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Does the monetary policy regime matter in the effect of credit on growth?

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Abstract

This study sheds light on the finance–growth link by (i) carefully taking into account the lessons learned from the empirical literature, (ii) extending the period of analysis to include the years following the global financial crisis (GFC), (iii) adding the monetary-policy regime as a concomitant factor in this relation, and (iv) running different specifications and following a robust econometric approach. We find that the positive effect of finance via credit vanishes between the end of the 1990s and the beginning of the 2000s, coinciding with most countries reaching a high level of bank credit and with the GFC. This finding is also observed if an inverted U-shaped specification is used to capture the relation between finance and growth. As for the monetary-policy regime, the results reveal that the inflation-targeting strategy does not exert a positive influence on economic growth.

KEYWORDS

finance, growth, inflation targeting, vanishing effect

JEL CLASSIFICATION

E42, E44, E51, E52

1 | INTRODUCTION

The traditional[1] view of the effects of finance on long-run economic growth is positive, firmly based on the contributions that an efficient financial system is supposed to deliver: (i) the pooling of savings through risk diversification and risk management by mobilizing savings; (ii) the facilitation of exchange through the reduction of transaction costs; (iii) the improvement of capital allocation through the production of ex ante information about investment opportunities, and (iv) the increase in investors' willingness to finance new projects through ex post monitoring and corporate governance. However, there are obviously more critical views about finance that have gained an audience since the global financial crisis (GFC). Heterodox scholars in general—and, more specifically, the financialization literature attached to the post-Keynesian school—have long insisted on the potential negative consequences of an uncontrolled financial system. Their main claim is that finance-dominated capitalism has several built-in contradictions, leading the economy toward recurrent crises and slow growth.[2]

In between these two extreme positions, a growing consensus is arising from recent empirical studies concluding that finance is fine, but only up to a point. The titles of much-cited papers, such as 'Too Much Finance?' by Arcand et al. (2015) and 'The Finance and Growth Nexus Revisited' by Beck et al. (2014), neatly exemplify these more balanced positions.

The main goal of this paper is twofold: first, to advance on this front by carefully revisiting the relationship between finance and growth, considering the main lessons extracted from the large body of empirical literature and including a time span that covers the GFC; and, second, to determine whether the monetary-policy regime of an economy makes a difference in this relationship. This second goal, which consists of studying the link between the monetary-policy regime and long-run growth, has not been much debated, despite being of paramount importance. The limited research, which is mostly empirical, is quite controversial and inconsistent. Moreover, credit growth has recently been found to be closely related to (trend) inflation and financial innovation (Benchimol & Qureshi, 2020). That is precisely why we find it relevant to introduce the inflation targeting (IT) approach to monetary policy as an additional factor of growth.

More concretely, the second goal of this study is focused on assessing the effect that the adoption of an IT monetary-policy regime could have on long-run growth. An IT strategy is widely considered the optimal stabilization policy for confronting any type of shock and keeping economic growth stable around potential output in the short-run (and inflation on target). However, IT can also have a positive effect on long-run growth: a direct one due to its contribution in achieving low and stable inflation and, perhaps even more importantly, because it presupposes a growth-friendly institutional setting (Barro, 2001; Bernanke, 2003; Svensson, 1997). However, there could also be an indirect and negative effect through its impact on credit growth and financial instability. By concentrating exclusively on keeping inflation low, IT critics have insisted that this strategy has distracted monetary authorities from monitoring credit growth and financial stability more closely, ultimately provoking excessive credit growth, high indebtedness, and the GFC (Gross & Semmler, 2019; Kose et al., 2018; Woodford, 2012).

Some of this paper's contributions are as follows. First, it extends the empirical literature on the finance–growth relationship, providing new empirical evidence since the available evidence to date is not entirely conclusive. We extend this literature by studying the impact of an IT monetary-policy regime on long-run growth, taking into account the direct and indirect effects through credit. Second, we use the largest available panel of countries over a long period. Third, we use a specific methodology based on generalized method of moments (GMM) specifications.

After running several model specifications, we conclude that the effect of credit on growth clearly vanishes—and this result is robust—because the variable capturing financial development ceases to have a significant impact on growth, even if we use a quadratic specification and if we include IT. Additionally, we find that IT through credit does have a significant negative effect on growth.

The paper is organized as follows. In Section 2, we discuss the effects credit, IT, and financial instability can have on long-run growth by reviewing the relevant literature. Section 3 presents the data and econometric strategy adopted, where we carefully address the lessons we extract from the previous analysis. Section 4 presents and discusses the results. Section 5 concludes the paper.

2 | GROWTH, FINANCE, AND THE MONETARY POLICY REGIME

2.1 | Finance and growth

The most influential paper for setting the terms of the subsequent debate about the link between finance (financial depth) and growth was probably that of Levine et al. (2000). Levine et al. conclude by saying,

> The panel and cross-sectional results tell the same story: the exogenous component of financial intermediary development is positively associated with economic growth; specifically, *the large, positive link between financial intermediary development and economic growth is not due to potential biases induced by omitted variables, simultaneity or reverse causation* (p. 63, emphasis added by this paper's authors).

Levine et al. (2000) draw on data from 47 countries of different levels of development for the period 1960–1995, using GMM and credit to the private sector over the gross domestic product (GDP) as the variable capturing financial development.

There is indeed a large body of empirical literature from which we can extract important lessons. In line with Valickova et al. (2015), the studies imply a positive and statistically significant effect, but estimates vary widely. The country sample, periods, and model specifications play a role in explaining the differences in results, as noted in the following.

(i) Rioja and Valev (2004a) use the same baseline model as Levine et al. (2000) and a GMM dynamic panel, but with 74 countries for the same period. The main question they ask is whether the effect of finance on growth depends on countries' levels of economic development. They determine that the effect is highest for high-income countries, positive but not as large for middle-income countries, and not significant for low-income countries. These authors also find that the link now varies according to the level of financial development; the strongest effect is for countries with a medium level of financial development, the effect is positive but smaller for countries with a high level of financial development, and the effect is not significant for countries with a very low level of financial development. In the same vein, but using a quadratic specification for bank credit, Cournède and Denk (2015) and Benczúr et al. (2019) focus their analysis on highly developed countries—the Organisation for Economic Co-operation and Development (OECD), the European Union, and the European Monetary Union—and find the effect of credit on growth to be positive, but only up to a certain level. Thus, these studies clearly show that the country sample affects the results. Therefore, the group of selected countries should be transparent and not 'aprioristic' to avoid the temptation to choose the 'correct' countries to obtain the desired results (Gantman & Dabós, 2012).

(ii) Papers choose time periods too freely, affecting the results. For more distant periods and lower credit levels, a positive effect is more likely to be found (Rioja & Valev, 2004b). Rousseau and Wachtel (2011) and Demetriades and Rousseau (2016) find the effect of finance on growth vanishes for the more recent period of 1990–2004.[3] The same phenomenon is observed by Cecchetti and Kharroubi (2012) and Arcand et al. (2015). The latter authors find that, for the ordinary least squares (OLS) estimation, credit no longer has a significant effect on growth for the period 1990–2010 or for the more extended periods of 1960–2005 and 1960–2010 when using GMM.

(iii) One must be aware of the econometric techniques used because these are not neutral. Although preliminary studies have used OLS and panel data, from Levine et al. (2000) onward, endogeneity problems have induced most studies to use dynamic panel data procedures such as GMM. However, the GMM approach, previously considered the Holy Grail of causality, is now more sceptical of causality claims that rely only on internal instruments (Panizza & Presbitero, 2013). Recent research has pointed out that this procedure is appropriate only if certain conditions are fulfilled (Roodman, 2007, 2009); to avoid an excessive number of instruments (independent variables), which inflates the statistical significance of some coefficients, a collapsed instrument specification must be used. Alternatively, the Windmeijer (2005) standard error correction model could be used; additionally, GMM panel estimation is much more malleable than OLS.

(iv) The use of a linear or quadratic term for credit must be considered. Shen and Lee (2006) find a negative effect for a linear specification, but not a significant effect for a quadratic one. Cecchetti and Kharroubi (2012) conclude that the financial sector size has an inverted U-shaped effect on growth. Law and Singh (2014) use an innovative dynamic panel threshold technique and find an inverse V shape for credit/GDP at the 90% level. Arcand et al. (2015) consider that Rousseau and Wachtel's (2011) vanishing effect is not real but, rather, due to econometric misspecification in not proposing the quadratic procedure. They obtain a positive coefficient for the credit variable in a linear form and a negative one for the quadratic form. The inverse U-shaped function for the credit variable is inferred from the lack of significance for the credit variable in linear form in later periods. Finally, Benczúr et al. (2019) show that the finding of a nonlinear, hump-shaped impact of financing on economic growth is robust, even when they focus on groups of only high-income countries. However, Cline (2015a, 2015b) is very critical about the quadratic form. So, one should be careful when deciding on the specification and be aware that using a quadratic one implies the assumption of a positive relationship between credit and growth up to a threshold level, a way to more likely obtain 'mainstream' results.

2.2 | IT and growth: The direct link

Regarding the link between IT and growth, the majority of empirical studies (Table 1) utilize standard panel data procedures but are a long way from providing a comparable outcome. This is first due to the diversity of independent variables included. Second, the country and time samples are different. Finally, the results from different techniques, such as difference in differences (DiD), error correction models, and GMM, are far from being easily comparable. Two studies (rows 1 and 5 in Table 1) show a clear positive relationship between IT and growth, whereas others (rows 4, 7, 9, and 10) either deny any relation or nuance the obtained positive relationship (rows 2 and 3). Moreover, two studies (rows 6 and 8) show a negative relationship between IT and growth. Consequently, the relation between IT and output growth remains a matter of controversy and hence requires additional empirical research to clarify it.

All in all, it must be stressed that most of the papers use a small number of countries and shorter periods, but, even more importantly, those using GMM run a model in which typical control variables are omitted. Therefore, we test whether there is a direct effect on growth from adopting an IT strategy, but we will do so in a more robust way, by including IT—both full-fledged IT (FFIT) and broad IT (BIT)—in a well-specified growth equation.

2.3 | IT and growth: An indirect effect through credit growth

We will not only analyze the relationship between IT and growth but also examine the link between credit and GDP growth for IT countries. Opting for an IT monetary-policy strategy entails reducing control over the quantity of money or credit growth and hence aggravates financial instability. The supposed advantage of IT is the central bank's commitment to a target rule instead of to an instrument rule (credit growth). IT was thought to reduce inflation instability, compared to other strategies (Svensson, 1997), although perhaps worsening credit growth volatility at the same time. Therefore, some have proposed the inclusion of a third target (financial stability) apart from a lower and stable inflation and output gap reduction in the central bank loss function, or the Taylor (1993) rule (Ajello et al., 2016; Gross & Semmler, 2019; Woodford, 2012). The central bank should lean away from financial instability and therefore use interest rates to exert an influence over credit growth. This approach can be considered relatively new, but Wicksell (1936), when recommending short-run interest rates as the most relevant tool of monetary policy, further warned about the risk of increasing credit instability.

The inclusion of financial stability as a monetary-policy objective has been suggested only recently, mainly after the GFC; IT strategies can provoke credit instability, as well as the creation of asset bubbles if credit growth is not supervised, which can lead to persistent unemployment (Gross & Semmler, 2019).

Recent literature, even among New Keynesian authors, has identified financial shocks as endogenous; this supports the defence of a monetary strategy that directly addresses the issue of financial instability beyond the compulsory use of macroprudential tools of financial regulation (Woodford, 2012). Moreover, the widespread utilization of quantitative easing through the application of asset-purchasing programs has suggested reducing credit growth (Gross & Semmler, 2019). However, most economic models accept the limited influence of interest-rate control over the price of assets; the required interest-rate change would be too significant, therefore putting in doubt the accomplishment of the other two objectives (Svensson, 2014).

TABLE 1 Empirical research regarding the link between IT and output growth

Authors	Period of study	Econometric procedure	Country sample	IT variable form	Sign of the relation	Dependent variable
Mollick et al. (2011)	1986–2004	Standard growth model: fixed effects & GMM panel data	22 industrial and 33 emerging economies	Dummy (IT soft and IT full)	Positive	Per capita GDP growth
Amira et al. (2013)	1979–2009, 3-year average	Standard growth model: OLS, pooled OLS, and 2-step GMM	36 emerging economies	Dummy IT	Positive but not stable	Previous GDP growth
Ayres et al. (2014)	Quarterly, 1985–2010	OLS estimation and fixed effects	51 developing countries	Lagged (4 lags) IT dummy	Limited impact on growth	Output growth
Kose et al. (2018)	1996–1999 versus 2007–2014	DiD approach	16 IT countries and 21 non-IT	–	Neutral	Output growth
De Guimaraes e Souza et al. (2016)	1970–2007	Panel error correction model approach	128 countries	Pulse (10 lags) dummy, soft and full IT	Positive, higher for developing countries	Output growth
Brito and Bystedt (2010)	1980–2006, 3-year average	Dynamic GMM, system GMM	59 emerging countries	Dummy IT	Negative	Output growth
Junankar and Wong (2020)	1980–2015, 3-year average	Dynamic GMM, system GMM	217 countries	Dummy IT	Neutral	Output growth
Khan (2021)	1990–2014	Propensity score matching	20 high-income and 39 middle-income countries	Dummy IT	Negative	Output growth
Ball and Sheridan (2004)	1960–1999	DiD approach	20 countries	–	Neutral	Output growth
Gambetti and Pappa (2009)	1970–2007	DiD approach	14 countries	–	Neutral	Output volatility

Source: Authors' elaboration.

Hence Svensson does not recommend leaning against financial instability, suggesting instead to leave the prevention of bubbles to the traditional macroprudential measures of banking supervision.

A study regarding monetary policy among IT countries from the OECD has revealed no real need to implement contractionary monetary policies to reduce inflation. Only among emerging markets has inflation volatility been higher, due to the commodity price cycle (Choi & Cook, 2018). The possibility of leaning against financial stability is particularly overlooked among IT countries when inflation evolution suggests just the opposite policy. In recent research carried out by the International Monetary Fund (IMF; see Choi & Cook, 2018), an empirical survey shows that, when the inflation rate is higher than the targeted one, countries usually suffer from tighter credit conditions, because central banks raise interest rates due to inflationary pressures. Nevertheless, there could be a conflict in monetary policy when inflation is below the target range and there is a trend toward loosening credit conditions (because the central bank is trying to avoid an excessively low inflation rate). This has been the case for core inflation for many IT countries, and, in this situation, IT would contradict the application of measures to avoid further credit expansion, putting into doubt the potential use of monetary policy to control credit growth. Therefore, strict IT could clearly contradict central bank measures aimed at controlling credit growth and could leave IT countries more open to the possibility of financial crises that could 'come along with large negative output and employment gaps' (Gross & Semmler, 2019, p. 59).

Consequently, there is a higher risk of financial crises provoked by credit instability inherent to IT. However, these authors have not proven empirically that IT is actually hindering output growth by allowing higher credit instability. For instance, Gross and Semmler (2019), using a vector autoregression procedure, have found that credit expansion does not reduce real GDP growth among IT countries. That is why, in our econometric specification of output growth, we include the interaction of IT and credit expansion as an additional explanatory variable. This inclusion will allow us to test the hypothesis put forward by the authors above, which relates lower output growth to high credit expansion uniquely among IT countries.

3 | DATA, VARIABLES, AND METHODS

We first drew an initial unbalanced panel of annual observations consisting of 205 countries for the period 1960–2015. However, as there is a significant gap in information for many countries and years and to ensure a better comparison of our results, we built a panel made up of all the countries with available information on our variables of interest. Therefore, our empirical evidence is based on a balanced panel of 76 countries (see Table A1 in Annex A). The variables included are those discussed in the theoretical considerations and that has been widely used in empirical studies on the finance–economic growth nexus. The dependent variable is the annual change of the real GDP per capita, measured as the logarithm of the difference of the real GDP per capita.

Our variables of interest are financial development and the adoption of IT. As in most of the literature, we quantify financial development by using credit extended to the private sector by deposit banks and other financial institutions as a share of the GDP (see Table A2 in Annex A) Following Arcand et al. (2015), we concentrate our analysis on the total credit to the private sector, without distinguishing whether it is obtained by the housing, consumer, or business sector.[4] The IMF financial development index could have been added to proxy for each country's financial development level, but we do not follow that focus because the IMF data start in 1980 and our study begins in 1960, and we try to follow the specifications of previous papers.

We introduce the variable of credit to the private sector in two different ways: either as the logarithm of total credit (percentage of the GDP) or only as a percentage of the GDP. In the latter case, we include the linear and quadratic forms of the variable. The control variables included are the usual ones: the initial GDP per capita (the real GDP in purchasing power parity in 2010 constant dollars) to capture the Solow–Swan convergence hypothesis, government consumption (as a share of the real GDP) to proxy for government size, trade openness (the GDP share of the sum of exports and imports) as the level of world-market integration, the average number of years of education, and the average inflation rate (annual change in the Consumer Price Index). Regarding the inflation rate, although the potential nonlinearity between inflation and growth is a relevant issue (Eggoh & Khan, 2014; Ibarra & Trupkin, 2016), we opt for the standard specification used in the finance–growth literature.

Regarding the possibility of including institutional variables to measure, for instance, the corruption level and political conflicts, they are certainly important for studying the ultimate determinants of long-run growth. However, the primary goal of our paper is to determine the effect of financial deepening and its interaction with the monetary policy strategy on long-run growth. Therefore, we have adopted a parsimonious approach in the specification of our baseline model, just as the main papers on this same issue (Arcand et al., 2015; Beck et al., 2012; Rousseau & Wachtel, 2011).[5] We also include time dummies to capture period-specific effects.

The sources of the variables are presented in Table A1 in Annex A. IT adoption is proxied through two dummy variables: one for full-fledged inflation targeters (FFIT) and the other for broad inflation targeters (BIT).[6] For FFIT, we follow the IMF classification, and for BIT we further include countries that 'have so much credibility that they can maintain low and stable inflation without full transparency and accountability with respect to an inflation target' (Carare & Stone, 2006, p. 1298).[7] However, the fact that the central bank targets IT does not necessarily imply that the central bank's loss function does not include, for example, unemployment objectives. For instance, Benchimol and Fourçans (2019) have proven that the Federal Reserve targeted the nominal GDP rather than inflation before and after the GFC.

We recognize the limitation of the IMF classification approach as other IT central banks might factually implement another monetary policy as the Fed has. The option for two IT categories is first due to the fact that most of the literature utilizes a limited sample of countries, while we have selected a much wider sample. Moreover, the fact that some countries, despite keeping an inflation anchor, are not strictly considered as implementing FFIT by the IMF led us to create a second category, following Carare and Stone (2006). All the independent variables are expressed in natural logarithms. The inflation rate is calculated as the hyperbolic sine transformation ($\hat{x} = \ln(x + \sqrt{x^2 + 1})$ to address zero values). Table 2 presents descriptive statistics.

We perform a test to measure the variance-inflation factors (VIFs) to detect potential multicollinearity between the independent variables in our models.[8] Based on the results, we conclude that their use does not induce a severe multicollinearity problem.

We conduct cross-country and panel regressions. We use OLS and GMM estimators. The OLS estimator is useful just for comparison purposes. When using this cross-sectional

TABLE 2 Descriptive statistics and pair correlations, 1960–2015, with annual data for 76 countries

Variable	GROWTH	GDPpc	CREDIT_PC	LnCREDIT	lnSCHOOL	lnGOV	lnINFL	lnTRADE	BIT	FFIT
Obs	4179	4256	3998	3995	4256	4126	3882	4126	4256	4256
Mean	2.08	7.69	41.50	3.32	1.42	2.62	2.48	3.97	0.12	0.08
SD	4.68	1.37	38.69	0.96	0.82	0.39	1.4	0.64	0.33	0.27
Min	−47.81	5.26	0	−2.81	−2.53	0.72	−4.27	1.59	0	0
Max	36.98	10.21	312.15	5.74	2.61	4.16	10.8	6.09	1	1
GROWTH	1.0000									
GDPpc	0.0008	1.0000								
CREDIT_PC	0.0199	0.4333	1.0000							
LnCREDIT	0.0727	0.4979	0.8533	1.0000						
lnSCHOOL	0.0458	0.6116	0.5263	0.6172	1.0000					
lnGOV	−0.0752	0.3558	0.3023	0.3550	0.2707	1.0000				
lnINFL	−0.1385	−0.1091	−0.2910	−0.2621	−0.0967	−0.1965	1.0000			
lnTRADE	0.0477	0.1130	0.1537	0.2284	0.2433	0.3019	−0.2325	1.0000		
BIT	0.0170	0.1237	0.3160	0.2720	0.2598	0.0952	−0.1453	0.0496	1.0000	
FFIT	−0.0175	0.2507	0.4507	0.3892	0.3461	0.2023	−0.2330	0.1362	0.8032	1.0000

Note: All variables are computed in logarithmic form, except the credit and IT variables (see the full list of variables and their detailed definitions in Annex A).

estimator, we take the average value of the variables for all countries over the period under study, so that there is only one observation per country. Therefore, to test the potential vanishing effect of credit, we first run a set of simple cross-country regressions in which the regressor is the real GDP per capita annual growth rate for different periods (1960–1997, 1960–2002, 1960–2007, 1960–2012, 1960–2015, and 1998–2015).

We establish these periods so that there is a break starting in 2008, to check the role of the GFC in the credit–growth relationship. We also include a more recent period (1998–2015), to analyze the growth–credit link in the most recent decades and to establish comparisons with other studies. This procedure, where we incrementally add a 5-year window and finally the 1998–2015 subperiod, allows us to systematically examine the changes in the nexus between finance and GDP growth over time.

We acknowledge that endogeneity problems and unobserved country-specific effects can exist, which can lead to biased results when using simple cross-sectional OLS regression; however, we consider this exercise useful, because it provides an insightful way to describe our data. The equation we use is as follows:

$$\begin{aligned}\mathrm{GROWTH}_i = {} & \alpha_i + \beta_1 \mathrm{lnGDPpc}_i + +\beta_2 \mathrm{lnCREDIT}_i + \beta_3 \mathrm{CREDIT\_PC}_i \\ & +\beta_4 \mathrm{CREDIT\_PC2}_i + \beta_5 \mathrm{lnSCHOOL}_i + \beta_6 \mathrm{lnINFL}_i + \beta_7 \mathrm{lnTRADE}_i + \beta_8 \mathrm{lnGOV}_i \\ & +\beta_9 \mathrm{BIT}_i \times \mathrm{lnCREDIT}_i + \beta_{10} \mathrm{FFIT}_i \times \mathrm{lnCREDIT}_i + \beta_{11} \mathrm{BIT}_i \times \mathrm{CREDIT\_PC}_i \\ & +\beta_{12} \mathrm{FFIT}_i \times \mathrm{CREDIT\_PC}_i + \varepsilon_i \end{aligned} \tag{1}$$

where GROWTH_i is the real GDP per capita annual growth rate; $\mathrm{lnGDPpc}_i$ is the logarithm of the initial real GDP per capita based on purchasing power parity (constant 2011 international dollars); lnGOV_i is the (logarithm of) government expenditures (percentage of the GDP); $\mathrm{lnTRADE}_i$ is the (logarithm of) trade (percentage of the GDP); lnINFL_i is the inverse hyperbolic sine transformation of the inflation rate;[9] $\mathrm{lnSCHOOL}_i$ is the (logarithm of the) average number of years of total schooling; $\mathrm{lnCREDIT}_i$ is the logarithm of credit to the private sector (percentage of the GDP); $\mathrm{CREDIT\_PC}_i$ is the credit to the private sector (percentage of the GDP); $\mathrm{CREDIT\_PC2}_i$ is the credit to the private sector squared (percentage of the GDP); FFIT_i is a dummy variable that takes the value of one if the country is a full-fledged inflation targeter, and zero otherwise; BIT_i is a dummy variable that takes the value of one if the country is a broad inflation targeter, and zero otherwise; BIT × lnCREDIT, FFIT × lnCREDIT, BIT × CREDIT_PC, and FFIT × CREDIT_PC are interaction terms; and ε_i is the error term.

To overcome the aforementioned problems, we use the GMM estimator. This estimator can handle important modeling concerns such as country-specific effects and the endogeneity of regressors while avoiding dynamic panel bias. It is quite flexible and accommodates unbalanced panels and multiple endogenous variables. When there is unobserved country-specific heterogeneity, it is often difficult to disentangle the effects of observed and unobserved time-invariant heterogeneity. Standard fixed and random effects estimators cannot be used because of multicollinearity issues. Therefore, it is common practice in empirical work to apply the GMM framework. In our models, we, therefore, include, as recommended in the econometric literature, time effects, and country-specific intercepts, to control for unobserved heterogeneity across countries. It is reasonable to believe that some countries have improved their financial system thanks to internal reforms. In addition, different countries could have different unobserved characteristics that affect their growth. These facts justify the inclusion of country-specific and time effects in our models.

To control for endogeneity, unobserved heterogeneity, or autocorrelation problems, dynamic panel regressions are estimated à la Arellano and Bover (1995), with robust standard errors and the Windmeijer (2005) small-sample correction. We use system GMM models because we consider this the most suitable approach as some of the variables can be highly persistent. With the purpose of looking at the long-run determinants of economic growth, we reduce business cycle fluctuations by averaging the data over five-year intervals. The first window (1960–1962) and last window (2013–2015) comprise only three years so there is a break in the crisis year (2008). Thus, we have 12 5-year windows. The equation used is as follows:

$$\begin{aligned} \mathrm{GROWTH}_{it} = {} & \alpha_i + \beta_1 \ln\mathrm{GDPpc}_{i,t-1} + \beta_2 \ln\mathrm{CREDIT}_{i,t-1} + \beta_3 \mathrm{CREDIT\_PC}_{i,t-1} \\ & + \beta_4 \mathrm{CREDIT\_PC2}_{i,t-1} + \beta_5 \ln\mathrm{SCHOOL}_{i,t-1} + \beta_7 \ln\mathrm{INFL}_{i,t-1} + \beta_7 \ln\mathrm{TRADE}_{i,t-1} + \beta_8 \\ & \ln\mathrm{GOV}_{i,t-1} + \beta_9 \\ & \mathrm{BIT}_{i,t-1} \times \ln\mathrm{CREDIT}_{i,t-1} + \beta_{10} \mathrm{FFIT}_{i,t-1} \times \ln\mathrm{CREDIT}_{i,t-1} \\ & + \beta_{11} \mathrm{BIT}_{i,t-1} \times \mathrm{CREDIT\_PC\_}_{i,t-1} + \beta_{12} \mathrm{FFIT}_{i,t-1} \times \mathrm{CREDIT\_PC}_{i,t-1} + \varepsilon_{i,t-1} \\ & + \delta_{t-1}. \end{aligned} \tag{2}$$

We run this model again for different periods, as before, including country-specific intercepts α_i and time-specific fixed effects δ_{t-1}. All variables are lagged by one period.

4 | RESULTS

4.1 | Results of the cross-sectional model

Table 3 presents the results of the OLS estimates for the cross-sectional data for the different subperiods. The first column (Model 1) in each subperiod includes the logarithm of credit to the private sector as an independent variable, and the second column (Model 2) supplements this information by including credit to the private sector as a percentage of the GDP in linear and quadratic form, which allow us to test the inverted U-shape hypothesis.

The results for the first subperiod (1960–1997) show that the logarithm of credit (Model 1 in Table 3) is positive and statistically significant. In addition, the linear term of credit is positive and statistically significant, whereas the quadratic term is negative and statistically significant. Control variables such as the initial GDP per capita, years of schooling, and inflation are significant and show the expected sign. The lack of significance for trade openness and government size is common in cross-sectional studies.

These results remain largely unchanged during the subsequent subperiods, though the sizes of the coefficients decrease as we include more years. This suggests that the growth–credit link is not vanishing, but weakening over time. However, in the most recent subperiod (1998–2015), we observe a vanishing effect, because the coefficient of the logarithm of credit loses its significance. Moreover, the linear term of the credit to the private sector variable is positive and significant, whereas the quadratic term is negative and significant. These findings are consistent with the vanishing effect hypothesis of Rousseau and Wachtel (2011) and the inverted U-shape found by Arcand et al. (2015), a more relevant outcome as we include the years after the GFC.

As a statistical significance in both the linear and quadratic terms of the credit variable is a necessary but not sufficient condition for a nonmonotonic relationship between credit and

TABLE 3 OLS estimates, baseline models

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015		1998–2015	
Variables	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
lnGDPpc	−0.623***	−0.658***	−0.641***	−0.681***	−0.659***	−0.700***	−0.740***	−0.776***	−0.743***	−0.778***	−0.727**	−0.747**
	(0.209)	(0.208)	(0.209)	(0.203)	(0.198)	(0.191)	(0.185)	(0.179)	(0.176)	(0.170)	(0.279)	(0.288)
lnCREDIT	1.005***		0.920***		0.763**		0.721**		0.722***		0.484	
	(0.285)		(0.290)		(0.297)		(0.278)		(0.265)		(0.340)	
CREDIT_PC		5.939**		5.604***		5.138**		4.527**		4.371***		3.665**
		(2.260)		(2.079)		(1.941)		(1.718)		(1.586)		(1.703)
CREDIT_PC2		−3.243**		−3.043**		−2.972**		−2.462**		−2.330**		−1.853**
		(1.624)		(1.378)		(1.240)		(1.046)		(0.942)		(0.775)
lnSCHOOL	1.352***	1.495***	1.474***	1.603***	1.603***	1.704***	1.680***	1.768***	1.688***	1.782***	1.594**	1.618**
	(0.405)	(0.390)	(0.442)	(0.417)	(0.454)	(0.427)	(0.446)	(0.428)	(0.441)	(0.423)	(0.656)	(0.676)
lnINFL	−0.256**	−0.293**	−0.283***	−0.321***	−0.297**	−0.331***	−0.199*	−0.228**	−0.199*	−0.228**	−0.215	−0.282
	(0.107)	(0.111)	(0.0978)	(0.103)	(0.120)	(0.112)	(0.108)	(0.101)	(0.102)	(0.0930)	(0.307)	(0.280)
lnTRADE	0.0477	−0.00410	−0.0162	−0.0994	−0.104	−0.228	−0.0372	−0.147	−0.0256	−0.138	0.119	−0.106
	(0.295)	(0.305)	(0.290)	(0.298)	(0.301)	(0.308)	(0.291)	(0.299)	(0.275)	(0.282)	(0.285)	(0.298)
lnGOV	−0.281	−0.229	−0.266	−0.226	−0.365	−0.341	−0.418	−0.406	−0.419	−0.406	−1.332***	−1.308**
	(0.637)	(0.631)	(0.633)	(0.626)	(0.587)	(0.591)	(0.521)	(0.528)	(0.483)	(0.493)	(0.501)	(0.522)
Constant	7.601***	5.059***	7.479***	5.336***	7.826***	6.279***	7.725***	6.288***	7.592***	6.178***	8.839***	8.407***
	(1.741)	(1.594)	(1.666)	(1.499)	(1.642)	(1.452)	(1.527)	(1.328)	(1.467)	(1.287)	(2.637)	(2.505)
Observations	78	78	78	78	78	78	78	78	78	78	78	78

TABLE 3 (Continued)

Variables	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015		1998–2015	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
R^2	0.502	0.493	0.531	0.532	0.547	0.557	0.547	0.557	0.571	0.579	0.261	0.284
R^2_adjusted	0.460	0.442	0.492	0.485	0.509	0.513	0.509	0.512	0.535	0.537	0.199	0.213
Akaike information criterion	256.78	260.24	248.33	250.22	234.93	235.29	221.17	221.53	212.59	213.06	280.07	279.58
Bayesian information criterion	273.28	279.09	264.83	269.08	251.43	254.14	237.66	240.39	229.08	231.92	296.56	298.43

Note: Robust standard errors are in parentheses.

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$.

TABLE 4 GMM estimates, baseline models

Variables	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015		1998–2015	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
lnGDPpc	−1.551***	−1.819***	−1.103***	−1.244***	−1.094**	−0.869**	−1.581***	−1.519***	−1.208**	−1.248***	−0.881***	−0.640*
	(0.537)	(0.428)	(0.417)	(0.408)	(0.442)	(0.337)	(0.447)	(0.361)	(0.474)	(0.407)	(0.319)	(0.395)
lnCREDIT	1.012**		1.107*		0.240		0.293		0.266		0.150	
	(0.393)		(0.651)		(0.496)		(0.428)		(0.427)		(0.279)	
CREDIT_PC		9.322***		6.007***		3.255*		5.473**		4.518*		−0.917
		(2.224)		(2.273)		(1.774)		(2.326)		(2.624)		(2.919)
CREDIT_PC2		−4.331***		−2.894**		−1.981**		−3.484***		−2.684*		0.346
		(1.367)		(1.205)		(0.931)		(1.200)		(1.388)		(1.409)
lnSCHOOL	3.083***	2.882***	2.464**	2.621***	2.983***	2.265***	3.326***	3.134***	2.681***	2.691***	2.889***	3.105**
	(1.137)	(0.775)	(1.091)	(0.600)	(0.925)	(0.602)	(0.915)	(0.762)	(0.799)	(0.730)	(0.919)	(1.308)
lnINFL	−0.186	−0.127	−0.213	−0.350*	−0.630***	−0.489***	−0.689***	−0.637***	−0.598**	−0.490**	0.016	−0.243
	(0.172)	(0.215)	(0.223)	(0.185)	(0.236)	(0.160)	(0.195)	(0.136)	(0.250)	(0.207)	(0.295)	(0.409)
lnTRADE	−0.781	0.413	−1.324	−0.357	−2.047**	−0.332	−3.262***	−2.521***	−1.904	−1.736*	−0.176	0.911
	(1.187)	(0.727)	(1.037)	(0.791)	(0.997)	(0.719)	(0.960)	(0.676)	(1.177)	(0.930)	(0.440)	(0.705)
lnGOV	−0.848	−1.242	−0.476	−0.692	0.127	−0.193	0.563	0.019	0.272	0.097	−2.077***	−3.047***
	(1.117)	(0.977)	(0.772)	(0.716)	(0.762)	(0.687)	(0.736)	(0.662)	(0.918)	(0.804)	(0.579)	(0.969)
Observations	425	425	499	499	571	571	646	646	719	719	294	294
No. of countries	76	76	76	76	76	76	76	76	76	76	76	76
No. of IVs	53	63	44	56	51	65	49	56	55	63	64	52

TABLE 4 (Continued)

Variables	1960–1997 Model 1	1960–1997 Model 2	1960–2002 Model 1	1960–2002 Model 2	1960–2007 Model 1	1960–2007 Model 2	1960–2012 Model 1	1960–2012 Model 2	1960–2015 Model 1	1960–2015 Model 2	1998–2015 Model 1	1998–2015 Model 2
ar1p	4.43e-05	3.74e-05	3.81e-05	3.83e-05	6.93e-06	4.33e-06	8.24e-06	3.82e-06	1.09e-06	9.45e-07	0.120	0.0129
ar2p	0.168	0.132	0.133	0.121	0.398	0.305	0.316	0.285	0.215	0.160	0.855	0.620
Hansen p value	.333	.222	.258	.176	.109	.106	.184	.339	.116	.292	.105	.100

Note: Time dummies are included but not reported for the sake of brevity. Windmeijer's (2005) robust standard errors are in parentheses. All variables are lagged by one period. All equations are estimated using system GMM. The instruments used in each specification are the (first) lagged values of the credit variables for the first-differences equations and the (one- to two-period) lagged values of the first differences for the level equations for the period 1960–1997. For the periods 1960–2002, 1960–2007, 1960–2012, and 1960–2015, we include the (first) lagged value of the credit variables for the first-differences equations and the (first) lagged values of the first differences for the level equations. For the period 1998–2015, we use the (one- to three-period) lagged values of the first differences for the level equations. The year dummies are used as instrumental variable (IV) style instruments for the equations in levels only.

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$.

TABLE 5 Test for an inverse U-shape

	1960–1997	1960–2002	1960–2007	1960–2012	1960–2015
Extreme point	1.07	1.03	0.82	0.78	0.84
Slope at *PCmin*	6.72***	4.27***	2.07*	3.38**	2.90*
Slope at *PCmax*	−10.92***	−7.51**	−6.00**	−10.81***	−8.03*
SLM test for inverse U-shape	2.45	2.11	1.66	2.06	1.60
p value	.007	.017	.048	.020	.055
Fieller 90% confidence interval	[0.88; 1.51]	[0.81; 1.52]	[0.31; 1.04]	[0.49; 0.93]	[0.21; 1.03]

Note: The results of the Sasabuchi–Lind–Mehlum test for an inverse U-shaped relationship. Robust standard errors are in parentheses.

***$p < .01$; **$p < .05$; *$p < .1$.

growth, we run the Lind–Mehlum (2010) test for the presence of an inverted U-shaped relationship. The results are presented in Table A3 in Annex A, showing a threshold for credit over the GDP around 90%, in line with the results of Arcand et al. (2015).

We extend our analysis by adding the IT variables to the previous models. We include the interaction effects between IT and the credit variables to test whether IT exerts an indirect effect on growth. Models 3 and 5 in Table 3 include the credit variable in logarithmic terms, and Models 4 and 6 include the credit variables as a percentage.

Looking at the results when the independent variables are IT (both BIT and FFIT) and credit in percentages (Models 4 and 6), we observe that the coefficient of the linear term of credit is positive and statistically significant in all the periods, meaning that credit is positively associated with growth. Indeed, this coefficient is the expected increase in growth for each additional point of increase in credit (over the average) when there is no IT. The quadratic term of credit is, in most cases, negative and statistically significant.

The IT coefficient is positive and statistically significant in the most recent periods and reflects the increase in GDP growth when countries have IT (more specifically, when countries have IT and credit is at its average value). Finally, the interaction term is negative and statistically significant in the most recent periods. This coefficient indicates that the switch from not having IT to having IT decreases the effect that credit has (in differential terms) on growth. In short, these results suggest that IT is associated with GDP growth; however, the impact of credit (in percent) on GDP growth is greater in countries without IT than in those with IT. These results are consistent in practically all the periods studied.

The interaction terms for the IT variables when credit is measured in logarithmic form (Models 3 and 5 in Table 3) are generally not statistically significant.

4.2 | Results of the dynamic panel model

Table 4 presents the results of the GMM estimator.[10] The results are consistent with OLS estimates and confirm the so-called *vanishing effect*. Moreover, the first relevant result not detected in other studies is that, in the most recent period (1998–2015), this vanishing effect occurs not only in the linear form, as it did for Rousseau and Wachtel (2011), but also in the quadratic form used by Arcand et al. (2015).

TABLE 6 GMM estimates with the BIT variable and interaction terms

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015		1998–2015	
	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4
lnGDPpc	−1.755***	−1.853**	−1.693***	−1.560***	−0.993*	−0.882**	−1.111**	−1.300***	−0.596	−1.118***	−0.615*	−0.485*
	(0.654)	(0.796)	(0.611)	(0.565)	(0.542)	(0.377)	(0.510)	(0.367)	(0.552)	(0.408)	(0.358)	(0.284)
lnCREDIT	0.981**		0.925**		0.352		0.888		1.012		0.577	
	(0.445)		(0.412)		(0.546)		(0.732)		(0.732)		(0.377)	
CREDIT_PC		9.086***		5.241**		3.988*		7.653**		4.136		−0.295
		(2.376)		(2.213)		(2.288)		(3.695)		(3.323)		(3.013)
CREDIT_PC2		−4.076**		−1.992		−2.078*		−4.145**		−1.507		0.731
		(1.647)		(1.401)		(1.251)		(2.022)		(1.793)		(1.513)
lnSCHOOL	3.283***	2.908***	3.054***	3.091***	2.744***	2.143***	2.514**	2.773***	1.553*	2.415***	1.728*	2.188**
	(1.143)	(1.076)	(0.966)	(0.720)	(0.981)	(0.651)	(1.045)	(0.756)	(0.483)	(0.744)	(0.676)	(1.002)
lnINFL	−0.170	−0.150	−0.183	−0.231	−0.562**	−0.456***	−0.540***	−0.505***	−0.465*	−0.387*	0.004	−0.317
	(0.209)	(0.255)	(0.177)	(0.184)	(0.230)	(0.173)	(0.191)	(0.131)	(0.261)	(0.200)	(0.256)	(0.345)
lnTRADE	−0.500	0.433	−0.093	0.022	−1.994**	−0.404	−2.776***	−1.945**	−1.522	−0.836	−0.461	0.731
	(1.337)	(0.862)	(0.869)	(0.881)	(0.910)	(0.712)	(0.866)	(0.923)	(1.040)	(0.855)	(0.470)	(0.732)
lnGOV	−1.057	−1.438	−0.589	−1.047	0.086	−0.249	0.452	−0.247	0.308	−0.600	−0.858*	−2.240***
	(1.169)	(1.349)	(0.775)	(0.840)	(0.739)	(0.792)	(0.633)	(0.711)	(0.844)	(0.748)	(0.470)	(0.847)
BIT	−2.044	12.465	0.800	4.796	−1.790	1.588	−3.409**	1.036	−3.977***	1.479	−1.416***	0.996
	(5.932)	(19.719)	(1.347)	(3.962)	(1.118)	(1.980)	(1.358)	(2.004)	(1.366)	(1.344)	(0.548)	(1.259)
BIT#lnCREDIT	−8.458		−2.486		−2.381**		−3.170**		−2.853***		−1.448***	
	(13.961)		(3.124)		(1.098)		(1.338)		(0.726)		(0.428)	

(Continues)

TABLE 6 (Continued)

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015		1998–2015	
	Model 3	**Model 4**	**Model 3**	**Model 4**	**Model 3**	**Model 4**	**Model 3**	**Model 4**	**Model 3**	**Model 4**	**Model 3**	**Model 4**
BIT#CREDIT_PC		−17.548		−5.564		−2.927		−4.167**		−3.427***		−2.178*
		(25.235)		(5.036)		(2.049)		(1.871)		(1.320)		(1.330)
Observations	425	425	499	499	571	571	646	646	719	719	294	294
No. of countries	76	76	76	76	76	76	76	76	76	76	76	76
No. of IVs	54	64	68	60	59	73	54	61	62	70	79	64
ar1p	4.18e−05	4.14e−05	7.46e−05	3.78e−05	1.20e−05	5.12e−06	2.66e−06	2.01e−06	5.31e−07	4.65e−07	0.0245	0.00922
ar2p	0.158	0.135	0.123	0.132	0.447	0.327	0.354	0.289	0.248	0.169	0.898	0.781
Hansen p value	.230	.132	.213	.224	.129	.151	.112	.214	.0805	.242	.228	.106

Note: Time dummies are included but not reported for the sake of brevity. Windmeijer's (2005) robust standard errors are in parentheses. All variables are lagged by one period. All equations are estimated using system GMM. The instruments used in each specification are the (one- to two-period) lagged values of the credit variables for the first-differences equations and the (one- to two-period) lagged values of the first differences for the level equations for the periods 1960–1997 and 1960–2002. For 1960–2007, 1960–2012, and 1960–2015, we include the (first) lag of the credit variables for the first-differences equations and the (first) lag of the values of the first differences for the level equations. For the period 1998–2015, we use the (one- to three-period) lagged values of the first differences for the level equations. The year dummies are used as IV-style instruments for the equations in levels only.

***$p < .01$; **$p < .05$; *$p < .1$.

TABLE 7 GMM estimates with the FFIT variable and interaction terms

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015		1998–2015	
Variables	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**
lnGDPpc	−1.755***	−1.853**	−1.589***	−1.712***	−1.082**	−0.994	−1.393***	−1.548***	−0.933**	−1.246***	−0.739**	−0.609*
	(0.654)	(0.796)	(0.607)	(0.537)	(0.467)	(0.695)	(0.486)	(0.377)	(0.451)	(0.382)	(0.314)	(0.346)
lnCREDIT	0.981**		0.945**		0.209		0.505		0.493		0.227	
	(0.445)		(0.405)		(0.510)		(0.512)		(0.544)		(0.415)	
CREDIT_PC		9.086***		5.355**		3.390		5.097*		4.193*		−1.585
		(2.376)		(2.161)		(4.474)		(2.698)		(2.336)		(2.148)
CREDIT_PC2		−4.076**		−1.943		−1.743		−2.847*		−1.784		0.807
		(1.647)		(1.336)		(2.415)		(1.471)		(1.194)		(1.048)
lnSCHOOL	3.283***	2.908***	3.022***	3.218***	2.929***	2.845**	2.991***	3.185***	2.233***	2.345***	1.957*	2.665**
	(1.143)	(1.076)	(0.973)	(0.708)	(0.906)	(1.108)	(0.925)	(0.806)	(0.825)	(0.712)	(1.017)	(1.040)
lnINFL	−0.170	−0.150	−0.172	−0.216	−0.566**	−0.324	−0.616***	−0.528***	−0.510**	−0.364*	−0.008	−0.270
	(0.209)	(0.255)	(0.178)	(0.185)	(0.233)	(0.302)	(0.181)	(0.145)	(0.241)	(0.207)	(0.312)	(0.372)
lnTRADE	−0.500	0.433	−0.158	0.073	−1.864*	−0.490	−3.015***	−1.635**	−1.587	−1.002	−0.201	1.087*
	(1.337)	(0.862)	(0.838)	(0.810)	(0.983)	(1.033)	(0.969)	(0.643)	(1.204)	(0.783)	(0.513)	(0.610)
lnGOV	−1.057	−1.438	−0.593	−1.068	0.083	−1.512	0.528	−0.286	0.208	−0.394	−1.390***	−2.468**
	(1.169)	(1.349)	(0.757)	(0.828)	(0.791)	(1.716)	(0.675)	(0.793)	(0.866)	(0.953)	(0.514)	(0.980)
FFIT	−2.044	12.465	1.092	6.172	−1.156	3.991	−2.155**	2.486	−2.383**	2.423*	−0.079	1.004
	(5.932)	(19.719)	(1.422)	(3.787)	(1.098)	(3.617)	(0.938)	(1.629)	(1.029)	(1.308)	(0.455)	(1.350)
FFIT#lnCREDIT	−8.458		−1.238		−2.368*		−1.893*		−2.504***		−0.732	
	(13.961)		(3.110)		(1.247)		(0.937)		(0.915)		(0.625)	

(Continues)

TABLE 7 (Continued)

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015		1998–2015	
Variables	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**	**Model 5**	**Model 6**
FFIT#CREDIT_PC		−17.548		−6.810		−4.081		−3.955**		−3.369**		−0.828
		(25.235)		(5.978)		(2.521)		(1.845)		(1.336)		(1.441)
Observations	425	425	499	499	571	571	646	646	719	719	294	294
No. of countries	76	76	76	76	76	76	76	76	76	76	76	76
No. of IVs	54	64	68	60	59	48	54	61	62	70	79	64
ar1p	4.18e-05	4.14e-05	6.65e-05	3.81e-05	1.47e-05	1.1e-05	7.06e-06	3.94e-06	1.32e-06	1.07e-06	0.0738	0.00455
ar2p	0.158	0.135	0.122	0.145	0.447	0.359	0.343	0.301	0.279	0.175	0.828	0.712
Hansen p value	.230	.132	.202	.304	.108	.117	.154	.204	.0939	.167	.178	.110

Note: Time dummies are included but not reported for the sake of brevity. Windmeijer's (2005) robust standard errors are in parentheses. All variables are lagged by one period. All equations are estimated using system GMM. The instruments used in each specification are the (one- to two-period) lagged values of the credit variables for the first-differences equations and the (one- to two-period) lagged values of the first differences for the level equations for the periods 1960–1997 and 1960–2002. For 1960–2007, 1960–2012, and 1960–2015, we include the (first) lagged values of the credit variables for the first-differences equations and the (first) lagged values of the first differences for the level equations. For the period 1998–2015, we use the (one- to three-period) lagged values of the first differences for the level equations. The year dummies are used as IV-style instruments for the equations in levels only.

***$p < .01$; **$p < .05$; *$p < .1$.

TABLE 8 GMM estimates with GFC and interaction terms

Variables	Model 7	Model 8
lnGDPpc	−0.467*	−0.829**
	(0.246)	(0.372)
lnCREDIT	0.335	
	(0.395)	
CREDIT_PC		1.995
		(2.634)
CREDIT_PC2		−0.305
		(1.612)
GFC	−1.575***	−0.008
	(0.503)	(0.710)
GFC × lnCREDIT	−0.726*	
	(0.433)	
GFC × CREDIT_PC		−1.994**
		(0.902)
lnSCHOOL	2.167***	2.728***
	(0.636)	(0.802)
lnINFL	0.170	0.244
	(0.235)	(0.269)
lnTRADE	0.942**	0.648*
	(0.479)	(0.389)
lnGOV	−0.710	−0.054
	(0.750)	(0.752)
Observations	719	719
No. of countries	76	76
No. of IVs	70	63
ar1p	6.18e−07	3.01e−06
ar2p	0.143	0.116
Hansen *p* value	.197	.292

Note: Windmeijer's (2005) robust standard errors are in parentheses. All equations are estimated using system GMM. The instruments used in each specification are the (one- to two-period) lagged credit variables for the first-differences equations and the (first) lagged values of the first differences for the level equations.

***$p < .01$; **$p < .05$; *$p < .1$.

TABLE 9 GMM estimates using 10-year periods

Variables	Model 1	Model 2
lnGDPpc	−1.165**	−1.124***
	(0.567)	(0.416)
lnCREDIT	0.491	
	(0.352)	
CREDIT_PC		2.798**
		(1.393)
CREDIT_PC2		−1.632**
		(0.700)
lnSCHOOL	2.390***	2.663***
	(0.737)	(0.677)
lnINFL	0.405**	0.272
	(0.196)	(0.196)
lnTRADE	0.184	−0.392
	(0.786)	(0.588)
lnGOV	−0.344	−0.644
	(1.110)	(0.910)
Observations	344	344
No. of countries	79	79
No. of IVs	54	63
ar1p	0.00211	0.00224
ar2p	0.810	0.752
Hansen *p* value	.0571	.0899

Note: Windmeijer's (2005) robust standard errors are in parentheses. All equations are estimated using system GMM. The instruments used in each specification are the (one- to four-period) lagged values of the first differences for the level equations. The year dummies are used as IV-style instruments for the equations in levels only.

***$p < .01$; **$p < .05$; *$p < .1$.

Besides this, private credit in logarithmic form has a significant positive effect on growth only during the first periods under study (1960–1997, 1960–2002). From 1960 to 2007 onward, the logarithm of the credit coefficient begins to be statistically nonsignificant. Both the linear and quadratic terms of credit as a percentage of the GDP are positive/negative and statistically significant, respectively, confirming the inverted U-shaped link hypothesis in most periods. Table 5 reports the results of the Sasabuchi–Lind–Mehlum test for the presence of a nonmonotonic relationship between credit and growth.

Tables 6 and 7 present the results with the BIT and FFIT, respectively. The first column (Models 3 and 5) includes the credit variable in logarithmic form, and the second column (Models 4 and 6) includes it as a percentage. The coefficient for BIT in Model 3 is negative and significant in the periods 1960–2012 and 1960–2015 and in the last period, 1998–2015. Hence,

TABLE 10 GMM estimates, omitting outliers

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
lnGDPpc	−0.868	−1.518***	−1.003	−1.044	−0.909	−0.665	−0.215	−1.168***	−0.651	−1.116***
	(1.300)	(0.464)	(0.810)	(1.037)	(0.653)	(0.912)	(0.364)	(0.399)	(0.673)	(0.432)
lnCREDIT	2.330*		2.024**		1.046		0.129		−0.174	
	(1.357)		(0.992)		(0.835)		(0.400)		(0.522)	
CREDIT_PC		11.919***		9.991*		6.282**		7.208**		4.919*
		(2.274)		(5.448)		(2.885)		(3.162)		(2.783)
CREDIT_PC2		−5.037***		−4.635*		−3.394*		−4.043**		−3.226**
		(1.235)		(2.802)		(1.993)		(1.806)		(1.554)
lnSCHOOL	1.320	2.193	1.580	1.214	1.609	1.405	0.477	2.219**	2.357***	3.688**
	(2.463)	(1.681)	(2.088)	(2.238)	(2.101)	(2.237)	(0.605)	(0.951)	(0.892)	(1.470)
lnINFL	0.028	0.431	−0.030	0.273	−0.512	−0.128	−0.262	−0.275	−0.984**	−0.678***
	(0.506)	(0.421)	(0.333)	(0.302)	(0.353)	(0.287)	(0.224)	(0.422)	(0.434)	(0.247)
lnTRADE	1.188	0.521	−0.263	−0.293	−0.620	−0.432	−0.275	−0.533	0.664	−0.412
	(1.290)	(0.662)	(0.988)	(1.200)	(0.958)	(0.792)	(0.728)	(0.712)	(1.025)	(0.560)
lnGOV	−1.010	−1.305	0.509	0.097	0.777	−0.626	−0.883	−0.444	−0.688	−1.896**
	(2.716)	(1.574)	(1.824)	(2.440)	(1.510)	(1.794)	(0.897)	(1.077)	(1.421)	(0.910)
Observations	264	264	383	383	320	320	573	573	559	559
No. of countries	60	60	64	64	61	61	76	76	72	72
No. of IVs	31	42	53	38	42	47	71	53	71	73

(Continues)

TABLE 10 (Continued)

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
ar1p	0.000597	0.000468	0.00147	0.000654	0.000485	0.000340	3.04e-05	3.33e-05	0.000194	0.000198
ar2p	0.301	0.259	0.340	0.248	0.400	0.289	0.851	0.867	0.0814	0.0492
Hansen p value	.392	.363	.339	.181	.374	.226	.281	.171	.176	.726

Note: Time dummies are included but not reported for the sake of brevity. Windmeijer's (2005) robust standard errors are in parentheses. All equations are estimated using system GMM. The instruments used in each specification are the (one- to four-period) lagged values of the first differences for the level equations. The year dummies are used as IV-style instruments for the equations in levels only.

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$.

TABLE 11 GMM estimates, dropping controls

Variables	1960–1997 Model 1	1960–1997 Model 2	1960–2002 Model 1	1960–2002 Model 2	1960–2007 Model 1	1960–2007 Model 2	1960–2012 Model 1	1960–2012 Model 2	1960–2015 Model 1	1960–2015 Model 2
lnGDPpc	−1.186**	−1.504***	−1.263**	−1.234***	−1.144***	−0.805**	−1.504***	−1.374***	−1.341***	−1.198***
	(0.512)	(0.555)	(0.513)	(0.450)	(0.406)	(0.319)	(0.439)	(0.342)	(0.431)	(0.319)
lnCREDIT	0.925*		1.137**		0.172		0.004		−0.052	
	(0.484)		(0.518)		(0.457)		(0.577)		(0.548)	
CREDIT_PC		8.219***		5.229**		3.567**		5.038*		4.217*
		(2.674)		(2.437)		(1.812)		(2.581)		(2.647)
CREDIT_PC2		−3.940**		−2.504**		−2.054**		−3.265**		−2.551*
		(1.704)		(1.258)		(0.899)		(1.336)		(1.389)
lnSCHOOL	2.317**	2.521***	2.586**	2.621***	2.844***	1.912***	3.795***	3.100***	3.536***	2.810***
	(1.148)	(0.850)	(1.254)	(0.791)	(0.886)	(0.714)	(1.078)	(0.852)	(1.050)	(0.796)
lnINFL	−0.267	−0.061	−0.215	−0.338*	−0.472***	−0.485***	−0.867***	−0.658***	−0.859***	−0.560***
	(0.171)	(0.218)	(0.224)	(0.191)	(0.175)	(0.146)	(0.305)	(0.178)	(0.320)	(0.187)
lnTRADE	−1.464	0.088	−1.177	−0.395	−1.036	−0.296	−2.713***	−2.121***	−2.012***	−1.843***
	(1.098)	(0.793)	(1.005)	(0.682)	(0.816)	(0.529)	(0.785)	(0.604)	(0.759)	(0.586)
Observations	427	427	501	501	573	573	648	648	721	721
No. of countries	76	76	76	76	76	76	76	76	76	76
No. of IVs	48	54	38	50	62	70	41	48	46	54
ar1p	4.51e−05	4.45e−05	3.49e−05	3.51e−05	5.06e−06	4.60e−06	6.11e−06	3.62e−06	1.29e−06	9.30e−07
ar2p	0.168	0.126	0.125	0.117	0.328	0.305	0.373	0.292	0.321	0.194

(Continues)

TABLE 11 (Continued)

	1960–1997		1960–2002		1960–2007		1960–2012		1960–2015	
Variables	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Hansen p value	.138	.120	.237	.161	.145	.171	.171	.282	.171	.345

Note: Time dummies are included but not reported for the sake of brevity. Windmeijer's (2005) robust standard errors are in parentheses. All equations are estimated using system GMM. The instruments used in each specification are the (one- to two-period) lagged credit variables for the first-differences equations and the (one- to two-period) lagged values of the first differences for the level equations for the periods 1960–1997 and 1960–2002. For 1960–2007, 1960–2012, and 1960–2015, we include the (first) lagged values of the credit variables for the first-differences equations and the (first) lagged values of the first differences for the level equations. For the period 1998–2015, we use the (one- to three-period) lagged values of the first differences for the level equations. The year dummies are used as IV-style instruments for the equations in levels only.

***$p < .01$; **$p < .05$; *$p < .1$.

IT does not contribute to growth in the long run but has a negative impact. Additionally, the interaction effects between BIT and credit (in logarithm form and as a percentage) are negative and statistically significant for the same periods as well, meaning that switching from not having BIT to having BIT decreases the effect that credit has (in differential terms) on GDP growth. When the FFIT variable is considered, the interaction term with credit in logarithmic form is significantly negative in the periods 1960–2007, 1960–2012, 1960–2015, whereas it is only statistically significant in the latter two periods when considering credit as a percentage.

4.3 | Robustness checks

First, we test whether the GFC could have affected the finance–growth relationship. After financial crises, which are always preceded by an excessive increase in credit volume, there is a credit downturn due to the process of deleveraging among economic agents, and the link between financial credit and growth consequently disappears (Takáts & Upper, 2013). Different experiences of so-called creditless recoveries, not only among emerging countries (Calvo et al., 2006), but also developed ones (Claessens et al., 2009), reveal that credit is replaced as a growth factor by currency depreciation, fiscal policy, or positive supply shocks. However, around 5 years after financial crises, the connection between credit and growth is recovered. So, the global nature of the GFC merits the corresponding robustness check.

Accordingly, we look at the whole period (1960–2015) and allow for the parameter of credit impact (in logarithmic form and as a percentage) to change after the GFC by introducing a dummy interaction variable (Models 7 and 8). The results reveal that the coefficient of the interaction term is negative and statistically significant (both when credit is in logarithmic or as a percentage), which suggests that the impact of credit on growth has lowered since the GFC (Table 8).

Second, we re-estimate our baseline models for the period 1960–2015, using 10-year periods, to control for longer business cycles. The results remain largely unchanged (Table 9). The credit variable in logarithmic terms is not statistically significant, but the growth–credit nexus shows an inverted U-shape (Model 2).

In Table 10, we present the results for the baseline model after removing observations (separately in each specification) that result in residuals being greater in absolute terms than three standard errors. Finally, in Table 11, we exclude one control variable (government consumption) that was statistically nonsignificant in some of the estimations presented in Table 4. The results of both tests are quite similar, showing a vanishing effect of credit on growth in the linear form, but not so in the quadratic one.

5 | CONCLUSIONS

The main objective of this study has been to test, first, the influence of bank credit development on per capita GDP growth and, second, the relationship between IT and output growth, an issue that, despite its potential relevance to growth, has not been widely studied. We have tried to check whether the previously observed positive relation between credit and growth disappears over time and whether high bank credit levels together with an IT strategy exert a negative effect on output expansion.

Our results suggest that bank credit growth has had a positive effect on long-run growth, but its effect has vanished since the end of the 1990s, and clearly so since the GFC. This is the first time that this conclusion has been obtained for such a large sample of countries and periods. These results are confirmed in the linear specification when we run several robustness checks, and also mostly so in the quadratic specification. However, cross-sectionally dependent related issues suggest that the results regarding vanishing effects should be viewed with caution.

In line with Arcand et al. (2015), we obtain a threshold level for a positive effect of bank credit on growth in the range of 80%–100%. Hence, it seems that we have already reached too high a level of bank credit in most countries; policies aimed at favoring further credit growth will no longer be effective for output growth. Even a certain reduction in bank credit growth might not be detrimental.

Regarding the effect of the IT monetary strategy, we can conclude that IT does not clearly favour growth as a positive and statistically significant coefficient cannot be obtained for most of the different time spans and specifications. However, the interaction between IT and credit expansion appears to exert a statistically significant negative influence on growth. Therefore, as a policy recommendation, we think that IT countries or central banks should avoid excessive bank credit growth when targeting inflation.

We acknowledge a need for more far-reaching research on these issues—for instance, by including the diverse development stages or geographical locations of countries, as well as their institutional settings. Different financial development estimates could be included as well, such as demand or supply credit indicators, cryptocurrencies volumes, and shadow banking measures.

DATA AVAILABILITY STATEMENT

Used data are available upon request.

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ENDNOTES

[1] This traditional view is already very well represented by Schumpeter (1911) and, more recently, by King and Levine (1993).

[2] The contribution of post-Keynesians to the understanding of the role that finance plays in the capitalism system is huge, but some of the leading authors could be considered to be Hein (2015), Lavoie (2016), and Minsky (1982).

[3] For the more distant period 1960–1989, the results are positive.

[4] Several studies have tried to disentangle the impact of enterprise or household credit on growth, finding that the latter has a limited or negative effect on growth (Beck et al., 2012; Sassi & Gasmi, 2014). However, the last paper of Bezemer et al. (2016) challenges these previous findings.

[5] We acknowledge and are grateful to the reviewer who suggested the inclusion of these variables in this paper.

[6] The literature used to distinguish between FFIT and BIT, for example, De Guimaraes e Souza et al (2016) and Mollick et al. (2011).

[7] Carare and Stone (2006) define this category as an 'implicit price stability anchor.' In our study, we include eurozone countries since their respective year of accession to the euro area, and the United States since 2012.

[8] The VIF shows the increase in the instability of the coefficient estimates due to multicollinearity. There is no formal cutoff value for the tolerance or VIF; however, a cutoff value of 10 is common (O'Brien, 2007). However, according to Allison (2012), regardless of the criterion of what constitutes a high VIF, there are at least three situations in which a high VIF is not a problem and can be safely ignored, one of which is when high VIFs are caused by the inclusion of the powers or products of other variables. The results of the VIFs are available from the authors upon request.

[9] We use the inverse hyperbolic sine transformation because it has grown in popularity in applied econometrics, particularly in the finance field (e.g., Arcand et al., 2015; Beck & Levine, 2004). The reasons are that, in general terms, this transformation is quite similar to a logarithm and it allows the retention of zero-valued (and even negative) observations. It is true that, when variable transformations are applied, one needs to be careful when it comes to interpreting coefficients as semielasticities. We re-estimated all the OLS and GMM models with the logarithmic transformation of the variable, and the results remain qualitatively unchanged.

[10] Empirical studies focused on the credit–growth relationship have not thus far taken into account potential cross-sectional dependence. We included some control variables that help to mitigate cross-sectional dependence. We ran the Pesaran cross-sectional dependence test in all our models. The results show cross-sectional dependence for most of the periods, except for the period 1960–2015. We estimated the CCEMG and AMG estimators (Eberhardt, 2012) using the Stata xtmg routine. However, due to the shortness of some of our panels, we could only run this routine for the periods 1960–2012 and 1960–2015, which does not allow us to test our hypotheses. We ran the cross-sectional dependence Pesaran tests in those estimations, and the results show that the CCEMG models do not completely pass the test. The estimations (AUG) show that the coefficients of the credit variables in the 1960–2015 period are not statistically significant. The results are available under request.

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ANNEX A

See Tables A1–A3.

TABLE A1 List of 76 countries

Algeria	Cote d'Ivoire	Kenya	Senegal
Argentina	Denmark	Korea, Rep.	Sierra Leone
Australia	Dominican Rep.	Lesotho	Singapore
Austria	Ecuador	Luxembourg	South Africa
Bangladesh	Egypt, Arab Rep.	Malawi	Spain
Belgium	Fiji	Malaysia	Sudan
Belize	Finland	Mauritania	Sweden
Bolivia	France	Mexico	Thailand
Botswana	Gabon	Nepal	Togo
Brazil	Ghana	Netherlands	Trinidad and Tobago
Burundi	Greece	Nicaragua	Turkey
Canada	Guatemala	Norway	United Kingdom
Cape Verde	Honduras	Pakistan	United States
Central African Republic	Iceland	Panama	Uruguay
Chile	India	Papua New Guinea	Venezuela, RB
China	Indonesia	Paraguay	Zimbabwe
Colombia	Iran, Islamic Rep.	Peru	
Congo, Dem. Rep.	Israel	Philippines	
Congo, Rep.	Italy	Portugal	
Costa Rica	Japan	Rwanda	

TABLE A2 Variable definitions

Indicator	Detailed definition	Source
GROWTH GDP per capita (constant 2010 US$)	The GDP per capita is GDP divided by the mid-year population. The GDP is the sum of the gross value added by all resident producers in the economy and any product taxes, minus any subsidies not included in the value of the products. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion and or degradation of natural resources. The data are in constant 2010 U.S. dollars.	World Bank Development Indicators
[GDP_pc] GDP per capita growth (annual %)	The annual percentage growth rate of the GDP per capita based on constant local currency. The aggregates are based on constant 2010 U.S. dollars. The GDP per capita is the GDP divided by the mid-year population. The GDP at the purchasers' prices is the sum of the gross value added by all resident producers in the economy and any product taxes, minus any subsidies not included in the value of the products. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion or degradation of natural resources.	World Bank Development Indicators
[SCHOOL] Average years of schooling	Average number of years of schooling.	Barro and Lee (2016)
[TRADE]	Trade is the sum of exports and imports of goods and services, measured as a share of the GDP.	World Bank Development Indicators
Trade (% of GDP) [INFL] Inflation, consumer prices (annual %)	Inflation, as measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that can be fixed or changed at specified intervals, such as yearly.	World Bank Development Indicators
[GOV] General government final consumption expenditure (% of GDP)	General government final consumption expenditures (formerly general government consumption) includes all government current expenditures for the purchases of goods and services (including employee compensation). It also includes most expenditures on national defence and security, but excludes government military expenditures that are part of the government's capital formation.	World Bank Development Indicators

(Continues)

TABLE A2 (Continued)

Indicator	Detailed definition	Source
[CREDIT_PC] Domestic credit to private sector (% of GDP)	Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries, these claims include credit to public enterprises.	World Bank Development Indicators
[BIT] Broad inflation targeting	List reported in the IMF publication 'Annual Report on Exchange Arrangements and Exchange Restrictions', completed with Carare and Stone's (2006) considerations regarding the application of a flexible IT approach. We include euro area countries from the date of each country's accession to the euro zone, and the United States from 2012.	IMF, other sources
[FFIT] Full-fledged inflation targeting	The list reported in the IMF publication 'Annual Report on Exchange Arrangements and Exchange Restrictions', strictly following the five essential elements of IT. The data are completed with information from Carare and Stone (2006), Ferreira de Mendonça and De Guimaraes e Souza (2012), Jahan (2017), and Roger (2010).	IMF, other sources

TABLE A3 Test for an inverse U-shape for OLS models

	1960–1997	1960–2002	1960–2007	1960–2012	1960–2015	1998–2015
Extreme point	0.91	0.92	0.86	0.92	0.93	0.99
Slope at *PCmin*	3.99***	3.77***	3.35***	3.04***	2.97***	2.55**
Slope at *PCmax*	−3.63**	−3.50**	−3.62**	−3.04**	−3.15**	−3.39***
SLM test for inverse U-shape	1.30	1.53	1.84	1.76	1.89	2.02
p value	.098	.064	.035	.040	.031	.024
Fieller 90% confidence interval	[0.70; 2.32]	[0.72; 1.67]	[0.66; 1.31]	[0.70; 1.48]	[0.73; 1.40]	[0.61; 1.24]

Note: The results of the Sasabuchi–Lind–Mehlum (SLM) test for an inverse U-shaped relationship. Robust standard errors are in parentheses.

***$p < .01$; **$p < .05$; *$p < .1$.