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DOES ISLAMIC BANKING DEVELOPMENT FAVOR MACROECONOMIC EFFICIENCY? EVIDENCE ON THE ISLAMIC FINANCE – GROWTH NEXUS

Laurent Gheeraert and Laurent Weill

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Abstract

This paper evaluates if the development of Islamic banking influences macroeconomic efficiency. We contribute then to the analysis of the relation between Islamic finance and economic growth. We do so by applying the stochastic frontier approach to estimate technical efficiency at the country level for a sample of 70 countries. We use a unique hand-collected database, which covers Islamic banks worldwide over the period 2000-2005. We find evidence that Islamic banking development favors macroeconomic efficiency. We have support for a non-linear relation with efficiency for Islamic banking development, measured by credit or by deposits. Increasing Islamic banking development enhances efficiency until a certain point beyond which expansion of Islamic banking becomes detrimental for efficiency.

JEL Classifications: G21, O16, O47.

Keywords: Islamic finance, financial development, aggregate productivity, efficiency, economic growth.

ملخص

تقوم هذه الورقة ما إذا كان تطوير العمل المصرفي الإسلامي يؤثر على كفاءة الاقتصاد الكلي. نساهم اذا بتحليل العلاقة بين التمويل الإسلامي والنمو الاقتصادي. ونقوم ذلك من خلال تطبيق نهج المجالية العشوائية لتقدير الكفاءة الفنية على المستوى القطري لعينة من 70 بلدا. و نستخدم قاعدة بيانات فريدة من نوعها من ناحية جمعها، والتي تغطي المصارف الإسلامية في جميع أنحاء العالم خلال الفترة 2000-2005. نجد أدلة على أن تطوير الخدمات المصرفية الإسلامية تزيد من كفاءة الاقتصاد الكلي. ولدينا دعم لعلاقة غير خطية كفء لتطوير الخدمات المصرفية الإسلامية، وتقاس عن طريق الائتمان أو عن طريق الودائع. لكن زيادة تطوير الخدمات المصرفية الإسلامية يعزز الكفاءة حتى نقطة معينة ومن بعدها يصبح التوسع في العمل المصرفي الإسلامي ضارا للكفاءة.

1. Introduction

There was an impressive expansion of Islamic finance in recent years. Mohieldin (2012) observes that the total value of Islamic financial assets has risen from about $5 billion at the end of the 80s to about $1000 billion in 2010. Islamic banking represents the vast majority of these assets with total banking assets for a total value of $939 billion in 2010, with Islamic banks particularly active in Middle East countries and in Southeast Asia. However academic literature investigating the impact of this phenomenon remains impressively scarce. A few microeconomic studies have analyzed these consequences by analyzing the differences in behavior between Islamic banks and conventional banks.[1] But the question to know the macroeconomic impact of Islamic banking remains widely ignored.

A huge strand of literature has shown that the development of financial intermediaries would contribute to economic growth (e.g. Levine and Zervos 1998; Levine, Loayza and Beck 2000). We can then wonder if the development of Islamic banking also fosters economic growth, and more generally if this impact is more or less beneficial than the development of conventional banking. These questions have major policy implications, as evidence on this issue would give economic motives to favor or prevent the expansion of Islamic finance. Such issue is of interest for all countries concerned by the development of Islamic finance, but it has taken a particular importance in the recent times. Indeed, following the Arab Spring, several leaders have claimed their willingness to enhance the presence of Islamic finance in their country, with some even willing to replace their banking system by a fully Islamic one.[2]

The aim of this paper is hence to investigate the macroeconomic impact of Islamic banking development by analyzing the relation between this development and productivity estimated at the macroeconomic level. To our knowledge, this is the first paper providing empirical results on the role of Islamic finance for economic development. We thus provide a contribution on the "Islamic finance-growth nexus".

Islamic finance can be defined as finance that conforms to Islamic law (*Shari'ah*) derived from the Qur'an and other sources. Among principles to be respected under *Shari'ah* is the prohibition against charging interest. However this prohibition does not mean that all forms of return are prohibited for the provider of funds in a financial transaction. Instead, interest is replaced by the concept of profit-and-loss sharing according to which both parties in a financial transaction are expected to share in the returns from a project. Another important aspect of Islamic finance is the prohibition against contractual uncertainty which forces contract terms to be clearly defined and without ambiguity. Also, Islamic finance cannot be used to finance sinful activities such as gambling or conventional banking.

Instead of analyzing the role of Islamic banking on economic growth, we focus on productivity for two reasons. First, there is a consensus that productivity growth plays a greater role than factor accumulation in explaining cross-country growth differences (Easterly and Levine 2001; Caselli 2005). So we focus on productivity, as it is the key driver of cross-country differences in economic development. Second, as the development of Islamic banking is a recent phenomenon, we cannot yet analyze its long-term impact on economic growth.

[1] For instance Cihak and Hesse (2010) on financial stability, Srairi (2010, 2011) on bank efficiency or Weill (2011) on competition.

[2] Among others, the Chairman of the National Transitional Council of Libya, Mustafa Abdul-Jalil, has claimed in October 2011 that, "new banks would be established on banking principles which comply with Islam's bank on interest and speculation. Interest would be cancelled from any personal loan already taken out for less than 10,000 Libyan dinars", while the Tunisian Prime Minister Hamadi Jbeli declared in June 2012 that, "Tunisia is looking to become a regional center for Islamic finance".

Levine (2005) explains that financial development can favor productivity and growth as the financial system contributes to ease information, enforcement, and transactions costs in financing decisions and transactions. The financial system can reduce these costs in several ways. Islamic banking development can contribute the same way as conventional banking development to productivity and growth following these mechanisms. However it could also provide a greater contribution to macroeconomic productivity for two reasons among others.

First, the financial system has the function to produce information ex ante about possible investments. Financial intermediaries enhance productivity by this channel, as banks reduce the costs of evaluating investment projects before lending decisions. Therefore, they allow a better allocation of capital. As Islamic banks propose profit and loss sharing financing instruments, they have incentives to perform a greater evaluation of the investment projects they finance. For this reason, we can expect Islamic banks to provide an even greater contribution than conventional banks to the production of information ex ante and thus the optimal allocation of capital.

Second, the financial system has the function to pool savings and by doing so financial intermediaries can help improve productivity of firms by reducing the transaction costs associated with the mobilization of savings from different economic agents and by reducing information costs for the savers. Therefore, as some individuals in Muslim countries can be reluctant to deposit their savings in conventional banks for religious reasons, Islamic banking development can increase the participation of individuals in the formal banking system and thus enhance the pooling of savings.

However the positive impact of Islamic banking development should not be taken for granted. These mechanisms might be not strong enough to allow a beneficial role for Islamic banking relative to conventional banking. Moreover some counterarguments can also be advanced. One can notably observe that the financial system has also the function to monitor firms and to exert corporate governance. Thus, financial intermediaries put pressure on firm managers to perform and increase productivity. However this argument is notably based on the binding nature of debt: 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). This incentive scheme can be less efficient in the context of profit and loss sharing instruments proposed by Islamic banks. Indeed the replacement of interest payment obligations by a share of profits reduces the threat of bankruptcy for managers.

To investigate this issue, we use an original measure of total productivity, macroeconomic efficiency. That method comes from the microeconomic literature and has been applied at the macroeconomic level in a couple of papers.[3] The idea is the measurement of countries' relative distance to an estimated common production frontier. We estimate the frontier with the stochastic frontier approach following Méon and Weill (2010a,b) and Kuhry and Weill (2010) among others. Both these papers have investigated the impact of financial intermediary development on macroeconomic efficiency, and tend to show a positive impact.

Data on Islamic banking development comes from a unique database, "IFIRST" ("Islamic Finance Recording and Sizing Tool"). This unique database was built in collaboration with professionals in the industry. It provides credit and deposits of all active Islamic banks worldwide over the period 2000-2005. In comparison with other sources of data, e.g.

[3] Moroney and Lovell (1997) have written a seminal paper in which they measure macroeconomic efficiency for a set of planned and market economies. Adkins, Moommaw and Savides (2002), Méon, Sekkat and Weill (2009) and Méon and Weill (2010b) analyze the impact of different facets of institutions on efficiency.

Bankscope, our database is exhaustive and does not suffer from misclassification issues. We are then able to compute measures of Islamic banking development with the ratios of credit and of deposits of all Islamic banks to GDP by country and by year.

The rest of the article is structured as follows: Section 2 presents data; Section 3 describes the methodology; Section 4 develops the empirical results and Section 5 concludes. 2.

2. Data

We use two sets of data: measures of Islamic banking development and macroeconomic data. We describe them in turn.

2.1. Data on Islamic banking development

In spite of the expansion of Islamic finance, it is still difficult nowadays to find reliable data on the Islamic banking industry. The most widely used database in empirical studies on Islamic banking is Bankscope (e.g. Cihak and Hesse 2010; Srairi 2010; Weill 2011). This generalist database covers a large number of financial institutions all around the world. It provides a binary classification of banks as Islamic or not. However data from Bankscope database raises several concerns. First, the database is not exhaustive which makes it difficult to obtain the aggregate measures of Islamic banking development. Second, misclassification issues have been reported (e.g. Cihak and Hesse 2010). Bankscope database defines an Islamic bank as a member of the International Association of Islamic banks plus 20 non-member banks that are considered 'Islamic' by Fitch Ratings. Nonetheless the final list of Islamic banks includes some banks, which do not report any Islamic operation, and omits some internationally recognized Islamic banks.

In the absence of a reliable and comprehensive database, we have built our own database on Islamic financial institutions. To do so, we developed a data-collection methodology and built, in collaboration with professionals in the industry, what is to our knowledge the first comprehensive database on Islamic banks globally. The IFIRST, or 'Islamic Finance Recording and Sizing Tool', is an electronic database dedicated to Islamic finance, which currently covers the period 2000-2005.

The database was built in three steps. First, we established, using classification criteria, an exhaustive list of Islamic banks active globally in the banking segment per year and per country. The list includes full-fledge Shariah-compliant institutions, as well as the rarely covered Islamic windows of conventional banks. Indeed some conventional banks have set-up Shari'ah-compliant departments or subsidiaries, called Islamic windows. We regard Islamic windows as Islamic financial institutions in our database. Then, we collected, yearly, a series of information on each institution in the list, with monetary variables in both local currency and US dollars. Finally, using intra- and extrapolation methods for missing data, we computed aggregates on the available variables.

IFIRST defines an Islamic financial institution as a financial institution whose products and operations are subject to approval and monitoring regarding Shari'ah-compliance, by a Shari'ah board. When the responsibility of the Shari'ah board is limited to a part of the institution's operations, i.e. an Islamic window, only that particular segment of the institution is retained as Islamic. An Islamic window can be a separate legal entity or a department of an institution. In any case, the Shari'ah-compliance requires that the funds and operations be segregated from the rest of the activities of the bank. This rule allows clearly identifying the scope of Shari'ah-compliant activities.

To classify a financial institution, IFIRST uses two criteria. First, the institution must be a 'deposit-money bank' following the IMF definition, i.e. a financial institution with liabilities in the form of deposits transferable by check or otherwise usable in making payments. Second, the main target client base of the financial institution must be individuals and not

corporations nor institutional investors. For each Islamic bank in our list, IFIRST collects accounting and operational information from a variety of sources, depending on availability. In order of priority, the following information sources are used.

The most reliable information, the primary source, is the one officially issued by the institution. This includes annual reports (found either through the website or sent by the institution upon request), the bank's website information, or press releases issued by the bank. Then, we resort to information from sources other than the institution itself. This includes reports from regulatory authorities, press clippings, or the CIBAFI Islamic finance directories. When no information is found in any of the above-mentioned sources, IFIRST uses a gap-filling method, based on data on comparable Islamic banks in the country or region. It must be stressed that primary source data cover more than 90% of the total size of the sector.

Monetary data in local currency are converted in US dollars using market exchange rates from the International Monetary Fund. Balance sheet elements are converted using the applicable exchange rate at the accounts closure date, whereas average exchange rates over the period are applied to elements of the profit and loss statements. IFIRST database includes notably the type of institution (whether it is a full-fledged entity or an Islamic window of a conventional bank) and accounting statement items for each bank.

Overall IFIRST database is a considerable improvement upon current datasets through the use of a strict methodology, which involves consistent definitions and criteria, an appropriate treatment of Islamic windows and a clear focus on a given segment of the banking industry (making institutions more comparable in terms of activities). It also provides an exhaustive coverage, which allows computing country and world totals, and a clear bottom-up construction of geographic aggregates (providing a disaggregation up to the institution level). Finally, the contents have been discussed and validated by a number of industry experts.

Using IFIRST, we are able to construct measures of the level of development of Islamic banking across countries. Our key variable is the ratio of Shari'ah compliant private credit to GDP to measure the development of Islamic banking in the overall banking system (*Islamic Credit to GDP*). Following Beck, Demirgüc-Kunt and Levine (2000), private credit is the value of credits by financial intermediaries to the private sector. Our variable is hence obtained by dividing the total Shari'ah-compliant private credit in US dollars (available in IFIRST) by GDP obtained from the World Development Indicators for each country and for each year.

We also consider a measure for the development of conventional banking (*Conventional Credit to GDP*), and a measure for the development of full banking (*Total Credit to GDP*) defined by the sum of both other ratios. To construct these variables, we combine data from IFIRST and from the Financial Structure Database (Beck, Demirgüc-Kunt and Levine 2000). Total credit is provided in this latter database and expressed as a ratio to GDP. We multiply the ratios by total GDP, using data from World Development Indicators, to obtain total credit and residually conventional credit.

We will use an alternative measure to consider the level of development of Islamic banking by taking into account deposits. This is in line with the works on the "finance-growth nexus" (e.g. Levine and Zervos 1998) focusing on the measure of credit in the link between financial development and growth, but considering also for robustness tests one measure considering liquid liabilities of banks. This second indicator is obtained by dividing the total Shari'ah-compliant banking deposits in US dollars (available in IFIRST) by GDP (*Islamic Deposits to GDP*) for each country and for each year. When considering deposits, we also

consider a measure for the development of conventional banking (*Conventional Deposits to GDP*), and a measure for the development of full banking (*Total Deposits to GDP*) defined by the sum of both other ratios.

2.2. Macroeconomic data

To estimate the production frontier, we need data on real output per worker, labor force, and real capital. Output per worker and labor force are taken from the World Development Indicators from the World Bank. Real capital data is computed by using data from Easterly and Levine (2001) on capital stock and data on aggregate investment from World Development Indicators. We follow the 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. In line with Easterly and Levine (2001), we consider a depreciation rate of 7%.

We use two control variables in the estimations: inflation, and latitude. There is no standard specification for the set of variables explaining macroeconomic efficiency in the literature. The choice of this set of control variables is motivated by three reasons. First, they have been used in former studies on macroeconomic efficiency.[4] Second, they are available for all countries for which we have all data to estimate efficiency and for which Islamic finance is of importance, meaning that their selection does not force us to reduce the sample of countries. Third, they do not have a high correlation with banking development variables. *Inflation* is defined by the logarithm of the inflation rate added to unity. This transformation is common in the literature as the inflation rate can take extreme values. *Latitude* is defined as the absolute value of the latitude of the country. Both variables come from World Development Indicators.

We consider the years 2000 to 2005 as we have data for Islamic banking in IFIRST database for these years. We select countries located outside Europe and Northern America. This choice is motivated by two reasons. First, we investigate the role of Islamic banking development on efficiency. This question makes a particular sense for countries from the Middle East and Southeastern Asia. So we need to focus on these geographic regions to have comparable countries. Second, we need to estimate macroeconomic efficiency, which is a relative measure of productivity. For this reason, a greater number of comparable observations increase the quality of the efficiency measures. For that reason, we want to increase the number of countries that can be compared. We are also limited by data limitations and most notably for physical capital. All in all, our final sample covers 70 countries.[5] Summary statistics are presented in Table 1.

3. Methodology

This section is devoted to the presentation of the technique used to examine the relation between Islamic banking development and macroeconomic efficiency. We first explain how we measure macroeconomic efficiency. We then present how we study its relation with development of Islamic banking.

[4] Kuhry and Weill (2010) used inflation is as a control variable , while latitude is considered in Méon and Weill (2010a,b) and Méon, Sekkat and Weill (2009).

[5] Those countries are: Algeria, Argentina, Bahrain, Bangladesh, Belize, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Cameroon, Chad, Chile, Colombia, Congo Dem. Rep., Costa Rica, Cote d'Ivoire, Cyprus, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Guyana, Honduras, India, Indonesia, Iran, Israel, Jordan, Kenya, Kuwait, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Nepal, Niger, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Rwanda, Saudi Arabia, Senegal, Singapore, South Africa, South Korea, Sri Lanka, Sudan, Swaziland, Syria, Thailand, Togo, Trinidad and Tobago, Tunisia, Uganda, Uruguay, Venezuela, Zambia.

3.1. Measuring efficiency

Our first task is to measure macroeconomic efficiency. We focus specifically 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 former applications at the macroeconomic level of Adkins, Moomaw and Savvides (2002) and Méon and Weill (2010a,b) among others. Aigner, Lovell and Schmidt (1977) initially proposed the stochastic frontier approach. The basic model assumes that observed production deviates from the optimal production by an error term, which, is the sum of a random disturbance and an inefficiency term. The random disturbance is a two-sided component, reflecting luck or measurement errors.

An alternative technique based on linear programming tools, DEA (Data Envelopment Analysis), could also be applied to estimate the production frontier. However, when comparing efficiency scores obtained with the stochastic frontier approach and DEA at the macroeconomic level, Weill (2006) has shown that efficiency measures are robust to the choice of the frontier technique.

Once each country's inefficiency is assessed, its relationship with Islamic banking development is measured. A natural way to do this would be to resort to a two-stage approach. That approach would consist in estimating efficiency scores in a first stage, then in regressing them on the set of explanatory variables including Islamic banking development in a second stage. However this approach presents two important econometric problems. First, it assumes that the efficiency terms are identically distributed in the estimation of the stochastic frontier model of the first stage, while in the second stage this assumption is contradicted by the fact that the regression of the efficiency terms on the explanatory variables suggests that the efficiency terms are not identically distributed. Second, the explanatory variables must be assumed uncorrelated with the arguments of the production frontier, or else the maximum likelihood estimates of the parameters of the production frontier function would be biased, because of the omission of the explanatory variables in the first stage. But then, the estimated efficiency terms that are explained in the second stage are biased estimates, as they are estimated relative to a biased representation of the production frontier. Hence we use the "one-stage procedure" developed by Battese and Coelli (1995), which solves those econometric problems. 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 macroeconomic level, such as Méon and Weill (2010a,b).

The estimated stochastic frontier model thus includes two equations. The first one is the specification of the production frontier. A Cobb-Douglas functional form is assumed, following its common specification in the empirical works on growth and macroeconomic efficiency (e.g. Adkins, Moomaw and Savvides 2002; Méon and Weill 2010a). We adopt constant returns-to-scale because, as Moroney and Lovell (1997, 1086) put it: "at the economy-wide level, constant returns-to-scale is virtually compelling." The production frontier is then as follows:

$$ln\,(Y/L)_{it} = \alpha_0 + \alpha_1\, ln\,(K/L)_{it} + \Sigma\, \beta_t D_t + v_{it} - u_{it} \qquad (1)$$

Where i index countries and t years of observation. (Y/L), (K/L) are respectively output per worker, and capital per worker. The frontier includes the dummy variables D_t for each year to control for year effects. 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. Let $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u / (\sigma_u^2 + \sigma_v^2)$. A higher value for σ means a greater gap between observed and actual productions, while γ measures the relative role of inefficiency and the random disturbance in pushing observed production below the frontier.

The second equation specifies inefficiency 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.

Equations (1) and (2) underline an additional advantage of efficiency scores obtained with stochastic frontier approach with respect to standard productivity measures. Namely, whereas total factor productivity measures performance by the whole difference between a country's actual and estimated productions, the stochastic frontier approach allows splitting the distance to the frontier in an inefficiency term and a random error, taking exogenous events into account.

3.2. Testing the hypotheses

Once the general method that allows measuring and explaining macroeconomic efficiency has been developed, testing hypotheses requires listing the variables that determine efficiency, that is to specify the arguments of vector z_{it}. The aim of our paper concerns the link between development of Islamic banking and efficiency. We then consider several sets of variables related to banking development to examine this relation.

The first specification examines the influence of banking development as a whole on efficiency. Here we include only *Total Credit to GDP*, so that we can check how banking development, whatever the type of banking, influences productivity. This provides a benchmark to compare the influence of Islamic banking development. The second specification concerns the association between Islamic banking development and efficiency. We include *Islamic Credit to GDP* as the only variable for financial development in the set of variables. This gives a first glance on the impact of Islamic banking development.

The third specification simultaneously includes the variables for each type of banking development: *Islamic Credit to GDP*, and *Conventional Credit to GDP*. We are then able to compare their effect on macroeconomic efficiency. Finally, the fourth specification has a set of three banking development variables by adding to the former one the interaction term between both types of banking development. This specification allows investigating the existence of substitution or complementarity between Islamic banking and conventional banking. A negative influence of the interaction term on efficiency in addition to the positive coefficient of banking development, for any of both types of banking, would mean that this banking development would be beneficial for efficiency; but that the development of the other form of banking would reduce this gain. In other words, there would be some substitution in the positive effects of banking development on efficiency between both forms of banking.

Reversely a positive influence of the interaction term on efficiency would mean that both forms of banking development have a greater beneficial impact on efficiency when the other one is more developed. There would hence be a complementarity between both forms of banking development.

Alternatively we proceed to the four same specifications for deposits to test the robustness of our results. As mentioned above, we focus on credit in line with former literature on the

finance-growth nexus. But we also consider deposits to have further evidence on the association between Islamic banking development and productivity.

4. Results

This section presents the main results of our estimations. We first provide the main results. We then turn to additional estimations by considering non-linear specifications.

4.1. Main estimations

We display the results of our estimations respectively with credit and with deposits in Tables 2 and 3. The upper-half of each table presents the coefficients of the production frontier, while the lower half is devoted to the determinants of inefficiency. As inefficiency is explained in the second equation, a minus sign indicates that a rise in the explanatory variable implies an increase in efficiency.

The upper-part of the tables reveals that the coefficient for capital per worker is always significant and is rather stable. The magnitude of the coefficient is of the same order than what is found on other papers. We observe that the parameter σ is statistically different from zero, which indicates that the stochastic production frontier is appropriate. Regarding the lower part of the tables, we first examine the results for the estimations with credit variables. Several conclusions emerge.

First, we observe that Total Credit to GDP has a positive impact on efficiency. It has a significant and negative coefficient, which means that it is associated with less inefficiency. Thus the importance of credit constitutes a positive factor for productivity. This finding is in line with former papers from Méon and Weill (2010) or Kuhry and Weill (2010). Both works conclude that there is a positive impact of the ratio of private credit to GDP, which is obtained from the Financial Structure database on macroeconomic efficiency. In a broader perspective, it also accords with the conclusions from Levine and Zervos (1998) and Levine, Loayza and Beck (2000) on the positive relation between credit and growth.

Second, we find some evidence of a beneficial impact of Islamic banking development on efficiency. In column 2, we consider Islamic Credit to GDP and Conventional Credit to GDP for banking development variables. We then observe no significant coefficient for Islamic Credit to GDP. However, in column 3, we add the interaction term between Islamic Credit to GDP and Conventional Credit to GDP. In that specification, we have significant and negative coefficients for both banking development variables, while the interaction term is significant and positive. Hence, Islamic Credit to GDP would exert a positive role on efficiency but this role would be weakened by the rise of Conventional Credit to GDP. The same conclusion also stands for Conventional Credit to GDP. In other words, there would be a substitution between Islamic banking development and conventional banking development in terms of positive effects for efficiency. This conclusion is of particular interest. It can be explained by the fact that greater development of one form of banking does not necessarily favor the other one and might rather contribute to replacing it.

Turning to control variables, we observe that results for both of them are very robust across the different specifications. Latitude is associated with more inefficiency as revealed by the positive coefficient it exhibits. This finding is not in line with intuition as it means that inefficiency increases as distance from the equator increases It also differs with what was observed for instance by Méon and Weill (2010a). However it must be stressed that our sample only includes countries located outside Europe and North America with a large concentration of countries in the southern hemisphere. So this major difference in the sample of countries might influence this result. We also find a negative coefficient for the inflation rate, which might again look at first glance at odds with the expectation. Nonetheless here again we need to stress that our sample of countries has a different

composition than the one generally used for analyzing efficiency. As a consequence, the average relation between inflation and efficiency is likely to be different.

We turn to the results with variables for deposits. First, when considering banking development as a whole, we observe a difference in the findings as we do not observe a significant coefficient for Total Deposits to GDP. Thus, banking development measured by the importance of deposits does not play a role on efficiency. This finding does not contradict former literature, which also suggests that the importance of credit plays a bigger role to favor economic development than the importance of deposits. Our results are reminiscent of those obtained by Méon and Weill (2010a). Those authors examine the impact of financial intermediary development on macroeconomic efficiency. While they show that the ratio of private credit to GDP is positively associated with efficiency, they observe no significant impact for the ratio of liquid liabilities of financial intermediaries to GDP, which is a measure closely related to the importance of bank deposits.

Second, when considering banking development by distinguishing both forms, we find again support for the positive influence of Islamic banking development on efficiency. Islamic Deposits to GDP is negative and significant, meaning that it is associated with lower inefficiency, in both specifications without or without the interaction term between both banking development variables.

In comparison with our results for credit, we do not find any significant coefficient for the interaction between both variables, which does not corroborate our results observed for credit on some substitution between both forms of banking development. It is also of interest to observe that Conventional Deposits to GDP is significant and positive. We also observe the same findings for control variables when we consider banking development variables for deposits rather than for credit.

All in all, our results tend to support a positive influence of Islamic banking development on efficiency. We can, however, wonder if the relation is linear between the different facets of banking development and efficiency. The next subsection investigates this possibility.

4.2. Non-linear estimations

We now consider the possible non-linearity in the relation between banking development and efficiency. To do so, we add squared terms for banking development variables in the specification of the set of variables.

In accordance with our main estimations, we consider two specifications of banking development variables to provide a broad view of the results. We first consider total banking development and its squared term to analyze the existence of a non-linear relation between banking development as a whole and efficiency. We then consider Islamic and conventional banking development with their variables and their squared terms.

We perform these estimations for credit and for deposits with results respectively displayed in Tables 4 and 5. A first remark of particular interest is that findings are exactly the same for the sign and the significance of coefficients when considering credit or deposits. We then make comments applying for both forms of banking development. The results can be summarized as follows.

We find evidence of non-linearity between total banking development and efficiency. In the first specification, we observe that the coefficient of the linear term for total banking development is significantly positive while the coefficient for the squared term is significantly negative. As inefficiency is explained in the estimations, it means that we show the existence of a U-shaped relation between total banking development and efficiency.

Banking development as a whole contributes to efficiency but only until a certain limit above which it hampers efficiency.

We also find evidence on non-linearity between Islamic banking development and efficiency but with opposite conclusions than for total banking development. In the second specification, we indeed show that the coefficient for the linear term is significant and negative while the coefficient for the squared term is significant and positive for Islamic banking development.

Thus, we find a reverse U-shaped relation between Islamic banking development and efficiency. In other words, we observe that Islamic banking development would favor efficiency as long as it does not exceed a certain threshold above, which it contributes to inefficiency.

The conclusion is the opposing one for conventional banking development, as the coefficient for the linear term is significantly positive while the coefficient for the squared term is significantly negative, which supports the existence of a U-shaped relation between conventional banking development and efficiency.

To have a more precise idea of the relation between Islamic banking development and efficiency, we measure the maximum of the quadratic function and compare it with the distribution of the data. The maximum respectively equals to 35.19% for *Islamic Credit to GDP* and 32.33% for *Islamic Deposits to GDP*. The distribution of the variable *Islamic Credit to GDP* shows us that this value is only exceeded by one country-year in our full sample (Iran for the last year of the period of our investigation), while no observation is beyond this maximum for the variable *Islamic Deposits to GDP*. So the relation between Islamic banking development and efficiency is significantly positive for all the observations in our sample. But the expansion of Islamic finance can make some countries exceed the values beyond which this form of finance has detrimental effects on efficiency.

Hence we obtain some evidence on the non-linear relation between Islamic banking development and efficiency. We cannot directly compare our results with other studies, as no paper to our knowledge has ever investigated the non-linear relation between banking development and macroeconomic efficiency.[6] However literature provides hints that this relation might not be linear, as evidence supports the view of the role of the level of economic development on the sign of this relation. Rioja and Valev (2004) on productivity growth and Méon and Weill (2010a) on macroeconomic efficiency provide evidence that the relation with financial intermediary development is conditional to the level of economic development.

5. Conclusion

In this paper, we have examined the relation between the development of Islamic banking and macroeconomic efficiency. To do so, we have estimated a stochastic frontier model on emerging and developing countries so that we have a large sample of comparable countries. We use exhaustive data on Islamic banking activities in credit and in deposits.

Overall we find evidence that Islamic banking development favors efficiency. Our results tend to show that a non-linear relation would exist between Islamic banking development and efficiency. Islamic banking would only favor efficiency as long as it does not exceed a certain level of development. The point beyond which Islamic banking development would have a detrimental effect on efficiency is likely to be exceeded in several countries, as it was

[6] When examining the relation between financial intermediary development and macroeconomic efficiency on a panel of countries from all continents, Kuhry and Weill (2010) and Méon and Weill (2010a) do not test the possibility of a non-linear relation.

close to the maximum of the distribution of our data for our period of investigation. These results are observed when Islamic banking development is measured through the importance of credit or deposits.

However we also find no clear evidence that conventional banking development would be positively associated with efficiency. A U-shaped form represents the relation between conventional banking development and efficiency, according to which conventional banking would only favor efficiency if it exceeds a certain level.

Our conclusions are of particular importance for the Islamic banking industry as we provide the first empirical investigation of the "Islamic finance-growth nexus" to our knowledge. All in all, they provide two main implications for the Islamic banking industry. On the negative side, there is no clear evidence that Islamic banking development would be a driving force of growth through productivity. This is a major lesson for policymakers willing to favor the expansion of Islamic finance. From an economic perspective, our findings suggest that such measures of economic policy might have limited influence on productivity. On the positive side, no evidence supports the view that conventional banking would be more beneficial than Islamic banking. So Islamic banking would not be an obstacle to aggregate productivity in comparison to conventional banking. In other words, our study does not provide elements to favor expansion of Islamic banking, nor to prefer supporting expansion of conventional banking.

However our study does not pretend at all to provide a definitive view on the relation between Islamic finance and growth. It opens avenues for further research by providing the first brick to the analysis of the "Islamic finance-growth nexus".

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Table 1: Summary Statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Log (Y/L)	7.696	1.331	4.002	10.582
Log (K/L)	8.694	1.858	5.691	21.205
Total Credit to GDP	36.014	34.635	0.550	160.870
Islamic Credit to GDP	1.881	5.820	0	36.150
Conventional Credit to GDP	34.133	34.079	0.550	160.870
Total Deposits to GDP	37.495	29.966	1.660	169.730
Islamic Deposits to GDP	2.001	5.771	0	31.710
Conventional Deposits to GDP	35.730	29.071	1.660	169.730
Inflation	0.030	0.032	-0.065	0.180
Latitude	0.191	0.123	0	0.511

Notes: The table provides the descriptive statistics for variables used in the estimations. Log(Y/L), Log(K/L), are respectively logarithms of output per worker, and physical capital per worker. All banking development variables are in percentage. Inflation is the logarithm of the inflation rate in percentage plus unity.

Table 2: Main Estimations with Credit

	(1)	(2)	(3)
Intercept	0.802***	0.808***	0.833***
	(3.85)	(38.58)	(40.79)
Log (K/L)	0.869***	0.867***	0.865***
	(39.47)	(41.13)	(41.63)
Year dummies	Yes	Yes	Yes
Intercept	-33.427***	-33.247***	-33.295***
	(17.02)	(77.55)	(24.99)
Inflation	-19.121***	-19.265***	-17.103***
	(11.84)	(57.44)	(15.60)
Latitude	36.962***	34.356***	35.642***
	(25.33)	(14.99)	(22.96)
Islamic Credit to GDP	-	-0.063	-0.367***
		(1.48)	(15.28)
Conventional Credit to GDP	-	-0.030	-0.031***
		(1.61)	(6.30)
Total Credit to GDP	-0.032***	-	-
	(3.00)		
(Islamic Credit to GDP) ×	-	-	0.004***
(Conventional Credit to GDP)			(10.50)
σ^2	20.172***	20.006***	20.237***
	(24.95)	(9.71)	(32.94)
γ	0.994***	0.993***	0.993***
	(1424.21)	(733.32)	(1252.83)
Log–likelihood	-434.307	-431.701	-429.344
N	406	406	406

Notes: The estimations are done with the one-step stochastic frontier model from Battese and Coelli (1995). 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 3: Main Estimations with Deposits

	(1)	(2)	(3)
Intercept	0.771***	0.725***	0.743***
	(3.69)	(3.62)	(3.83)
Log (K/L)	0.872***	0.880***	0.874***
	(39.99)	(40.89)	(41.99)
Year dummies	Yes	Yes	Yes
Intercept	-38.454***	-35.460***	-37.350***
	(29.12)	(5.73)	(23.55)
Inflation	-8.036***	-9.608***	-9.153**
	(4.04)	(4.31)	(2.16)
Latitude	32.268***	30.858***	26.910***
	(28.15)	(6.85)	(21.00)
Islamic Deposits to GDP	-	-0.360***	-0.320***
		(4.70)	(12.44)
Conventional Deposits to GDP	-	0.066***	0.057***
		(3.03)	(2.77)
Total Deposits to GDP	-0.015	-	-
	(1.21)		
(Islamic Deposits to GDP) ×	-	-	0.192^{E}-3
(Conventional Deposits to GDP)			(0.29)
σ^2	23.498***	20.001***	21.937***
	(23.59)	(7.43)	(27.24)
γ	0.994***	0.993***	0.993***
	(1842.76)	(819.52)	(1720.78)
Log-likelihood	-431.613	-430.371	-429.642
N	406	406	406

Notes: The estimations are done with the one-step stochastic frontier model from Battese and Coelli (1995). 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: Estimations for the Non-Linear Relation with Credit

	(1)	(2)
Intercept	0.859***	0.770***
	(5.21)	(3.92)
Log (K/L)	0.863***	0.871***
	(47.17)	(42.28)
Year dummies	Yes	Yes
Intercept	–31.923***	–30.181***
	(21.95)	(10.12)
Inflation	–17.443***	–12.749***
	(12.38)	(5.80)
Latitude	26.237***	26.257***
	(31.31)	(16.03)
Islamic Credit to GDP	–	–0.563***
		(7.85)
(Islamic Credit to GDP)²	–	0.008***
		(2.60)
Conventional Credit to GDP	–	0.289***
		(8.08)
(Conventional Credit to GDP)²	–	–0.002***
		(12.75)
Total Credit to GDP	0.200***	–
	(12.14)	
(Total Credit to GDP)²	–0.002***	–
	(18.63)	
σ^2	16.994***	15.094***
	(22.77)	(12.93)
γ	0.992***	0.991***
	(1072.51)	(893.39)
Log–likelihood	–431.784	–426.101
N	406	406

Notes: The estimations are done with the one-step stochastic frontier model from Battese and Coelli (1995). 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 5: Estimations for the Non-Linear Relation with Deposits

	(1)	(2)
Intercept	0.680***	0.660***
	(3.25)	(3.66)
Log (K/L)	0.882***	0.882***
	(39.61)	(48.09)
Year dummies	Yes	Yes
Intercept	–33.929***	–29.634***
	(16.33)	(33.34)
Inflation	–0.832	–4.665***
	(0.30)	(4.58)
Latitude	16.739***	18.582***
	(4.12)	(11.67)
Islamic Deposits to GDP	–	–0.873***
		(5.09)
(Islamic Deposits to GDP)²	–	0.027***
		(3.60)
Conventional Deposits to GDP	–	0.356***
		(22.72)
(Conventional Deposits to GDP)²	–	–0.002
		(2.62)
Total Deposits to GDP	0.349***	–
	(5.32)	
(Total Deposits to GDP)²	–0.002***	–
	(6.68)	
σ^2	16.367***	12.863***
	(9.24)	(25.19)
γ	0.991***	0.989***
	(719.46)	(751.44)
Log–likelihood	–425.470	–419.389
N	406	406

Notes: The estimations are done with the one-step stochastic frontier model from Battese and Coelli (1995). 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.