Potential Influence of Information Systems on Bank Risk

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***Abstract*— After the catastrophic outcome of the 2008 financial crisis Basel III intrudes new instruments to increase the banks sector stability. Banking sectors depend on a sophisticated ensemble of information systems for bank risk management. Therefore, this study investigates the impact of bank capital, information systems, charter value, control systems and market discipline regarding bank risk. The presented focus is on understanding to what extent do information systems increase the stability of banking sectors by using panel data from Palestine over the period from 1996-2014. In addition, Partial Least Square (PLS) is used to analysis the sample which includes 244 questionnaires from listed banks. The findings show that information systems are the most important predictor of bank risk, which is partly supported by Basel III. Therefore, this study is important not just for Palestine but also to those that have concern of bank risk trying to find a solution to future bank default.**

***Index Terms*—Information systems, Control system, Bank risk, Basel III, Palestine.**

I. Introduction

BANK risk management is one of the most important issues for bankers worldwide [1]. There are several examples of financial and banking crises; from Mexico at the end of 1994 and early 1995, to the Southeast Asia Banking Crisis [2], Brazil, Russia and Turkey, and the global financial crisis in 2008 [3, 4]. Those successive banking crises directed the attention of international economic and financial institutions such as the International Monetary Fund (IMF), the Bank for International Settlements (BIS), and the Group of Twenty (G-20) [5, 6]. Since those crises have a negative impact on globalization and since the mentioned countries adopted and encouraged the acceleration of financial and economic globalization [7, 8]. Therefore, they studied the reasons for the banking crises, especially the most significant cases, and then developed appropriate solutions [9, 10].

It turned out that the most effective reasons for banking crises are the increasing banking risks on one hand, and the bad management of those crises on the other [11, 12]. Moreover, the weak internal and external supervision (national control authorities) [4], and the non-adequate disclosure about the nature and range of risks [13] are further reasons. Banks use a remarkably sophisticated ensemble of information technologies for supporting their management control systems and enabling oversight by government regulators and industry watchdogs [14, 15]. Banks depend on a global network of data processing and information systems to provide their core banking services and to manage the complex financial and macroeconomic elements of their environment [15, 16].

In light of technological and financial developments in risk management safety and stability of the financial and banking systems depend on the bank's success in adopting sound and efficient strategies and systems for different banking risk management [17, 18]. In addition to policies that improve the quality of assets, particularly the loan portfolio, in order to reduce its risks and develop accounting systems, transparency, and disclosure, in accordance with international and local standards for accounting systems is necessary [19, 20]. Moreover, developing information systems and credit portfolios of the previous years. Also, providing human resources which enhance the capital adequacy "bank solvency" [21, 22]. Since the strongly capitalized banks which are managed by good management have the ability to face losses and grant credit to their clients and business facilities through the business cycle "economic volatility," this helps to strengthen public confidence in the banking system.

This research develops and tests a model of bank risk-taking with the primary focus being the role of bank disciplinary tools: bank capital, information systems, charter value, control systems and market discipline. This is the first study to explicitly analyze the influence of information systems and control systems on bank risk. Accordingly, the main goal of this study is to investigate to what extent the development of information systems leads to increased banking stability and decreased bank risk. Our sample includes panel data over the period from 1996-2014. In addition, 244 questionnaires from listed banks across the country of Palestine were used to validate our results. The findings show that bank risk is negatively related to information systems and positively related to control systems. Moreover, the results show that information systems factor is the most important predictor of bank risk.

The rest of the paper is organized as follows. Section II highlights the Palestine institutional background. Section III presents a literature review and hypotheses development. Section IV presents the research models. Section V documents the results and discussions. Section VI concludes this paper.

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II. Institutional Background

The Palestinian banking sector (PBS) has demonstrated success and progress, despite the difficulties and the stumbling economy in the Palestinian territories, in general, since the beginning of the uprising in September 2000. This is due to the banks being able to maintain their assets, recording significant increases in assets, and provide a variety of services and products to their clients.

This research highlights the current state through analysis of the consolidated balance sheets of banks operating in Palestine over the period of 1996-2014. Figure 1 shows the change rating percentage of credit on the Palestinian banking sector since 1996. The credit facilities at the end of 2014 was more than (4,871) Million USD, which means it is 41.2% of total assets. Moreover, there was an increase by 9.6% compare to the year 2013.

$$\Delta_i = \left((y_{i+1} - y_i) / y_i \right) * 100\%, \quad i = 1, 2, 3, \ldots, n \tag{1}$$

where Δ is change on credit, y is a credit by a year and n is some period of years.

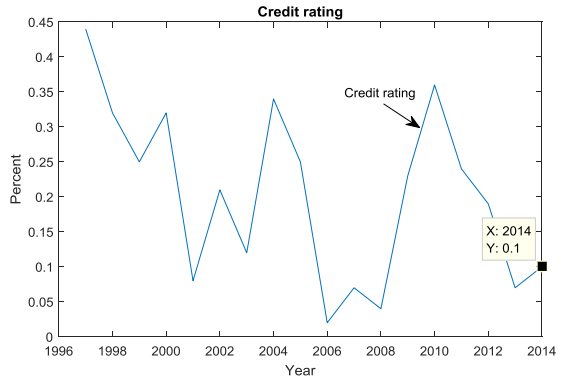

Fig. 1. Credit rating percentage.

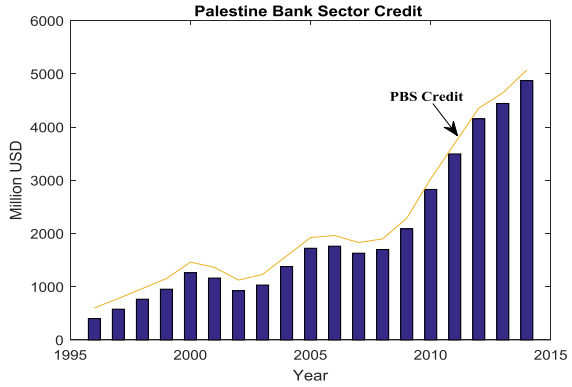

Fig. 2. PBS credit.

Figure 2 shows the PBS credit growth over the period from 1996-2014. It can be observed that there has been credit grow over the last five years, which means the Palestinian jurisdiction should encourage the banks to increase the capital reserve. Moreover, they should act to approve Basel III approaches and techniques particularly after the recent financial crisis.

Considering capital adequacy is one of the most important financial indicators to measure a bank's stability [23]. Therefore, this research investigates the Palestinian banking sectors capital adequacy. It uses the consolidated balance sheet of banks operating in Palestine provided from Palestine monetary authority (PMA). Moreover, calculating the capital adequacy according to the Basel formula and risk-weighted assets (RWA) is investigated [24-26].

$$C_i = (t_i + t_{ii}) / r, \quad i = 1, 2, 3, \ldots, n \tag{2}$$

where C is capital adequacy. t_i, t_{ii} and r are Tier I, Tier II and risk-weighted assets, respectively.

Although the capital adequacy in banking organizations was lower than the Basel requirement at the end of 2006 (6%), it rose 24% at the end of December 2014. Figure 3 shows the capital adequacy ratio over that period. Also, the figure illustrates the growth of the capital adequacy ratio paralleled with assets growth.

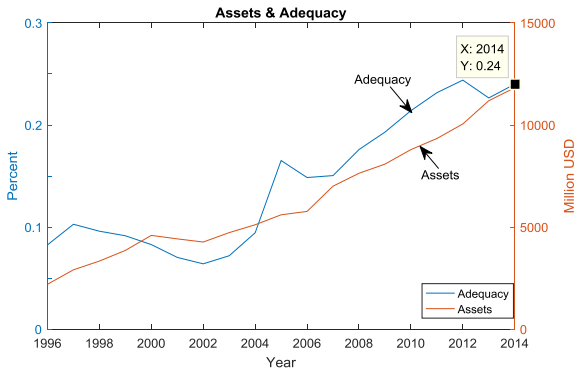

Fig. 3. Assets and capital adequacy.

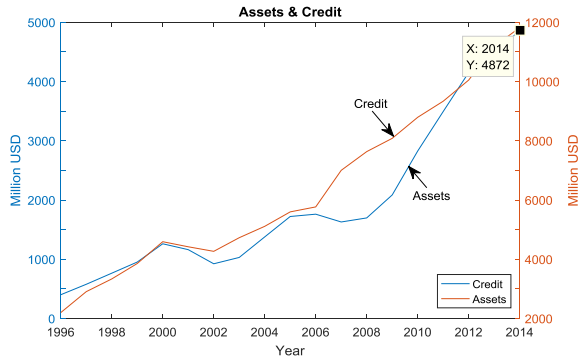

Fig. 4. Assets and credit growth.

Figure 3 shows that the total assets in Palestine's banking institutions rose 5.6% year on year to 11,822.27 USD million by the end of December 2014, which means the assets are growing year by year. It highlights the attention to the internal (internal audit) and external (banking supervisor) banking control system to act to increase their reserve. It can also be observed that the capital adequacy ratio is not stable although it's higher than the requirement in the Basel agreements (8%)[25, 27]. Moreover, Figure 4 shows the positive relationship between the assets and credit growth over the same period. The total credit in Palestine's banking institutions rose 9.6% year on year to 4,871.82 USD million at the end of December 2014. Thus, the total assets increased to 11,822.27 USD million.

III. Literature Review and Hypotheses Development

A. Bank capital

For the previous twenty years and in special, following the global finance crisis, bank capital regulation and control have been the subject of deep debate, for policymakers and academics. Contemporary bank regulation modifications have firstly concentrated on modification the numerator of capital ratios, though changes to the modifications, i.e., risk-weighted assets have been restricted [28-30]. Following [31], and [28] bank risk might initially reduce with rise in bank capital, but as the capital buffer builds-up banks might finally select to rise their risk levels. Therefore, the first hypothesis with respect to bank capital is as follows:

Hypothesis H_1: Bank risk initially decreases and then increases with bank capital.

B. Information systems

Recently, information system is playing a very significant role in banking sectors. The management information system (MIS) has several definitions such as a combination of hardware, software, infrastructure and trained personnel organized to facilitate planning, control, coordination, and decision making in an organization [16]. Recently, we have seen numerous occurrences of information security incidents, many of which involved with the attempts to acquire banking information for illegal profits and hence lead to increased business risk and lost revenues[32, 33]. Therefore, the authors argue about the relationship among information system and bank risk. Therefore, our second testable hypothesis is stated as follows:

Hypothesis H_2. Bank risk decreases with develop information systems.

C. Charter value

Charter value assistance to decrease the moral hazard issue in regarding to frank or implied safety net. Harmonious with this case, it is clear that there is a negative relationship among total risk and charter value [34, 35]. According to this discussion, it's clear that the total risk has negative relationship with charter value, systematic risk and idiosyncratic risk [34, 35]. On the other hand, several studies show that there is positive relationship among bank risk and charter value. Likelihood, this outcome as indicator for charter value chances to increase. We tendency more to [28] and [36] theoretical and experimental, results of [37], and ours expect that charter value decrease bank risk. So, the third hypothesis with respect to bank capital is as follows:

Hypothesis H_3. An increase in charter value lead to increase in bank risk.

D. Control systems

The banks use an advanced group of information technologies for upholding their management control systems and allowing to observe by government supervisors and business overseers [16]. Banks rely on an international system of data processing and information systems to offer their essential banking facilities and to manage the ganglion financial and macroeconomic basics of their environment [38]. The internal and external auditing considered as a lifeline for banks managers. It helps banking achieve its purposes by bringing a systematic, disciplined approach to assess and improve the efficiency of risk management, control, and governance. Therefore, the forth testable hypothesis is stated as follows:

Hypothesis H_4. Bank risk decreases with increasing internal and external control systems.

E. Market discipline

The term of market discipline in banking sector refers to the situation where the private segment agents such as stockholders, depositors or creditors undertake different costs that are magnified by banking practices followed by banks that require taking additional risk, henceforth, the private sector agents have to take further actions while considering these costs [28, 39]. For instance, banks maybe punish by increase the interest rates if they haven't insured depositors like subordinated debt holders, how are uncovered bank risk-taking, which led to withdrawing deposits [40]. Therefore, banks with great of subordinated debt are probable to display lower levels of equity risk [41-43]. Basel committee on banking supervision (BCBS) said that if the bank hasn't obligated in a specific level of risk, and the subordinated loan maybe face higher risk than the deposit insurance regime. So, the fifth hypothesis with respect to Market discipline is as follows:

Hypothesis H_5. An increase in market discipline, a decrease in bank risk.

IV. Research Models

A. Data collocation

To get the best sample, we sent our questionnaire to the Palestine banking sector. We collected 300 sets of responses from general managers, deputy managers, directors of facilities, directors of supporting facilities, heads of credit risk departments, internal audit managers, heads of branches, members of the committees of credit decision making, and credit official employees. After we had excluded 56 questionnaires because of incomplete responses, a total of 244 sets of responses remained. The questionnaire asked other questions such as the educational level and experience as shown in Table I.

TABLE I

DESCRIPTIVE STATISTICS OF RESEARCH RESPONDENTS.

Measure	Item	Frequency	Percentage %
Education level	Bachelor	86	35%
	Master degree	132	54%
	PhD degree	26	11%
Experience	Below 3 years	16	3%
	3-5 years	127	39%
	6-8 years	94	52%
	Above 8 years	7	7%

We collected data on bank capital, information systems, charter value, control systems and market discipline as independent variables, with bank risk as a dependent variable.

B. Empirical Method

This research investigates the relationship among bank risk as a dependent variable and Basel III factors as independent variables following this model:

$$BR_i = \alpha + \alpha_1 BC_i + \alpha_2 CV_i + \alpha_3 IS_i + \alpha_4 CS_i + \alpha_5 MD_i + \varepsilon_i \quad (3)$$

where *BR* is bank risk, *BC* is bank capital, *CV* is Charter value, *IS* is the information systems, *CS* is the control systems, and *MD* is market discipline. In the following text, each variable of Eq. (3) is investigated as dependent variables using sub-models as follows:

$$BR_i = \alpha + \beta_1 CGP_i + \beta_2 RRR_i + \beta_3 IXI_i + \beta_4 CRM_i + \beta_5 MCR_i + \beta_6 RFR_i + \beta_7 DCP_i + \beta_8 CMR_i + \beta_9 SMC_i + \beta_{10} IPR_i + \beta_{11} QSE_i + \varepsilon_i \quad (4)$$

$$BC_i = \alpha + \beta_1 CGC_i + \beta_2 CRP_i + \beta_3 CEC_i + \beta_4 CRG_i + \beta_5 CPA_i + \beta_6 PPA_i + \beta_7 ELP_i + \beta_8 EMP_i + \beta_9 DBD_i + \beta_{10} CPD_i + \beta_{11} SRP_i + \varepsilon_i \quad (5)$$

where *CGP* are credit risk goals and procedures, *RRR* is responsible for revising the financial results, *IXE* are the internal and external environments of the bank, *CRM* is executive credit risk management, *MCR* is the measure and control of risks, *RFR* is the revising of the financial results regularly, *DCP* is the development of credit policies of the banks, *CMR* is credit risk management and the responsibility, *SM* is separates between measuring and controlling credit risk, *IPR* is identifying and analyzing the potential risks, *QSE* is qualified staff with sufficient experience, *CGC* is credit granting criteria, *CRP* is credit risk policies, *CEC* are changes to economic conditions, *CRG* is credit risk guarantees, *CPA* is customer's periodic assessment, *PPA* is portfolio periodic assessment, *ELP* is the expected losses in the portfolio, *EMP* is the efficiency of monetary policy, *DBD* is to deal with bad debts, *CPD* is credit portfolio diversification, and *SRP* is sensitive risk pricing.

$$CV_i = \alpha + \beta_1 LCR_i + \beta_2 LNC_i + \beta_3 ICR_i + \beta_4 LQI_i + \beta_5 DRT_i + \beta_6 DHS_i + \beta_7 AIT_i + \varepsilon_i \quad (6)$$

$$IS_i = \alpha + \beta_1 RI_i + \beta_2 CP_i + \beta_3 MDS_i + \beta_4 IIS_i + \beta_5 EMR_i + \varepsilon_i \quad (7)$$

where *LNR* is the local credit rating, *LCR* is the limited number of customers classified, *ICR* is the internal credit rating systems, *LQI* is the low quality of credit information, *DRT* are the disclosure requirements and transparency, *DHS* is the develop of human capacities and skills, *AIT* is advanced information technology, *RI* is the reliability of information, *CP* is the credit portfolio, *CEC* is the data of information management systems, *IIS* is the internal information systems, and *EMR* is the efficiency to manage credit risks.

$$CS_i = \alpha + \sum_{i=2}^{n} \alpha_i \beta_i IA_i + \beta_2 XA_i + \varepsilon_i \quad (8)$$

where *CS* is a dependent variable and both the internal control (*IC)* and external control (*EC)* are independents variables. Then sub models are used to investigate *IC* and *EC*. The sub models are as follows:

$$IA_i = \alpha + \beta_1 EIA_i + \beta_2 IIA_i + \beta_3 ECM_i + \beta_4 APR_i + \beta_5 LCR_i + \beta_6 DWC_i + \beta_7 DEP_i + \beta_8 DCE_i + \beta_9 AIR_i + \varepsilon_i \quad (9)$$

$$XA_i = \alpha + \beta_1 IER_i + \beta_2 DEB_i + \beta_3 NTC_i + \beta_4 DRI_i + \beta_5 AAM_i + \beta_6 MAP_i + \beta_7 CBU_i + \beta_8 ACA_i + \beta_9 SRR_i + \varepsilon_i \quad (10)$$

where *EIA* is an effective internal audit, *IIA* is an independent internal audit, *ECM* evaluates credit management, *DPR* determines the accuracy of credit portfolio risks, *LCR* is limiting credit risks, *DWR* determines points of weakness in credit risk, *DEP* determines any exceptions in the procedures, *DCE* detects credit deterioration at an early stage, *AIR* is the assessment of the level and trends of credit risk, *IER* is an independent evaluation for bank risk, *DEB* determines the efficiency of board members in credit risk management, *NTC* is necessary to review the types of credit, *DRI* is dependent on the results of the internal audit, *AAM* assesses the ability of the bank's management, *MAP* monitors the aspects of the credit portfolio, *CBU* is control of the bank for urgent improvement of credit risk management, *ACA* assesses the adequacy of bank capital compared to credit risk, and *SRR* sets restrictions to limit risks.

$$MD_i = \alpha + \beta_1 SP_i + \beta_2 PFR_i + \beta_3 AAL_i + \beta_4 APA_i + \beta_5 MMR_i + \beta_6 TSR_i + \varepsilon_i \quad (11)$$

where *DP* is the disclosure policy, *PER* is the periodic financial performance reports, *AAL* assesses the assets and liabilities of the bank, *APA* is the accounting policies applied, *MMR* is the applied methods in managing and measuring credit risk, and *TSR* is the periodic disclosure including type and size of credit risk.

V. Analyses and Results

A. Planned analysis

Structural equation modeling (SEM) using the partial least squares (PLS) method is used to answer the research questions. In an external model, PLS analysis is used to estimate latent variables (LVs) based on the shared variance of observed variables, using the principal-component weights of the observed variables. The shift in each indicator indicates the

extent of its influence on a given LV, resulting in the best possible combination of weights for predicting the LV while accounting for observed variables. We first assumed that all of the hypothesized relations were linear, and used the software package SmartPLS to test the model using standard linear PLS analysis. The results of the preliminary analysis failed to support some of the hypotheses. However, an examination of bivariate data plots suggested the presence of asymmetric effects. Further correlation analysis of split samples also revealed nonlinear relationships. For instance, charter value may have two distinct effects: low and high levels of charter value may lead to lower performance than medium levels of charter value, while low to medium charter value can motivate individuals to achieve their highest performance. Accordingly, using WarpPLS™ [44] and the guidelines developed by Kock and Mayfield [45], the quality of the measures was assessed by inspecting item-to-total correlations.

B. PLS analysis

The measurement model shows how each block of items relates to its construct or latent variable. The PLS results indicate that a satisfactory level of convergent validity was achieved, based on certain criteria [44]. As shown in Table II, all of the item loadings were greater than 0.70 (all significant, $p < 0.001$), with the exception of the item measuring charter value and market discipline whose loading was lower than the 0.70 threshold. However, this item is retained for the following two reasons. (1) According to W. W. Chin [46], a loading below the threshold is acceptable if the loadings of other items measuring the same construct are high. (2) The loading was still higher than the cutoff point of 0.4 recommended by some scholars [47]. Regardless, the items lower than 0.4 have been omitted from analysis. Discriminant validity verified by measuring the difference between a construct's average variance extracted (AVE) value and its correlations with other constructs. To achieve a sufficiently high level of discriminant validity, the square root of the construct's AVE should be greater than its correlations with all other constructs [44]. As shown in Table III, the threshold for discriminant validity is also exceeded.

TABLE II

COMBINED LOADINGS AND CROSS-LOADINGS

	Bankrisk	BankCapi	DevIS	CharterV	IntContr	ExContr	MarketDi	InExCon
BRR	**0.792**	-0.036	0.019	-0.048	0.054	0.147	0.056	-0.101
IXE	**-0.871**	0.011	0.009	-0.001	0.045	0.148	0.065	-0.206
MCR	**-0.914**	-0.066	-0.033	0.018	-0.031	-0.143	-0.038	0.274
RFR	**0.936**	-0.035	-0.039	0.039	-0.094	-0.152	-0.091	0.065
DCP	**-0.735**	-0.001	-0.032	-0.019	-0.058	-0.101	-0.063	0.081
IPR	**0.886**	0.025	0.005	0.003	0.051	0.136	0.069	-0.099
QSE	**0.846**	0.001	-0.002	-0.002	0.039	0.154	0.072	-0.102
CGC	0.011	**-0.951**	0.002	0.007	0.037	0.161	0.054	-0.103
CRP	0.033	**-0.955**	0.001	0.008	0.03	0.171	0.23	-0.072
CEC	0.015	**0.854**	-0.001	0.007	0.04	0.159	0.27	-0.101
CRG	0.004	**0.811**	-0.093	-0.065	0.093	-0.145	0.209	0.171
DBD	0.003	**0.829**	0.004	0.008	0.025	0.254	0.069	-0.011
SFA	-0.039	**0.849**	0.04	-0.012	-0.007	-0.229	-0.016	0.068
RI	0.013	-0.009	**-0.916**	-0.004	0.042	0.25	0.064	-0.108
CP	0.024	0.01	**0.907**	-0.002	0.051	0.236	0.067	-0.106
DMS	0.02	-0.014	**0.817**	0.01	0.046	0.244	0.074	-0.199
IIS	-0.004	0.043	**0.836**	-0.005	0.056	0.247	0.058	-0.106
EMR	0.052	0.025	**0.816**	0.04	0.03	0.243	0.083	-0.196
LCR	0.067	0.074	0.027	**0.898**	-0.099	-0.159	-0.257	0.041
LNC	0.003	-0.01	0.007	**0.829**	0.041	0.253	0.274	-0.2
ICR	-0.139	0.048	0.351	**0.508**	-0.038	-0.244	-0.202	0.067
LQI	-0.126	-0.007	-0.023	**0.913**	0.023	0.166	0.25	-0.011
DHS	-0.007	0.031	0.016	**-0.515**	0.037	0.182	0.245	-0.113
AIT	-0.018	0.006	0.01	**-0.726**	-0.041	-0.245	-0.055	0.016
EIA	-0.004	-0.023	-0.004	0.001	**0.772**	0.253	0.169	-0.102
IIA	0.025	0.001	0.033	-0.037	**0.86**	0.229	0.108	-0.042
ECM	-0.023	0.035	0.038	0.086	**-0.878**	0.118	0.154	-0.013
DWC	0.014	-0.007	0.01	-0.021	**-0.823**	-0.154	-0.254	0.182
ALR	0.049	-0.042	-0.028	0.028	**0.829**	0.115	0.142	-0.118
IER	0.05	0.044	-0.023	-0.01	0.063	**0.875**	0.177	-0.2
RTC	0.01	-0.009	0.014	-0.006	0.034	**0.878**	0.255	-0.198
AAM	-0.004	0.005	0.004	-0.003	-0.022	**-0.893**	-0.262	0.207
CBU	-0.002	-0.003	-0.001	-0.002	-0.037	**0.871**	-0.266	0.215
PER	-0.027	-0.046	-0.031	-0.061	-0.044	-0.19	**0.806**	0.043
AAL	0.004	0.007	0.008	0.024	0.019	0.138	**0.875**	-0.094
APA	0.008	-0.028	0.012	0.022	-0.007	-0.157	**-0.734**	0.079
TSR	0.135	-0.029	-0.024	0.035	-0.061	-0.118	**0.699**	0.195
lv_IntC	0	0	0	0	1	0	0	**0.879**
lv_ExCo	0	0	0	0	-0.048	0.008	-0.181	**0.816**

Notes: Factor loadings greater than 0.40 are shown in boldface.

TABLE III

CORRELATIONS AMONG LATENT VARIABLES WITH SQUARE ROOTS OF AVES, LATENT VARIABLE COEFFICIENTS WINDOW

	Bankrisk	BankCapi	DevIS	CharterV	IntContr	ExContr	MarketDi	InExCon
Bankrisk	**0.354**	0.092	0.054	0.125	0.07	0.071	-0.048	0.018
BankCapi	0.092	**0.365**	0.078	0.062	0.287	0.059	-0.06	0.106
DevIS	0.054	0.078	**0.538**	0.098	0.034	0.132	0.025	0.085
CharterV	0.125	0.062	0.098	**0.408**	0.156	-0.008	-0.06	0.022
IntContr	0.07	0.287	0.034	0.156	**0.383**	0.074	-0.077	0.435
ExContr	0.071	0.059	0.132	-0.008	0.074	**0.344**	0.088	0.462
MarketDi	-0.048	-0.06	0.025	-0.06	-0.077	0.088	**0.311**	0.791
InExCon	0.018	0.106	0.085	0.022	0.435	0.462	0.791	**0.451**

Notes: Square roots of average variances extracted (AVEs) shown in diagonal.

C. Structural Model

The hypotheses were assessed by examining the parameters of the PLS structural model. The R^2 values obtained for dependent variables indicate the predictive power of a theoretical model, and standardized path coefficients indicate the strength of the relationship between the independent and dependent variables. Fig. 5 and Table IV depict the final structural model. The path coefficients can be taken as standardized beta weights, each of which was estimated after controlling for the effects of all of the other paths. The R^2 value of 0.67 indicates that the theoretical model explained a substantial amount of the variance in bank risk. In addition, the model accounted for 67% of the variance in bank risk. As the R^2 of a dependent variable must be at least 10% to ensure meaningful interpretation, the theoretical model demonstrated substantive explanatory power.

We examined the hypothesized structural relationships among the constructs displayed in Fig. 5 with a full structural model using the linear partial least squares (PLS) in WarpPLS. The model indices suggested that the full model fits the data relatively well (average block VIF (AVIF) = 1.032; average full collinearity VIF (AFVIF) = 3.051; Tenenhaus GoF (GoF) = 0.487; Sympson's paradox ratio (SPR) = 1.000; R-squared contribution ratio (RSCR) = 1.000; statistical suppression ratio (SSR) = 0.878), as shown in Table IV.

D. Main Results

In this sub-section, we report the main results of a more comprehensive analysis as follow. As shown in Figure 5 and Tables V and VI, the results suggest that develop information systems (DevIS) is the most important predictor of bank risk (17%) in terms of both status and quality, compared with market discipline (MarketDi) (11.5%), internal/external control systems (InExCon) (11.2%) and charter value (CharterV) (11.2%).

Our results show that bank risk is negatively related to DevIS ($p < 0.01$), supporting H_2. We also find a positively related to InExCon ($p < 0.01$), supporting H_4. In addition, H_5 is also supported ($p < 0.01$), as our results demonstrate that an increase in MarketDi leads to a decrease in bank risk. Findings show that H_3 is supported as reports show that CharterV is positively related to bank risk ($p < 0.05$). As results show, H_1 is not supported by our findings, indicating that there is no relationship between bank capital and bank risk. Moreover, results demonstrate that the bank risk would be increasing as CharterV, and InExCon lift, while with an increase in DevIS and MarketDi the bank risk will decrease.

In this study, we set out to determine which capabilities are most important for bank risk. The standardized path coefficient estimates displayed in Table V indicate that bank capital, develop information systems, charter value, control systems, and market discipline each affect bank risk differently. Develop information systems has the largest standard coefficient estimate, establishing it as the most important predictor for bank risk.

Table VI provides the total effects (i.e., direct and indirect effects) of each construct on bank risk. The empirical results reveal differences in the relative importance of the develop information systems and control systems on bank risk, with the order of importance as follows: develop information systems (0.17), market discipline (0.115), charter value and internal/external control systems (0.112). Note that the coefficient for develop information systems is the most important factor in bank risk.

E. Discussion

With regard of H_1, bank risk increases with increases bank capital. The results fail to accept the H_1, which means there is no relationship among the capital adequacy and bank risk. We have the same result as Mamiza Haq. et al [28]. The results are also consistent with the argument that careful management of bank capital can smooth stability of the banking system [49]. Moreover, a little bit different with Boyd and De Nicoló [50] which argues that increase bank capital maybe increases total risk. This result shows that the bank capital is significant to manage and reduce banking risks, which support BCBS documents.

The analysis result concerning the relationship among information systems and bank risk, Fig. 5 has shown a negative relationship. This supports H_2. Bank risk decreases with developing information systems. This result is the same as Paul Jeffery [48] which argue that the negative impact of developing the information systems on data integrity consequences of financial institutions will be an endless degradation of sensitive commercial and personal financial information due to internet hackers access to unsecure financial systems online if cyber-crimes using technology bombs. Patrick S. et al [41], they argue that many bank risks 'incidents result from inadequate protection of information assets. Besides, Neda. et al [49], said that the efficient information systems can reveal which customers combination can pinpoint profitable and default.

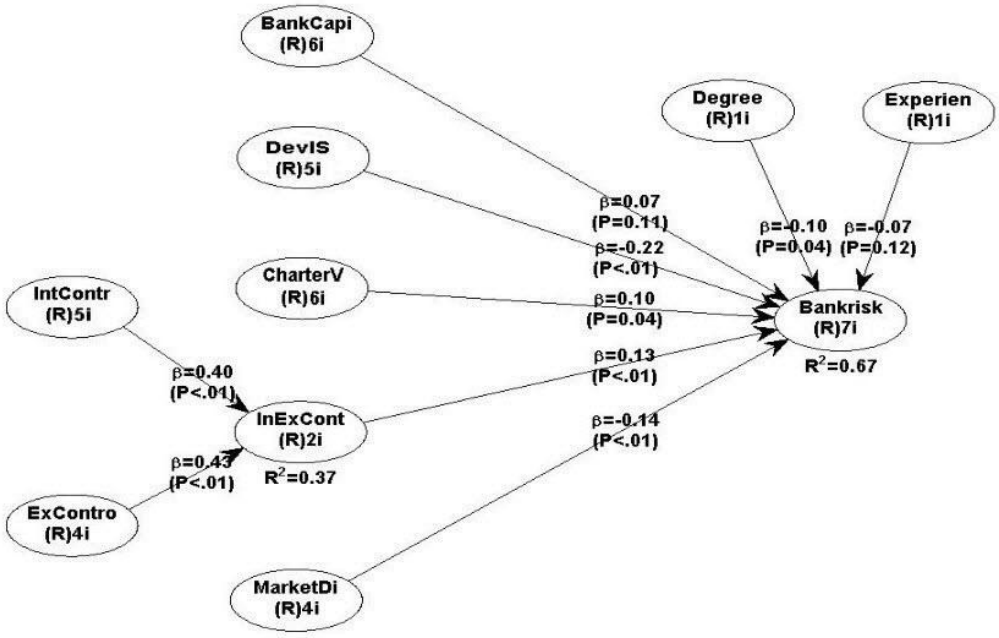

Fig. 5. Results of final structural equation model.

TABLE IV

FINAL STRUCTURAL EQUATION MODEL ESTIMATES

From	To	Hypothesis	Standardized coefficient estimate
Bank Capital (BankCapi)	Bank Risk	H_1	0.07[b]
Develop Information systems (DevIS)	Bank Risk	H_2	-0.22[a]
Charter Value (CharterV)	Bank Risk	H_3	0.10[a]
Internal/External Control Systems (InExCont)	Bank Risk	H_4	0.13[a]
Market Discipline (MarketDi)	Bank Risk	H_5	-0.14[a]

Final model: goodness of fit: Average block VIF (AVIF) = 1.032; Average full collinearity VIF (AFVIF) = 3.051; Tenenhaus GoF = 0.487; Sympson's paradox ratio (SPR) = 1.000; R-squared contribution ratio (RSCR) = 1.000; Statistical suppression ratio (SSR) = 0.878

Note:
*All hypotheses were evaluated using two-tail tests.
[a] $p < 0.01$.
[b] $p < 0.1$.

In addition, the PLS analysis shows that the relationship between the cheater value and bank risk is positive. This supports H_3. An increase in charter value leads to an increase in bank risk. Our result the same as Hellmann et al. [36], they found the positive relationship among charter value and bank risk. However, our result is different with Mamiza Haq. et al [28], which argue that the bank charter value decreases bank risk including equity risk, credit risk, and default risk. Anderson and Fraser [34] argue that the charter value has a negative relationship with total risk, systematic risk and idiosyncratic risk.

With regard to H_4, the result in Fig. 5 has shown the positive relationship among internal/external control systems and bank risk, which it contrasts to the orientation of H_4. Bank risk increases with increasing internal/external control systems. As previous researches indicated that chief executive officer (CEO) overconfidence can explain the cross-sectional heterogeneity in risk-taking behavior among banks [50, 51], our results demonstrate that the bank's CEO overconfidence leads to perceiving a secure condition due to their investment in internal/external control systems, which in fact, it is a source of overinvestment and outflows of bank resources. That could increase the total bank risk.

With regard to H_5, PLS analysis has shown that there is negative relationship among the market discipline and bank risk. We can observe the results in Fig. 5, which it is support H_5 an increase in market discipline, a decrease in bank risk. This result have similarity with several empirical studies such

as Park and Peristiani, which argue that the market discipline supporting the hypothesis that market discipline is at work. While, Martinez Peria and Schmukler [52], found the demonstrate that depositors discipline banks by withdrawing deposits and by requiring higher interest rate after crises. This result is different with Demirgüç-Kunt and Huizinga [53], Nier and Baumann [54], Hadad et al. [55] and Cubillas et al. [56] find that bank crises generally weaken market discipline as depositors anticipate stronger implicit guarantees in the future [28].

TABLE V

EFFECT SIZES FOR PATH COEFFICIENTS

	BankCapi	DevIS	CharterV	MarketDi	InExCon
Bankrisk	0.007	0.17**	0.112**	0.115**	0.112**

*Small effect, ** Medium effect, ***Large effect

TABLE VI

THE SUM OF DIRECT AND INDIRECT EFFECT OF LV ON PERFORMANCE

	BankCapi	DevIS	CharterV	MarketDi	InExCon
Bankrisk	0.007[b]	0.17[a]	0.012[a]	0.115[a]	0.112[a]

[a] $p < 0.01$.
[b] $p < 0.1$.

VI. CONCLUSION

This paper investigates PBS through Basel III factors, which are bank capital, information systems, cheater value, internal/external control systems and market discipline on bank risk. The results show that bank risk is negatively related to developed information systems and market discipline. Besides, bank risk has a positive relationship with charter value and control systems. While there is no relation between bank capital and bank risk. Moreover, the analysis results answer the research question; to what extent the development of information systems leads to increased banking stability and decreased bank risk. Our results show that the information systems is a pivotally important factor in bank risk. Given this finding, we recommend to increase the development of information systems regarding to decrease the bank risk.

In general, the findings of this research show that the information systems, charter value, control systems and market discipline affect bank risk. The information systems factor is playing a very significant role in bank risk. Thus, this study is important to all who have concern regarding bank risk and who try to find a solution to any future defect.

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