de Oliveira, Gabrielle Mari; Vasconcelos, Marcos Roberto

EVIDENCE OF HOW MACROPRUDENTIAL POLICIES IMPACT LATIN AMERICAN ECONOMIES DEPENDING ON THE TYPE OF THEIR MONETARY REGIME STRUCTURE°

EVIDENCE OF HOW MACROPRUDENTIAL POLICIES IMPACT LATIN AMERICAN ECONOMIES DEPENDING ON THE TYPE OF THEIR MONETARY REGIME STRUCTURE°

EVIDENCIA DE LA IMPORTANCIA DE LA ESTRUCTURA DEL RÉGIMEN MONETARIO PARA LOS IMPACTOS DE LAS POLÍTICAS MACROPRUDENCIALES EN LAS ECONOMÍAS LATINOAMERICANAS

Gabrielle Mari de Oliveira*
Marcos Roberto Vasconcelos**

Abstract

The objective of this study was to perform an empirical analysis of the macroeconomic effects of macroprudential policies and the influence of monetary regimes on these policies in the main countries of Latin America from 2007 to 2019. The countries analyzed were Argentina, Bolivia, Brazil, Costa Rica, Chile, Colombia, Ecuador, Mexico, Peru, and Uruguay. They were divided into countries that adopt the Inflation Targeting Regime (ITR) and those that have another monetary structure. For this end, the panel vector autoregression (PVAR) method was used. This paper points out that, in ITR countries, macroprudential policies achieve their goal of reducing credit. Moreover, other macroeconomic variables have the expected behavior. On the other hand, these policies seem to have contradictory impacts on non-ITR countries.

* Universidade Cesumar, Brasil. ORCID: https://orcid.org/0000-0002-9383-6485. E-mail: gabrielle-marideoliveira@gmail.com

** Universidade Estadual de Maringá, Brasil. ORCID: https://orcid.org/0000-0003-1476-4899. E-mail: mrvasconcelos@uem.br

Resumen

El objetivo de este trabajo es realizar un análisis empírico de los efectos macroeconómicos de la política macroprudencial y la influencia del régimen monetario sobre esta política en los principales países de América Latina desde 2007 hasta 2019. Los países analizados son Argentina, Bolivia, Brasil, Costa Rica, Chile, Colombia, Ecuador, México, Perú y Uruguay, divididos en países con Régimen de Metas de Inflación (RMI) y los que siguen otra estructura monetaria. Para ello se utiliza el método PVAR. En los países con RMI, la política macroprudencial alcanza su objetivo de reducir el crédito y las demás variables macroeconómicas tienen el comportamiento esperado. Por otro lado, la política macroprudencial parece tener impactos contradictorios en los países que no son RMI.

Palabras clave: política macroprudencial, América Latina, Régimen de Metas de Inflación.
Clasificación JEL: E42, E58, E61.

INTRODUCTION

The Global Financial Crisis (GFC) of 2007-2009 caused the deterioration of asset prices and the reduction of liquidity, in addition to serious impacts on economic activity. After this crisis, the need for a structured policy aimed at controlling the financial system became evident (Akerlof *et al*., 2014; Akinci & Olmstead-Rumsey, 2018). In this effort, discussions related to macroprudential policies arise, which generate broad theoretical and regulatory developments on them. According to Constâncio (2016), these policies aim to prevent and reduce systemic risks by seeking to achieve and preserve financial stability through measures concentrated on the credit and liquidity of financial institutions[1].

As macroprudential policies gained interest and importance, both for the financial system and for the real economy, they started to be structured and applied in several countries and to be supported by multilateral institutions such as the Financial Stability Board (FSB) and the Bank for International Settlements (BIS). As a developing field of research, studies related to impact assessments of macroprudential policies are relevant to help define their best tools and arrangements. In addition, investigations will allow understanding how the set of macroprudential actions should be implemented or how their efficacy is affected by specific characteristics of each economy.

These arguments support the main objective of this work: from the analysis of ten Latin American economies, to provide empirical evidence of the macroeconomic effects of macroprudential policies (tools related to the supply of credit), namely, their impacts on gross domestic product (GDP), inflation rates, and the volume of credit. We also sought to investigate the possibility of macroprudential and monetary policies, although having crossed objectives, are well articulated or cause overlapping effects in the economy, with the risk of bubble formation in the financial system.

In addition, this article aimed to ascertain whether the effects of macroprudential tools were similar in economies with a uniform monetary regime (Inflation Targeting Regime - ITR) or in those that have other arrangements. Thus, we could notice the influence of monetary regimes on the effectiveness of macroprudential policies. For instance, in works carried out for the Asian region, Kim and Mehrotra (2018) and Kim and Mehrotra (2019) determined that these policies have similar

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[1] Financial institutions are the target of macroprudential policies as they are the agents that provide credit to the economy.

impacts between countries that follow the ITR and those that do not. Therefore, we were interested in studying whether these results are repeated in Latin America.

We separated the countries into two groups. The first one comprises nations that adopt the ITR (Brazil, Chile, Colombia, Mexico, and Peru). The second those that have different monetary arrangements (Argentina, Bolivia, Costa Rica, and Ecuador). These groups make up the comparative analysis of the study. We analyzed the period between the first quarter of 2007 and the fourth quarter of 2019. The assessment was started in 2007 to capture the movements of the variables from the first signs of the GFC and to identify the policies applied since then.

To fulfill the research objectives, we used the panel vector autoregression (PVAR) method, which allowed us to apply impulses to the variables representing monetary and macroprudential policies and observe the results in the variables of interest in panel data. In addition, we could examine the interactions between these two types of policies and see how long their effects on the economy last.

The main findings indicate that, in the group that adopted the ITR, the policies seemed to be coordinated and showed signs of success in achieving their specific objectives. Monetary policies controlled inflation and had significant effects on product, and the macroprudential ones impacted credit levels, which could affect financial stability. On the other hand, in the countries with different monetary regimes (non-ITR), the results found in this work are contradictory or even insignificant, mainly for macroprudential policies.

In addition to this introduction, this article is divided into five more sections. The first one addresses the main reasons for the crisis of 2007/09, justifying the need for structuring macroprudential policies and their theory. Section II presents the methodological processes and the description of the variables. The third section details and discusses the results. Finally, Section IV provides the main considerations of this work.

I. THEORETICAL CONSTRUCTION OF MACROPRUDENTIAL POLICIES

The experience of the 2007-2009 financial crisis showed that credit expansion is an important component in the formation of financial imbalances, as highlighted by Ariccia, Igan, and Laeven (2012). Monetary policies, through interest rate, can contribute to increasing the demand for credit. Moreover, the combination of low interest and the boost of the credit supply distances asset prices from their

fundamental value, thus creating bubbles and an environment of growing systemic risk (Ashcraft & Schuermann, 2008). If there is a shock or a bubble burst, financial institutions start to have problems of capital and liquidity, becoming credit deficient and causing insolvency of economic agents (Brunnermeier, 2009). Highly leveraged financial and non-financial institutions exacerbate the problem, with severe consequences for economic activity (Helleiner, 2011).

The discussion on the causes of the 2008 crisis soon evidenced that the problem was the lack of a policy focused on the financial system and its stabilization, in addition to control over credit expansion. According to Reinhart and Rogoff (2009) and Schularick and Taylor (2012), recognition of the limitations of the policies applied until then made policymakers seek other tools to ensure financial and macroeconomic stability, either independently or as a complement to monetary policies. It is then that macroprudential policies emerged in the macroeconomic debate.

However, as pointed out by Blanchard, Dell'Ariccia, and Mauro (2014), economic policy managers should concentrate on the interactions between the application of macroprudential tools[2] and the management of interest rates, since the latter affects the behavior of the financial system, producing potential risks, and macroprudential policies impact aggregate demand through their effects on credit. Thus, these policies should be coordinated and thought of together, even with their individual objectives.

Thereby, it is necessary to pay attention to how macroprudential policies are transmitted to economic activity, mainly through the credit channel. Considering macroprudential tools focused on the supply of credit, this type of policy should be able to reduce credit in the economy, causing banks to restrict the availability of loans and, thus, contributing to the fall in consumption and investment. According to Karmakar (2016), this strategy provides structural stability to the financial system, as it controls credit levels and mitigates its potential volatility.

These transmission processes and implications are in line with the findings presented in this article for the ITR group of countries. In addition, they agree with the results shown by Kim and Mehrotra (2018), Kim and Mehrotra (2019), and Kim and Oh (2020) (studies for the Asian region). Aikman, Bush, and Taylor (2016) have also evaluated the macroeconomic effects of these policies in the United

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[2] Macroprudential policy tools include higher capital requirements for financial institutions (making them less likely to become insolvent if their asset prices fall); higher liquidity requirements (liquidity available in the event of a bank run); and cyclical capital requirements, so that institutions have buffers in periods of good performance; among others.

Kingdom and pointed out that changes in monetary policies acted on product and inflation, largely in line with the views of the New Consensus in Macroeconomics. They also noted that more restrictive macroprudential policies mainly modulated bank loans while decreasing production and leaving inflation unchanged. Similarly, Alam *et al*. (2019) examined 134 countries and concluded that the tightening of macroprudential policies reduces the growth of credit directed to households.

On the other hand, using the meta-analysis technique, Gambacorta and Murcia (2020) have shown the effects of macroprudential policies on the financial system of Argentina, Brazil, Colombia, Mexico, and Peru. They have determined that this type of policy mitigates credit cycles and reduces the risks of the banking sector. Minaya and Lupú (2017) have also observed that macroprudential actions slow credit growth in Peru. For their part, Rojas, Vegh, and Vuletin (2020) have identified that these policies decrease production in Argentina, Brazil, and Uruguay.

The aforementioned authors, with the exception of Kim and Mehrotra (2018) and Kim and Mehrotra (2019), have not differentiated countries in relation to their monetary regimes, as we do in this article. Moreover, this may influence the results of the analysis, as shown in Section III. In addition, the work of Kim and Mehrotra (2018), as well as the studies by Kuttner and Shim (2016), Kim and Mehrotra (2019), Richter, Schularick, and Shim (2019), and Kim and Oh (2020) have only evaluated the effects of measures focused on credit demand, such as loan-to-value (LTV) and debt-service-to-income (DTI), without considering actions on the supply of credit. As already indicated, this paper focuses on measures that impact the supply of credit.

II. METHODOLOGY AND DATA DESCRIPTION

To fulfill the aim of this work, the PVAR model was defined as the best methodological strategy. Fundamentally, this model allowed us to explore the implicit causal relationship between the variables studied. Thus, we could infer the existence or not of a causality in the observation of changes in macroprudential and monetary policies impacting the variables of economic activity. In addition, we examine the interactions between these policies.

The Latin American countries analyzed in our study were divided into two groups: those with an inflation targeting regime, called "ITR group," and those adopting another monetary arrangement, "non-ITR group." The database for this work includes quarterly information from the first quarter of 2007 to the fourth quarter of 2019 for all countries.

Through the PVAR method, impulses were applied to the interest rate (IR) variables, representative of monetary policies, and to the dummy variables[3], symbolizing macroprudential policies (PP). The IR variable stands for the interest rates at the end of the quarter, obtained from the International Financial Statistics (IFS), Global Economic Data, Indicators, Charts & Forecasts (CEIC), and the central banks of Peru and Uruguay.

Given that the countries do not have a history of macroprudential processes and do not undertake the same actions, we used measures focused on the supply of credit to create indexes of this type of policy: capital buffer, capital requirements, limits on the leverage of financial institutions, and loan loss provision requirements. The dummy variables assume a value of 1 when restrictive changes are observed in these policies and 0 when there is no change. Therefore, the intensity of the applied measure is not considered, but rather the amount and direction of implementation of the macroprudential action. We took this information from the databases provided by Alam *et al*. (2019), Cerutti, Claessens, and Laeven (2017), and by central banks of the examined countries.

In both groups, we analyzed the responses of the variables considered endogenous in the model: inflation rate - Consumer Prices Index (CPI); real GDP growth; and domestic bank credit. For inflation rate, we took into account the percentage variation of the same period of the previous year, obtained from the International Monetary Fund (IMF) and the central banks of Peru, Argentina, and Uruguay, exclusively for these countries[4]. For real GDP growth, measured as a percentage change from the same period in the previous year, IMF and CEIC data were used. In relation to domestic bank credit to the private non-financial sector in millions of US dollars (CTPS), the data were extracted from the BIS and the central banks of Peru, Uruguay, Costa Rica, Ecuador, and Bolivia, for these respective countries[5].

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[3] For this work, we used only 1 and 0 for dummy variables, where 1 represents a tightening policy and 0, when no policy was applied. The test was carried out with -1 (which would be to loosen the measure); however, there were few cases and only one for Brazil that generated inconsistency in the results. Thus, we chose normality and changes in macroprudential policies in the tightening sense, presenting logic. This is because when the central bank relaxes a policy, banks have already adapted to the new rules and, therefore, do not cause significant results.

[4] The Central Bank of Peru makes the data available in a 12-month percentage change. Therefore, for the years between 2007 and 2010, we averaged the months for the index of each quarter. After 2011, the information was collected by CEIC on a quarterly basis.

[5] The data for Uruguay are given monthly, thus an adjustment was made for each quarter.

GDP and the inflation rate are traditional representatives of the stability of a national economy and its general conditions, while credit is an indicator of the dynamics of the financial market and the formation of possible imbalances in the financial system. In addition, these three variables are strictly related to the supervision of monetary policies.

The vector of exogenous variables includes US IR and US GDP, that is, US interest rates and real GDP, respectively. These variables are applied because of the potential impact of monetary policies and economic activity in the United States on financial conditions, the real economy, and interest rates in Latin America.

In order to obtain more robust results, methodological processes were also used by means of the variables percentage of private consumption (_CONSUM) and percentage of private investment (_INVEST). They are potential transmission channels for the two types of policies. The data referring to private consumption as a percentage of nominal GDP were collected from CEIC and comprised the consumption of households and private companies, considering the non-profit institutions that provide services to households. However, for Costa Rica and Uruguay, the information was extracted from the Economic Commission for Latin America and the Caribbean (ECLAC)[6]. On the other hand, investment (gross fixed capital formation) was based on the ECLAC database.

II.1. PVAR model

We assumed that the economy i ($i = 1, 2,…, N$) is described by the following equation:

$$G(L)y_t^i = d^i + C(L)x_t + e_t^i, \tag{1}$$

where $G(L)$ and $C(L)$ are polynomial matrices in the *lag* of L; y_t^i is a vector of $M \times 1$ data of endogenous variables for country i at time t; x_t is a vector of $K \times 1$ data of exogenous or global variables; d^i is a constant matrix $M \times 1$; M and K represent the endogenous and exogenous variables in the model, respectively; and e_t^i expresses a vector of structural disturbances. Considering that these disturbances are mutually unrelated, var (e_t^i) is a diagonal matrix in which diagonal elements

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[6] Data for Costa Rica and Uruguay are available in domestic currency (values); therefore, we calculated the percentage in relation to nominal GDP. The same process was applied for investment (gross fixed capital formation, given the availability of data) for all countries.

are the variance of structural disturbances. The fixed individual effect, d^i, was introduced to control country-specific factors that are not taken into account in the model (Kim & Mehrotra, 2018).

According to Kim and Mehrotra (2018), a reduced form of the PVAR model was estimated with individual fixed effects, represented by the following equation:

$$yt^i = c^i + B(L)y^i_{t-1} + D(L)x_t + u^i t, \qquad (2)$$

where c^i is a constant vector $M \times 1$; $B(L)$ and $D(L)$ are polynomial matrices in *lag L*; and u^i is a vector $M \times 1$ of reduced-form residuals and var $(u^i)=\Sigma t$.

As the variance-covariance matrix of errors was not diagonal, and the errors of the reduced PVAR model presented contemporary relationships with each other, it was necessary to decompose the errors so that they became orthogonal. Therefore, Cholesky identification was introduced adopting a particular ordering of the variables of the system. In this case, the ordering took the variables that initially appeared in the system as weakly exogenous, while those that were arranged in the sequence were estimated as more endogenous (Vinhado & Divino, 2015).

All data were stable. Granger causality was also tested. In the construction of probability bands for impulse responses, we applied the Monte Carlo integration method. In addition, we verified the Dickey-Fuller unit root test (1981), the ADF-GLS test elaborated by Elliott, Rothenberg, and Stock (1996), and the Phillips-Perron test (1988). For this work, we used two and three lags considering the Akaike parameter for identification.

II.2. Data description

The following charts show the behavior of the variables real GDP, inflation rate, credit to the private sector, interest rate, and the implementation of macroprudential policies, respectively.
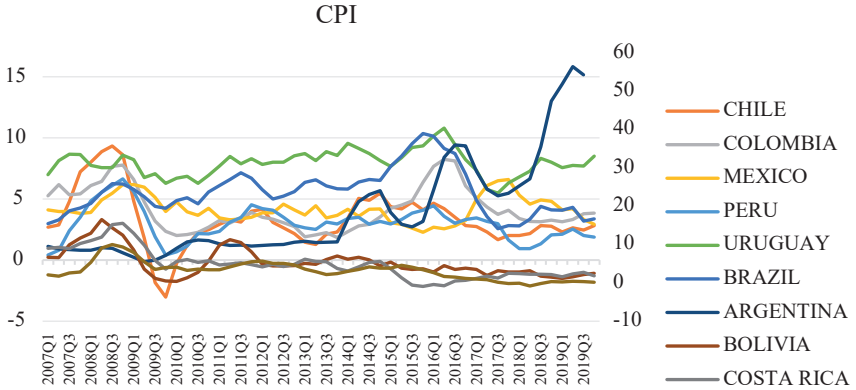
Chart 1. Performance of real GDP (in percentage) for the sample of countries in the ITR and non-ITR groups between the first quarter of 2007 and the fourth quarter of 2019

GDP (ITR)

GDP (non-ITR)
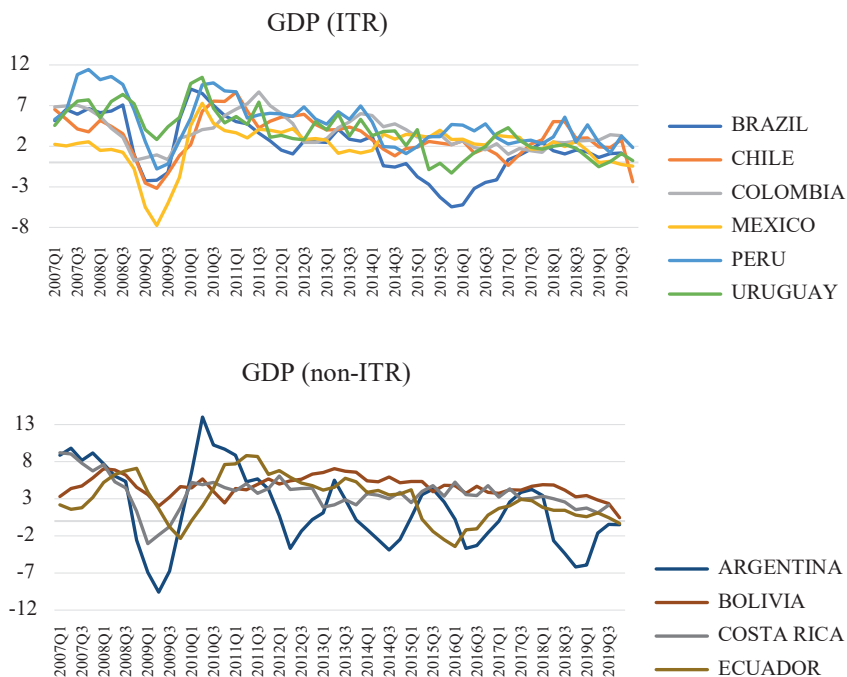
Source: Own elaboration based on the data obtained from IMF (2020) and CEIC (2020).

As can be seen in Chart 1, all the countries studied showed a weak economic performance as of the third quarter of 2008, which reflects the deleterious impact of the GFC. This fact is a consequence of the strong link between the Latin American economies and the United States, the epicenter of the crisis. Argentina, given its various internal crises, had other moments of negative real GDP, specifically in 2012, 2014, 2016, and between 2018 and 2019. Brazil, with the political and economic crisis of 2015, also experienced negative percentages of real GDP until the beginning of 2017.

Chart 2. Performance of inflation rate for the sample of countries in the ITR and non-ITR groups between the first quarter of 2007 and the fourth quarter of 2019

CPI

Note: Non-ITR countries are represented on the secondary axis.
Source: Own elaboration based on data obtained from IMF (2020) and the central banks of Peru, Argentina, and Uruguay (2020).

Chart 3. Performance of credit to the private sector (in millions of dollars) for the sample of countries in the ITR and non-ITR groups between the first quarter of 2007 and the fourth quarter of 2019

CTPS
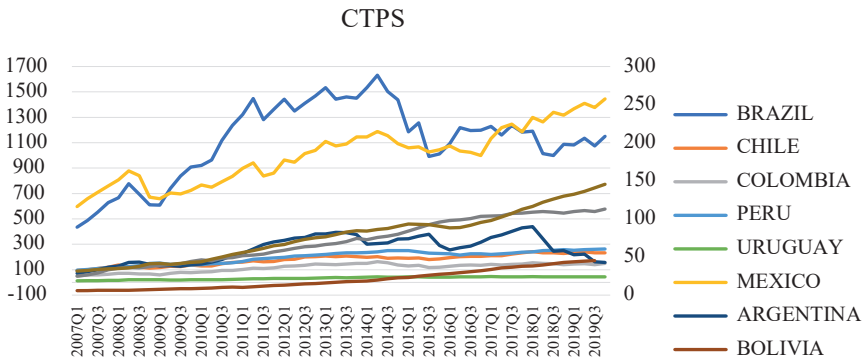
Note: Non-ITR countries are represented on the secondary axis.
Source: Own elaboration based on data obtained from BIS (2020) and the central banks of Peru, Costa Rica, Ecuador, Bolivia, and Uruguay (2020).

Chart 2 shows the fluctuations in the inflation rate in the sample of countries. Chile presented negative results for this variable between 2009 and 2010. Argentina was the most volatile economy, with an inflation rate of 54% in the last quarter of 2019, which reflects the crisis suffered by this country.

As can be seen in Chart 3, Brazil and Mexico stand out in relation to credit to the private sector. This fact evidences that these economies may have a more developed financial system compared to the other countries, in addition to being the largest ones in the sample. Moreover, according to Nuguer and Garcia (2016) and Alam *et al*. (2019), Brazil and Mexico have a history of using prudential measures since the 1990s, favoring the resilience of the financial system and making lending more solid.

Chart 4. Performance of interest rate for the sample of countries in the ITR and non-ITR groups between the first quarter of 2007 and the fourth quarter of 2019

IR (ITR)

IR (non-ITR)
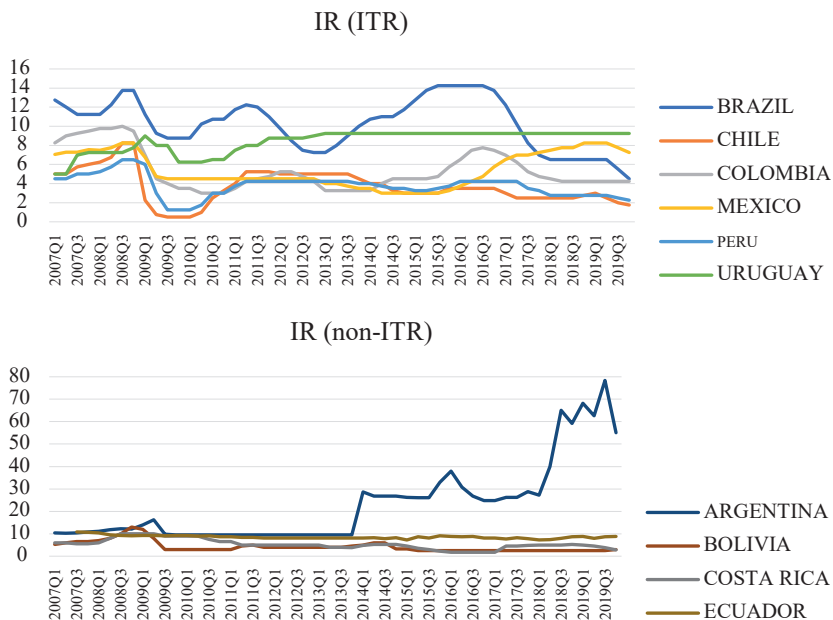
Source: Own elaboration based on data obtained from IFS (2020), CEIC (2020), and the central banks of Peru and Uruguay (2020).

Chart 4 shows that the ITR countries appear to have followed the main principle of the Taylor rule. During the period from 2007 to 2019, the interest rate and the price levels (Chart 2) were synchronized. This can indicate the functionality of this monetary arrangement in which the interest rate reacts to fluctuations in inflation to control it at levels close to its pre-established goals.

Chart 5. Implementation of macroprudential policies in the sample of countries between 2007 and 2019
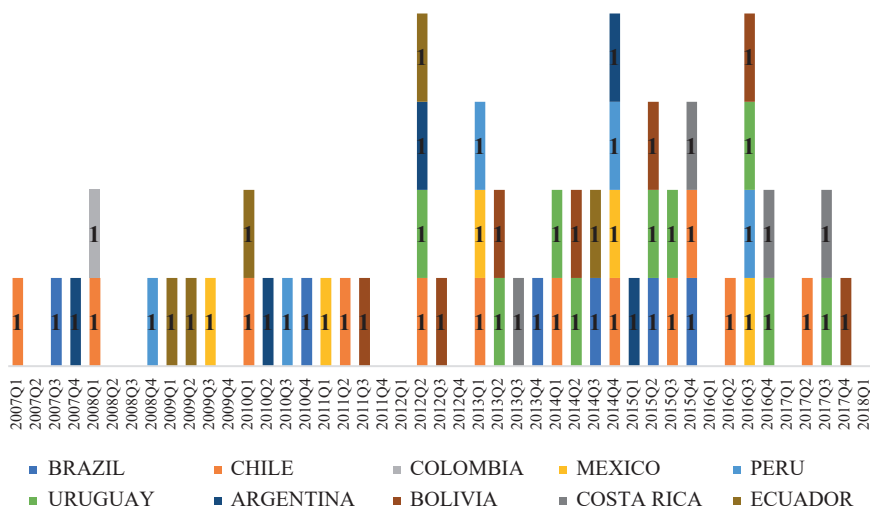
Source: Own elaboration based on the data obtained from Alam *et al*. (2019), Cerutti, Claessens, and Laeven (2017), and the documents and databases of the respective central banks of the countries examined.

Finally, Chart 5 presents the dynamics of the implementation and maintenance of macroprudential policies in the Latin American countries studied. As can be seen, there is a concentration of macroprudential measures in the period from 2014 to 2016.

III. PRESENTATION AND ANALYSIS OF RESULTS

In this section, we detail the results obtained with the model and the variables presented in Section II in order to analyze the effects of macroprudential and monetary policies on the real economy and on the financial system for the Latin American economies selected.

III.1. Results for the ITR group of countries

As explained in part (a) of Figure 1 (Figure 1(a)), there is evidence of sensitivity of real GDP of the sample of countries to an increase in interest rates. The results show that product decreases once contractionary monetary policies are implemented and grows only after the eighth quarter. Thus, real GDP reacts negatively to monetary policies in the long term, which indicates the strong influence of this type of policy.

After all, considering the transmission channels of monetary policies, when interest rates are rising, the reaction observed is the fall of investments in the productive sector, since the higher the interest rates, the greater the borrowing costs. Thus, companies avoid taking credit and, consequently, their levels of investment and consumption decrease (households behave similarly).

Figure 1(b) shows that the effects of macroprudential policies on GDP are analogous those of monetary policies. However, macroprudential measures do not have such an intense impact on real GDP. This is expected because this type of policy does not focus on economic activity, but rather on the conditions of the banking market, as highlighted by Smaghi (2014) and Yellen (2014).

Despite the more subtle result on real GDP, macroprudential policies end up indirectly influencing economic activity. This indicates the importance of considering the effects of this type of policy on the real economy before or together with the implementation of monetary policies, promoting possible adjustments in their management.

Figure 1(c) shows the response of credit to the private sector in relation to the shock in the interest rate. There is a fall until the eighth quarter (-2%) and, after that, this variable starts to have positive results, reaching 6% growth at the end of the third year. The possible explanation for this increase may be related to the fact that, when interest rates rise, controlling inflation (considering that these are countries that follow the ITR assumptions), the expectations of agents improve in relation to the future, which makes them seek more credit in the following periods, thus contributing to the advancement of this variable in the long term.

Figure 1. Impulse response of the variables GDP, CTPS, CPI, IR, and PP in the PVAR model for Brazil, Chile, Colombia, Mexico, Peru, and Uruguay
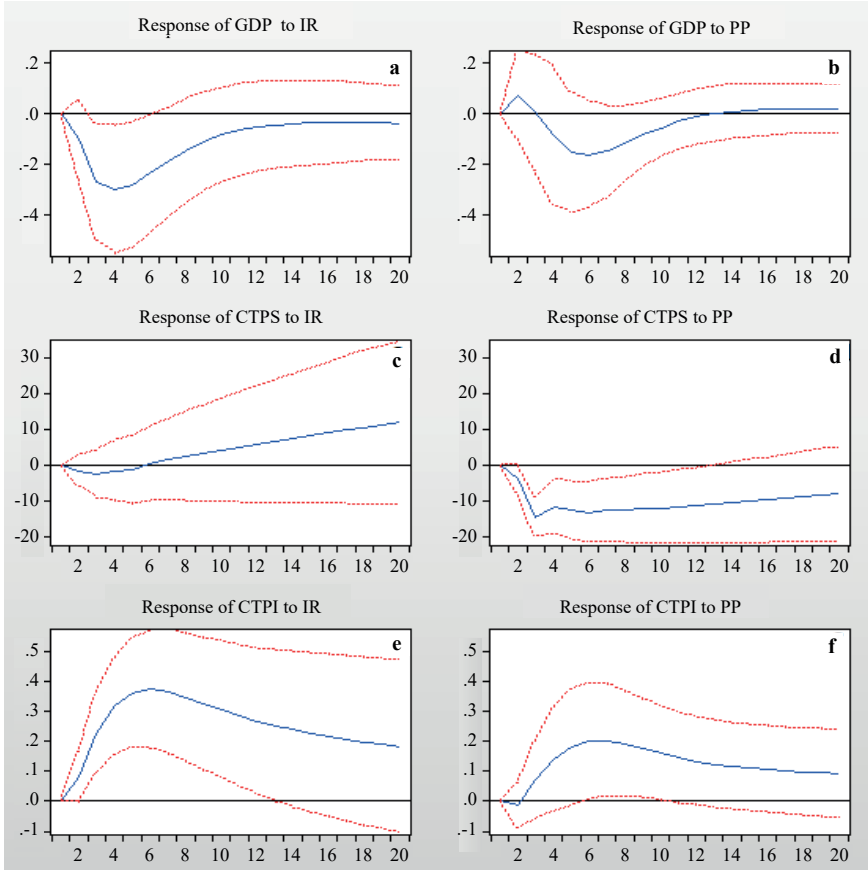
Note: PP = dummy variable for the policy; CPI = percentage change in the price level; GDP = percentage change in real GDP; CTPS = credit to the private sector; and IR = interest rate.
Source: Own elaboration.

As can be seen in the results of Figure 1(d), credit to the private sector presents a sharp fall of 14% in the third quarter due to restrictive prudential measures, and these effects are prolonged in the long term, stabilizing at -13% until the end of the fourth year. In other words, there is strong evidence that macroprudential policies fulfill their role of reducing credit in the ITR group. The impacts of these

policies on credit exposed here are comparable to those observed in Zdzienicka *et al*. (2015) and Cerutti, Claessens, and Laeven (2017).

Inflation, in turn, decreases in response to interest rates, as shown in Figure 1(e), according to the ITR logic. The increase in inflation observed in the short term is explained by the slow absorption process in relation to the interest rate and by inflation targeting regimes being structured by managers focused on future inflation expectations (that is, forward-looking systems).

Macroprudential actions had a similar impact on inflation, as evidenced in Figure 1(f). There is an initial rise in inflation, which loses strength over the quarters. The increase may be because the central bank takes some time to apply both macroprudential and monetary policies, heating the economy and the financial market. This result underlines that macroprudential policies should not aim to reduce inflation, thus reaffirming Smaghi (2014) and Yellen (2014).

These inferences are reinforced in Table 1, which presents the variance decomposition to observe the relative importance of policy tools in explaining the volatility of the variables.

Table 1. Variance decomposition for shocks in macroprudential and monetary policies

		1 YEAR	2YEARS	3 YEARS	4 YEARS
GDP	IR	2.94 (1.8)	5.36 (3.4)	5.63 (3.6)	5.66 (3.7)
	PP	0.22 (0.7)	1.46 (1.9)	1.60 (2.1)	1.59 (2.1)
CTPS	IR	0.14 (0.6)	0.14 (1.0)	0.48 (1.8)	1.16 (2.8)
	PP	5.10 (2.8)	6.62 (4.3)	6.58 (4.8)	6.15 (4.9)
CPI	IR	5.75 (2.4)	14.1 (5.7)	17.9 (7.4)	19.9 (8.3)
	PP	0.90 (1.1)	3.61 (3.1)	4.69 (3.8)	5.13 (4.2)

Note: PP represents the dummy variable for macroprudential policies. IR symbolizes the shock of monetary policies, that is, the interest rate. On the other hand, GDP is real GDP, CTPS represents credit to the private sector, and CPI is the inflation rate.
Note*: The standard deviation is shown in parentheses.
Source: Own elaboration.

In line with Figure 1, Table 1 evidences that the interest rate explains 5.66% of the behavior of real GDP in the fourth year, while macroprudential policies have

lower explanatory percentages. For credit, these policies handle for most of the fluctuations in credit. On the other hand, monetary policies have a more important role in unraveling price variations.

Next, we present the repercussions of macroprudential and monetary policies on private investment and consumption. As they are the components with the greatest weight in real GDP, it is important to test them to see if these policies influence product through consumption or investment.

III.2. Impacts of monetary and macroprudential policies on consumption and investment

In parts (a) and (c) of Figure 2, we can see how consumption and investment, respectively, respond in a similar way to the increase in the interest rate. Both variables show a sharp drop that continues in the long term. Consumption is reduced by 21% at the end of the first year, and investment reaches -12.2%. This is in line with what economic theory predicts: a positive interest rate movement discourages consumption and investment, which negatively impacts the performance of the economy.

Macroprudential measures are also capable of negatively influencing consumption and investment, possibly by lowering the level of credit, as shown in Figure 2 in parts (b) and (d). This type of policy seems to be able to reduce investments by up to 4.8% in the second year.

Therefore, the results evidence that macroprudential policies can be transmitted to economic activity through credit channels. In general, these policies can reduce credit in the economy, which results in banks limiting the supply of loans contributing to the decrease in consumption and investment. According to Karmakar (2016), this strategy provides structural stability to the financial system, as it controls credit levels and alleviates the volatility arising from the procyclical nature of credit markets.

Ultimately, there is evidence that macroprudential and monetary policies have some similar transmission channels among the variables and can cause comparable expectations and behaviors in economic agents. Since higher interest rates also make loan operations more expensive, the demand for credit decreases and, consequently, that of the productive sector (Romer, 2018). These impacts can affect consumption, investment, inflation rate, and real product, as well as macroprudential policies.

Figure 2(e) shows the interest rate response to an increase in macroprudential action. Both types of policies follow the same direction over time, which indicates that they are aligned in time for this group of countries in the period analyzed. Macroprudential and monetary policies seem to have been implemented in an articulated manner during the period examined here, each seeking its specific purpose, but in the same direction. As Svensson (2012) pointed out, although being independently controlled, these types of policies should be considered together, taking into account the cumulative effects of one type on the other.

As highlighted by Blanchard, Dell'Ariccia, and Mauro (2014), regulators should pay attention to the interactions between monetary and macroprudential policies. After all, the former can contribute to the increase in demand for credit, which in turn distances asset prices from their fundamental values, creating bubbles and an environment of growing systemic risk. If there is a shock or a bubble burst, financial institutions start to have problems of capital and liquidity, becoming credit deficient and causing insolvency of economic agents. Highly leveraged financial and non-financial institutions exacerbate the problem, with severe consequences for economic activity. On the other hand, macroprudential policies impact aggregate demand through their effects on credit. Once again, the importance of these two types of policies being coordinated and thought together is highlighted. These recommendations seem to be followed by the countries of the ITR group.

In short, in the ITR group, we can observe that macroprudential and monetary policies have similar effects on the variables studied. Both lead to a decrease in real GDP, inflation rate, private credit, consumption, and private investment. In addition, each type of policy has a greater impact on the economic indicators that are directly under its responsibility.

Next, we present the results obtained with the PVAR model in the non-ITR group of countries in order to prepare a comparative analysis with those that adopt the ITR.

Figure 2. Impulse response of the variables _CONSUM, _INVEST, IR, and PP in the PVAR model for Brazil, Chile, Colombia, Mexico, Peru, and Uruguay
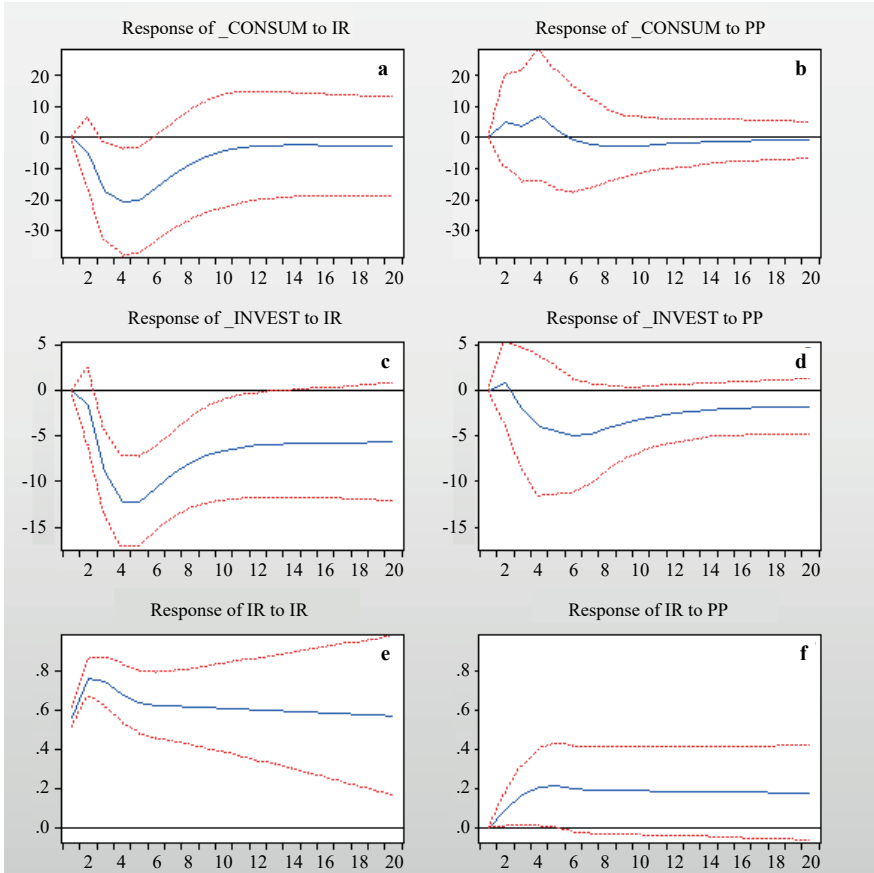
Note: PP= dummy variable for the policy; _CONSUM = percentage of total private consumption; _IN-VEST= percentage of total private investment; and IR= interest rate.
Note*: The bands are wide due to the loss of degrees of freedom with the addition of more variables in the model.
Source: Own elaboration.

III.3. Results for the non-ITR group of countries

Part (a) of Figure 3 shows the expected result of real GDP in relation to the increase in the interest rate. It indicates that this variable is negatively affected in

view of changes in monetary policies. This impact is in line with economic logic, as the interest rate reduces real GDP in the short term.

In Figure 3(b), real GDP presents effects opposite to what was expected in relation to the more restrictive macroprudential measures since there is an increase in real product from the second to the seventh quarter. These results differ from those found for ITR countries, which suggests that the impacts of macroprudential policies are distorted in non-ITR Latin American countries.

In relation to the other variables, pointing, first, to the effects produced on the inflation rate, we can conclude that this variable has a random behavior considering changes in the interest rate (Figure 3(e)). This is because there is no correct calibration of the real interest rate, as predicted by, for example, the Taylor rule. Monetary policies are not being implemented in a framework in which the rising nominal interest rate implies an increase in the real one (as in economies that adopt the ITR and that have the Taylor rule, or any other calibrated actual interest rate rule).

Regarding credit to the private sector, the interest rate initially causes growth of up to 1% in the second quarter and this increase continues until the end of the third year, as shown in Figure 4(c). Possibly, when new interest rates are announced, agents advance their loans and credit conditions in the present period with the regulations in force (Ivashina & Scharfstein, 2010). In this situation, they know that the credit conditions will have a high cost in the future and, thus, avoid indebtedness at higher rates, which increases credit in the short term using the limits currently available and contracted. In addition, it takes some time for the economy to absorb the impacts of higher interest rates.

After the twelfth quarter, credit showed a sharp drop due to changes in monetary policies. With higher interest rates, these economies are not able to control inflation, as previously explained. Thus, credit is reduced through the channel of expectations, as creditors consider inflation to be a negative attribute since the ability of debtors to generate cash deteriorates and their payment capacity decreases. In addition, higher levels of inflation may indicate greater volatility and, therefore, inflation uncertainty. This increases the chances that inflation will exceed the levels stipulated in the credit agreements and result in the transfer of wealth from creditors to debtors. All this set of factors can encourage banks to reduce their credit supply in the long term. Once again, the impact of monetary policies on these economies is evident, which can also be seen in Table 2.

Figure 3. Impulse response of the variables GDP, CTPS, CPI, IR, and PP in the PVAR model for Argentina, Bolivia, Costa Rica, and Ecuador
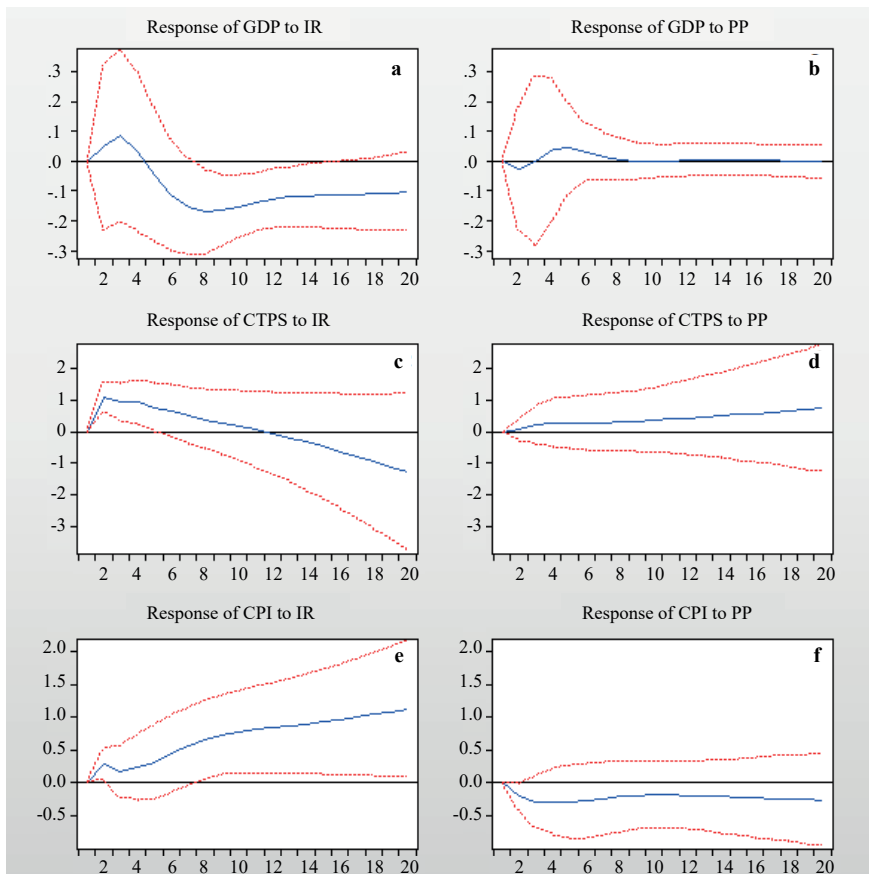
Note: PP = dummy variable for the policy; CPI = percentage change in the price level; GDP = percentage change in real GDP; CTPS = credit to the private sector; and IR = interest rate.
Source: Own elaboration.

Table 2. Variance decomposition for shocks in macroprudential and monetary policies

		1 YEAR	2 YEARS	3 YEARS	4 YEARS
GDP	IR	0.16 (1.2)	1.13 (1.4)	2.32 (2.4)	3.02 (1.8)
	PP	0.03 (0.8)	0.07 (0.8)	0.07 (0.8)	0.07 (0.8)
CTPS	IR	4.47 (2.8)	2.41 (2.6)	1.22 (2.2)	0.79 (1.9)
	PP	0.18 (0.8)	0.24 (1.1)	0.28 (1.1)	0.32 (1.2)
CPI	IR	0.72 (1.2)	2.10 (2.9)	4.09 (4.5)	5.29 (5.5)
	PP	0.95 (1.4)	0.87 (1.7)	0.72 (1.6)	0.63 (1.5)

Note: PP represents the dummy variable for macroprudential policies of capital requirements. IR symbolizes the shock of monetary policies, that is, the interest rate. On the other hand, GDP is real GDP, CTPS represents credit to the private non-financial sector, and CPI is the inflation rate. Note*: The standard deviation is shown in parentheses.
Source: Own elaboration.

Table 2 indicates that macroprudential policies have minimal explanatory factors in the variations in real GDP, credit, and inflation rate. The interest rate, on the other hand, justifies the fluctuations in these variables, including credit in all time horizons. Thus, we highlight, again, the small influence of macroprudential measures on the variables in view of the impacts of monetary policies. In other words, macroprudential policies do not seem able to achieve their main objective of impacting credit in the non-ITR group, while the interest rate causes immense losses in these economies, such as the decrease in credit and the rise in inflation in the long term, in addition to affecting product in the short term.

This is reinforced by what is observed in Figure 4(d). Credit increases in response to restrictive macroprudential measures, reaching an objective opposite to that of these policies. This result can be explained by the economic environment of the countries studied, which shows that they do not use macroprudential tools with the same efficiency as the ITR countries.

For example, Costa Rica presented credit growth after applying a tightening macroprudential measure in 2013 and 2015. According to the Central Bank of this country (2015), this fact is explained by the increase in the demand for foreign currency loans in 2015, as this period was characterized by the exchange rate sta-

bility and low costs. Moreover, since the macroprudential tool applied did not aim to reach foreign currency loans, it allowed the rise in this type of credit based on external resources, which resulted in the country's total credit growth.

An analogous effect occurred in the Bolivian economy in 2012. According to its Central Bank (2013), credit grew even with implementing restrictive macroprudential policies, motivated, mainly, by credit directed to mostly small companies. Moreover, the Central Bank of Bolivia indicated that this was the result of confidence in the country's business sector and the opening of new companies in that year. In other words, the borrowing agents did not see a constraint of macroprudential policies in an environment of recovery from the financial crisis, inflation volatility, and increase in the interest rate as an indicator of alert and uncertainty about the future, which would make them more cautious aand less demanding of credit in this period.

Similarly, these impacts may be affected by the fact that some of these countries do not have macroprudential policies under the full regulation of the central bank. In Ecuador, for instance, these policies are the responsibility of both its Central Bank and the Financial and Monetary Policy Regulatory Council. In Bolivia, on the other hand, they are coordinated only by the Financial Stability Council. Consequently, when a policy is not monitored by the same agency, it may not be aligned with the monetary policies applied by the central bank, which may result in opposite and overlapping effects on the economy and the cancellation of the impacts of the policies. This is reinforced by Figure 4(d), which shows how monetary policies do not cause reactions to changes in macroprudential ones.

The fact that macroprudential policies do not reduce credit in non-ITR economies also explains the effect on consumption and investment. Figure 4 indicates that tightening prudential measures generate an increase in these variables. These findings are in line with the effect shown by this type of policy on real GDP. They may be occurring because of poorly calibrated or structured macroprudential policies, such as the case of Costa Rica, as mentioned above.

The results of consumption (Figure 4(a)) and investment (Figure 4(c)) in response to monetary policies are in accordance with the effects of real GDP (Figure 3(a)). Both variables are reduced when the interest rate increases.

Figure 4. Impulse response of the variables _CONSUM, _INVEST, IR, and PP in the PVAR model for Argentina, Bolivia, Costa Rica, and Ecuador
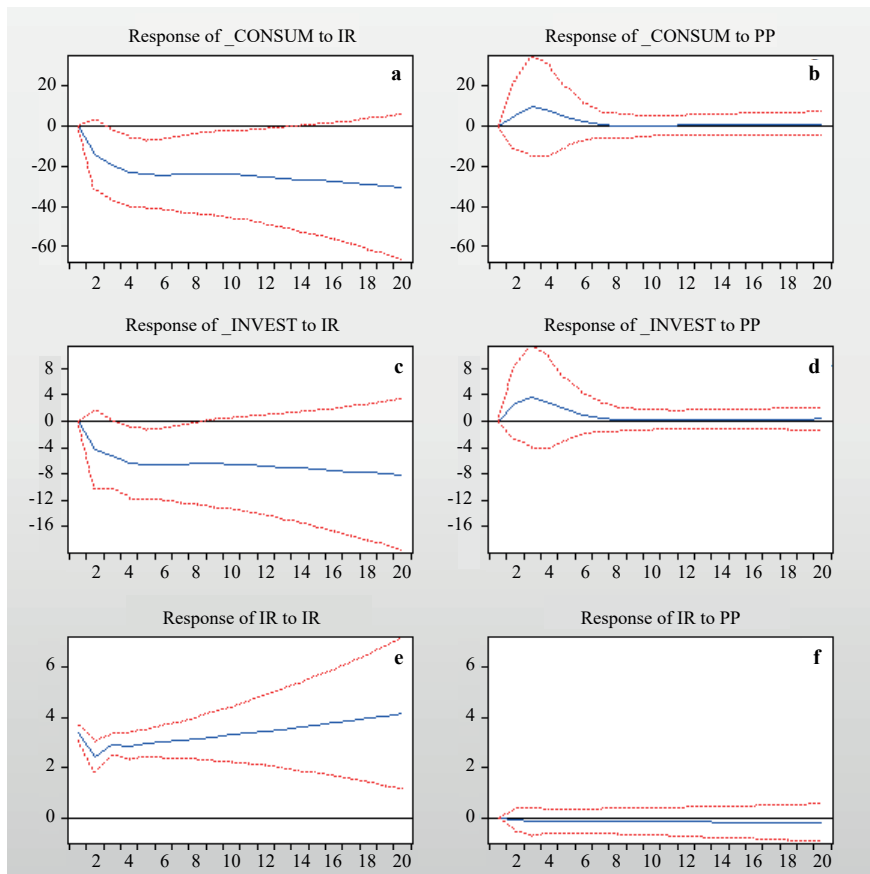
Note: PP= dummy variable for the policy; _CONSUM = percentage of total private consumption; _INVEST= percentage of total private investment; and IR= interest rate.
Note*: The bands are wide due to the loss of degrees of freedom with the addition of more variables in the model.
Source: Own elaboration.

CONCLUSION

Empirical research using the PVAR method has brought evidence that, in the ITR group of Latin America countries, macroprudential and monetary policies have similar effects on the variables studied. Both cause a decrease in real GDP, inflation rate, private credit, consumption, and private investment. In addition, each type of policy has a greater impact on the economic indicators that are under its direct responsibility: monetary policies highly affect product and inflation, while macroprudential have a more significant influence on credit. Moreover, the results show signs that the policies are coordinated in these economies, and regulators appear to consider the shocks they caused before executing the new macroprudential or monetary action.

There is likewise evidence to suggest the hypothesis that monetary and macroprudential policies have different repercussions between economies with a standard monetary context (ITR) and countries in the non-ITR group. In the latter group, the results found in this work are contradictory or not significant for macroprudential policies. It is worth noting, however, this indicates that these countries may have difficulty properly structuring and implementing their monetary and macroprudential policies. In other words, the problem involves issues of structuring economic policies that are beyond the scope of this work.

These findings highlight the importance of coordination between these types of policies. Consistent and satisfactory results of macroprudential policies appear to be observed only when they are aligned with an assertive monetary policy and in a monetary environment structured under an inflation targeting regime, as shown in the first group of countries.

There is still a lot to investigate, mainly in the deepening of the study in non-ITR countries and in variables such as defaults and their interrelationships with macroprudential measures.

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