The impact of innovation on banking performance: Evidence from Lebanese banking sector

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Abstract

This study examines the impact of innovation on performance of the Lebanese banks during 7 years period from 2009 to 2015. Based on a sample of seventeen Lebanese owned commercial banks, a Weighted Least Squares model was employed to investigate the relationship between two banking innovations, namely mobile banking and investment in computer software and banks' performance as measured by Return-On-Assets and Return-On-Equity. Four control variables were included in the study specifically bank's capitalization, cost efficiency, asset quality and bank's size. The findings of the study showed that the two innovations studied have both significant but opposite impact on banks' performance.

Keywords: innovation, mobile banking, computer software, banking performance, Lebanese banking sector, Lebanese owned commercial banks, Weighted Least Squares.

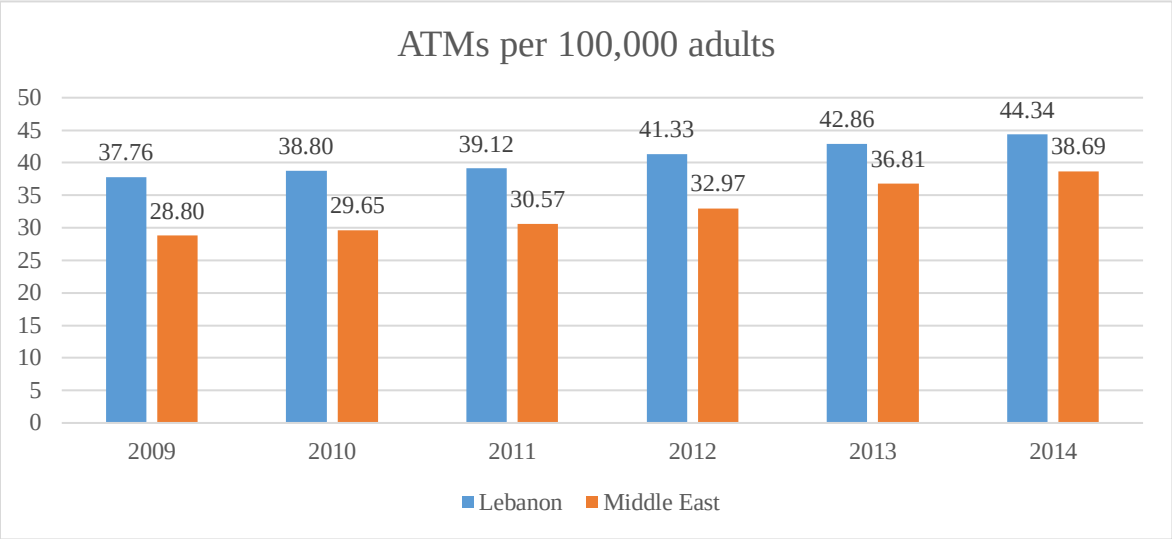
1. Introduction

Innovation is the application of better solutions that meet new requirements, in articulated or existing market needs. This is accomplished through more effective products, processes, services, technologies, or ideas that are readily available to markets, governments and society (Boston Consulting Group, 2009). Technological innovations affect banking sector as much as other economic sectors. DeYoung (2001) has forecasted that technological progress will destroy the models used in developing and delivering services in banks and will replace them with new and original ones.

In Lebanon, the banking sector is characterized by its high involvement in innovation. Most of Lebanese banks have high standards of excellence in terms of technology, high tech facilities, customer services and customer orientation where all transactions and operations are computerized (Sarji, 2017). Lebanese banking sector is always developing new means of payments and remote banking systems that facilitates banking transactions (ABL, 2014). They

have offered new delivery channels like Point Of Sale (POS) terminals, mobile banking and Automated Teller Machines (ATMs). The number of ATMs has reached 1,597 in 2014 distributed all around Lebanese territory (ABL, 2014). Moreover, according to World bank (2017), the number of ATMs per 100,000 adults in Lebanon is higher than the average in middle eastern countries between 2009 and 2014 (See figure 1 below).

Figure 1 - Number of ATMs per 100,000 adults: Comparison between Lebanon and Middle East.



Source: World Bank (2017)

Furthermore, the number of cards issued by banking system in Lebanon has reached 2.4 million cards in 2014 (ABL, 2014). Finally, according to BLOMINVEST (2016), 93% of Lebanese commercial banks offer digital banking services while only 7% of banks in Lebanon do not offer these services.

Despite the fact that Lebanese banking sector is highly affected by technological progress, few researchers have studied the impact of innovation on banking performance (Sujud and Hashem, 2017) compared to the number of researchers that have studied the same topic worldwide (Beccalli, 2007; Onay *et al.*, 2008; Al-Samadi and Al-Wabel, 2011; Akhisar *et al.*, 2015). These researchers have accused technological advances of the decreased performance encountered by many banks around the world during the global financial crisis of 2007-2009.

The results of the different studies were contradictory. Some researchers have found that banking innovations have positive impact on bank's performance (Onay *et al.*, 2008; Kithaka, 2014; Ben Romdhane, 2013), while others have showed that banking innovations negatively affect bank's performance (Al-Samadi and Al-Wabel, 2011). In addition, there are some studies that haven't found any significant association between innovation and banking performance (Khrawish and Al-Sa'di, 2011; Samout, 2016).

Consequently, there is a necessity to carry out a study in Lebanese banking sector that examines the relationship between financial innovations and banks' performance. Thus, the main objective of this study is to investigate the impact of different banking innovations, namely mobile banking and investment in computer software on Lebanese banks' performance. In order to achieve this purpose, a Weighted Least Squares regression was employed using unbalanced panel data from 17 Lebanese owned commercial banks from 2009-2015.

This research first, reviews the theoretical and empirical literature related to innovation and banks' performance. Second, it presents the research methodology employed to attain the objective of the study. Third, it provides the findings of the research and discusses them. Finally, it concludes.

2. The impact of innovation on banking performance: Theoretical and empirical evidence

Many researchers have examined the relationship between innovation and banks' performance theoretically and empirically. This study provides first, the Solow Paradox theory. Second, it discusses the impact of mobile banking and investment in computer software on banks performance. And finally, it provides an empirical evidence.

2.1. Solow Paradox Theory

The Solow paradox also called productivity paradox is originated by Robert Solow, a Nobel Prize winner in economics. During 1970s and 1980s, the United States (US) have witnessed a slowdown of productivity growth. The average labor productivity between 1947 and 1973 was 2.4% compared to 1% between 1973 and 1988 (Federal Reserve Bank of Richmond, 1989). This decrease in productivity was observed in spite of the huge development in Information

Technology (IT) investment. Accordingly, Solow (1987), as cited by Ben Romdhane (2013), has stated during his Nobel speech that "you can see the computer age everywhere but in the productivity statistics". Thus, the investment in IT has no impact on productivity. As result, many academic researchers have failed to prove any significance between IT investment and the increase in overall productivity in US (Yosri, 1992; Weill, 1992). Significant productivity can be attributed to transactional types of IT, but there are no gains associated with strategic systems or IT investment (Weill, 1992).

Many studies tried to explain the productivity paradox (Brynjolfsson, 1993). According to Brynjolfsson (1993), there are 4 categories to group the various explanations proposed: (1) Mismeasurement of outputs and inputs, (2) Lags due to learning and adjustment, (3) Redistribution and dissipation of profits, and (4) Mismanagement of information and technology.

Some other studies have resolved the productivity paradox, by proving that there is a delay between IT investment and productivity jump (Dewan and Kraemer, 1998). IT investments are productive, but their benefits are realized only after a lag period, during which complementary capital investments must be developed to allow for the use of computers to their full potential (David, 1990). Finally, many economists do not approve the existence of a productivity paradox. They view it more as a series of unwanted assumptions about the impact of IT on productivity than a paradox (David, 1990).

2.2. Mobile Banking and Financial Performance

Mobile banking, as previously defined, is a form of innovation that is used to make transactions through bank application downloaded on smart phones that are transformed into pocket banks. It refers to providing financial and banking services with the help of mobile telecommunication devices. These services are performed distantly from traditional branches. As a result, mobile banking could be denoted as branchless banking. Some authors consider mobile banking as an appendage of e-banking (Abaenewe *et al*., 2013), while others consider it as a separate delivery channel (Mwange, 2013)

Banking services that could be provided by mobile banking are in general: checking accounts balances, checking new products and services, simulating loans, monitoring transactions,

locating traditional branches and ATMs, transferring funds, converting currencies, paying bills and much more services. The diversification of these services depends on the degree of banks' involvement in innovation.

Many researchers have reviewed the impact of mobile banking on banks financial performance. As previously mentioned, the Solow paradox is the main theory used to explain the impact of mobile banking, and generally of IT investment, on banks productivity and performance. In many studies, Solow paradox has been rejected. According to Mwange (2013), mobile banking leads to higher financial performance through higher operational efficiency. This latter is achieved through conducting targeted marketing campaigns based on tracking customers' preferences. In consequence, bank's expenses in terms of marketing will decrease. Moreover, it is achieved through decreasing staff numbers since less face to face transactions are performed. Wishart (2006) stated that mobile banking could lead to higher customer loyalty, increased market shares and declining operational costs. According to Tiwari *et al*. (2006), 15% of banks customers would change their banks if it fails to provide mobile banking services in Germany. Mania (2012) has stated that mobile banking positively affect financial performance since banks could serve a larger number of customers within a shorter period of time. This positive relationship was supported by many researchers at different significance levels (Abaenewe *et al*., 2013; Kithaka, 2014; Kathuo *et al.*, 2015). Paradoxically, in line with Solow paradox, other researchers could not find any significant relationship between mobile banking and bank's financial performance (Alber, 2010; Mutua, 2013). According to Alber (2010), this insignificant relationship is attributed to 2 main reasons. First, high perceived risk in mobile banking and low confidentiality. And second, low knowledge about different services in mobile banking. Based on the previous discussion, this research considers that mobile banking positively affects banking performance.

H_1: Mobile banking has a significant positive impact on bank's performance.

2.3. Investment in Computer Software and Financial Performance

Computer software is an intangible asset. It is an essential component of IT in banks, which includes mainly hardware, software and IT services. The impact of investment in computer software on bank's financial performance has been widely studied in literature. Researchers have

either studied the impact of IT components together on financial performance (Jalal-karim and Hamdan, 2010) or examined the effect of different IT components on bank's financial performance separately (Beccalli, 2007; Ben Romdhane, 2013).

Beccalli (2007) has found evidence of Solow paradox theory when studying the impact of IT on financial performance of European Union (EU) banks. She found that IT investment has no clear effect on bank's performance measures (Return-On-Assets (ROA), Return-On-Equity (ROE) and efficiency). In conclusion, she recommended banks to decrease their investment in both hardware and software in order to increase their financial performance. Many other researchers have found support of this theory (Licht and Moch, 1999; Oluwagbemi *et al.,* 2011). However, Ben Romdhane (2013) have contradicted the Solow paradox and found evidence that IT investment in terms of hardware, software and IT services positively affect banks' efficiency. Also, both Lichtenberg (1995) and Prasad and Harker (1997) studies have contradicted this paradox. Chen and Zu (2004) have stressed on the necessity of IT investment for a better performance. Furthermore, Markus and Soh (1993) have supported the Solow paradox in small banks, while they found a contradiction of this paradox in large banks. Based on this, computer software is expected to positively affect banking performance.

H_2: Investment in computer software has a significant positive impact on bank's performance.

2.4. Empirical studies: Impact of innovation on banking performance

The studies that have examined the impact of innovation on banks' performance are numerous. This research divides them based on the sample region as follow: (1) international and (2) Middle East and North Africa (MENA) studies. Tables 1 and 2 below represents these two types respectively.

Table 1 - International Evidence: The impact of innovation on bank's performance

Study	Country	Purpose	Methodology	Variables	Results
Beccalli (2007)	European countries (Germany, France, Spain, Italy, UK)	The impact of different IT investments on banks' performance	*Sample:* • 737 banks *Period:* • 1993-2000 *Method:* • Ordinary Least Squares • Two-Stage Least Squares	*Dependent:* • ROA • ROE • Cost efficiency • Profit efficiency *Independent:* • IT to equity; • Computer hardware and software investments; • IT services (consulting, training, implementation and support) investment	IT to equity: • Significant negative impact on short term ROA and ROE • Significant positive impact on efficiency Computer hardware and software investments: • Negative impact on ROA, ROE and profit efficiency IT services: • Positive impact on ROA, ROE and profit efficiency
Onay *et al*. (2008)	Turkey	The impact of internet banking on banks' performance	*Sample:* • 14 commercial and saving banks *Period*: • 1996-2005 *Method*: • Generalized Least Squares	*Dependent:* • ROA • ROE • Return on financial intermediation margin *Independent:* • Presence of internet banking • Deposits to total assets • Percentage change in GDP per capita • Loans to total assets • Bank crisis • Lending rate	Internet banking: • Positive impact on all performance measures. Deposits to total assets and percentage change in GDP per capita: • Positive impact on all performance measures Loans to total assets and bank crisis: • Negative impact on all performance measures Lending rate: • Negative impact on ROA • Positive impact

					on ROE and return on the financial intermediation margin
European Central Bank (2009)	27 European countries	The relationship between bank performance and retail payment business	*Sample:* • 3,370 commercial, saving and cooperative banks *Period*: • 2000-2007 *Method*: • Multivariate regression	*Dependent:* • ROA • ROE • Profit efficiency • Cost efficiency *Independent:* • Log of number of transactions to population • Log of number of ATMs to total population • Log of number of retail payment offices to population • Economic growth. *Control:* • Bank risk • Bank stability • Industry concentration • Percentage of paper-based retail payment instruments (checks).	Log of number of transactions to population and Log of number of ATMs to total population • Positive impact on all performance measures Log of number of retail payment offices to population • Not significant with all performance measures.
Mwange (2011)	Kenya	The impact of mobile banking on banks' performance	*Sample:* • 25 commercial banks *Period*: • 2008-2012 *Method*: Multiple regression	*Dependent:* • ROA *Independent:* • Cost of investment in mobile banking • Number of customers registered on mobile banking • Number of mobile banking transactions.	Cost of investment in mobile banking and number of mobile banking transactions: • positive impact on ROA Number of customers registered on mobile banking • Negative impact on ROA
Kithaka (2014)	Nigeria	The impact of mobile banking on banks'	*Sample:* • 43 commercial banks *Period*:	*Dependent:* • ROA • ROE *Independent:*	All variables: • positive impact on all performance

		performance	• 2009-2013 *Method*: Multiple regression	• Annual amount of money moved through mobile banking • Number of users of mobile banking • Equity to assets ratio • Loans loss provision to total loans ratio • Loans to assets ratio • Operating cost to total income ratio	measures.
Akhisar *et al*. (2015)	23 developed and developing countries	The impact of innovation on banks' performance	*Period*: • 2005-2013 *Method*: Generalized Method of Moments	*Dependent:* • ROA • ROE *Independent:* • Number of cards issued by banks • Number of POS terminals • Number of ATMs to number of branches ratio • Number of customers using internet banking.	Number of customers using internet banking and number of POS terminals • Negative impact on all performance measures. Number of cards issued by banks and number of ATMs to number of branches • Positive impact on all performance measures

Table 2 - MENA Evidence: The impact of innovation on bank's performance

Study	Country	Purpose	Methodology	Variables	Results
Jalal-karim and Hamdan (2010)	Jordan	The impact of IT on banks' performance	*Sample:* • 15 listed banks *Period:* • 2003-2007 *Method:* • Pooled Least Squares	*Dependent:* • ROE • Earnings Per Share (EPS) • Market Value Added (MVA) • ROA • Net Profit Margin (NPM) *Independent:* • Investment in software, • Investment in hardware • Presence of phone banking, • Presence of internet banking, • Presence of SMS banking • Presence of cyber branches • Number of ATMs. *Control:* • Bank's size, • Deposits to assets • Credits to assets	ROE model: • Insignificant EPS, MVA, ROA and NPM models: • Highly significant
Alber (2011)	Saudi Arabia	The impact of banking expansion on profit efficiency	*Sample:* • 6 banks *Period:* • 1998-2007 *Method:* • Regression analysis	*Dependent:* • Actual ROA over best ROA ratio • Actual ROE over best ROE ratio • Actual Return-On-Capital (ROC) over best ROC ratio *Independent:* • Number of branches • Number of ATMs, • Number of POS machines • Presence of phone banking • Presence of computer banking • Presence of mobile banking	Number of branches: • Negative impact on ROE ratio • Insignificant with the other two ratios Number of ATMs: • Negative impact on all measures Phone banking: • Positive impact on all measures Number of POS, the presence of both computer and mobile banking: • Insignificant impact on all measures
Al-Samadi	Jordan	The impact of	*Sample:* • 15	*Dependent:* • ROE	Presence of e-banking, inflation rate and loans to

and Al-Wabel (2011)		innovation on banks' performance	commercial banks *Period:* • 2000-2010 *Method:* • Ordinary Least Squares	*Independent:* • Presence of e-banking services • Equity to assets • Nonperforming loans to total loans • Natural log of total assets • Loans to deposits • Operating costs to total assets • GDP growth • Inflation rate	deposits: • Negative impact on ROE Natural log of total assets, nonperforming loans and GDP growth: • Positive impact on ROE. Equity to assets and operating costs to total assets: • Insignificant impact on ROE.
Ben Romdhane (2013)	Tunis	The impact of IT on banks' performance	*Sample:* • 15 commercial banks *Period:* • 1998-2009 *Method:* • Standard Stochastic Frontier Approach	*Dependent:* • Cost efficiency *Independent:* • Technology investment (hardware and software, training and maintenance) *Control:* • Net interest income to GDP ratio, • Log of total assets, • Outstanding debts to total loans.	Investment in IT and log of total assets: • Positive impact on cost efficiency. Outstanding debts to total loans: • Positive impact on cost efficiency. Net interest income to GDP ratio: • Insignificant impact on cost efficiency.
Samout (2016)	Tunis	The impact of financial innovation on banks' performance	*Sample:* • 11 commercial banks *Period:* • 2005-2014 *Method:* • Regression analysis	*Dependent:* • ROE *Independent:* • Volume of financial resources • Level of diversification • Level of competition • Bank's size	Volume of financial resources and level of competition: • Insignificant impact on performance. Bank's size and diversification: • Positive impact on performance
Sujud and Hashem (2017)	Lebanon	The impact of innovation on banks' profitability and performance	*Sample:* • 200 senior managers from different banks' departments. *Method:* • 5-point Likert scale questionnaire • Regression	*Dependent:* • Profitability • ROA *Independent:* • ATMs • Credit and debit cards • Electronic funds transfer • Mobile banking • Internet banking • POS terminals	ATMs and POS terminals: • Insignificant impact on profitability and ROA Credit and debit cards: • Insignificant impact on profitability • Positive impact on ROA Electronic funds transfer: • Positive impact on

			analysis		profitability • Insignificant impact on ROA Mobile banking: • Eliminated in profitability model due to multicollinearity • Insignificant impact on ROA Internet banking: • Insignificant impact on profitability • Eliminated in ROA model due to multicollinearity

3. Research Methodology

The research methodology defines the process used to collect data for the empirical study. It is divided into four parts. The first presents the target population and sample. The second indicates the data sources. The third specifies how variables are measured. The last discusses the analysis techniques used.

3.1. Target population and sample

According to the Lebanese central bank database, there are 49 commercial banks in Lebanon. Based on their ownership, they could be divided into four groups: 32 Lebanese owned banks, 7 mixed (Lebanese and Arab) owned, 7 only Arab owned and 3 foreign owned banks. The population of this study is the Lebanese owned commercial banks. Foreign, Arab and mixed owned banks were excluded to ensure uniformity of the sample.

A non-probability sampling was used in order to select 17 banks. As a result, the sample represents 53.125% (17/32) of the total population. Other Lebanese owned banks were excluded due to lack of information in their annual reports. The total assets of the sample represent 88.78% of the total assets of Lebanese owned banks in 2015. Accordingly, the sample size is appropriate to represent Lebanese owned commercial banks.

Table 3 - Sample of the Lebanese commercial banks.

Banks	List of Abbreviation	Frequency of observation	% of observation
Audi Private Bank S.A.L	Audi	7	6.25%
Bank Beirut and Arab Countries S.A.L	BBAC	7	6.25%
Bank Libano-Commercial S.A.L	BLC	7	6.25%
Bank Libano-Française S.A.L	BLF	7	6.25%
BLOM Bank S.A.L	BLOM	7	6.25%
Bank Of Beirut S.A.L	BOB	7	6.25%
Byblos Bank S.A.L	Byblos Bank	7	6.25%
Credit Bank S.A.L	CB	4	3.58%
Credit Libanais S.A.L	CL	7	6.25%
Fenicia Bank S.A.L	Fenicia Bank	7	6.25%
First National Bank S.A.L	FNB	7	6.25%
FRANSABANK S.A.L	Fransabank	7	6.25%
Intercontinental Bank of Lebanon S.A.L	IBL	7	6.25%
Jammal Trust Bank S.A.L	JTB	7	6.25%
Lebanon and Gulf Bank S.A.L	LGB	5	4.46%
Middle East and Africa Bank S.A.L	MEAB	5	4.46%
Société Générale de Banque au Liban S.A.L	SGBL	7	6.25%
Total observations		112	100%

Table 4 - Distribution of Bank-Year observations over the period of 2009 to 2015.

		Frequency of bank year observation	% of bank year observation
Year	2009	14	12.5 %
	2010	14	12.5 %
	2011	16	14.3 %
	2012	17	15.2 %
	2013	17	15.2 %
	2014	17	15.2 %
	2015	17	15.2 %
	Total	112	100.0 %

Table 3 above presents the banks of the study along with their frequency and percentage of observations. Whereas, table 4 above shows the distribution of bank-year observations between 2009 and 2015.

Note that the differences in frequency, percentage of observations (table 3) and percentage of bank-year observations (table 4) are due to the lack of information for all the banks during the period of the study.

3.2. Data sources

The study has used a secondary and unbalanced panel data collected between 2009 and 2015. As a result, the research is based on 112 observations. The data concerning mobile banking application is collected from App Store or Android. However, the data concerning performance, investment in computer software and control variables was extracted from banks' annual reports. Table 5 below represents the secondary data sources.

Table 5 - Secondary data sources.

	Definition	**Data source**
Dependent variable	Performance	Banks' annual reports
Innovation variables	Mobile banking	App store and android
	Investment in computer software	Banks' annual reports
Control variables	Capitalization Cost Efficiency Asset Quality Bank's size	Banks' annual reports

All ratios used in the study were self-computed using Microsoft Excel.

3.3. Variables specification

Tables 6, 7 and 8 below presents the specification of dependent, independent and control variables respectively. They also provide the significance of each variable along with the previous studies that have used the same specifications.

Table 6 - Dependent variables: Proxies, significance and studies

Dependent variable	Indicator	Proxy	Significance	Studies
PERFORMANCE	Return-On-Assets (ROA)	$\frac{Net\ income}{Total\ asstes}$	Higher ROA indicates higher performance.	Beccalli, 2007; Onay *et al*., 2008; Jalal-Karim and Hamdan, 2010; Mwange, 2011; Khrawish and Al-Sa'di, 2011; Tan and Floros, 2012; Chronopoulos *et al.*, 2012; Kithaka, 2014; Saeed, 2014; Turgutlu, 2014; Akhisar *et al.*, 2015; Sujud and Hashem, 2017.
	Return-On-Equity (ROE)	$\frac{Net\ income}{Total\ equity}$	Higher ROE indicates higher performance.	Beccalli, 2007; Onay *et al*., 2008; Jalal-Karim and Hamdan, 2010; Al-Samadi and Al-Wabel, 2011; Chronopoulos *et al.*, 2012; Kithaka, 2014; Saeed, 2014; Turgutlu, 2014; Akhisar *et al.*, 2015; Samout, 2016.

Table 7 - Independent variables: Proxies, significance and studies

Independent variable	Indicator	Proxy	Significance	Studies
INNOVATION	Mobile banking (MB)	Dummy variable: • 0 if there is no MB • 1 if there is MB	If the bank has no mobile banking application (MB=0), it has a low involvement in innovation If the bank has a mobile banking application (MB=1), it has a high involvement in innovation	European Central bank, 2009; Alber, 2011; Hasan *et al.*, 2013; Ngumi, 2013; Muiruri and Ngari, 2014; Kashmari *et al.*, 2016.
	Investment in computer software (ICS)	Ln ($intangibles\ other\ than\ goodwill$)	Higher ICS indicates higher investment in innovation	Stoica *et al*., 2015.

Table 8 - Control variables : Proxies, significance and studies

Control variables	Indicator	Proxy	Significance	Studies
BANK SPECIFIC	Liquidity (L_1)	$\frac{Total\ loans}{Total\ asstes}$	Higher L1 ratio indicates lower liquidity	Sufian and Habibullah, 2009; Gul *et al.*, 2011; Lee, 2012; Francis, 2013; Trujillo-Ponce, 2013.
	Capitalization (CAR)	$\frac{Total\ equity}{Total\ asstes}$	Higher CAR indicates higher bank's capitalization	Athanasoglou *et al.*, 2005; Ben Naceur and Goaied, 2008; Flamini *et al.*, 2009; Dietrich and Wanzenried, 2011; Francis, 2013.
	Efficiency (EFF)	$cost\ to\ income\ ratio = \frac{operating\ expenses}{operating\ income}$	Higher EFF indicates lower cost efficiency	Heffernan and Fu, 2008; Dietrich and Wanzenried, 2011; Francis, 2013; Trujillo-Ponce, 2013.
	Asset quality (AQ)	$\frac{Nonperforming\ loans}{Total\ loans}$	Higher AQ indicates lower asset quality	Lee, 2012; Macit, 2012; Trujillo-Ponce, 2013.
	Bank's size (SIZE)	Ln(Total Assets)	Higher SIZE indicates higher bank's size	Athanasoglou *et al.*, 2005; Gul *et al.*, 2011; Macit, 2012; Tan and Floros, 2012; Trujillo-Ponce, 2013; Saeed, 2014; Turgutlu, 2014.

3.4. Analysis techniques

In order to determine the relationship between innovation and performance in Lebanese banking sector, a quantitative method to data analysis was used. The data was analyzed using a variety of statistical techniques performed through SPSS version 21.0 program. These techniques include descriptive statistics and multiple regression analysis. In order to perform the multiple regression analysis, there is a necessity to conduct various tests for the Classical Linear Regression Model (CLRM) assumptions.

The following 2 models were used in order to determine the cause and effect relationship between bank's performance and innovation:

$$ROAi,t = \alpha + \beta_1 MB_{i,t} + \beta_2 ICS_{i,t} + \beta_3 CAR_{i,t} + \beta_4 EFF_{i,t} + \beta_5 AQ_{i,t} + \beta_6 SIZE_{i,t} + \varepsilon \quad (1)$$

$$ROEi,t = \alpha + \beta_1 MB_{i,t} + \beta_2 ICS_{i,t} + \beta_3 CAR_{i,t} + \beta_4 EFF_{i,t} + \beta_5 AQ_{i,t} + \beta_6 SIZE_{i,t} + \varepsilon \quad (2)$$

Where:

- "ROA" and "ROE" : performance in bank "i" for period "t".
- "α" : Y-intercept.
- "β_i" : coefficient of variable where "i" ranges from 1 to 6.
- "$MB_{i,t}$" : mobile banking in bank "i" for period "t".
- "$ICS_{i,t}$" : investment in computer software in bank "i" for period "t".
- "$CAR_{i,t}$" : capitalization in bank "i" for period "t".
- "$EFF_{i,t}$" : cost efficiency in bank "i" for period "t".
- "$AQ_{i,t}$" : asset quality in bank "i" for period "t".
- "$SIZE_{i,t}$" : size of bank "i" in period "t".
- "ε " : error term.

4. Results and discussion

The results of the analysis techniques performed are presented thereafter. First, the descriptive statistics is showed. Second, the Classical Linear Regression Model assumptions (CLRM) are tested. Finally, the regression results are presented and discussed.

4.1. Descriptive Statistics

The descriptive statistics are performed in order to gain a preliminary understanding of banks' characteristics enrolled in the sample. The focus of this research is mainly on the mean, which measures the central tendency, and the standard deviation, which measures the dispersion. Table 9 below shows the descriptive statistics based on 112 observations. It shows the following:

Table 9 - Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MB	112	0	1	.35	.479
ICS	112	.0000	11.1096	5.4627	3.3457
CAR	112	.0496	.1232	.0849	.0128
EFF	112	31.7000	83.8000	53.1040	11.6287
AQ	112	.0010	.2128	.0335	.0399
SIZE	112	13.0982	17.5595	15.5658	1.1031
ROA	112	.0017	.0162	.0096	.0026
ROE	112	.0182	.1859	.1153	.0324
Valid N (listwise)	112				

This table shows the results of the descriptive statistics of the dependent and independent variables. Dependent variables are Return-On-Assets (ROA) calculated by net income to total assets ratio and Return-On-Equity (ROE) calculated by net income to total equity ratio. The independent variables are Mobile Banking (MB) a dummy variable which takes the value of 1 if the bank has a mobile banking application and 0 otherwise and Investment in Computer Software (ICS) measured by natural logarithm of intangibles other than goodwill. The control variables are: Capitalization (CAR) measured by equity to assets ratio; Cost Efficiency (EFF) measured by cost-to-income ratio; Asset quality (AQ) calculated by nonperforming loans to total loans ratio and Bank's size (SIZE) measured by natural logarithm of total assets.

Mobile banking (MB) has a mean of 0.35, which implies that on average 35% of banks in the sample have a mobile banking application. However, the large standard deviation (0.479) shows that there are large dispersions in the sample.

Natural logarithm of the investment in computer software (ICS) has a mean of 5.4627. This shows that Lebanese banks spend on average 235,599 USD[1] on their computer software. The standard deviation is large (3.3457).

Capitalization (CAR) has a mean of 0.0849. It indicates that equity represents on average 8.49% of total assets. So, Lebanese banks are well-capitalized. They are more capitalized than Chinese banks where equity to assets is equal to 5.1% (Tan and Floros, 2012). However, they are less capitalized than Sub-Saharan Africa (SSA) banks where equity to assets ratio is equal to 12.55% (Flamini *et al.*, 2009). The standard deviation (0.0128) shows a low dispersion in the sample.

[1] Since we are considering the natural logarithm of the investment in computer software, thus the amount spend on these software is equal to $e^{5.4627}$= 235.599 thousands USD.

Cost efficiency (EFF) has a mean value of 53.1040. This shows that on average operating costs constitutes 53.1040% of operating revenues. It is less than the average cost-to-income in Spanish banking sector (57.337%) (Trujillo-Ponce, 2013) and in Sub-Saharan Africa banking sector (62.98%) (Francis, 2013). Since a higher cost-to-income ratio indicates a less efficiency, Lebanese banks are more efficient than both Spanish and Sub-Saharan Africa banks. However, the standard deviation has an average value of 11.6287.

Asset quality (AQ) has a mean of 0.0335 which indicates that on average non-performing loans constitutes 3.35% of total customers' loans. This reflects a good AQ situation in Lebanese banks compared to banks in other countries. For example, in Spanish banking sector, the ratio of nonperforming loans to total loans is equal to 1.536 (Trujillo-Ponce, 2013) which is higher than that of Lebanese banks. Since higher nonperforming loans to total loans ratio indicates a poor asset quality, Lebanese banks have a better asset quality than Spanish banks. In addition, there is a large dispersion in the sample reflected by a high standard deviation (0.0399).

Bank's size (SIZE), which is the natural logarithm of bank's total assets, has a mean value of 15.5658. So, Lebanese banks are larger than both US (11.6) and Turkish (3.496) banks as found respectively by Hoffmann (2011) and Turgutlu (2014). In addition, the standard deviation has a value of 1.1031. This reflects that there is a little dispersion in the sample[2].

Return-On-assets (ROA) has a mean of 0.0096, which reflects that on average Lebanese banks get 0.96$ of profits for every 1$ invested in total assets. The average ROA in Lebanese banks is higher than that in US (0.79%) (Chronopoulos *et al.,* 2012) and Tunisian banks (0.6%) (Ben Naceur and Goaied, 2008). Plus, the standard deviation value is equal to 0.0026, which reflects a dispersion in the sample.

Return-On-Equity (ROE) has a mean of 0.1153, which shows that on average Lebanese banks get 11.53$ for every 1$ invested in shareholders' equity. However, the average ROE in both Turkish (0.1704) (Topak and Talu, 2017) and in US (0.20256) (Hoffmann, 2011) banking sectors

[2] The mean and standard deviation values were almost expected since thirteen (13) out of seventeen (17) banks in the sample are from the largest banks in Lebanon (Alpha banks).

are higher than that in Lebanese banking sector. Moreover, the standard deviation has a value of 0.0324 indicating a high dispersion.

4.2. Classical Linear Regression Model (CLRM) assumptions

Before going further into regression analysis, it is essential to test the assumptions of the CLRM. According to Saunders *et al.* (2009), there are four main assumptions for regression analysis:

1. Absence of heteroscedasticity
2. Absence of autocorrelation
3. Absence of multicollinearity
4. Presence of normal distribution

First, the heterogeneity of variance also called heteroscedasticity. It is the extent to which dependent and independent data do not have equal variances. In order to test heteroscedasticity, a Koenker test is performed for the two models. Table 10 below shows the results of Koenker test for both models.

Table 10 - Koenker Test.

Models	LM	P-value
1 (dependent: ROA)	23.507	.001*
2 (dependent: ROE)	26.281	.000*
(*) significant at 5%		

The null hypothesis for this test assumes that there is no heteroscedasticity. If the test shows a significant P-value (less than 0.05), so there is a rejection of the null-hypothesis. Based on table 10 above, both models have significant p-values. As a result, there is heteroscedasticity and we should reject the null hypothesis.

Second, autocorrelation refers to the situation where dependent variable at time "t" is related to its value at "t-1" (Saunders *et al.*, 2009). Durbin Watson Statistic is applied below (table 11) in order to test autocorrelation.

Table 11 - Durbin Watson (DW) Statistic.

Models	DW
1 (dependent: ROA)	1.083
2 (dependent: ROE)	1.043

Absence of autocorrelation is observed when DW is near 2 (Saunders *et al.,* 2009). Accordingly, there is autocorrelation in both models.

To overcome heteroscedasticity and autocorrelation issues, a Weighted Least Squares model should be used (Brooks, 2008).

Third, multicollinearity means the absence of correlation between independent variables. It is tested by the Variance Inflation Factor (VIF), tolerance and Pearson Product Moment Correlation Coefficient test.

Table 12 - VIF and Tolerance test.

Model		Collinearity Statistics	
		Tolerance	VIF
1 & 2	MB	.810	1.234
	ICS	.793	1.261
	CAR	.893	1.119
	EFF	.681	1.469
	AQ	.719	1.390
	SIZE	.423	2.366

This table shows the results VIF and tolerance tests. Model 1: dependent variable is Return-On-Assets (ROA) calculated by net income to total assets ratio. Model 2: dependent variable is Return-On-Equity calculated by net income to total equity ratio. The independent variables are Mobile Banking (MB) a dummy variable which takes the value of 1 if the bank has a mobile banking application and 0 otherwise and Investment in Computer Software (ICS) measured by natural logarithm of intangibles other than goodwill. The control variables are: Capitalization (CAR) measured by equity to assets ratio; Cost Efficiency (EFF) measured by cost-to-income ratio; Asset quality (AQ) calculated by nonperforming loans to total loans ratio and Bank's size (SIZE) measured by natural logarithm of total assets.

Table 12 above shows the results for both VIF and tolerance tests in model 1 and 2[3]. The absence of multicollinearity is observed when VIF has a value of less than 10 and tolerance has a value of

[3] The results of both VIF and tolerance tests are the same for both models. So, they were combined in table 12.

more than 0.1 (Saunders *et al.*, 2009). So, there is no multicollinearity between independent variables.

Table 13 - Multicollinearity Matrix.

	MB	ICS	CAR	EFF	AQ	SIZE	ROA	ROE
MB	1							
ICS	.110	1						
CAR	.203*	-.006	1					
EFF	-.215*	-.143	-.065	1				
AQ	-.064	.013	.123	.302**	1			
SIZE	.399**	.382**	.173	-.557**	-.431**	1		
ROA	.037	.254**	.206*	-.504**	-.205*	.346**	1	
ROE	-.084	.257**	-.304**	-.467**	-.238*	.231*	.857**	1

This table shows the results of the bivariate test, Pearson Product Moment Coefficient. Dependent variables are Return-On-Assets (ROA) calculated by net income to total assets ratio and Return-On-Equity calculated by net income to total equity ratio. The independent variables are Mobile Banking (MB) a dummy variable which takes the value of 1 if the bank has a mobile banking application and 0 otherwise and Investment in Computer Software (ICS) measured by natural logarithm of intangibles other than goodwill. The control variables are: Capitalization (CAR) measured by equity to assets ratio. Cost Efficiency (EFF) measured by cost-to-income ratio; Asset quality (AQ) calculated by nonperforming loans to total loans ratio and Bank's size (SIZE) measured by natural logarithm of total assets.

Table 13 above shows the result of Pearson Product Moment Coefficient test. According to Saunders *et al*. (2009), the "r" value of the test should be less than $|0.9|$ to avoid multicollinearity. Therefore, there is no multicollinearity between the variables.

Finally, to guarantee data normality, two tests were performed: skewness and kurtosis. Both tests' values should be within -1 and +1. Based on table 14 below, which presents the results of normality tests, we can conclude that mobile banking, capitalization and asset quality are not normally distributed. However, "*the assumption of normality could be ignored without incurring too many problems especially when the number of observation is higher than 30*" (Saunders *et al*., 2009, pp. 457, 459). Consequently, normality assumption is ignored.

Table 14 - Skewness and Kurtosis tests.

	N	Skewness Statistic	Kurtosis Statistic
MB	112	.646	-1.612
ICS	112	-.637	-.941
CAR	112	.654	1.007
EFF	112	.850	.631
AQ	112	2.393	6.504
SIZE	112	-.285	-.703
ROA	112	-.100	.588
ROE	112	.020	.417
Valid N (listwise)	112		

This table shows the results of skewness and kurtosis tests. Dependent variables are Return-On-Assets (ROA) calculated by net income to total assets ratio and Return-On-Equity calculated by net income to total equity ratio. The independent variables are Mobile Banking (MB) a dummy variable which takes the value of 1 if the bank has a mobile banking application and 0 otherwise and Investment in Computer Software (ICS) measured by natural logarithm of intangibles other than goodwill. The control variables are: Capitalization (CAR) measured by equity to assets ratio; Cost Efficiency (EFF) measured by cost-to-income ratio; Asset quality (AQ) calculated by nonperforming loans to total loans ratio and Bank's size (SIZE) measured by natural logarithm of total assets.

4.3. Regression results and discussion

In order to assess the relationship between innovation and bank's performance, a Weighted Least Squares (WLS) regression analysis is performed. The results of the WLS for model 1 and 2 are represented in table 15 below. This table shows that both models are highly significant since p-value is equal to 0.000. Adjusted R-squares for models 1 and 2 are respectively 61.3% and 71.8%. This means that 61.3% of variations in ROA and 71.8% of variations in ROE are explained by the variables studied.

Beta coefficients for Mobile Banking (MB) with both ROA and ROE are negative (-0.119 and -0.136 respectively). This indicates a negative effect of MB on performance. Mobile banking needs large investment and has low-income margins (Sujud and Hashem, 2017). Moreover, MB has a high perceived risk and low confidentiality (Alber, 2010). This finding contradicts Mwange (2011) and Kithaka (2014) results, since they have found a positive association between MB and performance in Kenyan and Nigerian banking sectors respectively. Moreover, contrary to Solow paradox theory contribution, MB has showed a highly significant relation with both ROA and

ROE at 1% level of significance. Hypothesis 1, which expects a positive and significant effect of MB on bank's performance, should be rejected.

Beta coefficients of investment in computer software (ICS) are equal to 0.361 and 0.345 with ROA and ROE respectively. So, ICS has a positive impact on banking performance. It has also a highly significant (at 1% level of significance) association with it. This contradicts the Solow paradox and the contributions of Licht and Moch, (1999), Beccalli (2007) and Oluwagbemi *et al.* (2011). However, it emphasizes the results of Prasad and Harker (1997), Chen and Zu (2004) and Ben Romdhane (2013). Higher investment in computer software leads to easier and faster transactions and higher customer care. As a result, banks will attract more potential customers and will perform better. Hypothesis 2, which expects a significant positive effect of ICS on performance, should be accepted.

Beta coefficient of Capitalization (CAR) was found to be positive (0.166) with ROA but negative with ROE. These findings are not contradictory. Mathematically, an increase of equity to asset ratio is due to either an increase in equity or a decrease in assets. All things being equal, when assets are decreased, both CAR and ROA increase. As a result, a positive impact of CAR on ROA is shown. However, when equity increases all things being equal, CAR will increase while ROE will decrease. This indicates a negative impact of CAR on ROE. Moreover, it was found that CAR has a statistically significant impact on both ROA and ROE (at 1% level).

Beta coefficient of cost efficiency (EFF) in both models was found negative (-0.560 with ROA and -0.558 with ROE). However, as previously mentioned cost-to-income ratio should be interpreted inversely since it indicates inefficiency. Accordingly, EFF has a positive and highly significant (at 1% level of significance) impact on performance as measured by both ROA and ROE.

Although beta coefficient of asset quality (AQ) in both models was found positive (0.074 and 0.056 with ROA and ROE respectively), they must be interpreted as being negative since asset quality is measured by NPL over total loans, and thus, by its inverse. It has been also found that AQ has a statistically insignificant impact on both bank’s performance variables.

Table 15 – WLS results for models 1 & 2

	Model 1: dependent variable ROA (net income to total assets)		Model 2: dependent variable ROE (net income to total equity)	
	Standardized Coefficients	Sig.	Standardized Coefficients	Sig.
	Beta		Beta	
(Constant)		.002***		.000***
MB	-.119	.062*	-.136	.013**
ICS	.361	.000**	.345	.000***
CAR	.166	.010***	-.415	.000***
EFF	-.560	.000***	-.558	.000***
AQ	.074	.257	.056	.320
SIZE	.122	.092*	.083	.175
R-square		63.4%		73.3%
Adjusted R-square		61.3%		71.8%
F statistic		30.299		48.139
Model significance P-value		.000		.000
Levels of significance: (***) 1%, (**) 5% and (*) 10%				
Note that: higher EFF ratio and higher AQ imply respectively lower efficiency and lower asset quality, so the results of beta coefficient for these two variables should be inversely interpreted.				

This table shows the results WLS regression analysis for Model 1 and 2. Model 1: Dependent variable is Return-On-Assets (ROA) calculated by net income to total assets ratio. Model 2: Dependent variable is Return-On-Equity calculated by net income to total equity ratio. The independent variables are Mobile Banking (MB) a dummy variable which takes the value of 1 if the bank has a mobile banking application and 0 otherwise and Investment in Computer Software (ICS) measured by natural logarithm of intangibles other than goodwill. The control variables are: Capitalization (CAR) measured by equity to assets ratio; Cost Efficiency (EFF) measured by cost-to-income ratio; Asset quality (AQ) calculated by nonperforming loans to total loans ratio and Bank's size (SIZE) measured by natural logarithm of total assets.

Bank's size (SIZE) was found to have a positive impact on ROA (beta coefficient is equal to 0.122) and on ROE (beta coefficient is equal to 0.083). However, it was only found significant with ROA at 10% level of significance.

Tables 16 below provides a summary of hypotheses rejection for both ROA and ROE.

Table 16 - Hypotheses rejection for Model 1 (dependent ROA) & 2 (dependent ROE).

Hypothesis	Variable	Expected relationship	Actual relationship (model 1)	Actual relationship (model 2)	Rejection
H1	Mobile Banking (MB)	+ & sig.	- & sig (10%)	- & sig. (5%)	Rejected
H2	Investment in Computer Software (ICS)	+ & sig.	+ & sig. (1%)	+ & sig. (1%)	Not rejected
Note: Sig: significant, Insig: insignificant					

5. Conclusion

Innovation severely affects banking sector, it is expected to destroy the models used in developing and delivering services and replace them with new and original ones (DeYoung, 2001). Examining the impact of innovation on bank's performance is crucial for many stakeholders. Using data of 17 Lebanese owned commercial banks from 2009 to 2015, this research focuses on the impact of mobile banking (MB) and investment in computer software (ICS) on the performance of Lebanese banks. Four control variables were also included in the study namely capitalization (CAR), cost efficiency (EFF), asset quality (AQ) and size (SIZE). Banking performance is measured by two ratios, Return-On-Assets (ROA) and Return-On-Equity (ROE). A weighted Least Squares estimation method was applied to avoid heteroscedasticity and autocorrelation issues.

The results of both models were similar, significant variables were mobile banking (MB), investment in computer software (ICS), capitalization (CAR) and cost efficiency (EFF). Bank's Size (SIZE) was only found significant with ROA. Asset quality has failed to prove any significance at any level. The direction of relationships between the significant independent variables and both ROA and ROE are the same in both models. The only difference was in the direction of capitalization that was positive with ROA and negative with ROE.

The results of the study are exploratory due to two main limitations related to sample size, type of data and choice of variables. First, data was collected from only 53.13% of "Lebanese owned banks" since the data of both the remaining 46.87% "Lebanese owned banks" and the other groups is unpublished electronically. Second, the data collected was only in a consolidated form taken from consolidated financial statements over 7 years' period for each bank. Third, the list of

banking innovations included in the study is not exhaustive. There may be other factors that could be included and consequently, this may alter the results of the study.

We should note that current research might be extended in various directions by: increasing the sample size, measuring performance using other than ROE and ROA such as profit before tax, margin and net interest margin and testing the effect of other innovations on bank's performance (number of credit and debit cards, number of POS terminals, number of ATMs).

References

[1] Abaenewe, Z.C., Ogbulu, O.M & Ndugbu, M.O. (2013). Electronic Banking and Bank Performance in Nigeria. West African Journal of Industrial & Academic Research, Vol. 6, No.1, pp.171-187.

[2] Akhisar, I., Tunayb, K.B. & Tunaya, N. (2015). The Effects of Innovations on Bank Performance: The Case of Electronic Banking Services. Procedia - Social and Behavioral Sciences. pp. 369 – 375.

[3] Alber, N. (2010). The effect of banking expansion on profit efficiency of Saudi banks. Second International Conference on Business and Economic Research (2nd ICBER 2011) Proceeding 269. Available at: https://www.researchgate.net/publication/227439499

[4] Al-Samadi, M. & Al-Wabel, S. (2011). The impact of E- banking on the performance of Jordanian banks. Journal of Internet Banking and Commerce. Vol. 16, No. 2, pp. 1-10.

[5] Association of Banks in Lebanon. (2014). Annual report edition 2014. Available at: http://www.abl.org.lb/subPage.aspx?pageid=9478

[6] Athanasoglou, P., Brissimis, S. & Delis, M.. (2005). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. Bank of Greece Working Paper No. 25. pp. 1-32.

[7] BCG, Boston Consulting Group. (2009). BCG Innovation 2009 Report.

[8] Beccalli, E. (2007). Does IT investment improve bank performance? Evidence from Europe. Università Degli Studi Di Macerata.

[9] Ben Naceur, S. & Goaied, M. (2008). The determinants of commercial bank interest margin and profitability: Evidence from Tunisia. Frontiers in Finance and Economics. Vol. 5, No.1, pp. 106- 130.

[10] Ben Romdhane, S. (2013). Impact of information technology on the performance of Tunisian banks: A stochastic frontier analysis with panel data. Asian academy of management journal of accounting and finance, Vol. 9, No. 2, pp. 95-125.

[11] BLOMINVEST BANK. (2016). Hurdles of Digital Banking in Lebanon. Available at: https://blog.blominvestbank.com/15923/hurdles-of-digital-banking-in-lebanon/

[12] Brooks, C. (2008). Introductory econometrics for finance. (2nd edn). United Kingdom: Cambridge University Press.

[13] Chen, Y. & Zhu, J. (2004). Measuring Information Technology's indirect impact on firm performance. Information Technology and Management, Vol. 5, pp. 9–22.

[14] Chronopoulos, D., Liu, H., McMillan, F. & Wilson, J. (2012). The dynamics of US Bank profitability. Available at http://ssrn.com/abstract=1972835
[15] DeYoung, R. (2001). The Financial Performance of Pure Play Internet Banks. Economic Perspectives. Vol. 25 No. 1, pp. 60-75.
[16] Dietrich, A. & Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. Journal of International Financial Markets, Institutions and Money. Doi:10.1016.
[17] European Central Bank. (2009). Return to retail banking and payments. Working paper series, No. 1135 / December 2009.
[18] Flamini, V., McDonald, C. A. & Schumacher, L. (2009). The determinants of commercial bank profitability in Sub-Saharan Africa (EPub). International Monetary Fund. Vol. 9.
[19] Francis, M. E. (2013). Determinants of commercial bank profitability in Sub-Saharan Africa. International Journal of Economics & Finance. Vol. 5, No. 9, pp. 134-147.
[20] Gul, S., Irshad, F. & Zaman, K. (2011). Factors affecting bank profitability in Pakistan. The Romanian Economic Journal. Vol. 14, pp. 61-87.
[21] Hasan, Mamman, & Farouk. (2013). Electronic banking products and performance of Nigerian listed deposit money banks. American Journal of Computer Technology and Application Vol. 1, No.10, pp. 138-148.
[22] Jalal-Karim, A. & Hamdan, A.M. (2010). The impact of information technology on improving banking performance matrix: Jordanian banks as case study. European, Mediterranean & Middle Eastern Conference on Information Systems 2010, April 12-13 2010, Abu Dhabi, UAE.
[23] Kashmari, A., Nejad, A.H.G., & Nayebyazdi, A. (2016). Impact of Electronic Banking Innovations on Bank Deposit Market Share. Journal of Internet Banking and Commerce. Vol. 21, No. 1, pp. 1-12.
[24] Kathuo, S., Rotich, G. & Anyango, W. (2015) Effect of mobile banking on the financial performance of banking institutions in Kenya. The Strategic Journal of Business and Change Management, Vol. 2, No. 98, pp 1440 – 1457.
[25] Khrawish, A.H. & Al-Sa'di, N.M. (2011). The Impact of E-Banking on Bank Profitability: Evidence from Jordan.
[26] Kithaka, E. (2014). The effect of mobile banking on performance of commercial banks in Kenya. Master's Thesis, University of Nairobi, Nairobi.
[27] Lee, S. W. (2012). Profitability determinants of Korean banks. Economics and Finance Review. Vol. 2, No. 9, pp. 6-18.
[28] Licht, G. & Moch, D. (1999). Innovation and Information Technology in Services. The Canadian Journal of Economics, Vol. 32, No.2, pp. 363-383. Available at: http://www.jstor.org/stable/136427
[29] Macit, F. (2012). Bank specific and macroeconomic determinants of profitability: Evidence from participation banks in Turkey. Economics Bulletin. Vol. 32, No. 1, pp. 586-595.
[30] Markus, L. & Soh, C. (1993). Banking on Information Technology: Converting IT Spending into Firm Performance.

[31] Muiruri, J.K. & Ngari, J.M. (2014). Effects of Financial Innovations on the Financial Performance of Commercial Banks in Kenya. International Journal of Humanities and Social Science. Vol. 4, No. 7, pp. 51-57.
[32] Mutua, R. (2013). The effects of mobile banking on the financial performance of commercial banks in Kenya. MBA Thesis, University of Nairobi, Nairobi.
[33] Mwange, J.A. (2013). The impact of mobile banking on financial performance of commercial banks in Kenya. Master's Thesis, University of Nairobi, Nairobi.
[34] Ngumi, P.M. (2013). Effect of bank innovations of financial performance of commercial banks in Kenya. Ph.D Thesis, JOMO Kenyatta University of Agriculture and Technology, Kenya.
[35] Oluwagbemi, O., Abah, J. & Achimugu, P. (2011). The impact of Information Technology in Nigeria's banking industry. Journal of Computer Science and Engineering, Vol. 7, No. 2, pp. 63–67.
[36] Prasad, B. & Harker, P. T. (1997). Examining the contribution of information technology toward productivity in US retail banking. (Working paper), Wharton School, University of Pennsylvania.
[37] Saeed, M. S. (2014). Bank-related, industry-related and macroeconomic factors affecting bank profitability: A case of the United Kingdom. Research Journal of Finance and Accounting. Vol. 5, No. 2, pp. 42-50.
[38] Samout, A. (2016). Innovation and performance of Tunisian banks. International Journal of Economics, Finance and Management Sciences, Vol. 4, No. 2, pp. 87-92. Available at: http://www.sciencepublishinggroup.com/j/ijefm
[39] Sarji, M.A. (2017). Information Technology and its influence on the Lebanese banking sector. Journal of Business and Management, Vol. 19, No. 4, pp. 19-28.
[40] Saunders, M. and Lewis, P. and Thornhill, A. (2009). Research methods for business students. (5th edn). England: Pearson Education Limited.
[41] Solow, R. (1987). We'd better watch out. New York Times Book Review, p. 36.
[42] Stoica, O., Mehdian, S. & Sargu, A. (2015). The impact of internet banking on the performance of Romanian banks: DEA and PCA approach. Procedia Economics and Finance. Vol. 20, pp. 610 – 622.
[43] Sufian, F., & Habibullah, M. S. (2009). Determinants of bank profitability in a developing economy: Empirical evidence from Bangladesh. Journal of Business Economics and Management. Vol. 10, No.3, pp. 207-217.
[44] Sujud, H. & Hashem, B. (2017). Effect of bank innovations on profitability and return on assets (ROA) of commercial banks in Lebanon. International Journal of Economics and Finance, Vol. 9, No. 4, pp. 35-50.
[45] Tiwari, R. Buse, S and Herstatt, C. (2006) Mobile Banking as Business Strategy: Impact of Mobile Technologies On Customer Behaviour and Its Implications for Banks. Working Paper No. 37. Presented at Technology Management for the Global Future - Proceedings of PICMET.
[46] Trujillo-Ponce, A. (2013). What determines the profitability of banks? Evidence from Spain. Accounting & Finance. Vol. 53, pp. 561-586.

[47] Turgutlu, E. (2014). Dynamics of profitability in the Turkish banking industry. Ege Academic Review. Vol. 14, No.1, pp. 43-52.
[48] World Bank. (2017). Data: Lebanon. Available at: https://data.worldbank.org/country/lebanon