Bank Concentration and Schumpeterian Growth: Theory and International Evidence

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Abstract

This paper investigates the relationship between economic growth and bank concentration. We introduce imperfect competition of the banking system in the Schumpeterian growth paradigm; we theoretically and empirically show that the effects of bank concentration on economic growth depend on the proximity to the worldwide technological frontier. The theory predicts that bank concentration has a negative and significant direct effect on economic growth, especially for countries close to the worldwide technological frontier. We empirically verify our theoretical predictions by using Cross-Country and Panel data of 125 countries over the period 1980-2010.

KEYWORDS: Schumpeterian Growth, bank concentration, technological frontier.

JEL: O3, O16, C21, C23.

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1 Introduction

The role of financial development in economic growth, first outlined by Schumpeter (1912) allowing a better capital allocation, is now at the heart of economic growth literature. The first serious attempt to empirically estimate the relation between financial development and economic growth backs to Robert King and Ross Levine. Indeed, King and Levine (1993a) using cross-country perspective found that various measures of the level of financial development are strongly associated with real per capita GDP growth, the rate of physical capital accumulation, and improvements in the efficiency with which economies employ physical capital. King and Levine (1993b) show that the level of a country’s financial development helps predict its rate of economic growth for the following 10 to 30 years. Since then, a large literature, exhaustively reviewed by Levine (2005), estimated this relation using numerous robustness checks to corroborate the intuition of Schumpeter (1912).

However, these authors implicitly assumed that the banking system evolves in an environment of perfect competition and our contribution in this literature is to study the effects of the banking system on economic growth in a context of imperfect competition. More precisely, we propose to evaluate the effect of bank concentration on economic growth both theoretically and empirically in the Schumpeterian growth paradigm. The literature devoted to the effects of bank concentration on economic growth leads to different and ambiguous results. In this paper, we propose to clarify this relation answering the two following main questions: What are the effects of bank concentration on economic growth in a theoretical and empirical framework? How do these effects evolve for a given country according to its proximity to the worldwide technological frontier? The answer to both these questions allows us to take a position in the existing literature mainly to provide a better understanding of the effects of market power and bank concentration on economic growth through a theoretical model validated by empirical estimates.

The effects of bank concentration on economic growth have been studied by Deidda and Fattouh (2005) using an AK endogenous growth model. They find that reduction in the level of concentration in the banking industry exterts two opposite effects on economic growth. On the one hand, it induces economies of specialisation which enhances intermediation efficiency and thereby economic growth. On the other hand, it results in duplication of fixed costs which is detrimental for efficiency and growth. Our article does not explore the channel of capital accumulation as Deidda and Fattouh (2005) or Badunenko and Romero-Avila (2013) did who found that a substantial part of the productivity growth attributable to physical capital accumulation should be predicted to the allocative efficiency role of financial development using nonparametric production frontier and add financial development.1 In our article, we demonstrate that the effect of bank concentration on economic growth is due to three channels. The first channel is captured by the loan rate through the imperfect Cournot competition in the banking system, the second channel is measured by the probability of entrepreneurial innovation through Schumpeterian endogenous growth model and the last channel deals with the proximity to the

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1Our empirical results are however robust using bank efficiency (net interest margin and overhead costs) as suggested by Badunenko and Romero-Avila (2013) for financial efficiency, for more details see columns (6) and (7) of Table 10.
worldwide technological frontier to explain the effects of convergence between countries through bank concentration. The banking sector is composed of $n$ identical banks, they collect deposits and lend loans to entrepreneurs. Deposits sector is assumed in perfect competition while the loans sector evolved in an imperfect Cournot competition. This last assumption allows us to capture the effects of bank concentration measured by the Herfindahl index on economic growth. Several empirical studies show that high bank concentration increases the cost of the credits, as Hannan (1991), who finds strong evidence that concentration is associated with higher interest rate across U.S. banking markets. Cetorelli (2002) explores the effect of banking market structure on the market structure of industrial sectors. He finds that banking concentration enhances industries market concentration, especially in sectors highly dependent on external finance. However these effects are weaker in countries characterized by higher overall financial development. Empirically Beck et al. (2004), use a cross-country approach, with firm-level data and investigate the effects of bank competition on firm financing constraints and access to credit. They show that bank concentration increases financing constraints and decreases the likelihood of receiving bank financing for small and medium-size firms, but not for large firms. Petersen and Rajan (1995) show that the competition in credit markets is important in determining the value of lending relationships and they find empirical evidence that creditors are more likely to finance credit-constrained firms when credit markets are concentrated because it is easier for these creditors to internalize the benefits of assisting the firms. Goldberg et al. (2000) show across local U.S. banking markets that concentration affects small business lending positively in urban markets and negatively in rural markets. We add a novelty to these studies theoretically testing the effects of bank concentration on the costs of credit, our first theoretical results show that bank concentration increases the cost of credit for entrepreneurs and at same time exerts a direct negative effect on economic growth.

Using the Schumpeterian paradigm, we theoretically show that the probability to innovate is a decreasing function of the bank concentration measured by the Herfindahl index. This result allows us to verify the empirical results obtained in the literature on the relationship between bank concentration and the creation of new firms. Some authors use empirical investigation to illustrate the effects of bank concentration on firms formation as Black and Strahan (2002) who find evidence across U.S. states that higher concentration results in less new firm formation, especially in states and periods with regulated banking markets. However Cetorelli and Gambera (2001) study the empirical relevance of banking market structure on growth. They show that bank concentration promotes the growth of the industrial sectors that are more in need of external finance by facilitating credit access to younger firms. They also find that of a general depressing effect on growth associated with a concentrated banking industry, which impacts all sectors and all firms indiscriminately.

In order to answer the second question of our article we measure the effects of bank concentration on the probability of entrepreneurial innovation according on the proximity to the worldwide technological frontier for a given country. We theoretically show that bank concentration has a negative and significant direct effect on economic growth and this effect is even more negative and significant when the country is close to the worldwide technological frontier.
These results contradict Deidda and Fattouh’s (2005) results who empirically find that bank concentration is negatively associated with industrial growth only in low income countries while there is no such association in high income countries. Despite the negative effect of bank concentration on economic growth through financing constraints, Beck et al. (2004) found that relation of bank concentration and financing constraints is reduced in countries with an efficient legal system, good poverty rights protection, less corruption, better developed credit registries and a large market share of foreign banks, while a greater extent of public bank ownership exacerbates the relation. However these results do not explore the effects of bank concentration on the convergence between countries in a theoretical framework and their results are obtained using cross-country evidence. Indeed using panel and cross-country data of 125 countries over the period 1980-2010, we empirically show that bank concentration has a negative and significant direct effect on the average per worker GDP growth rate and this effect is even more negative and significant when the country is close to the worldwide technological frontier. Our results are robust to the use of multiple measures of bank concentration, the introduction of several types of control variables: Financial development, school, macroeconomic policies (money growth, inflation, budget balance, government consumption and trade), bank regulation (activity restriction, required reserves, bank development and official supervisory power), bank efficiency (net interest margin and overhead costs), institutional policies (British, French and German legal origins) and the use of multiple econometric methods: OLS, IV and Arrellano-Bond GMM estimation.

In summary our paper brings a lot of novelties in the existing literature. First, while most papers use empirical cross-country estimates to test the effects of bank concentration on economic growth, our paper uses a theoretical model to measure the effects of bank concentration according to the proximity to the worldwide technological frontier for a given country and empirical estimates to validate our theoretical model. Second, to our knowledge, our theoretical model and empirical estimates are the first in the literature to establish the link between bank concentration and economic growth in a Schumpeterian growth paradigm. Finally, our sample includes developed, developing and emerging countries. To test the robustness of our results we use several estimations methods and several types of control variables. The remainder of the paper is organized as follows. The sections 2, 3, 4 and 5 outline the basic structure of the theoretical model, Section 6 confronts the theoretical predictions by using empirical investigation and Section 7 concludes.

2 A simple Schumpeterian theoretical framework

We use the theoretical framework developed this last decade in the Schumpeterian growth paradigm by Howitt and Mayer-Foulkes (2004), Aghion et al. (2005) or Acemoglu et al. (2006). Time is discrete and there is a continuum of individuals in each country. There are $J$ countries, indexed by $j = 1, ..., J$, which do not exchange goods and factors, but are technologically interdependent in the sense that they use technological ideas developed elsewhere in the world. Each

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2 Our empirical results are robust using bank regulation (activity restriction, required reserves, bank development and official supervisory power), for more details see columns (2)-(3)-(4) and (5) of Table 10.
country has a fixed population $L$, which we normalize to unity $L \equiv 1$, so that aggregate and per capita quantities coincide. Each individual lives two periods and is endowed with two units of labor services in the first period and none in the second. The utility function is assumed to be linear in consumption, so that $U = c_1 + \beta c_2$, where $c_1$ and $c_2$ are consumptions in the first and second period of life respectively, and $\beta \in (0,1)$ is the rate at which individuals discount the utility consumption in the second period relative to that in the first period.

**Production of final good.** Consider a country $j$, where in that follow we drop country-index without lost in generality, where there is only one general good $Y_t$, taken as the numéraire, produced by specialized intermediate goods and labor as:

$$Y_t = L^{1-\alpha} \int_0^1 A_t(\nu)^{1-\alpha} x_t(\nu)^{\alpha} d\nu \quad \text{with} \quad 0 < \alpha < 1$$  \hspace{1cm} (1)

where $x_t(\nu)$ is the country input of intermediate good $\nu$ such that $\nu \in [0,1]$, and $A_t(\nu)$ is the technological productivity parameter associated with it. The final good is used for consumption, as an input into entrepreneurial innovation and the production of intermediate goods. Producers of the general good act as perfect competitors in all markets, so that the inverse demands for intermediate good and labor are given by:

$$(\text{FOC}) \quad \left\{ \begin{array}{l} p_t(\nu) = \alpha x_t(\nu)^{\alpha-1} A_t(\nu)^{1-\alpha} \quad \text{for all sectors} \quad \nu \in [0,1] \\ w_t = (1-\alpha) Y_t \end{array} \right.$$  \hspace{1cm} (2)

**Production of intermediate goods.** For each intermediate good $\nu$, there is an innovator who enjoys a monopoly power in the production of this intermediate good, and produce a unit of the intermediate good by using 1 unit of final good. The firm maximizes its profits given by:

$$\pi_t(\nu) = p_t(\nu)x_t(\nu) - x_t(\nu) = \alpha x_t(\nu)^{\alpha} A_t(\nu)^{\alpha-1} - x_t(\nu)$$  \hspace{1cm} (3)

The first order condition allows us to find the equilibrium quantity of intermediate good $\nu$ of quality $A_t(\nu)$ given by: $x_t(\nu) = \alpha^{\frac{1}{1-\alpha}} A_t(\nu)$. The equilibrium price of the intermediate good $\nu$ is given by: $p_t(\nu) = \alpha^{-1}$, so that the equilibrium profit of intermediate firm is written as:

$$\pi_t(\nu) = (1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}} A_t(\nu) = \pi A_t(\nu)$$  \hspace{1cm} (4)

where $\pi \equiv (1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}$ so that the profit earned by the incumbent in any sector $\nu$ will be proportional to the productivity parameter in that sector.

**Net output and growth rate.** Substituting the equilibrium quantity $x_t(\nu)$ into the final good production function (1) shows that the equilibrium gross output of the general good is proportional to the average productivity parameter defined as: $A_t = \int_0^1 A_t(\nu) d\nu$, so that:

$$Y_t = \alpha^{\frac{2\alpha}{1-\alpha}} A_t$$  \hspace{1cm} (5)
as well as wages:

\[ w_t = (1 - \alpha)\alpha^{\frac{2\alpha}{1 - \alpha}} A_t \equiv \omega A_t \tag{6} \]

where \( \omega \equiv (1 - \alpha)\alpha^{\frac{2\alpha}{1 - \alpha}} \). Finally, let \( Y^\text{net}_t \) the net output defined as gross output minus the cost of intermediate goods which enters in the production of the general good, then

\[ Y^\text{net}_t = Y_t - \int_0^1 x_t(\nu)d\nu = (1 - \alpha)(1 + \alpha)\alpha^{\frac{2\alpha}{1 - \alpha}} A_t \tag{7} \]

Therefore, the growth rate of net output is the same to the average productivity parameter:

\[ 1 + g_t \equiv \frac{A_t}{A_{t-1}} \], and we focus on this last to determine the growth properties of the country.

3 Innovation

3.1 Technological Change

Following Aghion et al. (2005), in each intermediate good sector \( \nu \), a continuum of persons with an entrepreneurial idea is born in the period \( t \) which are capable of producing an innovation in the period \( t + 1 \) and if success become the \( \nu^{th} \) incumbent at \( t + 1 \). We denote \( \mu_{t+1}(\nu) \) the probability of entrepreneurial innovation, the level of technology of intermediate goods sector \( \nu \) in the period \( t + 1 \), \( A_{t+1}(\nu) \) follows the process:

\[
A_{t+1}(\nu) = \begin{cases} 
\bar{A}_{t+1} & \text{with } \mu_{t+1}(\nu) \\
A_t(\nu) & \text{with } 1 - \mu_{t+1}(\nu)
\end{cases}
\]

where \( \bar{A}_{t+1} \) denotes the worldwide technological frontier which grows at the constant rate \( g > 0 \). The average productivity thus evolves according to:

\[
A_{t+1}(\nu) = \mu_{t+1}(\nu)\bar{A}_{t+1} + (1 - \mu_{t+1}(\nu))A_t(\nu) \tag{8}
\]

In equilibrium, as we show below, the probability of entrepreneurial innovation will be the same in each sector: \( \mu_{t+1}(\nu) = \mu_{t+1} \). Replacing and integrating this equation on both sides, the average productivity becomes:

\[
A_{t+1} = \mu_{t+1}\bar{A}_{t+1} + (1 - \mu_{t+1})A_t \tag{9}
\]

Let us denote \( a_t \equiv \frac{A_t}{A_{t-1}} \) the proximity to the worldwide technological frontier of the average productivity of a country, its dynamics is given by the following law of motion:

\[
a_{t+1} = \mu_{t+1} + \frac{1}{1 + g}(1 - \mu_{t+1})a_t \tag{10}
\]
3.2 Demand for loans

At the beginning of second period, a household has the opportunity to become an entrepreneur (innovator) where the cost of innovation is given by:  

\[
\frac{Z_{t+1}(\nu)}{\bar{A}_{t+1}} = \psi \mu_{t+1}(\nu) \phi 
\]

(11)

where \(Z_{t+1}(\nu)\) is the total investment in terms of final good, \(\psi > 0\) is a parameter which affects the cost of innovation and where we assume that \(\phi \geq 2\) in order to warrant the existence of the equilibrium probability to innovate. The total investment is adjusted to the worldwide technological frontier \(\bar{A}_{t+1}\), to take into account that it becomes more expensive to maintain an innovation rate \(\mu_{t+1}(\nu)\) when the technological frontier advances.

The households earn a wage in the end of the first period; \(w_t\) given by (6), which they save on the bank with a return rate \(r_{D,t}\). They borrow the amount \((Z_{t+1}(\nu) - (1 + r_{D,t})w_t) = T_{t+1}(\nu)\) from the bank because the wage received is not sufficient to initiate an innovation. Therefore, in equilibrium, \(\mu_{t+1}(\nu)\) will be chosen by the innovators so as to maximize the expected net profits:

\[
\max_{\mu_{t+1}(\nu)} \pi \bar{A}_{t+1}(\nu) \mu_{t+1}(\nu) - r_{t+1} (Z_{t+1}(\nu) - (1 + r_{D,t})w_t) - (1 + r_{D,t})w_t
\]

\[
= \left[ \mu_{t+1}(\nu) \pi - \psi r_{t+1} \mu_{t+1}(\nu) \phi \right] \bar{A}_{t+1}(\nu) - (1 - r_{t+1}) (1 + r_{D,t})w_t
\]

where \(r_{t+1}\) is the loan rate. So, in equilibrium, the probability of entrepreneurial innovation is the same in each sector:

\[
\mu_{t+1} = \left( \frac{\pi}{\phi \psi r_{t+1}} \right) \frac{1}{\phi - 1} 
\]

(12)

Substituting equation (12) into the equation (11) and using \(Z_{t+1}(\nu) - (1 + r_{D,t})w_t = T_{t+1}(\nu)\) allows us to find the demand for loans for innovator’s which is decreasing with the loan rate \(r_{t+1}\) and the innovation cost parameter \(\psi\), increasing with the worldwide technological frontier \(\bar{A}_{t+1}\) and the net profits \(\pi\). Denoting that the wage is proportional to the local productivity such that \(w_t = \omega A_t\) as displayed in equation (6), the demand for loans, identical in each sector is given by:

\[
T_{t+1} = Z_{t+1} - (1 + r_{D,t})w_t = \psi \left( \frac{\pi}{\phi \psi r_{t+1}} \right) \frac{1}{\phi - 1} \bar{A}_{t+1} - (1 + r_{D,t})\omega A_t
\]

(13)

4 Banking Sector

We model the banking sector in a context of the Cournot competition for loans and we assume perfect competition for deposits (as initially proposed by Monti (1972) and Klein (1971) and reviewed in Freixas-Rochet (2007)). The banking sector is composed of \(n\) identical banks indexed by \(i = 1, ..., n\). Bank \(i\) pays linear transaction costs between loans and deposits

\[\text{For } \phi = 2, \text{ the cost of innovation is: } \frac{Z_{t+1}(\nu)}{A_{t+1}} = \frac{\psi}{2} \mu_{t+1}(\nu)^2\]
$C(D_{t+1}(i), T_{t+1}(i)) = \gamma_D D_{t+1}(i) + \gamma_T T_{t+1}(i)$, where $\gamma_D, \gamma_T \in [0, 1]$ are costs parameters associated with the deposits and loans activities respectively. In the period $t+1$, the bank chooses $T_{t+1}(i)$ and $D_{t+1}(i)$ so as to maximize its profits given by:

$$\Pi^B_{t+1}(i) = \left( r_{t+1}(i) \mu_{t+1} \sum_{i=1}^{n} T_{t+1}(k) - \gamma_T \right) T_{t+1}(i) - \tau B_{t+1}(i) - (r_{D,t+1} + \gamma_D) D_{t+1}(i)$$  \hspace{1cm} (14)

subject to the following constraints:

$$\begin{cases} 
T_{t+1}(i) = \psi \left( \frac{\pi}{\phi \psi \tau_{t+1}} \right)^{\frac{\phi}{\tau}} \bar{A}_{t+1} - (1 + r_{D,t}) \omega A_t \\
B_{t+1}(i) = R_{t+1}(i) + T_{t+1}(i) - D_{t+1}(i) \\
R_{t+1}(i) = \theta D_{t+1}(i) 
\end{cases}$$  \hspace{1cm} (15)

where $T_{t+1}(i)$ is the demand for loans of the bank $i$, $B_{t+1}(i)$ is the net position of the bank $i$ on the interbank market equals to the sum of the reserves $R_{t+1}(i)$ and loans minus deposits. $R_{t+1}(i)$ is the reserves of the bank $i$ which equal to a proportion $\theta$ of deposits. The interbank rate ($\tau$) and the coefficient of compulsory reserves ($\theta$) may be used as a policy instrument which the Central Bank tries to influence the monetary and credit policies, as noted by Freixas and Rochet (2007). Substituting the constraints, the problem becomes:

$$\Pi^B_{t+1}(i) = \left( r_{t+1}(i) \mu_{t+1} \left( \sum_{k=1}^{n} T_{t+1}(k) \right) - \tau - \gamma_T \right) T_{t+1}(i) - (\tau(\theta - 1) + r_{D,t+1} + \gamma_D) D_{t+1}(i)$$

subject to:

$$T_{t+1} = \psi \left( \frac{\pi}{\phi \psi \tau_{t+1}} \right)^{\frac{\phi}{\tau}} \bar{A}_{t+1} - (1 + r_{D,t}) \omega A_t$$

The banks have a same cost function taken linear and the same demand for loans, thus a unique equilibrium is given by: $T_{t+1}(i) = \frac{T_{t+1}}{n}$, so that the first order conditions are:

$$(\text{FOC}) \begin{cases} 
\frac{r_{D,t+1}}{n} = r_D^* = \tau(1 - \theta) - \gamma_D \\
\frac{r_{\mu}}{n} \mu_{t+1} + r_{t+1} \mu_{t+1} = \tau + \gamma_T 
\end{cases}$$  \hspace{1cm} (16)

The first condition shows that deposits return rate is constant, depends positively on interbank rate ($\tau$) but negatively on the coefficient of reserves ($\theta$) and the deposits management costs ($\gamma_D$). The Herfindahl index is equal to $H = \sum_{i=1}^{n} s_i^2$, where $s_i$ is the market share of the bank $i$. Banks are identical, so $s_i = \frac{1}{n}$, therefore the Herfindahl index becomes: $H = \frac{1}{n}$. The second condition allows us to find the loan rate according to the elasticity of the demand for loans:

$$\frac{r_{t+1} \mu_{t+1} - (\tau + \gamma_T)}{r_{t+1} \mu_{t+1}} = \frac{H}{\epsilon}$$  \hspace{1cm} (17)

where $\frac{1}{\epsilon}$ is the inverse of the elasticity of the demand for loans. This condition shows the well-known Lerner index which represents the market power of the bank. The inverse of the elasticity
of the demand for loans is given by:

\[
\frac{1}{\epsilon} = -\frac{T_{t+1}}{\partial T_{t+1} / \partial r_{t+1}} = \frac{\phi - 1}{\phi} - \frac{\bar{\omega} (\phi - 1)(1 + r_{D,t}) r_{t+1}}{\pi \left( \frac{\pi}{\phi r_{t+1}} \right)} a_t
\]  

where \( \bar{\omega} \equiv \frac{\omega}{1+g} \). We assume that \( r_{t+1} < \{ \bar{\omega} [\tau (1 - \theta) + (1 - \gamma_D)] a_t \}^{1-\phi} \left( \frac{1}{\phi} \right)^{\frac{1}{\phi}} \frac{1}{\phi}, \) to ensure that the Lerner index is positive. Using equations (12), (17) and (18) allows us to find the implicit relation between the loan rate \( r_{t+1} \), the proximity to the worldwide technological frontier \( a_t \) and Herfindahl index \( H \) such that:

\[
(\tau + \gamma_T) \left( \frac{\phi \psi}{\pi} \right)^{\frac{1}{\phi}} \frac{2-\phi}{\phi} r_{t+1} - H \bar{\omega}(\phi-1) [\tau(1-\theta) + (1-\gamma_D)] \left( \frac{\phi \psi}{\pi} \right)^{\frac{1}{\phi}} a_t r_{t+1} - \left( 1 - H(\phi - 1) \right) = 0
\]  

We derive, from this expression, the effect of the proximity to the worldwide technological frontier on loan rate \( r_{t+1} \).

**Proposition 1.** If \( \phi \geq 2 \), then the loan rate \( r_{t+1} \) is a decreasing function of the proximity to the worldwide technological frontier \( a_t \); \( \frac{\partial r_{t+1}}{\partial a_t} < 0. \)

**Proof.** See Appendix C.  

The following proposition establishes the link between loan rate and bank concentration. It shows theoretically that an increase in bank concentration increases the cost of credit.

**Proposition 2.** If \( \phi \geq 2 \) and \( r_{t+1} < \{ \bar{\omega} [\tau (1 - \theta) + (1 - \gamma_D)] a_t \}^{1-\phi} \left( \frac{1}{\phi} \right)^{\frac{1}{\phi}} \frac{1}{\phi}, \) then the loan rate \( r_{t+1} \) is an increasing function of the bank concentration \( H \) measured by the Herfindahl index; \( \frac{\partial r_{t+1}}{\partial H} > 0. \)

**Proof.** See Appendix C.  

Using equations (12), (17), (18) and the implicit relation (19), we derive the equilibrium probability of entrepreneurial innovation \( \mu_{t+1} \) according to the loan rate \( r_{t+1} \), the proximity to the worldwide technological frontier \( a_t \) and the Herfindahl index \( H \) is given by:

\[
\mu_{t+1} = \begin{cases} 
\left\{ \frac{\pi}{\phi \psi (\tau + \gamma_T)} \left[ 1 - H \left( \frac{\phi - 1}{\phi} - \bar{\omega}(\phi - 1) [\tau(1-\theta) + (1-\gamma_D)] \left( \frac{\phi \psi}{\pi} \right)^{\frac{1}{\phi}} a_t r_{t+1} \right) \right] \right\}^{\frac{1}{\phi-2}} \text{ if } \phi > 2 \\
\left\{ \frac{2\phi [\tau (1 - \theta) + (1 - \gamma_D)]}{\phi [1 - \phi \psi (\tau + \gamma_T)]} a_t \right\}^{\frac{1}{2}} \text{ if } \phi = 2
\end{cases}
\]  

\[ (20) \]
The condition $\phi \geq 2$ ensures that the probability of entrepreneurial innovation is strictly positive ($\mu_{t+1} > 0$) and less than one ($\mu_{t+1} < 1$). The following proposition shows that countries close to the worldwide technological frontier have higher probability to innovate.

**Proposition 3.** If $\phi \geq 2$, the probability of entrepreneurial innovation $\mu_{t+1}$ is an increasing function of the proximity to the worldwide technological frontier $a_t$; $\frac{\partial \mu_{t+1}}{\partial a_t} > 0$.

*Proof.* See Appendix C.

The next proposition provides our first prediction, it implies that bank concentration has a negative direct effect on the probability of entrepreneurial innovation.

**Proposition 4.** If $\phi \geq 2$ and $r_{t+1} < \{\tilde{\omega} [\tau(1-\theta) + (1-\gamma_D)] a_t \}^{\frac{1-\phi}{\phi}} \left( \frac{1}{\psi} \right)^{\frac{1}{\phi}} \frac{1}{\phi}$, the probability of entrepreneurial innovation is a decreasing function of the bank concentration $H$ measured by the Herfindahl index; $\frac{\partial \mu_{t+1}}{\partial H} < 0$.

*Proof.* See Appendix C.

Finally, the following proposition is the most important prediction of our theoretical model. It shows that bank concentration has a negative and significant effect on economic growth and this effect is even more negative when the country is close to the worldwide technological frontier. This result is validated by empirical estimations using cross-country and panel data which we present in section 6 of the article.

**Proposition 5.** If $\phi \geq 2$ and $r_{t+1} < \{\tilde{\omega} [\tau(1-\theta) + (1-\gamma_D)] a_t \}^{\frac{1-\phi}{\phi}} \left( \frac{1}{\psi} \right)^{\frac{1}{\phi}} \frac{1}{\phi}$, then the bank concentration has a negative and significant effects on economic growth for countries close to the worldwide technological frontier; $\frac{\partial^2 \mu_{t+1}}{\partial H \partial a_t} < 0$.

*Proof.* See Appendix C.

5 Dynamics and bank Concentration

Substituting the expression of the probability of entrepreneurial innovation into the equation (10) allows us to find the dynamics of the proximity to the worldwide technological frontier:

$$a_{t+1} = \mu(a_t) + \frac{1}{1+g}(1-\mu(a_t))a_t = F(a_t)$$

(21)

where the equilibrium probability of the entrepreneurial innovation is given by:

$$\mu(a_t) = \begin{cases} \left\{ \frac{\tau}{\phi \psi (\tau+\gamma D)} \left[ 1 - H \left( \frac{\phi-1}{\phi} - \tilde{\omega}(\phi - 1) [\tau(1-\theta) + (1-\gamma_D)] \left( \frac{\phi}{\phi-1} \right)^{\frac{1}{\phi-1}} a_t \right] \right] \right\}^{\frac{1}{\phi-2}} & \text{if } \phi > 2 \\ \left\{ 2\tilde{\omega} \tau(1-\theta) + (1-\gamma_D) a_t \right\}^{\frac{1}{2}} & \text{if } \phi = 2 \end{cases}$$

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8See Appendix C.
The proposition 6 shows that a given country reaches a unique and positive value of its proximity to the worldwide technological frontier and this equilibrium is stable. The steady state depends on the bank concentration of the country through the equilibrium probability to innovate as already suggested by the Propositions 4 and 5:

**Proposition 6.** If $\phi > 2$, then:

1. $F(a_t)$ is $z$-Lipschitz and contracting, where $z \equiv \frac{H}{(\phi - 2)(1 + g)} \left[\frac{\pi}{\phi \psi (\tau + \gamma T)}\right]^{2-\phi} < 1$.
2. The proximity to the worldwide technological frontier of a given country converges in the long run to the unique steady state value $a^*$, where $a^*$ is given by:

$$a^* = \frac{(1 + g)\mu^*}{\mu^* + g} < 1$$

**(Proof.** See Appendix D.)

**Main predictions:** Our theoretical model predicts two implications which are:

1. Bank concentration has a negative and significant direct effect on economic growth.
2. For countries close to the worldwide technological frontier; bank concentration has a significant and negative effect on economic growth.

### 6 Bank Concentration and Convergence: Cross-country and Panel Evidence

**6.1 Specification and data**

In this section we confront our theoretical predictions with evidence; the specification of our regression is as follows:

\[
\text{Growth}_{i,t} = \alpha + \delta_1 \text{CONC}_{i,t} + \delta_2 \text{CONC}_{i,t} \times \text{FRONT}_{i,t} + \sum_{k=1}^{K} \beta_k x_{k,i,t} + \xi_i + \zeta_t + \varepsilon_{i,t} \tag{23}
\]

where $i$ and $t$ denote country and period; $\alpha$, $\xi_i$ and $\zeta_t$ denote respectively the intercept, country and time fixed effects and $X_{i,t} = [x_{1,i,t}, ..., x_{K,i,t}]$ is a set of $K$ control variables defined below. We therefore test the link between growth and bank concentration using panel data of 125 countries over the period 1980-2010 where data are averaged over five 5-year periods between 1980 and 2010.\(^9\) Growth\(_{i,t}\) is the average per worker GDP growth rate over the 5 years periods using per worker GDP data from the Penn World Table 7.1 (Aten et al., 2012).\(^10\) The proximity of the

---

\(^9\)The first period covers the years 1980-1985; the second period covers the years 1986-1990; the third period covers the years 1991-1995 and so on. The last period covers the years 2006-2010.

\(^10\)We use RGDPWOK as a measure of real GDP and PWT 7.1 is public available at [https://pwt.sas.upenn.edu/](https://pwt.sas.upenn.edu/). Our results remain robust using RGDPCH, i.e. per capita GDP instead of per worker GDP. See Section 6.4 and Tables 7 and 8.
country $i$ to the worldwide technological frontier, defined as the maximum of initial per worker real GDP's at the beginning of each sub-periods of 5 years, subsumed as $a_t$ in the theoretical model and denoted $\text{FRONT}_{i,t}$ in our econometric specification, is measured as the logarithm of the ratio of the initial per worker real GDP of country $i$ over the 5 years period to the initial per worker real GDP of the country at the frontier.\footnote{We do not put the proximity to the worldwide technological frontier $\text{FRONT}_{i,t}$ in our econometric specification because we find a strong correlation equals to 0.923 between the interaction term $\text{CONC}_{i,t} \times \text{FRONT}_{i,t}$ and the proximity to the worldwide technological frontier $\text{FRONT}_{i,t}$ which leads to obvious multicollinearity problems.}

$\text{CONC}_{i,t}$ is the bank concentration, which is equal to the share of assets of the three largest banks in total banking system assets.\footnote{Concentration measures, from Beck \textit{et al.} (2010), are publicly available at http://www.econ.brown.edu/fac/Ross_Levine/IndexLevine.htm} Its value lies between 0 and 1. The value 0 indicates a low bank concentration and the value 1, a high bank concentration. Table 1 presents the summary statistics. The average of bank concentration is 0.737, while the minimum and maximum are 0.151 and 1 respectively. The countries with a high bank concentration over the period are: Afghanistan, Angola, Albania, Burundi, Benin, Botswana, Bulgaria, Bahrain, Cape Verde, Cyprus, Egypt, Ethiopia, Estonia, Gabon, Guyana, Madagascar, Kyrgyzstan. The countries with a low bank concentration over the period are: Guatemala, Luxembourg, Japan, Korea, Russia, Taiwan, United States. We use, as robustness checks another measure of bank concentration (Herfindahl index) in robustness section below, even if the sample’s size is much lower.

Other control variables, from the World Bank WDI,\footnote{The World Development Indicators are publicly available at http://www.worldbank.org/} are used in our estimations: school, private credit, macroeconomic policies (money growth, inflation rate, budget balance, government consumption and trade). \textit{School}, measured by the total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age. \textit{Private credit} provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. \textit{Private credit} is our proxy for the financial development following Aghion \textit{et al.} (2005) and Beck \textit{et al.} (2000) who argue that the private credit is a good measure of financial development. \textit{Macroeconomic policies} which include: \textit{Money growth} is an average annual growth rate in money; \textit{inflation}, \textit{consumer price index} 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 may be fixed or changed at specified intervals, such as yearly, the Laspeyres formula is generally used\footnote{Our results are robust to the use the inflation as measured by the annual growth rate of the GDP implicit deflator. For more information, see Section 6.4 and Table 9.}; \textit{budget Balance as \% of GDP} is cash surplus or deficit is revenue (including grants) minus
expense, minus net acquisition of non-financial assets. In the 1986 GFS manual non-financial assets were included under revenue and expenditure in gross terms; government consumption (% of GDP) includes all government current expenditures for purchases of goods and services (including compensation of employees) and trade calculated as the sum of exports (% of GDP) and imports (% of GDP).

Table 2 provides the correlations among the variables. The statistics show that there are some important correlations among the variables. The average per worker GDP growth rate and private credit are negatively correlated with the bank concentration. This suggests that less bank concentration may be better in providing financing. There is also a negative correlation between bank concentration and the frontier, we find that the average per worker GDP growth rate is negatively correlated with the frontier, which indicates the convergence effects. Bank concentration is negatively correlated with school but positively with the government consumption and trade.

6.2 Cross-country regressions results

Table 3 presents the results of cross-country regressions. We first regress the average per worker GDP growth rate on bank concentration. Bank concentration has a negative and significant direct effect on the average per worker GDP growth rate at 5%, column (1). In column (2), we add the interaction variable equals to the product of bank concentration (CONC) and the proximity to the worldwide technological frontier (FRONT) such that (CONC × FRONT) as suggested by our theoretical model. Bank concentration remains negative and significant at 1% as well as the interaction variable is significant and negative at 10%. This result implies that bank concentration has a negative and significant effect on the average per worker GDP growth rate for countries close to the worldwide technological frontier. The Column (3) regresses the average per worker GDP growth rate on bank concentration, the interaction variable and the legal origins. Bank concentration has a negative and significant direct effect on the average per worker GDP growth rate at 1%, the interaction term (CONC × FRONT) is also negative and significant at 5%. Columns (4)-(5)-(6) introduce respectively the control variables: Financial development measured by the private credit, school and macroeconomic policies which include (money growth M2, inflation rate, budget balance, government consumption and trade). Bank concentration has a negative and significant direct effect on the average per worker GDP growth rate at 1% and the interaction term remains respectively negative and significant at 5%, 1% and 5%. These results confirm the theoretical predictions which are bank concentration has a negative and significant direct effect on growth, especially for countries close to the worldwide technological frontier. The Column (7) regresses the average per worker GDP growth GDP on bank concentration, interaction term and all control variables listed above, bank concentration and interaction term remain negative and significant at 1%. To treat a possible endogeneity of bank concentration we
introduce an estimation with the instrumental variables in column (8). Following Aghion et al. (2005) we use English, French and German legal origins to instrument bank concentration CONC and we use legal origin interacted with the proximity to the worldwide technological frontier (FRONT×LEGOR) to instrument the interaction term (CONC×FRONT) and we include all control variables: Financial development, school and macroeconomic policies. We find that bank concentration remains negative and significant at 5% and the interaction term is also negative and significant at 1%, these findings are consistent with the predictions of our theoretical model. However, Laporta et al. (2008) found that the Legal origin is strongly correlated with much variables which are themselves strongly correlated with growth and therefore seem does not respect the restriction conditions. In order to remedy of this deficiency, we present a dynamic panel regressions based on Arrellano-Bond GMM estimator (Arrellano and Bond, 1991) in the next section.

6.3 Panel results

In this section, we verify the predictions using panel data. The results are presented in Table 4 without control variables and in Table 5 with control variables. We therefore regress the average per worker GDP growth rate on bank concentration. Column (1) uses OLS, column (2) introduces the country fixed effects and finally the column (3) uses country and period fixed effects. Bank concentration has a negative sign but not significant for the all three methods listed above. These results are robust to the introduction of the control variables: Financial development, school and macroeconomic policies. In a second step we introduce the interaction term between bank concentration and the proximity to the worldwide technological frontier (CONC×FRONT). Using OLS in the column (5) bank concentration has a negative and significant direct effect on the average per worker GDP growth GDP at 5%, but the interaction term remains negative and not significant. In the column (6) we use country fixed effects, the variable bank concentration remains negative and significant at 1% and the interaction term is also negative and significant at 5%. The country and period fixed effects are introduced in the column (7) bank concentration and the interaction term are negative and significant at 1%. These results confirm our theoretical predictions and empirical cross-country results. Bank concentration has a negative and significant direct effect on the average per worker GDP growth rate and this effect is even more negative and significant when the country is close to the worldwide technological frontier.

We introduce control variables in Table 5. In column (1), we regress the average per worker GDP growth rate on bank concentration and the interaction term, controlling for school. Using
OLS in column (1) bank concentration has a negative and significant direct effect on the average per worker GDP growth rate at 5% and the interaction term is negative and significant at 5%. In column (2), we introduce the country fixed effects bank concentration and the interaction term remain negative and significant at 1% and 5% respectively. Column (3) introduces country and period fixed effects bank concentration has a negative and significant direct effect on the average per worker GDP growth at 1% and interaction term remains negative and significant at 1%. Controlling for school our empirical results are robust and at same time they validate our theoretical predictions. The control variable financial development is introduced in columns (5)-(6) and (7). We find that bank concentration is respectively negative and significant at 10%, 5% and 1% using OLS, country fixed effects and country and period fixed effects. The interaction term is positive and not significant using OLS and country fixed effects but it is significant at 1% when we include period fixed effects, these results are not surprising because the theoretical model shows that the channel whereby bank concentration affects the growth is private credit. In columns (9)-(10) and (11) we control for macroeconomic policies, bank concentration is negative and significant at 10% but the interaction term is not significant using OLS. Column (10) introduces country fixed effects, bank concentration has a negative and significant direct effect on the average per worker GDP growth rate at 5% and the interaction term is negative and significant at 5%. The country and period fixed effects are introduced in column (11). We find that bank concentration and interaction term are negative and significant at 1%. Therefore, our theoretical predictions are robust to the introduction of various control variables and we show in the next section that results are also robust using other estimations methods as well as some other measures of our interest variable, i.e. bank concentration, other measure of inflation and using per capita GDP instead of per worker GDP.

Table 5 around here

6.4 Robustness checks

In order to remedy the problems of the legal origin in the estimation by the Instrumental Variables (IV) method in the cross-country section, we use the Arrellano et al. (1991) GMM estimation method. The results are presented in columns (4) and (8) of the Table 4 and in columns (4)-(8) and (12) of the Table 5. Regressing only the average per worker GDP growth rate on bank concentration, the Arrellano-Bond GMM method shows that bank concentration has a positive and not significant effect on growth GDP rate, column (4) of the Table 4. The column (8) introduces the interaction term; bank concentration and interaction term are negative and significant at 1%, column (8) of the Table 4. Controlling for school, financial development and macroeconomic policies, we find that bank concentration exerts respectively a negative and significant direct effect on the average per worker GDP growth rate at 1%, 5% and 5% and the interaction term remains negative and significant at 1%, columns (4)-(8) and (12) of the Table 5. In summary bank concentration has a negative and significant direct effect on the average per
We also use another variable to measure bank concentration. We use is the Herfindahl index defined in the theoretical section of our model. Then we estimate the average per worker GDP growth rate in our cross-country regression and the results are all robust. However the size of sample is smaller than the first case, we have 70 observations in the cross-country regression and there is not enough variability within countries to use this measure in the panel regressions. The results are presented in Table 6. The first column (1) regresses the average per worker GDP growth rate on bank concentration with OLS method, bank concentration exerts a negative but not significant effect on the average per worker GDP growth rate. In column (2) we add the interaction term between bank concentration and the proximity to the worldwide technological frontier, the coefficient associated with bank concentration is negative and significant at 10% while the interaction term is not significant but becomes significant when we introduce control variables (legal origins, column (3); financial development, column (4); school, column (5) and macroeconomic policies, column (6)). Bank concentration has a negative and significant direct effect at 1%, 5%, 5% and 5% respectively on the average per worker growth GDP rate and the interaction term has a negative and significant effect at 10% with legal origins, 10% with financial development, 5% with school and non-significant effect with macroeconomic policies. Column (7) regresses the average per worker GDP growth rate on bank concentration, the interaction term and the set of all control variables. Bank concentration has a negative and significant direct effect at 1% on the average per worker GDP growth rate and this effect is even more negative when the country is close to the worldwide technological frontier because the interaction term is negative and significant at 5%. Instrumental variables (IV) estimation is performed in column (8) and confirms the robustness of our main results since bank concentration and the interaction term remain negative and significant at 1%.

In tables 7 and 8, we test the robustness of our theoretical implications and empirical results using the average per capita GDP growth rate in cross-country and panel data. The Table 7 presents the results obtained in the cross-country regressions. The coefficient of bank concentration is negative and significant at 1% with OLS and IV methods and also for all control variables, columns (1) to (8). However the interaction term is negative and significant at 1% using IV method and controlling for legal origins, financial development, school and macroeconomic policies, columns (7) and (8).
Table 7 presents the results of panel data without control variables. Using the average per capita GDP growth rate, bank concentration exerts a negative but not significant effect on the average per capita GDP growth rate, column (1) with OLS, column (2) uses country fixed effects, column (3) adds country and period fixed effects and (4) uses Arrellano-Bond GMM estimation. The introduction of the interaction term implies that bank concentration has a negative and significant direct effect at 10% with OLS and 1% with country fixed effects, country and period fixed effects and Arrellano-Bond GMM estimation. The interaction term remains negative and significant at 1% except for OLS method, columns (5) to (8). Using the average per capita GDP growth rate confirms our results in Table 4 and at same time confirms our theoretical predictions.

We do this same exercise by changing the measure of inflation. We measure it by the annual growth rate of the GDP implicit deflator, see Table 9. The cross-country results are presented in columns (1)-(2) and (3) of the Table 9 and panel results in columns (4)-(5)-(6) and (7) of Table 9. The regression of the average per worker GDP growth rate on bank concentration, the interaction term and control variables shows that bank concentration has a negative and significant direct effect on the average per worker GDP growth rate and this effect is even more negative and significant when the country is close to the worldwide technological frontier.

Table 10 introduces bank control variables\textsuperscript{16} to test the robustness of our theoretical and empirical predictions. The second column introduces entry into the banking requirements variable, the coefficients associated to bank concentration and the interaction variable is negative and significant at 5% and 10% respectively. Column 3 controls for the interaction variable (CONC×REST), where REST is an indicator of bank’s ability to engage in business of securities underwriting, insurance underwriting and selling, and in real estate investment, management and development. Bank concentration has a negative and significant direct effect on the average per worker GDP growth rate at 10% and the interaction variable (CONC×FRONT) is negative and significant at 10%. The interaction variable (CONC×SUP), where SUP indicates official supervisory power is introduced in column 4, bank concentration and the interaction variable

\textsuperscript{16}Bank restriction and bank efficiency data, from Levine \textit{et al.} (2007) and Levine \textit{et al.} (2008), Survey of Bank Regulation and Supervision, publicly available at \url{econ.worldbank.org}
(CONC×FRONT) are negative and significant at 5% and 10% respectively. Column 5 regresses the average per worker GDP growth rate on bank concentration and the interaction variable (CONC×FRONT) and controlling for (CONC×BANKDEV), where BANKDEV indicates bank development and is measured as the ratio of bank credit to private firms as a share of GDP, bank concentration and the interaction term (CONC×FRONT) are respectively negative and significant at 1% and 5%. We show that bank concentration has a negative and significant direct effect on the average per worker GDP growth rate and this effect is even more negative when the country is close to the worldwide technological frontier after having controlled for bank restriction variables. Bank efficiency control variables are introduced in column (6) and (7). Indeed we use net interest margin as a fraction of total interest earning assets and overhead costs as share of total assets. Adding overhead costs bank concentration and interaction term remain negative and significant at 5% and 1% respectively, column 6. Column 7 regresses the average per worker GDP growth rate on bank concentration and interaction term (CONC×FRONT) and controlling for net interest margin, we find that bank concentration and interaction exert a negative and significant effect on growth rate at 5%. Controlling for bank efficiency our theoretical predictions and empirical results remain robust.

Table 10 around here

7 Conclusion

The effects of bank concentration on economic development have previously been studied in the literature. However these works focus on the empirical studies and the results are ambiguous and not clear. In this article we studied in a theoretical and empirical framework the role of the banking market structure in economic growth. The theoretical model uses Schumpeterian endogenous growth following Aghion et al. (2005) and the Cournot imperfect banking competition inspired by Monti and Klein (1972).

We theoretically show that bank concentration exerts a direct negative effect on economic growth. For countries close to the worldwide technological frontier, bank concentration has a negative effect on economic growth. In order to verify and validate our theoretical predictions we use econometric specification regressing the average per worker GDP growth rate on bank concentration and interaction term between bank concentration and the proximity to the worldwide technological frontier using cross-country and panel data over the period 1980-2010 of 125 countries. Our empirical results show that bank concentration has a negative and significant direct effect on the average per worker GDP growth rate and this effect is even more negative and significant when the country is close to the worldwide technological frontier. These results are robust to the use of different measures of bank concentration, to the introduction of control variables: School, financial development, legal origins (British, French and German), macroeconomic policies (money growth, inflation, budget balance, government consumption and trade), bank regulation (activity restriction, required reserves, bank development and official supervi-
sory power) and bank efficiency (net interest margin and overhead costs) as well as the use of multiple estimation methods: OLS, instrumental Variables (IV) and Arrellano-Bond GMM estimation.
Appendix A: Demand for loans

Case of $\phi > 2$. The demand for loans is given by:

$$T_{t+1} = Z_{t+1} - (1 + r_{D,t})w_t = \psi \left( \frac{\pi}{\phi \psi r_{t+1}} \right)^{\frac{\phi}{\phi-1}} A_{t+1} - (1 + r_{D,t})\omega A_t$$

(24)

We first derive this demand for loans with respect to loan rate $r_{t+1}$:

$$\frac{\partial T_{t+1}}{\partial r_{t+1}} = -\frac{\pi}{(\phi - 1)r_{t+1}^{\frac{\phi}{\phi-1}}} \left( \frac{\pi}{\phi \psi r_{t+1}} \right)^{\frac{1}{\phi-1}} A_{t+1}$$

(25)

then, multiplying by $r_{t+1}$, we obtain:

$$\frac{\partial T_{t+1}}{\partial r_{t+1}} r_{t+1} = -\frac{\pi}{(\phi - 1)r_{t+1}^{\frac{\phi}{\phi-1}}} \left( \frac{\pi}{\phi \psi r_{t+1}} \right)^{\frac{1}{\phi-1}} \bar{A}_{t+1}$$

(26)

and finally, we derive the inverse of the elasticity of the demand for loans as:

$$\frac{1}{\epsilon} = -\frac{T_{t+1}}{\partial T_{t+1}/\partial r_{t+1} r_{t+1}} = \frac{\phi - 1}{\phi} - \frac{\bar{\omega}(\phi - 1)(1 + r_{D,t})r_{t+1}}{\pi \left( \frac{\pi}{\phi \psi r_{t+1}} \right)^{\frac{1}{\phi-1}}} a_t$$

(27)

where $\bar{\omega} = \frac{\omega}{1 + g}$.

Case of $\phi = 2$. We derive the demand for loans with respect to loan $r_{t+1}$:

$$\frac{\partial T_{t+1}}{\partial r_{t+1}} = -\frac{\pi^2}{\psi r_{t+1}^{\frac{2}{1}}} \bar{A}_{t+1}$$

then, multiplying by $r_{t+1}$, we obtain:

$$\frac{\partial T_{t+1}}{\partial r_{t+1}} r_{t+1} = -\frac{\pi^2}{\psi r_{t+1}^{\frac{2}{1}}} \bar{A}_{t+1}$$

and finally, we derive the inverse of the elasticity of the demand for loans as:

$$\frac{1}{\epsilon} = -\frac{T_{t+1}}{\partial T_{t+1}/\partial r_{t+1} r_{t+1}} = \left( \frac{1}{2} - \frac{(\tau(1 - \theta) + (1 - \gamma D))\omega \psi}{\pi^2(1 + g)} r_{t+1}^{\frac{2}{1}} a_t \right)$$

(28)

Appendix B: Lerner Index

Case of $\phi > 2$. Recall that, first order conditions of a given bank is written as:

$$\begin{align*}
(H)r'_{t+1} T_{t+1} u_{t+1} + r_{t+1} u_{t+1} = \tau + \gamma T \\
(FOC) \quad \begin{cases} 
H r'_{t+1} T_{t+1} u_{t+1} + r_{t+1} u_{t+1} = \tau + \gamma T \\
r_{D,t+1} = r^*_D = \tau(1 - \theta) - \gamma D
\end{cases}
\end{align*}$$

(29)
The first line allows us to find the loan rate according to the elasticity of the demand for loans:

\[ r_{t+1} \mu_{t+1} - (\tau + \gamma T) = -H r_{t+1}' T_{t+1} \mu_{t+1} \]

so that dividing by \( r_{t+1} \mu_{t+1} \), we obtain the Lerner index expression:

\[
\frac{r_{t+1} \mu_{t+1} - (\tau + \gamma T)}{r_{t+1} \mu_{t+1}} = \frac{H}{\epsilon} \tag{30}
\]

where the inverse of the elasticity of the demand for loans is determined by:

\[
\frac{1}{\epsilon} = \frac{\phi - 1}{\phi} - \frac{\tilde{\omega}(\phi - 1)(1 + r_{D,t}) r_{t+1}}{\pi} a_t = \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^\frac{\phi}{\phi - 1} \tag{31}
\]

with \( \Gamma \equiv \tilde{\omega}(\phi - 1) [r(1 - \theta) + (1 - \gamma D)] \bar{\omega} \psi \pi r_{t+1}^2 a_t \). Therefore, the Lerner index is positive if \( \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^\frac{\phi}{\phi - 1} > 0 \), i.e. \( r_{t+1} < \left( \frac{\phi - 1}{\phi} \right)^\frac{\phi - 1}{\phi} \).

**Case of \( \phi = 2 \).** The Lerner index is given by:

\[
1 - \frac{\psi(\tau + \gamma T)}{\pi} = \frac{H}{\epsilon} \tag{32}
\]

where the inverse of the elasticity of the demand for loans is determined by:

\[
\frac{1}{\epsilon} = \frac{1}{2} - \frac{[\tau(1 - \theta) + (1 - \gamma D)] \tilde{\omega} \psi}{\pi^2} r_{t+1}^2 a_t \tag{33}
\]

**Appendix C: Proof of Propositions 1 to 4**

**Case of \( \phi > 2 \).** In order to prove the Propositions 1 to 4, we have to establish the implicit relation between the loan rate \( r_{t+1} \), the proximity to the worldwide technological frontier \( a_t \), Herfindahl index \( H \) and the probability to innovate \( \mu_{t+1} \). First, we rewrite the expression of \( r_{t+1} \mu_{t+1} \) using equation (12) such that:

\[
r_{t+1} \mu_{t+1} = \frac{2 - \phi}{\phi} \Omega r_{t+1} \tag{34}
\]

where \( \Omega \equiv \left( \frac{\pi}{\bar{\omega} \psi} \right) \frac{1}{\pi - 1} \). Then, substituting equation (31) and equation (34) into the equation (30), we get:

\[
1 - \frac{(\tau + \gamma T)}{\Omega} r_{t+1}^\frac{2 - \phi}{\phi - 1} = H \left( \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^\frac{\phi}{\phi - 1} \right) \tag{35}
\]

Finally, rewriting equation (35) allows us to find the implicit relation between the loan rate \( r_{t+1} \) and the proximity to the worldwide technological frontier \( a_t \):

\[
G(r_{t+1}, a_t) = \chi r_{t+1} - H \Gamma a_t r_{t+1}^\frac{\phi}{\phi - 1} - \rho = 0 \tag{36}
\]
where $\rho \equiv 1 - \frac{H(\phi-1)}{\phi}$ and $\chi \equiv \frac{(\tau + \gamma T)}{\pi}$.

**Case of $\phi = 2$.** We rewrite the Lerner index substituting equation (33) into the equation (32).

$$1 - \frac{\psi(\tau + \gamma T)}{\pi} = H \left( \frac{1}{2} - \left(1 - \theta \right) + (1 - \gamma D) \right) \omega \bar{\psi} r_{t+1}^2 a_t$$

and finally the equilibrium loan rate is obtained as:

$$r_{t+1} = \pi \sqrt{\frac{1 - \frac{2}{H} \left(1 - \frac{\psi(\tau + \gamma z)}{\pi} \right)}{2 \omega \psi [\tau(1 - \theta) + (1 - \gamma D)] a_t}}$$

(37)

**Proof of Proposition 1.**

**Case of $\phi > 2$.** The implicit function theorem implies directly that:

$$\frac{\partial r_{t+1}}{\partial a_t} = \frac{-\partial G(r_{t+1}, a_t)}{\partial a_t} < 0$$

(38)

since $\frac{\partial G(r_{t+1}, a_t)}{\partial a_t} = -HR_t^{\phi-1} < 0$ and $\frac{\partial G(r_{t+1}, a_t)}{\partial r_{t+1}} = \left( \frac{2 - \phi}{\phi - 1} \chi r_{t+1}^{\frac{3 - 2\phi}{\phi - 1}} - \frac{H\phi}{\phi - 1} \Gamma a_t r_{t+1}^{\frac{1}{\phi - 1}} \right) < 0$ if $\phi > 2$.

**Case of $\phi = 2$.** To prove the Proposition 1 for $\phi = 2$ we differentiate the equilibrium loan rate given by equation (37) with respect to the proximity to the worldwide technological frontier $a_t$:

$$\frac{\partial r_{t+1}}{\partial a_t} = -\frac{\pi \left(1 - \frac{2}{H} \left(1 - \frac{\psi(\tau + \gamma z)}{\pi} \right) \right)}{4 \omega \psi [\tau(1 - \theta) + (1 - \gamma D)] a_t^2 \sqrt{\frac{1 - \frac{2}{H} \left(1 - \frac{\psi(\tau + \gamma z)}{\pi} \right)}{2 \omega \psi [\tau(1 - \theta) + (1 - \gamma D)] a_t}}} < 0$$

(39)

**Proof of Proposition 2.**

**Case of $\phi > 2$.** The implicit function theorem implies directly that:

$$\frac{\partial r_{t+1}}{\partial H} = \frac{-\partial G(r_{t+1}, a_t)}{\partial H} > 0$$

(40)

since $\frac{\partial G(r_{t+1}, a_t)}{\partial H} = \left( \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^{\frac{\phi}{\phi - 1}} \right) > 0$ (by positivity of the Lerner index) and $\frac{\partial G(r_{t+1}, a_t)}{\partial r_{t+1}} = \left( \frac{2 - \phi}{\phi - 1} \chi r_{t+1}^{\frac{3 - 2\phi}{\phi - 1}} - \frac{H\phi}{\phi - 1} \Gamma a_t r_{t+1}^{\frac{1}{\phi - 1}} \right) < 0$ if $\phi > 2$. 

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Case of $\phi = 2$. To prove the Proposition 1 for $\phi = 2$ we differentiate the equilibrium loan rate given by equation (37) with respect to the Herfindahl index $H$:

$$\frac{\partial r_{t+1}}{\partial H} = \frac{\pi \left[ 1 - \frac{\psi(\tau + \gamma_d)}{\pi} \right]}{\tilde{\omega} \psi \left[ \tau(1-\tau) + (1-\gamma_d) \right] a_t H^2 \sqrt{\frac{1 - \frac{2}{\phi} \left[ 1 - \frac{\psi(\tau + \gamma_d)}{\pi} \right]}{2\tilde{\omega} \psi \left[ \tau(1-\theta) + (1-\gamma_d) \right] a_t}} > 0$$

(41)

**Proof of Proposition 3.**

Case of $\phi > 2$. We first derive the expression of the equilibrium probability to innovate and establish its properties and give a proof of proposition 2. Substituting equation (31) into equation (30) we get the following expression for the loan rate:

$$r_{t+1} = \frac{(\tau + \gamma_T)}{1 - H \left( \phi - 1 \right)} \frac{\phi}{\phi - 1} r_{t+1}^{\phi-1} \mu_{t+1}$$

(42)

which we substitute into equation (12) to obtain the equilibrium probability to innovate:

$$\mu_{t+1} = \left( H \frac{\phi}{\phi - 1} - \Gamma a_t r_{t+1}^{\phi-1} \right) \frac{1}{\phi - 2}$$

(43)

where $\kappa \equiv \frac{\pi}{\phi \psi(\tau + \gamma_T)}$. The probability of entrepreneurial innovation is positive and less than one if $\phi > 2$, since $\frac{\phi}{\phi - 1} > \Gamma a_t r_{t+1}^{\phi-1}$ (by positivity of the Lerner index) and since $\Gamma a_t r_{t+1}^{\phi-1} > \frac{\phi}{\phi - 1} - \frac{1}{\phi}$.

In order to prove the Proposition 2, we differentiate equation (43) to obtain:

$$\frac{\partial \mu_{t+1}}{\partial a_t} = \frac{1}{\phi - 2} \left( H \frac{\phi}{\phi - 1} - \Gamma a_t r_{t+1}^{\phi-1} \right) \frac{3}{\phi - 2} \left[ H \kappa \Gamma \left( r_{t+1}^{\phi} + a_t \frac{\phi}{\phi - 1} \frac{\partial r_{t+1}^{\phi} - 1}{\partial a_t} r_{t+1}^{\phi-1} \right) \right]$$

(44)

Since we assume that $\phi > 2$ and $\mu_{t+1} > 0$, $\frac{\partial \mu_{t+1}}{\partial a_t} > 0$ if $\left( r_{t+1}^{\phi} + a_t \frac{\phi}{\phi - 1} \frac{\partial r_{t+1}^{\phi} - 1}{\partial a_t} r_{t+1}^{\phi-1} \right) > 0$.

Substituting the expression of $\frac{\partial r_{t+1}^{\phi}}{\partial a_t}$ given by (38), we get:

$$\left( \frac{\phi}{\phi - 1} r_{t+1}^{\phi} - a_t \frac{\phi}{\phi - 1} \left( \frac{3 - \phi}{\phi - 1} r_{t+1}^{\phi} + H \frac{\phi}{\phi - 1} \Gamma a_t r_{t+1}^{\phi-1} \right) r_{t+1}^{\phi-1} \right) = \frac{\phi - 2}{\phi - 1} > 0$$

Case of $\phi = 2$. We first derive the expression of the equilibrium probability to the entrepreneurial innovation. Substituting equation (37) into equation (12) to obtain the probability
to innovate:

\[
\mu_{t+1} = \frac{2\bar{\omega} \left[ \tau(1-\theta) + (1-\gamma D) \right]}{\psi \left\{ 1 - \frac{2}{H} \left( 1 - \frac{\psi(\tau+\gamma z)}{\pi} \right) \right\}} a_t \tag{45}
\]

To prove the Proposition 2 for \( \phi = 2 \) we differentiate equation (45) such that:

\[
\frac{\partial \mu_{t+1}}{\partial a_t} = \frac{\bar{\omega} \left[ \tau(1-\theta) + (1-\gamma D) \right]}{\psi \left\{ 1 - \frac{2}{H} \left( 1 - \frac{\psi(\tau+\gamma z)}{\pi} \right) \right\}} > 0 \tag{46}
\]

Proof of Proposition 4.

Case of \( \phi > 2 \). To prove the Proposition 3, we use the equilibrium probability to innovate in equilibrium given by equation (43). Differentiating this equation with respect Herfindahl index \( H \), we get:

\[
\frac{\partial \mu_{t+1}}{\partial H} = -\frac{1}{\phi - 2} \left( \kappa \left[ 1 - H \left( \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^\phi \right) \right] \right)^{\frac{3-\phi}{\phi-2}} \left[ \kappa \left( \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^\phi \right) \right] < 0 \tag{47}
\]

Since we assume that \( \phi > 2 \) and \( \mu_{t+1} > 0 \), \( \frac{\partial \mu_{t+1}}{\partial H} < 0 \) if \( \left( \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^\phi \right) > 0 \). This condition implies that: \( r_{t+1} < \left( \frac{\phi - 1}{\phi \Gamma a_t} \right)^{\frac{1}{\phi}} \) (positivity of the Lerner index).

Case of \( \phi = 2 \). To prove the Proposition 3 for \( \phi = 2 \), we use the equilibrium probability to innovate given by (45). We differentiate the equation with respect to Herfindahl index \( H \), we get:

\[
\frac{\partial \mu_{t+1}}{\partial H} = -\frac{2\psi \bar{\omega} \left[ \tau(1-\theta) + (1-\gamma D) \right]}{H^2 \psi \left\{ 1 - \frac{2}{H} \left( 1 - \frac{\psi(\tau+\gamma z)}{\pi} \right) \right\}} a_t < 0 \tag{48}
\]

Proof of Proposition 5. Since we assume that \( \phi \geq 2 \) and \( \left( \frac{\phi - 1}{\phi} - \Gamma a_t r_{t+1}^\phi \right) > 0 \) (by positivity of the Lerner index). Proposition 3 and Proposition 4 allows us to find Proposition 5 given by:

\[
\frac{\partial^2 \mu_{t+1}}{\partial H \partial a_t} < 0
\]
Appendix D: Dynamics studies

The technology gap is given by:

\[ a_{t+1} = \mu(a_t) + \frac{1}{1+g}(1-\mu(a_t))a_t = F(a_t) \]  

where

\[
\mu(a_t) = \begin{cases} 
\{ \kappa \left[ 1 - H \left( \frac{\phi-1}{\phi} - \frac{\phi}{\pi} \frac{\phi}{r_{t+1}} \right) \right] \}^{\frac{1}{\phi-2}} & \text{if } \phi > 2 \\
\left\{ \frac{2\omega \tau (1-\theta) + (1-\gamma D)}{1 - \frac{\pi}{2} \left( 1 - \frac{2(1-\gamma D)}{\pi} \right) a_t} \right\}^{\frac{1}{2}} & \text{if } \phi = 2 
\end{cases}
\]

First of all, we evaluate the function \( F \) at the origin (i.e. \( a_t = 0 \)) and at the worldwide technological frontier (i.e. \( a_t = 1 \)). For \( \phi = 2 \), \( F(0) = 0 \) but \( F(0) > 0 \) if \( \phi > 2 \):

\[
F(0) = \begin{cases} 
\mu(0) = \left[ \frac{\pi}{\phi \psi (\tau + \gamma T)} \right]^{\frac{1}{\phi-2}} (1 - \frac{H(\phi-1)}{\phi}) > 0 & \text{if } \phi > 2 \\
\mu(0) = 0 & \text{if } \phi = 2 
\end{cases}
\]

At the worldwide technological frontier, we have (recall that \( \mu \) is a probability and therefore is between 0 and 1 as shown in the main text):

\[
F(1) = \mu(1) + \frac{1}{1+g}(1-\mu(1)) = \frac{g\mu(1) + 1}{1+g} < 1
\]

where

\[
\mu(1) = \begin{cases} 
\left\{ \frac{\pi}{\phi \psi (\tau + \gamma T)} \right\} \left[ 1 - H \left( \frac{\phi-1}{\phi} - \frac{\phi}{\pi} \phi \right) \left( \frac{\phi \psi}{\pi \psi} \frac{1}{r(1-\gamma T)} \right) \right]^{\frac{1}{\phi-2}} & \text{if } \phi > 2 \\
\left\{ \frac{2\omega \tau (1-\theta) + (1-\gamma D)}{1 - \frac{\pi}{2} \left( 1 - \frac{2(1-\gamma D)}{\pi} \right) a_t} \right\}^{\frac{1}{2}} & \text{if } \phi = 2 
\end{cases}
\]

By Proposition 3, we already know that \( F(a_t) \) is an increasing function of the proximity to the worldwide technological frontier \( a_t \) and \( F(a_t) \) is concave because the probability of entrepreneurial innovation is concave as well. Finally, to assure convergence to a positive value of the steady state of the proximity to the worldwide technological frontier for the case \( \phi = 2 \), we show that the slope at the origin is greater than 1. Indeed, the value of the derivative of the function \( F \) at the origin is given by:

\[
F'(0) = \mu'(0) + \frac{1}{1+g}(1-\mu(0))
\]

where equation (46), for the case \( \phi = 2 \), shows that the derivative of the equilibrium probability to innovate at the origin tends to infinity warranting that \( F'(0) > 1 \).
Proof of Proposition 6. At steady state \( a^* = F(a^*) \), where \( a^* \in [0, 1] \). Using the fixed point theorem, we show that:

1. \( F(a) \) is \( z \)-Lipschitz, therefore contracting and

2. \( F(a) \) converges to the unique steady state value \( a^* \)

\( F(a) \) is contracting if: \( \|F(1) - F(0)\| \leq z\|1 - 0\| = z \). Replacing the expressions of \( F(1) \) and \( F(0) \), we get:

\[
\|F(1) - F(0)\| = \left\| \mu(1) + \frac{1}{1+g}(1 - \mu(1)) - \mu(0) \right\|
\]

\[
= \left\| \frac{g\mu(1)}{1+g} + \frac{1}{1+g} - \mu(0) \right\|
\]

\[
= \frac{1}{1+g} \left\| g\mu(1) - (1+g)\mu(0) + 1 \right\|
\]

\[
= \frac{1}{1+g} \left\{ g \left[ 1 - H \left( \frac{\phi - 1}{\phi} - \Gamma r(1) \frac{\phi}{\phi - 1} \right) \right] \right\} \frac{1}{\phi - 2} - (1 + g) \left[ \kappa \left( 1 - H(\phi - 1) \frac{\phi}{\phi} \right) \right] \frac{1}{\phi - 2} + 1
\]

\[
\leq \frac{\kappa}{1+g} \left\{ g \left[ 1 - H \left( \frac{\phi - 1}{\phi} - \Gamma r(1) \frac{\phi}{\phi - 1} \right) \right] \right\} - (1 + g) \left[ \left( 1 - H(\phi - 1)\frac{\phi}{\phi} \right) \right] + 1
\]

\[
= \frac{H}{(\phi - 2)(1+g)} \frac{1}{\phi - 2} \left\| g\Gamma r(1) \frac{\phi}{\phi - 1} - \frac{\phi - 1}{\phi} \right\|
\]

\[
\leq \frac{H}{(\phi - 2)(1+g)} \frac{1}{\phi - 2}
\]

(54)

where \( \kappa \equiv \frac{\pi}{\phi\psi(\tau + \gamma/2)} \). Therefore, because the Lerner index is positive, \( F(a) \) is \( z \)-Lipschitz, with \( z \equiv \frac{H}{(\phi - 2)(1+g)} \kappa \frac{1}{\phi - 2} \), so \( F \) is contracting and the steady state value \( a^* \) is unique. ■
References


Table 1: Descriptive statistics

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Table 3: Cross-Country regressions

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Notes: p-value are in parenthesis, all regressions include a constant. Depend variable is the average per worker GDP growth rate over the period 1980-2010, when available. The regression in column (1) is estimated using OLS. The regression in column (2) is also estimated using OLS and adds the interaction term between bank concentration and proximity to the worldwide technological frontier. The regressions in columns (3), (4), (5) and (6) add respectively the following controls: Legal Origins (British, French and German), Financial Development, School and Macroeconomic Policies (Inflation rate, Money growth, Trade, Government Consumption and Budget Balance). The regressions in columns (7) and (8) include all control variables, where OLS is used in column (7) and IV is used in column (8) with the instruments: (Legal origins and the variable: FRONT×LEGOR).

Table 4: Panel regressions without control variables

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Notes: p-value are in parenthesis, all regressions include a constant. Depend variable is the average per worker GDP growth rate over the period 1980-2010, when available. The regressions in columns (1) and (5) are estimated using OLS, columns (2) and (6) include countries fixed effects, columns (3) and (7) include both countries and periods fixed effects and (4) and (8) are estimated with the Arrellano-Bond GMM estimator (Arrellano and Bond, 1991).
Table 5: Panel regressions with control variables

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</table>

Notes: *p*-values are in parenthesis, all regressions include a constant. Dependent variable is the average per capita GDP growth rate over the period 1980-2010, when available. The columns (1)-(4) include School with country and year dummies. The columns (5)-(8) include Financial development with country and period dummies. The columns (9)-(12) include the Macroeconomic variables (Inflation rate, Money growth, Trade, Government Consumption and Budget Balance) with country and year dummies. The columns (4), (8) and (12) use the Arellano-Bond GMM estimator (Arellano and Bond, 1991).
Table 6: Cross-Country regressions using Herfindahl Index

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<td>-0.046</td>
<td>-0.035</td>
<td>-0.040</td>
<td>-0.052</td>
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<td></td>
<td>(0.152)</td>
<td>(0.069)</td>
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<td>(0.044)</td>
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<td>(0.002)</td>
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<td>-0.008</td>
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<td>-0.007</td>
<td>-0.017</td>
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<td>(0.028)</td>
<td>(0.000)</td>
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Notes: $p$-value are in parenthesis, all regressions include a constant. Dependent variable is the average per worker GDP growth rate over the period 1980-2010, when available. The regression in column (1) is estimated using OLS. The regression in column (2) is also estimated using OLS and adds the interaction between bank concentration and proximity to the worldwide technological frontier. The regressions in columns (3), (4), (5) and (6) add respectively the following controls: Legal Origins (British, French and German), Financial Development, School and Macroeconomic Policies (Inflation rate, Money growth, Trade, Government Consumption and Budget Balance). The regressions in columns (7) and (8) include all control variables, where OLS is used in column (7) and IV is used in column (8) with the instruments: (Legal origins and the variable: FRONT×LEGOR).
Table 7: Cross-Country regressions using RDGPCH per capita GDP

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<tbody>
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<td>-0.021</td>
<td>-0.023</td>
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<td>-0.031</td>
<td>-0.035</td>
<td>-0.063</td>
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<tr>
<td></td>
<td>(0.009)</td>
<td>(0.008)</td>
<td>(0.006)</td>
<td>(0.017)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.000)</td>
<td>(0.008)</td>
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<td>CONC×FRONT</td>
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<td>-0.001</td>
<td>-0.002</td>
<td>-0.004</td>
<td>-0.001</td>
<td>-0.006</td>
<td>-0.008</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.733)</td>
<td>(0.385)</td>
<td>(0.263)</td>
<td>(0.076)</td>
<td>(0.376)</td>
<td>(0.025)</td>
<td>(0.008)</td>
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<td>yes</td>
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</table>

Notes: p-value are in parenthesis, all regressions include a constant. Depend variable is the average per capita GDP growth rate over the period 1980-2010, when available. The regression in column (1) is estimated using OLS. The regression in column (2) is also estimated using OLS and adds the interaction between bank concentration and proximity to the worldwide technological frontier. The regressions in columns (3), (4), (5) and (6) add respectively the following controls: Legal Origins (British, French and German), Financial Development, School and Macroeconomic Policies (Inflation rate, Money growth, Trade, Government Consumption and Budget Balance). The regressions in columns (7) and (8) include all control variables, where OLS is used in column (7) and IV is used in column (8) with the instruments: (Legal origins and the variable: FRONTC×LEGOR).

Table 8: Panel regressions without control variables using RGDP per capita GDP

<table>
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<tbody>
<tr>
<td>CONC</td>
<td>-0.008</td>
<td>-0.018</td>
<td>-0.011</td>
<td>0.016</td>
<td>-0.015</td>
<td>-0.051</td>
<td>-0.085</td>
<td>-0.125</td>
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<tr>
<td></td>
<td>(0.230)</td>
<td>(0.166)</td>
<td>(0.450)</td>
<td>(0.442)</td>
<td>(0.071)</td>
<td>(0.004)</td>
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<tr>
<td>CONC×FRONT</td>
<td>-0.002</td>
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<td>(0.216)</td>
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Notes: p-value are in parenthesis, all regressions include a constant. Depend variable is the average per capita GDP growth rate over the period 1980-2010, when available. The regressions in columns (1) and (5) are estimated using OLS, columns (2) and (6) include countries fixed effects, columns (3) and (7) include both countries and periods fixed effects and (4) and (8) are estimated with the Arrellano-Bond GMM estimator (Arrellano and Bond, 1991).
Table 9: Cross-Country and panel regressions using inflation measured by the annual growth rate of the GDP implicit deflator

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<td>-0.047</td>
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<td>-0.120</td>
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<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.054)</td>
<td>(0.041)</td>
<td>(0.002)</td>
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<td>(0.020)</td>
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<td>CONC×FRONT</td>
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<td>-0.010</td>
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<td></td>
<td>(0.096)</td>
<td>(0.003)</td>
<td>(0.000)</td>
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<td>(0.010)</td>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
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<td>yes</td>
</tr>
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</table>

Notes: \( p \)-value are in parenthesis, all regressions include a constant. Depend variable is the average per worker GDP growth rate over the period 1980-2010, when available. The regression in column (1) is estimated using OLS and add Macroeconomic policies. The regression in column (2) is also estimated using OLS and adds respectively the following controls: Legal Origins (British, French and German), Financial Development, School and Macroeconomic Policies (Inflation rate, Monetary growth, Trade, Government Consumption and Budget Balance). The IV is used in column (3) with the instruments: (Legal origins and the variable: FRONT×LEGOR). The columns (4)-(5)-(6)-(7) include the Macroeconomic policies variables (Inflation rate, Money growth, Trade, Government Consumption and Budget Balance) with country and year dummies. The column (7) uses the Arellano-Bond GMM estimator (Arellano and Bond, 1991).

Table 10: Cross-Country using bank control variables

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</table>

Notes: \( p \)-value are in parenthesis, all regressions include a constant. Depend variable is the average per worker GDP growth rate over the period 1980-2010, when available. The regression in column (1) is estimated using OLS. The regression in column (2)-(3)-(4)-(5) is also estimated using OLS and adds respectively the following controls: Entry into banking requirements, (CONC×REST), (CONC×SUP) and (CONC×BANKDEV). Bank efficiency control variables are introduced in column (6) and (7). Column (6) adds overhead costs and column (7) adds net interest margin.