Department of
Economics and Finance

Working Paper No. 16-02

Economics and Finance Working Paper Series

Guglielmo Maria Caporale
and Mohamad Husam Helmi

Islamic Banking, Credit and Economic Growth: Some Empirical Evidence

January 2016

http://www.brunel.ac.uk/economics

ISLAMIC BANKING, CREDIT AND ECONOMIC GROWTH: SOME EMPIRICAL EVIDENCE

Guglielmo Maria Caporale
Department of Economics and Finance
Brunel University London

Mohamad Husam Helmi
Department of Economics and Finance
Brunel University London

January 2016

Abstract

This paper examines the effects of Islamic banking on the causal linkages between credit and GDP by comparing two sets of seven emerging countries, the first without Islamic banks, and the second with a dual banking system including both Islamic and conventional banks. Unlike previous studies, it checks the robustness of the results by applying both time series and panel methods; moreover, it tests for both long- and short-run causality. In brief, the findings highlight significant differences between the two sets of countries reflecting the distinctive features of Islamic banks. Specifically, the time series analysis provides evidence of long-run causality running from credit to GDP in countries with Islamic banks only. This is confirmed by the panel causality tests, although in this case short-run causality in countries without Islamic banks is also found.

Keywords: Credit, growth, Islamic banking, causality tests

JEL classification: C32, C33, G21, O11

Corresponding author: Professor Guglielmo Maria Caporale, Department of Economics and Finance, Brunel University, London, UB8 3PH, UK. Tel.: +44 (0)1895 266713. Fax: +44 (0)1895 269770. Email: Guglielmo-Maria.Caporale@brunel.ac.uk

1. Introduction

The finance-growth nexus has been extensively investigated in the literature, with mixed evidence: some studies reach the conclusion that financial development boosts economic growth (e.g., Schumpeter, 1911; McKinnon, 1973; Shaw, 1973; King and Levine, 1993; and Beck et al., 2014), whilst others argue that causality runs in the opposite direction (e.g., Robinson, 1952; Berthelemy and Varoudakis, 1996; Ang, and McKibbin, 2007); Rousseau and Wachtel (2011) have reported that the linkage has become weaker over time. Moreover, there is no consensus on how to measure financial development and how to handle the endogeneity problem. Most recently, the Bank for International Settlements (BIS) has focused on the role of credit, and whether it might be used as an early warning indicator (EWI), since excessive lending is thought to be one of the main factors that have caused the global financial crisis of 2007-8. The credit-to-GDP ratio was in fact adopted by the Basel III committee (2010) as a guide to build up countercyclical capital buffers during booms in order to use them during crises (see Drehmann, 2013).

An interesting issue not thoroughly analysed in the literature is whether the relationship between credit and economic growth is different in countries with Islamic banks. Such institutions are not allowed to charge a predetermined interest rate, which is replaced by the ex-post profit and loss sharing rate (Chong and Liu, 2009). Further, they can only provide credit for transactions related to a tangible, underlying asset and cannot engage in any speculative activities (Hasan, Dridi 2010; Khan, 2010 and Kammer et al., 2015). Only a few empirical studies of countries with Islamic banking exist. Majid and Kassim (2010) find evidence supporting the "supply-leading" view. By contrast, Furqani and Mulyany (2009) report that economic growth causes financial development only in the short run in a country with Islamic banking such as Malaysia - on the whole, their analysis is consistent with the "demand-following" view. Abduh and Omar (2012) find bidirectional causality between Islamic finance and economic growth in Indonesia. Most recently, Imam and Kpodar (2015) conclude that countries with Islamic banks experience faster economic growth than those without Islamic banks.

The present paper aims to examine in depth the effects of Islamic banking on the causal linkages between credit and GDP by comparing two sets of seven emerging countries, the first without Islamic banks, and the second with a dual banking system including both Islamic and conventional banks. Unlike previous studies, it checks the robustness of the results by applying both time series and panel methods. Moreover, it tests for both long- and short-run causality; the former has been analysed in the traditional literature on the finance-

growth nexus, whilst the latter is relevant for the current debate on macro-prudential policies and the attempt by the BIS to identify the best EWIs. Our analysis also seeks to contribute to the on-going debate on whether the profit-and-loss sharing (PLS) paradigm of Islamic banking might lead to an optimal distribution of funds (Siddiqi, 1999), and on the role of Islamic finance in promoting economic growth rather than causing an increase in the price level by linking all financial transaction to real economic activities (Chapra, 1992; Mills and Presley, 999; Gulzar and Masih, 2015; Kammer et al., 2015).

In brief, our findings highlight significant differences between the two sets of countries. Specifically, the time series analysis provides evidence of long-run causality running from credit to GDP in countries with Islamic banks only. This is confirmed by the panel causality tests, although in this case short-run causality in countries without Islamic banks is also found. The layout of the paper is as follows: Section 2 briefly reviews the principles of Islamic banking; Section 3 describes the data; Section 4 outlines the methodology; Section 5 discusses the empirical results; finally, Section 6 offers some concluding remarks.

2. Islamic Banking

The principles of Islamic finance are based on the Quran, hadith[1] and Islamic jurisprudence (Sharia). The first is the prohibition of interest payment (Riba), defined by some Islamic scholars as usury, and by others as any pre-determined interest rate (Chong and Liu, 2009). In the Holy Quran, ten statements/verses condemned the practice of Riba or charging pre-determined interest rate. For example, the Surah/chapter al-Baqarah says: "O you who believe! Fear God and give up whatever remains of Riba (usury), if you are believers" (Quran 2:278). Another verse in the Surah al-Baqarah distinguishes between Riba and trading: “Allah has allowed trading and forbidden Riba (usury)” (Quran 2:275). Accordingly, many financial contracts are constructed on the basis of the difference between trading and Riba as well as Islamic jurisprudence (Sharia), for instance Musharaka (partnership), Mudharabah (profit-sharing), Murabahah (cost plus) and Ijarah (leasing) contracts[2]. Thus, Islamic financial institutions are not allowed to make money through pure financing, and financial contracts must be linked directly to real economic activities (Gulzar and Masih, 2015; Kammer et al., 2015). Each financial transaction is underpinned by an

[1] Hadith stands for the actions and quotations of the Prophet Mohammad, which are one of the main sources of Islamic guidance in many aspects of Muslim life including economic activities.

[2] For more details see Appendix A.

existing or potential real asset, in contrast to the case of conventional banks that can provide credit without such constraints (see Siddiqi, 2006 and Askari, 2012).

The second principle is based on the profit and loss sharing paradigm (PLS) between the two parties of any financial contract, which is seen as a crucial feature that distinguishes Islamic from conventional banks. Furthermore, the conventional ex-ante interest rate, which is a risk-shifting rate, is replaced by the ex-post profit and loss sharing rate (PLS), which is instead a risk-sharing rate (Chong and Liu, 2009). This is thought to encourage Islamic banks to invest in small and medium enterprises (SMEs) and long-term ventures, and thus to stimulate economic growth (Chapra, 1992; Mills and Presley, 999; Iqbal and Mirakhor, 2013). Furthermore, the prohibition of the conventional ex-ante interest rate is viewed as a foundation for improvements in both social justice and economic efficiency (El-Gamal, 2006 and Berg and Kim, 2014).

The third principle does not allow Islamic banks to engage in any speculative transactions, option and futures contracts, hedging, toxic assets, gambling and funding of any activities which are considered harmful to the community such as producing alcohol (Hasan, Dridi 2010; Khan, 2010 and Kammer et al., 2015). It is thought that financing such activities would cause an increase in prices rather than contributing to GDP. The fourth principle requires asset-backing: transactions should be related to a tangible, underlying asset. In addition, the main criterion for the allocation of credit by Islamic banks is the productivity of the project, instead of the creditworthiness of the customer as in the case of conventional banks. Therefore, credit is channelled to productive investment rather than speculative activities, which are not allowed according to the principles of Islamic finance (Di Mauro et al., 2013). Bernanke (2009) and Turner (2009) argue that excessive and unproductive credit growth, investment in speculative transactions and interest-based debt financing were in fact some of the main causes of the 2007-8 financial crisis. In contrast, in the Islamic banking system, these activities are either not allowed or partly mitigated – for instance, as highlighted by Mohieldin (2012), asset-backed debt guarantees a direct relationship between loans and the real economy. In this way, greater market discipline and financial stability are achieved (Di Mauro et al., 2013). Given the distinctive features of Islamic banking, one would expect to find differences in the role of credit between countries with and without Islamic banks. This is the issue analysed in the present study.

3. Data Description

We investigate the causal relationship between real credit to the private sector and real GDP in fourteen emerging countries with sufficiently long time series. These are divided into two groups (see Table 1): the first includes countries without Islamic banks, specifically Latin American countries with a similar level of development to those with Islamic banks, and without recent long periods of colonial history affecting their institutions (namely, Argentina, Brazil, Chile, Costa Rica, Ecuador, Guatemala, and Peru); the second includes countries with both Islamic and conventional banks according to the Bankscope database (Malaysia, Indonesia, Turkey, Iran, Jordan, Singapore and Tunisia). Oil exporting countries with Islamic banks are excluded from the sample since their economic growth might be mainly driven by oil revenues rather than financial development or credit. However, Iran has been included because its economy has many other industrial sectors and does not depend solely on oil revenues.

Table 1. Sample of Countries

Data Set 1 7 countries without Islamic Banks	Period	Data Set 2 7 countries with Islamic Banks	Period
Argentina	1993Q1-2013Q1	Indonesia	2001Q4-2013Q1
Brazil	2001Q4-2013Q1	Turkey	2001Q4-2012Q4
Chile	1997Q4-2013Q1	Iran	1994Q1-2007Q4
Costa Rica	2001Q4-2012Q4	Singapore	2003Q1-2013Q1
Ecuador	2001Q4-2012Q2	Jordan	1992Q1-2012Q4
Guatemala	2001Q4-2012Q4	Tunisia	2000Q1-2012Q4
Peru	1996Q1-2012Q4	Malaysia	2001Q4-2012Q4

The data source is the International Monetary Fund (IMF) database. The (seasonally adjusted) series are credit to the private sector (Cr), gross domestic product (GDP) and the consumer prices index (CPI). These have been logged and real credit (RCr) and GDP (RGDP) series have been created using the price deflator. Following the IMF definition of credit,[3] we calculated credit as gross credit injected into all private sectors of the economy, i.e. excluding credit to the government. This is because credit to the private sector increases in boom periods and decreases during credit crunches or crises, whereas credit to the public sector moves in the opposite direction (see Drehmann et al., 2011).

[3] "Claims on private sector include gross credit from the financial system to individuals, enterprises, nonfinancial public entities not included under net domestic credit, and financial institutions not included elsewhere" (IMF-IFS line 32d).

Table 2. Descriptive statistics for credit and GDP

Panel A: Countries without Islamic Banks

	Variable	Argentina	Brazil	Chile	CostaRica	Ecuador	Guatemala	Peru
Mean	Credit	99870.15	704847.3	18740.63	5508.063	10928.92	63548.12	61504.52
	GDP	683826.7	1257260	48099.18	3389.046	12900.84	65892.21	70018.58
St. Dev	Credit	85834.51	253648.7	22983.08	3123.105	4946.739	21882.91	31564.11
	GDP	595919.3	820646.9	7891.308	1407.419	4316.059	19632.00	29940.39
Min	Credit	37680.37	336492.6	19387.08	1467.960	4965.563	31259.41	21759.39
	GDP	223991.2	382406.9	9150.734	1417.687	6384.677	38467.71	32629.44
Max	Credit	408004.0	1220474	97289.74	11000.14	21859.28	121762.2	142796.1
	GDP	2461950	3093791	33867.75	5768.434	20984.91	101324.8	135014.2
Skewness	Credit	2.027	0.324	0.500	0.189	0.594	0.404	1.186
	GDP	1.466	0.806	0.398	0.158	0.249	0.245	0.693
Ex. kurtosis	Credit	6.347	1.878	2.025	1.535	2.298	3.00	3.244
	GDP	4.027	2.411	1.829	1.685	1.901	1.754	2.212
JB	Credit	93.346***	3.216	5.042	4.292	3.418	1.226	16.133***
	GDP	32.585***	5.652*	5.184	3.428	2.608	3.358	7.209**
Obs	Credit	81	46	62	45	43	45	68
	GDP	81	46	62	45	43	45	68

Panel B: Countries with Islamic Banks

Statistics	Variable	Indonesia	Turkey	Iran	Singapore	Jordan	Tunisia	Malaysia
Mean	Credit	1095585	274679.2	171511.7	256633.6	6923.090	26284.25	686856.2
	GDP	1118588	208677.6	175352.4	65438.53	2352.280	11538.97	161416.8
St. Dev	Credit	680260.3	217948.5	236101.7	77686.10	4428.236	9612.233	191713.5
	GDP	564432.2	83842.08	204990.3	15293.24	1433.630	3144.230	45998.68
Min	Credit	294763.6	33557.72	4636.539	168642.4	2004.358	13123.26	448221.6
	GDP	427350.1	68784.23	5269.603	39371.97	881.945	7162.824	88475.43
Max	Credit	2656303	772647.7	988511.3	432203.2	16138.58	48086.03	1106141
	GDP	2170798	360824.3	824121.5	87169.01	5687.685	17020.73	237320.7
Skewness	Credit	0.410	0.821	1.778	0.753	0.742	0.775	0.586
	GDP	0.730	0.185	1.413	-0.142	0.992	0.247	0.024
Ex. kurtosis	Credit	2.486	2.558	5.382	2.396	2.031	2.568	2.222
	GDP	1.804	2.060	4.102	1.795	2.576	1.656	1.766
JB	Credit	4.601	5.430*	59.58***	4.497	10.998***	5.289*	3.716
	GDP	4.028	1.913	29.93***	2.619	14.415***	4.186	2.856
Obs	Credit	46	45	78	41	84	49	45
	GDP	46	45	78	41	84	49	45

Note: *, **, and *** indicate significance at the 10 %, 5%, and 1% levels, respectively. JB is the Jarque-Bera test for normality.

Table 2 reports descriptive statistics and the Jarque-Bera test (JB) for normality for the two series in both sets of countries. Of those with Islamic banks, Jordan and Indonesia respectively have the lowest and highest economic output and volume of credit to the private sector (see Table 2, Panel B). The corresponding countries among those without Islamic banks are Costa Rica and Brazil (see Table 2, Panel B). In addition, the standard deviations for both series are higher in the countries with Islamic banks.

On the basis of the JB test the null of normality cannot be rejected for credit in Brazil, Chile, Costa Rica, Ecuador, Guatemala, Indonesia, Singapore and Malaysia; on the other hand, it is in the case of Argentina, Peru, Iran and Jordan at the 1% level. As for GDP, normality is rejected in four countries, namely Argentina, Peru, Iran and Jordan. Credit to the private sector exhibits excess kurtosis and skewness in three countries (Argentina, Peru and Iran), and so does GDP in two cases (Argentina and Iran). Skewness is positive in all cases, the only exception being Singapore, whose GDP is negatively skewed (see Table 2).

3. Methodology

The statistical approach taken in this study involves three steps. First, the order of integration of the variables is determined by means of unit root tests. Second, the existence of long-run equilibrium relationships is tested using cointegration techniques as in Engle and Granger (1987) and Johansen (1988, 1995) respectively. Third, Granger causality tests are carried out on the basis of the findings from the cointegration analysis – in the context of a VAR or a vector error correction model (VECM) respectively, depending on whether cointegration does not or does hold. In the former case the model is the following

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta \mathrm{RCR}_{\,t-i} + \epsilon_{1t} \tag{1}$$

$$\Delta \mathrm{RCR}_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i} \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta \mathrm{RGDP}_{\,t-i} + \epsilon_{2t} \tag{2}$$

where $RGDP_t$ is the log of real gross domestic product while RCR_t stands for the log of real credit to private sector; Δ is the first difference operator; α_1 and α_2 are constant drifts; β_{ji} and φ_{ji} are polynomials of order k-1 and ϵ_{1t} and ϵ_{2t} are the residuals. Failure to reject the null hypothesis of $H_0 : \sum_{i=1}^{k} \varphi_{1i} = 0$ implies that real credit to the private sector does not

Granger-cause real GDP. Similarly, failure to reject the null hypothesis of $H_0: \sum_{i=1}^{k} \beta_{2i} = 0$ implies that real GDP does not Granger-cause real credit to the private sector. Eqs. (1) and (2) are estimated when $RGDP_t$ *and* RCR_t are $I(1)$ and are not cointegrated using differenced data, and in levels if the series are I(0).

Following Engle and Granger (1987), if the order of integration of the series is I(1) and they are cointegrated, an error correction term (ECT) is introduced into the model. Therefore, a VECM is specified as follows:

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\ \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\ \Delta RCR_{\ t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t} \tag{3}$$

$$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\ \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\ \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t} \tag{4}$$

where α_1 *and* α_2 are constant drifts, ECT_{t-1} is the error correction term, which represents the deviations from the long-run cointegration relationship, and δ_1 *and* δ_2 denote the speeds of adjustment towards the long-run equilibrium, which are expected to be negative.

Therefore there are two sources of causality between $RGDP_t$ and RCR_t, either through the error correction term (ECT_{t-1}) or through the lagged dynamic terms $\Delta RCR_{\ t-i}$ in Eq. (3) or $\Delta RGDP_{t-i}$ in Eq. (4). Consequently, one can test for three types of causality between real GDP and real credit to the private sector. First, one can test whether $\Delta RCR_{\ t}$ Granger-causes $\Delta RGDP_t$ in the short run by carrying out a Wald test of the null hypothesis $H_0: \sum_{i=1}^{k} \varphi_{1i} = 0$. Second, one can test for long-run causality by performing a weak-exogeneity test on the coefficient of the lagged error correction term ECT_{t-1}. Failure to reject the null hypothesis H_0: δ_1=0 implies that real credit to the private sector does not Granger-cause real GDP in the long run. Third, strong exogeneity can be tested by testing the joint significance of the coefficients on the lagged dynamic terms and the lagged error correction term (Engle et al., 1983 and Charemza and Deadman, 1997). The null hypothesis in this case is H_0: $\sum_{i=1}^{k} \varphi_{1i} = \delta_1 = 0$. However, this test does not allow to distinguish between long- and short-run causality (Ang and McKibbin, 2007).[4]

[4] Note: the panel approach follows the same estimation process.

In the cointegration analysis, if the Engle-Granger (1987) and Johansen (1988, 1995) tests produce contradictory results, more weight is attached to the former given the poor finite sample properties of the latter (see Banerjee et al., 1986; Demetriades and Hussein, 1996) and the fact that, being a two-stage residual-based test, any error occurring in the first stage is passed directly onto the second stage (Asteriou and Hall, 2015). In the case of causality inference, we follow Demetriades and Hussein (1996): if the findings from the VECM and VAR specifications differ, we place more weight on the former.

Time-series techniques have been criticised because small sample distortions can affect the power of standard unit root and cointegration tests (see Christopoulos and Tsionas, 2004). These issues can be addressed using panel approaches (Ang, 2008) to carry out cointegration tests with higher power (Persyn and Westerlund, 2008). With this in mind, we apply various panel methods as well to check the robustness of our findings (see below).

5. Empirical Analysis

5.1 Unit root tests

As a first step, we carry out a battery of unit root tests to examine the stochastic properties of the individual series using Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981) and Phillips-Perron (PP) tests (Phillips-Perron, 1988). These tests suggest that real credit to the private sector and real GDP are non-stationary I(1) in the countries with and without Islamic banks. We also applied panel unit root tests, namely the MW (Maddala and Wu. 1999) and Im, Pesaran and Shin (IPS) tests (Im et al., 2003)[5], which confirm that both variables can be characterised as I(1).[6]

5.2 Cointegration Tests

Next, we test for the existence of a long-run relationship between real credit to the private sector and real GDP. For this purpose we use both time series (Engle and Granger, 1987 and Johansen, 1988, 1995) and panel cointegration (Pedroni, 2004, Kao, 1999 and Westerlund, 2007) methods. The Engle-Granger cointegration test results are reported in Table 3. The null hypothesis of no cointegration is rejected only for Ecuador in the case of the countries without Islamic banks (see Table 3, Panel A), and only for Iran at the 5% significance level in the other group (see Table 3, Panel B). These results are consistent with

[5] For further details on panel unit root tests, see Harris and Sollis (2003), Banerjee (1999), Christopoulos and Tsionas (2004), and Breitung and Pesaran (2008) among others.
[6] These tests are not reported but are available upon request.

those of Demetriades and Hussein (1996), who also failed to detect cointegration between real GDP per capita and various financial indicators in 11 out of the 16 countries in their sample. However, it is well known that the Engle-Granger cointegration tests have low power in the case of a relatively short sample such as ours (see Kremers et al., 1992 and Demetriades and Hussein, 1996).

Table 3. Results of the Engle-Granger cointegration test based on the residuals

Country	Variables in cointegration vector (RGDP and LCr)		
	Engle-Granger tau-statistic	*p*-values^	N
Panel A: Countries without Islamic Banks.			
Argentina	-0.916 (4)	0.916	76
Brazil	-2.843 (1)	0.172	44
Chile	-2.954 (0)	0.136	61
Costa Rica	-3.045 (3)	0.121	44
Ecuador	-4.757 (1)***	0.002	41
Guatemala	-2.608 (9)	0.256	35
Peru	-1.577 (2)	0.733	65
Panel B: Countries with Islamic Banks.			
Indonesia	-1.727 (8)	0.667	46
Turkey	-2.309 (4)	0.381	44
Iran	-3.757 (0)**	0.024	55
Singapore	-2.210 (1)	0.429	39
Jordan	-1.763 (11)	0.649	83
Tunisia	-1.841 (10)	0.613	38
Malaysia	-1.843 (0)	0.612	44

Note: */**/*** represent statistical significance at the 10%, the 5% and the 1% level, respectively. Null hypothesis *Ho:* series are not cointegrated. The critical values of MacKinnon (1996) for ADF test statistic are -3.04, -3.33 and -3.89 at the 10%, 5% and 1% respectively. ^ MacKinnon (1996) *p*-values. The optimal lag length, representing in parentheses, is selected by the Akaike Info Criterion (AIC). N is the number of obs. RCr is the real credit to private sectors and RGDP is the real GDP.

Therefore we also apply the multivariate tests of Johansen (1988, 1995). Because these are very sensitive to the lag length (see Banerjee et al., 1993, Cheung and Lai, 1993, and Chang and Caudill, 2005), we use the Schwarz information criterion (SC) to determine the optimal lag length, but include extra lags when required to remove serial correlation (as in Hunter and Menla Ali, 2014, where the Akaike information criterion (AIC) is used instead). Furthermore, to achieve normality, the following dummies were included: Chile 2008Q1, Argentina 2002Q2, and Tunisia 2011Q1, Jordan 2006Q1 and Singapore 2008Q4. We follow Dimitraki and Menla Ali (2015) and control for outliers defined as such when the residual is greater than $|3.5\sigma|$. [7]

[7] For a more detailed discussion about including a dummy variable when testing for cointegration, see Juselius and MacDonald (2004).

The results from the diagnostic tests for the residuals are displayed in Table 4. The LM tests provide no evidence of any remaining serial correlation (see both Panels A and B). Further, the null hypothesis of both homoscedasticity and normality cannot be rejected in any cases. Thus, we conclude that the VAR models are data congruent and carry out the Johansen cointegration tests using the optimal lag length reported in Table 4.

Table 4. VAR lag length and diagnostic tests

Panel A: Countries without Islamic Banks.							
Country	Argentina [*k*=5]	Brazil [*k*=5]	Chile [*k*=3]	Costa Rica [*k*=3]	Ecuador [*k*=7]	Guatemala [*k*=4]	Peru [*k*=3]
LM test	4.012 (0.404)	2.817 (0.588)	3.634 (0.457)	5.772 (0.216)	2.716 (0.606)	3.656 (0.454)	2.194 (0.700)
JB test	3.475 (0.481)	2.492 (0.646)	6.103 (0.191)	6.683 (0.153)	0.501 (0.973)	4.188 (0.381)	3.615 (0.461)
Hetro test	68.762 (0.288)	52.424 (0.745)	40.195 (0.417)	39.298 (0.324)	78.701 (0.642)	55.797 (0.299)	36.136 (0.462)
Panel B: Countries with Islamic Banks.							
Country	Indonesia [*k*=5]	Turkey [*k*=5]	Iran [*k*=6]	Singapore [*k*=3]	Jordan [*k*=4]	Tunisia [*k*=5]	Malaysia [*k*=5]
LM test	4.060 (0.398)	3.744 (0.441)	4.881 (0.299)	5.605 (0.230)	5.475 (0.241)	2.259 (0.688)	4.103 (0.392)
JB test	6.066 (0.194)	2.385 (0.665)	4.410 (0.353)	1.847 (0.763)	1.235 (0.872)	3.403 (0.492)	0.135 (0.997)
Hetro test	83.776 (0.486)	70.221 (0.172)	57.549 (0.892)	33.152 (0.733)	162.643 (0.052)	97.741 (0.202)	62.764 (0.484)

Note: *k* denotes number of lags based on the Schwarz information criterion (SC) and subject to removal of serial correlation. The null of LM test is no serial correlation. Breusch & Pagan (1979) test for heteroscedasticity with the null hypothesis *Ho*: Constant variance. The LM test and tests Breusch & Pagan are based on F-statistics. JB test is a chi-squared test for normality with *Ho*: residual are multivariate normal. *P-values* are in parentheses.

On the basis of the trace and eigenvalues statistics (see Table 5, Panel A), the null of no cointegration cannot be rejected at the 5% level only in the case Guatemala among the countries without Islamic banks; therefore it appears that there is a stable long-run relationship between credit and GDP almost in every case. As for countries with Islamic banks, both the trace and eigenvalue statistics reject the null hypothesis of no cointegration at the 5% level for all but of one of them, namely Turkey, for which the results are contradictory (see Panel B) – in this case we give more weight to the trace statistic that suggests cointegration, because this test is known to provide more robust results than the maximal eigenvalues one (see Luintel and Khan, 1999, and Lanne et al., 2002).

Table 5. Results of the Johansen cointegration tests

Country	Null Hypothesis: r=0; Alternative Null: r=1						
	Variables : RGDP and RCR						
	Maximum Eigenvalue Test			Trace Test			
	Max-Eigen statistic (λ_{max})	95% Critical Value	*p*-value^	Trace statistic (λ_{trace})	95% Critical Value	*p*-value^	*K*
Panel A. Countries without Islamic Banks.							
Argentina	19.519	14.264	0.007***	20.044	15.494	0.009***	5
Brazil	10.897	15.892	0.259	20.324	20.261	0.049**	5
Chile	15.796	14.264	0.028**	15.929	15.494	0.043**	3
Costa Rica	17.175	14.264	0.016**	18.884	15.494	0.015**	3
Ecuador	26.813	14.264	0.000**	27.670	15.494	0.000***	7
Guatemala	2.802	14.264	0.959	3.780	15.494	0.920	4
Peru	25.503	19.387	0.005***	33.213	25.872	0.005***	3
Panel B. Countries with Islamic Banks.							
Indonesia	26.972	14.264	0.000***	28.521	15.494	0.000***	5
Turkey	12.271	14.264	0.101	16.376	15.494	0.036**	5
Iran	29.077	15.892	0.000***	36.175	20.261	0.000***	6
Singapore	14.066	14.264	0.054*	16.852	15.494	0.031**	3
Jordan	17.803	15.892	0.024**	26.603	20.261	0.006***	4
Tunisia	33.687	15.892	0.000***	41.805	20.261	0.000***	5
Malaysia	39.738	14.264	0.000***	48.656	15.494	0.000***	5

Notes: */**/*** represent statistical significance at the 10% and 5% and 1% level, respectively. the table reports the Max-Eigen statistics and Johansen trace statistics (Johansen, 1995). *r* is the number of cointegration vectors. ^ is the respective *p*-values. *K* is the number of lag lengths based on Schwarz Information Criterion (SC), subject to the removal of serial correlation (see Table 4). RCR is the real credit to private sectors and RGDP is real GDP.

To summarise, the Johansen tests provide much stronger evidence of the existence of a long-run relationship between credit and GDP. The only exception is Guatemala - this might reflect the presence of nonlinearities, the need for a broader definition of credit[8], or the fact that credit did not have a significant role in financing economic activities during the period under investigation: its average growth rate was small or negative in Guatemala, as opposed to 12.4% in Latin America, during the period 2004-2011 (Hansen and Sulla, 2013).

Next, we carry out panel cointegration tests, specifically two residual-based tests (Pedroni, 2004 and Kao, 1999) tests and an error correction-based panel cointegration test (Westerlund, 2007). Pedroni (2004) suggested two groups of statistics. The first group, including four of them, involves pooling the within-dimension residuals, while the second, including three, is based on pooling the between-dimension residuals. There are several

[8] For example, according to Basel III, the ideal definition of credit should "include all credit extended to households and other non-financial private entities in an economy independent of its form and the identity of the supplier of funds" (BCBS, 2010 p 10). In addition, the BIS database defines the total credit series as "all sources of credit, independent of the country of origin or type of lender" Drehmann, (2013 p 42). However, BIS definition of total credit is beyond the scope of this chapter and it is available only for 40 advanced and emerging market economies (see Dembiermont et al., 2013).

possible estimators one could use, such as OLS, Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS). In their comprehensive study, Kao and Chiang (2000) found that both the FMOLS and OLS estimators suffer from small sample bias, and concluded that the DOLS method outperforms them. This is the estimator chosen here.

The results of the Pedroni (2004) and Kao (1999) tests are reported in Table 6 and 7 respectively. Both of them fail to reject the null hypothesis of no cointegration in the countries without Islamic banks. By contrast, both the panel ADF-Statistics and Group ADF-Statistics (without trend) indicate a long-run relationship at the 5% and 10% level respectively between credit and GDP in the countries with Islamic banks. When a time trend is included, four of the seven Pedroni statistics reject the null hypothesis of no cointegration between real credit to the private sector and real GDP (see Table 6 Panel B), whilst the Kao test does not suggest any long-run relationship for countries with Islamic banks (see Table 7).

Westerlund (2007) criticises the panel residual-based tests performed above (pointing out in particular that the common factor restriction might be invalid), and proposes four more advanced panel-cointegration tests with higher power. The first two, G_τ and G_α, are based on group-mean test statistics, which test the alternative hypothesis that the panel as a whole is cointegrated, whereas the other two, p_τ and p_α, are pooled test statistics, which are designed to test the alternative that at least one of the individual cross-sectional units is cointegrated (Persyn and Westerlund, 2008). The results for these tests are reported in Table 8. It can be seen that both group-mean statistics reject the null hypothesis of no cointegration in all three panels (comprising countries with and without Islamic banks and all countries in turn), suggesting the existence of a long-run relationship between real credit to the private sector and real GDP in each case. However, the other two panel statistics fail to reject the null hypothesis of no cointegration between the two variables.

Table 6. Results of the Pedroni panel cointegration tests based on the residuals

	No time trend		Time trend	
Test statistics	Statistic	*p*-value	Statistic	*p*-value
Panel A. Countries without Islamic Banks.				
Within dimension				
Panel v	-1.333	0.909	0.595	0.275
Panel rho	1.572	0.942	1.414	0.921
Panel PP	1.371	0.914	0.734	0.770
Panel ADF	1.559	0.941	0.517	0.697
Between dimension				
Group v	0.234	0.592	0.782	0.783
Group PP	-0.876	0.190	-0.179	0.428
Group ADF	-1.144	0.126	-0.790	0.214

Panel B. Countries with Islamic Banks.				
Within dimension				
Panel v	0.646	0.259	2.088	0.018**
Panel rho	-0.462	0.322	-0.198	0.421
Panel PP	-0.567	0.285	-0.668	0.252
Panel ADF	-1.902	0.028**	-2.431	0.007***
Between dimension				
Group v	0.073	0.529	-0.398	0.344
Group PP	-0.425	0.335	-1.350	0.088*
Group ADF	-1.388	0.082*	-4.368	0.000***
Panel C. All countries				
Within dimension				
Panel v	-1.030	0.848	1.764	0.038**
Panel rho	1.733	0.958	1.251	0.894
Panel PP	1.418	0.922	0.458	0.676
Panel ADF	1.427	0.923	-0.712	0.238
Between dimension				
Group v	0.217	0.586	0.271	0.606
Group PP	-0.921	0.178	-1.081	0.139
Group ADF	-1.791	0.036**	-3.647	0.000***

Note: */**/*** indicate that the null hypothesis of no cointegration is rejected at the 10%, 5% and 1% level, respectively. All tests are left-sided except the variance ratio which is right-sided (see Ozturk and Acaravic, 2010). Statistics are asymptotically distributed as normal. The null hypothesis is no cointegration, while the alternative hypothesis (1) within dimension is common AR coefficients and (2) it is individual AR coefficients between dimensions.

Table 7. Results of the panel cointegrationKao test based on the residuals

Kao test ADF-Statistics	Panel A. Countries without Islamic Banks	Panel B. Countries with Islamic Banks.	Panel C. All countries
t-stat	-0.645	-0.194	-0.803
p-value	(0.259)	(0.422)	(0.211)

Note: */**/*** represent statistical significance at 10%, 5% and 1% level respectively. The lag length for the ADF test is chosen based on the AIC criterion and Newey-West automatic bandwidth selection and Bartlett kernel.

Table 8. Results of the Westerlund (2007) Panel Cointegration test

	Panel A. Countries without Islamic Banks			Panel B. Countries with Islamic Banks			Panel C. All countries		
Test	Value	Z-value	*p*-value	Value	Z-value	*p*-value	Value	Z-value	*p*-value
G_τ	-4.748	-7.880	0.000***	-4.563	-7.272	0.000***	-4.656	-10.714	0.000***
G_α	-21.55	-3.840	0.000***	-22.10	-4.058	0.000***	-23.59	-6.580	0.000***
p_τ	-5.128	0.538	0.705	-4.322	1.477	0.930	-6.820	1.264	0.897
p_α	-7.218	0.769	0.779	-7.115	0.815	0.792	-8.285	0.419	0.662

Note: */**/*** represent statistical significance at the 10%, 5% and 1% level respectively. The Lags length and the leads are selected according to the Akaike Information Criterion (AIC). *P-values* are one sided test based on the normal distribution. τ and α refer to different test statistics. p_τ and p_α are pooled test statistics; G_τ and G_α are group mean test statistics. For further information about both pooled and group mean test statistics refer to Persyn and Westerlund (2008).

5.3 Causality Tests

Next we apply both time series and panel approaches to test for three types of causality (where the null hypothesis is that of no causality): short-run causality, using lags of the explanatory variables; long-run causality (weak exogeneity), using the error correction term; strong exogeneity, using both lags and the error correction term. As already mentioned, we estimate a VECM or a VAR in first differences depending on whether or not cointegration holds between real credit to the private sector and real GDP.

According to the Engle-Granger tests, there is a long-run equilibrium relationship only in the case of Iran and Ecuador. For these two countries the ECM-based causality tests suggest bidirectional long-run causality in Iran and unidirectional causality from real credit to the private sector to real GDP in Ecuador, at the 10% and 5% level of significance respectively (see Table 9, Panel A). The F-statistic fails to reject the null of no short-run Granger causality from credit to GDP in Ecuador but not in Iran at the 10% significance level (see Table 9, Panel B). The diagnostic tests (LM test, JB test, heteroscedasticity test, ARCH test) suggest no serial correlation, deviations from normality, heteroscedasticity, or ARCH effects in either case.[9]

Table 9. ECM test with Engle-Granger cointegrating vectors

Panel A: Ho: $\Delta Cr \nrightarrow \Delta GDP$

		SR Granger non-causality test (H_0: $all\ \varphi_{1i} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)			SR+LR Strong-exogeneity test (H_0:$all\ \varphi_{1i} = \delta_1 = 0$)	
	K	F-statistic	p-values	Coeff ECT_{t-1}	t-statistic	p-values	F-statistic[a]	p-values
Iran	6	2.243	0.057*	-0.387	-1.996	0.052*	2.773	0.018**
Ecuador	6	1.140	0.372	-0.467	-2.552	0.018**	1.807	0.1362

Panel B: Ho: $\Delta GDP \nrightarrow \Delta Cr$

		SR Granger non-causality test (H_0: $all\ \varphi_{2i} = 0$)		LR Weak-exogeneity test (H_0: δ_2=0)			SR+LR Strong-exogeneity test (H_0: $all\ \varphi_{2i} = \delta_1 = 0$)	
	K	F-statistic	p-values	Coeff ECT_{t-1}	t-statistic	p-values	F-statistic[a]	p-values
Iran	6	2.080	0.077*	-0.197	-2.923	0.005***	2.260	0.049**
Ecuador	6	2.560	0.049**	-0.063	-0.813	0.424	2.797	0.031**

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. K is number of lags in ECM. F-statistic is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = \delta_1 = 0$, and t-statistic is of the Wald statistics test for the significance of the null hypothesis H_0: δ_1=0. Part A and Part B are estimated using equations (3) and (4) respectively.

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\ \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\ \Delta RCR_{\ t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t} \quad (3)$$

$$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\ \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\ \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t} \quad (4)$$

[9] These and all subsequent test results are not reported but are available upon request.

Next we test for causality within a VECM framework for the countries where cointegration holds according to the Johansen tests. The results are reported in Tables 10 and 11 (t-statistic and F-statistics) respectively. Real credit to the private sector causes real GDP in the short run in Argentina and Ecuador at the 1% level, and at the 10% level in Brazil. Bidirectional short-run Granger causality is found in Ecuador. As for the long-run weak-exogeneity tests, the null hypothesis of non-causality from real credit to the private sector to real GDP is rejected in Chile and Ecuador at the 1% level, and in Costa Rica at the 10% level. The error correction term has a negative sign in all countries except Argentina and Brazil. On the other hand, long-run causality from real GDP to real credit to the private sector is found in Argentina and Brazil at the 10% and 1% level respectively (see Table 10, Panel B). Finally, the strong exogeneity tests suggest bidirectional causality in all countries except Peru and Costa Rica (see Table 10).

Table 10. ECM test with Johansen cointegrating vectors for countries without Islamic banks

Panel A: Ho: $\Delta Cr \nrightarrow \Delta GDP$

		SR Granger non-causality test (H_0: $all\ \varphi_{1i} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)			SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{1i} = \delta_1 = 0$)	
Country	K	F-statistic[a]	p-values	Coeff ECT_{t-1}	t-statistic[c]	p-values	F-statistic[b]	p-values
Argentina	5	9.920	0.000***	0.056	4.406	0.000***	13.082	0.000***
Brazil	5	2.086	0.095*	0.116	3.031	0.005**	4.702	0.001***
Chile	3	0.422	0.737	-0.260	-2.720	0.009***	3.587	0.012**
Costa Rica	3	1.091	0.366	-0.187	-1.910	0.064*	1.408	0.252
Ecuador	7	5.449	0.001***	-0.629	-3.830	0.001***	7.991	0.000***
Peru	3	0.276	0.842	-0.021	-0.272	0.785	0.290	0.883

Panel B: Ho: $\Delta GDP \nrightarrow \Delta Cr$

		SR Granger non-causality test (H_0: $all\ \varphi_{2i} = 0$)		LR Weak-exogeneity test (H_0: δ_2=0)			SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{2i} = \delta_1 = 0$)	
Country	K	F-statistic	p-values	Coeff ECT_{t-1}	t-statistic	p-values	F-statistic	p-values
Argentina	5	1.133	0.352	-0.023	-2.298	0.024***	2.561	0.027**
Brazil	5	3.802	0.009***	-0.038	-4.545	0.000***	19.952	0.000***
Chile	3	1.363	0.264	-0.122	-2.108	0.040**	7.006	0.000***
Costa Rica	3	1.826	0.161	-0.120	-2.923	0.006***	6.021	0.000***
Ecuador	7	2.928	0.029**	-0.127	1.372	0.185	2.906	0.026**
Peru	3	1.039	0.381	-0.088	-5.407	0.000***	12.110	0.000***

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. K is number of lags in ECM. In Panel A, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, F-statistic[b] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = \delta_1 = 0$, and t-statistic[c] is of the Wald statistics test for the significance of the null hypothesis H_0: δ_1=0. Panel A and Panel B are estimated using equations (3) and (4) respectively.

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\ \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\ \Delta RCR_{\ t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t} \quad (3)$$

$$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\ \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\ \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t} \quad (4)$$

There is evidence of short-run bidirectional causality in three out of the seven countries with Islamic banks (Iran, Singapore and Tunisia), and short-run unidirectional causality from real credit to the private sector to real GDP in Malaysia (see Table 11, Panel A). The weak exogeneity tests indicate that both variables are weakly exogenous at the 1% level in all countries with Islamic banks (at the 10% level in Indonesia only). Long-run causality from real GDP is found only in Jordan at the 5% level. The strong exogeneity tests imply bidirectional causality except for Indonesia and Turkey (see Table 11). It is noteworthy that in the long run real GDP causes real credit to the private sector in the countries without Islamic banks, while causality runs in the opposite direction in the countries with Islamic banks. In brief, our results provide strong evidence of long-run causality running from real credit to real GDP and weak evidence of bidirectional short-run causality in countries with Islamic banks. In contrast, for the countries without Islamic banks there is strong evidence of long-run causality running from real GDP to real credit.

Table 11. ECM test with Johansen cointegrating vectors for countries with Islamic banks

Panel A :Ho: $\Delta Cr \nrightarrow \Delta GDP$								
		SR Granger non-causality test (H_0: $all\ \varphi_{1i} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)			SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{1i} = \delta_1 = 0$)	
Country	K	F-statistic[a]	*p*-values	Coeff ECT(-1)	t-statistic	*p*-values	F-statistic[b]	*p*-values
Indonesia	5	1.753	0.148	-0.072	-1.952	0.063*	1.578	0.188
Turkey	5	0.966	0.455	-0.461	-2.847	0.008***	1.970	0.105
Iran	6	2.620	0.029**	-0.460	-2.876	0.006***	3.237	0.000***
Singapore	3	3.433	0.030**	-0.039	-4.350	0.000***	7.459	0.000***
Jordan	4	0.331	0.856	-0.087	-3.392	0.001***	3.756	0.004***
Malaysia	4	6.955	0.000***	-0.054	-4.906	0.000***	6.074	0.000***
Tunisia	8	10.525	0.000***	-0.024	-8.585	0.000***	17.717	0.004***
Panel B: Ho: $\Delta GDP \nrightarrow \Delta Cr$								
		SR Granger non-causality test (H_0: $all\ \varphi_{2i} = 0$)		LR Weak-exogeneity test (H_0: δ_2=0)			SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{2i} = \delta_1 = 0$)	
Country	K	F-statistic	*p*-values	Coeff ECT(-1)	t-statistic	*p*-values	F-statistic[a]	*p*-values[a]
Indonesia	5	0.899	0.5241	-0.078	-1.600	0.123	0.794	0.613
Turkey	5	1.124	0.370	-0.056	-1.327	0.195	1.259	0.307
Iran	6	3.496	0.004***	-0.152	-1.912	0.062*	4.305	0.000***
Singapore	3	2.948	0.049**	-0.004	1.674	0.104	2.256	0.000***
Jordan	4	1.301	0. 278	-0.055	-2.457	0.016**	2.045	0.083*
Malaysia	4	1.526	0.219	-0.083	1.800	0.081*	5.352	0.001***
Tunisia	8	4.158	0.004***	-0.008	-1.794	0.085*	7.219	0.000***

Notes: */**/*** represent statistical significance at 10%, 5% and 1% level, respectively. *K* is number of lags in ECM. In Panel A, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, F-statistic[b] is of the Wald statistics test for the significance of the null hypothesi H_0: $all\ \varphi_{1i} = \delta_1 = 0$, and t-statistic[c] is of the Wald statistics test for the significance of the null hypothesis H_0: δ_1=0. Part A and Part B are estimated using equations (3) and (4) respectively.

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\ \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\ \Delta RCR_{\ t-i} + \delta_1 ECT_{t-1} + \epsilon_{1t} \quad (3)$$

$$\Delta RCR_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i}\ \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\ \Delta RGDP_{t-i} + \delta_2 ECT_{t-1} + \epsilon_{2t} \quad (4)$$

These findings can be explained in terms of the principles of Islamic finance. As previously mentioned, Islamic banks spur economic growth by providing credit for productive investment (Gulzar and Masih, 2015; Kammer et al., 2015), their financial transactions being linked to real assets (Siddiqi, 2006 and Askari, 2012). Moreover, they provide credit to households and firms not normally dealing with the financial system for religious reasons, which results in higher financial inclusion and possibly higher economic growth (Imam and Kpodar, 2015). Although Choudhury (1999) found no evidence that Islamic banking stimulates output growth in a sample of countries including Turkey, his results might simply reflect the lack of Shariah law-complaint financial products (see Johnson, 2013). As for the countries without Islamic banks, our findings do not support the idea that credit or financial development has a crucial role in stimulating economic growth (see King and Levine, 1993; and Levine and Zervos, 1998 among others). This could be because the effects of credit and financial services depend on the allocation of loans to productive investment projects (see Ang and McKibbin, 2007). A weak effect could reflect an increase in credit in conjunction with a lack of monitoring from banks (see Moran, 1992, and Gavin and Hausman, 1996). This may lead to an inappropriate choice of projects as well as providing credit to unproductive or speculative activities. As argued by Cecchetti and Kharroubi (2012), finance can be a drag on economic growth once the ratio of credit to the private sector to GDP exceeds 90% - in fact Law and Singh (2014) found this ratio to be 88% for most countries without Islamic bank included in our sample[10].

The results for the cases when there is no cointegration and a VAR in first differences is estimated can be summarised as follows (see Table 12). Among the countries without Islamic banks bidirectional causality is found in Argentina, Brazil and Ecuador, and unidirectional causality from real GDP to real credit in Chile and Peru, whilst there is no evidence of causality in either direction in Costa Rica. These results are similar to those obtained from the ECM tests within the Johansen framework (see Table 10).

[10] The average credit/GDP ratios are 161.63%, 16.15%, 250.64%, 150.99%, 95.27%, 87.02 and 81.85 in Brazil, Argentina, Chile, Costa Rica, Guatemala, Peru, and Ecuador respectively.

As for countries with Islamic banks, causality runs from real credit to real GDP in Singapore, and in the opposite direction in Malaysia; there is bidirectional causality in Iran and Tunisia, and no causality in either directions in Indonesia, Turkey and Jordan. These results are consistent with those from the ECM tests. There is no sign of misspecification according to the diagnostic tests (not reported).

The panel causality test results are shown in Table 13. As already mentioned, the lag length is selected according to the Schwarz Bayesian Criterion subject to the removal of the serial correlation in the error term. In the countries with Islamic banks, long-run causality from real credit to real GDP is found at the 5% level while the F-statistic fails to reject the null hypothesis of no causality in the short run (see Table 13, Panel A2). By contrast, short-run causality from real credit to GDP is found for countries without Islamic banks (see Table 13, Panel A1). There is strong evidence of long-run causality from real GDP to real credit in both sets of countries, but no evidence of short-run causality (see Table 13, Panel B). However, bidirectional causality in the long run is found in the countries with Islamic banks. The diagnostic tests (not reported) suggest data congruence.

Table 12. Causality tests between real GDP and real Credit based on first differences

Panel A. Countries without Islamic Banks.

		Part A: $\Delta Cr \nrightarrow \Delta GDP$ (H_0: $all\ \varphi_{1i} = 0$)		*Part B:* $\Delta GDP \nrightarrow \Delta Cr$ (H_0: $all\ \beta_{2i} = 0$)	
Country	*K*	F-statistic[a]	*p*-values	F-statistic[b]	*p*-values
Argentina	5	7.461	0.000***	4.161	0.002***
Brazil	5	2.094	0.094*	2.258	0.075*
Chile	3	1.145	0.339	7.226	0.000***
Costa Rica	3	0.445	0.721	1.715	0.182
Peru	3	0.384	0.764	3.996	0.011**
Guatemala	5	15.369	0.000***	0.637	0.673
Ecuador	7	2.554	0.049**	2.389	0.059*

Panel B. Countries with Islamic Banks.

		Part A: $\Delta Cr \nrightarrow \Delta GDP$ (H_0: $all\ \varphi_{1i} = 0$)		*Part B:* $\Delta GDP \nrightarrow \Delta Cr$ (H_0: $all\ \beta_{2i} = 0$)	
Country	*K*	F-statistic[a]	*p*-values	F-statistic[b]	*p*-values
Indonesia	5	1.755	0.153	0.583	0.712
Turkey	5	0.592	0.705	1.378	0.262
Iran	6	2.418	0.042**	1.971	0.090*
Singapore	3	5.406	0.004***	1.751	0.177
Jordan	4	0.800	0.529	0.976	0.426
Tunisia	7	5.803	0.000***	4.497	0.002***
Malaysia	4	0.902	0.474	3.448	0.019**

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. *K* is number of lags. In both Panels A and B, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1i} = 0$, and F-statistic[b] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \beta_{2i} = 0$. Part A and Part B are estimated using equations (1) and (2) respectively.

$$\Delta RGDP_t = \alpha_1 + \sum_{i=1}^{k} \beta_{1i}\, \Delta RGDP_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, \Delta \mathrm{RCR}_{\,t-i} + \epsilon_{1t} \qquad (1)$$

$$\Delta \mathrm{RCR}_t = \alpha_2 + \sum_{i=1}^{k} \varphi_{2i} \Delta RCR_{t-i} + \sum_{i=1}^{k} \beta_{2i}\, \Delta \mathrm{RGDP}_{\,t-i} + \epsilon_{2t} \qquad (2)$$

On the whole, the long-run results obtained from the two approaches are rather similar: both suggest that real GDP causes real credit in the countries without Islamic banks except for Ecuador, whereas there is causality in the opposite direction in the countries with Islamic banks. Bidirectional long-run causality is found in two countries without Islamic banks (Chile and Ecuador, at the 1% level) and one with Islamic banks (Jordan, at the 5% level). However, there are differences between the two sets of short-run results: the panel tests suggest that short-run causality runs from real credit to real GDP in countries without Islamic banks (and that there is bidirectional causality in three of them, i.e. Iran, Singapore and Tunisia), whilst the time-series ones do not detect any.

Table 13. Results of the Panel causality tests

Panel A :$Ho: \Delta Cr \nrightarrow \Delta GDP$						
	SR Granger non-causality test (H_0: $all\ \varphi_{1,i,k} = 0$)		LR Weak-exogeneity test (H_0: δ_1=0)		SR+LR Strong-exogeneity test(H_0:$all\ \varphi_{1,i,k} = \delta_{1,i} = 0$)	
K	F-statistic	*p*-values	t-statistic	*p*-values	F-statistic[a]	*p*-values
Panel A1. Countries Without Islamic banks						
5	5.315	0.000***	-0.495	0.620	5.240	0.000***
Panel A2. Countries With Islamic banks						
5	0.875	0.453	-2.471	0.014**	2.119	0.078*
Panel A2. All Countries						
6	3.83	0.009***	-0.367	0.713	3.433	0.004***
Panel B: $Ho: \Delta GDP \nrightarrow \Delta Cr$						
	SR Granger non-causality test (H_0: $all\ \beta_{2,i,k} = 0$)		LR Weak-exogeneity test (H_0: $\delta_{2,i}$=0)		SR+LR Strong-exogeneity test(H_0:$all\ \beta_{2,i,k} = \delta_{2,i} = 0$)	
K	F-statistic	*p*-values	t-statistic	*p*-values	F-statistic[a]	*p*-values[a]
Panel B1. Countries Without Islamic banks						
5	1.247	0.290	-3.446	0.000***	3.153	0.008***
Panel B2. Countries With Islamic banks						
5	0.845	0.469	-2.109	0.035**	1.581	0.179
Panel B3. All Countries						
6	1.015	0.398	-2.311	0.021**	1.840	0.102

Notes: */**/*** represent statistical significance at the 10%, 5% and 1% level, respectively. *K* is number of lags in ECM. Total panel observations are 355, 338, and 677 for countries without Islamic banks, with Islamic banks and all countries respectively. F-statistic is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1,i,k} = 0$, F-statistic[a] is of the Wald statistics test for the significance of the null hypothesis H_0: $all\ \varphi_{1,i,k} = \delta_{1i} = 0$, and t-statistic is of the Wald statistics test for the significance of the null hypothesis H_0: δ_{1i}=0. Panel A and Panel B are estimated using equations (5) and (6) respectively

$$\Delta RGDP_{it} = \alpha_{1i} + \sum_{K=1}^{m} \beta_{1,i,k}\ \Delta RGDP_{i,t-k} + \sum_{k=1}^{m} \varphi_{1,i,k}\ \Delta \mathrm{RCR}_{\ i,t-k} + \delta_{1i} ECT_{i,t-1} + \epsilon_{1it} \quad (5)$$

$$\Delta RCR_{it} = \alpha_{2i} + \sum_{k=1}^{m} \varphi_{2,i,k}\ \Delta RCR_{i,t-k} + \sum_{k=1}^{m} \beta_{2,i,k}\ \Delta RGDP_{\ i,t-k} + \delta_{2i} ECT_{i,t-1} + \epsilon_{2it} \quad (6)$$

6. Conclusions

This paper has examined the relationship between real credit to the private sector and real GDP in two sets of emerging countries, with and without Islamic banks, with the aim of shedding light on the effects of Islamic banking on economic growth. Our extensive cointegration and causality analysis provides strong evidence of long-run causality running from real credit to real GDP and weak evidence of short-run causality in both directions in the countries with Islamic banks. In contrast, long-run causality appears to run in the opposite direction, i.e., from real GDP to real credit, in the countries without Islamic banks. These differences between the two sets of countries can be plausibly attributed to the distinctive features of Islamic banks, which provide loans to projects that are directly linked to real economic activities and are not allowed to engage in speculative transactions, in this way improving the allocation of resources in the economy and boosting long-run economic growth.

Therefore one could argue that policy makers aiming to stimulate growth should regulate commercial banks to increase the proportion of credit to productive investment and impose limits on engaging in speculative transactions; this is clearly an important issue, given the current debate on the causes of the global financial crisis, and the mounting evidence that excessive credit growth to finance speculative, unproductive activities was one of its main causes (see Bernanke, 2009 and Turner, 2009). In addition, they should favour a bigger market share for Islamic banks in the countries where they are present.

Future research should also consider possible nonlinearities in the relationship between credit and growth, and examine the robustness of the results by using other measures of credit such as total credit, the credit-to-GDP gap, credit to non-financial sector etc. (see Drehmann et al. 2011, and Drehmann and Tsatsaronis, 2014).[11]

[11] Note, however, that the new data set constructed by the BIS (Total credit to the non-financial sector) is only available for 40 advanced and emerging economies.

Appendix A

Islamic Financial models

Islamic Financial models	Explanation
Musharaka (partnership)	It is built on the idea of equity participation. Under Musharaka contract, each participant pays a percentage of the capital in the company. The profits or losses generated from the business will be shared between the owners based on an agreed profits and losses share called PLS (Ariff, 1988).
Mudharabah (profit-sharing)	Mudharabah is a contract between two parties: one party supplies the capital of the company, while the other party will be considered as an entrepreneur. Therefore, the Islamic bank becomes a shareholder on the bases that any profit or loss occurring from the business is shared between the two parties on a per-determined profit sharing percentage (Haron et al., 1994).
Murabahah (cost plus)	It is a financial contract for buying and selling a particular product. A Murabahah contract should specify the price, the cost of the item and the profit margin at the time of signing the contract. The role of the bank in a Murabahah financial instrument is to finance purchasing the good by buying it on the behalf of the customer. The bank will resell it to the customer after adding a mark-up to the cost price (Ariff, 1988; Haron et al., 1994).
Ijarah (leasing)	The Ijarah refers to an agreement between the lessor and the client to rent for example machinery, vehicles, a shop or any other equipment. An Islamic bank using an Ijarah financial instrument will buy the machinery or any other equipment and lease it to its customers for an agreed rent. If the customer requires the bank to buy the equipment as well, the rent and a monthly instalment as a part of the purchase will be incurred. (Zaher and Hassan, 2001).

References

Abduh, M. & Omar, M.A. (2012) "Islamic banking and economic growth: the Indonesian experience", *International Journal of Islamic and Middle Eastern Finance and Management,* 5(1), 35-47.

Ang, J.B. (2008) "A survey of recent developments in the literature of finance and growth", *Journal of Economic Surveys,* 22(3), 536-576.

Ang, J.B. & McKibbin, W.J. (2007) "Financial liberalization, financial sector development and growth: evidence from Malaysia", *Journal of Development Economics,* 84(1), 215-233.

Ariff, M. (1988) "Islamic Banking", *Asian-Pacific Economic Literature*, 2(2), 48-64.

Askari, H. (2012) "Islamic finance, risk-sharing, and international financial stability", *Yale Journal of International Affair,* 7(1), 1–8.

Asteriou, D. & Hall, S. (2015) *Applied econometrics,* 3nd edn, Palgrave Macmillan, Basingstoke.

Banerjee, A. (1999) "Panel data unit roots and cointegration: an overview", *Oxford Bulletin of Economics and Statistics,* 61(S1), 607-629.

Banerjee A, Dolado J.J., Galbraith JW. & Hendry DF. (1993), *Co-integration, Error Correction, and the Econometric Analysis of Non-Stationary Data*. Oxford University Press: Oxford.

Banerjee, A., Dolado, J.J., Hendry, D.F. & Smith, G.W. (1986) "Exploring equilibrium relationships in econometrics through static models: some Monte Carlo evidence", *Oxford Bulletin of Economics and Statistics,* 48(3), 253-277.

Basel Committee on Banking Supervision (BCBS) (2010) Guidance for national authorities operating the countercyclical capital buffer Basel Committee, Switzerland, December.

Beck, T., Degryse, H. & Kneer, C. (2014) "Is more finance better? Disentangling intermediation and size effects of financial systems", *Journal of Financial Stability,* 10(0), 50-64.

Berg, N. & Kim, J. (2014) "Prohibition of Riba and Gharar: A signaling and screening explanation?", *Journal of Economic Behavior & Organization,* 103, S146-S159.

Bernanke, B.S. (2009)"The crisis and the policy response", *Speech at the Stamp Lecture, London School of Economics, London, 13 January.*

Berthelemy, J. & Varoudakis, A. (1996) "Economic growth, convergence clubs, and the role of financial development", *Oxford Economic Papers,* 48(2), 300-328.

Breitung, J. & Pesaran, M.H. (2008) *Unit Roots and Cointegration in Panels*, Springer Berlin Heidelberg.

Breusch, T.S. & Pagan, A.R. (1979) "A simple test for heteroscedasticity and random coefficient variation", *Econometrica*, 46, 1287-1294.

Cecchetti, S.G. & Kharroubi, E. (2012) "Reassessing the impact of finance on growth", *BIS Working Paper Series*, No. 381.

Chang, T. & Caudill, S.B. (2005) "Financial development and economic growth: the case of Taiwan", *Applied Economics*, 37(12), 1329-1335.

Chapra, M.U., (1992) Islam and the Economic Challenge. Islamic Economic Series, vol. 17. Islamic Foundation, Leicester, UK.

Cheung, Y. & Lai, K.S. (1993) "Finite-sample sizes of Johansen's likelihood ratio tests for cointegration", *Oxford Bulletin of Economics and Statistics*, 55(3), 313-328.

Chong, B.S. & Liu, M. (2009) "Islamic banking: interest-free or interest-based?", *Pacific-Basin Finance Journal*, 17(1), 125-144.

Choudhury, M. (1999) "Resource mobilization and development goals for Islamic banks", *Proceedings of the Second Harvard University Forum on Islamic Finance: Islamic Finance into the 21st Century*, 31-50

Christopoulos, D.K. & Tsionas, E.G. (2004) "Financial development and economic growth: evidence from panel unit root and cointegration tests", *Journal of Development Economics*, 73(1), 55-74.

Dembiermont, C., Drehmann, M. & Muksakunratana, S. (2013) "How much does the private sector really borrow? a new database for total credit to the private non-financial sector", *BIS Quarterly Review, March*, 65–81.

Demetriades, P.O. & Hussein, K.A. (1996) "Does financial development cause economic growth? Time-series evidence from 16 countries", *Journal of Development Economics*, 51(2), 387-411.

Di Mauro, F., Caristi, P., Couderc, S., Di Maria, A., Ho, L., Kaur Grewal, B., Masciantonio, S., Ongena, S. & Zaheer, S. (2013) "Islamic finance in Europe", *Occasional Paper Series No. 146. European Central Bank.*

Dickey, D.A. & Fuller, W.A. (1981) "Likelihood ratio statistics for autoregressive time series with a unit root", *Econometrica*, 49, 1057-1072.

Dimitraki, O. & Menla Ali, F. (2015) "The long-run causal relationship between military expenditure and economic growth in china: revisited", *Defence and Peace Economics*, 26(3), 311-326.

Kremers, J.J., Ericsson, N.R. & Dolado, J.J. (1992) "The power of cointegration tests", *Oxford Bulletin of Economics and Statistics*, 54(3), 325-348.

Drehmann, M. (2013) "Total credit as an early warning indicator for systemic banking crises", *BIS Quarterly Review, June, 41-45*.

Drehmann, M., Borio, C. & Tsatsaronis, K. (2011) "Anchoring countercyclical capital buffers: the role of credit aggregates", *International Journal of Central Banking*, 7(4), 189-240.

Drehmann, M. & Tsatsaronis, K. (2014) "The credit-to-GDP gap and countercyclical capital buffers: questions and answers", *BIS Quarterly Review, March, 55–73*.

El-Gamal, M.A. (2006) Islamic *finance: Law, economics, and practice*, Cambridge University Press, New York.

Engle, R.F. & Granger, C.W. (1987) "Co-integration and error correction: representation, estimation, and testing", *Econometrica, 55*, 251-276.

Furqani, H. & Mulyany, R. (2009) "Islamic banking and economic growth: empirical evidence from Malaysia", *Journal of Economic Cooperation and Development*, 30(2), 59-74.

Gavin, M. & Ricardo, H. (1996) "The roots of banking crises: the macroeconomic context," in Ricardo Hausmann and Liliana Rojas-Suarez (eds), Banking crises in Latin America, Baltimore: Johns Hopkins University Press.

Gulzar, R. & Masih, A. (2015) "Islamic banking: 40 years later, still interest-based? Evidence from Malaysia", MPRA Paper, University Library of Munich, Germany. Available at http://EconPapers.repec.org/RePEc:pra:mprapa:65840.

Hansen, N.J. & Sulla, O. (2013) "Credit growth in Latin America: financial development or credit boom?" *IMF Working Paper* 13(106).

Haron, S., Ahmad, N. & Planisek, S.L. (1994) "Bank patronage factors of Muslim and non-Muslim customers", *International Journal of Bank Marketing*, 12(1), 32-40.

Harris, R. & Sollis, R. (2003) *Applied Time Series Modelling and Forecasting*. Chichester, UK: Wiley.

Hasan, M. & Dridi, J., (2010) "The effects of the global crisis on Islamic and conventional banks: a comparative study "*IMF Working Paper* 10(201).

Hunter, J. & Menla Ali, F. (2014) "Money demand instability and real exchange rate persistence in the monetary model of USD–JPY exchange rate", *Economic Modelling*, 40, 42-51.

Im, K.S., Pesaran, M.H. & Shin, Y. (2003) "Testing for unit roots in heterogeneous panels", *Journal of Econometrics*, 115(1), 53-74.

Imam, P. & Kpodar, K. (2015) "Is Islamic banking good for growth?", *IMF working paper, 15(81).*

Johansen, S. (1988) "Statistical analysis of cointegration vectors", *Journal of Economic Dynamics and Control,* 12(2), 231-254.

Johansen, S. (1995) *Likelihood-based inference in cointegrated vector autoregressive models,* Oxford University Press, Oxford; New York.

Johnson, K. (2013) "The role of Islamic banking in economic growth", CMC Senior Theses. Paper 642. Available at http://scholarship.claremont.edu/cmc_theses/642.

Juselius, K. & MacDonald, R. (2004) "International parity relationships between the USA and Japan", *Japan and the World economy,* 16(1), 17-34.

Kammer, M.A., Norat, M.M., Pinon, M.M., Prasad, A., Towe, M.C.M. & Zeidane, M.Z. (2015) "*Islamic finance: opportunities, challenges, and policy options", IMF Staff Papers* 15(5), 1-38.

Kao, C. (1999) "Spurious regression and residual-based tests for cointegration in panel data", *Journal of Econometrics,* 90(1), pp. 1-44.

Kao, C. & Chiang, M.-H. (2000) "On the estimation and inference of a cointegrated regression in panel data", in Baltagi B. H. (ed.), Advances in Econometrics: Nonstationary Panels, Panel Cointegration and Dynamic Panels, 15, 179–222.

Khan, F. (2010) "How 'Islamic' is Islamic banking?", *Journal of Economic Behavior & Organization,* 76(3), 805-820.

King, R.G. & Levine, R. 1993, "Finance, entrepreneurship and growth", *Journal of Monetary Economics,* 32(3), 513-542.

Lanne, M., Lütkepohl, H. & Saikkonen, P. (2002) "Comparison of unit root tests for time series with level shifts", *Journal of time series analysis,* (23) 6, 667-685.

Law, S.H. & Singh, N. (2014) "Does too much finance harm economic growth?", *Journal of Banking & Finance,* (41), 36-44.

Levin, A.T. & Lin, C. (1993) "Unit root tests in panel data: new results", *University of California at San Diego, Discussion Paper No. 93-56.*

Levine, R. & Zervos, S. (1998) "Stock markets, banks, and economic growth", *American economic review, 88,* 537-558.

Luintel, K.B. & Khan, M. (1999) "A quantitative reassessment of the finance–growth nexus: evidence from a multivariate VAR", *Journal of Development Economics,* 60(2), 381-405.

MacKinnon, J.G. (1996) "Numerical distribution functions for unit root and cointegration tests", *Journal of Applied Econometrics,* (11) 6, 601-618.

Maddala, G.S. & Wu, S. (1999) "A comparative study of unit root tests with panel data and a new simple test", *Oxford Bulletin of Economics and Statistics,* 61(S1), 631-652.

Majid, S.A. & Kassim, S. (2010) "Islamic finance and economic growth: The Malaysian experience". Paper presented in Kuala Lumpur Islamic Finance Forum, Kuala Lumpur, 2-5 August 2010.

McKinnon, R.I. (1973) *Money and capital in economic development,* the Brookings Institution, Washington, D. C.

Mills, P.S. & Presley, J.R. (1999) Islamic Finance: Theory and Practice. St. Martins Press, New York.

Mohieldin, M. (2012) "Realising the potential of Islamic finance", *World Economics,* 13(3), 127-142.

Moran, M. (1992) V. sundararajan and T. baliño, eds. banking crises: Cases and issues, washington, D.C.: *International monetary fund*, 1991.

Pedroni, P. (2004) "Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis", *Econometric theory,* 20(03), 597-625.

Persyn, D. & Westerlund, J. (2008) "Error-correction-based cointegration tests for panel data", *Stata Journal,* (8) 2, 232.

Phillips, P.C. & Perron, P. (1988) "Testing for a unit root in time series regression", *Biometrika,* 75(2), 335-346.

Robinson, J. (1953) The r*ate of Interest and Other Essays,* Magmillan, London.

Rousseau, P.L. & Wachtel, P. (2011) "What is happening to the impact of financial deepening on economic growth?", *Economic inquiry,* 49(1), 276-288.

Schumpeter, J., (1911) *The theory of economic development,* Harvard University Press, Cambridge, MA.

Shaw, E.S., (1973) *Financial deepening in economic development,* Oxford University Press, New York.

Siddiqi, M.N. (1999) "Islamic finance and beyond: premises and promises of Islamic economics", *Proceedings of the Third Harvard University Forum on Islamic Finance: Local Challenges, Global Opportunities*.

Siddiqi, M.N. (2006) "Islamic banking and finance in theory and practice: A Survey of state of the Art", *Islamic Economic Studies,* 13(2), 1-48.

Turner, A. (2009) "A regulatory response to the global banking crisis", *Financial Services Authority, London.*

Westerlund, J. (2007) "Testing for error correction in panel data*", *Oxford Bulletin of Economics and Statistics,* 69(6), 709-748.

Zaher, T.S. & Kabir Hassan, M. (2001) "A comparative literature survey of Islamic finance and banking", *Financial Markets, Institutions & Instruments,* 10(4), 155-199.