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Does financial intermediation matter for macroeconomic efficiency?

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Abstract: This paper investigates whether financial intermediary development influences macroeconomic technical efficiency on a sample of 47 countries, both developed and developing, over 1980-1995. We do so by applying Battese and Coelli (1995)'s method at the aggregate level. It is found that financial intermediary development, except financial depth, is on average associated with more efficiency. However we find strong evidence that this relationship is conditional on the level of economic development. The lower economic development the weaker is the impact of financial development on efficiency. That impact can even become negative in the poorest countries.

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1. Introduction

Over the last decade, empirical research has reached at least two key findings that have contributed to shape the common view of the determinants of growth. The first of those findings is a confirmation of the conclusions of the growth accounting literature. Namely, it is now agreed upon that factor accumulation is not the dominant engine of growth. This observation was for instance made by Easterly and Levine (2001), who observed that productivity growth accounted for the greater part of cross-country growth differences. The same conclusion stems from the development accounting literature surveyed by Caselli (2005). That is, cross-country income differences result chiefly from differences in total factor productivity.

At the same time, the accumulated evidence allowed to empirically settle the debate on the relationship between financial development and growth. More precisely, according to Honohan (2004, p.1), "the causal link between finance and growth is one of the most striking macroeconomic relationships uncovered in the past decade". Since King and Levine (1993)'s seminal contribution, that strand of research surveyed by Levine (2005) has repeatedly

reached the conclusion that financial development was instrumental in fostering growth, with various and always more refined techniques.

Moreover, those two key findings indeed overlap. Thus, the impact of financial intermediary development seems to run mainly through its effect on total factor productivity. This is the central finding of Beck, Levine and Loayza (2000), who also found that the relationship between financial intermediary development and productivity was much more robust than the relationship between financial intermediary development and capital accumulation. In other words, financial intermediary development robustly affects the main source of economic growth. As Mishkin (2005) points out, the causes of that phenomenon can be traced back to the real services provided by the financial sector. Specifically, the financial sector reduces transaction and information costs, and most of all acts as a coordinating device that allocates capital to efficient uses. The relevant allocation of capital not only determines its own productivity but also the productivity of all the other factors of production in the economy. The positive association between financial intermediary development and total factor productivity ensues.

Important related questions however remain unsettled. The first one concerns the dimension of financial intermediary development that matters most for productivity. Financial intermediary development is indeed a complex concept, which ranges from the provision of financial services to the importance of commercial banks relative to the central bank in granting loans. Second, although an average positive relationship has regularly been observed between financial development and economic performance, one may wonder if it does not hide specificities of particular subsets of countries. In other words, one may wish to determine whether non-linearities exist in that relationship. Indeed, such non-linearities were uncovered by Rioja and Valev (2004a), but their analysis only focused on growth, and not on its sources, let alone productivity.

Those are the questions that drive the present analysis. With the aim of addressing them, we use an original measure of total productivity, aggregate technical efficiency. That method originates from the microeconomic literature but was applied to aggregate production functions by Moroney and Lovell (1997). It consists in measuring countries' relative distance to an estimated common production frontier. In theory, productivity gaps could be disaggregated as the sum of a technological component and an efficiency component. However, due to the magnitude of productivity gaps and the ease with which technology can be transferred across borders, technology gaps are a doubtful explanation.

As will appear below, there are several reasons why macroeconomic performance is better measured using this approach than more usual performance indicators, like total factor productivity. The first one is that it provides a synthetic measure of performance. Indeed, unlike basic productivity measures such as per capita income, efficiency scores allow to include several input dimensions in the evaluation of performances. As a result, output is not only compared to the labor stock, but also to the stocks of physical capital and human capital. Second, technical efficiency provides relative measures of performance. Namely, the estimated common production frontier allows the comparison of each country to its best possible practice given its endowments. Instead, other measures of productivity compare countries whose endowments may differ greatly, which casts doubt on the meaning of such comparisons.

The structure of the paper is as follows. The next section describes the theoretical background of the influence of financial intermediary development on productivity. The way in which aggregate efficiency can be measured and analyzed is explained in the third section. The fourth section presents data and estimations. The last section concludes.

2. The theoretical relationship between financial development and efficiency

This section aims at briefly presenting the channels through which financial intermediary development may influence productivity. It is usually assumed that the relationship is positive but counterarguments suggest that a negative one cannot be ruled out.

The channels through which financial development positively impacts efficiency all rest on the fact the financial system emerges to ease information, enforcement, and transactions costs in financing decisions and transactions. Levine (2005) thus considers four main functions provided by the financial system to reduce these costs.[1] Accordingly, financial development allows the financial system to exert those functions more efficiently. However, several theoretical explanations of the link between financial development and growth hinge on the accumulation of physical capital, which would be favored by financial development. Because the focus of the present paper is efficiency, we do not pay attention to the effects of these functions on capital accumulation. Moreover, we focus on financial intermediaries, meaning that we do not comment upon the role of financial markets.

[1] He indeed considers five such functions, but the fifth, i.e. easing the trade, diversification and management of risk, is mainly provided by financial markets rather than financial intermediaries.

The first function of the financial system is to produce information ex ante about possible investments, and to provide a better allocation of capital. Financial intermediary development can improve productivity by this channel, as banks may reduce the costs of the evaluation of investment projects before the lending decision, and therefore allow a better allocation of capital. Indeed, several papers have underlined the reduction of the costs of acquiring and processing information (e.g. Boyd and Prescott, 1986). Furthermore, financial intermediaries may also promote technological innovation by identifying borrowers with the best chances of successfully launching innovations.

The second function of the financial system is to monitor firms and to exert corporate governance. The reasoning here is straightforward. By increasing the control of firm managers, financial intermediaries raise the pressure on them to perform and consequently increase their productivity. That pressure is beneficial because of the moral hazard problem in the management of firms, which results from the conflicts of interest between firms' managers and owners. The argument is notably based on the binding nature of debt. A loan contract with a financial intermediary reduces the "free cash-flow" at the disposal of managers (Jensen, 1986). Indeed, debt implies interest payment obligations that must be satisfied by managers, under the threat of bankruptcy if these obligations are not satisfied. Grossman and Hart (1982) also argue that debt financing provides better incentives for managers to perform, as they aim to avoid the personal costs of bankruptcy.

The financial system's third function is the pooling of savings. Financial intermediaries can thus help improve firms' productivity, by reducing the transaction costs associated with the mobilization of savings from different economic agents, and by reducing information costs for the savers. Therefore, this reduction of costs makes financial intermediaries useful to improve resource allocation, and also favor technological innovation.

The last function of the financial system consists in easing the exchange of goods and services. Indeed, financial development contributes to develop media of exchange and consequently facilitates the exchange of goods and services. Following Adam Smith's argument, this extension facilitates specialization, which is the main force behind productivity improvements.

A wide range of arguments therefore explains why financial intermediary development should raise productivity. They are however qualified by a few counterarguments that emphasize the aftermath of financial liberalization. Namely, financial liberalization is likely to increase the probability of financial crises, and thus hamper growth. Rajan (1994) notably argues that bankers' incentives are affected by financial liberalization in such a way that it

results in credit expansion and then in a greater volatility of output growth. In a closely related model, Dell'Aricia and Marquez (2006) show how financial liberalization in emerging countries can lead to a greater volatility of credit and a lower output growth.

These theoretical arguments are supported by empirical elements on developing countries. While De Gregorio and Guidotti (1995) observe a positive relationship between growth and financial development on a sample of 100 developed and developing countries on the period 1960-1985, they also point out that this relationship becomes negative when the investigation is restricted to Latin American countries. This finding is then interpreted as the consequence of the negative effects of financial liberalization during the 70s and the 80s in these countries.

Furthermore, Loayza and Rancière (2005) analyze the short and the long-term impacts of financial development on growth on a sample of 75 countries during the period 1960-2000. They conclude that the effects of financial development depend on the perspective taken. They thus find a positive long-term relationship between both variables, which coexists with a negative one in the short-term. They also explain this negative impact by the effects of financial liberalization in developing countries, this interpretation being supported by the observation that negative short-term effects are only significant in financially fragile countries.

In a nutshell, the literature provides several arguments explaining why financial intermediary development favors productivity, but the negative effects of financial liberalization qualify this positive impact in developing countries. Which effects dominate in which countries is therefore an empirical issue. By the same token the role of the various dimensions of financial development may evolve with economic development. The next section explains how we investigated those two issues.

3. Methodology

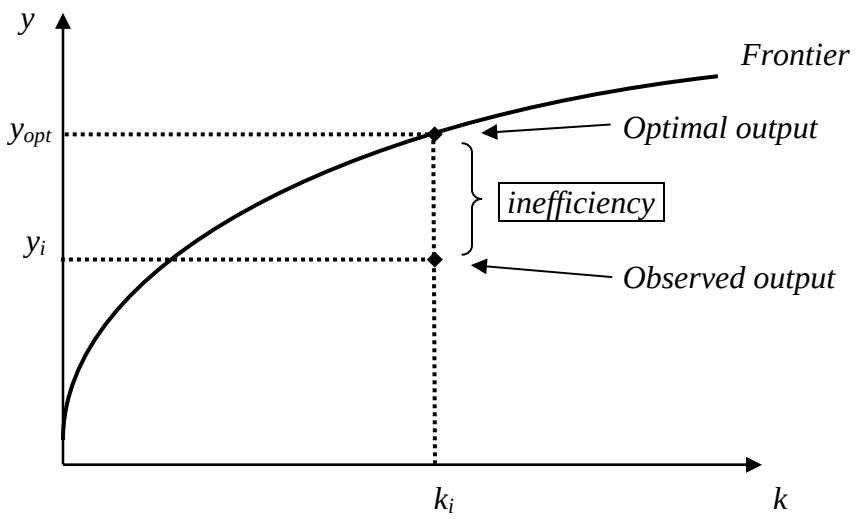
In this section, we first explain how we measured aggregate efficiency. We then present how we studied its determinants.

3.1. Measuring efficiency

Our first task here is to measure macroeconomic efficiency. We more specifically focus on technical efficiency, which measures how close a country's production is to what that

country's optimal production would be for using the same bundle of inputs. We resort to the stochastic frontier approach to estimate technical efficiency, following the former applications of Adkins, Moomaw and Savvides (2002) and Méon and Weill (2005) among others.[2]

Graph 1: The efficiency frontier



y output per worker, *k* capital per worker.

Once each country's inefficiency is assessed, its relationship with financial development must be measured. A natural way of doing it would be to resort to a two-stage approach. That approach would consist in estimating efficiency scores in a first stage, then regressing them on the relevant set of explanatory variables in a second stage. Though intuitive, this approach is inconsistent, because it assumes in the first stage that inefficiencies are independently distributed, while the second-stage regression does not respect that independence assumption.

We consequently resort to the one-stage approach developed by Battese and Coelli (1995). It consists in estimating a model that includes a production frontier as well as an equation in which inefficiencies are specified as a function of explanatory variables. This approach is more consistent than the two-stage approach, which may explain its popularity in studies of the determinants of technical efficiency at the aggregate level, such as Adkins, Moomaw and Savvides (2002) or Méon and Weill (2005).

The estimated stochastic frontier model thus includes two equations. The first one is the specification of the production frontier. We assume a constant returns-to-scale Cobb-Douglas

[2] Weill (2006) compares the efficiency measures obtained at the aggregate level with the stochastic frontier approach and with DEA (data envelopment analysis), an alternative technique based on linear programming tools. He concludes in favour of the robustness of efficiency measures to the choice of the frontier technique.

production technology[3], which we write as:

$$ln\,(Y/L)_{it} = \alpha_0 + \alpha_1\, ln\,(K/L)_{it} + \alpha_2\, ln\,(H/L)_{it} + \alpha_3\, t + v_{it} - u_{it} \qquad (1)$$

where *i* indexes countries and *t* years of observation. (*Y/L*), (*K/L*), (*H/L*) are respectively output per worker, capital per worker, and human capital per worker. Variable *t* accounts for the drift of the common production function over time. It is set to one during the first period, two during the second period, and so on. v_{it} is a random disturbance, reflecting luck or measurement errors. It is assumed to have a normal distribution with zero mean and variance σ_v^2. u_{it} is an inefficiency term, capturing technical inefficiencies. It is a one-sided component with variance σ_u^2. As is common in the literature, we assume a half-normal distribution for the inefficiency term.

The second equation specifies inefficiencies as:

$$u_{it} = \delta z_{it} + W_{it} \qquad (2)$$

where u_{it} is country *i*'s inefficiency, z_{it} is a $p \times 1$ vector of *p* explanatory variables, δ is a $1 \times p$ vector of parameters to be estimated, W_{it} the random variable defined by the truncation of the normal distribution with mean zero and variance σ^2 ($\sigma^2 = \sigma_u^2 + \sigma_v^2$).

Expressions 1 and 2 underline an additional advantage of efficiency scores obtained with stochastic frontier approach with respect to standard productivity measures that has not been mentioned so far. Namely, whereas total factor productivity measures performance by the whole difference between a country's actual and estimated productions, the stochastic frontier approach allows to split the distance to the production frontier between an inefficiency term and a random error, taking exogenous events into account.

3.2. Testing the hypotheses

Once the general method that allows to measure and explain aggregate efficiency has been developed, testing hypotheses requires to list the variables that determine efficiency, that is to specify the arguments of vector z_{it}. As underlined in the introduction, we wish to test two embedded questions. The first one concerns the general association between finance and

[3] When Hall and Jones (1999) estimate aggregate productivity in a related cross-country study, they find that results obtained with a Cobb-Douglas production function are very similar to the results obtained when the production function is not restricted to that specification. Kneller and Stevens (2003) reached similar conclusions when estimating aggregate efficiency frontiers.
We adopt constant returns-to-scale because, as Moroney and Lovell (1997, p.1086) put it, "at the economy-wide level, constant returns-to-scale is virtually compelling".

productivity, and more precisely the facet of financial intermediary development that affects efficiency. We therefore in turn include among the regressors three canonical measures of financial intermediary development that have repeatedly been used in the literature since King and Levine (1993). Namely, we first use the ratio of the volume of credit to private enterprises to GDP (*PrivateCredit*). That ratio measures the extent to which credit is allocated to private firms, as opposed to government or state-owned firms. It is consequently a measure of the financial sector size, which isolates credit issued to the private sector. It is therefore a measure of financial intermediary development considering who benefits from the credit.

We then use the ratio of liquid liabilities to GDP as a second measure of financial development (*LiquidLiabilities*). That ratio equals currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries divided by GDP. It is therefore also a measure of the overall size of the financial sector, also known as financial depth. Unlike the variable *PrivateCredit*, this indicator takes into account the provision of services by financial intermediaries. Levine, Loayza and Beck. (2000) however mentioned shortcomings of this indicator. It is indeed an imperfect indicator of the quantity of services provided by financial intermediaries, as it involves double counting of deposits by including deposits by one financial intermediary in another. Furthermore, it does not provide information on the effectiveness of the financial sector in reducing the costs of transactions and of acquiring information.

Finally, we also measure the role of commercial banks versus central banks in financing the economy, thanks to our third ratio (*CommercialCentralBank*), which is defined as the ratio of commercial banks assets divided by the sum of commercial banks and central banks assets. It is expected to be positively linked with efficiency, as commercial banks are more likely to identify profitable investments, to monitor their customers, and to provide good-quality services. Consequently, it is a measure of financial intermediary development taking into account who grants credit.

Two remarks need to be made on the three measures of financial intermediary development. *PrivateCredit* and *LiquidLiabilities* measure different dimensions of the size of the financial sector. *PrivateCredit* and *CommercialCentralBank* are linked with the importance of the private sector in the economy.

Namely, while this point is obvious for *PrivateCredit*, it can also be made for *CommercialCentralBank* because the relative importance of commercial banks is a proxy for the role of private banks in the banking industry. We complement the set of explanatory variables by the set of control variables that has become standard in the finance and growth

literature. Namely, we add the openness to trade ratio, the inflation rate, and the ratio of government expenditures to GDP to the arguments of vector z_{it}. Finally, we also control for ethnic fractionalization and latitude, which have been found to affect growth and efficiency (see e.g. Méon and Weill, 2005).

Jointly estimating expressions (1) and (2) with the set of dependent variables described above allows to determine the average association between financial development and growth. We do so by including the following equation modeling inefficiency for each index of the financial intermediary development[4]:

$$u_i = \delta_0 + \delta_1 Openness_i + \delta_2 Latitude_i + \delta_3 EthnicFraction_i + \delta_4 Inflation_i + \delta_5 GovernmentExpenditures_i + \delta_6 Finance_i + W_i \quad (3)$$

Where u_i is country i's inefficiency, W_i the random variable defined by the truncation of the normal distribution. *Openness* is proxied by the measure provided by Sachs and Warner (1995). This measure is a dummy variable, constructed upon the fact that a country is considered as closed if it fails one of five different criteria (the black market premium, the fact that the overall system is capitalist or communist, the extent of government intervention in the export sector, the level of tariff rates, the non-tariff barrier coverage). It is equal to one whether the country is open, and zero elsewhere. *Latitude* measures the country's distance to the equator. *EthnicFraction* is an index of ethnic fractionalization. *Inflation* stands for the truncated inflation rate, and *GovernmentExpenditures* measures the ratio of government expenditures to GDP. *Finance* is the relevant index of financial intermediary development. We use in turn the three indices that have been described above.

The above method allows testing the average relationship between financial development and aggregate efficiency over the whole sample. However, as that relationship may differ across subgroups of countries, we moreover investigate how it varies with economic development. To do so, we first run all the estimations anew with the addition of an interaction term between the relevant financial variable and the log of per capita GDP, meant to proxy economic development. This provides a first insight in the way in which the impact of financial development evolves with economic development.

That strategy however imposes the impact of financial development to be a linear function of economic development. To test for the possibility of a non-linear relationship, we use a second method that allows to separately assess the relationship in each quintile of the

[4] It has to be stressed that the equation (3) is the reformulation of the equation (2) of the stochastic frontier model applied in this work, where the explanatory variables are defined.

sample. More specifically, we first define a dummy variable for each of the first four quintiles of the sample defined over GDP per capita, then interact those dummies with the relevant financial development variable. When included in the set of regressors, those interacted terms allow to determine how the relationship between financial development and inefficiency differs across quintiles.

4. Data and results

Before we perform the analysis and comment our results, we need to present our dataset. This is done in the next subsection. The following subsection displays the result of the estimation of the average relationship on the whole sample, while subsection 4.3 displays the results of the estimations that discriminate sub-samples as a function of their economic development.

4.1. Data

Macroeconomic data for the estimation of the production frontier are the same as in Easterly and Levine (2001), and were downloaded from the Growth Development Network database of the World Bank. Output is measured in purchasing power parity dollars. Capital was computed by Easterly and Levine (2001) using aggregate investment thanks to a perpetual inventory method, where a year's capital stock is equal to the previous year's capital stock plus investment in that year minus depreciation.[5] Labor is measured as the number of workers. Human capital is proxied by the total number of years of schooling in the working-age population over 15 years old. It is taken from Barro and Lee's (2000) education dataset and was downloaded from the Economic Growth Resources website.

All financial data and most control variables are taken from Beck, Demirgüc-Kunt and Levine (2000)'s dataset. However ethnic fractionalization and distance to the equator come from the Growth Development Network database of the World Bank.

[5] That method is presented in more details in Easterly and Levine (2001).

Table 1
Summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Y/L	11,602.05	13,114.10	448.60	42,463.06
K/L	36,002.08	43,264.30	973.76	147,702.92
H/L	10.26	4.61	2.73	18.76
PrivateCredit	0.4520	0.3593	0.0211	1.7972
LiquidLiabilities	0.4830	0.3028	0.0434	1.9334
CommmercialCentralBank	0.7892	0.1980	0.0684	0.9946
Latitude	26.18	16.84	0.51	60.21
Ethnic Fractionalisation	37.38	29.79	0	89.00
Inflation	0.18	0.21	0.03	1.35
GovernmentExpenditures	17.87	8.24	6.01	52.32

The table presents the descriptive statistics for the means by country. Y/L, K/L, H/L, are respectively output per worker, physical capital per worker, and human capital per worker. We remind that openness is a dummy variable and inflation is the logarithm of the inflation rate in percentage plus unity.

Unless specified otherwise, all control variables were used in level in expression (2). The inflation rate stands as an exception. Namely, as it can take extreme values, we used the logarithm of that variable to limit the influence of such observations.[6]

All in all, we ended up with a sample of 47 countries over 1980-1995. We use four years: 1980, 1985, 1990, and 1995. The countries in the sample are both developed and developing, as can be shown in the list of countries provided in the Appendix. In the next section, we document the extent to which those differences are related to financial intermediary development.

4.2. Estimation of the average relationship

Table 2 displays the results of the estimation of expression (1) and (2). The upper-half of that table presents the coefficients of the production function, while the lower half is devoted to the determinants of inefficiency, that is expression (2). We used the Frontier

[6] More precisely, as inflation can also equal zero, we use log(1 + inflation).

software version 4.1 developed by Coelli (1996) to perform the maximum likelihood estimation of the stochastic frontier model. It must be stressed that it is inefficiency that is explained in the second equation, and that a minus sign consequently indicates that an increase in the explanatory variable implies a reduction in inefficiency, in other words a rise in efficiency.

The upper-part of the table reveals that the coefficients of the production function are fairly stable across estimations and always significant. Moreover, those coefficients are in line with other estimations that can be found in the literature. Kneller and Stevens (2003) for instance report coefficients for physical and human capital that are of the same order of magnitude. In addition, Adkins, Moomaw and Savvides (2002) also find a negative trend in the production function.

The lower part of table 2 allows to gauge the determinants of inefficiency. All significant control variables are intuitively signed. It thus appears that greater openness is in general associated with less inefficiency, although not robustly so. Likewise, inefficiency decreases as one moves further away from the equator, which is intuitive. That relationship is moreover very robust and always significant at the one percent level of confidence.

On the other hand, greater ethnic fractionalization is associated with more inefficiency, as revealed by the positive coefficient it exhibits. This finding is consistent with the view that ethnic fractionalization leads to social and political unrest, which hampers efficiency and productivity. However that variable fails to be significant when financial intermediary development is measured thanks to the liquidity ratio, suggesting some colinearity between those variables. *GovernmentExpenditures* is also significantly positive. This implies that efficiency decreases with the ratio of government expenditures to GDP, which may be due to some crowding-out phenomenon. Finally, inflation is never significant at conventional levels.

Table 2
Results for the estimation of the average relationship

	PrivateCredit	LiquidLiabilities	CommercialCentralBank
Intercept	0.55*	0.45	0.49
	(1.75)	(1.34)	(1.57)
K/L	0.79***	0.81***	0.79***
	(30.16)	(29.58)	(31.07)
H/L	0.13**	0.12**	0.12**
	(2.42)	(2.25)	(2.30)
Trend	–0.04***	–0.04***	–0.04***
	(3.26)	(3.42)	(3.23)
Intercept	0.35**	0.27	0.53***
	(2.50)	(1.55)	(2.93)
Openness	–0.07	–0.11	–0.10*
	(1.24)	(1.58)	(1.65)
Latitude	–0.82E–2***	–0.01***	–0.92E–2***
	(2.89)	(3.01)	(3.20)
EthnicFraction	0.20E–2**	0.17E–2	0.16E–2*
	(2.10)	(1.56)	(1.68)
Inflation	0.07	0.09	0.04
	(1.28)	(1.59)	(0.71)
GovernmentExpenditures	0.80**	0.84**	0.72**
	(2.18)	(2.02)	(2.19)
Finance	–0.35**	–0.10	–0.31**
	(2.32)	(0.61)	(1.96)
Sigma	0.06***	0.06***	0.06***
	(4.69)	(3.77)	(4.47)
Log–likelihood	47.73	44.84	47.14
N	188	188	188

K/L and H/L are respectively physical and human capital per worker. Absolute *t*-statistics are displayed in parentheses under the coefficient estimates. *, **, *** denote an estimate significantly different from zero at the 10%, 5% or 1% level.

However, the key variables of interest are those that proxy financial intermediary development, which appear on the bottom line of table 2. The first result is that financial intermediary development is in general associated with less inefficiency, as underlined by the negative coefficients that affect financial intermediary development variables. This is in line with the view, put forward by Levine (2005) and Mishkin (2005), that the financial sector provides real services that contribute to improving the allocation of capital.

However, all dimensions of financial intermediary development do not seem to be as effective in improving macroeconomic efficiency. Indeed, if the development of credit to the private sector and the relative importance of commercial banks in financing the economy are significantly associated with efficiency, financial depth in itself does not seem to affect it. More precisely if the coefficients exhibited by the variables *PrivateCredit* and

CommercialCentralBanks are both significant at the five percent level, *LiquidLiabilities* fails to pass the ten percent test by far.

The main conclusions of this first series of tests is that financial intermediary development matters for efficiency on average, but that what really matters is the share of the private sector, both in allocating and receiving credit. Financial depth as such does not indeed seem to affect efficiency. However, those conclusions only hold on average, that is for the whole sample. It may well be that the various facets of financial intermediary development play a different role at various stages of economic development. The next subsection investigates that possibility.

4.3. The impact of financial intermediary development as a function of economic development

Table 3 displays the results of the estimation of the relationships that include an interaction of financial intermediary development with economic development. The upper part of that table shows that the results pertaining to the parameters of the production function and control variables do not change with respect to table 2 both qualitatively and quantitatively. One may also remark that the fit of the estimation of expression 2, as measured by log-likelihood, increases, which is a hint against pooling all observations regardless of their economic development. However, the result of interest regards the evolution of the impact of financial intermediaries' development as economic development increases. In that respect, the broad picture obtained with the three measures of financial development is consistent across estimations, although details may slightly differ.

More specifically, the first column of table 3 displays the results that pertain to *PrivateCredit*. In that column it appears that the coefficient on financial development is significantly positive while the interaction term exhibits a negative coefficient. Moreover, the magnitude of the estimated coefficients is such that the overall impact of financial development on inefficiency is positive in least developed countries, while it becomes increasingly negative when output per capita exceeds a given threshold.[7]

[7] More specifically, the logarithm of per capita income in thousands dollars must be greater than $0.64/0.49 \cong 1.42$, which means that the threshold amounts to 4140 USD. About one half of the observations included in our sample fall below that threshold.

Table 3
Results for the estimation including the interaction with economic development

	PrivateCredit	LiquidLiabilities	CommercialCentralBank
Intercept	0.77**	0.80***	1.84***
	(2.50)	(2.65)	(7.21)
K/L	0.77***	0.76***	0.44***
	(26.16)	(29.48)	(13.58)
H/L	0.17***	0.17	0.07
	(3.41)	(0.34)	(1.51)
Trend	–0.04***	–0.04***	–0.01
	(3.42)	(3.00)	(1.06)
Intercept	0.22	0.20	1.65***
	(1.53)	(1.39)	(11.96)
Openness	–0.03	–0.04	0.02
	(0.47)	(0.55)	(0.71)
Latitude	–0.70E–2**	–0.81E–2***	–0.15E–2
	(2.30)	(2.59)	(1.21)
EthnicFraction	0.13E–2	0.31E–3	0.20E–2***
	(1.19)	(0.28)	(4.23)
Inflation	0.13**	0.16***	0.01
	(2.13)	(2.60)	(0.37)
GovernmentExpenditures	0.67*	0.50	0.03
	(1.84)	(1.40)	(0.18)
Finance	0.64***	0.88***	0.12
	(2.61)	(3.92)	(1.38)
Finance*Development	–0.45***	–0.49***	–0.57***
	(4.06)	(5.10)	(13.62)
Sigma	0.06***	0.07***	0.02***
	(4.26)	(5.29)	(83.68)
Log–likelihood	60.35	61.79	117.05
N	188	188	188

K/L and H/L are respectively physical and human capital per worker. Absolute *t*-statistics are displayed in parentheses under the coefficient estimates. *, **, *** denote an estimate significantly different from zero at the 10%, 5% or 1% level.

Table 4

Results for the estimation including the squared financial intermediary development variable

	PrivateCredit	LiquidLiabilities	CommercialCentralBank
Intercept	0.87***	1.62***	1.23***
	(2.61)	(4.74)	(3.69)
K/L	0.76***	0.63***	0.70***
	(25.34)	(18.28)	(20.81)
H/L	0.18***	0.21***	0.21***
	(3.32)	(3.73)	(4.00)
Trend	–0.38***	–0.03**	–0.03**
	(3.06)	(2.21)	(2.12)
Intercept	0.22	0.66***	0.58***
	(1.45)	(5.54)	(3.30)
Openness	–0.02	–0.02	0.39E–2
	(0.28)	(0.53)	(0.06)
Latitude	–0.70E–2**	–0.68E–2***	–0.31E–2
	(2.20)	(3.68)	(1.21)
EthnicFraction	0.95E–3	0.29E–3	0.33E–3
	(1.00)	(0.36)	(0.35)
Inflation	–1.01***	0.12**	0.09
	(2.91)	(2.06)	(1.31)
GovernmentExpenditures	0.95**	0.41*	0.57*
	(2.35)	(1.66)	(1.70)
Finance	–1.01***	–1.03***	–2.10***
	(2.91)	(6.75)	(5.00)
Finance*Quintile1	1.64***	1.97***	2.15***
	(3.56)	(7.12)	(5.37)
Finance*Quintile2	1.13***	1.32***	1.86***
	(2.96)	(5.85)	(4.94)
Finance*Quintile3	0.87**	0.99***	1.76***
	(2.32)	(6.33)	(4.64)
Finance*Quintile4	0.52	0.64***	1.55***
	(1.47)	(4.17)	(4.30)
Sigma	0.06***	0.04***	0.05***
	(4.63)	(6.62)	(5.12)
Log–likelihood	58.51	71.71	69.09
N	188	188	188

K/L and H/L are respectively physical and human capital per worker. Quintile1, Quintile2, Quintile3, Quintile4 are dummy variables respectively equal to one whether the observation belongs to the first, second, third or fourth quintile defined over GDP per capita. Absolute *t*-statistics are displayed in parentheses under the coefficient estimates. *, **, *** denote an estimate significantly different from zero at the 10%, 5% or 1% level.

A similar diagnosis can be made with the variable *LiquidLiabilities*, which appears in the second column of table 3. There again, the coefficient on financial development is significantly positive while the interaction term exhibits a negative coefficient. This is striking insofar as that measure of economic development did not appear significantly associated with aggregate efficiency in table 2. This provides an additional argument in favor of

discriminating countries according to their economic development in our estimations. As for *PrivateCredit*, the magnitudes of the point estimates imply that the development of financial intermediaries can be detrimental to efficiency below a given GDP per capita and beneficial beyond it.[8]

The results pertaining to the *CommercialCentralBank* index of financial development are slightly different. Namely, it is found that the coefficient on the variable itself is insignificant, but that the coefficient on the interaction term is negative. This implies that a greater involvement of commercial banks in the allocation of credit is beneficial to efficiency across the whole sample, but that the effect is greater in wealthier economies.

As mentioned above, those conclusions rest on a specification of the relationship between inefficiency and financial development that imposes that the coefficient of financial development be a linear function of economic development. Since that relationship may be non linear, we also resort to an alternative strategy where we estimate a different coefficient in each quintile of our sample. The results of that strategy are displayed in table 4.

As before, the results of table 4 confirm those of other estimations, as far as the production function and control variables are concerned. They also confirm the results of table 3 pertaining to the variation of the relationship between financial development and aggregate efficiency as economic development evolves. In addition, the picture sketched is independent of the measure of financial development that is used. Namely, given the coefficient of the financial development variable and those of quintile dummies, it appears that the impact of financial development on efficiency is always negative in the poorest quintiles. It then becomes almost inexistent in the median quintile before it turns positive, and increasingly so, in the richest quintiles. We therefore find that financial development can be detrimental to aggregate efficiency in poor countries and becomes beneficial in richer countries. Its impact is close to zero in middle-income countries.

Our results are reminiscent of those obtained by Rioja and Valev (2004b). These authors analyze the relationship between financial development and two sources of growth – capital accumulation and productivity growth – on a sample of 74 countries during the period 1961-1995, by using the three same measures of financial development as those used here. They find that the link between financial development and productivity growth depends on the level of economic development. Financial development contributes positively to growth for estimations performed on the full sample of countries. However the positive impact on

[8] The estimated threshold here amounts to 6025 USD, which means that 60% of the observations of our sample fall under that threshold.

productivity growth is only significant in middle-income countries and high-income countries. Indeed, the relationship between financial development and growth is significantly positive in low-income countries only because of the positive impact of financial development on capital accumulation.

Therefore, their conclusion that "the strong contribution of financial development to productivity growth does not occur until a country has reached a certain income level" (p.139) can be related to our finding of a positive relationship between financial development and efficiency only in countries above a certain level of economic development.

Our results can also be connected to those of DeGregorio and Guidotti (1995) and Loayza and Rancière (2005) on the relationship between financial development and growth. Both studies conclude that that relationship can be negative in developing countries, and blame it on the effects of financial liberalization. Namely, as pointed out notably by DeGregorio and Guidotti (1995), financial liberalization may have contributed to increase the likelihood of financial crises and thus hampered productivity.

The same phenomenon may explain our results regarding the differentiated relationship between financial development and efficiency. It has indeed to be stressed that our investigation focuses on the 1980s and the 1990s, i.e. a period marked by moves toward greater financial liberalization in developing countries but also by episodes of financial crises.

5. Concluding remarks

In this paper, we have examined the relationship between financial intermediary development and aggregate productivity, thanks to an efficiency frontier analysis. Our results show that financial intermediary development exerts on average a positive impact on aggregate productivity. However we find strong evidence that this relationship is conditional on the level of economic development. The lower economic development the weaker is the impact of financial development on aggregate efficiency. That impact can even become negative in the poorest countries. Therefore, our main conclusion is that financial intermediary development only exerts a positive impact if a certain level of economic development is reached. It is therefore no sufficient condition to ensure high aggregate productivity.

This analysis can still be extended in a number of ways. First, if the negative effects of financial liberalization on productivity runs through the occurrence of financial crises, then the impact of those crises should be analyzed. Second, the present analysis has not tackled the

impact of the development of financial markets. As it complements financial intermediaries, it should also be analyzed either alone or jointly with the development of financial intermediation, in the line of Beck and Levine (2004). Furthermore, the causality of the relationship could also be investigated. This opens avenues for further research.

Appendix

List of countries

Algeria, Australia, Bolivia, Cameroon, Canada, Chile, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, Ghana, Guatemala, Honduras, India, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Malaysia, Mauritius, Mexico, Netherlands, New Zealand, Norway, Pakistan, Paraguay, Philippines, Senegal, Sierra Leone, South Africa, South Korea, Sri Lanka, Sweden, Switzerland, Thailand, Trinidad and Tobago, Uruguay, USA, Uruguay, Venezuela, Zimbabwe.

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