“E-banking and risk management: evidence from the Cypriot public sector banks”

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E-banking and risk management: evidence from the Cypriot public sector banks

Abstract

E-banking has become one of the most powerful tools in the banking industry and so it has attracted the attention of many researchers and academics. The aim of this paper is twofold. Firstly, to explore the bankers' perception based on the advantages of electronic banking and the risks that are associated with electronic banking. Secondly, to explore banker's perception on the risk management principles of e-banking according to the 14 principles of Basel Committee in Cyprus. The main research instrument is a questionnaire. Multinomial regressions and other statistical tools are applied in this paper. Our findings suggest that most of the respondents, who are bankers in Cyprus, perceive e-banking as an advantage for reducing the risk of carrying cash, for the time saving and convenience. Surprisingly, the bankers do not consider that e-banking increases frauds and issues on data loss, and do not increase the chances of government access. Furthermore, our results indicate that the four major public banks in Cyprus identify risks and manage them according to the 14 principles of Basel Committee. Finally, a significant link between both the years of experience of banker and the position held in the banks; and the security control as one of the 14 principles of Basel Committee has been identified applying multinomial regression model. The results can strongly support the management team of each bank for the development of a more efficient strategy for the future of e-banking in Cyprus.

Keywords: e-banking, risk management, Basel, multinomial regression, Cyprus.
JEL Classification: G21, G32.

Introduction

The banking industry has undergone remarkable change in recent years. Advances in information technology have resulted in significant development in areas such as electronic banking, and the adoption of such technology is considered to be of major importance to the future of the banking sector (Welch, 1999; Menson, 2010). E-banking systems are now established on a worldwide basis and the use of such systems has transformed the manner in which banks function. Indeed, such systems are considered to be instrumental in the development of banking organizations and increasing market share (Menson, 2010).

It is considered that electronic banking is likely to offer an advanced business vision to the banking industry as a whole (Laudon & Traver, 2008). The purpose of this paper is to focus upon the changes that have occurred in the e-banking sector in Cyprus, and how these changes have affected their risk management practices. Electronic services were initially introduced in one bank in Cyprus in 2000 and, by the following year, all other banks in the country had public electronic services available via their websites. Electronic money transfers and withdrawals from automated machines (ATM) were the first services to be made generally available. The development of such services has led to the growth of Cypriot banks and altered the traditional practices in the sector (Gonzalez, 2008). The use of e-banking services has become commonplace in the developed world on both a commercial and personal consumer level. It is apparent that, along with development of online banking services, there will be an increase in associated risk (Abdou et al., 2014). It is considered that the level of risk is magnified as a result of banks offering services to their customers on a "24 hour 7 days a week" basis (Welch, 1999).

As banks have increased their range of products and services, they have become exposed to different types of risk. It is suggested that e-banking does not introduce new types of risks but does result in banks becoming more vulnerable to risk generally (Pennathur, 2001; Singh and Agnihotri, 2015). The main aims of this paper are to explore the bankers' perception of the advantages and associated risks of e-banking; and the bankers' perception on the risk management principles of e-banking, based on the 14 principles of the Basel Committee in the case of Cypriot public banks, is investigated. A subsidiary aim of this paper is to identify a possible link between the bankers' years of experience, their position and their perception of the risks associated with e-banking. The rest of this paper is organized as follows: the relevant literature is reviewed in Section 1 and details of the research methodology are provided in Section 2. An analysis of the results is given in

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Section 3 and the conclusion and suggestions for future research are provided in Final Section.

1. Review of relevant literature

The Internet may be considered as a collection of various networks that connect the world (Tapp, 2008) and has been defined as an open network by means of which people can communicate and interact (Simpson, 2002; Welch, 1999). The use of the Internet has had a major effect on industry and has provided the opportunity for businesses to improve the services that they offer (Tapp, 2008; Enders et al., 2006). Electronic commerce, known as e-commerce, enables transactions to be made between organizations by means of the world wide web (www). The growth of the 'www' creates numerous opportunities for various industries by introducing new approaches for the banking system (Welch, 1999). The term, known as e-banking, may be defined as 'the provision of retail and small value banking products and services through electronic channels' (Pennathur, 2001, p. 2104). E-banking can offer customers immediate access to their funds, irrespective of the time of day and the location of their local branch. Furthermore, the use of e-banking can increase the operational efficiency of the banks and minimize the level of human error (Nitsure, 2003). The range of services offered includes credit/debit cards, ATM, telephone and web-based banking (Nitsure, 2003).

E-banking services, for example, home banking, were first offered by four major banks in New York, USA in 1981 (Nitsure, 2003). Customers and businesses are able to access their accounts via the web and transfer funds between different accounts (Kocic, 2009). In the UK, e-banking was first introduced in 1983, offering similar services to those referred to above in the USA (Nitsure, 2003). Since the 1990s, banks throughout the world have taken the opportunity to promote their services and products via the Internet (Kocic, 2009). Indeed, some banks provide services which are only available via the Internet (Scholasticus, 2015). As one might expect, it is suggested that those customers who are more at ease with information technology are more likely to make use of e-banking services (Luštšik, 2003).

However, it has become apparent that some customers find online banking difficult to use and this has become a significant issue for the banks (Aladwani, 2001). It is clear that banks need to gain a greater understanding of the concerns of customers in relation to online banking (Katircioglu et al., 2011). In 2000, Marfin Laiki Bank became the first bank in Cyprus to offer e-banking services. In the following year, all other Cypriot banks introduced web-based facilities for their customers. The growth of such services in Cyprus led to significant changes in the operational strategies of the banks (Gonzalez, 2008). The dynamic process in which the technology evolved is considered to be made up of three phases, these being described as the fluid, transitional and specific phases (Singh et al., 2002). The fluid phase is considered to be the stage at which the technology and market place come together with very little idea as to where investment is likely to take place or prove most useful. The transitional phase is where the industry has a greater understanding of the needs of the customer base and tries to fulfil these requirements by means of products of an experimental nature. The third phase, namely, the specific phase, is the point at which the industry has a clearer understanding of the market and, therefore, is able to focus upon the specific needs of the clients (see, for example; Singh et al., 2002; Singh and Agnihotri, 2015).

The relationship between risk and return may be summarized by stating that the greater the risk that an investor is willing to take, the greater is the return. Risk also can be defined as the possibility of the investor not getting the return that is expected from the investment (Bessis, 1998; Hefferman, 1996). As online banking services have increased to such a significant extent over recent years that the regulatory agencies have become more concerned about the risks associated with such services. It is recognized that the benefits available offered to the banks by providing such services must be countered with an increased level of risk (Abdou et al., 2014).

In addition to traditional risk areas, such as interest rate movements and liquidity difficulties, banks are exposed to increased levels of operational and security risk (Pennathur, 2001). Operational risk is the malfunctioning of the reporting systems and, in the absence of efficient tracking of risk, can result in disastrous consequences (Bessis, 1998). Furthermore, operational risk is of importance as it can affect the reputation of the organization concerned (Kondabagil, 2007). Hefferman (1996) suggests that due to a reduction in human labor, there is less human error and, consequently, less operational risk. However, an alternative view is that the increased use of technology results in a greater level of operational risk (see, for example, Kondabagil, 2007).

Internal security issues may be considered to represent the biggest threat to the development of e-banking. For example, a clear risk to security is presented 'by unauthorized use of the computer by a bank employee, who can then manipulate data to alter account balances' (Pennathur, 2001, p. 2115). It should also be noted that fraudulent activities are not confined to staff within an organization, and information relating to, for example, bank customer accounts, can be illegally obtained by external parties. Furthermore, there is also the risk of viruses infecting the

computer systems of the banks (Pennathur, 2001). It is acknowledged, however, that the security issues, referred to above, cannot all be controlled and banks must try to manage these risks in an effective manner (FDIC, 2007; Nwogu and Odoh, 2015). It must also be appreciated that in the e-banking sector, the technology is constantly under development and there is considerable uncertainty regarding related legal issues. Breaking of rules can lead to damage to an organization's reputation and, in extreme cases, the right to continue to operate may be withdrawn (see, for example, Pennathur, 2001).

E-banking is a relatively new technology, having only been developed over the last two decades, and, consequently, the legal guidance relating to the sector is still somewhat unclear and constantly evolving. It is considered that a well-managed compliance function would reduce legal and compliance risks (Kondabagil, 2007). It is also apparent that different risk factors to which banks are exposed will affect the reputation of individual organizations and the sector in general (Kondabagil, 2007; Pennathur, 2001). The reputation of a bank can be affected by a range of factors, such as security breaches, fraud and customer dissatisfaction with electronic services offered. In addition, failure to protect confidential customer information can lead to significant loss of trust in the organization. It has been suggested that, if the reputation of one bank is placed at risk, then this can result in a significant effect on the overall sector, leading to systemic disruption (see, for example, Kondabagil, 2007; Pennathur, 2001).

It is also necessary to acknowledge that risks traditionally associated with the banking sector are still of importance. Unexpected movements in interest rates and losses incurred when customers fail to make loan repayments can have a significant effect on the performance of banks (Hefferman, 1996; Bessis, 1998). In addition, there is the risk associated with holding investment portfolios, the value of which can be significantly altered by movements in stock prices or exchange rates (Bessis, 1998; Singh and Agnihotri, 2015). In order for banks to make profit, they must take risk (Gup and Kolari, 2005). It is necessary for banks to recognize that there are many different types of risks and they should 'balance alternative strategies in terms of their risk/return characteristics with the goal of maximizing shareholder wealth' (Gup and Kolari, 2005, p. 12).

Customer bank accounts are exposed to additional security threats as a result of the provision of electronic services. Statistics provided by the Association for Payment Clearing Services (APCS) has shown an increase in the level of online banking fraud. Therefore, fourteen risk management principles in relation to e-banking were identified in Basel I, Basel Committee Report on Banking Supervision, 2001, publication No. 82 (Pennathur, 2001). Furthermore, Basel II, published in 2004, is considered to represent a comprehensive attempt to provide a set of incentives to encourage risk consciousness (Crockett, 20053). The Basel Committee considers that banks should ensure that all necessary risk management principles are followed so as to develop an improved e-banking service (Basel Committee, 2003).

The fourteen principles for e-banking, referred to above, cover board and management oversight, security controls and legal/reputational risk management. The board of directors and senior management are responsible for developing a risk management plan so as to ensure that any risks are identified and effectively managed. Security control is of great importance and essentially involves establishing appropriate authentication procedures and providing secure e-banking activities. The legal and reputational risk of an organization is clearly dependent upon security control (Basel Committee, 2003). On a worldwide basis, banks have a responsibility to ensure that customers gain the same level of confidence in the system, whether transactions are dealt with electronically or on a personal basis with bank employees (Basel Committee, 2003; BIS, 2003). Although the e-banking issues have been the subject of a number of many research papers in the past, this is the first such investigation in relation to Cypriot banks. It is of importance, particularly after the recent crisis in the Cypriot banking sector, to provide clear guidance to the decision makers on the advantages and the risks associated with e-banking. Furthermore, it is necessary to clearly identify bankers' perceptions on risk management practices that are associated with the 14 Basel principles.

2. Research methodology

The main research instrument used in this paper is a questionnaire. The questionnaire is mainly designed to provide answers to the main research aims, as follows: firstly, to capture information regarding bankers' perception on the advantages of the e-banking services; secondly, to discover the perception of bankers in relation to the risks that are associated with the e-banking services; and, thirdly, to investigate how banks manage the risks associated with e-banking based on the 14 principles of Basel Committee in the Cypriot banking sector.

The questionnaire was distributed to bankers who work in the four major public banks and their branches in Cyprus, namely, Marfin Laiki Bank, Bank of Cyprus, Alfa Bank and Elliniki Bank, in the last quarter of 2011. A total of 100 questionnaires were sent out either via e-mail or personally. The final sample included branch managers, senior risk management officers and staff involved in any e-banking activities.

The rationale behind using such a large sample is to gain a comprehensive appreciation of how various e-banking issues are dealt with and whether decision makers understand e-banking advantages and risks. In addition, an understanding might be gained as to how risk management principles for e-banking based on the 14 Basel principles may vary across different banks. A total of 78 questionnaires were returned (a response rate of 78%), a positive level of participation by the Cypriot banks' employees. The questionnaire was designed to achieve the objectives and to provide clear guidelines to the Cypriot banking sector in relation to e-banking issues. The information gathered from the questionnaires provided some significant results as described below (see Appendix A for more details).

The research questionnaire is divided into three sections. Section A covers the demographic information of the Cypriot banks' participants. Section B covers the following two aspects: bankers' perception of the advantages of e-banking; and bankers' perception of the risk associated with e-banking. This Section comprises 18 questions, based on a seven-point Likert scale; 9 for each of the two aspects. Section C covers risk management principles for e-banking based on the 14 principles of Basel Committee. This Section comprises three sub-sections as follows: board and management oversight (principles 1-3); security controls (principles 4-10); and legal reputational risk management (principles 11-14). These 14 questions (principles) are based on a seven-point Likert scale. Respondents are asked to indicate their degree of agreement with each of the questions, choosing from answers on a seven-point Likert scale, as shown in Appendix A.

2.1. Multinomial regression. A multinomial regression is a process of regression analysis, designed to interpret the responses of the dependent variable to the explanatory independent variables. This form of regression is able to analyze variables from several categories and has a high likelihood of demonstrating relationships across categories irrespective of demographic influences. The multinomial regression formula is as follows:

$$1(\alpha,\beta)=\prod_{i=1}^{n}[\pi_1(X_i)^{y_{1i}}\ \pi_2(X_i)^{y_{2i}}\ \pi_3(X_i)^{y_{3i}}\ldots\ldots\pi_n(X_i)^{y_{ni}}], \quad (1)$$

where 1 is the usual indicator function; α and β are the model parameters; π_1, π_2, $\ldots\pi_n$ are the probabilities of various attributes, respectively; X_i are the covariates of the i th attribute; y_{1i} is an indicator variable which is 1 if the i th attribute is of type 1, or 0, otherwise, etc (see, for example, Abdou et al., 2012).

3. Results and discussion

3.1. Descriptive statistics. Table 1 shows descriptive statistics for the participants' demographic information. It is obvious that more than 75% of our sample participants have 5 years or more of work experience; and more than 40% have 10 years or more of experience. Similarly, more than 30% of our sample participants are holding a position of bank clerk; and almost 45% of our participants are holding other positions which involve e-banking activities, including Chief Risk Officers (CROs). In addition, 14% of our participants are Executives. All participants are working in public banks and all of their banks are using e-banking services, as shown in Table 1.

Table 1. Descriptive statistics of the participants' demographic information

Item	Sub-heading	*N* = 78	%
Years of experience	Less than 2 years	6	7.690
	2 to 5 years	12	15.38
	5 to 10 years	28	35.89
	10 or more years	32	41.02
Position	Executive	11	14.10
	Manager	8	10.25
	Bank clerk	24	30.76
	Other	35	44.87
Type of bank	Public bank	78	100.0
	Private bank	0	0.000
	Privatized bank	0	0.000
Whether the bank offers e-banking services	Yes	78	100.0
	No	0	0.000

Tables 2a, 2b and 2c show descriptive statistics for the bankers' perception of the advantages of e-banking, risk associated with e-banking and risk management principles based on the 14 Basel committee principles. In relation to the advantages of e-banking, all our sample participants show dif-

ferent levels of agreement to our questions and the vast majority are in strong agreement to our questions' statements. In addition, there is evidence of statistically significant differences at the 99% confidence level between different respondents' answers (i.e., slightly agree, moderately agree and strongly agree) for five questions, as shown by the chi^2 test. This, to some extent, illustrates that the staff of the Cypriot banks understand what the advantages of e-banking are.

For the advantages of e-banking, our results show that "Electronic banking saves time" is the most important question with a mean score of 6.92 followed by "Electronic banking minimizes the risk of carrying cash" with a mean score of 6.91. On the other hand, our mean score analysis shows that "Electronic banking increases operational efficiency" is the least important with a score of 5.85, as shown in Table 2a. Our findings are similar to previous investigations in other countries. The first two set of questions are used on previous studies in Estonia, Pakistan and the UK. In their study for Pakistani banks, Kaleem and Ahmad (2008) show that the mean scores are almost the same. However, in a UK study by Moutinho and Phillips (2002), the results are different and the highest mean scores are given to statements that are based on the reduction of cost transactions, quick responses, and the quality of e-banking services. Birch and Young (1997) have opposite findings; they found that HR requirements are reduced significantly because branches began to close with the introduction of e-banking. In each country the HR requirements differ. In our study, it is considered that HR has a slightly lower mean score due to the lower level of use of e-banking services in Cyprus.

Table 2a. Descriptive statistics for bankers' perception of the advantages of e-banking

QUESTIONS	SlA		MA		SrA		Mean	St.dev.	Chi^2	df	Sig.
Section B1	Frq.	%	Frq.	%	Frq.	%					
E-banking minimizes the cost of transactions	2	2.6	20	25.6	56	71.8	6.692	0.5174	58.154	2	0.000
E-banking saves time	-	-	6	7.7	72	92.3	6.923	0.2681	55.846	1	0.000
E-banking minimizes inconvenience	-	-	13	16.7	65	83.3	6.833	0.3750	34.667	1	0.000
E-banking provides up-to-date information	24	30.8	19	24.4	35	44.9	6.141	0.8637	5.154	2	0.076
E-banking increases operational efficiency	31	39.7	28	35.9	19	24.4	5.846	0.7908	3.000	2	0.223
E-banking reduces HR requirements	23	29.5	32	41.0	23	29.5	6.000	0.7729	2.077	2	0.354
E-banking facilitates quick responses	16	20.5	26	33.3	36	46.2	6.256	0.7802	7.692	2	0.021
E-banking improves service quality	-	-	16	20.5	62	79.5	6.794	0.4064	27.128	1	0.000
E-banking minimizes the risk of carrying cash	-	-	7	9.0	71	91.0	6.910	0.2876	52.513	1	0.000

Notation: SlA = Slightly agree; MA = Moderately agree; SrA = Strongly agree; St.dev. = Standard deviation; Frq. = Frequency. None of the respondents choose any of the other four categories, namely, slightly disagree, moderately disagree, strongly disagree or neutral.

In relation to the risk associated with e-banking, somewhat surprisingly all our sample participants show different levels of disagreement to our questions. Our mean analysis clearly shows that all the respondents have similar views and opinions based on the questions that are given to them. In addition, there is an evidence of statistically significant differences at the 99% confidence level between different respondents' answers (i.e., slightly disagree, moderately disagree and strongly disagree) for seven out of nine questions, as shown by the chi^2 test. This illustrates that the Cypriot banks' staff do understand the risks that are associated with e-banking, as shown in Table 2b.

Table 2b. Descriptive statistics for bankers' perception of the risks associated with e-banking

QUESTIONS	SlD		MD		SrD		Mean	St.dev.	Chi^2	df	Sig.
Section B2	Frq.	%	Frq.	%	Frq.	%					
Electronic banking has the chance of data loss	34	43.6	24	30.8	20	25.6	2.179	0.8177	4.000	2	0.135
Electronic banking has the chance of fraud	35	44.9	26	33.3	17	21.8	2.230	0.7882	6.231	2	0.044
Electronic banking has the chance of government access	66	84.6	9	11.5	3	3.8	2.807	0.4850	93.000	2	0.000
E-banking lacks information security	-	-	22	28.2	56	71.8	1.282	0.45291	14.821	1	0.000
E-banking charges a high cost for services	-	-	11	14.1	67	85.9	1.141	0.35030	40.205	1	0.000
E-banking has many legal and security issues	3	3.8	19	24.4	56	71.8	1.320	0.5463	56.846	2	0.000
E-banking needs expertise and training	-	-	14	17.9	64	82.1	1.179	0.3862	32.051	1	0.000

Table 2b (cont.). Descriptive statistics for bankers' perception of the risks associated with e-banking

QUESTIONS	SlD		MD		SrD		Mean	St.dev.	Chi²	df	Sig.
E-banking has inadequate information on the website	6	7.7	11	14.1	61	78.2	1.294	0.6053	71.154	2	0.000
E-banking has less operational reliability	2	2.6	17	21.8	59	75.6	1.269	0.5012	67.154	2	0.000

Notation: SlD = Slightly disagree; MD = Moderately disagree; SrD = Strongly disagree; St.dev. = Standard deviation; Frq. = Frequency. None of the respondents choose any of the other four categories, namely, slightly agree, moderately agree, strongly agree or neutral.

In relation to the risks associated with e-banking, our results show that "Electronic banking has the chance of government access" is the question resulting in the strongest level of disagreement, with a mean score of 2.81. As shown in Table 2b, our results show that the respondents disagree that e-banking activities have security and legal issues, that they do not provide a variety of information in their websites and that the services lack security information. On their investigations of data loss in relation to e-banking services in Singapore, Kaleem and Ahmad (2008) and Cunningham and Gerrard (2003) conclude that the majority of consumers fear fraud and data loss, and customers have trust issues when it comes to e-banking. This is clearly opposite to our findings as the Cypriot bankers strongly disagree with the fraud and data loss issues.

Table 2c. Descriptive statistics for risk management principles for e-banking

QUESTIONS	SlA		MA		SrA		Mean	St.dev.	Chi²	df	Sig.
Section C	Frq.	%	Frq.	%	Frq.	%					
Board and management oversight (Principles 1-3)											
The bank has established an effective management over all e-banking activities in terms of risks	6	7.7	12	15.4	60	76.9	6.692	0.6096	67.385	2	0.000
The bank has established a comprehensive security control process	3	3.8	16	20.5	59	75.6	6.717	0.5320	66.077	2	0.000
The bank has established a comprehensive and ongoing due diligence and management oversight process for outsourcing relationships and other third-party dependencies	9	11.5	17	21.8	52	66.7	6.551	0.6959	40.231	2	0.000
Security controls (Principles 4-10)											
The bank has measures for the authentication of e-banking customers	4	5.1	18	23.1	56	71.8	6.666	0.5735	55.692	2	0.000
The bank promotes non-repudiation and accountability for e-banking transactions	6	7.7	17	21.8	55	70.5	6.628	0.6264	50.846	2	0.000
The bank uses appropriate measures to ensure segregation of duties	-	-	11	14.1	67	85.9	6.859	0.3503	40.205	1	0.000
The bank uses proper authorisation controls within e-banking systems, databases and applications	2	2.6	4	5.1	72	92.3	6.897	0.3810	122.15	2	0.000
The bank ensures the data integrity of e-banking transactions, records, and information	7	9.0	12	15.4	59	75.6	6.666	0.6379	63.308	2	0.000
The bank has establishments of clear audit trails for e-banking transactions	7	9.0	16	20.5	55	70.5	6.615	0.6492	50.077	2	0.000
The bank takes measures to ensure the confidentiality of key bank information	3	3.8	13	16.7	62	79.5	6.756	0.5143	76.692	2	0.000
Legal reputational risk management (Principles 11-14)											
The bank has appropriate disclosures for e-banking services	2	2.6	20	25.6	56	71.8	6.692	0.5174	58.154	2	0.000
The bank ensures the privacy of customer information	8	10.3	21	26.9	49	62.8	6.525	0.6785	33.769	2	0.000
The banks capacity, business continuity and contingency planning to ensure availability of banking systems and services is effective	5	6.4	11	14.1	62	79.5	6.730	0.5737	75.462	2	0.000
The bank has incident response planning	3	3.8	14	17.9	61	78.2	6.743	0.5206	73.000	2	0.000

Notation: SlA = Slightly agree, MA = Moderately agree; SrA = Strongly agree, St.dev. = Standard deviation, Frq.= Frequency. None of the respondents choose any of the other four categories, namely, slightly disagree, moderately disagree, strongly disagree or neutral.

In relation to the risk management principles, all our sample participants show different levels of agreement to our questions and the vast majority are in strong agreement to our questions' statements. In addition, there is an evidence of statistically significant differences at the 99% confidence level between different respondents' answers (i.e., slightly agree, moderately agree and strongly agree) for all the 14 Basel committee principles, as evident by the chi^2 test. This clearly illustrates that the Cypriot banks' staff do understand

the requirements of Basel committee principles under the various subsections, namely, Board and Management Oversight, Security Controls and Legal Reputational Risk Management, as shown in Table 2c.

Our results in Table 2c show that there is a general strong agreement in respect of all the 14 principles. The most important statement, which received the highest mean score of 6.89, is "The bank uses proper authorisation controls within e-banking systems, databases and applications". Our findings confirm that Cypriot bankers strongly believe that their banks recognize the risks and manage the problems according to the principles of Basel Committee on the e-banking activities. Finally, our findings indicate that Cypriot pubic banks, namely, Laiki Marfin Bank, Bank of Cyprus, Elliniki Bank and Alpha Bank have adopted all the principles and have taken appropriate steps to ensure that all risks and challenges are well managed for a safer and efficient e-banking system.

3.2. Multinomial regression models. We use IBM SPSS 20 to run multinomial regression. The aim is to investigate whether there are significant differences in the level of understanding various e-banking issues based on both years of experience and the position held by the participants in the Cypriot banking sector. The reason behind choosing multinomial regression models is that it has the advantage in that it allows the effects of the different covariates to be unscrambled, whilst other statistical tools such as ANOVA, investigate each of the variables individually. Also because the dependent variable (i.e., years of experience or position held) is polytomous, that is, its values are made up of more than two categories.

3.2.1. Multinomial models based on bankers' years of experience. Table 3a shows the multinomial regression model results for the years of experience of bankers in relation to each of the three main categories, namely, advantages of e-banking, risk associated with e-banking and risk management principles based on the 14 Basel committee principles. The overall model is significant at the 90% confidence level with *P*-value of 0.073 and *Pseudo* R^2 of 15.5%. It is clear that there are insignificant differences between the number of years of experience of the bankers and the level of understanding e-banking issues in the Cypriot banking sector. However, it is worth noting that there is a statistically significant difference at the 95% confidence level between those who have less than two years of experience and those who have more than ten years of experience, as shown in Table 3a. This means that the smaller the number of years of experience (i.e., less than 2 years), the higher the level of understanding risk management principles, in comparison to those staff with a higher number of years of experience (i.e., 10 years or more). This can be explained by the fact that younger staff are likely to be more aware and familiar with the level of technology associated with e-banking services, whilst more experienced Cypriot bankers may not have enough knowledge in relation to e-banking services.

Table 3a. Multinomial regression model based on bankers' years of experience as a dependent variable

Years of experience		B	Std. error	Df	Sig.
Less than 2 years	Intercept	-90.438	44.561	1	.042
	AOEB	5.034	3.529	1	.154
	RAWEB	-.844	2.894	1	.771
	ALLPRINS	**8.446**	**4.271**	**1**	**.048**
2 to 5 years	Intercept	-35.850	23.253	1	.123
	AOEB	1.261	1.908	1	.509
	RAWEB	-.199	1.788	1	.911
	ALLPRINS	4.021	2.447	1	.100
5 to 10 years	Intercept	2.450	14.940	1	.870
	AOEB	-1.315	1.314	1	.317
	RAWEB	-1.520	1.361	1	.264
	ALLPRINS	1.258	1.718	1	.464

Notation: the reference category is: 10 years or more. AOEB = Advantages of e-banking; RAWEB = Risks associated with e-banking; ALLPRINS = All the 14 Basel Principles.

These findings led to an extended analysis of the 14 risk management principles, where they are split into their main three categories, namely, Board and Management Oversight (BMO), Security Controls (SC) and Legal Reputational Risk Management (LRRM), as shown in Table 3b. The overall model is significant at the 90% confidence level with *P*-value of 0.091 and *Pseudo* R^2 of 20.5%. It is obvious that Security Control is the most important component out of the three categories. Table 3b shows that there is a statistically significant difference between bankers who have less than 2 years of experience and those who have more than 10 years of experience in relation to security control at the 10% level, as shown in Table 3b.

Table 3b. Multinomial regression model based on bankers' years of experience as a dependent variable

Years of experience		B	Std. error	Df	Sig.
Less than 2 years	AOEB	5.941	4.013	1	.139
	RAWEB	-.466	3.023	1	.878
	SC	**6.322**	**3.338**	**1**	**.058**
	BMO	.769	1.615	1	.634
	LRRM	2.153	2.234	1	.335
2 to 5 years	Intercept	-37.187	23.841	1	.119
	AOEB	1.278	1.860	1	.492
	RAWEB	-.405	1.822	1	.824
	SC	1.244	1.635	1	.447
	BMO	.535	1.139	1	.639
	LRRM	2.468	1.515	1	.103
5 to 10 years	Intercept	.104	15.297	1	.995
	AOEB	-1.304	1.355	1	.336
	RAWEB	-1.567	1.380	1	.256
	SC	1.682	1.292	1	.193
	BMO	-.265	.764	1	.728
	LRRM	.183	.806	1	.821

Notation: The reference category is: 10 years or more. AOEB = Advantages of e-banking, RAWEB = Risks associated with e-banking, SC = Security control, BMO = Board and management oversight, LRRM = Legal reputational risk management.

3.2.2. Multinomial models based on positions held by bank staff. Table 4a shows the multinomial regression model results for positions held by staff in the banks in relation to each of the three main categories, namely, 0 advantages of e-banking, risk associated with e-banking and risk management principles based on the 14 Basel committee principles. The overall model is insignificant with *P*-value of 0.464 and *Pseudo* R^2 of 11.6%. The findings indicate that there are insignificant differences between the different positions held by staff and the level of understanding of e-banking issues in the Cypriot banking sector, as shown in Table 4a. However, an extended analysis of the 14 risk management principles, where they are split into their main three categories, namely, Board and Management Oversight (BMO), Security Controls (SC) and Legal Reputational Risk Management (LRRM), as shown in Table 4b, is conducted in this study.

Table 4a. Multinomial regression model based on positions held by bank staff as a dependent variable

Position held		B	Std. error	Df	Sig.
Executive	Intercept	35.830	19.199	1	.062
	AOEB	-2.831	1.739	1	.103
	RAWEB	.152	1.821	1	.933
	ALLPRINS	-2.830	2.258	1	.210
Manager	Intercept	-19.186	26.494	1	.469
	AOEB	.343	2.211	1	.877
	RAWEB	2.088	2.005	1	.298
	ALLPRINS	1.784	2.757	1	.518
Bank clerk	Intercept	24.424	15.668	1	.119
	AOEB	-1.215	1.354	1	.370
	RAWEB	.823	1.404	1	.558
	ALLPRINS	-2.728	1.776	1	.125

Notation: The reference category is: Other. AOEB = Advantages of e-banking, RAWEB = Risks associated with e-banking, ALLPRINS = All the 14 Basel Principles.

The overall model is significant at the 95% confidence level with *P*-value of 0.049 and *Pseudo* R^2 of 28.2% (Table 4b). It is obvious that Security Control is the most important component out of the three categories. Table 4b shows that there is a statistically significant difference between bankers who held a manager position and those who held other positions, such as CROs, in relation to security control at the 5% level, as shown in Table 4b. Similarly, there is a statistically significant difference between bankers who held a clerk position and those who held other positions in relation to the same category, namely, security control at the 10% level, as shown in Table 4b. This clearly suggests that security control is the

most critical issue, and needs special attention as the risks and threats through a bank's web are numerous. To conclude, our findings suggest that Cypriot bankers perceive e-banking as an advantage for reducing the risk of carrying cash, for the time saving and convenience. They also do not believe that e-banking increases the level of fraud and issues on data loss and, in addition, may increase the chances of government access. Furthermore, our results indicate that the four major public banks in Cyprus identify risks and manage them according to the 14 principles of Basel Committee. Finally, a significant link between the years of experience (particularly less than 2 years of experience) and the position held (particularly managers and bank clerks positions) and the 14 principles of Basel Committee has been identified applying multinomial regression model, namely, security control.

Table 4b. Multinomial regression model based on positions held by bank staff as a dependent variable

Position held		B	Std. Error	Df	Sig.
Executive	Intercept	37.880	20.629	1	.066
	AOEB	-2.706	1.739	1	.120
	RAWEB	.191	1.842	1	.917
	SC	-2.295	1.765	1	.193
	BMO	-1.369	.962	1	.155
	LRRM	.396	1.218	1	.745
Manager	Intercept	-68.060	38.886	1	.080
	AOEB	1.700	3.122	1	.586
	RAWEB	3.456	2.372	1	.145
	SC	**8.236**	**3.804**	**1**	**.030**
	BMO	.585	1.517	1	.700
	LRRM	-1.600	1.167	1	.170
Bank clerk	Intercept	27.922	16.858	1	.098
	AOEB	-1.253	1.366	1	.359
	RAWEB	.790	1.433	1	.581
	SC	**-2.410**	**1.364**	**1**	**.077**
	BMO	-1.302	.802	1	.104
	LRRM	.505	.942	1	.592

Notation: The reference category is: Other. AOEB = Advantages of e-banking, RAWEB = Risks associated with e-banking, SC = Security control, BMO = Board and management oversight, LRRM = Legal reputational risk management.

Conclusion

This study has focused upon the perception of bankers of the advantages and associated risks of e-banking. In addition, bankers' perception of the risk management principles of e-banking based upon the 14 principles of the Basel Committee are also considered, specifically, in the case of major public banks in Cyprus. It is reasonable to suggest that an investigation of this nature is justified, particularly in the light of the recent crisis in the Cypriot banking sector.

The results show that the bankers consider e-banking to be advantageous in that it is convenient, saves time and minimizes the risk of carrying cash. Somewhat surprisingly, the data indicate that the bankers do not consider that the level of fraud and the risk of data being lost are increased as a result of e-banking. Furthermore, the results indicate that Cypriot bankers recognize risks and manage them in accordance with the principles of the Basel Committee on e-banking. The findings also provide evidence that the four Cypriot banks under consideration have taken appropriate measures to ensure that risks are managed in such a way so as to provide a safer and more efficient e-banking system. It is also noted that younger, less experienced banking staff are more familiar with the technology associated with e-banking services. Future research could be extended to include private banks and to include other banking industries in other European countries. The investigation could be extended to include customer perceptions in relation to both advantages and the risk associated with e-banking.

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Appendix A: Research questionnaires

Section A: Demographic information

1. Years of work experience in the banking field (please tick the appropriate box).

   Less than 2 years ☐ 2 to 5 years ☐ 5 to 10 years ☐ 10 years or more ☐

2. Please specify your position (please tick the appropriate box)

   Executive ☐ Manager ☐ Bank Clerk ☐ Other (please specify) ☐ .....

3. What bank type are you working (please tick the appropriate box).

Public bank ☐ Private bank ☐ Privatized bank ☐

4. Does your bank offer online banking service(s).

Yes ☐ No ☐

Section B: on a scale of 1 to 7 (please circle the appropriate answer). 1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = moderately agree, 7 = strongly agree.

1. Banker's perception of the advantages of e-banking								
No.		**Scale**						
1	E-banking minimizes the cost of transactions	1	2	3	4	5	6	7
2	E-banking saves time	1	2	3	4	5	6	7
3	E-banking minimizes inconvenience	1	2	3	4	5	6	7
4	E-banking provides up-to-date information	1	2	3	4	5	6	7
5	E-banking increases operational efficiency	1	2	3	4	5	6	7
6	El-banking reduces HR requirements	1	2	3	4	5	6	7
7	E-banking facilitates quick responses	1	2	3	4	5	6	7
8	E-banking improves service quality	1	2	3	4	5	6	7
9	E-banking minimizes the risk of carrying cash	1	2	3	4	5	6	7

2. Banker's perception of the risks associated with e-banking								
No.		**Scale**						
1	E-banking has the chance of data loss	1	2	3	4	5	6	7
2	E-banking has the chance of fraud	1	2	3	4	5	6	7
3	E-banking has the chance of government access	1	2	3	4	5	6	7
4	E-banking lacks information security	1	2	3	4	5	6	7
5	E-banking charge a high cost for services	1	2	3	4	5	6	7
6	E-banking has many legal and security issues	1	2	3	4	5	6	7
7	E-banking needs expertise and training	1	2	3	4	5	6	7
8	E-banking has inadequate information on the website	1	2	3	4	5	6	7
9	E-banking has less operational reliability	1	2	3	4	5	6	7

Section C: on a scale of 1 to 7 (please circle the appropriate answer). 1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = moderately agree, 7 = strongly agree.

Risk Management Principles for e-banking based on the 14 principles of Basel Committee								
No.	**Questions**	**Scale**						
BOARD AND MANAGEMENT OVERSIGHT (PRINCIPLES 1-3)								
1	The bank has established an effective management over all e-banking activities in terms of risks	1	2	3	4	5	6	7
2	The bank has established a comprehensive security control process	1	2	3	4	5	6	7
3	The bank has established a comprehensive due diligence and management oversight process for outsourcing relationships and other third-party dependencies	1	2	3	4	5	6	7
SECURITY CONTROLS (PRINCIPLES 4-10)								
4	The bank has measures for the authentication of e-banking customers	1	2	3	4	5	6	7
5	The bank promotes a non-repudiation and accountability for e-banking transactions	1	2	3	4	5	6	7
6	The bank uses appropriate measures to ensure segregation of duties	1	2	3	4	5	6	7
7	The bank uses proper authorisation controls within e-banking systems, databases and applications	1	2	3	4	5	6	7
8	The bank ensures the data integrity of e-banking transactions, records, and information	1	2	3	4	5	6	7
9	The bank has established clear audit trails for e-banking transactions	1	2	3	4	5	6	7
10	The bank takes measures to ensure the confidentiality of key bank information	1	2	3	4	5	6	7
LEGAL REPUTATIONAL RISK MANAGEMENT (PRINCIPLES 11-14)								
11	The bank has appropriate disclosures for e-banking services	1	2	3	4	5	6	7
12	The bank ensures the privacy of customer information	1	2	3	4	5	6	7
13	The bank's capacity, business continuity and contingency planning to ensure availability of - banking systems and services is effective	1	2	3	4	5	6	7
14	The bank has incident response planning	1	2	3	4	5	6	7