The Impact of Inflation Targeting on Public Debt: An Evidence from Propensity Score Matching Approach[1]

Aymar Berenger Ismael Nana[2] iD
İsmail Onur Baycan[3] iD

Enflasyon Hedeflemesinin Kamu Borçlarına Etkisi: Eğilim Skoru Eşleştirme Yöntemleri ile Analizi	The Impact of Inflation Targeting on Public Debt: An Evidence from Propensity Score Matching Approach
Öz	**Abstract**
Bu çalışma, enflasyon hedeflemesi politikasının iç ve dış kamu borcu üzerindeki etkisini gelişmiş ve gelişmekte olan ülke gurupları için eğilim skoru eşleştirme yöntemini kullanarak inceler. Enflasyon hedeflemesi rejiminin ortalama işlem etkisi ile işleme tabi olanlar üzerindeki ortalama işlem etkilerini tahmin etmek için en yakın komşu eşleştirme, radyan, katmanlaştırma ve kernel eşleştirme olmak üzere dört eşleştirme yöntemi ile analiz eder. Sonuçlar, enflasyon hedeflemesi politikasının dış kamu borcunu hem gelişmiş hem de gelişmekte olan ekonomiler için azalttığını güçlü ve istatistiksel olarak anlamlı şekilde ortaya koyar. Ayrıca enflasyon hedeflemesi uygulanmasının gelişmekte olan ekonomilerde iç kamu borcunu azalttığı istatistiksel olarak anlamlı şekilde ortaya konulur.	This study uses the Propensity Score Matching (PSM) approach to examine the impact of adopting the Inflation Targeting (IT) policy on internal and external public debt both for the groups of advanced and developing economies. We investigate the matching results to estimate the Average Treatment Effect (ATE) and Average Treatment Effect on the Treated (ATT) by employing different matching methods of nearest-neighbor, radius, stratification, and kernel matching. Our results are robust and statistically significantly reveal that adopting the IT policy reduces external public debt both for developed and developing economies. Moreover, on average, the adoption of IT policy leads to a statistically significant reduction of internal public debt for developing economies.
Anahtar Kelimeler: Eğilim Skoru Eşleştirme, Enflasyon Hedeflemesi, Kamu Borcu	**Keywords:** Propensity Score Matching, Inflation Targeting, Public Debt
JEL Kodları: C14 E31 H63	**JEL Codes:** C14 E31 H63

Araştırma ve Yayın Etiği Beyanı	Bu makale, bilimsel araştırma ve yayın etik kurallarına uygun olarak hazırlanmıştır.
Yazarların Makaleye Olan Katkıları	Yazarların makaleye katkı oranları eşittir.
Çıkar Beyanı	Yazarlar açısından ya da üçüncü taraflar açısından çalışmadan kaynaklı çıkar çatışması bulunmamaktadır.

1. Introduction

The economic globalization of the countries in the world led to an increase in commercial exchanges. It also allowed countries that did not have sufficient resources to look for international loans to finance their growing needs for financing. However, this source of funding is not without consequences. Several countries in debt have found it difficult to pay their due.

Developing countries, as many industrialized countries have done in the past, import capital to accelerate growth. Nowadays, debt most often takes the form of government borrowing from the public. In addition, commercial banks, international institutions (Regional Development Banks, IMF, World Bank, and institutions), or other countries can make loans.

In some countries, public debt has prioritized public budget allocations, leaving paltry resources available for development expenditure. One witnessed in the 1980s a debt crisis that emerged in Latin America, especially when, in 1982, Mexico could not pay its debt; this situation subsequently heckled the balance payment from several countries, including that of oil-importing countries. However, the mid-1990s marked a turning point in the public debt of developing countries. Whereas the external and internal public debt was equal in 1998, ten years later, the public debt towards the national agents represents almost three times the public debt due to external creditors. This dizzying progress affects all countries in the South, although this trend is less pronounced in the poorest countries of sub-Saharan Africa. More recently, the financial crisis that erupted in 2008, and the economic depression that followed, have caused a deterioration in the public finances of many countries. Public debt ratios observed recently in some countries, especially those in the Euro area, have reached levels never seen before.

Developing countries are highly dependent on external funding. As debt increased at a slower pace in 2018 compared to the record year of 2017, the burden continues to grow. According to the recent data from the World Bank Group (2019), these countries' total outstanding external debt reached $ 78 trillion, up 5.3%[4]. The increase is more marked - 12% - for short-term debt, which weighs 2.2 trillion.

Based on the Institute of International Finance (IIF) 2019 global debt monitor report, falling interest rates fuelled the debt of the emerging market in the first quarter of 2019. As a result, that debt reached a record amount of nearly $ 70 trillion, more than twice their gross domestic product (GDP). As a result, the public debt of non-financial companies, financial institutions, and households in all emerging countries reached 69.1 trillion dollars (61.240 billion euros) or 216% of GDP, against 68.9 trillion a year earlier. The debt ratio, which relates the stock of debt to GDP, grew fastest in Chile, South Korea, Brazil, South Africa, Pakistan, and China in the space of a year, according to IIF data. In the same period, within developed countries, the increase in indebtedness in the first quarter was mainly due to countries that increased by 1,000 billion dollars. Finland, Canada, and Japan recorded the most significant increase in their year-over-year debt ratio. At the same time, some Eurozone countries such as the Netherlands, Portugal, and Ireland continued their debt reduction efforts.

High debt can impact the effectiveness of the monetary policy regardless of the level of development in the country. When the exchange rate is under pressure, a high debt level (mainly denominated in foreign currencies) can result in delicate arbitration for the monetary

---

[4] International Debt Statistics 2020

authorities: to limit the depreciation of the money and exit from rising interest rates, and contain the financing costs. Central banks can indirectly influence public debt, mainly through their communication (private or public). Institutional monetary policy arrangements, such as targeting inflation with operational independence from central banks, could discipline fiscal policy, curb debt accumulation, and reduce inflationary pressures.

Initially, the inflation targeting policy was part of the monetary rules centered on the operational instrument's interest rate. Since then, the issue of inflation-production arbitrage has arisen with new approaches: the optimal smoothing of the interest rate, the nature of targeting, the time dimension of the rule, etc. On the nature of targeting, Svensson (1999) proposes price level targeting because it presents a definite advantage (free lunch) in inflation variability. Price level targeting means a policy that reacts systematically to changes in price level relative to the target path to avoid long-term price level drift. Similarly, inflation targeting is a policy that responds systematically to shifts in the inflation rate from the target rate, which implies the possibility of long-term price drift.

As we can notice, the 2020 pandemic crisis result in a sharp increase in all countries' public debt and deficit. However, public debt often exceeded 100%, sometimes 200%, of GDP in periods of war and fell significantly in post-war periods, marked by high inflation (but also strong growth in GDP volume). Based on such historical examples, this study revolves around a guiding question: *Did the countries adopting inflation targeting as monetary policy face a change in their public debt?*

The experience of some countries with inflation targeting forms the basis for this article. It proposes to provide preliminary responses to candidate countries to adopt targeting to manage their public debt better. This study shows the potential impact of adopting IT policy on the different types of public debt (internal and external) in the group of advanced economies and developing economies (emerging market + least developed countries). First, we propose an analysis based on descriptive statistics of the inflation and public debt series (internal and external). Secondly, we complete our study with a Propensity Score Matching (PSM) approach. To define the contours of our research better, we examine whether or not:

- Inflation targeting is favorable to a reduction in internal public debt in general and in the different countries (advanced and developing economies) ;
- Inflation targeting is favorable to reducing external public debt in general and in different countries (advanced and developing economies).

After presenting the objective of our study on inflation targeting and public debt, the rest of this paper is organized as follows. Section two discusses the review of existing literature. Section three provides details about the data, methodology, and empirical strategy employed to analyze the impact of IT on public debt. Section four presents the empirical results. Finally, section five concludes.

2. Literature Review

It is common to hear that "inflation reduces the debt." That is one of the reasons why some argue that higher inflation would have positive repercussions on the economy in the context of excessive indebtedness of the countries. According to Akitoby et al. (2014), higher inflation is likely to decrease public debt through three channels. First, governments can capture more resources through monetary creation and seigniorage receipts. Second, inflation erodes the real value of the debt. However, the effectiveness of that channel depends on the maturity of debt and its denomination in foreign currencies, as well as concerning the reaction of interest rates to the acceleration of inflation. Indeed, the central bank is likely to raise its key rates to preserve price stability. Also, inflation has prompted private agents to demand higher interest rates on new issues of government securities. Third, inflation affects the primary balance if the tax is progressive, and the tax brackets are not indexed to inflation[5]. Finally, an acceleration of inflation would facilitate deleveraging in the public sector and private agents. That situation would accelerate the recovery of economic activity, thus increasing tax revenues. In this case, as Blanchard et al. (2010) and more recently Ball (2013) suggested, an increase in inflation targets would reduce the risk that economies would fall into a liquidity trap or, if necessary, would increase their chances of getting out. Hilscher et al. (2014) corroborate in the same direction and highlight that higher inflation leads to the higher real value of public debt stock. To do this, they employ a method focused primarily on the ex-ante perspective of the budget constraint, a set of plausible counterfactuals, and some detailed debt information. Their study shows that in the United States of America, the impacts of an increase in inflation on the budgetary burden are reasonable. Almost half of the debt could be erased in ten years by combining high inflation with a crackdown.

Akitoby et al. (2014) have studied the effect of inflation on the public debt to GDP ratio of G7 countries. Their simulations suggest that if inflation remained low at around zero for five years, the net debt to GDP ratio would increase by an average of 5% points at the end of the period. Conversely, if inflation were to stay at 6% for five years, the net debt to GDP ratio will fall on average by 11 to 14 percentage points. Accelerating inflation would effectively decrease the public debt burden. It would be more effective if the central banks did not tighten monetary policy.

A low and stable price level with high growth is one of the main economic objectives of most governments in the world. Unfortunately, to promote economic growth, some countries, more specifically developing countries, often have to go into debt to finance the budget deficits. Nguyen (2015) focuses on the impacts of public debt on inflation in developing economies in Asia from 1990 to 2012. His study shows that public debt has a positive effect on inflation, which implies that in these countries, the fiscal policy with an inflated level of the public debt to finance the budget deficits is inflationary. The study of the relationship between inflation and public debt on three continents, conducted by Van Bon (2015), is accordant with the whole sample. That means that public debt has a markedly positive impact on inflation, while inflation is significant and negatively impacts public debt. This result is partly in agreement with that of Harmon (2012). The latter carried out a study on the impact of public debt on GDP growth, inflation, and the interest rate in Kenya between 1996 and 2011. After using simple linear regression models, it appears that there is a low positive relationship between public debt and

---

[5] http://www.blog-illusio.com/article-alimenter-l-inflation-pour-reduire-la-dette-publique-123903503.html (accessed: 17.07. 2020)

inflation. In contrast, the relationship is negative for GDP growth, interest rates, and public debt. By using a VEC model estimated by the Johansen approach, Nastansky et al. (2014) showed, through his study with quarterly data for Germany for the period 1991-2010, that the level of public debt positively impacts on consumer prices index, meaning that public debt statically causes inflation and vice versa.

With empirical study, other authors, such as Taghavi (2000), examined the assumption that public debt has potentially negative effects on inflation, growth, and investment in the major European economies. After using the auto-regressing vector and cross cointegration models, the results suggest that debt appears to be inflationary in the long run. However, its impact on short-term inflation is unclear, while debt has a negative and significant effect on investment and ambiguous effects on growth.

For some people, the increase in public debt would lead to inflation in highly indebted countries. Sargent and Wallace (1981) expressed this view agrees with Kwon et al. (2006). Indeed, they conducted an empirical study on the relationship between inflation and public debt with panel data concerning 71 countries from 1963 to 2004 using the OLS regression estimate and the VAR model. The results show that the relationship is strong and weak in other developing countries in indebted developing economies, but it does not exist for advanced economies. However, in the case of an inflexible exchange rate regime, this relationship becomes weak.

The dynamic interaction of debt and budget deficits with economic variables such as the interest rate, inflation, output, and the trade gap has been the subject of some studies. That is the case for Kannan and Singh (2007), who applied the 2 SLS simulation technique from 1971 to 2006 and found that debt and public budget deficits have a negative effect on all the macroeconomic variables considered in the medium and long term. The interest rate plays a capital role in public accounts and public debt. Considering it as an essential variable for analyzing the impacts of public debt and fiscal deficits on the interest rates in Nigeria, Obi & Nurudeen (2009) concluded that deficits and public debt positively impact the interest rates. However, the study on the macroeconomic impacts of the public debt in the United States carried out by Wheeler (1999) shows that public debt has a negative sign and significant effect on interest rates, the prices level, and production.

Few empirical studies provide results on the linkage between domestic debt and inflationary effects. However, some studies find a weak link between internal debt and inflationary effects. Indeed, the empirical study carried out by Bildirici and Ersin (2007) on the relationship between domestic debt and inflation for nine countries during 1980-2004 shows that in countries experiencing inflation, the inflationary process was high fueled by rising domestic debt costs. In the least developed countries, inflation is perceived as a critical problem. Thus, according to Ahmad et al. (2012), internal debt and domestic debt services improve the price level in Pakistan; in other words, they have a significantly positive impact on the price level.

3. Data and Methodology

This section presents the data used to realize the estimations in the first subsection. The methodology employed to examine the impacts of inflation targeting on macroeconomic variables is provided in the second subsection.

3.1. Data

This study uses the PSM approach to examine the impact of adopting IT on internal and external public debt. Our sample consists of two economies (advanced and developing[6]) for 46 countries. The treatment group in our study consists of 22 that combine advanced and developing economies that have adopted the IT framework by the end of 2015. The control group consists of 24 countries that do not target inflation (See the list of countries in appendices 1 and 2). Due to the availability of the data, we specify that our data are annual and start from 1990 to 2019. The choice of the year 1990 is because it corresponds, on the one hand, to the date of the first adoption of IT by New Zealand. On the other hand, according to some economists, the stability of the inflation observed in these countries is due instead to economic conditions and not to the inflation targeting observed from the nineties (Cecchetti and Ehrmann, 1999; Dueker and Fisher, 1996).

Some papers have highlighted two starting dates, namely default, and conservative inflation targeting, according to the literature. In other words, the two dates are differentiated by the fact that the first, which is "informal or soft" inflation targeting (Vega & Winkelried, 2005), is the date officially declared by the central banks as the date of adoption. On the other hand, the second date, "full-fledged or formal" IT, is considered by academics as the data from which central banks began to meet the criteria required to be classified as inflation targeting. Therefore, in this study, we exclusively used the data issued by the central banks.

Our outcome variable, public debt, is disaggregated into domestic public debt and external public debt. Thus, in this study, we use the outstanding international public debt securities to GDP (%) as the variable for external public debt and the outstanding domestic public debt securities to GDP (%) as that of the domestic public debt.

Table 1 shows the variables used for this study. The various macroeconomic data to which our study relates mainly come from the following different databases: IMF database, World Bank Development Indicator (WDI), Bank for International Settlements (BIS), and the Chinn-Ito Index.

---

[6] We notice that in this group we combined developing and emerging countries

Table 1: List of variables

Variable	Definition	Source
External public debt	The amount of international public debt securities (outstanding) as a share of GDP. It covers long-term bonds and notes and money market instruments placed on international markets.	BIS
Domestic/Internal public debt	Amount of domestic public debt securities (outstanding) issued in domestic markets as a share of GDP. It covers long-term bonds and notes, treasury bills, commercial paper, and other short-term notes.	BIS
FDI	Net inflows (% of GDP). Foreign direct investment is the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor.	WDI
Inflation	The average consumer price index (CPI). The rate of inflation is the percent change in the average CPI	WEO (IMF)
Current account	Current account balance (% of GDP) = government current account balance as a percentage of the GDP	WDI
Gross Domestic Product per capita	GDP per capita (constant 2010 US$)	WDI
Financial development	Domestic credit is provided by the financial sector (% of GDP). It includes all credit to various sectors on a gross basis, except credit to the central government, which is net. The financial sector includes monetary authorities, deposit money banks, and other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits).	WDI
Financial openness[7]	The Chinn-Ito index (*KAOPEN*) measures a country's degree of capital account openness. *KAOPEN* is based on the binary dummy variables	The Chinn-Ito Index

Source: The Chinn-Ito Index, WDI, WEO (IMF), BIS.

3.2. Methodology

This study is examined in two stages. The first stage consists of conducting a statistical analysis of the internal and external public debt evolution in the countries that have adopted it. To do this, one presents in separate tables the average and the average of the standard deviation of inflation and of the various public debts over time intervals, namely: 1) over the entire period of study (1990-2019), 2) the pre-targeting period (from 1990 to the date of adoption of each country), 3) the post-targeting period (from the date of adoption to 2019). Secondly, the study differs by using a wide variety of non-parametric PSM techniques to eliminate the problems that often arise in studies with traditional linear regression methods (Baycan, 2016).

• First, due to the randomized valuation feature of the method, there is no problem of selection bias that is frequently encountered in traditional linear time or panel data models.

• Secondly, a specific functional form is not required for this method. Therefore, the results are not affected by omitted variable bias.

• Third, another advantage of the propensity score matching approach is that it does not generate extrapolation outside of the common support.

---

[7] Chinn, Menzie D. and Hiro Ito (2006), "What Matters for Financial Development? Capital Controls, Institutions, and Interactions," *Journal of Development Economics,* Volume 81, Issue 1, Pages 163-192 (October).

- Fourth, the estimator does not need a monotonic transformation as it is non-parametric.

- Finally, alternative models that use an instrumental variable enable us to reach the results without being exposed to errors and deficiencies caused by choosing the correct instrumental variable.

Estimated propensity scores are made using one or a combination of four main methods to adjust. (1) Stratification, (2) Matching, (3) Medium variable / Regression setting, and (4) Weighting.

While the number of variables observed increases, they will face the problem of dimensionality in matching these features. Initial studies assessed the changes and matched the observations by basing them on a single variable vector or hosting the variables. It is simple to map a few common variables using two dummy variables. However, estimating the average treatment effect will be complex as the number of variables increases.

The average treatment effect on the treated (ATT) of inflation targeting refers to the following:

$$ATT = E(Y_{i1}|IT_i = 1) - E(Y_{i0}|IT_i = 1) \qquad (1)$$

where IT_i is a dummy indicator showing whether the countries adopt IT policy or not. If the country i adopts an IT policy, IT value takes 1 and 0 if not. Thus, $(Y_{i0}|IT_i = 1)$ equals the counterfactual outcome that change in external or internal public debt would have occurred if the country i had not conducted IT and ($Y_{i1}|IT_i$=1) gives the value of change in external or internal public debt if country i has implemented IT. Therefore, equation (1) demonstrates that the ATT unit shows the difference between the outcome obtained after the adopted IT policy and the possible result that the value would have reached if it had never been adopted IT policy. However, although the first term in this equation is observable, the second term in the ATT is impossible to observe, which is problematic. After a policy regime change, no knowledge regarding the inflation rate would be apparent if the country did not decide to choose the policy. On the contrary, when the decision to change the political regime is non-random, and the treatment allocation is made randomly, the problem disappears. According to the results on the decision of countries to switch to an inflation-targeting regime, the process of policy regime changes is non-random. The choice of this regime is also influenced by the institutional infrastructures and the economic characteristics of these countries. Therefore, there is a link between the observable variables and the impact of the outcome variable called the "self-selection" problem. The propensity score matching method solves this self-selection problem on observables.

The propensity score matching approach shares similar observed characteristics between non-inflationary targeters and inflation targeters. This statement leads to matching treated and untreated units practically and compares the differences between the average external and domestic public debt change in a counterfactual way.

Then, based on the conditional independence: $Y_0 \perp IT|.X$ and $Y_1 \perp IT|.X$. From this assumption, we can rewrite the equation (1) as:

$$ATT = E[Y_{i1}|IT_i = 1, X_i] - E[Y_{i0}|IT_i = 0, X_i] \qquad (2)$$

where $(Y_{i1}|IT_i = 1, X_i)$ refers to the average external and internal public debt in the ith country that changed after the adoption of the regime under conditions X_i. The term $[Y_{i0}|IT_i =$

$0, X_i]$ indicates the average external and internal public debt in the ith country that maintained its monetary policy under the same conditions X_i. For the latter term $E[Y_{i1}|IT_i = 1, X_i]$, we substitute $[Y_{i0}|IT_i = 0, X_i]$, which ensures all the parameters in our equation consist of observables.

The problem of dimensionality that arises from the increased number of observed covariates finds a solution in propensity scores between the matching of untreated and treated units on their propensity scores (Rosenbaum and Rubin, 1988).

$$P(X_i) = Pr[IT = 1|X_i] \tag{3}$$

Estimating the propensity score that takes the value between 0 and 1 denotes the probability function. Based on the same assumption, equation (2) conditional on a propensity score can be rewritten as:

$$ATT = E[Y_{i1}|IT = 1, P(X_i)] - E[Y_{i0}|IT_i = 0, P(X_i)] \tag{4}$$

Common support assumption at evaluation PSM method guarantees to overcome biased ATT estimation. The common support necessary condition indicates the equation as:

$$0 < P(X_i) = \Pr(|D_i = 1|X_i) < 1 \tag{5}$$

After providing the common support condition, ATT indicates the mean difference in external and internal public debt over the common support, adequately weighted by the propensity score distribution of all economies in the data set.

The Average Treatment Effect (ATE) quantifies the difference in mean (average) scores between the group that received the treatment and the control group that did not receive the treatment. In a randomized trial (i.e., an experimental study), the average treatment effect can be estimated from a sample using a comparison of the average results for the treated and untreated units. The nature of treatment or outcome is relatively unimportant in estimating the ATE -i.e., for the estimation of the ATE, treatment must be applied to some units and not to others. However, this treatment's nature is not related to the estimation of ATE.

The effect of the treatment for individual i is as follows: $y_1(i) - y_0(i) = \beta(i)$. In this general case, this effect differs from one individual to another. The ATE is given by:

$$ATE = \frac{1}{N}\sum_i(y_1(i) - y_0(i)) \tag{6}$$

where the summation takes place over all N individuals from the overall population, $y_1(i)$ represents the numerical value of the outcome variable for i if the individual received the treatment, and $y_0(i)$ represents the numerical value of the outcome variable for individual i if the individual did not receive the treatment.

The ATE on the treated unit shows the difference between the result obtained after the treatment and the possible outcome the unit would have achieved if it had never been processed. In the specific case of our study, the ATE shows the country's different economic performances before and after adopting the inflation targeting policy. Several matching algorithms improve the quality of the results drawn from the propensity score estimates in the existing literature. As pointed out by Lucotte (2012), the evaluation of the treatment effect through an estimated propensity score is employed by different matching methods that use different approaches:

(i) *Nearest neighbor matching* consists of matching each treated unit with one or more untreated units that are closest according to the propensity score. The more the number of

neighbors, the more we get knowledge by reducing the variance. However, a drop in quality by using the matching algorithms is possible;

(ii) *Radius matching*: in case the nearest neighbor remains far away, estimation from nearest neighbor matching cannot yield accurate ATT results. The radius matching estimator addresses this problem by imposing a maximum propensity score distance threshold. This estimator allows each processed observation to be matched with unprocessed observations and with estimated propensity scores that fall within a specified radius.

(iii) *Kernel matching*: Kernel matching considers the weighted averages of all economies. This method is different from the two previous ones, which construct a counterfactual matching from a few processed observations. This approach consists of matching the treated units to all the control units using different weights proportional to the proximity of the control units. In our study, we use Epanechnikov kernel matching methods.

(iv) *Stratification matching:* this approach consists of partitioning the common support of the propensity score into a set of intervals. According to Caliendo and Kopeinig (2008), the measure depends on the average difference within each interval of inflation rates between the observations of inflation targeters and non-inflationary targeters.

Concerning control variables, they refer to those that increase the probability of transition to the inflation targeting regime and further determine the external and internal public debt. By performing several preliminary regressions, only the specifications for which the balancing property is satisfied are retained to examine the effect of IT economies on the reduction of the external and internal public debt of developing, emerging, and advanced economies.

4. Empirical Results

This section discusses the effectiveness of the IT policy. First, we document a descriptive statistical analysis between inflation and public debt (internal and external) in the first subsection. Then, we reveal the analysis by employing the PSM methodology in the following subsections.

4.1. Descriptive statistical analysis

As part of this statistical analysis, we analyze inflation data and internal and external public debt between the pre-inflation targeting and inflation-targeting periods. Our study covers a total of 22 countries that have adopted inflation targeting, including ten advanced economies and 12 developing economies. Tables 2 and 3 show the inflation statistics for advanced and developing economies adopting inflation targeting policy. For example, Table 3 shows that all countries in advanced economies except Japan have experienced a significant drop in their inflation after adopting the IT policy. Thus, the average inflation of countries with advanced economies with inflation targeting goes from 5.93% during the pre-IT period to 2.05% during the post-IT period.

Furthermore, this drop-in inflation is accompanied by a drop in its volatility, measured by the standard deviation. This average volatility goes from 2.44 during the pre-IT period to 1.31 during the post-IT period. Such results show the significant change in the inflation dynamics between the periods before and after the IT policy. The results document that controlling the volatility contributes to a better economic performance in these countries.

Table 2: Inflation in advanced economies (1990-2019)

	Total Period		Pre-IT		Post-IT	
	Mean	s.d	Mean	s.d	Mean	s.d
Australia	2.5966	1.4035	3.8333	3.1342	2.4592	1.1160
Canada	2.0166	1.0834	4.8	-	1.7892	0.6668
Czech Rep.	3.1333	2.8010	11.554	4.1729	2.8869	2.5844
Israel	4.76	5.4283	13.228	3.4466	2.1826	2.4163
Japan	0.4833	1.1528	0.3782	1.2094	0.8285	0.9375
South Korea	3.5266	2.2981	5.4181	2.5396	2.4315	1.2138
New Zealand	2.1266	1.2806	-	-	2.1266	1.2806
Norway	2.2233	0.8888	2.5181	0.8072	2.0526	0.9094
Sweden	1.95	1.6173	4.4666	3.8591	1.6703	0.9797
U.K	2.46	1.6302	7.25	0.3535	2.1178	1.0143
Mean	**2.5276**	**1.9584**	**5.9384**	**2.4403**	**2.054**	**1.311**

Table 3 below presents the inflation and volatility statistics for the developing economies consisting of emerging markets and the least developed countries practicing inflation targeting. According to the results, we see that the level of inflation for some countries is too high before the IT period (Brazil: 936.4%; Peru: 673.72%; Poland: 103.66%; Russia: 137.38%; and Turkey: 60.53%) while during the post-policy adoption period inflation is lower and remains stable (the highest rate in this category is 9.54% in Turkey). Indeed, the average inflation during the pre-IT was 167.62% against 4.98% during the post-IT period, a considerable drop of about 97.02%. Moreover, this drop is accompanied by a significant decline in volatility in these countries from 323.1 to 2.48. In summary, considering all the samples, the levels of inflation and volatility are higher for the pre-IT period than for the post-IT period. The next step in this work is to assess the effect of IT policy on public debt. In other words, it is a question of determining the internal and external public debt situation in the countries whose monetary policy targets inflation. In recent years, debt has become a matter of concern again, not only because of the macroeconomic impact it could have on economic performance but also because of the possible adverse effects on the conduct of monetary policy.

Table 3: Inflation in developing economies (1990-2019)

	Total Period		Pre-IT		Post-IT	
	Mean	s.d	Mean	s.d	Mean	s.d
Brazil	285.31	728.0095	936.4	1113.521	6.2714	2.546594
Colombia	10.71	8.9727	23.4	4.3792	5.2714	2.355025
Hungary	10.2766	9.7272	21.054	7.7973	4.0368	2.56498
Indonesia	9.2333	9.9788	12.36	13.290	6.1066	2.947509
Mexico	9.8566	9.3094	19.409	9.5459	4.3263	0.9774
Peru	271.09	1363.914	673.725	2146.994	2.6777	1.2492
Philippines	5.8866	3.8281	8.675	4.1378	4.0277	2.184923
Poland	29.976	106.2056	103.6625	195.5449	3.1818	3.1787
Russia	115.6033	321.137	137.38	348.7777	6.72	5.1431
South Africa	7.0433	3.2409	9.89	3.4329	5.62	2.0130
Thailand	3.01	2.2957	4.96	2.0473	2.035	1.7484
Turkey	36.7366	32.729	60.5312	27.736	9.5428	2.9544
Mean	66.2276	216.612	167.620	323.100	4.9847	2.4886

Table 4: External public debt in advanced economies (1990-2019)

	Total Period		Pre-IT		Post-IT	
	Mean	s.d	Mean	s.d	Mean	s.d
Australia	1.5825	1.2799	3.411	0.1815	1.3012	1.1309
Canada	10.0445	3.6075	15.245	-	9.8651	3.5327
Czech Rep.	2.7594	2.5807	0.5253	0.0580	3.4393	2.5898
Israel	3.3022	1.5535	1.4599	0.2839	3.8629	1.3231
Japan	0.0901	0.0341	0.0787	0.0275	0.1275	0.0269
South Korea	2.5567	2.2024	2.5270	1.4618	2.5739	2.5743
New Zealand	0.7311	0.1860	-	-	0.7311	0.1860
Norway	0.4414	1.0930	1.5762	0.9844	-0.8747	0.3794
Sweden	9.4726	3.999	11.0153	0.1142	9.3012	4.1875
U.K	0.4727	0.2963	0.3301	0.0072	0.4829	0.3044
Mean	3.1453	1.6832	4.0187	0.3898	3.081	1.6235

Tables 4 and 5 show the average external public debt statistics and volatility for advanced and developing economies, respectively. In Table 5, we observe that the level of the external public debt of these advanced economies which adopted inflation targeting was 4.01% during the pre-inflation targeting period and decreased to 3.08% during the inflation targeting period, i.e., a significant decrease in the external public debt to the height of 23.33%. The same result is observed in Table 6 (external public debt for developing economies) with a decrease in external public debt from 6.66% during the pre-inflation targeting period to 5.01% during the post-IT period, i.e., a reduction of 24.77%. Thus, we find no significant differences between the two groups of countries before and after the adoption of IT in terms of external public debt.

Regarding the volatility of external public debt, we find that under the inflation targeting regime, there has been an increase from 0.38 to 1.62. That implies that debt has become more volatile in advanced economies during the post-IT period (Table 5). Furthermore, as for advanced economies, we notice a slight increase in volatility (2.03 to 2.04) in developing economies, implying more volatility after adopting IT (Table 6).

Table 5: External public debt in developing economies (1990-2019)

	Total Period		Pre-IT		Post-IT	
	Mean	s.d	Mean	s.d	Mean	s.d
Brazil	5.6469	3.1630	4.645	3.0566	7.9844	2.0316
Colombia	7.3426	2.3997	8.2674	2.055	5.1846	1.6830
Hungary	13.5183	6.2471	14.7018	4.3021	11.1786	8.3876
Indonesia	1.5901	2.8444	3.8151	2.1020	-0.6348	1.3164
Mexico	5.9228	2.0117	5.0842	1.0971	9.1094	1.3494
Peru	8.3189	1.2569	8.7940	1.3574	7.5310	0.4350
Philippines	11.8100	3.1435	12.912	3.2256	10.1557	2.1400
Poland	7.5718	4.4316	9.277	3.9359	2.8802	0.7643
Russia	4.6326	3.4396	2.1564	0.576	5.127	3.564
South Africa	2.9110	1.1742	3.520	0.9431	1.6911	0.2911
Thailand	1.0732	0.929	0.663	0.8163	1.893	0.5034
Turkey	5.9316	1.2179	6.4418	0.9751	5.4851	1.2602
Mean	6.3558	2.6882	6.6623	2.0347	5.0168	2.0455

Table 6: Internal public debt in advanced economies (1990-2019)

	Total Period		Pre-IT		Post-IT	
	Mean	s.d	Mean	s.d	Mean	s.d
Australia	27.0396	17.4459	30.5066	16.0841	4.5039	2.2379
Canada	59.5764	6.2960	59.629	6.40	58.0298	-
Czech Rep.	20.6830	7.6309	23.6621	6.0165	10.8945	1.7082
Israel	37.4216	6.3034	39.4675	5.7499	30.6997	1.4342
Japan	123.5891	56.4352	189.0418	14.8772	103.668	48.5798
South Korea	21.3474	12.7087	29.0629	8.6257	8.0207	5.0988
New Zealand	17.3675	11.1201	17.3675	11.1201	-	-
Norway	16.1902	3.4042	16.968	3.885	14.845	1.7320
Sweden	36.9706	13.3615	34.756	12.1674	56.8996	1.4762
U.K	35.8698	11.5830	37.018	11.116	19.7925	0.8120
Mean	39.6055	14.6288	47.7479	9.6041	34.1504	7.8848

Then there is the analysis of the internal public debt in Tables 6 and 7. Table 6 shows statistics about advanced economies that the average domestic public debt, which was 47.74% during the pre-IT period, decreased to 34.15% during the inflation-targeting period. This decrease in domestic public debt is also observed in the developing economies in our sample shown in Table 7 that have adopted IT (25.21% pre-IT versus 15.96% post-IT). The volatility of the domestic public debt of countries with advanced economies is less volatile (pre-IT 9.60 against post-IT 7.88) and that of countries of developing economies that are less volatile after adopting IT (pre-IT 6.06 versus 4.12 post-IT). One could conclude that the adoption of IT causes a significant decrease in the volatility of the domestic public debt of countries with advanced economies; in other words, inflation targeting policy reduces the uncertainty of inflation.

Table 7: Internal public debt in developing economies (1990-2019)

	Total Period		Pre-IT		Post-IT	
	Mean	s.d	Mean	s.d	Mean	s.d
Brazil	47.7646	17.959	56.9643	12.8766	26.2987	3.7577
Colombia	19.6311	7.2294	23.7034	4.0598	10.129	1.773
Hungary	39.3765	11.294	46.2134	8.0472	27.5672	3.3361
Indonesia	12.3977	6.3515	11.698	2.5814	13.096	8.7235
Mexico	15.5221	10.1240	21.852	6.4711	4.5876	3.7687
Peru	3.59076	4.5990	6.1652	3.4901	-0.66719	1.9931
Philippines	28.4129	4.4233	29.92	4.619	26.149	3.0469
Poland	30.4717	13.7903	36.723	10.2385	13.278	3.5590
Russia	5.2571	2.3522	7.156	1.6234	4.877	2.3119
South Africa	34.24	6.693	33.8777	7.5364	34.967	4.856
Thailand	17.5311	9.8403	23.5994	4.8323	5.3947	4.1510
Turkey	23.1868	8.6355	22.4580	6.3936	23.8244	10.3835
Mean	23.5572	7.7874	25.2176	6.0615	15.9627	4.1249

4.2. Analysis with the Propensity Score Matching (PSM)

This section examines the Average Treatment Effect on the Treated (ATT) and the Average Treatment Effect (ATE) on the lagged inflation rate, GDP per capita, current account of balance, trade, financial openness, financial development (proxied by domestic credit to the private sector), and FDI. The following section concerns the empirical estimation of the propensity scores to the outcome variables of external and internal public debt. We present results employing several matching technics to examine the effect of IT policy on external and internal public debt for both groups of countries. Before going any further on the estimation of the PSM, we first point out a descriptive statistic of the independent and dependent variables used in this study.

Table 8 Descriptive statistics from 1990 to 2019

Variable	Advanced economies					Developing economies				
	Obs	Mean	Std. Dev	Min	Max	Obs	Mean	Std. Dev	Min	Max
Extpubdebt	840	5.11	6.51	-6.65	31.66	570	9.14	14.83	-4.13	97.63
Intpubdebt	840	39.9	29.74	-11.77	215.02	570	25.16	21.07	-4.32	105.3
GDPP	840	1.71	2.72	-11.40	23.94	570	2.812	4.674	-27.56	43.3
CPI l1	839	3.7	20.82	-4.48	552.08	569	30.185	182.31	-3.75	2947.7
FDI	840	5.58	11.82	-43.46	198.07	570	3.292	5.054	-48.28	54.8
Trade	840	59.37	343.5	-7946.7	3616.1	570	55.449	404.18	-2353.4	9110.4
Curac	840	1.14	6.296	-23.72	25.92	570	-1.921	6.223	-26.12	17.47
Kaopen	840	1.90	0.868	-1.219	2.385	570	-0.028	1.196	-1.92	2.33
Domcredit	840	110.5	4692	0.18	253.26	570	54.19	40.51	3.29	166.50

Table 8 presents the descriptive statistics of the variables employed for this study while considering the two groups of countries: Advanced and developing economies. It appears that the advanced economies, unlike the developing ones, obtain high averages as a result of most of the variables, except the external public debt and the GDP per capita, where developing economies acquire high averages.

4.3. Estimation of scores

To have a control group and a reasonably comparable treatment group, it is essential to first sort the observations according to their estimated propensity scores (PS) and isolate countries in the control group whose estimated PS is lower than the lowest score in the group treated (Persson 2001). We estimate the propensity score using the probit model, where IT is the binary and dependent variables. The binary variable takes the value 0 if a country does not operate under the IT policy in a given year and 1 if it operates under the IT policy.

Table 9: Propensity scores for both external and domestic public debt

Variable	Advanced economies		Developing economies	
	Coef.	**Prob**	**Coef.**	**Prob**
GDPP	0.0214	0.252	-0.031**	0.019
	(0.0189)		(0.0130)	
CPI_l1	-0.0318*	0.091	0.0009	0.282
	(0.0188)		(0.0014)	
FDI	-0.0443***	0.000	-0.023*	0.058
	(0.0077)		(0.0121)	
Trade	-0.000289**	0.029	-0.00009	0.471
	(0.0001)		(0.0001)	
Curac	-0.00343	0.671	0.019**	0.038
	(0.0080)		(0.0089)	
Kaopen	-0.166***	0.008	0.087*	0.097
	(0.0629)		(0.0510)	
Domcredit	0.0001	0.860	-0.005***	0.000
	(0.001)		(0.001)	
Cons	0.205	0.217	0.689***	0.000
	(0.1663)		(0.0859)	
N. of obs	**839**		**570**	

Note: Robust std errors in brackets. ***, **, and *, indicate the significance level of 1%, 5%, and 10%, respectively.

Table 9 reports the probit estimation of the propensity scores in advanced economies and developing economies, based on the starting date (see appendix 1). In the advanced economies group, the negative sign of the lag-inflation is in accordance with the coefficient in Lin and Ye (2007, 2009), Ball and Sheridan (2004), De Mendonça and e Souza (2012). We find that the past inflation in developing economies is not significant and had a positive sign. The current account balance is negative and not significant for advanced economies but has a positive sign and is significant for developing economies. Foreign direct investment inflows are negative but significant for advanced and developing economies, contrasting to a positive coefficient in Vasileva (2018). Financial openness is significant for both groups but remains negatively correlated with the probability of adopting IT in advanced economies and positively in developing economies. The real GDP per capita growth rate is significant. It negatively correlates with IT adoption by developing economies, while it is not significant in advanced economies and has a positive sign. The trade openness variable is negative for both types of economies. Still, it remains significant only for advanced economies, meaning that adopting IT policy leads to more trade activities abroad for these countries. Financial development has a negative sign and is significant only for the group of developing economies.

Figures 1 and 2 represent the numerical densities of adopting inflation targeting countries and non-inflation targeting countries according to their propensity score ranges. The vertical section indicates the number of countries in these Figures, while the horizontal section in the

chart indicates the density distribution of the propensity scores. The red blocks in the upper part of the horizontal line indicate the density distribution of the propensity scores for the country group that adopted IT. The blue blocks show the density distribution of the propensity scores for countries that did not adopt IT. Figures 1 and 2 indicate that propensity scores are overlapped, and common support is provided.

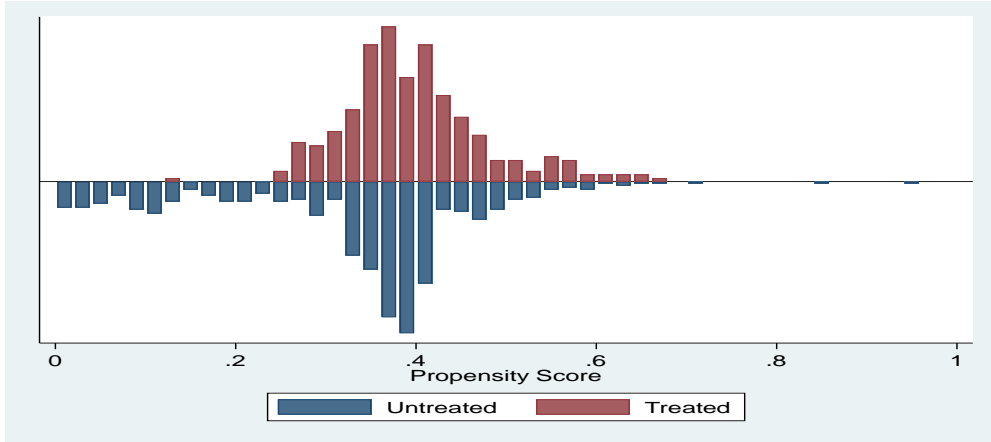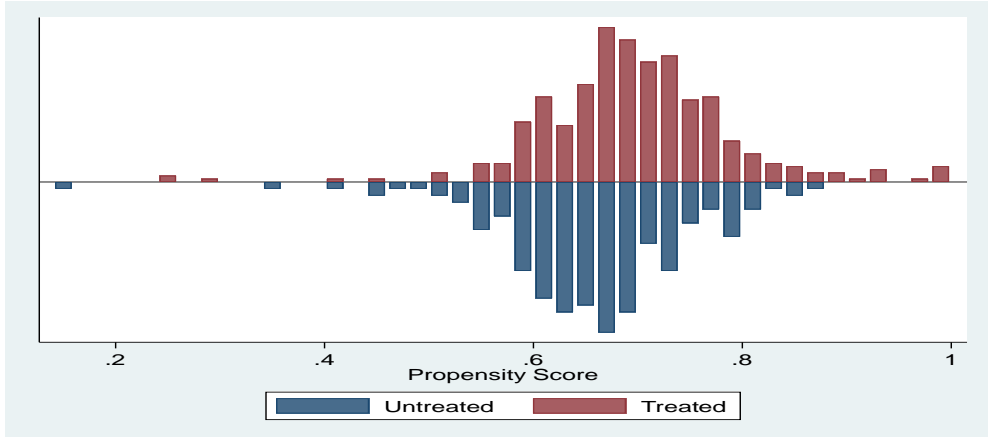Figure 1: Propensity score for advanced economies

Figure 2: Propensity score for developing economies

4.4. Results from matching the effect of IT on internal and external public debt

In this part of the study, we reveal the matching results by employing different matching techniques: Radius matching, Nearest-Neighbor Matching, Stratification Matching, and Kernel Matching. Tables 10 and 11 represent the treatment effect's impact on the external and internal public debt in advanced and developing economies.

Firstly, we analyzed the impact of the adoption of IT on external public debt for advanced and developing economies. According to Table 10, all the coefficients in the two groups of countries are negative, and this negative effect is statistically significant for all of the matching techniques used both for advanced and developing economies. On average, the magnitude of the estimated ATT concerning the external public debt ranges from -4.22 (nearest-neighbor matching, n=1) to -3.7 (kernel matching) percent in the group of advanced economies and ranges from -10.5 (stratification matching) to -7.51 (radius matching, r=0.01) percent in the group of developing economies. There is strong and robust evidence that the adoption of the IT policy has quantitatively essential and statistically significant impacts on reducing external public debts on average by at least 3.7 percent than non-IT advanced counterparts and by at least 7.5 percent compared to non-IT developing counterparts. In other words, if non-IT advanced economies had preferred an inflation-targeting framework, their external public debt would have been, on average, at least 3.7 percent lower. Additionally, the results reveal that if non-inflation targeting developing countries had adopted an inflation targeting regime, their external public debt would have decreased by 7.5 points.

Table 10: Estimates of ATT of the external public debt

External public debt	Nearest neighbor matching			Radius matching			Kernel matching	Stratification matching
	n=1	n=2	n=3	r=0.01	r=0.03	r=0.05		
Advanced economies	-4.2***	-3.8***	-3.9***	-3.9***	-3.8***	-3.6***	-3.7***	-3.8***
	(0.79)	(0.63)	(0.63)	(0.48)	(0.46)	(0.48)	(0.37)	(0.50)
Developing economies	-8.0***	-8.02***	-8.3***	-7.51***	-8.6***	-8.2***	-8.56***	-10.5***
	(2.91)	(2.78)	(2.59)	(0.71)	(0.54)	(4.43)	(0.23)	(1.76)

Note: bootstrapped std errors (via 100 replications) in brackets. ***, **, and *, indicate the significance level of 1%, 5%, and 10%, respectively.

Table 11: Estimates of the ATT of the internal or domestic public debt

Internal public debt	Nearest neighbor matching			Radius matching			Kernel matching	Stratification matching
	n=1	n=2	n=3	r=0.01	r=0.03	r=0.05		
Advanced economies	1.09	-0.28	-0.46	-0.55	-1.62	-2.03	-1.85	-1.41
	(3.19)	(3.06)	(3.20)	(2.63)	(2.71)	(2.57)	(2.59)	(2.67)
Developing economies	-5.01**	-5.85**	-6.02**	-5.94***	-5.85***	-6.3***	-6.13***	-6.86***
	(2.57)	(2.96)	(2.57)	(2.31)	(1.87)	(1.99)	(1.90)	(2.24)

Note: bootstrapped std errors (via 100 replications) in brackets. ***, **, and *, indicate the significance level of 1%, 5%, and 10%, respectively.

Table 11 concerns the internal public debt and identifies that none of the coefficients is significant for any of the matching methods for the advanced economies. This means that the internal or domestic debt of the inflation targeting in the group of advanced economies is insignificant after adopting the policy. On the other hand, in developing economies, the adoption of IT decreases internal debt. Indeed, as we can see in Table 11, each test showed a negative sign and significant coefficient of the internal debt meaning that the inflation targeting

has a negative effect on the internal debt of this group of countries that decided to adopt inflation targeting. On average, the magnitude of the estimated ATT concerning internal public debt ranges from -6.86 (stratification matching) to -5.01 (nearest-neighbor matching, n=1) percent. To put it another way, the results show that if inflation targeter developing economies had not adopted the IT policy, internal public debt would have been at least 5.01 percent higher.

4.5 Results from matching the effect of IT on external and internal public debt by using ATE

Tables 12 and 13 provide robust matching results for the IT policy based on the advanced and developing economies. The estimated ATE on our sample from the matching methods (nearest neighbor, radius, and kernel) is negative and statistically significant for developing economies. Focussing on external and internal public debt, IT lowers the external and internal public debt for developing economies. The results are negative and statistically significant for advanced economies, with the external public debt non-significant for internal public debt. On average, the magnitude of the estimated ATE concerning the external public debt ranges from -4.06 (nearest-neighbor matching, n=2) to -3.34 (radius matching, r=0.01) percent in the advanced economies and ranges from -8.57 (nearest-neighbor matching, n=2) to -6.63 (radius matching, r=0.01) percent in developing economies. In other words, the adoption of IT significantly reduces external public debt both for developed and developing economies. Moreover, on average, the adoption of IT creates a significant reduction in internal public debt for developing economies. On average, the magnitude of the estimated ATE concerning internal public debt ranges from -4.44 (nearest-neighbor matching, n=2) to -2.73 (nearest-neighbor matching, n=1) percentages points.

Table 1: Estimates of the ATE of the external public debt

External public debt	Nearest neighbor matching			Radius matching			Kernel matching
	n=1	n=2	n=3	r=0.01	r=0.03	r=0.05	
Advanced economies	-3.41***	-4.06***	-3.95***	-3.34***	-3.37***	-3.41***	-3.56***
	(0.87)	(0.82)	(0.71)	(0.80)	(0.74)	(0.79)	(0.41)
Developing economies	-6.85***	-7.80***	-8.57***	-6.63***	-6.90***	-6.85***	-7.33***
	(2.95)	(2.85)	(2.52)	(2.51)	(2.65)	(2.41)	(1.52)

Note: bootstrapped std errors (via 100 replications) in brackets. ***, **, and *, indicate the significance level of 1%, 5%, and 10%, respectively.
Source: Author

Table 13: Estimates of the ATE of the internal or domestic public debt

Internal public debt	Nearest neighbor matching			Radius matching			Kernel matching
	n=1	n=2	n=3	r=0.01	r=0.03	r=0.05	
Advanced economies	-3.32	-2.09	-2.74	-2.85	-3.1	-3.32	-0.85
	(3.52)	(3.84)	(3.26)	(3.65)	(3.63)	(3.02)	(2.66)
Developing economies	-2.73*	-4.44*	-4.36*	-3.19*	-2.90*	-2.73*	-6.43*
	(2.88)	(2.65)	(2.36)	(2.75)	(2.87)	(3.04)	(1.89)

Note: bootstrapped std errors (via 100 replications) in brackets. ***, **, and *, indicate the significance level of 1%, 5%, and 10%, respectively.
Source: Author

We find that adopting an inflation-targeting regime reveals lower levels of external public debt in developing and advanced economies. In the case of external public debt, inflation targeting results in lower external public debt, and these results are statistically and economically significant for developing and advanced economies. Concerning internal public debt, the findings suggest debt reduction through the adoption of the inflation targeting regime in developing economies.

The results report that the control group in the group of advanced and developing economies may follow the monetary policy adopted by the inflation-targeting countries, especially for countries where the public debt is a drag on their economic development.

5. Conclusion

IT is a relatively new monetary strategy for most countries. However, since its inception in the 1990s, there has been an increase in the number of adherents to this monetary policy to such an extent that inflation targeting is considered to be the cornerstone of the new monetary system (Rose, 2007). Various articles on inflation targeting support this monetary policy through its remarkable performance.

The method implemented in this study is propensity score matching, which is the most suitable methodology to solve the self-selection problem to evaluate the counterfactual analysis of inflation targeting. The decision to adopt inflation targeting is not random, resulting in biased and overestimated results when using linear econometric techniques. Thus, this study's propensity score matching method performs various analyses while addressing self-selection bias. The evaluation process of the inflation targeting regime takes place in several stages. First, probit regression calculates propensity scores between each treatment and control individuals. Next, we visually analyze the density distribution with the resulting common support plot of the estimated propensity score in the untreated and treated units. Finally, the last step consists of estimating the treatment's average effect on the treated and that of the average effect of the treatment to evaluate the role of an inflation targeting regime. Four different matching methods are employed in the study: nearest-neighbor matching, radius, kernel, and stratification matching approaches. This research examines the effects of this monetary policy on internal and external public debts both in the groups of advanced and developing economies.

Based on the results, the countries that adopted IT achieved lower and less volatile inflation rates than in later periods. IT thus contributes to a large extent to maintaining price stability. So, besides price stability, the firm commitment to keeping inflation low has also helped anchor inflation expectations around the target value. Also, advanced economies' average external public debt equals 3.14%, with an average volatility of 1.68, while that of developing economies is 6.35%, with an average volatility of 2.68. The domestic public debt seems similar to that of the external public debt, with an average of 39.60% and a volatility of 14.62 for advanced economies against 23.55% and a volatility of 7.78 for the developing economies. Therefore, this monetary regime is suitable for sustainable internal and external public debt.

The results from the propensity score matching analysis reveal that both of the employed methods of ATT and ATE present similar coefficient signs and degrees of significance. Based on the results of ATT, two groups of countries are examined. On average, we find a decrease in their internal and external public debt, except for the analysis of the internal debt of advanced economies, where despite the inflation targeting policy, the results did not have a significant

effect. On average, the magnitude of the estimated ATT concerning the external public debt ranges from -4.22 (nearest-neighbor matching, n=1) to -3.7 (kernel matching) percent in the group of advanced economies and ranges from -10.5 (stratification matching) to -7.51 (radius matching, r=0.01) percent in the group of developing economies. There is strong and robust evidence that the adoption of the IT policy has quantitatively essential and statistically significant impacts on reducing external public debts on average by at least 3.7 percent than non-IT advanced counterparts and by at least 7.5 percent compared to non-IT developing counterparts. In other words, if non-IT advanced economies had preferred an inflation-targeting framework, their external public debt would have been, on average, at least 3.7 percent lower. Additionally, the results reveal that if non-inflation targeting developing countries had adopted an inflation targeting regime, their external public debt would have decreased by 7.5 points. On average, the magnitude of the estimated ATT concerning internal public debt ranges from -6.86 (stratification matching) to -5.01 (nearest-neighbor matching, n=1) percent. To put it another way, the results show that if inflation targeter developing economies had not adopted the IT policy, internal public debt would have been at least 5.01 percent higher.

According to the results, the IT regime helps reduce external public debt for advanced and developing economies and reduces internal public debt. In other words, the interpretation of the results of ATE method reveals that, on average, the magnitude of the estimated ATE concerning the external public debt ranges from -4.06 (nearest-neighbor matching, n=2) to -3.34 (radius matching, r=0.01) percent in the advanced economies and ranges from -8.57 (nearest-neighbor matching, n=2) to -6.63 (radius matching, r=0.01) percent in developing economies. That is, the adoption of IT significantly reduces external public debt both for developed and developing economies. Moreover, on average, the adoption of IT creates a significant reduction in internal public debt for developing economies. On average, the magnitude of the estimated ATE concerning internal public debt ranges from -4.44 (nearest-neighbor matching, n=2) to -2.73 (nearest-neighbor matching, n=1) percentages points. In short, the results are robust and show that employing the ATE for matching also reveals that if non-inflation targeting countries had adopted inflation targeting, their external public debts would statistically significantly have been lower both for the advanced and developing economies and their internal public debts would statistically significantly have been lower for the group of developing economies.

References

Ahmad, M. J., Sheikh, M. R., & Tariq, K. (2012), "Domestic debt and inflationary effects: An evidence from Pakistan," International Journal of Humanities and Social Science, 2(18), 256-263.

Akitoby, B., Komatsuzaki, T., & Binder, A. (2014), "Inflation and Public Debt Reversals in the G7 Countries," IMF Working Papers, WP/14/96.

Ball, L. M. (2013), "The case for four percent inflation," working paper, (No. 607).

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

Baycan, I. O. (2016), "The Effects of Exchange Rate Regimes on Economic Growth: Evidence from Propensity Score Matching Estimates, Journal of Applied Statistics, 43 (5), 914-924

Bildirici, M., & Ersin, O. O. (2007), "Domestic debt, inflation, and economic crises: a panel cointegration application to emerging and developed economies," Applied Econometrics and international development, 7(1).

Blanchard, O., Dell'Ariccia, G., & Mauro, P. (2010), "Rethinking macroeconomic policy," Journal of Money, Credit and Banking, 42, 199-215.

Bousrih J. (2011), "L'adoption de la politique de ciblage de l'inflation dans les marchés émergents: apport théorique et validation empirique. Economies et finances. Université Rennes 1, 2011. Français. tel-00646573

Cecchetti, S. G., & Ehrmann, M. (1999), "Does inflation targeting increase output volatility? An international comparison of policymakers' preferences and outcomes", (No. w7426), National bureau of economic research.

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.

Dueker, M., and Fischer, A. M. (1996), "Inflation targeting in a small open economy: Empirical results for Switzerland." Journal of Monetary Economics 37.1: 89-103.

Hammond, G. (2011), "State of the Art of Inflation Targeting," Centre for Central BankingStudies Handbook No. 29, London: Bank of England.

Harmon, E. Y. (2012), "The impact of public debt on inflation, GDP growth, and Interest rates in Kenya" (Doctoral dissertation).

Hilscher, J., Raviv, A., & Reis, R. (2014), "Inflating away the public debt? An empirical assessment (No. w20339)," National Bureau of Economic Research.

Kannan, R., & Singh, B. (2007), "Debt-deficit dynamics in India and macroeconomic effects: A structural approach," MPRA Paper No. 16480.

Kwon, G., McFarlane, L., & Robinson, W. (2006), "Public Debt, Money Supply, and Inflation: A Cross-Country Study and its Application to Jamaica," International Monetary Fund (IMF) Research Paper Series.

Lin, S., & Ye, H. (2007), "Does inflation targeting really make a difference? Evaluating the treatment effect of inflation targeting in seven industrial countries," Journal of Monetary Economics, 54(8), 2521-2533.

Lin, S., & Ye, H. (2009), "Does inflation targeting make a difference in developing countries?", Journal of Development Economics, 89(1), 118-123.

Majid T. 2000, "Debt, growth, and inflation in large European economies: a vector auto-regression analysis," Journal of Evolutionary Economics, Springer, vol. 10(1), pages 159-173.

Nastansky, A., Mehnert, A. and Strohe, H. G. (2014), "A Vector Error Correction Model for the Relationship between Public Debt and Inflation in Germany", No 51, Statistische Diskussionsbeiträge, Universität Potsdam, Wirtschafts-und Sozialwissenschaftliche Fakultät.

Nguyen, B. (2015), "Effects of fiscal deficit and money M2 supply on inflation: Evidence from selected economies of Asia," Journal of Economics, Finance and Administrative Science, 20, 49-53.

Obi, B., & Nurudeen, A. (2009), "Do Fiscal Deficits Raise Interest Rates in Nigeria? A Vector Autoregression Approach," Journal of Applied Quantitative Methods, 4(3).

Persson, T. (2001), "Currency unions and trade: how large is the treatment effect?", Economic Policy, 16(33), 434-448.

Roger, S. (2010), "Inflation Targeting Turns 20," Finance & Development 47, No. 1, 46-49.

Rose, A. K. (2007), "A stable international monetary system emerges: Inflation targeting is Bretton Woods, reversed," Journal of International Money and Finance, 26(5), 663-681.

Rosenbaum, P. R. (2002), "Overt bias in observational studies," In Observational studies (pp. 71-104), Springer, New York, NY.

Rosenbaum, P. R., & Rubin, D. B. (1983), "The central role of the propensity score in observational studies for causal effects," Biometrika, 70(1), 41-55.

Sargent, T. J., & Wallace, N. (1981), "Rational Expectations and the theory of economic policy," Rational expectations and econometric practice, 1, 199-214.

Svensson, L. E. (1997), "Inflation forecast targeting: Implementing and monitoring inflation targets," European economic review, 41(6), 1111-1146.

Svensson, L. E. (1999), "Inflation targeting as a monetary policy rule," Journal of monetary economics, 43(3), 607-654.

Svensson, L. E. (2002), "Inflation targeting: should it be modeled as an instrument rule or a targeting rule?" European Economic Review, 46(4-5), 771-780.

Van Bon, N. (2015), "The relationship between public debt and inflation in developing countries: Empirical evidence based on difference panel GMM," Asian Journal of Empirical Research, 5(9), 128-142.

Vasileva, I. (2018), "The Effect of Inflation Targeting on Foreign Direct Investment Flows to Developing Countries," Atlantic Economic Journal, 46(4), 459-470.

Vega, M., & Winkelried, D. (2005), "Inflation targeting and inflation behavior: a successful story?" International Journal of Central Banking, 1(3), 153-175.

Wheeler, M. (1999), "The macroeconomic impacts of government debt: An empirical analysis of the 1980s and 1990s," Atlantic Economic Journal, 27(3), 273-284.

Internet resources

"International Debt Statistics 2020"

https://data.worldbank.org/products/ids (accessed: 01.02.2022)

"the Institute of International Finance (IIF) 2019 Global Debt Monitor Report"

https://www.iif.com/Research/Capital-Flows-and-Debt/Global-Debt-Monitor (accessed: 08.04.2022)

"Richard Hiault. Posted on Dec 19, 2019, at 4:04 p.m. Updated Dec 19, 2019 2019 at 17:48," https://www.lesechos.fr/monde/enjeux-internationaux/la-bombe-a-retardement-de-la-dette-des-pays-en-developpement-1157884 (accessed: 7.08.2020)

http://www.blog-illusio.com/article-alimenter-l-inflation-pour-reduire-la-dette-publique-123903503.html, (accessed: 17.07. 2020)

Appendices

Appendix 1: Inflation targeting countries

Countries	Starting date	Countries	Starting date
Australia	1993	New Zealand	1990
Brazil	1999	Norway	2001
Canada	1991	Peru	2002
Colombia	1999	Philippines	2002
Czech Republic	1997	Poland	1998
Hungary	2001	Russia	2015
Indonesia	2005	South Africa	2000
Israel	1997	Sweden	1993
Japan	2013	Thailand	2000
Korea, Republic of	2001	Turkey	2006
Mexico	2001	United Kingdom	1992

Sources: Hammod 2011, Roger 2010

Appendix 2: List of control group countries (Countries not adopting inflation targeting policy)

Argentina	Ireland
Austria	Italy
Belgium	Lebanon
China	Malaysia
Croatia	Netherlands
Cyprus	Pakistan
Denmark	Portugal
Finland	Singapore
France	Slovenia
Germany	Spain
Greece	Switzerland
Hong-Kong	United States of America