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ORIGINAL RESEARCH

The finance-growth nexus and public-private ownership of banks in Brazil since 1870

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Abstract
How does finance affect economic growth? And does ownership matter? This paper investigates whether and how deposits in public vis-a-vis in private banks affect economic growth. It uses the power-ARCH framework with annual time series for Brazil from 1870 to 2018. There are three main findings: (a) the indirect impact of domestic financial development on economic growth is negative, whereas that of international financial development is positive, (b) the direct short-run effect of public and private banks is negative, while only for the latter does the positive direct long-run effect dominate, and (c) the indirect and direct short-run effect of public ownership banks is greater in size than that of private ownership banks.

Keywords Brazil · Direct short- and long-run effects · Economic growth · Financial development · Indirect impact · Private and public ownership

JEL Classification C14 · O40 · E23 · D72

1 Introduction

How does finance affect economic growth? And how does ownership matter? This paper investigates whether (and how differently) deposits in public and in private banks affect economic growth over extremely long-time horizons using an uncommon econometric framework. More specifically, we focus on indirect and direct short- and long-run effects of finance on the growth rate of Brazilian gross domestic product (gdp). The Brazilian case is particularly interesting when studying the relationship between finance and economic performance. Brazil is relevant because of its size (both in terms of populations and output), its hegemonic role in South America and its relatively important role globally.

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Within a power-ARCH (PARCH) framework and using annual time series data for Brazil covering the period from 1870 to 2018, the aim of this paper is to put forward answers to the following questions. What is the relationship between finance, economic growth and volatility? Are the effects of these changes in financial development direct (on economic growth) or indirect (via the conditional volatility of growth)? Does the intensity and sign of these impacts vary over time? Does the intensity of these effects vary with respect to short- versus long-run considerations? Is the intensity of these effects constant across the different eras or phases of Brazilian economic history (in other words, are they independent of the main structural breaks we estimate)?

There is an extensive literature on the finance and growth nexus. Its main objective is to establish whether financial development causes economic growth and to identify and understand the main mechanisms through which this occurs (cf. (Demirguc-Kunt et al., 2013), and references therein). Our econometric results support, as the main finding, the notion that the development of financial institutions should occupy centre stage in understanding the process of economic growth. For the case of Brazil it is found to have more direct and robust impacts than, for instance, trade openness. Hence the paper relates closely to the literature on the finance-growth nexus.

Schumpeter (1911) argues that entrepreneurs need credit to finance new production techniques. Banks are considered as key players in facilitating the aforementioned activities and promoting economic development. Therefore, well-developed financial institutions could be an efficient mechanism to direct financial resources to the most productive sectors of the economy. Schumpeter (1934); Gurley and Shaw (1955) and Goldsmith (1969) argue that financial development is central to economic growth, while (Hicks, 1969) illustrates this case by documenting how financial development drove industrialisation in England by encouraging flows of capital.

Moreover, the aforementioned scholars highlight the importance of advancing policies targeted at developing the financial system in order to promote economic growth, for instance by creating more financial institutions and offering a greater variety of financial services and products, in order to achieve a positive impact on the saving–investment process, and hence on growth (see for more details (Ang, 2008)). Nevertheless, this approach had little effect on promoting policy making, first due to the fact that it was not suggested in a "formal manner", and second due to the domination of the Keynesian ideology (Ang, 2008).

More recent endogenous growth scholarship concludes that the financial sector plays a constructive role in the economy (Bencivenga & Smith, 1991). In addition, financial development leads to more efficient allocation of resources, reduces uncertainty and transaction costs, and promotes more rapid capital accumulation and technological advancement (Roubini & Sala-i-Martin, 1992; King & Levine, 1993; Greenwood & Smith, 1997; Levine, 1997, 1999, 2005). It should be noted, however, that authors such as Gavin and Hausmann (1996), and Loayza and Rancière (2006) argued that in the short-run financial liberalisation and expansion without any constraints could cause banking crises and thus economic collapse. Kar et al. (2011) highlight the difficulty in establishing the exact relationship between economic growth and financial development and argue that there is no clear evidence on the direction of the causality between them.

So far empirical research has been dominated by cross-country studies on the impact of financial development on growth. This is due to lack of availability of data for developing economies. The majority of these cross-country studies highlight the beneficial effect of financial development on growth [see King and Levine (1993); Rajan and Zingales (1998); Levine et al. (2000) and Rioja and Valev (2004)]. However, generalizing and applying their findings in each country could impose serious challenges since the nature and way of operating

of financial institutions is substantially different from country to country [see (Arestis & Demetriades, 1997; Demetriades & Andrianova, 2004) and Ang (2008)]. This paper tries to improve matters in this regard by focusing on a single country (as opposed to following the common practice of trying to learn something about growth by focusing on the mean or median country).

We believe this study can further our understanding about economic growth because: (a) we study only one individual country over a very long period of time with annual frequency data,[1] (b) we provide new evidence about the public-private ownership of banks in Brazil since 1870 (this is the first study to the best of our knowledge that addresses the issue of public vs private bank ownership for the Brazilian case since 1870), and (c) we choose an econometric methodology that has been seldom used in the empirical growth literature despite the fact that it easily allows us to contrast the direct (short- and long-run impacts) to the indirect (i.e., via the volatility channel) effects of each of our candidate reasons, and distill the consequences of accounting for important structural breaks on the robustness of our key results.

Another important benefit of our choice of econometric framework is that it helps to shed light on an important and resilient puzzle about the relationship between output growth and its volatility. While Ramey and Ramey (1995) show that growth rates are adversely affected by volatility, Grier and Tullock (1989) argue that larger standard deviations of growth rates are associated with larger mean rates. The majority of ARCH papers examining the growth-volatility link are restricted to these two key variables. That is, they seldom assess whether the effects of the presence of other variables affect the relation and, on the rare occasions that happens, it is usually inflation and its volatility that comes into play.[2] One contribution of this paper is to study if and how the growth-volatility relationship changes in light of a wider set of variables. Note also that the use of annual data allows us to perform a more appropriate test of the hypothesis that predicts a positive effect of output variability and uncertainty on the growth rate of output.[3]

Our results can be organized in three main effects: (a) indirect (via volatility), (b) direct short- and long-run and (c) structural break effects. Regarding the indirect effects we argue that the impact of domestic financial development on the conditional volatility of economic growth is negative, whereas that of international financial development is positive. Notably, our parameter estimations highlight the significantly higher (in absolute magnitude) negative indirect impact of public ownership banks (compared to that of private ownership banks). Our results are robust to the presence of trade openness and public deficit (both these variables affect growth negatively).

As for the direct short- and long-run effects, we find that domestic financial development affects growth negatively in the short- but positively in the long-run, whereas the impact of international financial integration is positive in both cases. An important finding in the finance-growth literature is that the impact of finance on growth tends to be positive in the long- but

[1] Some studies access Brazil's performance for a cross-country perspective (Loyaza and Rancière, 2006), while others are more focused on the period from the 1930's onwards-trying to explain the growth rate of Brazil in the period 1930–1997 (Abreu & Verner, 1997).

[2] For a comprehensive review of this literature see (Fountas et al., 2006) In addition, Gillman and Kejak (2005) bring together for comparison several main approaches to modeling the inflation-growth effect by nesting them within a general monetary endogenous growth model with both human and physical capital.

[3] Black (1987) argues that investments in riskier technologies will be pursued only if the expected return on these investments (expressed as the average rate of output growth) is large enough to compensate for the extra risk. As real investment takes time to materialize, such an effect would be more likely to obtain in empirical studies utilizing low-frequency data.

negative in the short-run. Our estimates add a novel element to this by documenting such a pattern only for private (not for public) banks. Furthermore, there is a significantly higher (in absolute magnitude) negative short-run impact of public ownership banks (compared to that of private ownership banks). Trade openness and public deficit have a negative influence on growth that is restricted in the short-run.

Finally, we subjected all these results to the presence of structural breaks. This is an important exercise given the very long-term nature of the data. We find that the basic results remain once structural breaks are taken into account. A noteworthy aspect of these findings is that (i) the indirect effect of public bank ownership is stronger before the start of the Great War, 1911, and (ii) the indirect role of private bank ownership intensifies after 1962. The latter indicates the increasing role of private ownership in economic growth of Brazil during a period which coincides with the so-called "Economic Miracle" era. In short, the main results from this analysis suggest that financial development (domestic and international) exhibits robust first-order effects on growth and its volatility. Trade openness and public deficits play important yet secondary roles. In our view, this is because the effects of these variables do not extend to the long-run.

The paper is organized as follows. Section 2 provides the related literature on the link between financial development and Brazilian economic growth. Section 3 describes the data and Sect. 4 provides details and justification for our econometric methodology. Section 5 presents our baseline econometric results. Section 6 concludes and suggests directions for future research.

2 Related literature

One of the most important contributions to the study of long–term Brazilian economic growth is Abreu and Verner (1997). They studied the contribution of financial development, with emphasis on the period 1930–1990. They did not find evidence that financial development boosted growth. They argued that increased public sector savings proved (disappointingly) to have only a small impact on gdp, and attempts to include monetary variables as explanations for either short-term or long-term economic growth in Brazil came to naught. According to them, financial development fails to explain the economic growth in Brazil in this particular period. However, our results present a different story for the following reasons. By using a different econometric approach and longer-term data, we find that financial development affects long-term growth positively, whereas the short-run impact is negative and robust. In other words, we differentiate by reporting that domestic financial development affects growth negatively in the short-run but positively in the long-run (whereas the positive short-run impact of international financial integration disappears in the long-run). Our estimates add a novel element to this by documenting such a pattern only for private (not for public) banks.[4]

Recent studies on either Latin America or Brazil have covered this particular period and have paid attention to the study of financial development. Bittencourt (2012) finds that financial development played a significant role in promoting growth in Latin America. Castelar et al. (2005) examined the link between financial development, growth and equity. Also, Stefani (2007) investigated this relationship in Brazil between 1980 and 2006 by using cointegration methods. Further, some papers shed some light on how relative factors like interest

[4] For a brief summary of our contribution and additional testing that focuses on the period 1930–1990 please see the robustness check section below as well as the Online Appendix.

rates and inflation affect Brazil's recent growth [see Muinhos and Nakane (2006) and Vale (2005)]. Most of these papers concluded that there was a strong positive relationship between financial development and output growth in Brazil, yet they have not investigated this relationship over the long-term, and nor have they assessed whether this is a more or less important reason vis-a-vis the other important factors economic historians normally highlight (such as trade openness, public finances, and inflation or macroeconomic instability).

To better understand the Brazilian case and its standing in the world economy we provide a brief comparison of prosperity (proxied by per capita gdp) between Brazil and other nations from Latin America and Western Europe. To accomplish this we plot (and compare) the level of Brazilian per capita gdp against that of Latin American (namely Argentina, Chile, Colombia, Uruguay and Venezuela) and Western European Countries (i.e. France, Germany, Portugal, Spain and United Kingdom) for the period 1870 to 2016 [obtained from Bolt et al. (2018)]. More specifically, Figures A1.a and A1.b in the Online Appendix report the level of Brazilian per capita gdp relative to Latin American and Western European countries respectively. The graphs show that Brazil has the lowest economic prosperity compared to both groups of countries by a considerable amount for most of the sample period.

The region of Latin America consists of a number of countries that experienced various degrees of financial development and economic prosperity. Figure A1.a suggests that despite the fact that most Latin American countries displayed comparable degrees of economic uncertainty the Brazilian economic welfare was only comparable to that of Colombia and Venezuela till around 1910, although well behind after that period. On the other habd Argentina, which faced a magnitude of political unrest similar to that of Brazil, enjoyed much higher economic welfare.

In sum, the period since 1870 is an important one in Brazil as it sees the country's economic take-off and it becoming an emerging market.[5] However, there is still debate about which factors better explain this remarkable transformation. Financial development (both domestic and international) is one of the main reasons often highlighted by economists and economic historians. The main objective of this paper is to evaluate the relative merits of the factors behind these explanations. More specifically, we try to contribute to the literature by studying how financial development and bank ownership affected the process of economic growth in Brazil.

3 Data

The data set we put together for this paper covers the period between 1870 and 2018 for Brazil. The basic data source is Mitchell (2003). Data were recorded yearly including: the growth rate of gdp at level[6] (*gdp*), deposits in commercial banks over gdp (*cbd*), deposits at Bank of Brazil over gdp (*dbb*), and money supply 1 over gdp (*m1*).[7]

Based on the literature on growth and finance (Levine, 2005; Campos et al., 2012, 2016) we use a broad range of measures of financial development, some reflecting depth and others efficiency aspects. One note of caution is that there are various aspects of financial develop-

[5] See the Online Appendix for a short summary of the Brazilian economic background since 1870.

[6] Furthermore, for robustness purposes we downloaded the Maddison growth rate of per capita gdp introduced by Bolt and Van Zanden (2014) and plotted it against our growth rate of gdp. The two lines were significantly intertwined (graph available upon request).

[7] The money standards of the data changed from time to time and figures are often incomplete for a given subperiod. Therefore, in order to find relatively complete series to avoid bias as much as possible, other resources are included i.e. the Federal Reserve Bank of St' Louis, U.S.A (FRED 2023).

ment which may be considered important but for which data are only available after about 1950 or 1960 (e.g., share of credit to the private sector over gdp, intermediation spreads, bank credit and bank credit/deposits ratio) and hence cannot be used in the present study.

Cbd is defined as the sum of time deposits in commercial banks and deposits (other than time deposits) at the end of the period in commercial banks over gdp, and alongside *dbb* it tries to capture the efficiency of the financial sector and not its relative size [see Campos et al. (2012) and Campos et al. (2016)]. Data have been reported by Mitchell (2003) but due to missing values we follow Pelaez and Suzigan (1976) to reconstruct the series. The second financial development indicator, *dbb*, is measured by the added value of time deposits and deposits (other than time deposits) at the end of the period in the central bank over gdp. *Cbd* and *dbb* serve as proxies of the private and public bank ownership respectively. The third and final one is *m1* [retrieved from Mitchell (2003)]. One potential drawback of this measure is that the ratio reflects the depth or the relative size of the financial system and not its efficiency. Given *m1*'s and *dbb*'s more restrictive nature we use both of them as a robustness check of our results and thereby we attach greater weight to commercial bank deposits (as a proxy of domestic financial development).

Our two financial development indicators, namely *cbd* and *dbb*, will allow us to conduct a deeper analysis of the issue of ownership, a topic that has not been sufficiently studied in the frame of the finance-growth nexus literature. Does ownership matter? How do payoffs in terms of economic growth vary according to whether financial development is in the form of deposits at public or at private banks? We construct historical data series that separate deposits at private banks from those in public banks. Our data for deposits at commercial banks exclusively covers private banks. On the other hand, Bank of Brazil today is a public bank and has been a state-owned bank for most of its history. Yet its history has been long and convoluted: Bank of Brazil was founded in 1808 and is the oldest (and largest by assets) financial institution in Latin America. It was bankrupt twice (in 1821 and 1898) and changed name, structure and functions many times.[8]

Because the Brazilian Central Bank was created only after World War II, Bank of Brazil has for long periods performed several of its tasks (e.g., issuing currency, having a monopoly over currency transactions and serving as Treasury holder). The head of the Bank of Brazil has always been a political appointment, nominated by the President. Although these gradations and changes are clearly important and do raise some caveats, it is also clear that Bank of Brazil is best classified throughout its history as a public-owned bank. This is broadly accepted in the literature [cf. Berg and Haber (2009), and Goldsmith (1986)] and is thus followed here.

We also use data on various factors often utilized to explain the economic performance of Brazil over the long-run (cf. (Abreu & Verner, 1997)) such as international financial development, trade openness, and public deficit. Despite the fact that in the period since 1930 Brazil remained a closed economy, international financial development is expected to have played a significant role in Brazil's economic growth. Abreu and Verner (1997) argue that from 1930–1980 Brazil had a unique foreign economic orientation, with bold export promotion policies and a rather closed domestic market. We use the level of interest rate in U.S. (*us*) as our proxy of the global financial market. The U.S. interest rates are obtained from Friedman and Schwartz (1982).[9] The measures of trade openness (*to*) and public deficit (*pd*) were obtained from Mitchell (2003) and the Brazilian Institute of Geography and Statistics—

[8] Haber writes about the Brazilian economy in the late 1890s: "The banking system then began to expand, led and controlled by a semi-official super-bank, the third Bank of Brazil, which acted both as a commercial bank and as the treasury's financial agent" (2003, p. 271).

[9] Due to the historic perspective of the paper and the lack of available data, the U.S. interest rate is used as a proxy for international financial development. However, we do acknowledge the fact that if the U.S. interest

(IBGE 2009). Trade openness is measured as the ratio of imports plus exports to gdp, while public deficit is the ratio of total public deficit to gdp. Because the original series (with the exception of growth rate of gdp) are I(1), they enter our models in first differences for stationarity purposes. All data are graphically illustrated in Figs. 1, 2, 3, 4, 5, 6 and 7 (with the exception of growth rate of gdp the rest of the series are plotted in first difference). Table B in the Online Appendix provides the definitions and data sources of the variables used in the regression analysis. We also plot the data at level in Figures 8 to 17 in the Online Appendix.

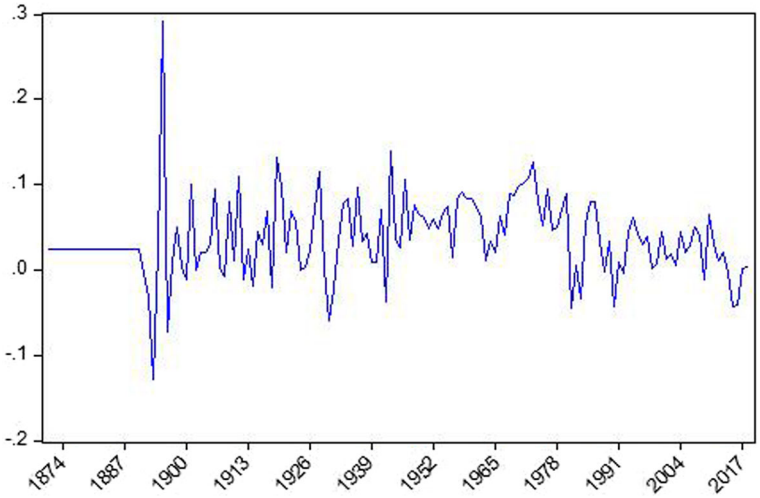

Fig. 1 Growth rate of Brazil GDP

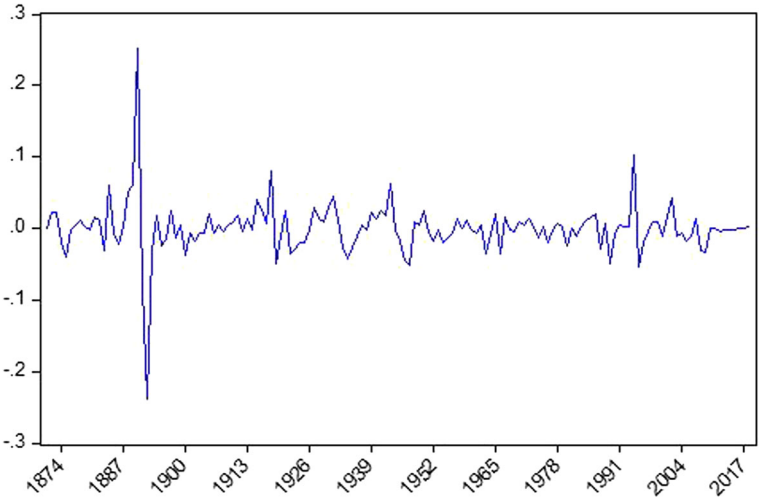

Fig. 2 Commercial bank deposits over GDP (in first difference)

Footnote 9 continued
rate affects any variable in the home country, it also means that it would systematically impact the home country gdp as well at some point through some direct or indirect channels. Data were also obtained from FRED (2023).

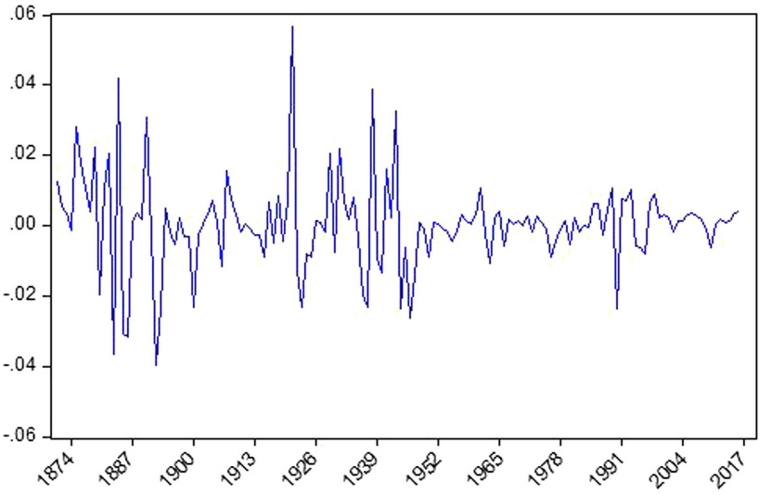

Fig. 3 Deposits at Bank of Brazil over GDP (in first difference)

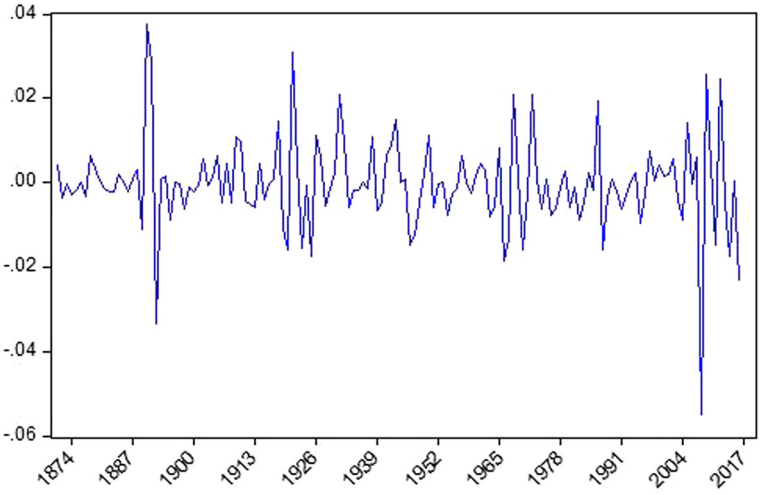

Fig. 4 Money supply (M1) over GDP (in first difference)

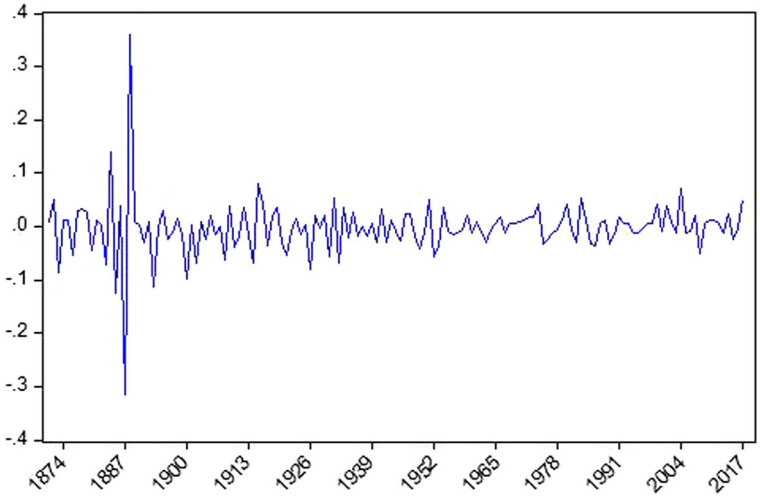

Fig. 5 Trade openness over GDP (in first difference)

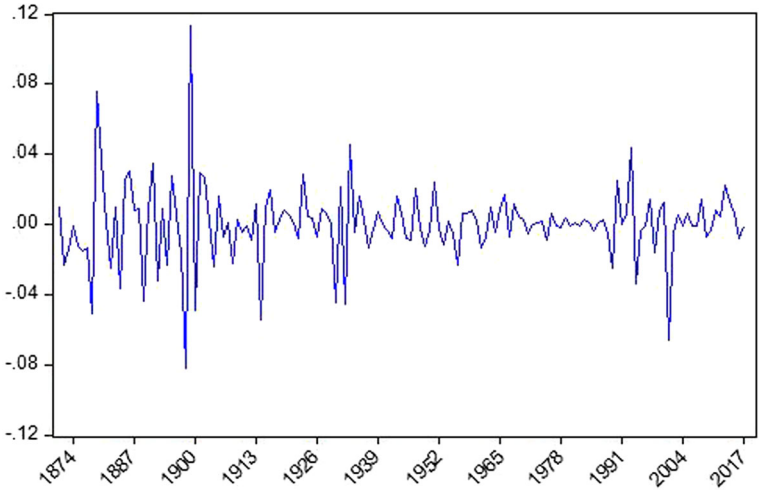

Fig. 6 Public deficit over GDP (in first difference)

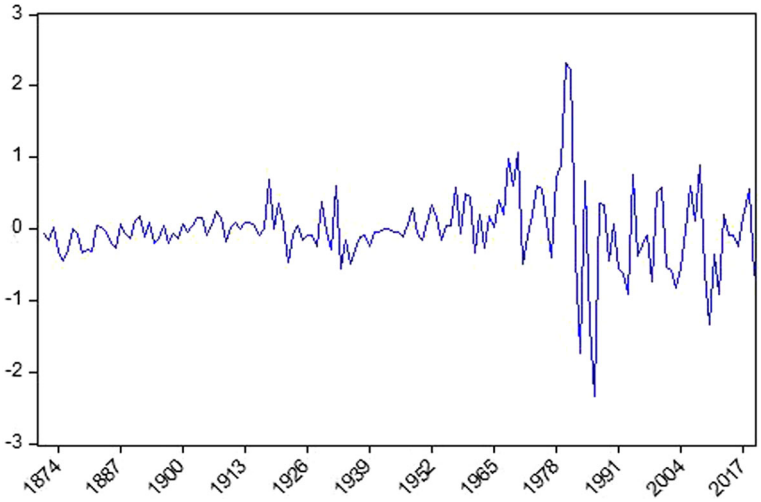

Fig. 7 U.S. Interest rate (in first difference)

4 The model

4.1 Power ARCH specification

In order to study the indirect effects of our set of explanatory variables we employ the PARCH model of Ding et al. (1993), which quickly gained currency in the finance literature.[10] Let growth (y_t) be equal to a drift plus a time-varying disturbance augmented by the in-mean effect of output volatility on output (h_t):

$$y_t = c + k \log(h_t) + \epsilon_t, \tag{1}$$

with $\epsilon_t = e_t h_t^{\frac{1}{2}}$ and k captures the effect of volatility on growth. In addition, $\{e_t\}$ are independently and identically distributed (i.i.d) random variables with zero mean and unit variance, while h_t is the conditional variance of output growth, which is positive with probability one and is a measurable function of the sigma-algebra Ω_{t-1}, which is generated by $\{y_{t-1}, y_{t-2}, \ldots\}$.

The conditional variance of growth is specified as a symmetric PARCH(1, 1) process:

$$h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} |e_{t-1}|^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \sum_{i=fd,to,pd,us} \phi_i x_{i,t-l} + \gamma y_{t-n}, \tag{2}$$

where δ (with $\delta \in (0, \infty)$) is the heteroscedasticity parameter, l and $n \in \mathbb{Z}_{\geq 1}$; α and β are the ARCH and GARCH coefficients respectively, x_{it} is either the financial development variable or one of the other explanatory variables,[11] namely trade openness, public deficit and U.S. interest rate and γ is the level coefficient for the nth lag of growth. The model imposes a Box-Cox power transformation of the conditional standard deviation process and the absolute

[10] See, for example, Karanasos and Kim (2006). Karanasos and Schurer (2005, 2008) and Canepa et al. (2023) use this process to model output growth and inflation respectively.

[11] Because the original series are I(1), they enter our models in first differences for stationarity purposes.

residuals, [following Ding et al. (1993) asymmetric effects were initially considered in our model, though the coefficients were insignificant and hence omitted from the analysis]. In order to distinguish the general PARCH model from a version in which δ is fixed (but not necessarily equal to two) we refer to the latter as (P)ARCH.

The PARCH model increases the flexibility of the conditional variance specification by allowing the data to determine the power of absolute residuals for which the predictable structure in the volatility pattern is the strongest. This feature in the volatility process has important implications for the relationship between financial development, growth and its volatility. There is no strong reason for assuming that the conditional variance is a linear function of lagged squared errors. The common use of a squared term in this role is most likely to be a reflection of the normality assumption traditionally invoked. However, if we accept that growth data are very likely to have a non-normal error distribution, then the superiority of a squared term is unwarranted and other power transformations may be more appropriate (for more details see the Online Appendix).

The Tables below report the estimated parameters of interest for the period 1870–2018. These were obtained by Quasi-Maximum likelihood (QML) estimation, which is robust to the presence of normality as implemented in EVIEWS and described by Bollerslev and Wooldridge (1992). Once heteroscedasticity has been accounted for, our specifications appear to capture the serial correlation in the power transformed growth series. Moreover, the tests for remaining serial correlation suggest that all the models seem to be well-specified since there is no remaining autocorrelation in either the standardized or squared standardized residuals at 5% statistical significance level (due to space limitations results are not tabulated but are available upon request).[12] In our paper we do not run the indirect and direct effects concurrently because with annual data we do not want to overparametrize our model.

Furthermore, our set of variables comprises domestic and international financial developments and it allows us to investigate how differently deposits in public vis-a-vis in private banks affect economic growth. As a robustness check we estimate our model using $\sqrt{h_t}$ for the in-mean effect. We also estimate it using an EGARCH specification. The results (not reported) are qualitatively similar to the ones we report in the paper.

4.2 Error correction model

We also investigate the direct short- and long-run effects on economic growth. In order to estimate the direct short- and long-run relationships we employ the following error correction (P)ARCH form

$$\Delta y_t = \mu + \sum_{i=fd,to,pd,us} \theta_i \Delta x_{i,t-l} + \varphi(y_{t-1} - c - \sum_{i=fd,to,pd,us} \zeta_i x_{i,t-1}) + \varepsilon_t, \qquad (3)$$

where θ and ζ capture the direct short- and long-run effects respectively, and φ is the speed of adjustment to the long-run relationship (we recall that x_{it} denotes the first difference of the explanatory variable). This is accomplished by embedding a long-run growth regression into an autoregressive distributed lag (ARDL) model [see, for example, Loayza and Rancière (2006), and Campos et al. (2012, 2016)]. In other words, the term in parenthesis contains the long-run growth regression, which acts as a forcing equilibrium condition:

[12] We also run the ARCH effect tests in the underlying data. For all of our variables the results show rejection of the null hypothesis of homoscedasticity in the squared residuals. See Table A.1 in the Online Appendix.

$$y_t = c + \sum_{i=fd,to,pd,us} \zeta_i x_{it} + u_t, \tag{4}$$

where u_t is $I(0)$.[13] The lag of the second difference of either the financial development (domestic or international) or trade openness or public deficit ($\Delta x_{i,t-l}$) characterizes the direct short-run effect. The condition for the existence of a long-run relationship (dynamic stability) requires that the coefficient on the error-correction term be negative and not lower than -2 (that is, $-2 < \varphi < 0$).[14]

We also take into account the PARCH effects by specifying the error term ε_t as follows:

$$\varepsilon_t = e_t h_t^{\frac{1}{2}}, \tag{5}$$

where

$$h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} |e_{t-1}|^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}}. \tag{6}$$

5 Empirical results

We present our main results in two interdependent blocs: the indirect and the direct (short and long-run) effects. We proceed with the estimation of the (P)ARCH(1, 1) models in eqs. (1)–(2), and (3)–(6) in order to take into account the serial correlation observed in the levels and power transformations of our time series data. Tables 1 and 2 below report the estimated parameters of interest for the period 1870–2018. Our results are presented following specific types of effects. That is, we discuss indirect (via volatility), direct (short- and long-run), public vis-a-vis private bank ownership and structural break effects.

5.1 Indirect and direct effects

Indirect Effects

One of the main advantages of the (P)ARCH framework is that it allows us to study indirect growth effects from the full set of explanatory variables described above on economic growth through the predicted component of growth volatility (conditional on its past values). Table 1 reports the indirect effects for each of the explanatory variables on growth via the volatility channel.[15] As we can see from this table, the effect of conditional or predicted volatility on growth is in all cases positive ($k > 0$) and statistically significant at high levels. The power

[13] Notice that all variables are $I(0)$ in the long-run growth regression, that is Eq. (4). In addition, notice that in Eq. (3) all regressors are lagged.

[14] Notice that we can estimate Eq. (3) in two steps as in Loayza and Rancière (2006). That is, first estimate the long-run slope coefficients (ζ_i) in Eq. (4). In this case, and as all data in Eq. (4) is $I(0)$, with stationary data the long-run parameters from an ordinary least squares (OLS) regression are not super consistent. Therefore, since in the long-run estimation contemporaneous variables are involved, it would require the use of instrumental variables (IV); see for example, Hunter et al. (2017, pp. 50–51) and the examples in Chapter 8. Second, the estimation of the short-run coefficients (including the speed of adjustment φ) is done through conditional maximum likelihood and using the estimates of the long-run slope coefficients previously obtained. Alternatively, we have recalculated the parameters on $x_{i,t-1}$ in Eq. (3) using a one step linear estimation, see robustness check in Section 5.1 below for further discussion.

[15] In the expressions for the conditional variances reported in Table 1, various lags of growth (from 1 to 12) were considered with the best model ($n = 8$) chosen on the basis of the minimum value of the AIC.

Table 1 Indirect effects of financial development, trade openness, public deficit and US interest rate on economic growth

	k	ϕ_{fd}	ϕ_{to}	ϕ_{pd}	ϕ_{us}	α	β	γ	δ
m1	0.01 (4.69)	−0.21 (−2.11) $l-6$	−0.12 (−2.84) $l-8$	−0.11 (−2.36) $l-3$	0.01 (5.29) $l-1$	0.40 (4.04)	0.36 (3.46)	0.12 (4.25) $n-8$	1.00
cbd	0.01 (7.25)	−0.09 (−2.67) $l-8$	−0.09 (−1.70) $l-8$	−0.14 (−2.44) $l-3$	0.01 (1.67) $l-8$	0.40 (3.03)	0.39 (2.59)	0.13 (5.23) $n-8$	1.00
dbb	0.01 (2.06)	−0.37 (−5.07) $l-5$	−0.07 (−6.31) $l-8$	−0.08 (−5.58) $l-3$	0.01 (2.02) $l-6$	0.46 (5.32)	0.41 (5.49)	0.15 (3.43) $n-8$	1.00
bcc	0.01 (8.72)	−0.01 (−9.57) $l-2$	−0.39 (−2.18) $l-2$	−0.76 (−6.15) $l-5$	0.02 (5.08) $l-8$	0.54 (5.97)	0.31 (2.31)	0.14 (1.65) $n-8$	0.70

Table reports parameter estimates of indirect effects for the following models:
$y_t = c + k\log(h_t) + \varepsilon_t$,
$h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \sum_{i=fd,to,pd,us} \phi_i x_{i,t-l} + \gamma y_{t-n}$,
$x_{fd,t-l}$ is either m1 or commercial bank deposits (cbd) or deposits at Bank of Brazil (dbb) or bank credit in all commercial banks (bcc)
$x_{to,t-l}$ is trade openness (to), $x_{pd,t-l}$ is public deficit (pd)
and $x_{us,t-l}$ is the U.S. interest rate (l and n are the order of the lags
The numbers in parentheses are z statistics

Table 2 The direct short- and long-run effects on growth

	θ_{fd}	θ_{to}	θ_{pd}	θ_{us}	ζ_{fd}	ζ_{to}	ζ_{pd}	ζ_{us}	φ
m1	−0.23 (−1.68) $l-3$	−0.01 (−0.17) $l-5$	−0.13 (−2.09) $l-6$	0.01 (3.04) $l-5$	0.24 (2.66)	0.01 (0.73)	0.05 (1.62)	0.01 (2.74)	−0.68 (−9.94)
cbd	−0.24 (−4.49) $l-3$	−0.04 (−2.28) $l-2$	−0.13 (−4.60) $l-3$	0.01 (2.08) $l-6$	0.03 (7.71)	−0.01 (−0.19)	0.01 (0.12)	0.01 (0.75)	−0.77 (−8.77)
dbb	−0.76 (−2.66) $l-4$	−0.20 (−2.24) $l-5$	−0.15 (−1.03) $l-8$	0.01 (1.20) $l-5$	−0.07 (−1.06)	−0.03 (−1.42)	0.03 (0.41)	0.01 (2.91)	−0.51 (−3.36)

Table reports parameter (mean) estimates for the following model:
$\Delta y_t = \mu + \sum_{i=fd,topd,us} \theta_i \Delta x_{i,t-l} + \varphi(y_{t-1} - c - \sum_{i=fd,to,pd,us} \zeta x_{i,t-1}) + \varepsilon_t$,
$h_t^{\frac{\delta}{2}} = \omega + \alpha \left|u_{t-1}\right|^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}}$.
θ_i and ζ_i capture the direct short- and long-run effects respectively
φ indicates the speed of adjustment to the long-run relationship
$x_{i,t-l}$ can be the first difference of either financial development or trade openness or public deficit or U.S. interest rate. l and n are the order of the lags
The short- and long-run impact of bcc is insignificant and hence omitted from the model
The numbers in parentheses are z statistics

term coefficients δ are rather stable, with the Akaike IC (AIC) criteria choosing a (P)ARCH specification with power term in most of the cases equal to 1.00. In the current analysis, we present our results for the indirect impacts on growth.

The parameters we are most interested in are ϕ_{fd} and ϕ_{us} (see columns 3 and 6). We find that the (indirect) impact of domestic financial development on the conditional volatility of economic growth is negative and statistically significant, whereas that of U.S. interest rate is

positive. Interestingly, the size of the effect (in terms of magnitude) for public bank ownership is higher than that for private bank ownership ($0.37 > 0.09$). These results are robust to the presence of trade openness and public deficit, which also affect volatility negatively.

Our results suggest that exogenous increases in domestic financial development have a negative and significant indirect impact on growth (notice that the lagged short-run direct effect is also negative; see the analysis below). In other words, more financial development is associated with a lower proportion of growth volatility, which is anticipated by the relevant economic agents. Moreover, the lower the share of the growth volatility that is anticipated, the lower the growth rates we observe (supporting the Black hypothesis).

On the other hand, higher U.S. interest rates are associated with a larger proportion of growth volatility and the larger the share that is anticipated by agents, the higher the growth rates we observe. Therefore, international financial integration registers a positive influence on growth, which is also both indirect and direct (see below the short- and long-run effect). This is intuitive, as reductions in the U.S. interest rate lead to a reduction of the price of money internationally, which in turn leads to reduced levels of risk. This result, according to international empirical evidence, is becoming increasingly characteristic of internationalized economies.

Furthermore, both trade openness and public deficit have a negative indirect impact on growth. Interestingly, this negative influence reflects one of the costs many economists associate with trade liberalization and fiscal consolidation efforts: in the short-run, reductions in the share of trade and public deficit in gdp increase the amount of growth volatility that economic agents are not able to anticipate ($\phi < 0$). This higher volatility translates into higher rates of economic growth (since $k > 0$).

In summary, we find strong evidence that domestic financial development has a negative indirect (via volatility) impact on growth whereas U.S. interest rate (international financial development proxy) affects it positively. Trade openness and public deficit affect volatility negatively. Finally, for all the set of our explanatory variables, both the indirect and direct short-run effects work in the same direction**.** We now turn to the investigation of the direct short- and long-run effects.

Direct Short- and Long-Run Impact

Table 2 displays the results on the estimation of the direct short- and long-run parameters linking our explanatory variables with growth. In all cases, the estimated coefficient on the error correction term (φ) lies within the range -0.77 to -0.51 which is well within the dynamically stable range $(-2, 0)$. We find important differences in terms of direct short- and long-run behaviour of our explanatory variables. More specifically, we focus our analysis first on those obtained from the domestic financial development. In the short-run, we find that it affects growth negatively (see the θ_{fd} column in Table 2), whereas in the long-run the impact is positive (only for the case of m1 and cbd, see the ζ_{fd} column). Thus, our results square well with recent findings by Loayaza and Rancière (2006), among others, in that the sign of the relationship between economic growth and financial development depends on whether the movements are temporary or permanent (the effect being negative in the former and positive in the latter case). On the other hand, our parameter estimates report a positive short- and long-run influence of international financial development on growth (see the θ_{us} and ζ_{us} columns respectively). The latter finding is similar to the one reported by Campos et al. (2012) for Argentina. The results for trade openness and public deficit indicate a negative impact on growth that is restricted in the short-run.

In summary (see also Table 5), we find that domestic financial development affects growth negatively in the short-run but positively in the long-run, whereas the impact of international

financial integration is positive in both cases. Overall, we argue that both domestic and international financial development have an important direct role in the economic growth of Brazil. Interestingly, the short-run effects of the international financial development are in the opposite direction from those of domestic financial development. Furthermore, public deficit and trade openness also play a significant role in Brazilian growth but only in the short-run.

Our findings with respect to financial development and trade openness reveal an interesting aspect of the forces that drive the Brazilian economic growth. In particular, the negative (direct) short-run impact of domestic financial development and trade openness on growth suggests that emerging markets, such as Brazil (with an economy oriented towards exporting primary goods, i.e. soybeans, sugar and coffee among others), that attempt either (i) to expand their weak domestic financial systems without promoting financial reforms (substantial financial sector reforms took place in Brazil as early as in the 1960 s) or (ii) to increase their exposure/openness to trade without adopting to new technologies to achieve economies of scale, experience negative economic outlooks in the short-run. As far as the negative effect of public deficit on growth is concerned, our estimates bring to the surface the long-standing discussion among macro-economists on the importance of the rationalization of public spending in order to maintain a benign macroeconomic environment and social tranquillity.

Robustness Check

The existing theoretical as well as empirical literature on the growth-finance relationship postulates that in a bank-based financial system, bank credit is the major instrument of financial intermediation through which financial development transmits the effects on growth. Credit-deposit ratio may also be considered as another measure of the efficiency of financial intermediation at a given level of deposits (data were available for a very short period of time, 1973 onward, and hence this measure of financial development was omitted from our analysis).

To corroborate our results further we considered in our analysis the growth rate of bank credit in all commercial banks (bcc), which was obtained from the Federal Reserve Bank of St' Louis as an additional measurement of financial development efficiency. However, the data were only available for the period 1948 to 2018. The indirect negative influence of this variable confirms our baseline results. The direct short- and long-run effects were statistically insignificant and are hence omitted from our modelling.

However, before proceeding we must note that one possible important drawback of the identification strategy is omitted variable bias. To address this issue, we control for the effect of inflation rate (inf), population (pop), and regime and regulatory authority (reg), measured by the authority score (this indicator is computed by substracting the autocracy score from the democracy score, for more details see Table B), and examine whether controlling for these three variables the effects of our key domestic financial development measurements become weaker, stronger or remain unchanged.[16] With regards to the indirect effects, our results indicate a negative (positive) effect of inflation (population and regulatory authority) on economic growth, (see the parameter estimates ϕ_{reg}, ϕ_{inf} and ϕ_{pop} in Table 3 respectively). As for the direct influences, our findings show a positive (negative) long-run impact of the

[16] We also considered certain factors such as the adverse physical geography [see Miguel et al. (2004) and Atsalakis et al. (2021)] measured for instance by the variation in rainfall as well as the annual temperature, the human capital formation measured by the average years of education [see Spruk (2016)], the effect of culture on growth [see McCleary and Barro (2006)], the foreign direct investments (as well as their net inflows and net outflows), unemployment rate, central government debt as a share of gdp and the immigration rate, which potentially directly or indirectly affect economic growth. However, due to the historical scope of this paper (since 1870), these factors could not be included in our empirical estimations due to the unavailability of data.

population and authority score (inflation) on economic growth, whereas the effect disappears in the short-run in the majority of the cases (see the parameter estimates θ_{pop}, $\theta_{\inf}$, θ_{reg}, ζ_{pop}, $\zeta_{\inf}$, ζ_{reg} in Table 4, respectively). In addition, the parameter estimates show that the key findings for the indirect and direct (short- and long-run) impacts of domestic financial development on growth remain qualitatively unchanged (see parameter estimates ϕ_{fd} in Table 3, θ_{fd} and ζ_{fd} in Table 4). That is, there is a negative (positive) indirect and direct short-run (long-run) effect on economic growth.

To corroborate our analysis further we recalculate the parameters on $x_{i,t-1}$ in Eq. (3) using a one step linear estimation [see for example Banerjee and Hndery (1992), and Pinshi (2020)]. Overall, our key findings for domestic financial development remain unchanged. The results are also robust to the inclusion of pop, inf and reg (see Tables A.3 and A.4 in the Online Appendix). Abreu and Verner (1997) by employing money supply as a measure of financial development argued that there is no evidence that financial development boosted growth. To investigate this further we re-run, for the period 1930 to 1993, the same PARCH regressions as with Tables 3 and 4 respectively, when the financial development measure is $m1$ and bcc (see Tables A.4 and A.5 in the Online Appendix). Our initial results on the effects of financial development (indirect and direct short- and long-run) on growth are confirmed even during this shorter period of time. More specifically we find (i) a negative indirect effect of both $m1$ and bcc on growth, whereas the direct effect of $m1$ and bcc is positive and (ii) a negative short-run effect of $m1$ on growth (the effect of bcc is statistically insignificant). The latter provides further evidence of the contribution of the PARCH effect compared to standard OLS estimates. Finally we explore to what extend data definitions change our conclusions. By running a methodology similar to that of Abreu and Verner (1997) for the period 1930–1993 (see Table A.7 in the Online Appendix), but by utilizing bcc as an indicator of financial development (instead of money supply) we find a negative effect on growth though statistically insignificant (confirming our findings from Table 2).

Table 3 Indirect effects on economic growth—robustness check

	k	ϕ_{fd}	ϕ_{to}	ϕ_{pd}	ϕ_{us}	ϕ_{pop}	$\phi_{\inf}$	ϕ_{reg}	α	β	γ	δ
m1	0.01 (8.79)	−0.19 (−2.36) $l-6$	−0.14 (−7.05) $l-8$	−0.11 (−4.25) $l-3$	0.01 (4.33) $l-1$	0.01 (2.21) $l-2$	−0.01 (−0.85) $l-2$	0.01 (3.47) $l-2$	0.46 (4.96)	0.37 (4.34)	0.16 (7.20) $n-8$	1.00
cbd	0.01 (3.63)	−0.10 (−2.40) $l-8$	−0.14 (−1.61) $l-8$	−0.13 (−1.80) $l-3$	0.01 (1.60) $l-8$	0.01 (0.13) $l-2$	−0.01 (−2.11) $l-2$	0.01 (2.64) $l-2$	0.35 (2.91)	0.40 (2.78)	0.20 (5.53) $n-8$	0.90
dbb	0.01 (8.69)	−0.89 (−5.45) $l-5$	−0.25 (−2.47) $l-8$	−0.17 (−1.82) $l-3$	−0.01 (−1.26) $l-6$	0.01 (0.40) $l-1$	−0.01 (−1.67) $l-2$	0.01 (2.33) $l-2$	0.33 (4.01)	0.49 (5.33)	0.27 (4.62) $n-8$	0.70
bcc	0.01 (6.14)	−0.01 (−3.58) $l-6$	−0.30 (−4.37) $l-2$	−0.18 (−2.05) $l-6$	0.01 (1.83) $l-6$	0.01 (5.18) $l-1$	−0.01 (−2.87) $l-2$	0.01 (4.19) $l-2$	0.23 (2.58)	0.44 (3.12)	0.24 (3.31) $n-9$	0.80

Table reports parameter estimates of indirect effects for the following models:

$$y_t = c + k\log(h_t) + \varepsilon_t,$$

$$h_t^{\frac{\delta}{2}} = \omega + \alpha h_{t-1}^{\frac{\delta}{2}} \mid e_{t-1} \mid^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}} + \sum_{i=fd,to,pd,us,pop,\inf,reg} \phi_i x_{i,t-l} + \gamma y_{t-n},$$

$x_{fd,t-l}$ is the first difference of either m1 or commercial bank deposits (cbd) or deposits at Bank of Brazil (dbb)

or bank credit in all commercial banks (bcc), $x_{to,t-l}$ is trade openness (to), $x_{pd,t-l}$ is public deficit (pd), $x_{us,t-l}$ is the U.S. interest rate, $x_{pop,t-l}$ is the population (pop), $x_{\inf,t-l}$ is the inflation rate (inf) and $x_{reg,t-l}$ is the authority score (reg) and l and n are the order of the lags. The numbers in parentheses are z statistics

Table 4 The direct short- and long-run effects on growth-robustness check

	θ_{fd}	θ_{to}	θ_{pd}	θ_{us}	θ_{pop}	$\theta_{\inf}$	θ_{reg}	ζ_{fd}	ζ_{to}	ζ_{pd}	ζ_{us}	ζ_{pop}	$\zeta_{\inf}$	ζ_{reg}	φ
m1	−0.36 (−1.98) *l*−3	−0.21 (−6.21) *l*−5	−0.23 (−2.75) *l*−6	0.01 (1.68) *l*−4	0.01 (1.71) *l*−2	−0.01 (−0.71) *l*−2	−0.01 (−0.01) *l*−2	0.23 (1.88)	0.01 (1.54)	−0.01 (−0.46)	0.01 (0.82)	0.01 (8.33)	−0.01 (−2.05)	0.01 (4.92)	−0.80 (−8.01)
cbd	−0.29 (−2.70) *l*−3	−0.07 (−3.21) *l*−2	−0.17 (−2.68) *l*−3	0.01 (2.45) *l*−6	0.01 (1.30) *l*−2	−0.01 (−0.54) *l*−2	−0.01 (−0.57) *l*−2	0.32 (1.68)	−0.01 (−0.35)	−0.27 (−2.15)	0.01 (0.52)	0.01 (3.51)	−0.01 (−2.11)	0.01 (3.85)	−0.75 (−7.88)
dbb	−0.51 (−3.51) *l*−4	−0.06 (−2.74) *l*−5	−0.02 (−0.17) *l*−8	0.01 (0.06) *l*−4	0.01 (0.66) *l*−2	0.01 (0.14) *l*−2	−0.01 (−0.21) *l*−2	−0.04 (−1.28)	−0.03 (−4.22)	0.04 (0.91)	0.01 (2.39)	0.01 (11.51)	−0.01 (−2.55)	0.01 (6.18)	−0.61 (−6.21)

Table reports parameter (mean) estimates for the following model:

$$\Delta y_t = \mu + \sum_{i=fd,topd,us,pop,\inf,reg} \theta_i \Delta x_{i,t-l} + \varphi(y_{t-1} - c - \sum_{i=fd,to,pd,us,pop,\inf,reg} \zeta x_{i,t-1}) + \varepsilon_t,$$

$$h_t^{\frac{\delta}{2}} = \omega + \alpha \left|u_{t-1}\right|^{\delta} + \beta h_{t-1}^{\frac{\delta}{2}}.$$

θ_i and ζ_i capture the direct short- and long-run effects respectively. φ indicates the speed of adjustment to the long-run relationship. $x_{i,t-l}$ can be the first difference of either the financial development (fd) or trade openness (to) or public deficit (pd) or U.S. interest rate (us) or population (pop), or inflation rate (inf) or the authority score (reg). *l* and *n* are the order of the lags. The short- and long-run impact of bcc is insignificant and hence omitted from the model. The in parentheses are z statistics

5.2 Public vis-a-vis private banks

In a novel paper (La Porta et al., 2002) argue that public ownership of banks has a negative impact on growth. According to their estimations a 10% increase in public ownership reduces annual growth of per capita gdp by 0.14–0.24%. The aforementioned study changed the view of the policy makers around the world on how they perceived public banks. Even the International Monetary Fund's recommendation is in favour of the privatisation of public banks in both developed and developing economies [see for more details Körner and Schnabel (2010)].

Our findings with respect to private and public banks are interesting and important. First we argue that the influence of private ownership (that is deposits in commercial banks) and public ownership (deposits at Bank of Brazil) on economic growth tends to be both direct and indirect. Interestingly, our parameter estimations highlight the significantly higher (in magnitude) negative indirect and direct short-run effects of public banks (compared to that of private banks) on growth. These results are robust to controlling for potential omitted variables biases (such as trade openness, government deficit, international financial development, population, inflation and authority score). The substantially higher (in absolute value: almost four and three times, respectively) negative effect of public bank ownership on growth highlights the extent to which the former affects the latter and the direction policy makers should take towards bank ownership, banking regulation and growth-enhancing policies in the case of Brazil.

Further decomposing these growth effects in their short- and long-run aspects is key. This is so not only because of the relatively large time window (historical series) but also because an important finding in the finance-growth nexus literature is that the effect of finance on growth tends to be positive in the long- but negative in the short-run. Our results for Brazil not only provide broad support for this finding, but also add a novel element to it, namely, that this asymmetry holds only for private (not for public) banks. We only find evidence of such a pattern (negative impact on growth in the short- and positive in the long-run) for private banks. This suggests that macro analysts and policy makers could anticipate (and subsequently review) the implications of their decisions on private bank ownership in both the short- and long-run, whereas for public banks these influences are restricted in the short-run. Table 5 reports a summary of our results.

Table 5 Summary results

	m1	cdb	dbb	us	to	pd
Indirect	−	−	−	+	−	−
Short-run (direct)	−	−	−	+	−	−
Long-run (direct)	+	+	0	+	0	0

−: negative; +: positive; 0: zero

5.3 Structural breaks

Considering the role of structural changes, we adopt an important robustness test, that of the existence of structural breaks. We use the methodology developed by Bai and Perron (2003) to observe whether or not there are any structural breaks in growth as well as the main explanatory variables of our study, namely the financial development indicators.[17] For the economic growth series, we identify only one structural break, coinciding with the end of World War I, that is, for the year 1918. Interestingly, the financial development variables reveal different break dates. We estimate two breaks for the *m1* series, one in 1889 and another in 1930 (though statistically insignificant and hence omitted from the subsequent analysis), both reflecting massive changes in monetary policy following two important coups d'etat (1889 is the end of the Empire and the start of the Republic, whereas the one in 1930 marks the start of the "Estado Novo').

For both deposits at Bank of Brazil and at commercial banks there is one break before World War I (1911 and 1914 respectively) while only for the latter do we identify a second break in 1962. More specifically, the second break concerning private bank ownership takes place just before a major re-organization of the Brazilian financial system that culminated with the establishment of the Central Bank, after the military coup in March 1964.

We find our results (regarding the effects of the domestic financial development) to be robust to the inclusion of the structural break dummies (see the Online Appendix for structural break modelling). Specifically, (i) it influences growth volatility negatively and (ii) there is a negative impact on growth in the short-run and a positive one in the long-run (only for the case of m1 and cbd) (see Tables A.8 and A.9, respectively)**.**

Interestingly, the indirect and the direct short-run effects of m1 become weaker after the identified structural break in 1889, a result in line with the historical experience, [see Triner (1996) and Goldsmith (1986); and the $\varphi_{fd}^{(1)}$ column of Table A.8, and the $\theta_{fd}^{(1)}$ column in Table A.9, respectively]. By the same token, i) the indirect effect of public bank ownership is stronger before the start of the Great War, 1911 (see the $\varphi_{fd}^{(1)}$ column of Table A.8) and (ii) the indirect role of private bank ownership intensifies after 1962 (see the $\varphi_{fd}^{(2)}$ column of Table A.8).

The breakpoint analysis corroborates our baseline results on the importance of public vs private bank ownership in the finance-growth nexus. From one side public banks play a more important indirect role (via volatility), whereas from the other private banks stimulate output growth in the long-run. One point worth mentioning is to look at the structural breaks in the estimated GARCH parameters. One way of moving forward could be the methodology introduced by Karanasos et al. (2021, 2022); Yfanti et al. (2023) and Canepa et al. (2023); see also Karanasos et al. (2023). Nevertheless, one potential limitation of the robustness of our results is that these papers use daily observations. To that extent, in our paper we do not use breaks in the GARCH parameters because with annual observations we seek not to overparametrize our model.

5.4 Discussion

Our findings suggest that a better understanding of Brazilian growth patterns since the late 19th century may not only advance new policies but also promote the necessary political

[17] For U.S. interest rate and, interestingly, for growth volatility we find no structural breaks. For trade openness and public deficit the breaks were statistically insignificant and are hence omitted from the models.

support for their implementation. The importance of our findings lies in the fact that those proposals for deep reforms in Brazil will not win wide public acceptance if they are not perceived to respond to a credible account of how policies that are "wrong" in 2001 appeared "right" for half of the last century (see (Pinheiro et al., 2004)).

When policy reforms promote the development of a robust and stable financial system, financial services improve, accelerating economic growth, which in turn leads to reduced levels of extreme poverty on a sustainable basis.

Concluding, the predominant view in many developing and socialist countries was that state-owned financial institutions played an important role in reducing poverty. This was based on the idea that the private sector was not capable of supplying the necessary resources to crucial sectors of the economy. Nevertheless, despite their poor performance (which is confirmed by our results, that is a negative effect of public banks on growth), those institutions continued to dominate the financial sector. Our findings indicate that public ownership has generally proved to be inferior to private ownership perhaps for two reasons: (a) opportunistic behaviour on the part of politicians (the use of public institutions for personal political purposes) and (b) weak forms of corporate governance (for example poorly performing public institutions will eventually be bailed out, something that does not happen in the case of private ownership).

6 Conclusions and future research

Using a PARCH framework and data for Brazil from 1870 to 2018 we attempted to shed light on the following questions: What is the relationship between, on the one hand, financial development (domestic and international) and on the other hand, economic growth and (predicted) growth volatility? Are these effects fundamentally and systematically different? Does the intensity and the direction (the sign) of these effects vary over time, in general and, in particular, do they vary with respect to short- versus long-run considerations? Does ownership matter? We find that the main explanatory factors, solely in terms of their negative lagged indirect/direct (short-run) effects on economic growth in Brazil, turn out to be the domestic financial development indicators. Further, we find robust evidence that the U.S. interest rate affects growth positively both indirectly (via its volatility) and directly (both in the short- and long-run). Our results are robust to the inclusion of other economic variables i.e. trade openness and public deficit.

By observing a double negative effect (both direct and indirect) of domestic financial development on output growth the impact of the former on the latter is burdensome. Thus, macro theorists should incorporate the domestic financial development into their growth analysis.

We also find important differences in terms of the direct short-run and long-run behaviour of our key variables. More specifically, we argue that domestic financial development influences growth negatively in the short-run but positively in the long-run, whereas the impact of international financial integration is positive in both cases. Furthermore, the impact of private and public ownership on economic growth tends to be both direct and indirect. However, our parameter estimations highlight the significantly higher (in absolute magnitude) negative indirect and direct short-run effects of public banks (compared to those of private banks) on growth. Finally, trade openness and public deficit influence output growth negatively in the short-run. Our results are robust to the inclusion of population, inflation, and authority score as well as dummy variables.

The main goal of this study was to assess the role of domestic and international finance as well as that of public vs private bank ownership on Brazilian economic growth. Nevertheless, there are some limitations of the present study that should be addressed in subsequent studies. One such limitation is that the empirical evidence does not provide a definite account of the causal link between finance and growth since we do not exploit plausibly exogenous sources of variation in Brazil's long-run growth and do not use a research design that would allow us to exploit such channels. However, these concerns are greatly alleviated (with careful identification strategies and the lagged estimations or structural breaks) to the extent that our regressions yield consistent results. In addition, due to the historical scope of this paper, certain factors such as the adverse physical geography measured, for instance, by the variation in rainfall as well as the annual temperature, the human capital formation measured by the average years of education, the effect of culture on growth, the foreign direct investment and the immigration rate, which potentially directly or indirectly affect economic growth, could not be considered due to the unavailability of data.

These findings are interesting but they also matter because they raise a number of new questions that we believe may be useful in motivating future research. Here we highlight two suggestions. Regarding the role of finance in the process of economic development, our findings reinforce a large body of previous research in that we also show a positive impact of financial development on growth in the long-run. We can not however underestimate the fact that Brazil is unique. Put differently, Brazil is an outlier and further research could try to replicate our analysis using the historical experience of other countries (ideally in a panel setting). That is, studying the relationship between financial development and economic growth in a panel of developing countries would strengthen what we know so far. Yet, the data requirements are very heavy indeed, with most developing countries lacking historical data even on key figures, such as the level of gdp, going back to the beginning or middle of the XIXth century. This, of course, does not make this task less important.

The second suggestion refers to a possible methodological improvement, namely the application of the smooth transition error correction model (see Jawadi et al. (2019) for alternative applications). This would clearly represent progress and is something we feel future research should try to address.

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Declarations

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

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