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Effect of the Use of Derivative Instruments on Accounting Risk: Evidence from Banks in Emerging and Recently Developed Countries

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The purpose of this paper is to assess the level of accounting risk that banks, in both emerging and recently developed countries, face by using derivative instruments. On the whole, results show that forwards negatively affect leverage risk, the use of swap contracts has negative effect on credit risk, the use of options generally increases risk, and finally the use of futures minimally contributes to bank risk. There is some evidence that forwards and swaps are used primarily for risk-control purposes, while options tend to be used for speculative purpose. The main finding is that banks in the sample do not seem to be at risk by using derivative instruments.

Key Words: Derivatives; Bank; Accounting risk; Panel econometrics.
JEL Classification Numbers: G21, G32.

1. INTRODUCTION

The widespread use and the rapid growth of derivative activities as well as the increase of instability of the financial system around the world has

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fuelled the debate about whether derivative instruments reduce or exacerbate risk in financial institutions and especially in banks. In addition, emerging countries are the most affected by the recent financial crisis because of the fragility of their financial system and the higher likelihood of their banks to fail. The purpose of this study is to examine whether the use of derivative instruments affects the risk of banks in emerging countries with respect to recently developed countries.

An overview of the literature shows that only two articles have studied the effect of the use of derivative instruments on bank risk: Focusing only on banks from industrial countries Chaudhry et al. (2000) and Reichert and Shyu (2003) find that options generally increase bank risk while swaps decrease bank risk. Indeed, choosing the sample period 1989-1993, Chaudhry et al. (2000) find that options increase almost all of the five capital market measures of risk (total return risk, systematic risk, interest rate risk, foreign currency risk, and unsystematic risk) for each bank. In contrast, forwards have no significant effect on any type of capital market measure of risk. However, swaps decrease total risk and foreign currency risk. Extending their sample to US, European and Japanese banks, Reichert and Shyu (2003) used four capital market measures of risk: market beta, interest beta, currency beta, and EVaR during the period 1995-1997. Their results indicate that outside the United States of America, futures and forward contracts have little consistent impact upon the four measures of bank risk, while the use of options increases the beta interest for banks in all three of the geographic areas. On the other hand, both interest rate and currency swaps generally reduce risk.

The study contributes to the literature in several ways — most notably regarding the debate that derivative instruments are risky activities and are implicated in the recent financial crisis around the world. Therefore, the paper allows to check whether banks are at risk or not by using derivative instruments. Moreover, because of the limited number of papers that have studied the effects of the use of derivatives on bank risk, this study also attempts to fill this gap in the literature. In addition, this paper will be the first to provide empirical evidence regarding the effect of derivative instruments on bank risk in emerging and recently developed countries. Lastly, to our knowledge, this paper will also be the first to provide evidence concerning the relationship between accounting risk and the use of derivative instruments.

The aim of this paper is then to explore the effect of the use of derivative instruments on accounting risk for banks in both emerging and recently developed countries. This paper tends to compare results obtained from banks in emerging countries and those collected from banks in recently developed countries. The common results of the overall sample and the two subsamples show that forwards have a negative effect on leverage risk,

swaps negatively affect credit risk 2, and futures have a positive but weak effect on total risk.

Some experts in economics remain sceptical about the risk effect of the use of derivatives and its implications in recent financial crisis. The findings of this paper contradict this point of view. Thus, despite scepticism about the implication of derivatives in recent financial crisis, regulators should continue to encourage banks to get involved in derivative activities.

The rest of the paper is organised as follows. Section 2 reveals statistics about the use of derivatives in emerging and developing countries. It also presents a literature review of the association between the use of derivative instruments and risks. In Section 3, data and sample are described. Then the model, the methodology and the variables used in the study are specified. In Section 4, the empirical results are interpreted and analysed. Lastly, Section 5 provides summary and conclusions with policy implications regarding the paper.

2. BACKGROUND

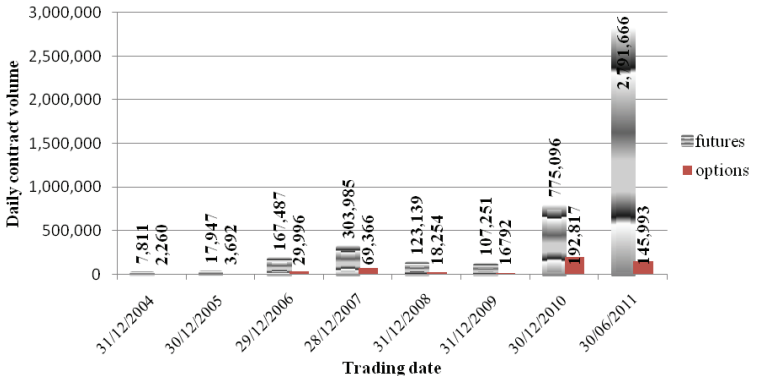
2.1. Overview of the use of derivatives in emerging and recently developed countries

Data from stock exchanges and other financial sources clearly prove a remarkable increase in the use of derivative instruments use in emerging and recently developed countries for the last two decades. As it is showed in Figure 1, the number of futures and option contracts traded daily in Russian Stock Exchange jumped respectively, from 7,811 and 2,260 on 31st December 2004, to 2,791,666 and 145,993 contracts on 30th June 2011. Figure 2 explains the increase in the volume of the two types of option contracts traded in Tel-Aviv Stock Exchange, during the period between 1996 and 2010. Regarding futures, Figure 3 demonstrates that futures trading value, in Turkish Derivatives Exchange, grew regularly during the period between 2005 and 2010 going from 1,727.08 in 2005 to 246,231.50 million USD in 2010[1]. Additionally, in the period going from 2000 to 2010, the growth of futures trading value in Korea Exchange increased constantly jumping from 766,843.64 million USD to 8,782,490.43 as showed in Figure 4.

Observing such statistics undoubtedly proves the increase in the use of derivative instruments in emerging and developing countries during the last decade. Therefore, it is important to study what effect these financial activities have on financial institutions, especially banks and the recent debate about the implication of such activities in the latest financial crisis.

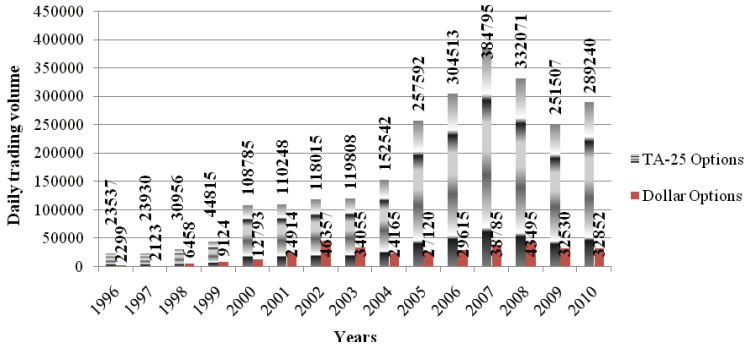
[1]Source: Turkish Derivatives Exchange www.turkdex.org.tr

FIG. 1. Growth in the number of option and futures contracts in Russian Stock Exchange



Source: http://www.rts.ru/en/archive/fortsmarketresults.html

FIG. 2. Growth in options trading volume in Israeli Stock Exchange



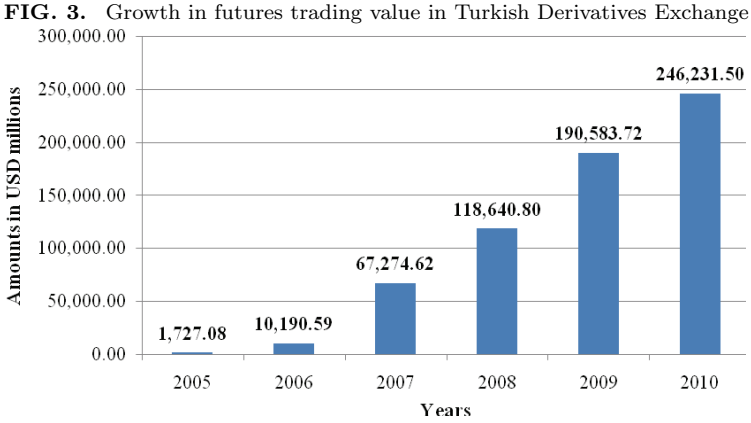
Source: www.tase.co.il

Before viewing literature about the effect of the use of derivatives on bank risk, we present in the following subsection a brief review of papers studying relationship between the use of derivatives by firms and the risk for these firms.

2.2. Relationship between derivative activities and risks: a literature review

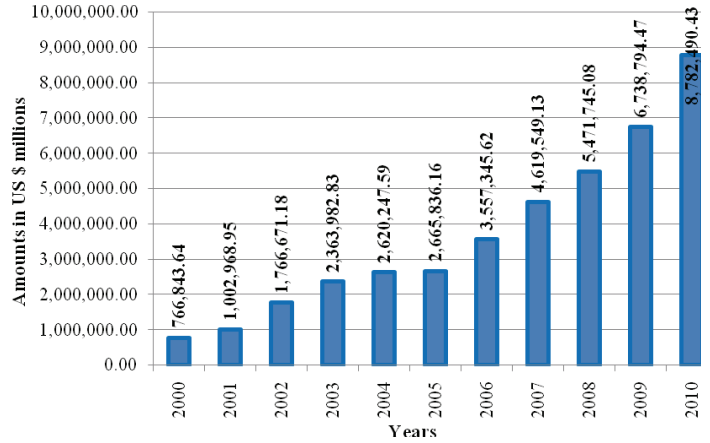
Bali, Hume and Martell (2004) demonstrate that there is no significant effect of credit derivatives on interest rate exposure. In contrast, Bartram et al. (2008) deduce that the use of credit derivatives decreases total risk and systematic risk of firms. Also, Chung (2002) finds that using derivatives decreases corporate risk. Furthermore, Hentschel and Kothari (2001) conclude that, compared to non-users, users of derivatives are less at risk.

FIG. 3. Growth in futures trading value in Turkish Derivatives Exchange



Source: www.turkdex.org.tr

FIG. 4. Growth in futures trading value in Korea Exchange



Source: http://eng.krx.co.kr/

The results of Nguyen and Faff (2002) indicate that currency derivatives reduce the exchange risk for firms. Last year, Clark and Mefteh (2010) found that the relationship between the use of foreign currency derivatives and foreign currency exposure is limited.

2.3. Effect of the use of derivatives on bank risk

Concerning banking literature studying the effect of derivatives on bank risk, there is a lack of studies focusing on the relationship. Indeed, only two articles (Chaudhry et al., 2000; Reichert and Shyu, 2003) examined the effect of derivative instruments on bank risk in industrial countries.

The results of the study conducted by Chaudhry et al. (2000) on US commercial banks reveal that the use of options tends to increase all types of bank risks for all US banks. Swaps, in contrast, have a negative effect on bank risk, while, the effect of forwards on bank risk is not significant. Moreover, Reichert and Shyu (2003) find that the use of options increases the beta interest rate for all US, European and Japanese banks, while both interest rate and currency swaps generally reduce risk.

Otherwise, focusing only on credit derivatives Instefjord (2005) deduces that credit derivatives increase bank risk in England. Recently, and without splitting derivatives by instruments Yong et al. (2009) find that the use of derivative activities increases long-term interest rate exposure and decreases short-term interest rate exposure of Asian Pacific banks.

Unpublished papers investigate also the effect of the use of derivative instruments on different types of bank risks. For example, Shanker (1996) finds that the use of swaps, futures, and options reduces interest-rate risk. Choi and Elyasiani (1996) find that options are positively related to both interest-rate and currency risk, while currency swaps reduce exchange rate risk. Finally, and similarly to the study conducted by Yong el al. (2009), Hirtle (1996) finds that the use of interest-rate derivatives increases the interest-rate exposure of bank holding companies (BHC). Cyree and Huang (2006) conclude that users and dealers of derivatives have higher risk compared to non-users. The results of Pai and Curcio (2005) confirm that derivatives enhance credit risk and liquid risk exposures of bank holding companies. Pai et al. (2006) find that credit risk exposure is reduced by using interest rate derivatives, but is increased by using exchange rate currency derivative.

Finally, Shao and Yeager (2007) find that the use of credit derivatives as buyer's protection reduces total risk while using derivatives as seller's protection increases risk.

3. DATA AND METHODOLOGY

Data and sample of the paper as well as the models are described in this section.

3.1. Data sample description

Accounting data were obtained from balance sheets and income states from bank websites. The sample is defined by 137 banks coming from emerging (74 banks) and recently developed countries (63 banks). The study covers the period from 2003 to 2010.

The classification into emerging and recently developed countries is based on the list of countries by Human development Index (HDI) used by the United Nations Office in 2010. According to HDI, countries equal to 0.784

are classified as developed countries and countries that are below this index countries are considered as emerging countries[2]. We call recently developed countries those that have been recently considered as emerging countries by United Nations Office.

Table 1 exposes the list of banks and their countries (as well as hyperlinks to bank web sites).

The main motivation for choosing banks from emerging countries is the fragility of the financial system of such countries and the higher likelihood of their banks to fail. Choosing to study on recently developed countries is motivated by the fact that such countries have recently been considered as emerging countries and have still had until now fragile financial systems compared to advanced countries. So advanced countries like United States, Japan and those from Western Europe are excluded from our sample. Additionally, no study investigating the effect of derivative instruments on bank risk has focused on banks from emerging countries and also from recently developed countries. In the literature, both the existing articles conducted by Chaudhry et al. (2000) and Reichert and Shyu (2003) were limited to banks from developed or advanced countries.

3.2. Sample statistics

The overall sample is composed of 137 banks from both emerging and recently developed countries. Banks in emerging countries represent 54.015% of the total banks, while banks in recently developed countries represent 45.985%. The overall sample is spread over five regions. Europe is represented by 54 banks, Asia by 69 banks of which 17 are from the Gulf States and 9 from the Middle-East. Banks from Latin America are eight. Africa is represented by six banks of which five are from South Africa. Regarding dealer banks, the sample is defined by twelve dealer banks[3]

Regarding the use of derivatives, forwards are the most used instruments by banks in overall sample. Swaps are the second most used instruments with 128 banks. Moreover, 101 banks are involved in using options, while only 70 banks use futures. The two most used instruments are forwards and swaps with a percentage equal to 89.78% of total banks.

Concerning banks in emerging countries, the most used instrument is forwards with a percentage equal to 94.59% of total banks. With a percentage equal to 89.19% of total banks, swaps are the second most used instrument, whereas, percentages of banks using option and futures contracts are respectively 60.81% and 45.95% of total banks. The most used pair is forwards and swaps with a percentage equal to 82.43% of total banks.

[2]For more details see the web site en.wikipedia.org/.../List_of_countries_by_Human...

[3]Hellenic Cyprus Bank; Hang Seng Bank; Hapoalim ; EON Berhard; OCBC Malaysia; United Bank Limited; BRE Polish; PKO; OCBC Singapore ; First Rand Bank; ABSA; Industrial Bank of Korea

TABLE 1.

Banks and their countries of overall sample

Panel A. Banks of emerging countries

Countries and bank names	Countries and bank names	Countries and bank names
Argentina	Kuwait	18.1 Muskat Bank
1.1 Bank Hipotecario	11.1 Bank Bahrain Kuwait	Pakistan
1.2 BBVA Banco FRANCÉS S.A.	11.2 Burgan Bank	19.1 United Bank Limited
Brazil	11.3 Gulf Bank Kuwait	Philippine
2.1 Banco ITAÚ S.A.	Latvia	20.1 Philippine National Bank
2.2 Santander Banespa	12.1 Aizkraukles Banka Latvija	Russia
Bulgaria	12.2 AS SEB banka Latvijas Unibanka	21.1 Gazprombank
3.1 Postbank Eurobank EFG	12.3 Baltic International Bank	21.2 TransCreditBank
3.2 Raiffiensen Bank Bulgaria	12.4 DNB Nord Banka	Saudi Arabia
3.3 Unit Credit Bulgaria	12.5 Latvijas Krājbanka	22.1 Arab National Bank
Chile	12.6 Latvijas Biznesa Banka	22.2 Banque Saudi Fransi
4.1 Banco de Chile	12.7 Norvik Banka	22.3 Saudi British Bank
4.2 Banco Santander	12.8 Parex Banka	South Africa
4.3 BCI	12.9 Rietumu Banka	23.1 ABSA Bank
China	12.10 Trasta Komercbanka	23.2 Capitec Bank
5.1 Bank of China Limited	Lebanon	23.3 FirstRand Ltd.
Croatia	13.1 Banque Audi SAL Audi Saradar	23.4 Imperial
6.1 Erste & Steiermärkische Bank D.D	13.2 BLOM Bank SAL	23.5 Sasfin Bank
6.2 HPB	13.3 Libanese Canadian Bank	Thailand
6.3 Hypo Alpe Adria Bank D.D.	Lithuania	24.1 Bangkok bank
6.4 Jadranska Banka Sibenik	14.1 AB Citadele Bankas Parex Bankas	24.2 Bank of Ayudhya
6.5 Privrednabanka banka Zagreb	14.2 DNB Nord Banka	24.3 Kasikorn Bank
6.6 Zagrebacka Banka	14.3 ŠIAULIU BANKAS	24.4 Krung Thai Bank
India	14.4 Swedbank	Turkey
7.1 HDFC Bank	14.5 Ukio Bankas	25.1 Akbank
7.2 ICICI Bank	Malaysia	25.2 Anadolubank Anonim Şirketi
Indonesia	15.1 CIMB Bank	25.3 Garanti Bankasi
8.1 Bank Danamon	15.2 EON Bank	25.4 Sekerbank
Jordan	15.3 OCBC Bank	25.5 Ziraat Bankasi
9.1 Capital Bank	Mauritius	Vietnam
9.2 Jordan Ahli Bank	16.1 MCB	26.1 SacomBank Saigon Thuong Tin Bank
9.3 Jordan Kuwait Bank	Mexico	261.2 ACB Vietnam
Kazakhstan	17.1 HSBC Mexico	
10.1 Halyk Bank	Oman	

Panel B. Banks of recently developed countries

Countries and bank names	Countries and bank names	Countries and bank names
Bahrain	6.2 OTP Bank	13.4 VUB Banka
1.1 Ahli United Bank B.S.C.	6.3 UniCredit Bank Hungary Zrt.	Slovenia
1.2 Arab Banking Corporation	Israel	14.1 Abanka Vipa d.d. Slovenska
1.3 Ithmaar Bank	7.1 BANK LEUMI	14.2 Factor Banka d.d.
1.4 United Gulf Bank	7.2 FIBI Bank	14.3 NLB
Cyprus	7.3 Bank Hapoalim	14.4 SKB banka, d. d.
2.1 Bank of Cyprus	7.3 Bank Hapoalim	14.5 UniCredit Slovenija d.d.
2.2 Hellenic Cyprus Bank	Poland	South Korea
Czech Republic	10.1 Bank BPH S.A.	15.1 Industrial Bank of Korea
3.1 Česká spořitelna	10.2 Bank Pekao S.A.	15.2 Korea Exchange Bank
3.2 CSOB	10.3 BRE Bank	Taiwan
3.3 Komerční banka	10.4 Bank Zachodni WBK	16.1 Bank Sinopac
3.4 Raiffensenbank	10.5 Kredyt Bank S.A.	16.2 CHANG HWA COMMERCIAL BANK
3.5 UniCredit Bank	10.6 Nordea Bank Polska S.A.	16.3 China Trust Commercial Bank
Estonia	10.7 PKO Bank Polski	16.4 E. Sun Bank
4.1 SEB Pank	Qatar	16.5 Hua Nan Commercial Bank
4.2 Swedbank	11.1 Ahli United Qatar	16.6 Landbank
Hong Kong	11.2 Commercial Bank of Qatar	16.7 Mega International Commercial Bank
5.1 Bank of East Asia	11.3 Qatar National Bank	16.8 Taishin International Bank
5.2 Chong Hing Bank	Singapore	16.9 Taiwan Business Bank
5.3 DAH SING Bank	12.1 DBS Bank	16.10 Union Bank of Taiwan
5.4 Fubon Bank	12.2 OCBC Bank	United Arab Emirates
5.5 Hang Seng Bank	12.3 United Overseas Bank	17.1 First Gulf Bank
5.6 Shangai Commercial Bank	Slovakia	17.2 Machreq Bank
5.7 Wing Hang Bank	13.1 Dexia banka Slovensko a.s Výročná správa	17.3 National Bank of Abu Dhabi
Hungary	13.2 Ludova Banka Volksbank	
6.1 KERESKEDELMI ÉS HITELBANK ZRT.	13.3 Tatra banka	

As for banks in recently developed countries, all banks use forwards. Except for Arab Banking Corporation Group, all the banks are involved in swap contracts. Moreover, the percentage of banks from Panel B using options represents 90.48% of total banks, while only a percentage equal to 57.14% of banks use futures. Except for Arab Banking Corporation, all the banks in recently developed countries use forwards and swaps.

All these results are detailed in Table 2.

Details in derivative instruments statistics are presented in Table 3.

Concerning the overall sample, the amount of derivative instruments represents 133.25% of total assets covering the period of the study between 2003 and 2010, and with an average bank size of approximately $26 billion.

TABLE 2.

Number and percentage of banks per derivative instruments used

	Number of banks			Percentage		
Instruments	Total	Emerging	Recently developed	Total	Emerging	Recently developed
FWD+SWP+OPT+FUT	64	28	36	46.71%	37.84%	57.14%
FWD+SWP+OPT	101	44	57	73.72%	59.46%	90.48%
FWD+SWP+FUT	68	32	36	49.63%	43.24%	57.14%
FWD+OPT+FUT	64	28	36	46.71%	37.84%	57.14%
SWP+OPT+FUT	64	28	36	46.71%	37.84%	57.14%
FWD+SWP	123	61	62	89.78%	82.43%	98.41%
FWD+OPT	101	45	57	73.72%	60.81%	90.48%
FWD+FUT	70	34	36	51.09%	45.95%	57.14%
SWP+OPT	97	42	57	70.80%	56.76%	90.48%
SWP+FUT	69	33	36	50.36%	44.59%	57.14%
OPT+FUT	66	30	36	48.17%	40.54%	57.14%
FWD	133	70	63	97.08%	94.59%	100%
SWP	128	66	62	93.43%	89.19%	98.41%
OPT	101	45	57	73.72%	60.81%	90.48%
FUT	70	34	36	51.09%	45.95%	57.14%

During the study period swaps are the most represented instruments with notional amount equal to 17,312,022.70 USD, i.e. a percentage of 67.18% of total assets, while futures represent 16.93% of total assets. Statistics per year indicate that the highest notional amount of instruments traded is swaps defined by 77.04% of assets in 2005. In contrast, the lowest percentage refers to futures in 2010 with 10.41% of total assets.

In the sample composed only of banks in emerging countries, the most representative instrument in percentage of total assets is forwards with a percentage in the sample period equal to 40.79%, whereas the percentages of swaps and futures are respectively 36.72% and 32.84%, and finally the percentage of options is the lowest with a percentage equal to 18.98%.

Regarding sample composed only of banks in recently developed countries, the percentage of swaps of total assets is the highest with a percentage during the sample period equal to 87.97%, while futures represent only a percentage of 3.48% of total assets during the sample period.

Compared to banks from recently developed countries, banks from emerging countries use more futures. Furthermore, the use of derivative instruments in banks from emerging countries seems to be more balanced compared to banks in recently developed countries. Furthermore, with the

TABLE 3.

Description of derivative notional amounts[5] per year

Panel A. Overall sample

	FWD		**SWP**		**OPT**		**FUT**		**FWD+SWP+OPT+FUT**		**TA**
Year	Amount*	%	Amount*	%	Amount*	%	Amount*	%	Amount*	%	Amount*
2003	430,740.20	21.85	754,883.69	38.30	273,355.94	13.87	492,725.18	25.00	1,951,705.02	99.02	1,970,911.13
2004	528,269.18	24.72	1,607,371.07	75.22	367,659.18	17.20	596,596.66	27.91	3,099,896.1	145.06	2,136,888.88
2005	517,281.68	20.94	1,902,523.67	77.04	453,940.52	18.38	717,703.19	29.06	3,591,449.07	145.43	2,469,425.70
2006	642,509.40	22.17	2,096,940.67	72.35	584,769.86	20.17	755,465.76	26.06	4,079,685.70	140.77	2,898,097.65
2007	1,050,916.16	31.14	2,576,562.61	76.34	620,333.97	18.38	443,328.21	13.13	4,691,140.96	139.00	3,374,730.20
2008	1,551,341.39	38.03	2,938,724.00	72.05	906,817.18	22.23	434,948.49	10.66	5,831,831.07	142.98	4,078,739.26
2009	1,435,881.97	34.40	2,595,909.33	62.27	618,153.10	14.82	437,665.32	10.50	5,087,609.73	122.05	4,168,431.02
2010	1,851,487.45	39.70	2,814,967.71	60.32	817,277.34	17.51	485,884.01	10.41	5,969,616.52	127.92	4,666,389.20
Total	8,015,077.09	31.10	17,312,022.70	67.18	4,643,053.99	18.02	4,364,316.85	16.93	34,334,470.7	133.25	25,766,503.80

Panel B. Banks from emerging countries

	FWD		**SWP**		**OPT**		**FUT**		**FWD+SWP+OPT+FUT**		**TA**
Year	Amount*	%	Amount*	%	Amount*	%	Amount*	%	Amount*	%	Amount*
2003	119,781.38	16.25	148,469.75	20.15	92,725.392	12.58	419,768.32	56.96	780,744.84	105.94	736,970.85
2004	139,966.18	16.92	172,320.83	20.83	134,311.05	16.24	520,749.93	62.95	967,348.001	116.94	827,208.47
2005	156,204.77	15.70	301,084.53	30.27	155,252.59	15.61	661,928.99	66.54	1,274,470.89	128.13	994,691.71
2006	236,907.68	18.68	403,495.21	31.81	192,905.41	15.21	671,503.59	52.94	1,504,811.90	118.63	1,268,453.18
2007	502,842.63	32.99	639,249.42	41.94	240,374.65	15.77	398,601.36	26.15	1,781,068.06	116.84	1,524,316.95
2008	1,055,504.15	51.65	820,317.66	40.14	576,299.95	28.20	399,138.47	19.53	2,851,260.24	139.53	2,043,502.90
2009	1,082,979.94	52.45	844,593.28	40.90	343,513.39	16.64	381,799.71	18.49	2,652,886.33	128.49	2,064,725.28
2010	1,485,556.81	65.78	973,676.36	43.11	488,786.49	21.64	394,997.73	17.49	3,343,017.40	148.03	2,258,376.66
Total	4,779,743.55	40.79	4,303,207.04	36.72	2,224,168.93	18.98	3,848,488.14	32.84	15,155,607.70	129.33	11,718,246.00

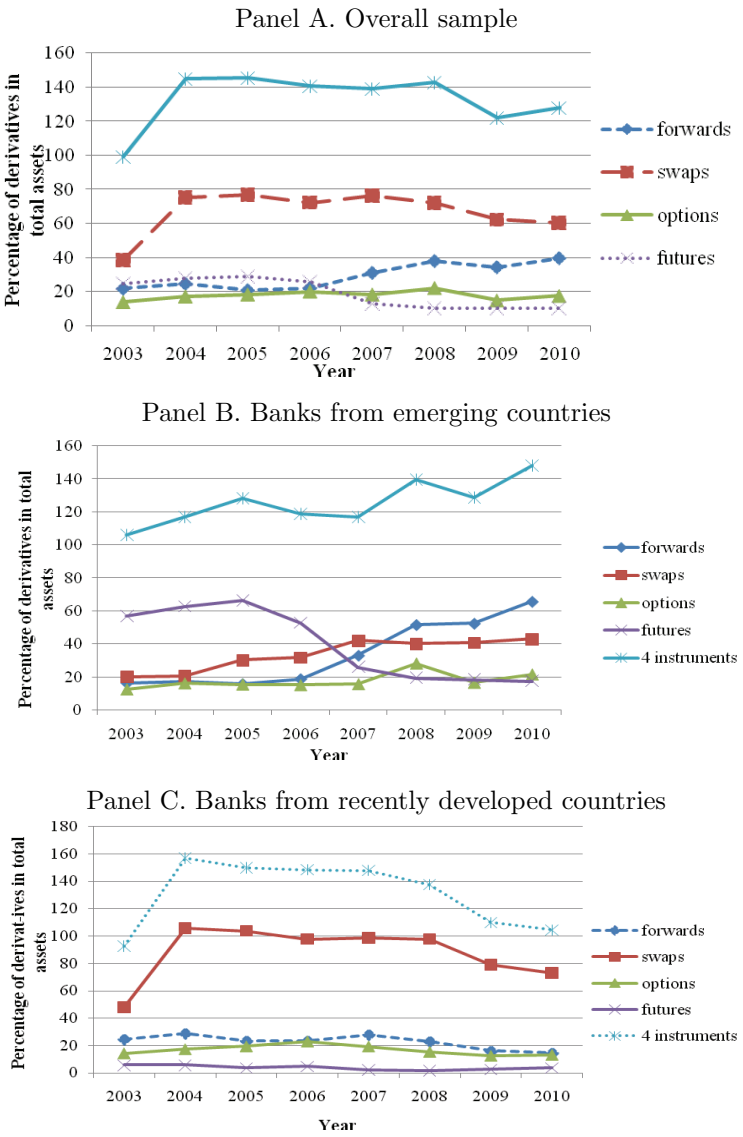
Panel C. Banks from recently developed countries

	FWD		**SWP**		**OPT**		**FUT**		**FWD+SWP+OPT+FUT**		**TA**
Year	Amount*	%	Amount*	%	Amount*	%	Amount*	%	Amount*	%	Amount*
2003	311,206.66	24.47	610,977.79	48.05	180,840.81	14.22	73,004.08	5.74	1,176,029.33	92.50	1,271,501.81
2004	390,825.40	28.72	1,437,844.46	105.67	233,582.09	17.17	75,986.82	5.58	2,138,238.77	157.15	1,360,648.84
2005	362,151.06	23.28	1,612,498.17	103.67	299,339.92	19.24	55,894.27	3.59	2,329,883.42	149.79	1,555,386.66
2006	406,780.60	23.29	1,705,191.60	97.65	397,048.62	22.74	84,408.05	4.83	2,593,428.88	148.51	1,746,282.59
2007	556,477.74	27.82	1,973,869.67	98.68	383,719.35	19.18	44,958.15	2.24	2,959,024.91	147.92	2,000,343.87
2008	498,320.06	22.88	2,128,921.48	97.76	332,673.24	15.28	35,942.64	1.65	2,995,857.43	137.56	2,177,600.08
2009	354,556.01	15.89	1,762,346.45	78.99	276,728.22	12.40	56,030.26	2.51	2,449,660.95	109.80	2,231,064.80
2010	367,255.19	14.52	1,850,910.03	73.21	331,591.76	13.11	91,405.01	3.61	2,641,161.98	104.47	2,528,215.58
Total	3,247,572.74	21.84	13,082,559.70	87.97	2,435,524.01	16.38	517,629.285	3.48	19,283,285.70	129.67	14,871,044.20

use of derivative instruments, banks from emerging countries seem to be more balanced compared to banks in recently developed countries.

Figure 5 illustrates the evolution of the four derivative instruments from 2003 to 2010.

FIG. 5. Evolution of derivative instruments



From Figure 5 Panel A, statistics review reveals that the percentage of swaps in total assets is the highest, followed by forwards. Conversely, the percentages of options and futures are low. From Panel B, statistics on evolution of the four instruments from emerging countries show the net decrease of futures use after the year 2005. Concerning the use of options, there is a little increase during the sample period. However, the use of swaps and especially forwards has jumped continuously. Finally, from Panel C, it can be observed that there has been a decrease in the use of derivative instruments among banks from recently developed countries especially from the year 2004. The percentage of swaps of total assets is the highest compared to the other instruments, while the percentages of futures in total assets are very low.

3.3. Methodology

The variables as well as the model used in the study are presented here.

Risk measures

Accounting data are used to find out the volatility of return on assets, leverage risk, credit risk, and liquidity risk. Volatility of return on assets is defined by the standard deviation of return on assets calculated from quarterly income statements. Leverage risk is defined by the annual part of equity in total assets, credit risk is defined by the annual total of gross loans or loan loss reserves on total assets. Liquidity risk is defined by annual total of liquid assets on total assets.

Description of variables

Table 4 presents the variables employed in the study along with their definitions and use in previous studies.

The dependent variables are regressed on derivative instruments and control variables. Control variables are defined by net interest margin, size of the bank, and dummy variables reflecting dealer bank and country belonging. Regarding the heterogeneity of the sample, like in the study by Agusman et al. (2007) country dummy variables are included to control for the differences in the banking structure and regulatory environments, and the different economic and political characteristics that may affect the relation between derivative instruments and accounting measures of risk.

Independent variables can be divided in three groups. The first group is defined by the variables of interests which are the four derivative instruments, FWD, SWP, OPT and FUT which define respectively Forwards, Swaps, Options, and Futures. The second group is defined by control variables defined by EQTA, LIQTA, GLTA, LLRTA, NIMTA and SIZE which define respectively capital, liquidity, gross loan, loan loss reserve, net interest margin, and bank size. The last group is defined by dummy variables

TABLE 4.

Description of variables

Labels	Description	Proxy for	References
Dependent variables			
EQTA	the ratio of book-value-equity-to-total-assets	Leverage risk	Agusman et al. (2007)
LIQTA	the ratio of liquid-assets-to-total-assets	Liquidity risk	Agusman et al. (2007)
GLTA	the ratio of gross-loans-to-total-assets	Credit risk	Agusman et al. (2007)
LLRTA	the ratio of loan-loss-reserves-to-total assets	Credit risk	Agusman et al. (2007)
SDROA	the standard deviation of return before taxes on assets estimated from quarterly income statements	Overall risk	Agusman et al. (2007)
Independent variables: derivative instruments			
FWD	Notional value of forwards divided by total assets	Forwards	Chaudhry et al. (2000)
SWP	Notional value of swaps divided by total assets	Swaps	Chaudhry et al. (2000)
OPT	Notional value of options divided by total assets	Options	Chaudhry et al. (2000)
FUT	Notional value of futures divided by total assets	Futures	Chaudhry et al. (2000)
Independent variables: control variables			
NIM	The difference between total interest income and total interest expense expressed, as a percentage of total assets.	Net interest margin	Chaudhry et al. (2000)
SIZE	Natural log of total assets	Bank size	Chaudhry et al. (2000); Reichert and Shyu (2003)
DEAL	1 if bank is a member of the International Swaps and Derivative Association (ISDA), 0 otherwise	Dealer	Chaudhry et al. (2000);
COUNTRY	Dummy variable equals 1 when bank is issued from, 0 otherwise	Country variable	Agusman et al. (2007)

expressed by DEAL and COUNTRY which designate country variable of each bank. The dichotomous variable (DEAL) takes a value one for dealer banks and zero otherwise.

Empirical model

Firstly, the stationarity of all the variables is checked using Augmented Dickey Fuller Tests.

Secondly, random effect panel regression models are conducted for each risk measure as follows:

$$\begin{aligned} \text{Risk measure}_{i,t} &= \gamma_0 + \gamma_1 \text{FWD}_{i,t} + \gamma_2 \text{SWP}_{i,t} + \gamma_3 \text{OPT}_{i,t} + \gamma_4 \text{FUT}_{i,t} \\ &+ \gamma_5 \text{NIMTA}_{i,t} + \gamma_6 \text{SIZE}_{i,t} + \gamma_7 \text{DEAL}_{i,t} \\ &+ \sum_{k=1}^{K} \gamma_{8,k} \text{COUNTRY}_{i,t,k} + u_i + e_{i,t}, \end{aligned} \tag{1}$$

Where the risk measure is one of EQTA; GLTA, LLRTA, LIQTA, or SDROA. To estimate the parameter values, instrumental variable method defined by two-stage least squares regression is used in order to reduce problems associated with the correlation between the error terms and the independent variables. In addition, the estimation method accounts for heteroskedasticity. Computer software STATA 10 ® is used to estimate regressions.

The aim is to empirically test the relations between capital market risk measures and derivative instruments.

TABLE 5.

Descriptive statistics of variables

Overall sample					
Variable	obs	Mean	Std. Dev.	Min	Max
forward_ta	1096	0.2350828	0.7126471	0	11.44581
swap_ta	1096	0.4380229	1.139643	0	19.05018
option_ta	1096	0.0962719	0.2643791	0	3.171793
future_ta	1096	0.0886387	0.8672898	0	16.55449
eq_ta	1096	0.1015851	0.0662958	0.0076783	0.8883663
gl_ta	1096	0.552936	0.1655101	0.0027081	1.316956
llp_ta	1096	0.0190712	0.0198194	0.0001153	0.2971173
liq_ta	1096	0.0764697	0.0784041	0.0018693	1.172807
sdroa	1096	0.0054191	0.01179	0.0000158	0.160993
nim_ta	1096	0.0300701	0.0452898	−0.0203432	0.7741674
logta	1096	9.115405	1.602598	3.700833	12.8508
Banks from emerging countries					
Variable	obs	Mean	Std. Dev.	Min	Max
forward_ta	592	0.2170967	0.7874827	0	11.44581
swap_ta	592	0.3414481	1.226196	0	19.05018
option_ta	592	0.0864477	0.3103667	0	3.171793
future_ta	592	0.14829	1.174734	0	16.55449
eq_ta	592	0.1079798	0.0739125	0.0076783	0.8883663
gl_ta	592	0.5453748	0.1755079	0.0518053	0.9786363
llp_ta	592	0.0219015	0.0219911	0.000126	0.2971173
liq_ta	592	0.0934499	0.0873722	0.005702	1.172807
sdroa	592	0.0067582	0.0135852	0.000102	0.1368865
nim_ta	592	0.0381799	0.0598567	−0.0007066	0.7741674
logta	592	8.633109	1.722919	3.700833	12.8508

Banks from recently developed countries					
Variable	obs	Mean	Std. Dev.	Min	Max
forward_ta	504	0.2562093	0.6133057	0.0000661	6.006302
swap_ta	504	0.5514599	1.018284	0	7.84602
option_ta	504	0.1078115	0.1968067	0	1.632256
future_ta	504	0.018572	1.313557	0	16.55449
eq_ta	504	0.0940739	0.0551765	0.0159273	0.5714437
gl_ta	504	0.5618175	0.1526296	0.0027081	1.316956
llp_ta	504	0.0157468	0.016322	0.0001153	0.1185839
liq_ta	504	0.0565246	0.0606192	0.0018693	0.3289781
sdroa	504	0.0038461	0.0090094	0.0000158	0.160993
nim_ta	504	0.0205442	0.0093427	−0.0203432	0.0494628
logta	504	9.681913	1.227989	5.666411	12.34253

4. EMPIRICAL RESULTS

This section focuses on the empirical relationship between the use of derivative instruments and bank risk.

4.1. Descriptive statistics

Table 5 describes statistics of variables used in the model covering the overall sample and the two subsamples.

4.2. Regression analysis

Table 6 below presents the parameter estimates from Equation 1 for each of the five risk measures. In this table, it should be noted that insignificant independent variables were removed from the models, and the regressions re-estimated to get more precise estimates.

From Table 6, panel A, it is found that the use of forwards negatively affects leverage risk and liquidity risk at levels of significance respectively equal to 1% and 10%. The association between swaps and the two credit risk measures indicates a negative relationship at a level of significance equal to 1%. Options positively affect leverage risk and credit risk 1 at levels of significance respectively equal to 1% and 5%, while the relationship between options and total risk is negatively and weakly significant at a level of significance equal to 10%. As for futures, results indicate that the use of futures positively but weakly affects total risk at a level of significance equal to 10%. Net interest margin positively affects leverage risk, credit risk 2 and liquidity risk but it has a negative effect on credit risk 1 at a level of significance equal to 1%. Size has a positive effect on leverage risk and liquidity risk but it negatively affects credit risk 1 at a level of 1%. The dummy variable that defines dealer banks is negatively significant

TABLE 6.

Estimated coefficients

Panel A. For overall sample

	EQTA (Leverage risk)	GLTA (Credit risk 1)	LLRTA (Credit risk 2)	LIQTA (Liquidity risk)	SDROA (Total risk)
Constant	0.1551135^{***} (0.01315)	0.5482274^{***} (0.0377125)	0.0318569^{***} (0.0013297)	0.0718038^{***} (0.0138603)	0.0079017^{***} (0.0007778)
FWD	-0.005751^{***} (0.0019697)	insignificant	insignificant	-0.0029418^{*} (0.0015855)	insignificant
SWP	insignificant	-0.0136368^{***} (0.0032783)	-0.0015535^{***} (0.0002621)	insignificant	insignificant
OPT	0.0169053^{***} (0.0051756)	0.0190371^{**} (0.0093309)	insignificant	insignificant	-0.0047164^{*} (0.0026211)
FUT	insignificant	insignificant	insignificant	insignificant	0.0007763^{*} (0.0004512)
NIM	0.797544^{***} (0.0786721)	-0.4859484^{***} (0.0663234)	0.0697491^{***} (0.0109894)	0.3754465^{***} (0.0930716)	insignificant
LOG	-0.0107483^{***} (0.0014023)	0.0147786^{***} (0.0036482)	insignificant	-0.009032^{***} (0.0014829)	insignificant
DEAL	-0.012498^{***} (0.0029331)	insignificant	insignificant	-0.0247658^{***} (0.0051801)	insignificant
COUNTRIES	See details of the country dummies in appendix.				Some are significant
R-squared	0.5684	0.4591	0.3270	0.4834	0.2984
F statistic	26.57^{***}	67.47^{***}	63.22^{***}	46.33^{***}	24.13^{***}
Number of obs	1096	1096	1096	1096	736

with leverage risk and liquidity risk at a level of significance equal to 1%. As regards the effect of regressions of country variables, only the variable that defines banks from Indonesia is not significant with any type of risk measures.

From Panel B, results focused on emerging countries expose that forwards negatively affect leverage risk at a level of significance equal to 5% and liquidity risk at a level of significance equal to 10%, and it has a positive effect on total risk at a level of significance equal to 10%. Swaps have negative effect on credit risk 2 and liquidity risk at a level of significance equals to 1%. Options have positive effect on leverage risk and liquidity risk at levels of significance respectively equal to 1% and 5%, and negative effect on total risk at a level of significance equal to 10%. And finally futures negatively affect leverage risk and positively total risk at a level of significance equal to 10%. Net interest margin positively affect leverage risk, credit risk 2 and liquidity risk at a level of significance equal to 1%, but

Panel B. For emerging countries

	EQTA (Leverage risk)	GLTA (Credit risk 1)	LLRTA (Credit risk 2)	LIQTA (Liquidity risk)	SDROA (Total risk)
Constant	0.1379832^{***} (0.0131371)	0.3608178^{***} (0.0379863)	0.0305181^{***} (0.0014924)	0.1091668^{***} (0.0193169)	0.0073691^{***} (0.0008091)
FWD	-0.0072193^{**} (0.0032143)	insignificant	insignificant	-0.0041709^{*} (0.0021829)	0.0086751^{*} (0.0049607)
SWP	insignificant	insignificant	-0.0012426^{***} (0.0002543)	-0.0053625^{***} (0.0012004)	insignificant
OPT	0.023765^{***} (0.0080161)	insignificant	insignificant	0.0273734^{**} (0.0129902)	-0.0101757^{*} (0.0055368)
FUT	-0.002826^{*} (0.0016431)	insignificant	insignificant	insignificant	0.0015838^{*} (0.0009134)
NIM	0.8118519^{***} (0.0803363)	-0.4564403^{***} (0.0605393)	0.0653069^{***} (0.0107152)	0.3721157^{***} (0.0948732)	insignificant
LOG	-0.0081553^{***} (0.001383)	0.021895^{***} (0.0041033)	insignificant	-0.0093782^{***} (0.0017837)	insignificant
DEAL	-0.0288609^{***} (0.0065563)	insignificant	insignificant	-0.0256994^{***} (0.0095755)	insignificant
COUNTRIES	See details of the country dummies in appendix.				
R-squared	0.6129	0.5497	0.2517	0.4617	0.3687
F statistic	22.12^{***}	112.05^{***}	61.40^{***}	30.56^{***}	26.72^{***}
Number of obs	592	592	592	592	432

has a negative effect on credit risk 1 at the same level of significance. Size has a negative effect on leverage risk and liquidity risk but positively affects credit risk 1 all at a level of significance equal to 1%. The dummy variable that defines dealer bank negatively affects leverage risk and liquidity risk at a level of significance equal to 1%.

From Panel C, results limited to recently developed countries show that forwards have a negative effect on leverage risk at a level of significance equal to 1%. Swaps negatively affect at a level of significance equal to 1% the two credit risk measures, but it has a positive effect on leverage risk at a level of significance equal to 5%. While options positively affect credit risk 2 and negatively liquidity risk at a level of significance respectively equal to 10%. And finally, the use of futures has a positive effect on leverage risk and total risk at a level of significance equal to 10% but negatively affect credit risk 1 at a level of significance equal to 1%. Regarding control variables, net interest margin positively affects credit risk 2 and liquidity risk at levels of significance respectively equal to 1% and 5%. Size has negative effect on leverage risk, credit risk 1 and liquidity risk but positively affects credit

Panel C. For recently developed countries

	EQTA (Leverage risk)	GLTA (Credit risk 1)	LLRTA (Credit risk 2)	LIQTA (Liquidity risk)	SDROA (Total risk)
Constant	0.2786251*** (0.0445082)	0.5699885*** (0.0113673)	0.0324165*** (0.0053214)	0.1784943*** (0.0238287)	0.0187453*** (0.0068745)
FWD	−0.0122533*** (0.0028496)	insignificant	insignificant	insignificant	insignificant
SWP	0.0052534** (0.0021781)	−0.0273719*** (0.0049557)	−0.003378*** (0.000882)	insignificant	insignificant
OPT	Insignificant	insignificant	0.004761* (0.0026644)	−0.0182626* (0.0097805)	insignificant
FUT	0.0721828** (0.0314471)	−0.1734052*** (0.0557002)	insignificant	insignificant	0.0188567* (0.0114387)
NIM	Insignificant	insignificant	0.3898091*** (0.0742684)	0.6609709** (0.2854685)	insignificant
LOG	−0.0165964*** (0.0042108)	0.0232479*** (0.0048278)	−0.0013331*** (0.0004836)	−0.0093396*** (0.0020648)	−0.00132** (0.0005988)
DEAL	Insignificant	insignificant	insignificant	−0.0264916*** (0.0061646)	insignificant
COUNTRIES	See details of the country dummies in appendix.				Some are significant
R-squared	0.5021	0.3331	0.4755	0.4467	0.0837
F statistic	26.01***	51.81***	30.10***	21.63***	11.02***
Number of obs	504	504	504	504	304

*, ** and *** respectively indicate statistical significance at the 10%, 5% and 1% levels. ( ) indicate standard deviation of the estimators. Years 2003—2010.

risk 1 all at a level of significance equal to 1%. As for dummy variables, the variable that defines dealer banks is negatively significant with liquidity risk at a level of significance equal to 1%.

5. DISCUSSION

This paper aims to clarify the effect of derivative instruments on bank accounting risk. To this end, the main question is as followed: "Using derivative instruments, do banks increase or decrease their accounting risk?" Thus, the major objective of the paper is to determine the risk of banks from emerging and recently developed countries in using derivative instruments.

5.1. Interpretation of the results

For overall sample, finding that the coefficient of the association between derivative instruments and total risk is so low confirms that the effect of

derivative instruments on total risk is weak. The result about control variables rejects the thesis stipulating that size increases bank risk. In contrast, capital, liquidity, gross loan and net interest margin have no significant effect on any type of risk measures. Consequently, it appears that in general the control variables do not significantly affect the four risk measures. The result about dummy variable that defines dealer banks rejects the thesis stipulating that dealer banks are at risk.

For emerging countries, the result about the dummy variable that defines dealer bank rejects the thesis stipulating that dealer banks are at risk.

For recently developed countries, the result about the variable that defines dealer banks rejects the thesis stipulating that dealer banks are at risk. Finally, deduced results show no strong significance in the association between derivative instruments and total risk. Indeed, dealer and non-dealer banks appear to similarly manage accounting risk.

5.2. Summary

To summarize, the overall results indicate that forwards have a negative effect on leverage risk and liquidity risk respectively at 1% and 10% level of significance. Swaps also negatively affect the two credit risk measures at level of significance equal to 1%. In contrast, options have a positive effect on leverage risk and credit risk 1 respectively at 1% and 5% level of significance, and have a negative but weak effect on total risk at 10% level of significance. And finally, futures positively but mildly affect total risk at a level of significance equal to 10%.

Table 7 sums up the main regression results about the association between the four derivative instruments and the four accounting risk measures.

5.3. Banks from emerging countries Vs banks from recently developed countries: a comparison analysis

Common features

Common results of the two subsamples show that the use of forwards has a negative effect on leverage risk, swaps negatively affect credit risk 2, and the use of futures has a positive and mild effect on total risk. There is evidence that forwards and swaps are used for hedging purposes both from banks in emerging countries and those in recently developed countries. Furthermore, it appears that banks use less future contracts especially banks from recently developed countries.

Difference features

Differences between Panel B and Panel C are related to leverage risk and liquidity risk. For banks from recently developed countries, using futures has a positive effect on leverage risk, while it has a negative effect for banks from emerging countries. It appears that banks from emerging countries

TABLE 7.

Summary table of regression coefficient signs

Panel A. For overall sample

	Forwards	Swaps	Options	Futures
Leverage risk	-	NS	+	NS
Credit risk 1	NS	-	+	NS
Credit risk 2	NS	-	NS	NS
Liquidity risk	-	NS	NS	NS
Total risk	NS	NS	-	+

Panel B. For emerging countries

	Forwards	Swaps	Options	Futures
Leverage risk	-	NS	+	-
Credit risk 1	NS	NS	NS	NS
Credit risk 2	NS	-	NS	NS
Liquidity risk	-	-	+	NS
Total risk	+	NS	-	+

Panel C. For recently developed countries

	Forwards	Swaps	Options	Futures
Leverage risk	-	+	NS	+
Credit risk 1	NS	-	NS	-
Credit risk 2	NS	-	+	NS
Liquidity risk	NS	NS	-	NS
Total risk	NS	NS	NS	+

manage the risk of using futures better than banks from recently developed countries. The use of option contracts by banks from recently developed countries has a negative effect on liquidity risk while it has a positive effect with banks from emerging countries. Indeed, banks from recently developed countries deal with options in a better way.

The evidence reported in this study suggests that the use of forwards and swaps contracts reduces risk, options tend to increase risk, and the use of futures contributes minimally to risk. Observing that the majority of banks mainly use forwards and swaps, we deduce that sample banks are not at risk by using derivative instruments.

6. CONCLUSIONS

This study examines the impact of four derivative instruments (options, swaps, forwards, and futures) on five measures of accounting risk for banks. Bank risk is measured in terms of leverage risk, liquidity risk, credit risk 1, credit risk 2 and total risk. Empirical results using pooled data for 2003—

2010 collected from overall sample and two sub-samples. The overall sample is composed of banks from emerging as well as from recently developed countries.

Regarding main results collected from the overall sample and the two sub-samples, we retain that in general the use of forwards and swaps decrease bank risk while the use of options positively affects bank risk, and finally the use of futures has a mildly significant effect on bank risk. Overall, it appears that forwards and swaps are used as a hedging tool while options are viewed as playing a more speculative role.

Hence, the implication of derivatives in recent financial crisis should be reviewed. Thus, the ongoing debate that derivative instruments are the principal cause of the most recent financial crisis should be revised.

APPENDIX

Table a. Estimated coefficients for overall sample, years 2003—2010

	Leverage risk	Credit risk 1	Credit risk 2	Liquidity risk	Total risk
Constant	0.1551135^{***}	0.5482274^{***}	0.0318569^{***}	0.0718038^{***}	0.0079017^{***}
	(0.01315)	(0.0377125)	(0.0013297)	(0.0138603)	(0.0007778)
FWD	-0.005751^{***}	insignificant	insignificant	-0.0029418^{*}	insignificant
	(0.0019697)			(0.0015855)	
SWP	insignificant	-0.0136368^{***}	-0.0015535^{***}	insignificant	insignificant
		(0.0032783)	(0.0002621)		
OPT	0.0169053^{***}	0.0190371^{**}	insignificant	insignificant	-0.0047164^{*}
	(0.0051756)	(0.0093309)			(0.0026211)
FUT	insignificant	insignificant	insignificant	insignificant	0.0007763^{*}
					(0.0004512)
NIM	0.797544^{***}	-0.4859484^{***}	0.0697491^{***}	0.3754465^{***}	insignificant
	(0.0786721)	(0.0663234)	(0.0109894)	(0.0930716)	
LOG	-0.0107483^{***}	0.0147786^{***}	insignificant	-0.009032^{***}	insignificant
	(0.0014023)	(0.0036482)		(0.0014829)	
DEAL	-0.012498^{***}	insignificant	insignificant	-0.0247658^{***}	insignificant
	(0.0029331)			(0.0051801)	
Argentina	0.0696391^{***}	-0.211748^{***}	-0.0159613^{***}	0.0806974^{***}	insignificant
	(0.0198943)	(0.0260792)	(0.0032072)	(0.0140726)	
Brazil	insignificant	-0.4419428^{***}	-0.0185841^{***}	0.0376956^{***}	0.0395416^{***}
		(0.0343203)	(0.0023226)	(0.0110197)	(0.0116018)
Bahrain	0.1143362^{***}	-0.2959398^{***}	-0.0156397^{***}	0.0520752^{***}	insignificant
	(0.0190553)	(0.0297273)	(0.002316)	(0.010192)	
Bulgaria	0.0158552^{*}	-0.0581215^{**}	-0.0134186^{***}	0.0701717^{***}	insignificant
	(0.008423)	(0.0246933)	(0.0025407)	(0.007036)	
Chile	-0.0369538^{***}	0.0402918^{**}	-0.0205024^{***}	0.0801256^{***}	-0.0046631^{***}
	(0.005115)	(0.0158307)	(0.0014238)	(0.0071016)	(0.0009065)
China	insignificant	-0.0237^{***}	-0.0152271^{***}	insignificant	-0.004334^{***}
		(0.0052)	(0.0015248)		(0.0008724)
Croatia	0.0231912^{***}	-0.0617292^{***}	insignificant	0.0863455^{***}	insignificant
	(0.006266)	(0.0151491)		(0.0087679)	
Cyprus	insignificant	-0.1153181^{***}	insignificant	0.0638292^{***}	insignificant
		(0.017972)		(0.0074897)	
Czech Republic	0.0096343^{**}	-0.1670715^{***}	-0.018917^{***}	0.0319995^{***}	-0.0030653^{***}
	(0.0039073)	(0.0284205)	(0.0014501)	(0.0056592)	(0.0007916)
Estonia	0.04612^{***}	insignificant	-0.0236617^{***}	0.0329897^{***}	-0.0062446^{***}
	(0.0071056)		(0.0033925)	(0.006666)	(0.0008539)

Hong Kong	0.0269037^{***}	-0.2155659^{***}	-0.0277293^{***}	0.1415185^{***}	insignificant
	(0.0040746)	(0.0141914)	(0.001938)	(0.0141504)	
Hungary	0.0211612^{***}	-0.0969228^{***}	-0.0187124^{***}	0.0560294^{***}	insignificant
	(0.0067252)	(0.0281117)	(0.002012)	(0.0080973)	
India	insignificant	-0.0100^{***}	-0.0283498^{***}	0.1295377^{***}	-0.0038914^{***}
		(0.0017)	(0.0016069)	(0.0257392)	(0.0010126)
Indonesia	insignificant	insignificant	insignificant	insignificant	insignificant
Israel	0.0136935^{***}	-0.0598289^{***}	-0.0292938^{***}	0.1776901^{***}	-0.0049417^{***}
	(0.0043082)	(0.0155154)	(0.001302)	(0.0120948)	(0.0012005)
Jordan	0.0305367^{***}	-0.1580256^{***}	-0.0103041^{***}	0.1539372^{***}	insignificant
	(0.0087222)	(0.0249036)	(0.0038612)	(0.0157685)	
Kazakhstan	0.0229092^{**}	insignificant	0.0269609^{**}	0.1240348^{***}	insignificant
	(0.0094437)		(0.0110825)	(0.0226604)	
Kuwait	0.0343644^{***}	-0.1204964^{***}	insignificant	0.1297191^{***}	-0.0037954^{***}
	(0.007373)	(0.0258362)		(0.0110037)	(0.0010189)
Latvia	insignificant	-0.1274686^{***}	-0.0118919^{**}	0.0488524^{***}	insignificant
		(0.0262118)	(0.0046297)	(0.0066151)	
Lebanon	insignificant	-0.4745122^{***}	-0.0266508^{***}	0.2648205^{***}	-0.0040912^{***}
		(0.01632)	(0.0014192)	(0.0192587)	(0.0008365)
Lithuania	insignificant	insignificant	-0.0160086^{***}	0.0570094^{***}	-0.0035566^{***}
			(0.0037154)	(0.0087389)	(0.0009584)
Malaysia	0.0194871^{***}	-0.044056^{**}	-0.012029^{***}	0.1463103^{***}	-0.0044464^{***}
	(0.0038898)	(0.0221632)	(0.002166)	(0.0101032)	(0.001969)
Mauritius	insignificant	insignificant	insignificant	0.0500992^{***}	0.0339757^{***}
				(0.0137702)	(0.0128994)
Mexico	insignificant	-0.1780016^{***}	-0.0069785^{**}	0.1763195^{***}	-0.0050533^{***}
		(0.0370564)	(0.0028403)	(0.0112219)	(0.0013135)
Oman	0.0396397^{***}	insignificant	insignificant	0.0582646^{***}	-0.0063188^{***}
	(0.0092581)			(0.0178827)	(0.0008313)
Pakistan	insignificant	-0.1139405^{***}	insignificant	0.1086687^{***}	-0.0044274^{***}
		(0.0208225)		(0.0077868)	(0.0008527)
Philippine	0.0311887^{***}	-0.3397767^{***}	0.0297366^{***}	0.0187939^{***}	-0.0073729^{***}
	(0.0046924)	(0.018075)	(0.0085547)	(0.0052583)	(0.0007788)
Poland	0.0275051^{***}	-0.0530884^{**}	insignificant	0.055468^{***}	-0.0041492^{***}
	(0.005015)	(0.0230845)		(0.0061979)	(0.0009092)
Qatar	0.0913808^{***}	-0.1132514^{***}	-0.0237127^{***}	0.0647226^{***}	-0.0048944^{***}
	(0.0088383)	(0.0187956)	(0.0019951)	(0.0119994)	(0.0010448)
Russia	insignificant	-0.155738^{***}	-0.0094645^{***}	0.1858338^{***}	insignificant
		(0.0322388)	(0.0026311)	(0.0669509)	

Saudi Arabia	0.0367631^{***}	-0.0903308^{***}	-0.0194941^{***}	0.0983635^{***}	insignificant
	(0.0048538)	(0.0164904)	(0.001849)	(0.0110218)	
Singapore	0.0647507^{***}	-0.2144101^{***}	-0.0156941^{***}	0.1018443^{***}	-0.0057701^{***}
	(0.0048354)	(0.0242228)	(0.0015886)	(0.0089836)	(0.000893)
Slovakia	insignificant	-0.1079358^{***}	-0.0160585^{***}	0.040571^{***}	insignificant
		(0.0305096)	(0.0025762)	(0.0105824)	
Slovenia	insignificant	insignificant	insignificant	0.0226479^{***}	-0.0061636^{***}
				(0.0056229)	(0.0007824)
South Africa	0.0338109^{***}	0.055458^{***}	-0.0151158^{***}	0.0917715^{***}	-0.0067681^{***}
	(0.0103942)	(0.0208534)	(0.0017633)	(0.0101473)	(0.0008343)
South Korea	0.018304^{***}	insignificant	-0.0210231^{***}	0.0796045^{***}	-0.0054588^{***}
	(0.0053264)		(0.0013769)	(0.008003)	(0.000849)
Taiwan	insignificant	-0.0603936^{***}	-0.026307^{***}	0.0388832^{***}	-0.0063598^{***}
		(0.0144349)	(0.0013451)	(0.0066916)	(0.0007979)
Thailand	0.0171506^{***}	insignificant	insignificant	0.0324971^{***}	-0.0055125^{***}
	(0.0065174)			(0.0058077)	(0.0008851)
Turkey	0.0231517^{***}	-0.2059404^{***}	-0.0211061^{***}	0.0569072^{***}	insignificant
	(0.0062829)	(0.0291501)	(0.0023688)	(0.0078067)	
United Arab Emirates	0.068559^{***}	-0.1156283^{***}	-0.0166024^{***}	0.1096181^{***}	insignificant
	(0.0087933)	(0.0227667)	(0.0019611)	(0.013405)	
Vietnam	insignificant	-01783498^{***}	-0.0306245^{***}	0.0605457^{***}	insignificant
		(0.0272118)	(0.0013232)	(0.0085153)	
R-squared	0.5684	0.4591	0.3270	0.4834	0.2984
F statistic	26.57^{***}	67.47^{***}	63.22^{***}	46.33^{***}	24.13^{***}
Number of obs	1096	1096	1096	1096	736

*, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels. ( ) indicate standard deviation of the estimators.

Table b. Estimated coefficients for emerging countries, years 2003—2010

	Leverage risk	Credit risk 1	Credit risk 2	Liquidity risk	Total risk
Constant	0.1458448^{***}	0.7267235^{***}	0.0308693^{***}	0.1214615^{***}	0.0075834^{***}
	(0.0205941)	(0.0091913)	(0.004071)	(0.0226087)	(0.0010643)
FWD	-0.0058097^{**}	0.0148069^{*}	insignificant	-0.0038731^{*}	0.0093869^{*}
	(0.002277)	(0.0082986)		(0.002182)	(0.005656)
SWP	insignificant	insignificant	-0.000333^{**}	-0.0056277^{***}	insignificant
			(0.0001636)	(0.0012588)	
OPT	0.0284657^{***}	insignificant	insignificant	0.0284497^{**}	-0.0105712^{*}
	(0.0093993)			(0.0132858)	(0.0057595)
FUT	-0.0039515^{**}	insignificant	insignificant	insignificant	0.0016446^{*}
	(0.0018213)				(0.0009473)

NIM	0.8412569^{***}	-0.6122843^{***}	0.058843^{***}	0.3694749^{***}	insignificant
	(0.081442)	(0.036938)	(0.0114226)	(0.0963988)	
LOG	-0.0065504^{***}	insignificant	-0.0015232^{***}	-0.0106004^{***}	insignificant
	(0.002132)		(0.0003767)	(0.0021096)	
DEAL	-0.0301087^{***}	insignificant	insignificant	-0.024055^{**}	insignificant
	(0.00523)			(0.0095601)	
Argentina	0.0420097^{**}	-0.2721849^{***}	insignificant	0.0463493^{***}	insignificant
	(0.0205738)	(0.0269377)		(0.0146039)	
Brazil	-0.0333071^{**}	-0.4383081^{***}	insignificant	insignificant	0.0404938^{***}
	(0.0148733)	(0.0324178)			(0.0115213)
Bulgaria	insignificant	-0.1169977^{***}	insignificant	0.0334981^{***}	insignificant
		(0.0231873)		(0.0081842)	
Chile	-0.0338413^{***}	insignificant	-0.0040387^{***}	0.047716^{***}	-0.005226^{***}
	(0.0041785)		(0.0012176)	(0.0057771)	(0.0011281)
China	-0.0568718^{***}	-0.2231001^{***}	-0.0039581^{**}	-0.0392298^{***}	insignificant
	(0.0070524)	(0.0148039)	(0.0018266)	(0.0113759)	
Croatia	insignificant	-0.1173371^{***}	0.0115362^{***}	0.0498437^{***}	insignificant
		(0.0125601)	(0.0017606)	(0.0095347)	
India	-0.0218716^{***}	-0.2128074^{***}	-0.0114839^{***}	0.0725727^{***}	-0.0038746^{***}
	(0.0076907)	(0.0156692)	(0.0014885)	(0.0222706)	(0.0011899)
Indonesia	-0.0385695^{***}	-0.1634618^{***}	insignificant	insignificant	insignificant
	(0.0110908)	(0.0328114)			
Jordan	insignificant	-0.2224872^{***}	insignificant	0.1162821^{***}	insignificant
		(0.0221705)		(0.0163572)	
Kazakhstan	insignificant	-0.067622^{***}	0.0417157^{***}	0.0884896^{***}	insignificant
	(0.0261284)		(0.0114258)	(0.0232055)	
Kuwait	insignificant	-0.1601715^{***}	0.0135176^{**}	0.0950527^{***}	-0.0040013^{***}
		(0.0259459	(0.0064992)	(0.0107616)	(0.0011757)
Lebanon	-0.0269261^{***}	-0.5168167^{***}	-0.0115838^{***}	0.2295498^{***}	-0.0041066^{***}
	(0.005977)	(0.0150356)	(0.0013495)	(0.0188244)	(0.0010371)
Malaysia	insignificant	-0.0830847^{***}	0.0033758^{*}	0.1133301^{***}	-0.0044244^{**}
		(0.0209789)	(0.0019982)	(0.0095732)	(0.0020908)
Mauritius	-0.0341767^{***}	-0.0500059^{***}	0.0116349^{***}	insignificant	0.032228^{***}
	(0.0092712)	(0.0160644)	(0.0024323)		(0.0118463)
Mexico	-0.0435881^{***}	-0.2097604^{***}	0.0097614^{***}	0.1443357^{***}	-0.0091371^{***}
	(0.0072111)	(0.0365452)	(0.0026413)	(0.010586)	(0.0029578)
Oman	insignificant	-0.0390423^{*}	0.0149088^{***}	insignificant	-0.0103035^{***}
		(0.0219939)	(0.0033881)		(0.0026092)

Pakistan	-0.0169509^{**}	-0.1612783^{***}	insignificant	0.0717529^{***}	-0.0042145^{***}
	(0.0067352)	(0.0202356)		(0.0123474)	(0.0010879)
Philippine	insignificant	-0.389828^{***}	0.0439373^{***}	insignificant	-0.0070982^{***}
		(0.0165432)	(0.0085373)		(0.0010541)
Russia	insignificant	-0.195738^{***}	0.0058241^{**}	0.149996^{**}	insignificant
		(0.0281596)	(0.0024663)	(0.0673867)	
Saudi Arabia	insignificant	-0.1257009^{***}	insignificant	0.0594207^{***}	insignificant
		(0.0153177)		(0.008821)	
South Africa	insignificant	insignificant	insignificant	0.0559076^{***}	-0.0064671^{***}
				(0.0114892)	(0.001103)
Thailand	-0.0188903^{***}	insignificant	0.0188405^{***}	insignificant	-0.0071444^{***}
	(0.0070269)		(0.0027832)		(0.0013012)
Turkey	-0.0102276^{*}	-0.2392823^{***}	-0.0052156^{**}	0.0227069^{***}	insignificant
	(0.0061525)	(0.0267745)	(0.0022492)	(0.0073626)	
Vietnam	-0.0330969^{***}	-0.2410145^{***}	-0.0177111^{***}	0.0233418^{**}	insignificant
	(0.0085521)	(0.0241792)	(0.001537)	(0.0097746)	
R-squared	0.7270	0.7085	0.5039	0.4727	0.3881
F statistic	21.98^{***}	86.32^{***}	60.93^{***}	32.70^{***}	23.00^{***}
Number of obs	472	472	472	472	328

*, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels. ( ) indicate standard deviation of the estimators.

Table c. Estimated coefficients for recently developed countries, years 2003—2010

	Leverage risk	Credit risk 1	Credit risk 2	Liquidity risk	Total risk
Constant	0.2767355^{***}	0.3127947^{***}	0.0183376^{***}	0.2538888^{***}	0.0201107^{***}
	(0.0342121)	(0.0524063)	(0.001471)	(0.0247863)	(0.0076768)
FWD	-0.0068656^{***}	insignificant	-0.0025527^{**}	-0.0074443^{**}	-0.0002631
	(0.0020134)		(0.0010374)	(0.0032305)	(0.0009608)
SWP	insignificant	-0.0324013^{***}	-0.001545^{***}	0.006968^{***}	-0.0004746
		(0.0060469)	(0.0005688)	(0.0026689)	(0.0004309)
OPT	insignificant	0.0332667^{*}	insignificant	-0.026685^{**}	0.0001535
		(0.0184104)		(0.0111438)	(0.0019033)
FUT	0.0930402^{**}	-0.249701^{***}	insignificant	insignificant	0.0219624^{*}
	(0.0418118)	(0.0756926)			(0.0132388)
NIM	insignificant	1.465852^{*}	insignificant	insignificant	-0.0329643
		(0.8455961)			(0.0615332)
LOG	-0.0152577^{***}	0.0232479^{***}	insignificant	-0.0078432^{***}	-0.0007804
	(0.0031678)	(0.0048278)		(0.0018266)	(0.0006373)
DEAL	insignificant	insignificant	insignificant	-0.0268901^{***}	0.0048976
				(0.0062476)	(0.0039759)

Bahrain	0.0403489^{***}	-0.1512284^{***}	insignificant	-0.135236^{***}	-0.006115^{***}
	(0.015713)	(0.0237217)		(0.016234)	(0.0023356)
Cyprus	-0.0682114^{***}	insignificant	0.0228405^{***}	-0.1207963^{***}	-0.0011017
	(0.0061898)		(0.0037085)	(0.013255)	(0.0076884)
Czech Republic	-0.0509336^{***}	insignificant	insignificant	-0.1500134^{***}	-0.006551^{***}
	(0.0061106)			(0.0121373)	(0.0014346)
Estonia	insignificant	insignificant	-0.0087045^{**}	-0.1544008^{***}	-0.0097184^{***}
			(0.0034316)	(0.0128418)	(0.0016575)
Hong Kong	-0.0371587^{***}	-0.0926265^{***}	-0.0124381^{***}	-0.0442775^{***}	Not included[1]
	(0.0063649)	(0.0148251)	(0.0019993)	(0.0168601)	
Hungary	-0.0314823^{***}	insignificant	insignificant	-0.1249905^{***}	Dropped
	(0.0094302)	(0.0142425)			
Israel	-0.0491568^{***}	0.0659049^{***}	-0.0142619^{***}	insignificant	-0.0126618^{***}
	(0.0047783)	(0.020563)	(0.0014099)		(0.0023054)
Latvia	-0.0696819^{***}	insignificant	insignificant	-0.1333153^{***}	-0.0075009^{***}
	(0.0169747)			(0.0161592)	(0.002527)
Lithuania	-0.0766756^{***}	0.1369409^{***}	insignificant	-0.1269228^{***}	-0.0096696^{***}
	(0.0128779)	(0.0297699)		(0.0165069)	(0.0027955)
Poland	-0.0301544^{***}	0.0764094^{***}	0.0206999^{***}	-0.1316767^{***}	-0.0087672^{***}
	(0.008065)	(0.0248673)	(0.0041492)	(0.0133753)	(0.0016446)
Qatar	0.0276522^{***}	insignificant	-0.0082433^{***}	-0.1192321^{***}	-0.0100206^{***}
	(0.0096615)		(0.0021325)	(0.0165724)	(0.0019669)
Singapore	insignificant	insignificant	insignificant	-0.0997033^{***}	-0.0119811^{***}
				(0.0147296)	(0.0025854)
Slovakia	-0.0650588^{***}	insignificant	insignificant	-0.1373247^{***}	-0.0066661^{***}
	(0.0101153)			(0.0151835)	(0.0020996)
Slovenia	-0.0732199^{***}	0.1472716^{***}	0.0122808^{***}	-0.1612694^{***}	-0.0109112^{***}
	(0.0098251)	(0.0316754)	(0.0032203)	(0.0142304)	(0.0019214)
South Korea	-0.0401928^{***}	0.0999457^{***}	-0.0051935^{***}	-0.1061117^{***}	-0.0090691^{***}
	(0.0060355)	(0.0192242)	(0.0014429)	(0.0121856)	(0.0015891)
Taiwan	-0.064525^{***}	0.0631827^{***}	-0.0115833^{***}	-0.1492456^{***}	-0.0108038^{***}
	(0.005256)	(0.0160603)	(0.0014778)	(0.0127567)	(0.0021411)
United Arab Emirates	insignificant	insignificant	insignificant	-0.0737245^{***}	-0.0068432^{***}
				(0.0179006)	(0.0023236)

R-squared	0.3865	0.2949	0.2170	0.4114	0.1143
F statistic	27.05***	40.46***	58.78***	24.08***	8.98***
Number of obs	624	624	624	624	408

*, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels. ( ) indicate standard deviation of the estimators.

[1] Banks from Hong Kong are excluded from the sample because of the absence of quarterly reports in their web sites

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