Research Paper

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Inflation targeting and public debt reduction for emerging countries: a treatment effect approach

By Mahmoud Arbouch

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This paper aims to investigate the impact of an inflation targeting framework adoption by the central bank, on the reduction of public debt ratios in emerging countries, through the potential discipline-enhancing effect of inflation targeting on the conduct of fiscal policy in general. The impact evaluation method used is the Propensity Score Matching (PSM), which allows the evaluation of the treatment effect of inflation targeting on fiscal discipline, in terms of public debt reduction, in emerging countries that have adopted this monetary policy framework. The analysis sample includes 40 emerging countries, of which 19 adopted inflations targeting at least one year during the period 1990-2019, and 21 countries never did. The empirical results show that, on average, the adoption of inflation targeting allowed reductions of the ratio of public debt, in the range of 5.9 to 7.5 percent of GDP, for the considered emerging countries.

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Policy Center for the New South

Rabat Campus of Mohammed VI Polytechnic University - Rocade Rabat Salé
11103 Morocco.
Email : contact@policycenter.ma
Phone : +212 5 37 54 04 04 / Fax : +212 5 37 71 31 54
Website : www.policycenter.ma

RESEARCH PAPER

Inflation targeting and public debt reduction for emerging countries: a treatment effect approach*

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1. INTRODUCTION

In December 1989, New Zealand adopted a new approach to monetary policy, based on achieving an explicit inflation target, making it the first country to adopt this monetary policy framework. Today, 27 countries, developed, emerging and developing, are following New Zealand's lead in adopting inflation targeting as the anchor for their monetary policy. The Czech Republic, Hungary, and Poland also adopted inflation targeting as they transitioned from planning-based to market-oriented economies. After the 1997 crisis, several emerging countries also moved to inflation targeting, which forced them to abandon the fixed exchange rate regime[1].

Any monetary policy framework generally relies on a nominal anchor as the variable used to ensure price stability. One of the most common pegging policies used by developing countries is to link the domestic currency to a foreign currency or a basket of foreign currencies.[2] While this approach has advantages in terms of domestic currency stability, it does not allow for automatic adjustments to external shocks, such as a negative terms of trade shock (the value of a country's exports relative to its imports), for example. Moreover, such a choice of peg, which amounts to adopting a fixed exchange rate regime, forces the country in question to exercise control over the movement of capital, to guarantee the autonomy of its monetary policy (Mundell, 1963). To address the limitations of the fixed exchange rate regime in adjusting to external shocks, several emerging economies have adopted more flexible exchange rate regimes, which has led them to find a new nominal anchor for their monetary policies.

Thus, many central banks began to target money supply growth to curb inflation. This approach is quite effective if the central bank has the ability to effectively control the money supply in circulation (which requires, among other things, a strong transmission of central bank decisions from the policy rate to the rest of the interest rates, as well as the absence of a black market in foreign exchange), and if money growth is linked to inflation in a fairly stable way over time.. However, monetary targeting has had only limited success because the demand for money is often unstable, due to innovations in financial markets. As a result, many countries with flexible exchange rate regimes have begun to target inflation more directly, based on the transmission mechanisms between central bank policy instruments (such as interest rates) and inflation.

Presented as an alternative to money supply growth targeting, inflation targeting is a monetary policy framework in which the central bank declares an explicit inflation target, and commits to achieving it over the medium term, as the ultimate priority for the conduct of its monetary policy. The inflation targeting framework is characterized by four main aspects (Mishkin, 2004) and (Heenan, Peter and Roger, 2006):

- The main task of a central bank is to ensure price stability, which is the primary objective of monetary policy. To this end, the bank has broad operational autonomy.
- A quantitative inflation target is set, and the central bank is fully committed to achieving it.
- The central bank reports on the achievement of the stated objective in accordance with the obligations of transparency of the strategy pursued and its execution.
- The monetary authorities constantly make a forward-looking assessment of inflation, drawing on the arsenal of information at their disposal.

1. For some emerging countries, the choice to abandon the fixed exchange rate regime was the result of the collapse of the latter.

2. The choice of foreign currencies that make up the basket of quotations for a national currency is based on the structure of international trade of the country in question.

In practice, inflation targeting consists of the central bank comparing its medium-term inflation forecasts with its target rate (the rate deemed appropriate for the economy in question by the monetary authorities). Thus, the difference between the inflation forecast and its target determines the reaction of the central bank via its main monetary policy instruments.[3] In this sense, some countries have chosen inflation targets in symmetric intervals around a midpoint, while others have identified a point rate of inflation (Table 1). One of the major advantages of inflation targeting is that it makes it possible to reconcile the fact of having an explicit monetary policy rule with the discretionary character necessary for its effective implementation (Lucas, 1972).

The adoption of inflation targeting by emerging countries has resulted in two major developments. First, transparency and communication have become the foundation of central banks' operational independence, and the main means used to anchor inflation expectations. Second, inflation targeting by central banks has generally taken the form of flexible targeting (Svensson, 1997). Thus, instead of trying to reach the target all the time, the central bank focuses on the medium term, which is usually two to three years. This allows the central bank to pursue other short-term objectives, such as smoothing output or supporting employment, for example. Thus, inflation targeting allows monetary policy to respond to economic shocks in a rather discretionary way.

Regarding the impact of inflation targeting on macroeconomic performance, it is often difficult to make a clear distinction between the specific impact of this policy framework and the impact of the broader economic reform package. However, the empirical evidence on inflation targeting argues for the effectiveness of this framework in controlling inflation and anchoring inflationary expectations. Moreover, these positive results are generally not accompanied by negative effects on growth or interest rate volatility.

Moreover, in some countries, notably in Latin America, the adoption of inflation targeting has been accompanied by an improvement in the conduct of fiscal policy. Indeed, the adoption of inflation targeting would promote the autonomy of the central bank and would discourage the financing of the public deficit using the monetary base. As a result, the government is constrained to be more rigorous in managing public spending, which would result in the control or even reduction of public debt ratios.

This work aims at assessing the impact of an adoption of inflation targeting by central banks in emerging countries on the reduction of public debt (we consider central government debt hereafter) using a treatment effect impact evaluation approach, namely the Propensity Score Matching (PSM) method. The rest of the paper is organized as follows: the second section presents a literature review. The data used and the methodology adopted are presented in section 3. While section 4 presents the results of the analysis. Finally, section 5 concludes by outlining the main policy implications considering the empirical results.

2. LITERATURE REVIEW

Many theoretical and empirical studies have examined the impact of inflation targeting on macroeconomic performance through key variables, such as the inflation rate, the output level, and different interest rates, among these studies there are Mishkin (1997); Svensson (1997); Bernanke et al. (1999); Goncalves and Salles (2008); Lin and Ye (2009). In considering the potential role of inflation targeting in improving macroeconomic conditions, these studies emphasize that the success of this approach depends heavily on certain institutional dimensions, namely the central

3. The main conventional instruments of the central bank are the policy rate, the reserve requirement, and the open market operations.

bank independence and transparency. Besides, the structural characteristics of the economy, as well as technical dimensions related to the implementation of this monetary policy framework, can also influence the effectiveness of inflation targeting.

In addition, there is an economic literature that has analyzed the links between monetary and fiscal policy, and in particular the link between inflation and public debt or deficit. In this vein, Sargent and Wallace (1981) argue that a very lax fiscal policy could force monetary policy to deviate from its main task of ensuring price stability, in favor of debt monetization. This result was confirmed by Leeper and Walker (2011), and Villieu (2011). On the other hand, Amato and Gerlach (2002), Fischer et al. (2002), Vu (2004), Catao and Terrones (2005), and Wimanda, Turner, and Hall (2011) found that in several developing countries, high inflation rates are often accompanied by large government deficits, usually financed by the monetary base.

Alesina and Tabellini (1987), Obstfeld (1991), Jensen (1994), Van der Ploeg (1995), Van Arle et al. (1995), and Minea et al. (2012) agree that if the central bank decides to give significant weight in its reaction function[4] to the objective of price stability, it will be forced to put more effort into tax mobilization to increase tax revenues while rationalizing the management of public expenditures. This would systematically lead to a control of the public debt ratios. And given that the adoption of inflation targeting requires economic and institutional reforms related to the independence and transparency of the central bank in its monetary policy decisions, the implementation of this framework could have a discipline-enhancing effect on the conduct of fiscal policy, which will be deprived of central bank financing and will consequently opt for fiscal mobilization and a reduction in the public deficit.

Empirical work by Miles (2007), Tapsoba (2010), and Abo-Zaid and Tüzemen (2011) investigated the effectiveness of the inflation targeting framework on strengthening fiscal discipline in developing countries and came to conclusions that confirm this positive impact. Huang and Wei (2006), Minea and Villieu (2008), and Minea, Tapsoba, and Villieu (2012) have also showed that inflation targeting encourages an improvement in the institutional quality of monetary policy, and that this monetary framework encourages governments to improve the efficiency of the tax collection system and to rationalize public spending. Lucotte (2012) conducted a similar analysis of 59 countries (19 of which are inflation targeters, and 40 non-targeters), over a period from 1980 to 2009, using the propensity score matching method, to conclude that inflation targeting had a significant effect on fiscal discipline and tax revenue mobilization effort. Kadria and Ben Aissa (2014) investigate whether the implementation of the inflation targeting framework leads to a reduction in the fiscal deficit for emerging countries, also using the propensity score matching method, for a sample of 41 countries (20 of which are inflation targeters, versus 21 non-targeters) over the period 1990-2010, and concluded that, on average, the adoption of targeting has had a significant effect on the fiscal deficit.They conclude that, on average, the adoption of targeting had a significant effect on reducing the budget deficit for these countries. More recently, Nana and Baycan (2022) used the same approach to examine the impact of inflation targeting on domestic and external public debt for a group of advanced and developing economies. Their results affirm that the adoption of this monetary policy framework significantly reduces internal and external public debt for the group of countries considered.

On the basis of this review of the theoretical and empirical literature, which highlights the disciplining effect of inflation targeting on fiscal policy, we can affirm that the governments of emerging countries could achieve an ex-post reduction in their public deficits, and consequently control their public debt, after adopting this monetary policy framework.

4. The reaction function describes the strategy followed by the central bank in conducting monetary policy. It represents the solution of a minimization problem of a loss function with respect to the main monetary policy instruments.

Thus, the contribution of this paper to the above-mentioned literature would be to assess the impact of the adoption of inflation targeting on the fiscal discipline of developing countries, in terms of the reduction of their public debt levels, using a micro-econometric impact evaluation approach, which is the Propensity Score Matching (PSM).

3. DATA AND METHODOLOGY

3.1. Data

The study's sample includes 40 emerging countries and spans from 1990 to 2019. Of these 40 countries, 19 have already adopted inflation targeting for at least one year during the study period (the treatment group), compared to 21 that have never adopted this monetary policy framework (the control group). The treatment group is composed of all emerging market countries that adopted the targeting framework during the period mentioned above, while the control group was selected on the basis of the criteria defined by Lin and Ye (2009), namely the level of economic development and the size of the country in terms of population.[5] Table 1 presents the sample of countries selected, the respective years of adoption of inflation targeting, and the targets adopted for inflation-targeting countries.

Table 1

Sample of countries considered, with the year of adoption of inflation targeting and inflation target rate for inflation targeting countries

Inflation targeting countries (Treatment group)	**Year of adoption of inflation targeting**	**Inflation target**	**Non-inflation targeting countries (Control group)**
Brazil	1999	4.5 +/- 2	Angola
Chile	2000	3 +/- 1	Bulgaria
Colombia	1999	2 - 4	Bolivia
Czech Republic	1997	3 +/- 1	Dominican Republic
Ghana	2007	8.5 +/- 2	Algeria
Guatemala	2005	5 +/- 1	Ecuador
Hungary	2001	3 +/- 1	India
Indonesia	2005	5 +/- 1	Jordan
Israel	1997	2 +/- 1	Kenya

5. Given these two criteria, the control group includes only countries with a higher GDP per capita than the poorest country in the treatment group and a higher population than the least populated country in the treatment group.

South Korea	1998	3 +/- 1	Morocco
Mexico	2001	3 +/- 1	Mali
Peru	2002	2 +/- 1	Malaysia
Philippines	2002	4 +/- 1	Nigeria
Poland	1999	2.5 +/- 1	Pakistan
Romania	2005	3 +/- 1	Paraguay
Russia	2015	4	Senegal
Thailand	2000	0.5 – 3	Singapore
Turkey	2006	5.5 +/- 2	El Salvador
South Africa	2000	3 - 6	Serbia
			Tunisia
			Uruguay

Source: IMF Annual Report on Exchange Arrangements and Restrictions (AREAER) (2020).

An initial comparison of inflation levels for the countries in the treatment group (the inflation targeters) before and after the adoption of inflation targeting indicates that, on average, inflation fell from 138% before the adoption of targeting to 5% after its adoption (Figure 1). However, this drastic decline in inflation could by no means be entirely due to the adoption of the targeting framework. Indeed, several countries in the treatment group were already experiencing remarkably high inflation rates in the pre-targeting period, mainly in the 1990s and early 2000s. For example, inflation during this period averaged 1095% in Brazil, 956.8% in Peru, 131.6% in Poland, 98.6% in Romania, and 82% in Russia (Table 2). Thus, the sharp decline in inflation on average between the pre-targeting and post-targeting periods would be more related to the evolution of macroeconomic discipline in these countries than to the adoption of the inflation targeting framework.

Regarding the evolution of public debt for the countries in the treatment group, between the pre- and post-targeting periods, it fell from an average of 38% in the pre-targeting period to 37% in the post-targeting period, thus marking a quasi-stagnation (Figure 2). This small change in public debt between the two periods cannot provide information on the impact of inflation targeting on public debt reduction, because assessing the impact of targeting in this way completely ignores what the public debt ratios of the targeting countries would have been if they did not adopt the inflation targeting policy. This represents a counterfactual situation that we will try to identify through the application of the propensity score matching method.

Figure 1

Average inflation rate before and after the adoption of inflation targeting for the treatment group

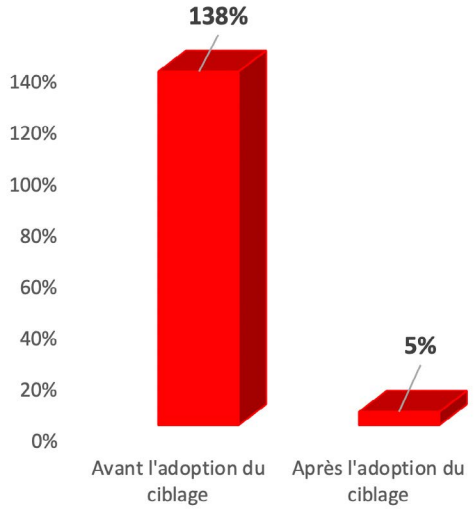
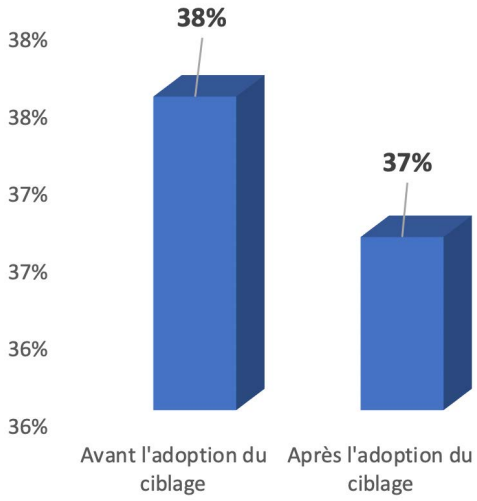


Figure 2

Average public debt before and after the adoption of inflation targeting for the treatment group



Source: Author's calculation

Table 2

Average public debt and inflation for treatment group, 1990-2019, before and after inflation targeting (IT)

	Average inflation rate (%)		**Public debt (% of GDP)**	
	Before IT	After IT	Before IT	After IT
Brazil	1095.0	6,3	55.1	66.8
Chile	14.0	3,3	29.0	13.6
Colombia	24.2	6,0	13.1	32.2
Czech Republic	11.9	4,6	11.7	25.8
Ghana	26.4	13,1	44.5	43.0
Guatemala	12.4	5,3	24.3	23.8
Hungary	21.8	4,4	70.9	67.0
Indonesia	12.4	6,3	48.2	28.9
Israel	14.5	2,6	111.2	74.2
South Korea	5.7	2,5	11.2	27.8
Mexico	20.4	4,6	25.5	27.2
Peru	956.8	2,7	N.A	25.7

Philippines	9.0	3,9	51.7	55.9
Poland	131.6	3,8	31.5	44.4
Romania	98.6	4,7	21.8	28.7
Russia	82.0	7,4	38.2	13.5
Thailand	5.5	2,0	9.9	27.7
Turkey	63.8	9,0	41.0	34.4
South Africa	10.8	5,4	38.5	36.9

Source : WDI, WEO

The variables considered in the study are: IT (a binary variable that takes 1 for a targeting country in a year when there was effective inflation targeting, and 0 for non-targeting countries), the ratio of central government debt to GDP, which will represent the outcome of our impact evaluation (GOV_DEB), the inflation rate of the previous year as the annual average of the CPI (INF-1), the trade openness rate, defined as the ratio of imports plus exports to GDP, financial openness based on The Chinn-Ito index, which captures the degree of capital account openness by ranging from 0 to 1 (FIN_OPEN), net FDI inflows as a percent of GDP (FDI), credit to the non-financial sector as a percent of GDP (CRED), and the annual growth rate of GDP per capita (GDPPC_G). The exact definitions and sources of the variables used are presented in Table A.1 in the Appendix.

Table 3

Descriptive statistics of the variables used.

Variables	Obs	Average	Std. Dev	Min	Max
INF-1	1183	41.003	313.473	-6.242	7481.66
TRADE	1174	75.320	56.046	13.388	437.327
FIN_OPEN	1200	0.528	0.346	0	1
FDI	1170	3.226	5.229	-40.081	60.235
CRED	1156	-1.382	6.326	-28.697	43.398
GDPPC_G	1183	2.253	3.572	-26.411	12.508
GOV_DEB	1144	45.510	27.168	3.253	233.267

Source : Author's calculations, IMF, WDI, The Chinn-Ito index

3.2. Methodology

The impact evaluation method chosen to conduct this work is the *Propensity Score Matching* (PSM in what follows). This method consists of constructing two groups with similar characteristics, a treatment group (the targeters in our case, IT=1), and a control group (the non-targeters IT=0). The idea is to use the control group as a counterfactual, which will allow us to deduce what level the public debt of the treated countries would have reached if they had not conducted inflation targeting. To do this, this method matches the units in the treatment group with those in the control group, based on propensity scores estimated from a *Probit* model, where we regress our variable of interest (IT) on the rest of the control variables described above (which will be contained in a vector X_{it}), except for the variable (GOV_DEB) which represents the *outcome*. Subsequently, the estimated propensity scores will identify a common support for treated and untreated units. The impact of the program is thus deduced as the difference in the average public debt ratio between the treated and control units, on the common support.

In addition, the empirical validity of PSM rests on two fundamental assumptions. First, the conditional independence assumption which implies that, conditional on a set of observable characteristics X_{it}, the outcome variables GOV_DEB_{i0} and GOV_DEB_{i1} are independent of the treatment variable IT_{it}. This hypothesis is to be accepted as untestable since the same countries cannot be observed in both situations (treated and untreated). The conditional independence assumption is expressed mathematically as follows[6] :

$$(GOV\_DEB_{i0}, GOV\_DEB_{i1} \perp IT_{it} \mid X_{it}) \qquad (1)$$

The second assumption is the existence of a common support of propensity scores. This condition ensures that there are control group countries that are comparable to each of the treatment group countries. Formally, the common support condition can be written as follows:

$$0 < P(X_{it}) < 1 \qquad (2)$$

With X_{it} : the vector of control variables described above, which will be used in the estimation of the Probit model.

Thus, the average treatment effect on treated (ATT) can be estimated as follows:

$$ATT = E(GOV\_DEB_{i1}|IT_{i1}=1, P_{i)} - E(GOV\_DEB_{i0}|IT_{i0}=0, P_i) \qquad (3)$$

With: $E(GOV\_DEB_{i1}|IT_{i1}=1, P_{i)}$, the average public debt for the targeting countries on the common support (treatment group), and $E(GOV\_DEB_{i0}|IT_{i0}=0, P_i)$ the average public debt for the non-targeting countries also on the common support (control group), and with similar characteristics to the targeting countries, allowing matching on the basis of propensity scores.

Matching based on propensity scores can be conducted using different matching algorithms, of which we selected the following three for this work:

(i) *Nearest neighbor matching:* a method of matching each treated unit with one or more untreated units that are the closest, according to the propensity score. The higher the number of neighbors, the better the quality of the matching through a reduction of

6. This assumption can be relaxed as (GOV_DEBi0 ⊥ ITit | P(Xit)), because we want to estimate the average treatment effect on the treated and not on the whole sample and therefore it is sufficient that the variables GOV_DEBi0 and ITit are independent.

the variance. However, the use of this algorithm may impoverish the impact evaluation approach, if the distance between the propensity scores of treated and untreated units is relatively large.

(ii) *Radius matching:* in the case where the nearest neighbor remains quite distant, the estimation from the nearest neighbor matching may lead to an impact evaluation estimate that is not very accurate. The *Radius matching* method addresses this problem by imposing a maximum threshold to tolerate for the distance between propensity scores. This method allows each treated unit to be matched with untreated units with respective propensity scores within a specified radius.

(iii) *Kernel matching* is a non-parametric method that matches each treated unit with a weighted average of all units in the control group (the untreated units). The weights used are generally inversely proportional to the distance between propensity scores between treated and untreated units. We can use several possible kernels (Tricube, Gaussian, Epanechnikov, Uniform ...). In this study, we use the Tricube method.

4. RESULTS

4.1. Estimation of propensity scores

We begin by estimating the propensity scores using the Probit model[7] presented in equation (4), where the endogenous variable considered is inflation targeting adoption (IT).

$$IT_{it} = X'_{it} * \beta + e_{it} \qquad \text{avec} : \beta = (\beta_0\ \beta_1\ \beta_2\ \beta_3\ \beta_4\ \beta_5\ \beta_6) \qquad (4)$$

$$= \beta_0 + \beta_1 * INF\text{-}1_{it} + \beta_2 * TRADE_{it} + \beta_3 * FIN\_OPEN_{it} + \beta_4 * FDI_{it} + \beta_5 * CRED_{it} + \beta_6 * GDPPC\_G_{it} + e_{it}$$

The results of the Probit model estimation are presented in Table 4. We note that apart from the GDPPC_G variable, the rest of the explanatory variables are statistically significant. Indeed, the coefficients associated with the variables *INF-1, TRADE, FIN_OPEN,* and *FDI* are statistically significant at the 1% level, while the coefficient associated with the variable *CRED*, is statistically significant at the 5% level. The explanatory power of the model, captured by McFadden's Pseudo-R2 is about 16.3%.

Regarding the signs associated with the estimated coefficients, the negative correlation between inflation and the probability of adopting targeting would be explained by the fact that countries eThe negative correlation between inflation and the probability of adopting targeting could be explained by the fact that countries tend to adopt this framework in periods of high inflation, as mentioned in Lin and Ye (2009), Ball and Sheridan (2004), De Mendonça and Souza (2012). The positive coefficient associated with FIN_OPEN is also consistent with the literature, according to which an opening of the capital account is often accompanied by a shift to a flexible exchange rate regime, which is itself a prerequisite for the adoption of inflation targeting, in order to guarantee the autonomy of monetary policy, according to Mundell's Incompatibility Triangle (Mundell, 2002). The positive coefficient associated with FIN_OPEN is also consistent with the literature, according to which an opening of the capital account is often accompanied by a shift to a flexible exchange

7. The estimation was conducted through a pooled panel, which explains the number of observations of 1104.

rate regime, which is in itself a prerequisite for the adoption of inflation targeting, in order to guarantee the autonomy of monetary policy, according to Mundell's Incompatibility Triangle (Mundell, 1963). The positive coefficients on the *FDI* and *CRED* variables could be explained by the fact that an increase in the inflow of Foreign Direct Investment (FDI) or an increase in credit to the non-financial sector would be a sign of economic maturity, which could encourage a shift towards inflation targeting.

Table 4

Propensity score estimates with a *Probit* model

	IT
INF-1	-0.073*** (0.009)
TRADE	-0.008*** (0.001)
FIN_OPEN	1.020*** (0.135)
FDI	0.028*** (0.009)
CRED	0.016** (0.008)
GDPPC_G	0.019 (0.014)
Cons	-0.065 (0.128)
Number of observations	1104
Pseudo-R^2	0.163

Note: Values in parentheses indicate standard deviations of estimates. ***, ** represent statistical significance at the 1%, and 5% thresholds respectively.

The estimation of propensity scores from the results of the *Probit* model is presented in equation (5) below:

$$P_i = F(X'_{it} * \beta) = F(\beta_0 + \beta_1 * INF\text{-}1_{it} + \beta_2 * TRADE_{it} + \beta_3 * FIN\_OPEN_{it} + \beta_4 * FDI_{it} + \beta_5 * CRED_{it} + \beta_6 * GDPPC\_G_{it}) \quad (5)$$

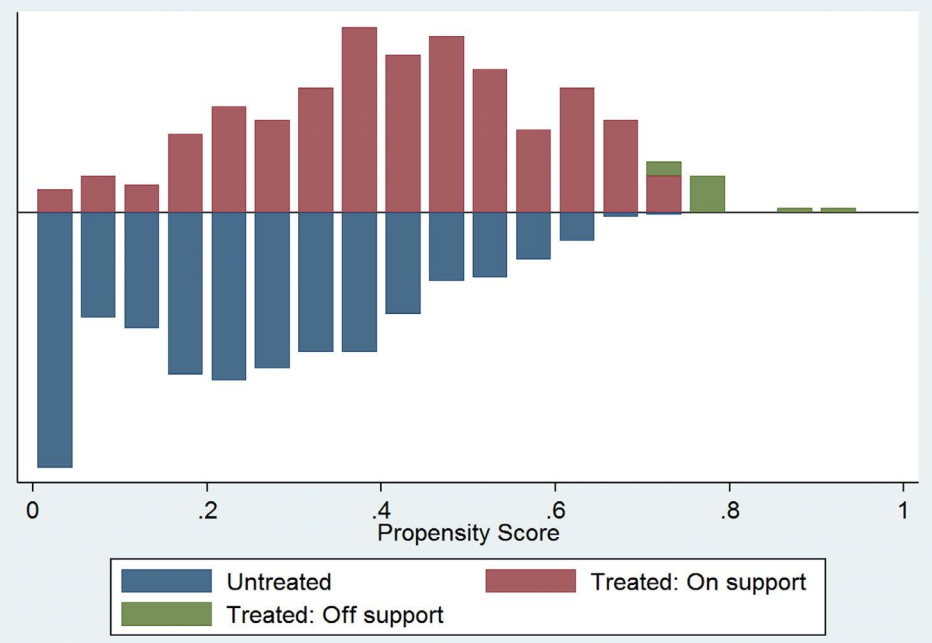
With F: the cumulative distribution function of the normal distribution.

Figure 3 presents the probability densities of inflation targeting and non-targeting countries by their respective propensity scores. The y-axis shows the proportion of countries, while the x-axis represents the propensity scores associated with each proportion of countries. The red and blue bars indicate the distribution of propensity score density of inflation targeting and non-targeting countries respectively, which are on the common support, while the green bars are associated

with target countries, off the common support, due to non-matching with non-targeting countries based on the respective propensity scores. Thus, we can observe the existence of a relatively large common support, where the propensity scores of non-targeting countries and almost all target countries are overlapping (Figure 3).

Figure 3

Propensity score distribution and common treatment support



4.2. Matching results

The matching results indicate that the adoption of inflation targeting leads to a reduction in public debt of between 5.9 percent and 7.5 percent of GDP, depending on the three different matching approaches. In fact, the *Nearest-Neighbor Matching* algorithm shows average treatment effects on the treated (ATT), of the order of -7.5%, -6.5% and -7.4% for numbers of matched units of N=1,2, and 3 respectively, while the *Kernel Matching* algorithm shows an ATT of -5.9%. These two algorithms led to the elimination of 13 observations from the common support, out of the 335 initially untreated observations. The use of the *Radius Matching* algorithm (r=0.001), results in an ATT of -6.9 %, with a removal of 90 treated observations from the common support. The number of untreated observations on the common support is 769 for the three approaches (Table 4). Thus, the estimation results corroborate the theoretical arguments mentioned earlier regarding the impact of adopting inflation targeting on public debt reduction for emerging countries.

Table 4

Matched estimates of the effect of treatment on public debt (in % of GDP)

	Matching Algorithms				
	Nearest-Neighbor Matching			Radius Matching	Kernel Matching
	N=1	N=2	N=3	Tricube	Tricube
	IT				
Average treatment effect on treated (ATT)	- 7.549** (3.190)	-6.502*** (2.144)	-7.490*** (2.837)	-6.962** (3.275)	-5.913*** (1.478)
Treated observations on the common support	322	322	322	245	322
Treated off the common support	13	13	13	90	13
Untreated observations	769	769	769	769	769

Note: Values in parentheses indicate Bootstrap standard deviations based on 500 replications. ***, ** represent statistical significance at the 1%, and 5% thresholds respectively.

4.3. Evaluation of the matching quality

One way to assess the quality of the matching is to conduct balancing tests, which consist of a test of equality of means, for all control variables used for propensity score estimation, for the treated and untreated group. The results of the balancing tests for the different explanatory variables indicate the non-rejection of the null hypothesis of equality of means for a risk of 5%, according to the two-tailed Student's t-test. This suggests that our matching is consistent (Table 5).

Table 5

Matching balancing tests

Variable	**Average**			**t-test**	
	Treated	Untreated	% bias	t	p-value
INF-1	4.873	6.345	-1.2	-0.64	0.521
TRADE	72.404	69.836	5.0	0.82	0.414
FIN_OPEN	0.627	0.618	2.5	0.32	0.747
FDI	3.286	3.266	0.3	0.06	0.955
CRED	-1.442	-1.679	4.2	0.60	0.546
GDPPC_G	2.671	2.804	2.5	0.32	0.747

5. CONCLUSIONS AND IMPLICATIONS FOR ECONOMIC POLICY

This paper has attempted to assess the impact of an adoption of the inflation targeting framework on the conduct of fiscal policy, in terms of reducing public debt levels for emerging countries. Building on previous work that studied the disciplining effect of inflation targeting policy on fiscal policy in general, and using the propensity score matching method, the results of this work indicate that inflation targeting could have a positive and significant effect on public debt reduction in emerging countries. The results of this work indicate that inflation targeting could have a positive and significant effect on public debt reduction in emerging countries.

The main policy implications can be twofold: First, the adoption of the inflation-targeting framework may promote central bank independence, while at the same time encourage governments to put more discipline in public expenditure management, and to increase the efficiency of their tax collection systems. Second, the benefit in terms of public debt reduction that could result from the adoption of inflation targeting can be seen as an argument for a migration to more flexible exchange rate regimes for those emerging countries that still adopt fixed exchange rate regimes. A choice of exchange rate policy which obviously depends on the validation of a certain number of prerequisites, in relation to economic fundamentals.

Finally, despite the numerous theoretical and empirical elements that demonstrate its effectiveness in the conduct of monetary policy, the inflation targeting framework can in no way be seen as a panacea for the control of inflation and could not substitute for the conduct of an overall sound economic policy.

References:

Abo-Zaid, S., & Tuzemen, D. (2011). Inflation targeting: A three-decade perspective. Journal of Policy Modeling, 5940(20).

Alesina, A., & Tabellini, G. (1987). Rules and discretion with non-coordinated monetary and fiscal policies. *Economic Inquiry*, 25(4), 619-630.

Amato, J. D., & Gerlach, S. (2002). Inflation targeting in emerging market and transition economies: lessons after a decade. *European Economic Review*, 46, 781-790.

Ball, L. M., & Sheridan, N. (2004), Does inflation targeting matter? The inflation-targeting debate *University of Chicago Press*. 249-282.

Bernanke, B. S., Laubach, T., Mishkin, F. S., & Posen, A. S. (1999). Inflation targeting: Lessons from the international experience. *Princeton, NJ: Princeton University Press*.

Catao, L. A. V., & Terrones, M. E. (2005). Fiscal deficits and inflation. *Journal of Monetary Economics*, 52(3), 529-554.

De Mendonça, H. F., & e Souza, G. J. D. G. (2012). Is inflation targeting a good remedy to control inflation? *Journal of Development Economics*, 98(2), 178-191.

Fischer, S., Sahay, R., & Vegh, C. A. (2002). Modern hyper- and high inflations. *Journal of Economic Literature*, 40(3), 837-880.

Gonçalves, C., & Salles, J. (2008). Inflation targeting in emerging economies: What do the data say? *Journal of Development Economics*, 85, 312-318.

Heenan. G., Marcel. P, and Scott. R, (2006). Implementing Inflation Targeting: Institutional Arrangements, Target Design, and Communication. *IMF Working Paper* 06/278

Huang, H., & Wei, S-J. (2006). Monetary policies for developing countries: the role of institutional quality. *Journal of International Economics*, 70, 239-252.

Jensen, H. (1994). Loss of monetary discretion in a simple monetary policy game. *Journal of Economic Dynamics and control*, 18(3-4), 763-779.

Kadria, M., Ben Aissa. M. S., (2014). Implementation Of Inflation Targeting and Budget Deficit Performance In Emerging Countries: A Treatment Effect Evaluation. *The Journal of Applied Business Research* – July/August 2014. Volume 30, Number 4.

Leeper. E., Walker. T. B., & Davig. T. M., (2011). Inflation and the fiscal limit. *European Economic Review*, 55(1), 31-47.

Lin, S., & Ye, H. (2009). Does inflation targeting make a difference in developing countries? J*ournal of Development Economics*, 89, 118-123,

Lucas, Robert Jr, (1976). Econometric policy evaluation: A critique, Carnegie-Rochester Conference Series on Public Policy, Elsevier, vol. 1(1), pages 19-46, January.

Lucotte, Y. (2012). Adoption of inflation targeting and tax revenue performance in emerging market economies: An empirical investigation. *Economic Systems*, 387(20).

Miles, W. (2007). Do inflation targeting handcuffs restrain leviathan? Hard pegs vs. inflation targets for fiscal discipline in emerging markets. *Applied Economics Letters,* 14(9), 647-651.

Minea, A., Tapsoba, R., & Villieu, P. (2012). Can inflation targeting promote institutional quality in developing countries? mimeo.

Minea, A., Villieu, P. (2008). Financial development, institutional quality and inflation targeting. (Unpublished Paper).

Mishkin, F., Bernanke, B. (1997). Inflation targeting: A new framework of monetary policy? *Journal of Economic Perspectives*, 11, 97-116.

Mishkin. F, (2004), Can Inflation Targeting Work in Emerging Market Countries? NBER Working Paper 10646 (Cambridge, Massachusetts: National Bureau of Economic Research)

Mundell, Robert A. (1963), Capital Mobility and Stabilization Policy Under Fixed and Flexible Exchange Rates. *Canadian Journal of Economic and Political Science* 29 (4): 475–485.

Nana, A. B. I. ve Baycan, İ. O. (2022). The Impact of Inflation Targeting on Public Debt: An Evidence from Propensity Score Matching Approach, *Eskişehir Osmangazi Üniversitesi İİBF Dergisi*, 17(2), 479 – 501.

Obstfeld, M. (1991). Dynamic seigniorage theory: An exploration. Center for Economic Policy Research (London), (Discussion paper 519).

Sargent, T. J., & Wallace, N. (1981). Some unpleasant monetarist arithmetic. Quarterly Review of the Federal Reserve Bank of Minneapolis, 5, 1-17.

Svensson, Lars E. O., (1997). Inflation forecast targeting: Implementing and monitoring inflation targets, *European Economic Review*, Elsevier, vol. 41(6), pages 1111-1146, June.

Van Aarle, B., Bonvenberg, L., & Raith, M. (1995). Monetary and fiscal policy interaction and government debt stabilization. *Journal of Economics*, 62(2), 111-140.

Van der Ploeg, F. (1995). Political economy of monetary and budgetary policy. *International Economic Review*, 36(2), 427-439.

Villieu, P. (2011). Quel objectif pour la dette publique à moyen terme ? *Revue d'Économie financière*, 103(3), 79-98.

Vu, U. (2004). Inflation dynamics and monetary policy strategy: Some prospects for the Turkish economy. *Journal of Policy Modeling*, 26 (8–9), 1003-1013.

Wimanda, E. R., Turner, P. M., & Hall, M. J. B. (2011). Expectations and the inertia of inflation: The case of Indonesia. *Journal of Policy Modeling*, 33(3), 426-438.

ANNEXE

Table A.1

List of variables

Variable	Definition	Source
IT	A binary variable that takes 1 for a country adopting inflation targeting, and 0 otherwise	Built by the author
GOV_DEBT	Central government debt to GDP ratio	WEO (IMF)
INF-1	Previous year's inflation rate as an annual average of the CPI	WDI
TRADE	Trade openness, calculated as the ratio of imports plus exports to GDP	WDI
FIN_OPEN	Financial openness based on The Chinn-Ito index, which captures the degree of openness of the capital account by being between 0 and 1	The Chinn-Ito database
FDI	Net inflow of Foreign Direct Investment (FDI) as % of GDP	WDI
CRED	Credit to the non-financial sector as % of GDP	WDI
GDPPC_G	GDP per capita annual growth rate	WDI

About the Author, Mahmoud Arbouch

Mahmoud Arbouch is an Economist at the Policy Center for the New South. He is a graduate engineer from the National Institute of Statistics and Applied Economics (INSEA – Rabat). Mahmoud is currently a Ph.D. student at the Faculty of Governance Economic & Social Sciences of the Mohammed VI Polytechnic University (FGSES – UM6P), working on the impact of public infrastructure on growth and welfare in Morocco. He previously worked on topics related to infrastructure development and financing in Sub-Saharan Africa, regional economics in Morocco, the economic aspects of migration, as well as some sectoral policies in Morocco. Mahmoud is also interested in macroeconomic policies and long-term development. Before joining the economic research team at the Policy Center for the New South, his research focused on monetary policy at Bank Al-Maghrib (Central Bank of Morocco).

Policy Center for the New South

Mohammed VI Polytechnic University, Rocade Rabat-Salé, 11103
Email : contact@policycenter.ma
Phone : +212 (0) 537 54 04 04 / Fax : +212 (0) 537 71 31 54
Website : www.policycenter.ma