

## External shocks and monetary policy under the inflation targeting regime (ITR): an analysis of the determinants of inflation for the period 2000-2021

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### Abstract:

*This article theoretically and empirically investigates the determinants of inflation in a sample of 83 countries, including countries that adopt an inflation targeting regime (ITR) and countries that do not, for the period 2000 to 2021. The hypothesis that guides the research is that the recent events or shocks in the global economy (the subprime crisis, the “Eurozone” crisis, the COVID-19 pandemic and, more recently, the war in Ukraine, among others) have resulted in supply shocks – exchange rates, food and energy – causing a rise in inflation and bringing recessive effects that may be more pronounced in ITR countries, given the greater institutional rigidity of the regime. The empirical part of the research includes an analysis of the determinants of inflation in the sample of ITR and non-ITR countries, with a focus on variables that represent supply shocks, in addition to a proxy for the existence of global conflicts, the latter being a potential contribution of the research. The main results, despite the differences between developed and developing economies, suggest that the commodity index, exchange rate variations, and global conflicts positively impacted inflation in the analyzed period.*

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### How to cite this article:

Araujo E., de Araújo E., Ribeiro R. da Fonseca M., Mourão P. (2023), “External shocks and monetary policy under the inflation targeting regime (ITR): an analysis of the determinants of inflation for the period 2000-2021”, *PSL Quarterly Review*, 76 (306):293-311.

DOI: <https://doi.org/10.13133/2037-3643/18034>

### JEL codes:

E42, E52, F62

### Keywords:

external shocks, inflation targeting regime (ITR), economic performance, world economy

### Journal homepage:

<http://www.pslquarterlyreview.info>

The events of the last decades of the 20th century, which led to the end of the Bretton Woods System, were followed by profound changes in the international monetary and financial system, in particular, through the establishment of floating exchange rates and the deepening of global economic integration, especially the financial integration.

In this context, consistent with the needs of the new phase of capitalist accumulation, new theories and recommendations of economic policies began to guide governments in promoting deregulation and liberalization policies to achieve stability and a growth economy in the long run. The new agenda began in developed countries, first under Britain’s Thatcher government in 1979, followed by the Reagan Administration in the United States in 1981; little by little, the



agenda was extended worldwide, reaching developing economies in the 1990s.<sup>1</sup> Internally, the developmentalist state, which was in crisis in many countries, was impelled to reorient public spending, keep the debt under control, and seek inflationary stabilization, opening space for the action of the private sector; this “state” was considered the true protagonist of development. Thus, in economic relations with the rest of the world, a pragmatic but growing process of trade and financial liberalization was instituted, while, internally, the scope of state intervention was reduced, prioritizing price stability. At the same time, there was an increasing number of economic crises, such as monetary and financial crises, in the real economy that originated in the most diverse countries, with direct and contagious effects, and had an increasing reach, due to the strong integration of markets (Galesi and Lombardi, 2009; Allegret et al., 2012; Parlak et al., 2021; Araujo et al., 2020).

In this regard, in the early 1990s, a theoretical framework began to gain ground – the New Macroeconomic Consensus (NMC). With roots in several schools of economic thought linked to mainstream economics (New Classics, New Keynesians, Real Business Cycles), the NMC's main policy recommendation is the adoption of the inflation targeting monetary regime or simply the inflation targeting regime (ITR), which is seen as “state of the art” in the conduct of monetary policy. The ITR assumes that money has effects in the short run – because of price rigidities – but not in the long run, so that monetary policy should not be conducted in a discretionary manner. The relevant instrument of action – the short-term interest rate or the “policy rate” – should be manipulated in such a way as to drive inflation to the center of some target previously stipulated by the economic authorities, raising it whenever GDP is growing close to the potential GDP or inflation is close to the established target; this came to be known as a kind of “reaction function of the central bank”.

The ITR was introduced first in developed countries – in New Zealand in 1990, Canada in 1991, and the United Kingdom in 1992. Later, Sweden, Finland and Australia joined the regime, which, from the 1990s and 2000s, reached several other economies – developed and developing – including Brazil in 1999. Currently, 31 countries officially implement the ITR.

After more than three decades of experience with the ITR, it is clear that it has been an instrument that allowed adopting countries to keep inflation rates under relative control. However, the theory and practice of central banks under ITR around the world showed that their main objective of macroeconomic policy – to which all others are subordinated – was monetary stability. The range of policies, methods and tools that central banks could use to achieve their objective was also narrowed. This became problematic, especially in the context of economic crises such as those mentioned above, as it drove central banks to opt for the one-instrument-one-goal route; relevant issues, such as output stability and financial stability were relegated to the background and excluded from the scope of many of these central banks.

In view of the above, this article aims to theoretically and empirically investigate the effects of external shocks on monetary policy in a sample of 83 countries, adopters and non-adopters of the ITR during the period between 2000 and 2021, to determine whether the effects of these shocks may be more pronounced in ITR economies. The empirical analysis included variables representative of supply shocks and, also, as a potential contribution of the study, a proxy variable for the existence of global conflicts. Calculated by the Uppsala Conflict Data Program (UCDP, 2023), this variable aims to capture the effects of conflicts in the international environment on the price level data. The hypothesis that guides the research is

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<sup>1</sup> For more details on the globalization process, liberalization and deregulation policies and their effects on developed and developing countries, see Kose et al. (2009) and Mishkin (2005).

that the crises that have affected the world economy in recent decades (the subprime crisis, the Eurozone crisis, the COVID-19 pandemic and, more recently, the war in Ukraine, among other crises) have resulted in supply shocks – of exchange rates, food and energy, especially oil, in addition to other commodities, culminating in increased global inflation and recessive effects, which seem to be more pronounced in countries that adopt the ITR, given the greater institutional rigidity of this regime.

In fact, since price stability is the essence of monetary policy and since inflation must be fought, even to the detriment of other economic variables such as increased production and employment, it is more difficult for the economy to accommodate the occurrence of supply shocks. This difficulty is often exacerbated by even stricter characteristics, such as a short time horizon for inflation to converge to the target, which prevents the mechanisms of monetary policy transmission from functioning properly and having the desired effect on final targets. This rigidity characteristic of the ITR leads to the adoption of a monetary policy that ends up becoming much more rigid in the short term and, with this, there is the possibility of a stronger and prolonged recessive effect in these countries.

This article is organized as follows. After this introduction, the next section provides a theoretical analysis of the ITR, discussing its basic assumptions and highlighting the context and characteristics of the countries that adopted it as a monetary regime. Section 2 analyzes the economic shocks or crises starting in the 2000s, highlighting the effects on macroeconomic variables, as well as the role of monetary policy in this context. Section 3 describes an investigation of the determinants of inflation through an analysis of panel data for the 83 adopters and non-adopters of the ITR, with emphasis on the variables representing the supply shocks, in addition to a proxy for the conflicts. The main results, despite the differences between developed and developing countries, indicated that the commodity index, exchange rate variations, and global conflicts positively impacted inflation in the analyzed period. This leads to the importance of reassessing the theories and practices of central banks to achieve greater effectiveness and impose less sacrifice on the part of society in terms of output and employment.

## **1. Monetary policy under the ITR: Context and theoretical framework**

Since the 1970s, changes in the world economy have challenged the conduct of economic policymakers in different countries. Together with the rise of new ideas in the field of macroeconomics, a favorable scenario was created for the emergence of a new theoretical framework for the conduct of economic authorities, namely, the New Macroeconomic Consensus (NMC).

Supported by the theoretical and empirical elements of mainstream economic schools of thought (New Classics, New Keynesians, Real Business Cycles), the NMC postulates that a low and stable inflation rate is the condition for long-term growth. In this view, money would have real effects in the short run due to nominal price and wage rigidity but not in the long run, when money neutrality prevails. In addition, there is the idea of (rational) expectations of economic agents, which plays a crucial role in determining inflation and in the transmission of monetary policy. Finally, fiscal policy is seen as playing a passive role as a means of stabilization, and the existence of an independent central bank improves the efficiency of monetary policy (Carvalho, 2015).

Inserted in the theoretical framework of the NMC, the ITR is seen as the state of the art in the conduct of monetary policy; the short-term interest rate or the policy rate as a relevant instrument is used to drive inflation to the center of some target previously stipulated by the economic authorities, raising it whenever GDP is growing close to potential GDP or inflation is close to the established target.

In general, the theoretical framework that describes the functioning of the economy under ITR is represented by three equations: one for the behavior of output, another for the dynamics of inflation determination, and, finally, a strategy or feedback rule for conducting monetary policy:

$$(y_t - y^*_t) = h(X_t, R_t, Z_t) \quad (1)$$

$$\pi_t = (y_t - y^*_t), s_t \quad (2)$$

$$r_t - p_t = (r_t - r^*_t) \quad (3)$$

Equations (1) and (2) relate the output gap to inflation and to a vector of exogenous variables ( $X_t$ ) and ( $R_t$ ), which are, respectively, net exports and government expenditures and its tax structure. The variable ( $Z_t$ ) represents an error term. Equation (3) shows a simple strategy for the political conduct of the central bank (BC), in which the current real effective interest rate and its nominal level are a function of the difference between current inflation ( $\pi_t$ ) and the interest rate target inflation ( $\pi_t^*$ ) (Fontana, 2009).

In the set of equations described above, it is worth noting that monetary aggregates do not appear among the variables, indicating that the monetary authority cannot contain inflation by controlling the money stock since there are rigidities in the short run, but it can establish inflation control via the nominal interest rate, supporting the hypothesis of endogenous money, at least in the short term.

This rule for the conduct of monetary policy was systematized by Taylor (1993), based on observation of the conduct of the Federal Reserve (FED) – the US central bank – and it became known as Taylor's rule or the central bank reaction function. It postulates that the central bank determines the basic interest rate to achieve an inflation target, explicit or implicit, and to keep the economy growing close to its potential, suggesting that the process of conducting monetary policy is modeled by a feedback rule, which relates the basic interest rate to the output gap and the deviation of inflation from a target.<sup>2</sup>

$$i_t = a_1 + a_2(\pi_t - 1 - \pi^*) + a_3 \quad (4)$$

with  $a_1 = \pi_t - 1 + i$

where:

$i_t$  = basic interest rate;

$i$  = real interest rate long-run (equilibrium)

$\pi_{t-1}$  = inflation rate (accumulated);

$\pi^*$  = inflation target; and

$y_t$  = deviation (percentage) of real GDP in relation to potential GDP; that is,  $y_t = 100 \left( \frac{PIB_t - PIB^*}{PIB^*} \right)$

<sup>2</sup> Later, Clarida, Gali and Gertler (1999) proposed a modification to Taylor's rule, introducing a smoothing term (autoregressive component) to capture the relative inertia of the interest rate, explaining the relationship between this rate and its lags, so that the following equation is:  $it = a_1 i_{t-1} + (1 - a_1)[a_2 + a_3(\pi_{t+1}^E) + a_4 y_{t+1}^E]$ .

$$\dot{i}_t = a_1 \dot{i}_{t-1} + (1 - a_1)[a_2 + a_3(\pi_{t+1}^E - \pi^*) + a_4 y_{t+1}^E] \quad (5)$$

Currently, 31 countries have adopted the ITR. The reasons that led to the adoption were quite diverse. According to Paula and Saraiva (2015), two aspects deserve attention. The first concerns the inefficiency of nominal anchors, such as exchange rate targets and monetary targets, which were used to guide the expectations of economic agents, enabling the control of inflation. The second aspect has to do with the rise of the NMC in the 1990s, a theoretical framework that influenced economies around the world. It is based on ideas such as the impossibility of monetary policy to affect real variables of the economy, such as output and employment, on a permanent basis, which is consequently contrary to the discretion of monetary policy.

In addition, at that time some countries were experiencing severe inflationary episodes and, faced with the difficulty of addressing the problem, found in the ITR framework a strategy for stabilizing prices and maintaining them in the medium and long term and, above all, a relatively simple rule for the conduct of domestic monetary policy from then on. In other cases, such as South Korea and Chile, the context was one of economic growth, which may have stimulated increases in price levels (Fonseca et al., 2016). It is worth noting that, in other countries, such as Mexico and Brazil, high inflation rates had complex roots of a structural and institutional nature related to the economic development process, such as external indebtedness, which was aggravated by the oil crisis and the rise in international interest rates in the late 1970s and early 1980s.

In this context, some governments began to implement monetary controls and to monitor credit, exchange rates, interest rates and reserves as part of their initial measures and studies and only later officially adopted the ITR; this was the case for Mexico, South Africa, South Korea and Chile. For this reason, at the time of the implementation of the ITR, most countries already registered relatively low rates of the inflation. Table 1 describes the history of adoption and the main characteristics in countries that officially implemented the regime.

According to table 1, there is diversity in how the ITR is implemented in the countries that adopt it. Regarding central bank (CB) independence in terms of autonomy to define the inflation target, in 15 of the 31 countries, the government and the CB jointly define the inflation target; in 3 countries (South Africa, Norway and the United Kingdom), the government alone determines the inflation target; and in the other 13 countries, the central bank determines the inflation target. Regarding the convergence horizon, most countries adopt a medium-term convergence period, between two and three years, a fact that gives greater flexibility to the regimes; while anchoring expectations, it allows for short-term divergences.

Table 1 – Characterization of the ITR in developed and developing countries

Country	Year of adoption of the ITR	Target established by the CB or government	Inflation measure used	Effective inflation (2021)	Inflation target (2021)	Goal type	Goal horizon
South Africa	2000	G	H CPI	6.22	4.50	Range	On a continuous basis
Australia	1993	CB and G	H CPI	2.80	2.50	Range	Medium term
Brazil	1999	CB and G	H CPI	11.10	3.75	P + T	Yearly target
Canada	1991	CB and G	H CPI	8.07	2.00	P + T	Six to eight quarters
Kazakhstan	2015	CB	H CPI	13.93	5.00	Range	Six to eight quarters
Chile	1999	CB	H CPI	7.56	3.00	P + T	Around two years
Colombia	1999	CB	H CPI	6.50	3.00	Range	Medium term
South Korea	1998	CB (with G)	C CPI	2.50	2.00	P + T	Three years
Costa Rica	2000	CB	H CPI	2.03	3.00	P + T	Twelve to twenty-four months
Philippines	2002	CB and G	H CPI	2.29	3.00	P + T	Medium term
Hungary	2001	CB	H CPI	6.30	3.00	Point	Medium term
Indonesia	2005	CB and G	H CPI	6.02	4.00	P + T	Medium term
Iceland	2001	CB and G	H CPI	6.00	2.50	Point	On average
Israel	1997	CB and G	H CPI	2.13	2.00	Range	Within two years
Jamaica	2006	CB and G	H CPI	7.43	4.00	Range	Medium term
Japan	2013	CB	H CPI	-0.88	2.00	Point	Medium to long term
Mexico	2001	CB	H CPI	5.16	3.00	P + T	Medium term
Norway	2001	G	H CPI	16.91	2.50	Point	Medium term
New Zealand	1989	CB and G	H CPI	4.33	2.00	Range	Medium term
Paraguay	2011	CB	H CPI	7.12	4.00	P + T	Eighteen to twenty-four months
Peru	2002	CB	H CPI	8.42	1.50	P + T	At all times
Poland	1998	CB	H CPI	5.05	2.50	P + T	Medium term
United Kingdom	1992	G	H CPI	0.37	2.00	Point	At all Times
Czech Republic	1997	CB	H CPI	3.33	2.00	P + T	Medium term
Romania	2005	CB and G	H CPI	5.42	2.50	P + T	Medium term
Russia	2015	CB	H CPI	16.47	4.00	Point	Twelve months
Serbia	2009	CB and G	H CPI	5.91	3.00	P + T	Medium term
Sweden	1995	CB	H CPI	2.98	2.00	Point	Two years
Thailand	2000	CB and G	H CPI	1.90	2.00	P + T	Eight quarters
Turkey	2006	CB and G	H CPI	28.95	5.00	P + T	Three years
Uruguay	2008	CB and G	H CPI	10.01	5.00	Range	Twenty-four months

Notes: i) HCPI: Headline Consumer Price Index; ii) CCPI: Core Consumer Price Index; iii) P + T: point with tolerance band; iv) CB: Central Bank; v) G: Government.

Source: based on Hammond (2012), Huang et al. (2019), and Central Banks (2023).

Regarding the type of target, this can be a point target or a band. A point target can be considered a characteristic of a more rigid regime, while a band allows greater flexibility. According to table 1, most countries use a one-off target plus a tolerance band, which establishes lower and upper limits for inflation. Regarding the inflation measure used, all countries use the consumer price index, which can be a full index or a measure of core inflation, that is, a measure that excludes components more sensitive to the various types of shocks in the calculation of inflation. Only South Korea uses core inflation, with other countries using the full index. However, according to Hammond (2012), several of the latter countries publish forecasts of core inflation, which allows for a reduction in the volatility of the price index, avoiding excessive use of monetary policy in the event of supply shocks.

Over the last three decades many countries started adopting the ITR as an anchor to stabilize inflationary expectations in their economies. During this period, a considerable number of studies were developed in order to understand the role of the regime, with some suggesting that the ITR has been a predominantly positive framework: Fraga et al., 2003; Gonçalves and Salles, 2008; Solanes and Flores, 2012; and Andersen et al., 2014, among others.

However, many researches were not conclusive about the benefits of the ITR on economic performance and macroeconomic stability. For instance, Brito and Bysted (2008) estimated a panel data model to investigate the impact of ITR on inflation and output growth in a group of 24 countries between 1999 and 2006, among them 13 ITR adopters and 11 non-ITR adopters, controlling for time-varying effects, country-specific effects, and simultaneity. The main results indicated that the responses of ITR countries regarding domestic interest rates when faced with an increase in inflation are greater and more persistent compared to non-ITR adopters. Furthermore, responses in terms of exchange rate policy management are weaker in countries under ITR and they do not make monetary policy more responsive to increases in international reserve flows.

Ball (2010), compares the performance of advanced economies in light of their different monetary regimes and differentiates three cases: adopters of the ITR, member countries of the Eurozone, and other traditional monetary regimes (other nominal anchors) in the last quarter of the 20th century. Among the conclusions of the study is the fact that adoption of the ITR in the advanced countries had a relatively modest impact on the fall in average inflation rates, and there was no evidence that the adoption of inflation targets improved product performance or interest rate behavior.

Agenór and Silva (2013) developed a study for upper-middle-income countries that adopted the ITR, considering the context of the post-international financial crisis (2008) and the challenges that the regime has faced in meeting its goals since then. Among the challenges were fiscal deficits, the destabilizing effects of capital flows on the exchange rate, and variations in commodity prices. According to the authors, many of the difficulties of domestic monetary policy in reaching determined objectives could be minimized by connecting the management of this policy with other measures, such as microeconomic and macroeconomic macroprudential policies, proactive credit policies, and reduction of systemic risk, combined with a strong fiscal policy that keeps the risk premium low and stable. Such actions would be complementary instruments to the ITR that could increase its effectiveness.

Walker (2018) studied the behavior of inflation in 14 developing economies since the adoption of the ITR until 2016. According to the study, the regime helped reduce the inflation rate in the economies and stabilize inflation expectations; it also made policies more transparent and open. However, it was suggested that the ITR could be more effective if there

was greater coordination between monetary and fiscal policy aimed at greater stability in the price level.

Chugunov et al. (2019) developed a study for a sample of 35 OECD countries and another 40 emerging countries, adopters and non-adopters of the ITR, in the period 1990-2017 that aimed to understand the role of this regime in macroeconomic performance. By using a panel data model for 75 countries, the research suggested that the adoption of inflation targets did not have a significant impact on the GDP growth rate, both in OECD countries and emerging countries; however, it did lead to a slight decrease in product volatility. Furthermore, under the ITR, the results showed, for emerging economies, a deceleration in the level and volatility of consumer price indices.

Zhang and Wang (2022) analyze whether the adoption of the ITR has an influence on economic performance by analyzing a set of 68 countries, adopters and non-adopters of the ITR. A difference of this research was that it observed the ITR in terms of its dynamics – considering the fact that, in most countries, inflation targets change over time – as well as tolerance intervals and their amplitude. The study's results suggested that countries adopting the ITR that exhibited better results in terms of inflation targets recorded over time did not exhibit better trajectories in terms of economic performance and even in terms of short-term inflation. The reason, according to the authors, might be related to aspects such as the loss of competitiveness resulting from free exchange rate fluctuation.

In summary, an increasing number of studies have pointed out many limiting aspects of the ITR, especially after the international financial crisis of 2007-2008, which makes it necessary to discuss the effects of these shocks on inflation and economic performance.

Next, the analysis turns to external shocks and their effects on the fluctuations of macroeconomic variables and monetary policy.

## **2. External shocks, fluctuations in domestic variables and monetary policy in the period 2000-2021**

Several real, monetary and financial crises have been recorded since the last decades of the 20th century. In the globalized context, with the advanced degree of integration of financial markets and the international division of labor, where production is organized around global production chains, these economic and financial tensions not only have immediate effects but usually imply possible medium- and long-term consequences. These consequences impact such variables as commodity, food and energy prices, in particular oil, which result in accelerating inflation; public indebtedness and its consequences; economic destabilization; and trade imbalances resulting from restrictive monetary policies.

Some of the main shocks on the world economy during this period are highlighted in table 2, below:



Table 2 – *Chronology of the main global crises since the 2000s*

<b>Crisis</b>	<b>Reason</b>	<b>Country of origin</b>	<b>Year</b>
“Dot-com bubble”	Falls in share prices of internet-connected companies	United States	2000
Attack on the Twin Towers (USA)	Terrorist attack on the twin towers of the World Trade Center in New York	United States	2001
Turkey crisis		Turkey	2001
Argentine crisis	Worsening of the fiscal crisis and, in the external sector, great shortage of reserves	Argentina	2001
Turkey crisis	Public debt and banking system crisis arising from high interest rates and exchange devaluation	Turkey	2001
War in Afghanistan	US invasion of Afghanistan as part of that country’s measures to combat terrorism, in retaliation for the September 11, 2001 attacks	Afghanistan	2001
Iraq War	Invasion of Iraqi territory by American troops in search of weapons of mass destruction and, in particular, terrorist groups linked to the attack on the twin towers in 2001	Iraq	2003
Subprime crisis	Burst of the stock “bubble” in the US real estate market	United States	2008
Eurozone crisis	Sovereign debt crisis in some countries that are part of the Eurozone	Europe	2010
COVID-19 pandemic	Discovery of a new type of virus – the Corona virus (COVID-19) – and the WHO’s declaration of a pandemic	China	2020
War in Ukraine	Russia’s invasion of Ukraine due to a dispute over territories and to retaliate against the Ukrainian government for actions considered contrary to Russian interests	Ukraine	2022

The direct and contagious effects brought about by these crises are widely documented and are particularly more pronounced in developing economies. Among the various consequences, depending on the nature of the shock, are: effects on the terms of trade, increases in production costs; and inflationary effects resulting, for example, from exchange rate pass-through, effects on financial markets, and psychological effects.

Among the studies that deal with shocks on the world economy and their effects is the study by Galesi and Lombardi (2009) of 33 countries – developed and developing – in Europe and Asia, mainly to observe the inflationary impacts, the exchange rate pass-through, and the extension or persistence of oil and food price shocks. Variables such as core inflation, “full” inflation, industrial production, short-term interest rates and nominal exchange rate were considered. The authors used the Global Vector Autoregressive (GVAR) methodology to study the short-run inflationary effects of common external shocks, as well as the international transmission of shocks from large economies/regions, such as the United States and the Eurozone, to smaller economies. The main results of the survey suggested that oil price shocks have a greater impact on nominal inflation in the short term. The initial magnitude of the shock response in the US was approximately twice as large as that in the euro area. Industrial production also decreased significantly in the US and in the Eurozone following an oil shock.

The impact on interest rates in large economies was relatively small and decreased over time; however, its transmission occurred differently in each region. This suggests that the reaction functions of central banks depend on the magnitude of the locally spread shocks and their persistence in each of the countries considered. There was a modest impact on the exchange rate, although it increased over time. Food shocks had a greater impact on inflation in developing countries.

Allegret et al. (2012) also analyzed the effects of oil price shocks, monetary shocks originating in the US economy, and international financial shocks on the fluctuations of domestic variables in East Asian countries, namely, China, Korea, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore and Thailand. The authors estimated a structural VAR model with block exogeneity (SVARX model) for the period 1990-2012, with analysis of variance decomposition and impulse-response function; through this, they documented an increasing impact of external shocks on domestic variables since the mid-1990s. Among other things, the study found: a greater increase in the producer price index (PPI) than GDP in all countries except Hong Kong and Indonesia; a variation in the nominal exchange rate; and the implementation of restrictive policies in some countries, such as China. The study showed that shocks in the real price of oil exert more important impacts compared to monetary and financial shocks originating in the US, with the exception of countries more interconnected with world financial centers, such as Hong Kong, Japan and Singapore. For the other countries, there was an increasing importance of regional financial shocks. Therefore, in this regard, it is suggested that shocks of a real nature have more pronounced effects because they affect the trade channel, which is very relevant in these economies given the episodes of regional origin.

Parlak et al. (2021) measured the impact of frequent exogenous shocks in the small economies of the ECCU (Eastern Caribbean Currency Union), which comprises six countries: Antigua and Barbuda, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines. Although none of these countries adopted the ITR, external shocks had a considerable impact, such as changes in global economic activity, tourism flows, oil prices, granting of passports, foreign direct investment (FDI) and natural disasters. Using an analysis methodology called canonical correlation (CCA) and a panel data model, the study showed that, in the period between 1980 and 2017, fluctuations in oil prices had significant effects on inflation, while, for the other types of shocks, the most pronounced effects were on GDP. In addition, it was evidenced that variations in FDI flows and in the granting of passports had effects on the countries' trade balance. Finally, one of the objectives of this study was to evaluate the effects of the shocks resulting from the COVID-19 pandemic, leading to substantial contractions in production in all ECCU countries and to the deterioration of the current account balance in most of them, especially due to the strong dependence on tourism flows.

Considering countries that adopt the ITR, Araujo et al. (2023) conducted a study of Brazil, Chile, Colombia, Guatemala, Mexico and Peru, six of the eight countries that adopted the ITR in the region between 2000 and 2020. The study estimated an autoregressive Markov-switching vector (MS-VAR) model using the following variables: interest rate, consumer price index, economic activity index, and national currency/US dollar exchange rate, to analyze the response of some relevant variables to changes in interest rates. Using a nonlinear approach, the results of economic policy were investigated in two different contexts: periods of high and low interest rate volatility, which refers to times of global instability, for example. Among the main results was that countries were susceptible to the global financial and commodities cycle, so interest rates were higher, as were prices, in these times of global instability. There was also

a trend of appreciation of real exchange rates, with volatile and procyclical behavior of the terms of trade, which is strongly related to GDP in these countries. Therefore, the authors argue that the rigid aspects of the ITR in the region, combined with the reforms after the 1990s, contributed to bringing a competitive disadvantage to the productive structure of these economies; that structure is currently based on commodities of global interest, making these economies subject to the volatility of global financial cycles and the restrictions of the international monetary hierarchy, suggesting that a reassessment of the adopted economic policies is in order, especially the monetary policy.

Regarding the role of monetary policy, or even the monetary regime for price stabilization, Isaac and Akutson (2023) conducted a study of panel data for the six member states of the West African Monetary Zone (WAMZ), namely, Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone, for the period 2000-2021. The variables used were the basic interest rate or policy rate, domestic credit, the money supply, and the exchange rate, with inflation being the dependent (explained) variable. Among the main results of the study, the authors found that, only in Gambia, changes in policy rates impacted short-term inflation and also, for WAMZ, the money supply effect on price stability is not significant statistically, revealing a weak link between monetary policy and stability of prices. However, despite the differences between countries, in the long run, monetary policy was more effective in achieving price stability; this indicates, in the authors' view, the importance of greater coordination between monetary and fiscal policies in terms of development of financial markets, a coordination that aims at growth and faces the structural problems that are typical for those developing countries.

Regarding the use of other tools, Carrasco and Hoyle (2021), conducted a study, based on the documented cases of several countries, that used a theoretical model designed to reflect the effects of exchange rate interventions in emerging countries to cope with economic shocks. The main results of the study, where exchange rate interventions are modeled as a tool of unconventional monetary policy that operates simultaneously with the conventional interest rate, indicated that, conditioned to external shocks, an exchange rate intervention policy is successful in reducing the exchange rate, reducing the volatility of credit, investment and production, and making substantial welfare gains when compared to a pure floating exchange rate regime.

Considering studies for a single country, Araujo et al. (2020) investigated the effectiveness of monetary policy in Brazil after the adoption of the ITR, considering the behavior of the global financial cycle (GFC), i.e., times of economic expansion and high liquidity and, conversely, times of retraction economy and reversal of foreign capital flows, under the assumption that this decisively interferes with the effectiveness of monetary policy. The study used an autoregressive vector model with Markov chains (MS-VAR) for the period 2000-2017, considering the influence, under monetary policy, of the traditional variables used in the literature, in addition to a proxy to represent the CFG, more specifically, a volatility index, which demonstrates expectations in the stock market. The authors observed that the effectiveness of monetary policy is influenced by the context of global economic instability, which was associated with an increase in the price level, in both monetary policy regimes (high or low inflation); this indicates that, in moments of reversal, the effects of a higher exchange rate contribute to increasing prices but, even in the expansion phase, volatility contributes to inflation, suggesting that agents may be trying to protect their profit margins by raising prices.

Considering the mentioned aspects, we now turn to the empirical analysis of the determinants of inflation.

### 3. An empirical analysis of the determinants of inflation

As noted above, the main objective of this study is to investigate the determinants of inflation in a sample of 83 countries, including countries that adopt the ITR and countries that do not, from 2000 to 2021.<sup>3</sup>

To understand the main factors that help to explain inflation behavior, the article starts with the interpretation by Taylor (1993), described in section 2, according to which the process of conducting monetary policy can be modeled by a feedback rule; this relates (positively) the basic interest rate to the output gap – the difference between the output and the potential output of the economy – and the deviation of inflation from a target. This rule is based on the concept that inflation is determined by factors on the demand side; thus, the interest rate is the main instrument of monetary policy and must be calibrated to contract demand and make inflation tend to the target.

However, other authors identify that the causes of inflation are most often linked to the supply side of the economy (Davidson, 2011; Wray, 1997). According to Davidson, supply shocks tend to cause an increase in costs, such as higher commodity prices or electricity shortages. The author also emphasizes that pressures from abroad tend to influence domestic price trajectories, so variables such as the degree of openness of an economy, the exchange rate, and the evolution of prices abroad are sources of change in the general domestic price level.

Starting from the determinants of inflation in the theoretical framework of the ITR and other determinants that are more in line with the theoretical discussion conducted in this study, the article will empirically analyze the determinants of inflation based on the following equation:

$$inf_{i,t} = inf_{i,t-1} + gap\_y_{i,t} + interest_{i,t} + rer_{i,t} + ic_{i,t} + ucdp_{i,t} + \mu_{i,t} \quad (6)$$

where *inf* is inflation measured by the consumer price index; *gap\_y* is the difference between GDP and potential GDP; *interest* is the policy interest rate; *rer* is the real effective exchange rate calculated for each country; *ic* is the commodity price index; and *ucdp* is a variable used as a proxy for the existence of global conflicts calculated by the Uppsala Conflict Data Program. It should be noted that this database is the world's leading provider of data on organized violence and the oldest ongoing data collection project on civil war, with its data being systematically defined and studied.

The term  $\mu$  incorporates the specific unobserved fixed effects for each country and an error term, whereas the subscripts *i* and *t* represent the countries and years of the sample.

The econometric methodology adopted is the use of a dynamic panel data model and the generalized method of moments (GMM), more specifically the GMM estimator developed after Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). According to Roodman (2009), such estimators are appropriate in terms of the use of panel data when we have the following: i) a linear functional relationship; ii) a lagging dependent variable, that is, one influenced by its past values; iii) explanatory variables that are not strictly exogenous, that is, predetermined and/or endogenous; iv) individual fixed effects; v) heteroscedasticity and autocorrelation within groups of individuals; and vi) the possibility of using internal instruments based on their own lagged variables or external instruments.

<sup>3</sup> The sample time period, as well as the number of countries included, was determined by data availability.

### 3.1 Estimated model results

Table 3 summarizes the results of the estimation of equation (1) for 4 distinct groups of countries: i) the 83 countries in the entire sample, ii) the 41 developing countries, iii) the 42 developed countries, and iv) the 31 countries of the sample that adopted the ITR. Regarding the analysis of the results, the estimated coefficients of all the variables analyzed are economically and statistically significant in explaining the behavior of inflation, with some specificities.

Table 3 – Results of the estimations of the determinants of inflation

	All countries	Developing countries	Developed countries	ITR countries
	<i>Ln inflation</i>	<i>Ln inflation</i>	<i>Ln inflation</i>	<i>Ln inflation</i>
<i>L.lninflation</i>	0.203**	0.295***	0.226*	0.303***
	-0.08	-0.091	-0.127	-0.093
<i>L2.lninflation</i>	-0.183***	-0.195**	-0.034	-0.041
	-0.039	-0.099	-0.111	-0.08
<i>L.lngdpgap</i>	0.069**	0.110**	0.407*	0.290***
	-0.029	-0.05	-0.02	-0.089
<i>L.D.lninterest</i>	-0.400*	-0.122	-0.148*	-0.024
	-0.213	-0.267	-0.043	-0.125
<i>L.D.lnrer</i>	0.320**	0.642***	2.387	0.794*
	-0.123	0.171	-1.864	-0.462
<i>L.lnic</i>	0.534**	0.690**	0.241**	0.327***
	0.262	0.321	0.102	-0.051
<i>L.D.lnucdp</i>	0.594**	0.374**	0.708***	0.344**
	0.251	0.156	0.209	-0.159
<i>Constant</i>	4.724***	3.536***	0.498*	-0.939*
	-1.394	-1.205	-0.262	-0.55
Observations	1,566	816	750	483
Number of countries	83	41	42	31
AR(1)	1.30E-05	0.00777	0.000575	0.000232
AR(2)	0.383	0.279	0.33	0.33
Hansen	0.902	0.925	0.956	0.9611
Number of Instruments	79	79	79	79

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Notes: With the exception of the variables output gap and inflation rate, which are already in first difference, the variables are the difference of the logarithm and can be interpreted as the rate of change.

As for the first variable presented in the table, which is the inflation lagged, it had a positive and significant sign, which can be interpreted as the positive contribution of inflationary inertia on the level of current inflation, i.e., the share of inflation that is explained by the past behavior of inflation itself.

The positive and significant sign of changes in the nominal exchange rate is in line with the post-Keynesian discussions on the determinants of inflation, which emphasize that exchange devaluations tend to cause significant price pressures in domestic economies, as corroborated by Carrasco and Hoyle (2021) for example. The only exception is the group of advanced countries, which can be explained by the fact that exchange rates tend to be more stable in these economies and less susceptible to exchange rate and financial crises.

In the same vein, there is the result referring to the variations in the commodity price index, which summarizes the price behavior of a significant set of commodities in the international market. In practice, prices of commodities are not fixed but follow global demand and supply capacity. It is possible to interpret the changes in this index as an external determinant of inflation. The coefficient for this variable indicates that positive variations in the price of commodities contribute to increasing domestic inflation. This result is in line with many studies mentioned in section 3, such as Galesi and Lombardi, 2009, and Allegret et al., 2012.

The output *gap* variable represents the difference between the output of the economy and its potential output, whose proxy is a trend in output, calculated using the Hodrick-Prescott filter (Hodrick and Prescott, 1997), and represents the pressures on inflation arising from demand shocks. The results show that, in fact, increases in the output gap imply an increase in inflation in the set of countries analyzed. This means the demand-side pressure plays an important role in explaining inflation.

The output gap variable represents the difference between the output of the economy and its potential output. Its proxy is a trend in output, calculated using the Hodrick-Prescott filter (Hodrick and Prescott, 1997), and represents the pressures on inflation arising from demand shocks. The results show that, in fact, GDP growth above its trend is positively correlated with inflation in the set of countries analyzed.

The use of the proxy variable for the existence of global conflicts calculated by the Uppsala Conflict Data Program (UCDP, 2023), which is a contribution of the study, attempts to capture the effects of conflicts in the international environment on the level of inflation. Regarding this variable, table 3 shows that, in the general model (which encompasses all countries), it presented a positive and significant coefficient, indicating that positive variations in this index of global conflicts contribute to the increase in inflation in the analyzed period.

Finally, the coefficient relative to the interest rate variable had the expected negative sign but it was significant only for the complete sample and for the group of developed countries. For countries that adopt an ITR and for developed countries, the coefficient of the interest rate was not significant in explaining inflation. The result, although surprising, is in line with some econometric studies that show that there is a low sensitivity of the inflation rate to changes in interest rates, so that a stabilization policy based solely on changes in the policy rate has been ineffective in fighting inflation. Therefore, controlling inflation has resulted in a high sacrifice rate and needs to trigger other channels of monetary transmission, such as the exchange rate channel (Modenesi and Araújo, 2013). The low and stable interest rate levels prevailing in many of the countries in the sample may also have contributed to the non-significance of the interest rate in this model.

Finally, to give consistency to the GMM estimator, it is necessary that the instruments used in the model are valid. In this regard, Arellano and Bond (1991) suggest two tests: i) the Hansen test, whose null hypothesis is that the instruments are overidentified, and ii) the autocorrelation test to verify whether the differentiated error presents second-order autocorrelation. Furthermore, as the generated estimates crucially depend on the validity of the instruments used to identify the endogenous variables, the Hansen test was performed to test the joint validity of the instruments used. Failure to reject the null hypothesis of the test indicates that the instruments used are robust. Thus, the tests for the three models indicate that the restrictions used are valid. The serial autocorrelation test examines the hypothesis that the error term is not serially correlated; more specifically, it tests whether the differentiated error term is serially correlated in second order (by construction, the differentiated error term is probably correlated serially in first order, even if the original error term is not). The tests indicated that the null hypothesis of the absence of a second-order serial correlation in the differentiated error term cannot be rejected.

Therefore, it can be concluded from the results of the estimations that, in general, the variables suggested as determinants of inflation were relevant to explain this variable in the studied period and in the set of countries analyzed.

#### 4. Closing comments

In this paper we described the results of a study to investigate the determinants of inflation in a sample of 83 countries, including countries that adopt the ITR and countries that do not, for the period 2000-2021 in view of the external shocks in the world economy and their consequences, with particular interest in countries that adopt the ITR.

Based on a theoretical framework of the ITR and a contextualization of exogenous shocks and the role of monetary policy, we provided an empirical analysis through a panel data model in order to understand the role of the supply shocks on the performance of monetary policy, especially by including a proxy for the existence of global conflicts that attempts to capture the effects of conflicts in the international environment on the level of inflation. It should be noted that this database is the world's leading provider of data on organized violence, which was a potential contribution of the study.

Among the main results of the study, considering the empirical literature and the data, it should be noted that there is a remarkable instability in the world economy at the threshold of this 21st century due to the occurrence of global shocks. These impact the trajectory of several macroeconomic variables, inflation and output in particular, demanding action from the economic authorities to ensure stability and mitigate the recessive effects.

Corroborating this analysis, the findings of the econometric model, despite the differences between developed and developing countries, indicated that the variables representing the exogenous shocks played a relevant role in explaining inflation, namely, the commodity index, exchange rates and global conflicts, which positively impacted inflation in the considered period. In this case, the present analysis shows that the performance of the ITR, which presupposes demand inflation, combating it with rising interest rates, ends up leading to suboptimal results.

This leads to the importance of reassessing the theories and practices of central banks that adopted the ITR and focus on one-goal-one-instrument, despite the chaotic context that

accompanies the global shocks/crises in recent decades. Nontraditional tools, such as foreign exchange interventions, could be important allies to achieve greater effectiveness of economic policies, imposing less sacrifice on society in terms of output and employment.

## Appendix

Table A1 – Description of the variables used with their respective sources

Variable	Description	Source
<i>gap_inf</i>	Deviation of inflation in relation to the target established by the Central Bank. The data were computed from the date of adoption, for countries that adopted after the year 2000.	IMF (2023b); CBA (2023); CBC (2023); CNB (2023); CBI (2023); BoI (2023); Bjp (2023); RBNZ (2023); NB (2023); BOK (2023); SR (2023); BoE (2023); BCB (2023); CBCh (2023); CBCo (2023); CBCR (2023); CBH (2023); CBInd (2023); BJ (2023); NBK (2023); BM (2023); CBPar (2023); CRBP (2023); BSP (2023); NBP (2023); NBR (2023); CBRF (2023); NBS (2023); SARB (2023); BOT (2023); TCMB (2023); BCU (2023)
<i>gap_y</i>	Difference between GDP and potential GDP obtained by applying an HP filter	IMF (2023b); CBA (2023); CBC (2023); CNB (2023); CBI (2023); BoI (2023); Bjp (2023); RBNZ (2023); NB (2023); BOK (2023); SR (2023); BoE (2023); BCB (2023); CBCh (2023); CBCo (2023); CBCR (2023); CBH (2023); CBInd (2023); BJ (2023); NBK (2023); BM (2023); CBPar (2023); CRBP (2023); BSP (2023); NBP (2023); NBR (2023); CBRF (2023); NBS (2023); SARB (2023); BOT (2023); TCMB (2023); BCU (2023)
<i>interest</i>	Interest rate established by the BC	IMF (2023a); CBA (2023); CBC (2023); CNB (2023); CBI (2023); BoI (2023); Bjp (2023); RBNZ (2023); NB (2023); BOK (2023); SR (2023); BoE (2023); BCB (2023); CBCh (2023); CBCo (2023); CBCR (2023); CBH (2023); CBInd (2023); BJ (2023); NBK (2023); BM (2023); CBPar (2023); CRBP (2023); BSP (2023); NBP (2023); NBR (2023); CBRF (2023); NBS (2023); SARB (2023); BOT (2023); TCMB (2023); BCU (2023)
<i>rer</i>	Real effective exchange rate calculated for each country	BIS (2023); Darvas (2012 and 2021)
<i>ic</i>	General price index of all commodities traded in the world	IMF (2023b)
<i>ucdp</i>	Proxy that measures the existence of global conflicts calculated by the Uppsala Conflict Data Program	UCDP (2023)

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