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Does Islamic Banking Development Favour Macroeconomic Efficiency?

Evidence on the Islamic Finance – Growth Nexus[+]

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Abstract

This study evaluates whether the development of Islamic banking influences macroeconomic efficiency. Thus, we contribute to the analysis of the relation between Islamic finance and economic growth 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 that covers Islamic banks worldwide over the period 2000-2005, finding evidence that Islamic banking development favours macroeconomic efficiency. Furthermore, we have support for a non-linear relation with efficiency for Islamic banking development, which is measured by credit or by deposits. Although increasing the development of Islamic banking enhances efficiency up to a certain point, the expansion of Islamic banking becomes detrimental for efficiency beyond this point.

JEL Codes: G21, O16, O47.
Keywords: Islamic finance, financial development, aggregate productivity, efficiency, economic growth.

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1. Introduction

There has been an impressive expansion of Islamic finance in recent years. Mohieldin (2012) observes that the total value of Islamic financial assets has risen from approximately $5 billion at the end of the 1980s to approximately $1000 billion in 2010. Islamic banking represents the vast majority of these assets with banking assets that had a total value of $939 billion in 2010; in addition, Islamic banks are particularly active in Middle Eastern countries and in Southeast Asia. However, the academic literature that investigates the impacts of this phenomenon remains impressively scarce, although a few microeconomic studies have analysed these consequences by analysing the differences in behaviour between Islamic banks and conventional banks.[1] Nevertheless, the question regarding the macroeconomic impact of Islamic banking remains widely ignored.

A huge strand of the literature has shown that the development of financial intermediaries contributes to economic growth (for example Levine and Zervos, 1998; Levine, Loayza and Beck, 2000). Thus, we wonder if the development of Islamic banking also fosters economic growth, and more generally, if the impact of Islamic banking 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 favour or prevent the expansion of Islamic finance; such issues are of interest for all of the countries that are concerned by the development of Islamic finance, but they have assumed special importance in recent years. Indeed, following the Arab Spring, several leaders have proclaimed their willingness to enhance the presence of Islamic finance in their country, and some of these leaders are even willing to replace their banking system with a fully Islamic one.[2]

Hence, the goal of this study is to investigate the macroeconomic impact of Islamic banking development by analysing the relation between this development and productivity that is estimated at the macroeconomic level. To our knowledge, this is the

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

[2] Among others, Chairman Mustafa Abdul-Jalil of the National Transitional Council of Libya claimed in October 2011 that 'new banks would be established on banking principles which comply with Islam's ban 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'.

first paper that provides empirical results on the role of Islamic finance in economic development. Thus, we provide a contribution to the 'Islamic finance-growth nexus'.

Islamic finance can be defined as finance that conforms to Islamic law (*Shariah*), which is derived from the Qur'an and other sources. Among the principles to be respected under *Shariah* 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 with the concept of profit-and-loss sharing, which implies that 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 requires contract terms to be defined clearly and without ambiguity. Additionally, Islamic finance cannot be used to finance activities that Islam considers sinful, such as gambling or conventional banking.

Instead of analysing 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 countries' growth differences (Easterly and Levine, 2001; Caselli, 2005). Hence, we focus on productivity, which is the key driver of countries' differences with respect to economic development. Second, as the development of Islamic banking is a recent phenomenon, we cannot yet analyse its long-term impact on economic growth.

Levine (2005) explains that financial development can favour productivity and growth as the financial system contributes to the available information, the enforcement, and the transactions costs of financing decisions and transactions. The financial system can reduce these costs in several ways. Furthermore, the development of Islamic banking can contribute to productivity and growth in the same way as the development of conventional banking by following these mechanisms. However, the development of Islamic banking could also provide a greater contribution to macroeconomic productivity for two principal reasons, which are explained below.

First, the financial system has the function of producing information ex ante about possible investments. Banks enhance productivity by using this information, as they reduce the costs of evaluating investment projects before they make lending decisions. Therefore, banks allow for a better allocation of capital. Inasmuch as Islamic banks

propose profit–and-loss-sharing financial instruments, they have strong 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, to the optimal allocation of capital.

Second, the financial system has the function of pooling savings, and therefore, financial intermediaries can help improve the productivity of firms by reducing the transaction costs that are associated with the mobilisation of savings from different economic agents and by reducing the information costs for the savers. Therefore, as some individuals in Muslim countries are reluctant to deposit their savings in conventional banks for religious reasons, the development of Islamic banking can increase the local population's participation in the formal banking system, and therefore, enhance the pooling of savings.

However, the positive impact of Islamic banking development should not be taken for granted, as these mechanisms may not be sufficiently strong to allow a beneficial role for Islamic banking relative to conventional banking. Moreover, some counterarguments can be advanced. For example, one can observe that the financial system has the function of monitoring firms and exerting corporate governance. Thus, financial intermediaries place pressure on firm managers to perform and increase productivity. However, this argument is based on the binding nature of debt: debt implies interest-payment obligations that must be satisfied by managers, who are 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 the profit-and-loss-sharing instruments that are proposed by Islamic banks, as the replacement of interest-payment obligations by a share of profits reduces the threat of bankruptcy for managers.

To examine this issue, we use an original measure of total productivity, namely, macroeconomic efficiency. Our method comes from the microeconomics literature and has been applied at the macroeconomic level in a few studies.[3] The idea is to measure countries' relative distance from an estimated common production frontier. We estimate

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

this frontier with the stochastic frontier approach by following Méon and Weill (2010a,b) and Kuhry and Weill (2010), among others; both of these studies have investigated the impact of financial intermediary development on macroeconomic efficiency and tend to show a positive impact.

The data on Islamic banking development come from a unique database, which is known as the 'IFIRST' (the 'Islamic Finance Recording and Sizing Tool'). This database was built in collaboration with industry professionals, and it provides the credit and deposits of all of the active Islamic banks worldwide over the period 2000-2005. In comparison with other sources of data (for example Bankscope), our database is exhaustive and does not suffer from misclassification issues. Thus, we are able to compute the measures of Islamic banking development with the ratios of credit and of the deposits of all Islamic banks to the local GDP by country and by year.

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

2. Data

We use two sets of data: measures of the development of Islamic banking and macroeconomic data. We describe these datasets in that order.

2.1. Data on Islamic banking development

Despite the expansion of Islamic finance, it is still difficult to find reliable data on the Islamic banking industry. The most widely used database in empirical studies on Islamic banking is Bankscope (for example Cihak and Hesse, 2010; Srairi, 2010; Weill, 2011). This generalist database covers a large number of financial institutions around the world and provides a binary classification of banks as either Islamic or not Islamic. However, data from the Bankscope database raise several concerns. First, the database is not exhaustive, making it difficult to obtain aggregate measures of Islamic banking

development. Second, misclassification issues have been reported (for example Cihak and Hesse, 2010). The Bankscope database defines an Islamic bank as either a member of the International Association of Islamic banks or one of the 20 non-member banks that are considered 'Islamic' by FitchRatings. Nonetheless, the final list of Islamic banks includes certain banks that do not report any Islamic operation and omits certain internationally recognised Islamic banks.

In the absence of a reliable and comprehensive database, we have built our database on Islamic financial institutions. To accomplish this feat, we developed a data-collection methodology and collaborated with professionals in the industry to build (to our knowledge) the first comprehensive global database on Islamic banks. The IFIRST, or 'Islamic Finance Recording and Sizing Tool', is an electronic database that is dedicated to Islamic finance that currently covers the period 2000-2005.

The database is built in three steps. We first use classification criteria to establish an exhaustive list of Islamic banks that are globally active in the banking sector per year and per country. This list includes both completely Shariah-compliant institutions and the rarely covered Islamic windows of conventional banks, as certain conventional banks have set up Shariah-compliant departments or subsidiaries that are referred to as Islamic windows. We regard Islamic windows as Islamic financial institutions in our database. Then, we collect an annually updated series of information on each institution in the list, which includes monetary variables in both the local currency and US dollars. Lastly, using intrapolation and extrapolation methods to determine the missing data, we compute 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 their Shariah compliance by a Shariah board. When the responsibility of the Shariah board is limited to a part of the institution's operations, that is an Islamic window, only that particular segment of the institution is considered to be Islamic. While an Islamic window can be a separate legal entity or a department of an institution, Shariah compliance requires that the Islamic funds and operations are segregated from the other the activities of the bank. This rule allows for us to clearly identify the scope of Shariah-compliant activities.

To classify a financial institution, IFIRST uses two criteria. First, the institution must be a 'deposit-money bank' according to the IMF definition, that is a financial institution with liabilities in the form of deposits that are transferable by check or otherwise usable in making payments. Second, the main client base of the financial institution must be individuals and neither corporations nor institutional investors. For each Islamic bank on our list, IFIRST collects accounting and operational information from a variety of sources, which depends on the information's availability. In order of priority, the following information sources are used.

The most reliable information is the data that are officially issued by the institutions themselves, which include annual reports (these reports were either found through the website or sent by the institution upon request), the banks' website information, and press releases by the banks. We then resort to information from other sources, such as reports from regulatory authorities, press clippings, and the CIBAFI Islamic-finance directories. When no information is found in any of these sources, IFIRST uses a gap-filling method that is based on data from 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 currencies are converted into US dollars using the market exchange rates from the International Monetary Fund. In addition, 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. The IFIRST database includes the type of institution (namely, whether it is a full-edge entity or an Islamic window of a conventional bank) and the accounting-statement items for each bank.

Overall, the IFIRST database is a considerable improvement upon the current datasets because of its use of a strict methodology that 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 their activities). In addition, this database provides exhaustive coverage, allowing for one to compute country and world totals, and a clear bottom-up construction of the relevant

geographic aggregates (which provides disaggregation up to the institution level). Lastly, 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 Shariah-compliant private credit to GDP, which measures the development of Islamic banking in the overall banking system (*Islamic Credit to GDP*). Following Beck, Demirgüc-Kunt and Levine (2000), private credit is defined as the value of the credits that are given by financial intermediaries to the private sector. Hence, our variable is obtained by dividing the total Shariah-compliant private credit in US dollars (available in IFIRST) by the GDP, which is obtained from the World Development Indicators, for each country and for each year.

Furthermore, we consider both a measure for the development of conventional banking (*Conventional Credit to GDP*) and a measure for the development of both of the studied types of banking (*Total Credit to GDP*), which is defined by the sum of the other two ratios. To construct these variables, we combine the data from IFIRST and the data 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 the total GDP using data from the World Development Indicators to obtain the total credit and the residually conventional credit.

We will use an alternative measure to consider the level of development of Islamic banking by taking deposits into account; this practice is in line with the works on the 'finance-growth nexus' (for example Levine and Zervos, 1998), which focus on the measure of credit in the link between financial development and growth, but also test one measure that considers the liquid liabilities of banks to ensure robustness. This second indicator is obtained by dividing the total Shariah-compliant banking deposits in US dollars (available in IFIRST) by the GDP (*Islamic Deposits to GDP*) for each country and for each year. In addition, when we consider deposits, we use a measure for the development of conventional banking (*Conventional Deposits to GDP*) and a measure for the development of both of the studied types of banking (*Total Deposits to GDP*) that is defined by the sum of the other two ratios.

2.2. The macroeconomic data

To estimate the production frontier, we need data on the actual output per worker, the labour force, and real capital. The output per worker and the labour force are taken from the World Development Indicators of the World Bank. Furthermore, the real capital data are computed using data from Easterly and Levine (2001) on capital stock and data on aggregate investment from the World Development Indicators. We follow the perpetual inventory method whereby a year's capital stock is equal to the previous year's capital stock plus the investment in that year and minus the depreciation. In accordance with Easterly and Levine (2001), we assume 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 that explain macroeconomic efficiency in the literature. The choice of this set of control variables is made for three reasons: first, these variables have been used in former studies on macroeconomic efficiency.[4] Second, these variables are available for all of the countries for which we have all of the necessary data to estimate efficiency and for which Islamic finance is of importance; thus, these variables' selection does not force us to reduce the sample of countries. Third, these variables do not have a high correlation with the banking-development variables. *Inflation* is defined by the logarithm of the inflation rate added to unity, and 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 the World Development Indicators.

We consider the years 2000 to 2005, as we have data for Islamic banking in the IFIRST database for these years. We select countries that are located outside of Europe and North America. This choice is motivated by two reasons: first, we investigate the role of the development of Islamic banking with respect to efficiency. Because this question makes particular sense for countries from the Middle East and Southeast Asia, 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. Thus, having a greater number of comparable observations increases the quality of the

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

efficiency measures. For that reason, we want to increase the number of countries that can be compared. Furthermore, we are limited by the data's limitations, which are notable with respect to physical capital. Overall, our final sample covers 70 countries.[5] The summary statistics are presented in Table 1.

3. Methodology

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

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 if it used the same bundle of inputs.

We resort to the stochastic frontier approach to estimate technical efficiency, and we follow the former applications of this method at the macroeconomic level that were made by Adkins, Moomaw and Savvides (2002) and Méon and Weill (2010a,b), among others. The stochastic frontier approach was initially proposed by Aigner, Lovell and Schmidt (1977). The basic model assumes that the observed production deviates from the optimal production by an error term that is the sum of a random disturbance and an inefficiency term. The random disturbance is a two-sided component that reflects chance or measurement errors.

[5] Those countries are the following: 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, and Zambia.

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

Once each country's inefficiency is assessed, its relationship with the development of Islamic banking is measured. A natural way to perform this measurement would be to employ a two-stage approach that would consist of estimating the efficiency scores in a first stage, then regressing these scores on the set of explanatory variables and 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 that would be made in the first stage, even though 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 to be uncorrelated with the arguments of the production frontier; otherwise, the maximum likelihood estimates of the parameters of the production-frontier function would be biased due to the omission of the explanatory variables in the first stage. However, 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. This procedure consists of estimating a model that includes both a production frontier and an equation in which inefficiencies are specified as a function of the 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 the study by Méon and Weill (2010a,b).

Thus, the estimated stochastic frontier model includes two equations. The first equation is the specification of the production frontier. A Cobb-Douglas functional form is assumed based on the common specification of this form of production function in the

empirical works on growth and macroeconomic efficiency (for example Adkins, Moomaw and Savvides, 2002; Méon and Weill, 2010a). 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'. Then, the production frontier is 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 indexes the countries and t indicates the years of observation. Furthermore, (Y/L) and (K/L) are the output per worker and capital per worker, respectively. The frontier includes the dummy variables D_t for each year to control for the year-specific effects. In addition, v_{it} is a random disturbance that reflects luck or measurement errors; it is assumed to have a normal distribution with zero mean and variance σ_v^2. Lastly, u_{it} is an inefficiency term that captures technical inefficiencies; it is a one-sided component with variance σ_u^2. In accordance with common practice in the literature, we assume there is a half-normal distribution for the inefficiency term. Let $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and let $\gamma = \sigma_u / (\sigma_u^2 + \sigma_v^2)$. Then, whereas a higher value for σ means there is a greater gap between the observed and actual productions, γ measures the relative role of inefficiency and the random disturbance in pushing the observed production below the frontier.

The second equation specifies inefficiency as follows:

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

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

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

3.2. Testing the hypotheses

Once the general method that allows for us to measure and explain macroeconomic efficiency was developed, testing our hypotheses requires listing the variables that determine efficiency, that is specifying the arguments of the vector z_{it}. The goal of our study concerns the link between the development of Islamic banking and efficiency. We then consider several sets of variables that are related to banking development to examine this relation.

The first specification examines the overall influence of banking development on efficiency. Here, we only include the variable *Total Credit to GDP* to determine how productivity is influenced by banking development regardless of the type of banking. This assessment provides us with a benchmark with which to compare the influence of banking in general with Islamic banking in particular. The second specification concerns the association between the development of Islamic banking and macroeconomic efficiency. We include *Islamic Credit to GDP* as the only variable in the set of variables that models financial development, which gives us our first glimpse of the impact of Islamic banking development.

The third specification simultaneously includes the variables for each type of banking development, namely, *Islamic Credit to GDP* and *Conventional Credit to GDP*. Thus, we are able to compare their effects on macroeconomic efficiency. Lastly, the fourth specification uses a set of three banking-development variables by adding to the former variables the interaction term between both types of banking development. This specification allows for us to investigate 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 either type of banking would mean that one type of banking development is beneficial for efficiency but the development of the other form of banking reduces this gain. That is, there would be substitution among the positive effects of banking development on efficiency between both forms of banking.

Conversely, a positive influence of the interaction term on efficiency would mean that each form of banking development has a greater beneficial impact on efficiency

when the other form is more developed. Hence, there would be complementarity between both forms of banking development.

Alternatively, we proceed to the same four specifications for deposits to test the robustness of our results. As mentioned above, we focus on credit in conformity with the previous literature on the finance-growth nexus. However, we also consider deposits to gain 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; then, we turn to additional estimations by considering non-linear specifications.

4.1. The main estimations

We display the results of our estimations on credit and deposits in Tables 2 and 3, respectively. Whereas the upper half of each table presents the coefficients of the production frontier, 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 a decrease in inefficiency, or in other words, an increase in efficiency.

The upper parts of the tables reveal that the coefficient for capital per worker is always significant and is rather stable. The magnitude of this coefficient is on the same order as the results in other studies. We observe that the parameter σ is significantly different from zero, indicating that the stochastic production frontier is appropriate. With respect to the lower parts of the tables, we begin by examining the results for the estimations with credit variables. Several conclusions emerge.

We first observe that the variable *Total Credit to GDP* has a positive impact on efficiency. Indeed, this variable has a significant and negative coefficient, indicating that it is associated with less inefficiency. Thus, the importance of credit constitutes a positive

factor for productivity. This finding is in agreement with previous studies from Méon and Weill (2010) or Kuhry and Weill (2010); both of these works conclude that there is a positive impact of the ratio of private credit to GDP, which is ascertained from the Financial Structure database on macroeconomic efficiency. From a broader perspective, our work also accords with the conclusions from Levine and Zervos (1998) and Levine, Loayza and Beck (2000) with respect to the positive relation between credit and growth.

Second, we find a certain degree of evidence of a beneficial impact of the development of Islamic banking on efficiency. In column 2, we consider the variables *Islamic Credit to GDP* and *Conventional Credit to GDP* as the banking-development variables. Although we observe no significant coefficient for *Islamic Credit to GDP*, in column 3 we add the interaction term between *Islamic Credit to GDP* and *Conventional Credit to GDP*. In that specification, we obtain significant and negative coefficients for both banking-development variables, and furthermore, the interaction term is significant and positive. Hence, although *Islamic Credit to GDP* exerts a positive role on efficiency, this role is weakened by the rise of *Conventional Credit to GDP*. The same conclusion also holds for *Conventional Credit to GDP*. That is, there is substitution between Islamic banking development and conventional banking development in terms of the positive effects on efficiency. This conclusion is of particular interest because it can be explained by the fact that greater development of one form of banking does not necessarily favour the other form and may even contribute to replacing it.

With respect to the two control variables, we observe that the results for both of these are very robust across the different specifications. Indeed, *Latitude* is associated with more inefficiency, which is revealed by the positive coefficient it exhibits. This finding is not in line with intuition, as it means that inefficiency increases as one selects countries that are further away from the equator. Furthermore, this finding also differs from what was observed, for instance, by Méon and Weill (2010a). However, it must be stressed that our sample only includes countries that are located outside Europe and North America with a large concentration of countries in the tropics. Clearly, this major difference in the sample of countries might influence our result. Furthermore, we find a negative coefficient for the inflation rate, which may also appear to be at odds with expectations. Nonetheless, we need to stress once again that our sample of countries has a

different composition than the sample that is generally used for analysing efficiency. Consequently, the average relation between inflation and efficiency is likely to be different in our case.

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

Second, when we consider banking development by distinguishing both forms of banking, we again find support for the positive influence of the development of Islamic banking on efficiency. Because the variable *Islamic Deposits to GDP* is negative and significant, it is associated with lower inefficiency in both specifications, and hence, in our specifications regardless of whether they have the interaction term between the two banking-development variables.

In comparison with our results for credit, we do not find a significant coefficient for the interaction between the two variables, which does not corroborate our results with respect to credit on substitution between both forms of banking development. Furthermore, it is of interest to observe that the variable *Conventional Deposits to GDP* is significant and positive. In addition we observe the same findings for the control variables when we consider the banking-development variables for deposits rather than for credit.

Overall, our results tend to support a positive influence from the development of Islamic banking on efficiency. However, we wonder if the relation between the different

facets of banking development and efficiency is linear. The next subsection investigates this possibility.

4.2. Non-linear estimations

In this subsection, we consider the possible non-linearity of the relation between banking development and efficiency. To achieve this objective, we add squared terms for the 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 the total banking development and its squared term to analyse the existence of a non-linear relation between overall banking development and macroeconomic efficiency. We then consider Islamic and conventional banking development with their variables and squared terms.

We perform these estimations for credit and for deposits, and the respective results are displayed in Tables 4 and 5. It is of particular interest that our findings are exactly the same with respect to the sign and the significance of the coefficients when we consider credit or deposits. We comment on the application of both forms of banking development, and the results are summarised below.

We find evidence of non-linearity between the total banking development and macroeconomic efficiency. In the first specification, we observe that the coefficient of the linear term for total banking development is significantly positive, whereas the coefficient for the squared term is significantly negative. As inefficiency is explained in the estimations, we show the existence of a U-shaped relation between the total banking development and efficiency. Banking development overall favours efficiency but only until a certain limit is reached; when the banking development exceeds this limit, it hampers efficiency.

In addition, we find evidence of non-linearity between the Islamic banking development and macroeconomic efficiency but with opposite conclusions than for the total banking development. In the second specification, we do indeed show that, whereas

the coefficient for the linear term is significant and negative, 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. That is, we observe that Islamic banking development favours efficiency as long as it does not exceed a certain threshold, above which it contributes to the deterioration of efficiency.

The conclusion is exactly the opposite of the conclusion with respect to conventional banking development, as the coefficient for the linear term is significantly positive but the coefficient for the squared term is significantly negative, supporting the existence of a U-shaped relation between conventional banking development and efficiency.

To gain a more precise conception of the relation between Islamic banking development and efficiency, we can measure the maximum of the quadratic function and compare it with the distribution of the data. The maximums equal 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 (namely, Iran for the last year of the period of our investigation), and furthermore, no observation is beyond this maximum for the variable *Islamic Deposits to GDP*. Thus, the relation between Islamic banking development and efficiency is significantly positive for all of the observations in our sample. However, the expansion of Islamic finance could result in certain countries exceeding the limiting values beyond which this form of finance has detrimental effects on efficiency.

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

[6] When they examine 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.

macroeconomic efficiency provide evidence that the relation of these factors with financial intermediary development depends on the level of economic development.

5. Conclusion

In this study, we have examined the relation between the development of Islamic banking and macroeconomic efficiency. To achieve this goal, we estimated a stochastic frontier model on emerging and developing countries to obtain a large sample of comparable countries. We use exhaustive data on Islamic banking activities with respect to credit and deposits.

Overall, we find evidence that the development of Islamic banking favours efficiency. Our results tend to show that a non-linear relation exists between Islamic banking development and efficiency. Islamic banking only favours efficiency as long as it does not exceed a certain level of development. The point beyond which Islamic banking development has a detrimental effect on efficiency is likely to be exceeded in several countries, as this development was close to the maximum of the distribution of our data in our period of investigation. These results are observed when Islamic banking development is measured by means of the importance of credit or deposits.

However, we also find no clear evidence that conventional banking development is positively associated with efficiency. A U-shaped curve represents the relation between conventional banking development and efficiency, according to which conventional banking only favours 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'. Overall, our results provide two main implications for the Islamic banking industry. First, there is no clear evidence that Islamic banking development is a driving force of growth through productivity. This result is a major lesson for policymakers who are willing to favour the expansion of Islamic finance. From an economic perspective, our findings suggest that such economic-policy measures might have limited influence on productivity. Second, no evidence supports the view that conventional banking is more

beneficial than Islamic banking. Thus, Islamic banking is not an obstacle to aggregate productivity in comparison to conventional banking. That is, our study does not provide evidence that leads us to favour the expansion of Islamic banking, nor does our work lead us to prefer the expansion of conventional banking.

Although our study does not intend to provide a definitive view of the relation between Islamic finance and growth, it opens avenues for further research by taking the first step in the analysis of the 'Islamic finance-growth nexus'.

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Table 1
Summary statistics

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

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

Table 2
The main estimations with respect to credit

The estimations are performed 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 that is significantly different from zero at the 10%, 5% or 1% level, respectively.

	(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) × (Conventional Credit to GDP)	-	-	0.004***
			(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

Table 3
The main estimations with respect to deposits

The estimations are performed 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 that is significantly different from zero at the 10%, 5% or 1% level, respectively.

	(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) × (Conventional Deposits to GDP)	-	-	0.192^{E}-3
			(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

Table 4
Estimations for the non-linear relation with credit

The estimations are performed 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 that is significantly different from zero at the 10%, 5% or 1% level, respectively.

	(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

Table 5
Estimations for the non-linear relation with deposits

The estimations are performed 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 that is significantly different from zero at the 10%, 5% or 1% level, respectively.

	(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

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