possible given our data constraints. We end up with a time-frame ranging between 1982 and 1999 with the treatment period in 1994. [8]

## 4.2 Outcome variables

We measure exports in US dollars with data from Penn World Tables. Abadie (2021) note that if the treated units effected are "extreme" in the level of the outcome variable or the predictor variables, the convex hull condition will not hold and we will not get a desirable fit in the pre-treatment period. This is somewhat of a concern in our case as for many of the treated units values of both outcome and predictor variables are "extreme" i.e. lie at one tail of the distribution of values.

This problem can be solved by various transformations of the outcome variable. One such transformation is to normalize the outcome variable as a fraction of some other relevant variable. For instance, Stricker and Baruffini (2020) use the unemployment rate and not the pool of employed people as their outcome variable and Abadie et al. (2010) use cigarette sales per capita and not total cigarette sales. Given the nature of our data, we proceed by transforming exports as a percentage of GDP. However, we also proceed with conducting an analysis of total exports simply measured in USD.

[8] Due to additional data constraints for the analysis of exports to France, we have to limit our analysis to the period 1982-1998 for that analysis.

Turning away from export values, we are also interested in changes in volumes exported and therefore use an export volume index from World Development Indicators and transform it to 100 = 1982. This method follows on the work of Opatrny (2019) and Aono et al. (2021) who also use an index; it is convenient to set this to 100 for the start of the pre-treatment period.

In addition to using these outcome variabes, we also look at exports with the largest export partner of the CFA zone, France. See Section 4.3 below.

Another important discussion regarding the outcome variable is how to use it as a predictor variable in the specification of the synthetic control. Abadie (2021) note that the inclusion of the outcome variable as a predictor is crucial to obtain a desirable pre-treatment fit but that "the researcher has some flexibility in the way pre-intervention outcomes are incorporated".

A series of seminal papers including Billmeier and Nannicini (2013), Kreif et al. (2016) and Bohn et al. (2014) use the entire set of lagged outcome values in the pre-treatment period as predictor variables producing a low pre-treatment RMSPE. However, Kaul et al. (2015) strongly advises against this approach as they show theoretically that it makes all other predictor variables irrelevant, effectively biasing the estimator. Nonetheless, they do recognize that the inclusion of the outcome variable as a predictor can be important to generate a pre-treatment fit with a low RMSPE. We follow Abadie et al. (2010) and use three values of the outcome variable, $X_j = [Y_{j,T_0-11}, Y_{j,T_0-5}, Y_{j,T_0}]$ i.e. the first and last year in the pre-treatment period as well as a year in the middle (1988).[9]

## 4.3 Predictor variables

We draw on the literature on the determinants of export growth notably Woldemichael and Cerra (2017), Freund and Pierola (2012), Eichengreen and Gupta (2013) and Rodrik (2008) when selecting predictor variables. Given this literature and our data constraints, we use real effective exchange rate (REER) volatility, inflation, investment as a percentage of GDP, GDP per capita and GDP growth rate (current 2017 national prices) as our predictor variables for the analysis of exports measured in USD, the export volume index and exports as a percentage of GDP.

[9] 1987 can also be used but it does not alter the results.

We use headline CPI inflation data from the World Bank[10]. With data from Bruegel, we calculate REER volatility as the as standard deviation over the past 3 years.[11] The remaining variables are from the Penn World Table version 10.0.

### From the gravity equation to the synthetic control method

The SCM has recently been applied to the study of bilateral trade flows by Hannan (2017), Adarov (2018), Gunnella et al. (2021), among others. They all make use of the gravity equation as the theoretical foundation to guide the choice of predictors.

A major benefit of this gravity-based bilateral SCM approach is that since the gravity equation typically has very high predictive power[12] , bias in the post-treatment period will be reduced. Another advantage of conducting a bilateral analysis with a larger trading partner is that it is easier to find an appropriate fit in the pre-treatment period, as the CFA countries generally export relatively large amounts of goods to France. This means that the values of the outcome variable are no longer "extreme" in comparison to the donor pool.

Theoretically, we rely on the following standard gravity equation following Hannan (2017):

$$E_{ijt} = \Lambda_t M_{it} M_{jt} \Theta_{ijt}$$

where $E_{ij}$ is exports in USD from country $i$ to country $j$ in year $t$, $\Lambda_t$ represents common year-specific shocks and $\Theta_{ijt}$ represents dyadic effects i.e. the ease of exporting from country $i$ to destination $j$. $M_{it}$ and $M_{jt}$ are the so called monadic effects where $M_{it}$ represents export-specific supply factors and $M_{jt}$ import-specific demand factors.

We select predictor variables based on this equation and include the geographical distance between the largest cities in each pair, GDP of each country, population of each country, real effective exchange rate volatility of each country and two dummy variables for common primary language and colonial relationship as predictor

[10] Inflation in Emerging and Developing Economies Data Base

[11] This follows Woldemichael and Cerra (2017) but we use 3 years instead of 5 to avoid substantial data losses.

[12] We run a standard OLS regression with the chosen predictor variables and obtain an $R^2$ of 0.79 in the full sample.

variables. The recent literature has also stressed the importance of accounting for multilateral trade resistance (MTR). Due to data constraints for our countries of interests, we use remoteness as a proxy for MTR.[13]

# 5 Results

## 5.1 Exports as a percentage of GDP

Treatment effects are shown in Figure 2 on page 31. At first glance, it seems that we observe structural changes in exports as a percentage in GDP following the devaluation for 8 out of 12 countries (Central African Republic, Chad, the Republic of Congo, Côte D'Ivoire, Gabon, Mali, Senegal and Togo), although in some of these countries the difference between the synthetic control and the treated unit is small. However, for Gabon, the Republic of Congo, Côte D'Ivoire and Togo, the estimated treatment effects are sizeable, typically double digits, measured in percentage points.

In Table 1, we show the difference between the treated and the synthetic control in 1994, 1996 and the mean effect in the post-treatment period. p-values are generated from the in-space placebo tests (same for Tables 3, 4 and 5).

[13] We calculate remoteness as:

$$R_{it} = \sum_j \frac{D_{ij}}{y_{jt} \div y_{wt}}$$

where $D_{ij}$ is the distance between country $i$ and $j$, $y_j t$ the GDP of country $j$ in year $t$ and $y_{wt}$ the world GDP in year $t$.

Table 1: Treatment Effects: Exports as a percentage of GDP

Outcome variable is exports as a percentage of GDP

| | Effect in 1994 | Effect in 1996 | Mean effect ($t > T_0$) |
|---|---|---|---|
| Benin | 0.15 | -3.71 | -3.62 |
| Burkina Faso | 3.63 | 1.05 | 4.47 |
| Cameroon | 4.68 | -4.21 | -6.27 |
| Central African Republic | 6.32 | 4.30 | 6.29 |
| Chad | 0.59 | -1.55 | -0.87 |
| Rep. Congo | 13.30** | 18.8** | 20.80 |
| Côte D'Ivoire | 11.80** | 11.70* | 12.20 |
| Gabon | 11.10** | 13.62* | 13.16 |
| Mali | 4.38 | 3.00 | 4.71 |
| Niger | 2.63 | 4.11 | 3.43 |
| Senegal | 5.61 | 1.90 | 2.87 |
| Togo | 11.33* | 7.09 | 7.16 |
| Mean | 6.29 | 4.68 | 5.03 |

The effects refers to the difference between the treated unit and the synthetic control

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (p-values are not calculated for the mean effects)

In 1994, the estimated effect is positive for all treated countries ranging from 0.15 to 13.30 pp. The mean effect across treated countries is also positive and relatively high in 1996 though the effects seem to have dissipated slightly two years after the devaluation. The mean of means effect is also positive at 5.03 pp.

Examining the graphs in Figure 2, although we do observe what seems to be structural deviations from a long term trend in more than half of the countries analysed, only for four of these do we observe statistically significant effects in any of the post-treatment years when running in-space placebo effects (Gabon, the Republic of Congo, Côte D'Ivoire and Togo). For a visual representation of this inference test see Figure 3 on page 32.

Why do we not observe statistically significant effects in the other four countries? One possible explanation is that the changes in these countries are small in magnitude - though important nevertheless. The small changes, for instance observed in Senegal, are dwarfed by large movements in other untreated countries. This results in the treatment effect not being observed as "extreme" in the sample, leading to the high p-value.

However, when we conduct Chow tests to check for a structural break in the time-series data at the time of the devaluation, we can conclude that indeed a structural break in exports as a percentage of GDP has taken place not in just Gabon, the Republic of Congo, Côte D'Ivoire and Togo but also for the Central African Republic (with an estimated p-value of 0.0102), for Mali (with a p-value of 0.0003) and for Senegal (with a p-value of 0.0074), although for Togo we do not see any significant p-value. See Table 2 below:

Table 2: Post to pre RMSPE and Chow test p-values

The dependent variable is exports as a share of GDP

| | RMSPE p-value | Chow test P-value |
|---|---|---|
| Benin | 0.620 | 0.938 |
| Burkina Faso | 0.793 | 0.702 |
| Cameroon | 0.179 | 0.376 |
| Central African Republic | 0.156 | 0.010** |
| Chad | 0.269 | 0.185 |
| Rep. Congo | 0.036** | 0.020** |
| Côte D'Ivoire | 0.0959* | 0.007*** |
| Gabon | 0.144 | 0.004*** |
| Mali | 0.290 | 0.000*** |
| Niger | 0.473 | 0.465 |
| Senegal | 0.516 | 0.007*** |
| Togo | 0.854 | 0.340 |

The Chow test is calculated by regressing the outcome variable on its lag assuming a structural break in 1994

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As with the in-space placebo generated p-values, the post- to pre-treatment RMSPE p-values also suggest that only a in a few counties (Rep. of Congo and Côte D'Ivoire) do we see significant effects. This is probably in part driven by the relatively poor pre-treatment fit for the treated units; this inflates the generated post- to pre-treatment RMSPE p-values. This poor pre-treatment fit is most likely a result of "extreme values" of some of the predictors of the treated units.

## 5.2 Exports measured in USD

If exporters take advantage of the devaluation by lowering prices, we would only expect an increase in exports measured in USD if the price elasticity of demand for exports from the CFA zone is above unity and thus leads to an increase in volumes.

Any other mechanisms, such as a direct increase in the price of exports measured in USD, are unlikely as input costs measured in USD will most likely increase for exporters following the devaluation.

Our findings in Table 3 suggest a statistically significant contraction in exports for two countries and non-significant effects for most other. Only for Côte D'Ivoire, do we find a positive and statistically significant effect (in 1996). Overall, across the zone, we observe a slight contraction that does not dissipate as time goes by.

Table 3: Treatment Effects: Exports measured in USD

Outcome variable is exports measured in USD millions

| | Effect in 1994 | Effect in 1996 | Mean effect ($t > T_0$) |
|---|---|---|---|
| Benin | -815.99 | -778.31 | -1077.70 |
| Burkina Faso | -323.59 | -410.40 | -437.08 |
| Cameroon | -1353.84** | -1722.69* | -1847.46 |
| Central African Republic | 63.34 | 81.69 | 71.98 |
| Chad | -184.36 | -145.92 | -147.90 |
| Rep. Congo | -208.23 | 66.05 | -44.029 |
| Côte D'Ivoire | 46.54 | 1229.17* | 968.27 |
| Gabon | -387.39 | -671.15 | -980.45 |
| Mali | -254.39*** | -84.84 | -138.34 |
| Niger | -197.57 | -95.47 | -114.56 |
| Senegal | -273.98 | -634.35 | -659.53 |
| Togo | -1.09 | 33.50 | -30.94 |
| Mean | -324.21 | -261.06 | -369.81 |

The effects refers to the difference between the treated unit and the synthetic control
* p < 0:1, ** p < 0:05, *** p < 0:01 (p-values are not calculated for mean effects)

In Table 7, we present the post- to pre-treatment RMSPE and Chow test p-values. For no country, do we observe statistically significant effects with the former method of generating p-values. For the Chow test, we observe statistically significant effects for Cameroon, the Central African Republic and Côte D'Ivoire, somewhat in line with the results in Table 3.

## 5.3 Export volume indices

The effects of the devaluation of the export volume index (100=1982) are shown in Table 4 below.

Table 4: Treatment Effects: Export volume index

Outcome variable is an export volume index (100 = 1982)

| | Effect in 1994 | Effect in 1996 | Mean effect ($t > T_0$) |
|---|---|---|---|
| Benin | NA | NA | NA |
| Burkina Faso | 16.61 | 89.02*** | 113.95 |
| Cameroon | -84.77* | -143.23* | -104.67 |
| Central African Republic | 160.49** | 124.40* | 195.91 |
| Chad | -53.66 | -49.37 | -36.55 |
| Rep. Congo | -78.15* | -113.60* | -75.93 |
| Côte D'Ivoire | 17.50 | 26.62 | 34.61 |
| Gabon | -41.91 | -51.04 | -58.68 |
| Mali | -90.90 | -102.01* | -57.36 |
| Niger | -33.32 | -34.37 | -36.26 |
| Senegal | 2.66 | 5.15 | 22.85 |
| Togo | 138.90*** | 149.60*** | 131.00 |
| Mean | -4.24 | -9.00 | 11.72 |

The effects refers to the difference between the treated unit and the synthetic control
Due to high volatility, an adequate fit with $J > 1$ was not found for Benin.
* p < 0:1, ** p < 0:05, *** p < 0:01 (p-values are not calculated for mean effects)

We observe large heterogeneity across the zone. For Burkina Faso, the Central African Republic and Togo, we observe statistically significant and positive effects. However, for Cameroon, the Republic of Congo and for Mali, we observe statistically significant and negative effects. These countries were experiencing an upward trend in export volumes, but the devaluation seemed to have broken this trend and volumes were more or less constant after 1994, creating a gap between the treated units and the synthetic control in the post-treatment period. Surprisingly, the mean effect in the post-treatment period across the zone is positive, whereas the effects in 1994 and in 1996 are. This may suggest a sluggish response in supply volumes with larger positive effects at the end of the post-treatment period.

The RMSPE and Chow test p-values in Table 7 are generally in line with these results but we observe significant effects for Côte D'Ivoire and Senegal suggesting that for some countries the volume response may have been more immediate.

## 5.4 Exports to France (USD)

Similar to exports measured in USD, we do not observe any positive effects for most countries. Using p-values generated with the in-space placebo test, we observe statistically significant negative effects for two countries, Gabon and Niger. See Table 5 below:

Table 5: Treatment Effects: Exports to France

Outcome variable is exports to France measured in USD millions

| | Effect in 1994 | Effect in 1996 | Mean effect ($t > T_0$) |
|---|---|---|---|
| Benin | -5.70 | -6.91 | -6.13 |
| Burkina Faso | -15.50 | -28.99 | -23.25 |
| Cameroon | -19.45 | -121.52 | -65.88 |
| Central African Republic | -4.68 | -11.99 | -8.71 |
| Chad | -0.59 | -4.25 | -3.57 |
| Rep. Congo | 8.27 | -7.61 | -2.00 |
| Côte D'Ivoire | 12.56 | 75.90 | 111.53 |
| Gabon | -88.57** | -320.28*** | -213.08 |
| Mali | -7.32 | -19.236 | -13.75 |
| Niger | -136.09*** | -229.39** | -136.49 |
| Senegal | -4.59 | -24.47 | -13.86 |
| Togo | -6.54 | -29.56 | -13.73 |
| Mean | -22.349 | -60.69 | -32.41 |

The treatment effects refers to the difference between the treated unit and the synthetic control
* p < 0:1, ** p < 0:05, *** p < 0:01 (p-values are not calculated for mean effects)

It may be that some CFA countries are able to increase exports to other countries following the devaluation and thus move away from the dependence on France as their main export partner. However, as these results are not significantly different from the effects on total exports measured in USD, these results should rather be seen as a confirmation of the results in Section 5.2.

## 5.5 Robustness checks

Although we have used three different approaches to constructing p-values and relied on different sets of predictor variables and outcome variables to make our results robust, the synthetic control method ultimately depends on the assumption that no other major idiosyncratic shocks affecting the outcome variable occurred around the time of the treatment period. The method also relies on the assumption that agents do not anticipate the treatment intervention and that we have no interference. The following sections discuss a set of possible confounding factors.

### Anticipation

If firms and consumers anticipate and respond in advance to the change in policy, the effects estimated with SCM will be biased (Abadie, 2021). In order to rule out such anticipation effects, we examine changes in publications and financial flows around 1994 to determine whether the devaluation was highly anticipated by markets.

We collect data on the number of papers, articles and books published in the 1990s with the word "CFA franc" using Google scholar, newspapers.com and the Bodleian Library SOLO search engine. As shown in Figure 4 on page 33, we observe no significant changes in the number of publications published in the years leading up to the devaluation for any of the sources, suggesting the policy was relatively unexpected.

Additionally, in Figure 5, using data from the World Bank, we note that whereas a large sudden stop can be observed at the time of the Great Recession, no substantial effects on aggregate net FDI flows or on aggregate net foreign assets can be observed in or just prior to 1994. We conclude that capital markets did not react to either the anticipation of the devaluation nor the devaluation itself.

### Interference

Interference i.e. that the untreated countries are affected by the assignment of treatment to treated countries will confound our analysis (Abadie, 2021).[14] In our case, this may be an issue, as a possible underlying mechanisms driving our results could be trade diversion from neighbouring countries.

To test for spillovers of this kind, we run SCM tests for exports measured in USD assuming that all ten neighbouring countries were treated in 1994.[15] We further exclude the CFA countries from the donor pool. Using p-values generated from the in-space placebo test, we observe statistically significant effects for 15 out of 54[16] hypotheses tested. We see positive effects for four of these post-treatment years and negative effects for 11. With 54 hypotheses, we have an FWER of 94 % at a 5 %

[14] This is equivalent to the stable unit treatment values assumption

[15] These are Algeria, The Democratic Republic of Congo, The Gambia, Ghana, Guinea, Guinea-Bissau (excluded as they joined the WAEMU in 1997), Mauritania, Liberia, Libya, Nigeria and Sudan.

[16] Sudan excluded due to improper fit

significance level. This is of course high, but with the presence of 11 statistically significant negative post-treatment years, we cannot rule out the possibility that of trade diversion may slightly interfere with our results. This remains a slight limitation of this paper, as we cannot fully determine whether the results are driven by trade diversion or trade creation.

### Creation of WAEMU and intra-zone trade

The day after the devaluation in 1994, Benin, Burkina Faso, Côte D'Ivoire, Mali, Niger, Senegal and Togo jointly created the West African Economic and Monetary Union (WAEMU). The aim of this customs unions was to reinforce the common market and ensure the free movement of goods and services as well as physical and human capital. Roughly around the same time, the remaining six CFA zone countries making up the Central African Economic and Monetary Community (CEMAC) agreed to a reduction in intra-zone tariffs.

The fact that the creation of WAEMU and the reduction in intra-zone tariffs in CEMAC coincide with the devaluation may potentially pose a threat to our identification. However, it should be noted that African intra-continental trade was very low - and still is low in sub-Saharan Africa. For instance, in the period 1990-2003, the ratio of intra-zone exports to total exports was 8.3 % in WAEMU. Although intra-zone exports grew by 12.4 % in WAEMU between 1994 and 1998 this increase is tiny compared to the growth in inter-continental exports. (Tsangarides and van den Boogaerde, 2005) Furthermore, Tsangarides and van den Boogaerde (2005) note that integration has been slow in the zone and substantial frictions persisted within the unions in the 1990s. We thus conclude that these policies do not pose a major threat to our identification.

### Structural reforms

The 1994 CFA franc devaluation was, like most other devaluations, accompanied by structural reforms. The IMF and the World Bank encouraged the CFA zone members to pursue policies such as prudent fiscal and monetary policies, trade liberalization, tax reforms and liberalization of state-owned enterprises. Debt relief through the Enhanced Structural Structural Adjustment Facility (ESAF) was also implemented. (Tsangarides and van den Boogaerde, 2005)

Although, these reforms typically take time to influence the supply response of the exporters, it may be difficult to distinguish between the pure effect of the devaluation and the effect of the reforms on the supply response as the supply response to the devaluation may also be sluggish. It should however be noted that the mid 1980s were also characterised by structural adjustment programs in the CFA zone without significant increases in the exports growth (Constant, 2012). Constant (2012) and Bouvet et al. (2022) further suggest that the attempts for structural reform largely failed resulting in limited output growth following the devaluation.

Despite this, the inability to differentiate the pure effect of the devaluation from effects from other policies remains a feature of this paper. Hence, the 1994 devaluation of the CFA franc should be seen as rather unique and the results should be applied with caution to other episodes of devaluation.

### Foreign tariffs

A potential confounding factor in our analysis is whether tariffs changed in or around 1994. If a substantial drop is observed in foreign tariffs around the time of the devaluation it would be hard to disentangle the effects from the devaluation from those of the tariff reduction. Although, we do observe a substantial drop in foreign tariffs around this period, this is not unique to the CFA zone. We use data from CEPII to calculate the mean foreign tariff for the CFA zone and the rest of the world. In Figure 6, mean foreign tariffs imposed on the CFA zone and on the rest of the world largely move in tandem and although a gap emerges around 1994, this difference is tiny - roughly equal to 1 percentage point.

### Commodity prices

As the CFA zone countries were primarily exporters of primary commodities in 1994, an obvious determinant of the value of exports is global commodity prices. A simultaneous increase in the price of these may be a potential confounder. In Figure 7 on page 35, we plot the price indices (1990 = 100) for the six most important export commodities in the zone. For most indices, there is no major change around the time of the devaluation except for the price of coffee which increased by a factor of three in a period of a couple of months after the devaluation.

Although, this may somewhat confound our results, the CFA zone countries are not specialized in the production of coffee. In 1995, coffee beans made up 8.3 % of the exports for Côte D'Ivoire, 7.9 % for Togo and lower for the other member countries. In comparison, cotton made up 21.2 % of Togo's export in 1995 and cocoa beans made up 26.1 % of Côte D'Ivoire's exports in 1995. (OEC, 2022)

# 6 Discussion

As noted in Section 2, two criteria are needed for the devaluation to give rise to an increase in real exports. The first of these, that the nominal devaluation translates into a real devaluation, was met in the case of the CFA franc devaluation. The average real effective exchange rate dropped by 44.6 % in January 1994 and appreciated slightly the following months but has to date not recovered.[17] The second criterion, that exports respond to relative prices, is further discussed in the next section.

## 6.1 Supply side responses

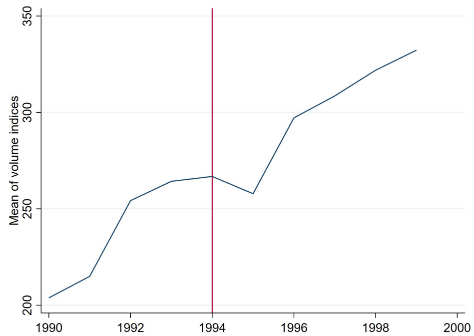
Our results suggest an increase in exports as a percentage of GDP, a slight contraction in exports measured in USD and in exports to France. For trade volumes, the responses were heterogeneous and possibly slow to emerge, suggesting a sluggish volume response.

To further analyse the supply responses that give rise to these results, we create a value index (1982=100) measured in CFA francs for each treated country which we plot next to the mean of the export volume index around the time of the devaluation.[18] The mean of these export value indices goes from 114.9 to 208.5 between 1993 and 1994 which constitutes a 81.7 % increase in the value of exports from the CFA franc zone. As the mean of the volume indices is more or less constant between 1993 and 1994, the increase is almost entirely driven by increases in the prices (measured in CFA francs) set by the exporters in the region. More precisely, as exports are typically invoiced in USD or another international currency, exporters do not decrease prices measured in USD by much following the devaluation suggesting a high exchange-rate pass through. See Figure 1 below:

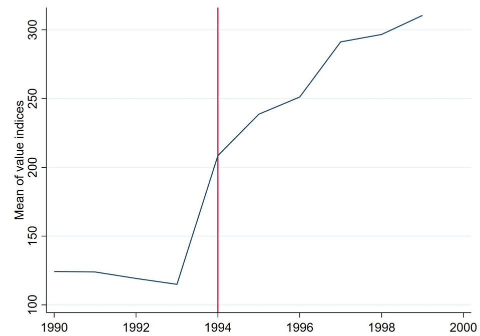
[17] Author's calculations using data from Bruegel. This conclusion is also reached in Reinhart (1995)

[18] Unfortunately, due to very high pre-treatment RMSPEs when using exports measured in CFA francs as our outcome variable, we are not able to conduct SCM analysis of this variable.

Figure 1: Supply-side responses




Volume response




Price response

Data: Penn World Tables and World Development Indicators. Author's own calculations.

The fact that the mean of the volume indices does not increase substantially until 1996 suggests a sluggish volume supply response with trade flows being slow to respond to relative prices.

One possible explanation is that exporters are constrained in their capacity to increase production. Following the devaluation, inflation soared across the zone averaging 28.2 % in 1994 and 12.4 % in 1995 to gradually come down to 5.0 and 4.1 % in 1996 and 1997 respectively.[19] As input prices sky-rocketed, firms' production choices may have been disrupted, making it challenging to increase capacity.

It is also important to note that the CFA economies specialise in primary commodities (OEC, 2022). It may be difficult to increase the supply of exports if the base of one's export sector is in agricultural goods, petroleum products or minerals, rather than manufacturing goods unless large inventories are kept. (Bhagwat and Onitsuka, 1974)

These supply-side responses are consistent with our findings both with regards to exports as a percentage of GDP and with regards to exports measured in USD. As the increase in prices of exports measured in CFA francs far outweighs the inflation levels, the export sector expands as a percentage of GDP. With a sluggish volume response disrupted by the high inflation but with prices increasing by more than 80 % following the devaluation, exports measured in USD decrease slightly, but not by much compared to the synthetic control. Given the fact that exporters from these

[19] Author's own calculations. Source: World Bank

countries are most likely price-takers with very limited market power in international markets, the high exchange-rate pass through observed is no surprise.

It is important to note that a negative effect estimated with the SCM does not necessarily imply that we observe a decrease in export volumes or exports measured in USD after the devaluation. It only implies that if the devaluation had not happened, these variables would have stood higher in the post-treatment period than what we actually observed in the data. In fact, for all four outcome variables except exports to France, the average level across all CFA countries were higher in the three years following the devaluation than the three years before. See Table 6 below.

Table 6: Post to Pre Trends

| | Mean (1991-1993) | Mean (1994-1996) |
|---|---|---|
| Exports as a share of GDP | 0.221 | 0.281 |
| Export volume index | 244.500 | 273.933 |
| Exports measured in USD | 1176.528 | 1238.209 |
| Exports to France (USD) | 189.507 | 164.505 |

Note: In this table, we present the mean of the mean values of key variables across all CFA countries in the three years before and after the devaluation.

For exports measured in USD, the three-year mean in the post-treatment period is mostly driven by the value in 1996 where we see a rebound in volumes together with a moderate increase in prices measured in CFA francs leading to higher exports measured in USD.

## 6.2 Exchange rate misalignment and possible depegging

The devaluation was an attempt to correct for severe and persistent exchange rate misalignment and to boost competitiveness and therefore exports. In part it succeeded in decreasing the real effective exchange rate and to increase exports as a percentage of GDP despite a slight contraction in exports measured in US dollars compared to the synthetic counterfactual case as this paper has confirmed. However, the CFA franc was still pegged to the French franc and from 2002 to the euro. The following decades saw an increase in the real effective exchange rate replicating the misalignment path of the euro area again creating a misalignment which may have hurt the zone's export prospects.

Zafar (2021) using a CGE model in the spirit of Devarajan et al. (1993) estimated the CFA franc to be more than 30 % misaligned in CEMAC and more than 20 % in WAEMU in 2020 in line with recent IMF estimates. Using data from the CEPII database EQCHANGE, we calculate the exchange rate to be on average 13.2 % overvalued in 1993 and 21.4 % undervalued in 1994 suggesting a 34.6 % change in exchange rate misalignment. [20]

Hence, if the CFA zone countries were to depeg from the euro today and let the value of the CFA franc be fully determined by market forces, the change in misalignment would be of a similar magnitude to the devaluation in 1994. Among policy makers in the zone, the interest in depegging the CFA franc from the euro has grown considerably the past decade. The Macron-Outtara reform of 2019 proposed the replacement of the CFA franc by the "eco" whilst remaining pegged to the euro. This was a big step to depegging and achieving monetary and fiscal independence.

If similar structural reforms are implemented curbing domestic inflation, the effects of the possible depeg may have similar effects to that of the devaluation in 1994 on exports. This however assumes that the demand and supply responses are of a similar magnitude today as in 1994. It is likely that the supply response in 1994 is a lower bound of the possible supply response if the CFA zone were to depeg today. The member countries have diversified their exports since 1994 and reduced their share of production in primary commodities. However, devaluation under a fixed exchange rate regime is different from depegging. A free floating currency implies greater uncertainty and higher volatility which may affect exports and investment negatively compared to a fixed currency. (Arize et al., 2008)

All in all, further research in this field is needed to better model the consequences should the CFA zone depeg from the euro. Structurally modelling this possible scenario taking into account general equilibrium effects is of importance.

[20] We use a broad index of 186 trading partners, 5-year time-varying windows and the REER based approach. Source: Couharde et al. (2018)

# 7 Concluding remarks

Exchange rate misalignment is a persistent feature of developing countries with fixed currency regimes. The 1994 devaluation of the CFA franc was an attempt to correct this misalignment and boost competitiveness. By applying the synthetic control method, we find that following the devaluation the export sector expanded as a percentage of GDP, on average standing 5.03 percentage points higher than the synthetic counterfactual in the six years after the devaluation. However, this does not imply a larger amount of exports measured in US dollars. In fact, we observe a slight contraction compared to the synthetic control in total exports from the zone and exports to the largest trading partner, France. Analysing the supply-responses both in terms price-setting and volume responses suggests that a sluggish volume response together with an exchange rate pass through of around 0.8 in 1994 may be reasons for these results. Constraints to increasing production including credit-constraints and high input costs are likely to have resulted in this sluggish volume response.

We argue that the change in exchange rate misalignment caused by the devaluation is of a similar magnitude to a scenario where the CFA franc is depegged from the euro, a case which is getting increasingly likely. Hence, these findings are important lessons for policy makers in the CFA franc zone as we are likely to see the CFA franc buried and a new monetary regime to take place in the next few years.

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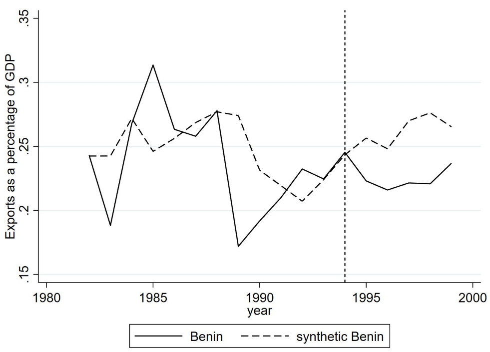
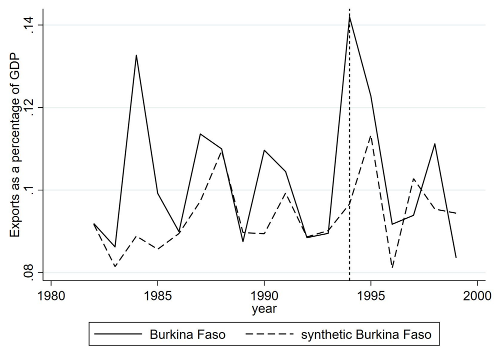
# 8 Additional Tables and Figures

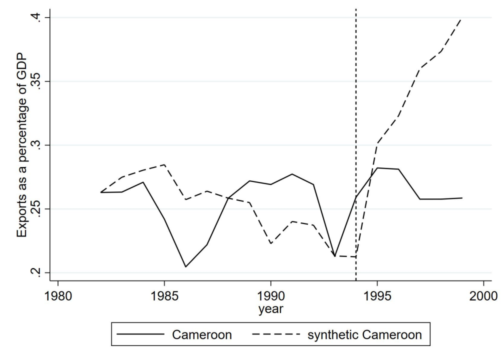
Figure 2: Treatment effects for exports as a percentage of GDP



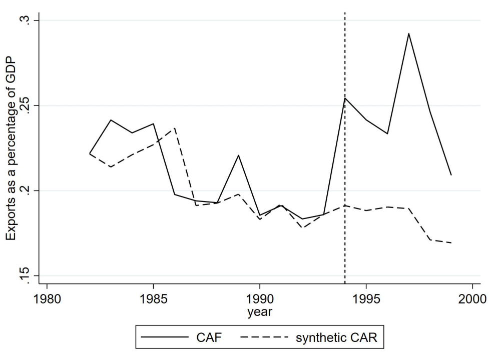

(a) Benin



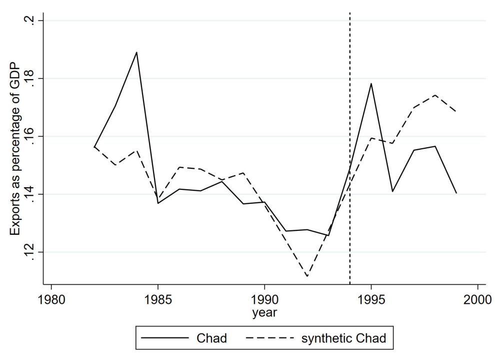

(b) Burkina Faso



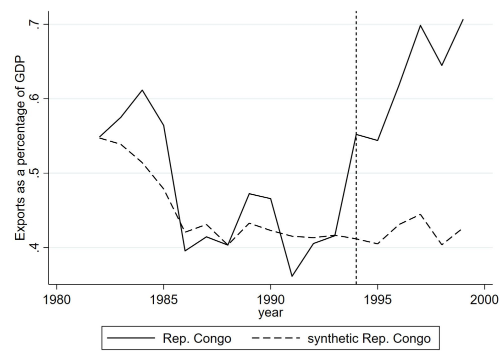

(c) Cameroon



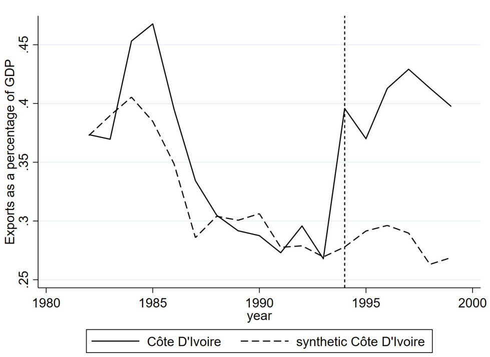

(d) CAR



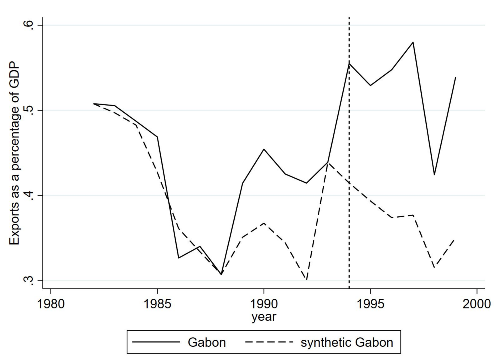

(e) Chad



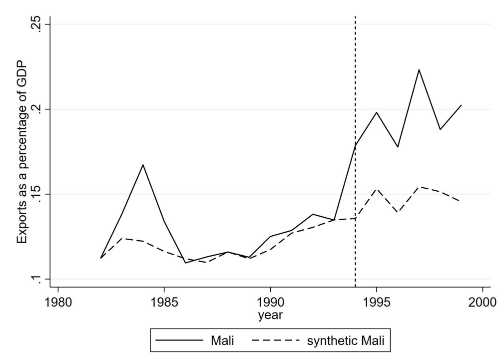

(f) Rep. of Congo



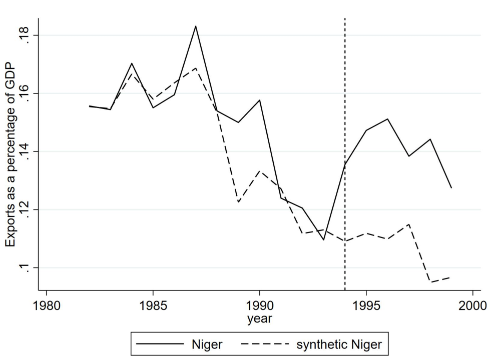

(g) Côte D'Ivoire



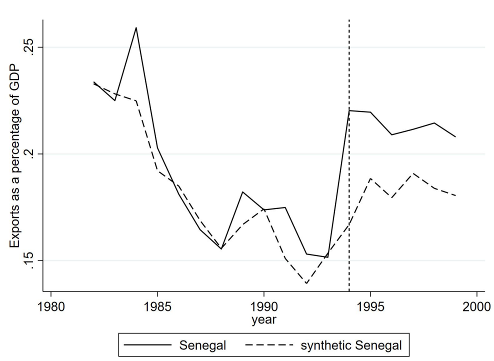

(h) Gabon



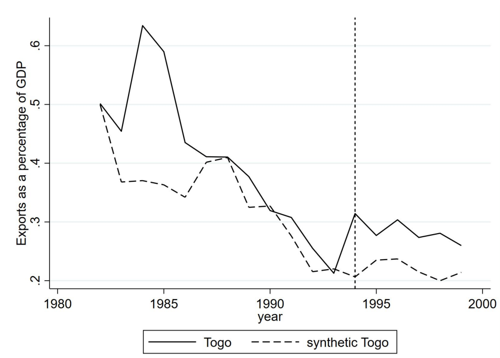

(i) Mali




(j) Niger



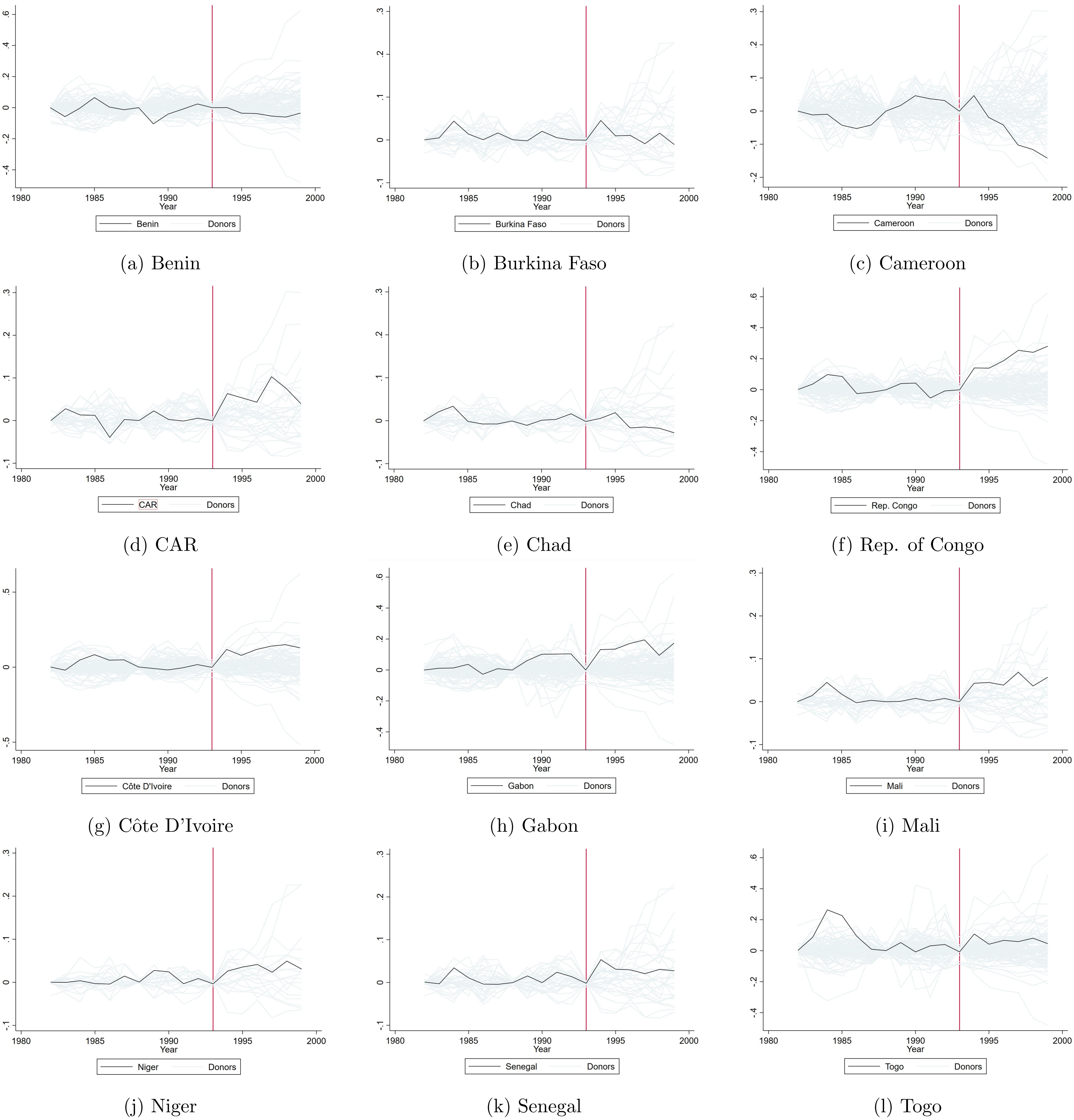

(k) Senegal




(l) Togo

Note: The distance between the treated unit and synthetic control in the post-treatment period is interpreted as the causal effect.

Figure 3: In-space placebo tests for exports as a percentage of GDP




(a) Benin (b) Burkina Faso (c) Cameroon

(d) CAR (e) Chad (f) Rep. of Congo

(g) Côte D'Ivoire (h) Gabon (i) Mali

(j) Niger (k) Senegal (l) Togo

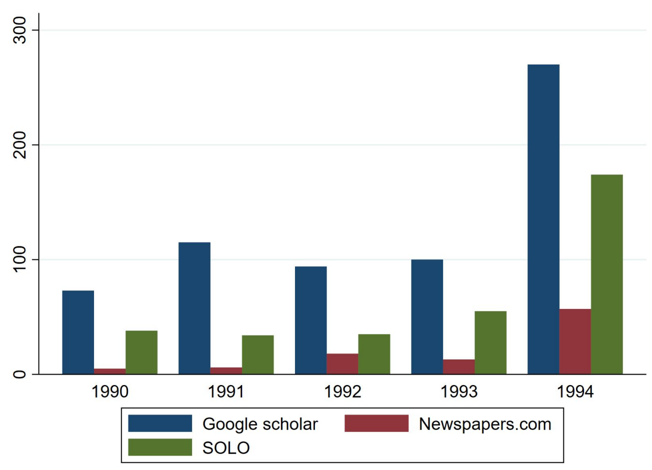
Note: Red line is at the end of $T_0$ i.e. in 1993.

# Table 7: Chow test and post to pre RMSPE p-values

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| | $\phi$ | Chow | $\phi$ | Chow | $\phi$ | Chow |
| Benin | 0.926 | 0.493 | NA | NA | 0.766 | 0.278 |
| Burkina Faso | 0.103 | 0.247 | 0.0556* | 0.0212** | 0.403 | 0.559 |
| Cameroon | 0.212 | 0.0504* | 0.553 | 0.969 | 0.865 | 0.312 |
| Central African Republic | 0.568 | 0.0298** | 0.130 | 0.00006*** | 0.662 | 0.162 |
| Chad | 0.295 | 0.130 | 0.889 | 0.0917* | 0.662 | 0.784 |
| Republic of Congo | 0.867 | 0.295 | 0.188 | 0.604 | 0.623 | 0.656 |
| Côte D'Ivoire | 0.663 | 0.0027*** | 0.0625* | 0.0210** | 0.716 | 0.0005*** |
| Gabon | 0.183 | 0.157 | 0.609 | 0.107 | 0.592 | 0.380 |
| Mali | 0.133 | 0.341 | 0.818 | 0.803 | 0.364 | 0.00886** |
| Niger | 0.663 | 0.273 | 0.400 | 0.182 | 0.636 | 0.104 |
| Senegal | 0.138 | 0.424 | 0.812 | 0.0058*** | 0.935 | 0.724 |
| Togo | 0.957 | 0.910 | 0.0590* | 0.000*** | 0.610 | 0.278 |

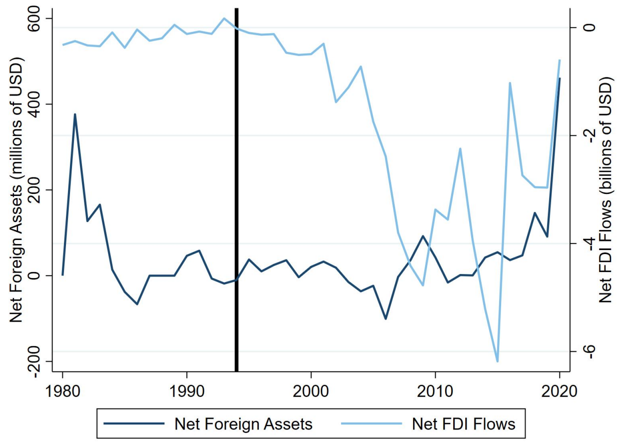
The first two columns (1), represents p-values for exports measured in USD, the following two (2) for export volume index and the last two (3) for exports to France. $\phi$ is the post to pre-RMSPE p-value. An adequate fit with $J > 1$ was not found for Benin for the analysis of the volume index.
The Chow test p-value is computed by regressing the outcome variable on its lag and testing for a structural break at the time of the treatment.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

# Figure 4: New publications including the word 'CFA franc'



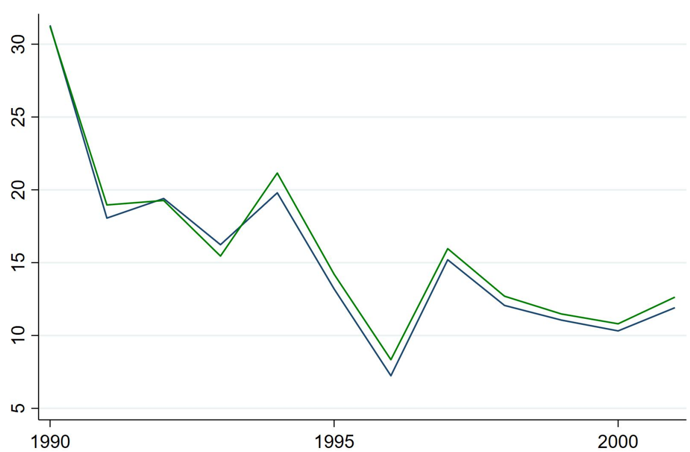

Data: Google scholar, Newspapers.com, SOLO Bodleian Libraries

Figure 5: Financial flows



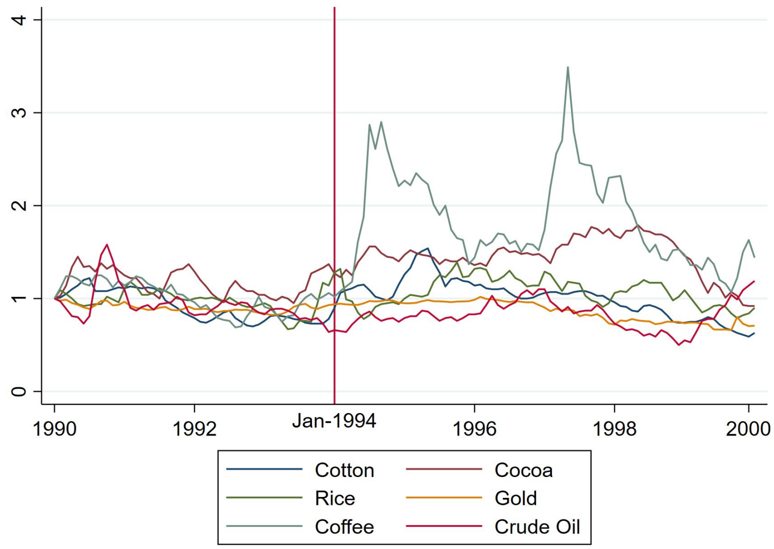

Data: World Development Indicators, World Bank

Figure 6: Foreign tariffs




Note: In this figure, we plot the mean foreign tariffs imposed on the CFA zone in blue and mean foreign tariffs imposed on non-CFA countries in green. Data: CEPII and author's own calculations

Figure 7: Commodity prices indices (1990 = 100)




Data: St Louis Federal Reserve Bank

Table 8: Comparison of 'trimmed' sample to the full and African samples

Outcome variable is the mean effect across countries in 1994

| | % of GDP | USD | Volume | to France |
|---|---|---|---|---|
| Trimmed sample | 6.29 | -324.21 | -4.24 | -22.35 |
| Full sample | 6.01 | -189.53 | -0.74 | -28.05 |
| African sample | 4.66 | -163.25 | -17.82 | -36.64 |

Note: p-values are not calculated for these mean effects