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Banking risk in a financial crisis environment – a comprehensive literature review and meta-analysis

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Resumo

Este artigo lida com os impactos do capital dos bancos sobre a rentabilidade e risco. A avaliação de risco no setor bancário tem vindo a ser considerado um tema muito importante e cada vez mais proeminente na literatura bancária e que, inclusivamente, ganhou especial atenção depois das recentes crises financeiras, especialmente a europeia, a primeira a surgir desde a formação da zona do euro, que colocaram a nu um número crescente e significativo de problemas e preocupações relacionado com o risco de falências bancárias em instituições 'too big to fail' onde antes elas eram quase inimagináveis. Neste artigo, procuramos examinar o impacto do capital dos bancos sobre a rentabilidade e o risco. Veremos também se questões como a assimetria da informação, a importância dos bancos no sistema financeiro e o risco sistémico desempenham papéis significativos na evolução das falhas do setor bancário. O artigo começa por apresentar uma revisão abrangente da literatura que mostra o estado da arte sobre o tema em discussão. Em termos metodológicos faz um sobrevoo das abordagens recentes que os autores têm utilizado, entre outras e em particular, dos modelos de dados de painel. Aborda também as diversas técnicas de estimação incluindo os métodos EGLS e GMM para estimar painéis dinâmicos. A amostra recorre a bancos de dados com informação bancária dos EUA e de diversos países europeus, colhida em diferentes e largos períodos de tempo. Esta seção faz uma resenha dos principais métodos utilizados na literatura especializada. O artigo contém também uma secção onde apresenta uma meta-análise para comparar os resultados publicados pelos estudos consultados e referidos na revisão da literatura; fazendo, assim, de alguma forma, uma síntese dos melhores artigos publicados nos últimos anos bem como dos resultados empíricos conseguidos e respetiva discussão.

Palavras-chave

Risco bancário, rentabilidade, painel dinâmico, risco de colisão, crise financeira da UE, meta-análise

Abstract:

This article deals with the impacts of banks capital on profitability and risk in banks. Risk assessment in the banking sector has been considered a very important and increasingly prominent topic in the banking literature and has even gained special attention after the recent financial crises, especially in Europe, the first to emerge from the eurozone creation, which exposed a growing number of significant problems and concerns related to the risk of bank failures in 'too big to fail' institutions where before they were almost unimaginable. In this paper, we attempt to examine the impact of bank capital on profitability and risk. We will also see if issues such as information asymmetry, the importance of banks in the financial system and systemic risk play significant roles in the evolution of bank failures. The article begins by presenting a comprehensive review of the literature that shows the state of the art on the subject under discussion. In methodological terms, it overlaps the recent approaches that authors have used, among others, and particularly, panel data models. It also addresses the various estimation techniques including the EGLS and GMM methods for estimating dynamic panels. The sample uses databases with bank information from the US and several European countries, collected in different and wide periods of time. This section reviews the main methods used in the literature. The article also contains a section where it presents a meta-analysis to compare the results published by the studies consulted and referred in the review of the literature; thus, in some way, making a synthesis of the best articles published in recent years as well as the empirical results achieved and their discussion.

Keywords:

Bank risk, profitability, dynamic panel, crash risk, EU financial crisis, meta-analysis

Resumo alargado

Este artigo-dissertação lida com os impactos do capital dos bancos sobre a rentabilidade e risco bancário num ambiente particularmente turbulento, os anos da crise geral e da crise financeira e em particular bancária que se iniciou em 2007 nos Estados Unidos da América com a queda do Lehman Brothers.

A avaliação de risco no setor bancário tem vindo a ser considerado um tema cada vez mais importante e mais proeminente na literatura dedicada a estudar os bancos e as variáveis que mais influenciam o risco bancário. Este tópico, inclusivamente, ganhou especial atenção depois das recentes crises financeiras, especialmente a europeia, a primeira a surgir desde a formação da zona do euro, que colocaram a nu um número crescente e significativo de problemas e preocupações relacionados com o risco de falências bancárias em instituições 'too big to fail' como era hábito dizer-se, mas que, apesar de na altura serem quase inimagináveis, vieram a acontecer.

Nesta dissertação, procuramos em particular examinar o impacto do capital dos bancos sobre a rentabilidade e o risco. Veremos também se questões como a assimetria da informação, a importância dos bancos no sistema financeiro e o risco sistémico desempenham papéis significativos na evolução das falhas do setor bancário.

O estudo começa por apresentar uma revisão abrangente da literatura que mostra o estado da arte sobre o tema em discussão.

Em termos metodológicos faz um sobrevoo das abordagens recentes que os autores têm utilizado, entre outras e em particular, dos modelos de dados de painel, estáticos ou dinâmicos. Aborda também as diversas técnicas de estimação incluindo os métodos EGLS e GMM para estimar painéis dinâmicos. As referências citadas aquando da revisão da literatura referem os resultados que resultaram da aplicação destas e outras metodologias a informações contidas em amostras muito diversificadas de bancos oriundas das mais importantes databanks ou bancos de dados internacionais especializados em informação bancária dos EUA, da União Europeia e de diversos países europeus e asiáticos e outros, repartida por diferentes e largos períodos de tempo.

São inúmeros os estudos ou artigos já produzidos com dados e abordagens metodológicas diversificadas, com amostras de bancos de diversos países e continentes, com alguns resultados que chegam a ser contraditórios entre si. Face a este estado de coisas, e mais importante do que colher uma amostra bancária pessoal e recorrer a uma das metodologias citadas e chegar aos nossos próprios resultados, pareceu-nos justificar-se juntar toda a informação e resultados recolhidos e tentar chegar a algumas conclusões, uma espécie de síntese dos resultados até agora publicados, isto é, fazer uma meta-análise. Assim, esta dissertação inclui também um capítulo com a referida meta-análise comparativa dos

resultados publicados pelos estudos consultados e referidos na revisão da literatura que reputamos dos melhores artigos publicados nos últimos anos bem como dos resultados empíricos conseguidos e respetivas discussões.

Para concluir, e em jeito de síntese, este artigo é um trabalho de pesquisa que trata do tópico de risco bancário em um ambiente de crise financeira que inclui uma revisão abrangente da literatura. Faz um levantamento do estado da arte do risco bancário após a crise financeira global e europeia de 2008 que trouxe muitos problemas para quase todos os países mais desenvolvidos da OCDE, ou seja, os Estados Unidos, o membro da UE estados, Japão e muitos outros. Apresenta também uma síntese dos métodos utilizados pela literatura referenciada, nomeadamente a apresentação dos modelos de dados em painel, dinâmicos estáticos e sobretudo dinâmicos, e os métodos de estimação (EGLS ou GMM) entre outros. Noutra seção, apresenta uma meta-análise dos resultados empíricos encontrados por diferentes autores e artigos para diferentes países e períodos de dados. Além disso, lista as variáveis e tipos de dados usados nas aplicações empíricas e apresenta uma discussão sintética dos resultados.

Este documento preenche uma lacuna na literatura dedicada ao estudo do risco bancário, uma vez que apresenta uma meta-análise dos resultados publicados usando diferentes amostras de países, bancos, métodos e dados num momento que podemos identificar quase como o fim da primeira grande crise financeira e bancária, após a criação do euro-grupo europeu.

Index

List of abbreviations

A

ACTR - Activity Restrictions

B

BCBS - Basel Committee on Banking Supervision

C

CAPR - Capital Requirements

CRD - Capital Requirements Directives

CR4 - Concentration Ratio

D

DCPS - Domestic Credit to Private Sector

DEP – Deposit

E

EFC- European Financial Crisis

EGLS - Estimated General Least Squares

EU – European Union

F

FRB - Federal Reserve Board

FDIC – Federal Deposit Insurance Corporation

G

GCP – Creditor Protection

GDP – Gross Domestic Product

GFC – Global Financial Crisis

GLE - Legal efficiency

GLS- Generalized Least Squares

GMM – Generalized Method of Moments

GSP - Shareholder Protection

GW - GDP Growth Rate

H

HHI – Herfindahl-Hirschman index

I

INFL – Inflation

L

LADSF - Liquid Assets to Customer and Short-term Deposits

LLGL – Lon Loss Reserves to Gross Loans

LLR **-** Loan Loss Reserves

M

MAS – Monetary Authority of Singapore

MDPM - Market Discipline and Private Monitoring

N

NITA - Net Loans to Total Assets

O

OECD – Organization for Economic Cooperation and Development

OLS – Ordinary Squares Regression

R

RBI – Reserve Bank of India

RIR - Real Interest Rate

ROA - Return on Assets

ROE – Return o Equity

S

SCP – Structure Conduct Performance

SPR – Supervisory Power

U

USA – United States of America

US – United States

1. Introduction

This first section introduces the theme under study, the main objectives of the research and the main research hypothesis.

An interesting issue to discuss here is how bank capital affect risk. In response to the recent global financial crisis, the Basel Committee on Banking Supervision (BCBS) tried to update the procedures for capital and banking rules. Basel III proposes many new capital, leverage, and liquidity standards to reinforce banking sector's regulation, supervision, and risk management. The capital patterns and new capital safeguards require banks to maintain more and higher levels of capital quality than under current Basel II laws (Chien-Chiang Lee, Meng-Fen Hsieh, 2013). Regulators in most dominions worldwide are still planning to implement the new agreements (Basel II), but have widely varying timelines and are restricting the use of varying approaches. In 2008 the USA Federal Reserve Board (FRB) proposed a rule for public comment that should institute certain less-complex methodologies for calculating risk-based capital obligations. This proposal would be available for banks, bank holding companies, and savings associations not subject to the advanced approaches of Basel II. More importantly, the recent credit crisis has emphasized the need to better understand the determinants of bank risk with lower levels of bank capital (Festic et al., 2011, Chien-Chiang Lee, Meng-Fen Hsieh, 2013).

The EU-28 has already implemented the Basel II agreement through the EU Capital Requirements Directives (CRD), and many European banks have reported their capital adequacy ratios according to the new system in early 2008. Singapore (MAS) also implemented Basel II for all Singapore-incorporated banks on January 2008. India (RBI), on his turn, implemented the Basel II standardized norms on March 2009 and is moving to internal credit ratings for operational risks in banks. In this context it is not surprising that the relationship between bank capital and risk (profitability) has recently become a cause for alarm, especially as the level of capital may origin beneficial and adverse effects on bank profitability. Despite this, empirical work on the topic is either scarce or mixed. Barth et al. (2008) find that Philippines, Singapore and Indonesia, are strengthening capital requirements, while South Korea and Japan are easing their capital requirements, in the aftershock due to their crises. Argentina, made the same change before this crisis, while South Korea, Malaysia, Singapore, and Thailand gave supervisors more explicit power, what was not considered helpful for bank performance and stability (Barth et al., 2006, Barth et al., 2008, Chien-Chiang Lee and Meng-Fen Hsieh, 2013). Studies focusing on the relationship between capital and risk also present mixed results (Aggarwal and Jacques, 1998).

Recent papers find a positive relationship between capital and risk, this meaning that regulators encourage banks to increase their capital proportionally to the amount of risk taken, which refers to the 'regulatory hypothesis' (Pettway, 1976; Shrieves and Dahl, 1992; Berger, 1995; Demirgüç-Kunt and Huizinga, 2000; Iannotta et al., 2007; etc.). Other articles find a negative relationship between capital and risk, the 'moral hazard hypothesis', whereby banks have incentives to exploit existing flat deposit insurance schemes (Demirgüç-Kunt and Kane, 2002). Jahankhani and Lynge (1980), Brewer and Lee (1986), Karels et al. (1989), Jacques and Nigro (1997), and Agusman et al. (2008) show that equity-to-total assets is negatively related to risk. As pointed by Kahane (1977), Koehn and Santomero (1980), and also by Kim and Santomero (1988), banks could answer to regulatory actions, forcing them to increase their capital by increasing asset risk (Altunbas et al., 2007). Capital and risk are likely to be influenced by the level of profitability in the banking sector (Hughes and Moon, 1995, Hughes and Mester, 1998, and Altunbas et al., 2007, Chien-Chiang Lee & Meng-Fen Hsieh, 2013).

The relationship between capital and profitability usually focuses on the macro prospective, or the 'structure-conduct-performance (SCP) hypothesis'. Some researches show that operating performance is significantly related to market structure (measured by concentration indices, such as the four-bank concentration ratio (CR4) or the Herfindahl-Hirschman index (HHI)). Market structure which refers to the degree of market concentration within an industry, represents the degree of competition within a specific industry. Competitiveness to indicators of countries' banking system structures and regulatory regimes are related, and consistently with some other studies, there is no evidence that their competitiveness measure negatively relates to banking system concentration or to the number of banks in the market (Claessens and Laeven, 2004). A subsequent increase in the level of bank capital should lead to an increase in profitability due to lower insurance expenses on uninsured debt. Alternatively, a bank that holds a relatively high proportion of capital is unlikely to earn high profits, thus far, it is less exposed to risk (Goddard et al., 2004, Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Previous studies on the relationship between capital and risk (profitability) mainly focus on the U.S. and / or the European area, with a small discussion and insight on the banking industry in Asian economies (Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Hence, in order to allow for changes in the macroeconomic environment that might systematically impact on the observed risk and capital in any given year, binary variables are usually added to the specification; otherwise, macroeconomic factors are treated as control variables, implying a linear relationship between capital and risk. The question now arises as to whether the U.S. or the European Union results are valid for other continents and countries like the Asian ones. Researches applied to the banks of other countries out of the USA and the EU are scarce, but very important, since they are the predominant source of finance for

businesses of the private sectors (Deesomsak et al., 2004, Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Risk valuation in the banking sector has been a prominent topic in the banking literature. The Global Financial Crisis (hence-forth GFC) and the European Financial Crisis (henceforth EFC) evidenced a need both for efficient risk measurement and for prediction of risk (Avramidis and Pasiouras, 2015), and a renewed interest on financial networks risk (Billio et al., 2012; Minoiu and Reyes, 2013; Leon and Berndsen, 2014). The literature related to the networks of financial institutions has advanced in recent years with the use of network analysis to infer the level of risk of the financial network through measures such as the degree of financial institutions' connection. The degree is related to the systemic risk; a high value of this measure in a financial system makes the transmission of negative shocks easier through the system probably because of illiquidity or collapse (Bilio et al., 2012). Several papers used the concept of connectedness to infer about the firmness of a financial network (Nier et al., 2007; Minoiu and Reyes, 2013; Diebold and Yilmaz, 2014, Kosmidou, K., et al., 2017).

An important indicator of risk during a crisis is individual risk, which takes the form of firm-specific or idiosyncratic stock crashes. This kind of risk is estimated using unsystematic stock returns, thus excluding market-wide arrangements. In this respect, unsystematic stock crash or tail risk is rather related to firm-specific risk than systemic risk. The recent financial crises augmented worries on the tail risk of banks due to the possible signing of reduced future performance (Cohen et al., 2014). Dewally and Shao (2013) and Cohen et al. (2014) add evidence to support the relation between the chance of a future stock crash and the existence of earnings management by banks during a crisis' period. Some authors state that banks that hide negative news at a higher frequency than other banks have increased chances of crashing in the future. In essence, an important factor in cases of high endemic risk is data asymmetry. Hutton et al. (2009) argue that information asymmetry caused by a delay in the diffusion of bad news is related to higher future crash risk. They base their declaration on the fact that after a certain point firms can no longer keep the bad news and their subsequent discovery leads to a crash. Furthermore, idiosyncratic risk is believed significant, especially in the case that a bank is considered important in the network during a financial crisis, because crash may be diffused in the system and affect other banks (Balla et al., 2014). Consequently, there are reasons to believe that additional firm-specific features of the properties of the financial network, which are related to information asymmetry, the importance of the bank in the network and the diffusion of shocks, may also provide evidence on future idiosyncratic risk. This kind of elements include the importance of certain financial firms' role in the financial system (centrality), as well as, the degree of clustering of financial firms, which measures how closely the nodes in a network are linked. In other words, centrality provides a proxy of the importance of a node in the system, whereas clustering refers to the proximity of a node with other nodes in the network. These network characteristics are related to the characterization of "too big to fail" and "too interrelated to fail" for financial institutions. I.

e., the importance of some nodes in the system, assessed through the degree of how central they are in the network (centrality), as well as the degree of how related the financial institutions are in the financial network (clustering), may in turn affect their future unsystematic risk, i. e., the risk that is endemic to a particular asset such as a stock. The financial institutions that are more central in the system are also more important. Hereafter, they likely face higher pressure from regulators, auditors and other users of their financial data compared to other financial institutions that are less important in the financial system. This pressure leads to less information asymmetry, which in turn lowers the risk of future bank failures. Another reason for the lower idiosyncratic risk of some nodes in the system could be that they are more resilient to shocks. Allen and Gale (2000) argument that "complete" financial systems, where all nodes are connected (which indicates a high degree of clustering), are more stabilized compared to "incomplete" financial systems. Even if the system or network is not "complete" and shows a core-periphery structure, a bank that is central in the system and therefore has a higher clustering degree may face less risk because of the probably intervention of the government aimed at preventing systemic risk (domino effects) in the banking sector.

The purpose of the Kosmidou et al. (2017) study is to examine the information asymmetry factors as well as the network characteristics that are important in the prediction of idiosyncratic risk for banks during the financial crises. The study provides a complete evidence on the stock crash risk of the banking sector for banks. As determinants of information asymmetry and network characteristics, we use opacity and measure the importance of the financial institutions in the network and the power of their relationship with other financial institutions (local clustering). The first research question is to what extent is the importance of a financial institution related to future stock crash risk. Furthermore, given the discussion above on the likely resilience of institutions, which have high clustering coefficients, to shocks, one could assert that the more important a financial institution is or the higher the clustering coefficient is, the less probable a future stock crash will be. The second research question is to examine if institutions that are more prominent in the financial system or have high clustering coefficients are more protected from future crashes, despite having high levels of opacity. Opacity has been found to be positively related to future stock crashes for banks during a crisis (Cohen et al., 2014). However, this relationship is expected to be less significant and positive for more prominent financial institutions in the network or institutions that are highly clustered. Centrality also seems to lead to a more positive relationship between opacity and future risk for banks located in countries affected by crisis. In contrast, centrality and clustering are found to relate to lower future stock crash risk in some of the model specifications to lead to a more positive relationship between opacity and future risk for banks domiciled or located in crisis-affected countries. In contrast, centrality and clustering are found to relate to lower risks of future stock crash in some of the model specifications.

Chien-Chiang Lee and Meng-Fen Hsieh (2013), on their turn, conclude that first, along with the change in the categories of banks, investment banks have the lowest and positive capital effect on profitability, whereas commercial banks reveal the highest reverse capital effect on risk. Second, banks in low-income countries have a higher capital effect on profitability; banks in lower-middle income countries have the highest reverse capital effect on risk, while banks in high-income countries have the lowest values. Third, banks in Middle Eastern countries own the highest and positive capital effect on profitability. Far East & Central Asian banks have the largest reverse capital effect on risk, while the lowest value occurs in the banks of the Middle Eastern countries. Finally, the results also reveal that persistence of profit is greatly affected by different profitability variables, and all risk variables show persistence from one year to the next one.

The remainder of the study is organized as follows: Section 2 provides a review of the relevant literature, Section 3 describes the methods and data sources usually used in similar papers, section 4 presents a meta-analysis of the results encountered by the papers referred in the literature review with a small discussion and Section 5 concludes.

2. Theoretical background

The relationship between capital and risk is very interesting to study since it is important to clear how the level of capital structure is related to risk for banks. The relationship between banks capitalization and their risk-taking behaviors is one of central topics in banking studies, because of the potential implications for regulatory policies. Chien-Chiang Lee and Meng-Fen Hsieh (2013) article provide a wide-ranging literature survey on the topic. As can be seen, from the prospective of data selection most studies either focus on U.S. or on European banks and only a very small number cover other countries banking systems.

From the methodology viewpoint, most studies use static panel data models (e.g., Altunbas et al. (2007)). This influential paper, uses a static panel data model to analyze the relationship among capital, risk, and efficiency for a sample of European banks between 1992 and 2000. Other researches adopt a dynamic panel data approach, and estimate it with the Estimated General Least Squares (EGLS) or the Generalized Method of Moments (GMM) techniques. On his turn, Chien-Chiang Lee and Meng-Fen Hsieh (2013) adopt a two-step dynamic panel data approach to assess the relationships among banking capital, profitability, and risk. Following these last authors, capital, profitability, and risk should be considered simultaneously when examining the regulatory, structure-conduct-performance (SCP) and moral hazard hypotheses, since a change in banks' capital levels gives rise to a change in banks' profitability and risk, thus, the level of capital should be treated as an endogenous variable to test the regulatory and moral hazard hypotheses (Chien-Chiang Lee, Meng-Fen Hsieh, 2013). The GMM method solves the possible simultaneity between the degree of capital and profitability (risk) and takes into account the causal effect of the exogenous component. The data covered in Chien-Chiang Lee and Meng-Fen Hsieh (2013) research in the extended period after 2000 could account for the fact that more financial deregulation took place, and while adopting the dynamic model, it can provide the persistence of profitability (risk) estimation. It also considers more profitability (or risk) variables, as compared to Altunbas et al. (2007), that use a single profitability variable (return on assets, ROA) and risk (loan loss reserve, LLR).

Finally, Altunbas et al. (2007) ignore the possible effects of income levels and geographic regions, as well as financial market regulations and institutional developments. (Chien-Chiang Lee and Meng-Fen Hsieh, 2013)

An already ancient but innovator research by Pettway (1976) appreciates the relationship between capital structure and risk for U.S. banks and bank holding companies over the period of 1971 and 1974, surprisingly finding a positive relationship between equity-to-total-assets and risk. Shrieves and Dahl (1992) also adopt U.S. data and reach the same positive result.

Similar results are reached by other authors that made works applyed to Europe data, such as Rime (2001), Iannotta et al. (2007) and Chien-Chiang Lee and Meng-Fen Hsieh (2013).

There are also opposite results. In a utility maximizing and mean-variance framework, banks with relatively low risk aversion will choose relatively high leverage (low capital) and relatively high asset risk (Kim and Santomero, 1988). Equity-to-total-assets are found to be negatively related to risk (Jahankhani and Lynge, 1980; Brewer and Lee, 1986; Karels et al., 1989; Jacques and Nigro, 1997; and Agusman et al., 2008). More specifically, Jahankhani and Lynge (1980) adopt data from 95 U.S. commercial banks over 1972–1976. Brewer and Lee (1986) analyze 44 U.S. bank holding companies during 1978–1984. Karels et al. (1989) explore 24 U.S. banks between 1977 and 1984. Jacques and Nigro (1997) conduct a study on 2,570 U.S. FDIC-insured commercial banks during 1990 and 1991, offering evidence of a negative association between changes in risk and capital. Agoraki et al. (2011) find that capital requirements reduce risk in general, but for banks with market power this effect significantly weakens or can even be reversed (Chien-Chiang Lee, Meng-Fen Hsieh, 2013). The negative relationship between capital and risk may refer to the 'moral hazard hypothesis' that undercapitalized banks take on excessive risk to exploit existing flat deposit insurance schemes (Demirgüç-Kunt and Kane, 2002). On his turn Kwan and Eisenbeis (1997) explore findings that show a positive effect of inefficiency on risk-taking, which supports the moral hazard hypothesis that poor performers are more vulnerable to risk-taking than high performance banks. As for a different country sample, the same result is still found, such as in Altunbas et al. (2007) and Agusman et al. (2008). As noted by Shrieves and Dahl (1992), a positive correlation between capital and risk may result from regulatory costs, the unintended impact of minimum capital requirements, bankruptcy cost avoidance, or risk aversion by bank managers, while a negative correlation may result from the mispricing of deposit insurance. Altunbas et al. (2007) further refer to a positive relationship between capital and risk as the 'regulatory hypothesis', meaning regulators encourage banks to increase their capital commensurably with the amount of risk taken, while a negative relationship may refer to the 'moral hazard hypothesis' that banks have incentives to exploit existing flat deposit insurance schemes (Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

For the renowned puzzle between capital and risk suggested by Hughes and Moon (1995), Hughes and Mester (1998), and Altunbas et al. (2007), capital and risk are also likely to be influenced by banking firms' level of profitability. However, the existent literature on capital structure and risk seldom takes profitability into consideration. Capital is found to be associated with positive profitability (Berger, 1995; Jacques and Nigro, 1997; Demirgüç-Kunt and Huizinga, 2000; Rime, 2001; and Iannotta et al., 2007, Chien-Chiang Lee and Meng-Fen Hsieh, 2013). Differing from the positive relationship between capital and profitability, Altunbas et al. (2007) find that inefficient European banks appear to have more capital. Goddard et al. (2004) shows that the relationship between the capital-assets ratio and profitability is positive in six major European banking sectors for the period 1992–1998.

However, Goddard et al. (2010) discover that a negative relationship between the capital ratio and profitability reflects the standardized risk-return payoff for eight European Union member countries between 1992 and 2007 (Chien-Chiang Lee and Meng-Fen Hsieh, 2013)

Another literature group concentrate on the relationship between capital and profitability focuses on the macro prospective, structure-conduct-performance hypothesis. The results of such research show that operating performance is significantly related to market structure, market structure, which refers to the degree of market concentration within an industry, represents the degree of competition within the specific industry. Heggestad (1977), Short (1979), and Akhavein et al. (1997) find that, within a financial system characterized by less competition, firms tend to have larger scales of operation, and this, in turn, leads to much more market concentration and profits (Hannan and Berger, 1991; Neumark and Sharpe, 1992; Demirgüç-Kunt and Huizinga, 1999; Chien-Chiang Lee, Meng-Fen Hsieh, 2013).

Since the unfolding/development of the GFC – Global Financial Crisis and the EFC-European Financial Crisis, the endemic risk of banks got ample academic attention because of the impacts and failures of important players in the financial markets. Even though both the Global and European Financial Crisis (GFC and EFC) were originated in the financial sector soon they were transmitted into the real economy. The initial triggers of the lethal assets created liquidity problems because of the incapability of banks to raise funds in the market. Longstaff (2010) identifies liquidity as one of the key factors that lead to contamination in the financial markets. However, he also notes that contagion likely stems from increases in the risk premium of a market, which are fueled from negative events that occur in another market. These two factors (liquidity and risk premium) are shown to trigger financial contagion during the GFC-Global Financial Crisis (Longstaff, 2010). Kosmidou et al. (2015) report similar results and show that the European debt crisis was soon transformed into a liquidity crisis, whereas the subsequent release of an increasing volume of negative news negatively affected stock prices in the EU markets. The worries about the crisis are also triggered by the large socio-economic problems that a banking crisis may generate (Wagner, 2007; Acharya, 2009). Jin and Myers (2006) argued that less transparent markets faced more frequent crashes. A large torrent of the literature that followed Hutton et al. (2009), for industrial firms and Cohen et al. (2014), for banks) provided support to this hypothesis by showing that less financial transparency increased the possibility of a future stock crash. However, a managerial decision in delaying the revelation of bad news may be limited by higher pressure from regulators, auditors and other users of the financial information of a bank. This is the case of financial institutions that are more important in the financial network and are noted as “too big to fail” banks. It could be emphasized that in this case, future crash risk is reduced by the ability of these institutions to absorb the shocks or government intervention to avoid a negative shock coming from institutions that are central to the market. One could simply use the size of the financial institution as a proxy for the institution’s importance. Watts and Zimmerman (1978) used firm size to examine the

exposure of firms to political costs by arguing that larger firms are more susceptible to political costs. However, the size may proxy for several things, making this examination more difficult. As Cahan (1992) argues, the simplicity of this proxy may affect the conclusions. Financial network analysis is a tool that has gained popularity in recent years in relation to other methods (i.e., pairwise correlations), due to its ability to take into consideration the full planning of the relations of a member of the network, defined as a node with other members of the network. Elliott et al. (2014) use financial network analysis to develop proxies for the integration of financial institutions and provide useful applications of it. Acemoglu et al. (2015) examine systemic risk and contagion under a financial network approach and report that low shocks in magnitude may not affect an interconnected system. However, after a certain point of shock magnitude, an interconnected network may face a loss of stability. Previous studies have devised measures of systemic risk using the notion of connectedness. Billio et al. (2012) propose several relationship measures (Diebold and Yilmaz, 2014, Kosmidou, K., et al., 2017). Glasserman and Young (2015) study internal relationship and its effects on the contagion and diffusion of banking shocks. The authors note that when the starting financial institution has high influence and is too connected, the diffusion effects are important if the rest of the financial institutions have heterogeneous sizes. The authors provide a numerical example using data for the 2010 European Banking Authority stress tests, which provides support to their theoretical model. Network analysis for financial institutions may help in identifying the important institutions in the financial system. Two key network measures that may help model the position of a financial institution in the financial system are centrality and clustering, where centrality means the importance of a financial institution in a network in relation to the other vertices. Thus, in this manner, centrality provides a kind of measure of risk since the more important a bank is in a financial system, the more likely its risk will be diffused in the system. The basis for using this kind of network is related to the work of Glasserman and Young (2015), who show that the relation between connectivity and stability (the inverse of contagion) in the network is affected by the heterogeneity of the financial institutions' size. However, instead of using the actual size of the bank as a proxy for centrality, the authors directly measure centrality using the concept of eigenvector centrality (Bonacich, 1987, Bonacich and Lloyd, 2001). The authors propose the use of eigenvector centrality as a measure of the importance of a node in a network. This kind of measure has several advantages over other measures of centrality, as discussed in Bonacich (2007). In contrast, clustering draws on the work of Watts and Strogatz (1998) and provides a measure of local interconnectivity (Markose et al., 2012). Markose et al. (2012) paper state that in core-periphery models, a high clustering coefficient is evidence of the "too interrelated to fail" assumption for the financial institutions belonging to the highly clustered central core. This finding is observed because clustering measures the interconnectedness at the local level, and as such, it is a proxy of how close the neighbors of a node are. Georg (2013) argues that the specific type of network proposed by Watts and Strogatz (1998) that has a high clustering coefficient but small average path length, termed as "Small World

Networks", is prone to contagion. Minoiu and Reyes (2013) provide evidence that the clustering coefficients among a large number of countries rose to a pick just before the GFC-Global Financial Crisis. Lastly, Tabak et al. (2014) argue that specific types of clustering proposed by Fagiolo (2007) may lead to higher systemic risk (Kosmidou, K. et al., 2017).

3. Methodological issues

In methodological terms the published papers include different econometric techniques and methods such as regression with OLS (Pettway, 1976, Karel et al. 1989) and 2SLS (Aggarwal & Jacques, 1989), 3SLS to estimate simultaneous equations models (Jacques &Nigro, 1997, Shim, 2010, Rime, 2001, Shieves &Dahl, 1992), static and dynamic panel data models estimated by EGLS or GMM methods (Augusman et al., 2008, Atumbas et al. 2007, Brewer & Lee 1986, Demiguç-Kunt &Huizinga, 2000, Goddar et al. 2004, (dynamic model), Yannota et al. (2007), Jahankhani & Lyngee (1980), Granger-causality analysis (Berger, 1995), CAPM and correlation (Karel et al. 1989), among other authors. As can be seen panel data models either static or dynamic are preponderant.

In econometrics, panel data or longitudinal data are multi-dimensional data involving measurements over time. Panel data contain observations of multiple phenomena obtained over multiple time periods for the same countries, firms, banks or individuals.

Time series and cross-sectional data can be thought of as special cases of panel data that are in one dimension only (one panel member or individual for the former, one time point for the latter). A study that uses panel data is called a longitudinal study or panel study.

A panel has the form

$$X_{it},\ i=1,\ldots,\ N \text{ and } t=1,2,\ldots,\ T \qquad (1)$$

where i is the individual dimension and t is the time dimension. A general and simple panel data regression model is written as $y_{it}=\alpha+\beta' X_{it}+u_{it}$. Different assumptions can be made on the precise structure of this general model. Two important models are the fixed effects model and the random effects model.

Consider a general panel data model of the form (2)

$$\begin{aligned} y_{it} &= \alpha + \beta' X_{it} + u_{it}, \\ u_{it} &= \mu_i + \nu_{it}. \end{aligned} \qquad (2)$$

where μ_i are individual-specific, time-invariant effects which are fixed over time., whereas v_{it} is a time-varying random component.

If μ_i is unobserved, and correlated with at least one of the independent variables, then it will cause omitted variable bias in a standard OLS regression. However, panel data methods, such as the fixed effects estimator or alternatively, the first-difference estimator can be used to control for it.

If μ_i is not correlated with any of the independent variables, ordinary least squares linear regression methods can be used to yield unbiased and consistent estimates of the regression parameters. However, as μ_i is fixed over time, it will induce serial correlation in the error term of the regression. This means that more efficient estimation techniques are available. Random effects method is a special case of feasible [GLS-generalized least squares] which controls for the structure of the serial correlation induced by μ_i.

Dynamic panel data describe the case where a lag of the dependent variable is used as regressor:

$$y_{it}=\alpha+\beta'X_{it}+u_{it}+\gamma Y_{i,t-1}+u_{it} \quad (3)$$

The presence of the lagged dependent variable violates strict exogeneity, that is, endogeneity may occur. The fixed effects' estimator and the first differences' estimator both rely on the assumption of strict exogeneity. Hence, if u_{it} is believed to be correlated with one of the dependent variables, an alternative estimation technique must be used. Instrumental variables or GMM techniques are commonly used in this situation, such as the Arellano–Bond estimator.

The two-step dynamic panel data approach suggested by Arellano and Bover (1995) and Blundell and Bond (2000) uses dynamic panel GMM technique to address potential endogeneity, heteroskedasticity, and autocorrelation problems in the data (Doytch and Uctum, 2011). The system estimator provides for a more flexible variance-covariance structure under the moment conditions. The GMM approach is superior to the traditional OLS in examining financial variable movements. Driffill et al. (1998) indicate that a conventional OLS analysis of the actual change in the short rate on the relevant lagged term spread yields coefficients with some wrong signs and wrong size.

There are two different estimators for the dynamic panel models: (i) the difference panel estimator that eliminates a potential source of omitted variable bias in the estimation, and (ii) the system panel model estimator that combines the regression difference with the regression in levels to reduce the potential biases and imprecision associated with the difference estimator (Arellano and Bover, 1995).

Linear GMM estimators have one- and two-step variants. The two-step estimator that we use is generally more efficient than the one-step estimator, especially for the system GMM. The Windmeijer's (2005) finite-sample correction to report standard errors of the two-step estimation, without which those standard errors tend to be severely downward biased, can be employed.

The dynamic panel model technique – the GMM model – is particularly well-suited to handle short macro panels with endogenous variables and is also helpful in improving the bias

induced by omitted variables in cross-sectional estimates and the inconsistency caused by endogeneity. The dynamic GMM technique at the same time allows to control for the endogeneity bias induced by reverse causality running from profit (or risk) to banking capital and other explanatory variables.

In the dynamic panel data approach and GMM method to estimate the parameters, even though there is correlation or heteroskedasticity among the equations, the estimated standard deviation still appears to be robust. Therefore, the independent variable with lagged periods should be included in Eqs. (1) and (2), as shown below. Beyond the dynamic panel data, the model that establishes the relationship between bank capital and profitability (risk) is based on the earlier literature. According to the earlier literature discussion and this study' purpose of research, it is necessary to modify the works of Altunbas et al. (2007), Casu and Girardone (2006) and Goddard et al. (2004) to establish the relationship between bank capital and profitability (risk).

This paper mainly investigates the relationships among capital, profitability, and risk for banks with the latest and a wider range of panel. The relationship between bank capital and profitability (risk) can be specified as follows (4) and (5):

$$\pi_{it} = \alpha_0 + \alpha_1 \pi_{it-1} + \alpha_2 CP_{it} + \alpha\prime F_{it} + \lambda_i + \eta_{it}, \quad \forall i, t.$$

$$V_{it} = \beta_0 + \beta_1 V_{it-1} + \beta_2 CP_{it} + \beta\prime F_{it} + \mu_i + v_{it}, \quad \forall i, t.$$

Here t and i denote time period and banks, respectively, $\lambda_i(\mu_i)$ is an unobserved bank-specific effect, and $\eta_{it}(v_{it})$ is the idiosyncratic error term. Eqs. (4) and (5) are designed to examine the impact of bank capital on bank profitability and risk, respectively. Term CP_{it} is the level of bank capital, proxied by the equity-to-assets ratio; p_{it} refers to the i-th bank's profitability in year t, proxied by four profitability variables: return on assets (ROA), return on equities (ROE), net interest margin (NIM), and net interest revenue against average assets (NR). Here, V_{it} denotes the i-th bank's risk in year t, proxied by three risk variables (Lepetit et al., 2008): variance of ROA (VROA), variance of ROE (VROE), and loan loss reserves (LLR). Term Fit includes the set of explanatory variables, while α_1 and β_1 are the estimated persistence coefficient for profitability and risk, respectively. A significant α_1 implies that there is abnormal profitability or that risk will last from one year to the next (Goddard et al., 2004, 2010). Banks are always accompanied by the feature of profitability persistence, difficulty in entry-and-exit, a monopoly on resources, and a special ability for management resource allocation. Thus, it is crucial to consider the persistence of profitability through the dynamic panel model.

As for the related internal control variables, according to Casu and Girardone (2006), Short (1979), and Smirlock (1985), they include loan loss reserves to gross loans (LLGL), net loans to total assets (NITA), and liquid assets to customer and short-term deposits (LADSF). The coefficients of LLGL and NITA are expected to be positive with profitability (risk). A higher level of loans implies that a higher profit (risk) will be generated. On the contrary, LADSF is expected to be negative with profitability (risk), since keeping more liquid assets is usually accompanied with lower return (risk). (Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Four macro control variables are set as the related external control variables: inflation (INFL), GDP growth rate (GW), domestic credit to private sector (DCPS), and real interest rate (RIR). The coefficients of INFL and RIR are uncertain. In high-inflation countries, banks may charge customers more, yet at the same time they face due loans that are shrinking. A higher GW may imply that banks can generate more profitability and less risk, but DCPS may go another way. Since a greater DCPS refers to a financial environment that is more competitive, then DCPS should be negative (positive) to profitability (risk). (Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Four variables on financial market regulations and four institutional developments are finally included. The four financial market regulations followed from Agoraki et al. (2011) and Delis et al. (2011) are Capital requirements (CAPR), Supervisory power (SPR), Market discipline and private monitoring (MDPM), and Activity restrictions (ACTR). CAPR is an index of capital requirements that accounts for both initial and overall capital stringency. It is calculated by considering the sources of funds used as capital and by considering various issues that emerge during the calculation of the capital-to-assets ratio. The index takes values between 0 and 8, with higher values indicating greater capital stringency. SPR measures the power of supervisory agencies, indicating the extent to which these authorities can take specific actions against bank management and directors, shareholders, and bank auditors. This index takes values between 0 and 14 with higher values indicating more SPR. MDPM is an indicator of market discipline and shows the degree to which banks are forced to reveal accurate information to the public and whether there are incentives to increase market discipline. This index ranges between 0 and 8 with higher values indicating greater MDPM. Finally, ACTR is a proxy for the level of restrictions on banks' activities in each country. It is determined by considering whether participation in securities, insurance, and real estate activities and ownership of non-financial firms are unrestricted, permitted, restricted, or prohibited. ACTR takes values between 4 and 16, with higher values indicating higher restrictions.

The four institutional developments are Deposit insurance explicit (DEP), Shareholder protection (GSP), Creditor protection (GCP), and Legal efficiency (GLE). According to Demirgüç-Kunt and Kane (2002), under the explicit deposit insurance schemes banks have more incentives for risk-taking. (Chien-Chiang Lee & Meng-Fen Hsieh, 2013). The last three variables are proxies for corporate governance. GSP and GCP range from 0 to 5, with higher

scores for higher protection, while GLE is the multiple value for the rule of law and the efficiency of the judicial system.

To specify whether the instruments are valid, we can adopt the specification test suggested by Blundell and Bond (2000) and use the Sargan test of over-identifying restrictions, which examines the validity of the instruments. If the null hypothesis of the Sargan test for validly over-identifying restrictions cannot be rejected, then the instrumental variables are valid. On the contrary, if we reject the null hypothesis, then the instrumental variables are inappropriate. Under the null of joint validity of the full instrument set, the Sargan test statistics are asymptotically chi_2. The second test examines the hypothesis that the error term is not serially correlated. In both the difference regression and the system difference-level regression, we test whether the differenced error term is second-order serially correlated.

4. Results and discussion: a meta-analysis

Recent papers referred in the literature review find a positive relationship between bank capital and bank risk. This means that regulators encourage banks to increase their capital proportionally to the amount of risk taken, which refers to the 'regulatory hypothesis' (Pettway, 1976; Shrieves and Dahl, 1992; Berger, 1995; Demirgüç-Kunt and Huizinga, 2000; Iannotta et al., 2007; etc.). Other papers find a negative relationship between bank capital and bank risk, the 'moral hazard hypothesis', whereby banks have incentives to exploit existing flat deposit insurance schemes (Demirgüç-Kunt and Kane, 2002). On their turn Jahankhani and Lynge (1980), Brewer and Lee (1986), Karels et al. (1989), Jacques and Nigro (1997), and Agusman et al. (2008) show that equity-to-total assets is negatively related to risk. As pointed by Kahane (1977), Koehn & Santomero (1980), and Kim & Santomero (1988), banks could answer to regulatory actions, forcing them to increase their capitals by augmenting asset risks (Altunbas et al., 2007). Capital and risk are likely to be influenced by the level of profitability in the banking sector (Hughes and Moon, 1995, Hughes and Mester, 1998, and Altunbas et al., 2007, Chien-Chiang Lee & Meng-Fen Hsieh, 2013).

Competitiveness to indicators of countries banking system structures and regulatory regimes are consistently related with some other studies. There is no evidence that their competitiveness measure negatively relates to banking system concentration or to the number of banks in the market (Claessens and Laeven, 2004). A subsequent increase in the level of capital should lead to an increase in profitability due to lower insurance expenses on uninsured debt. Alternatively, a bank that holds a relatively high proportion of capital is unlikely to earn high profits; thus far, it is less exposed to risk (Goddard et al., 2004, Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Institutions that are more prominent in the financial system or have high clustering coefficients are more protected from future bank crashes, despite having high levels of opacity, opacity that has been found to be positively related to future stock crashes for banks during a crisis (Cohen et al., 2014).

Pettway (1976) appreciates the relationship between capital structure and risk for U.S. banks and bank holding companies over the period 1971 - 1974, surprisingly finding a positive relationship between equity-to-total-assets and risk. Shrieves and Dahl (1992) also adopt U.S. data to reach the same positive result. Similar empirical evidence is reached by applying European data (Rime, 2001, Iannotta et al., 2007 and Chien-Chiang Lee and Meng-Fen Hsieh 2013).

But the results are not always like this. There are also opposite results. In a utility maximizing and mean-variance framework, banks with relatively low risk aversion usually choose relatively high leverage (low capital) and relatively high asset risk (Kim and Santomero, 1988). Equity-to-total-assets are found to be negatively related to risk (Jahankhani and Lynge, 1980; Brewer and Lee, 1986; Karels et al., 1989; Jacques and Nigro, 1997; and Agusman et al., 2008). More specifically, Jahankhani and Lynge (1980) adopt data from 95 U.S. commercial banks over 1972–1976. Brewer and Lee (1986) analyze data from 44 U.S. bank holding companies; the period is 1978–1984. Karels et al. (1989) use data from 24 U.S. banks between 1977 and 1984. Jacques and Nigro (1997) conduct a study on 2,570 U.S. FDIC-insured commercial banks during 1990 and 1991, founding evidence of a negative association between risk and capital changes. Agoraki et al. (2011), find that capital requirements reduce risk in general, but for banks with market power this effect significantly weakens or can even be reversed. (Chien-Chiang Lee and Meng-Fen Hsieh, 2013). The negative relationship between bank capital and risk may refer to the 'moral hazard hypothesis' that undercapitalized banks take on excessive risk to exploit existing flat deposit insurance schemes (Demirgüç-Kunt and Kane, 2002). On his turn, Kwan and Eisenbeis (1997), explore findings that show a positive effect of inefficiency on risk-taking, which supports the moral hazard hypothesis that poor performers are more vulnerable to risk-taking than high performance banks. Different country samples and analysis conduct also to the same result; it is the case of Altunbas et al. (2007) and Agusman et al. (2008), among others. As noted by Shrieves and Dahl (1992), a positive correlation between capital and risk may result from regulatory costs, the unintended impact of minimum capital requirements, bankruptcy cost avoidance, or risk aversion by bank managers, while a negative correlation may result from the mispricing of deposit insurance. Altunbas et al. (2007) further refer to a positive relationship between capital and risk as the 'regulatory hypothesis', this meaning that regulators encourage banks to increase their capital commensurably with the amount of risk taken, while a negative relationship may refer to the 'moral hazard hypothesis' that banks have incentives to exploit existing flat deposit insurance schemes. (Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Capital is found to be associated with positive profitability (Berger, 1995; Jacques and Nigro, 1997; Demirgüç-Kunt and Huizinga, 2000; Rime, 2001; Iannotta et al., 2007 and Chien-Chiang Lee and Meng-Fen Hsieh, 2013). Differing from the positive relationship between capital and profitability, Altunbas et al. (2007) find that inefficient European banks appear to have more capital. Goddard et al. (2004), show that the relationship between the capital-assets ratio and profitability is positive in six major European banking systems with statistical data from the period 1992–1998. However, Goddard et al. (2010), discover that a negative relationship between the capital ratio and profitability reflects the standardized risk-return payoff for eight European Union member countries between 1992 and 2007 (Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

The relationship between bank capital and profitability focuses on the macro prospective, structure-conduct-performance hypothesis. The results of such research show that operating performance is significantly related to market structure. Market structure, which refers to the degree of market concentration within an industry, represents the degree of competition within this specific industry. Heggestad (1977), Short (1979), and Akhavein et al. (1997) find that, within a financial system characterized by less competition, firms tend to have larger scales of operation, and this, in turn, leads to much more market concentration and profits (Hannan and Berger, 1991; Neumark and Sharpe, 1992; Demirgüç-Kunt and Huizinga, 1999; Chien-Chiang Lee and Meng-Fen Hsieh, 2013).

Liquidity and risk premium are shown to trigger financial contagion during the GFC - Global Financial Crisis (Longstaff, 2010). Kosmidou et al. (2015) report similar results and show that the European debt crisis was soon transformed into a liquidity crisis, whereas the subsequent release of an increasing volume of negative news negatively affected stock prices in the EU markets. The preoccupations about the crisis are also related to the large socio-economic problems that a banking crisis may generate (Wagner, 2007; Acharya, 2009).

5. Concluding Remarks

This work is a research paper that deals with the banking risk topic in a Financial Crisis Environment. It includes a complete literature review in order to state the state of the art of the banking risk after the 2008 global and European financial crisis that brought many problems to almost all the most developed countries of the OECD, namely the United States, the EU member states, Japan and many others.

It also presents a synthesis of the methods used by the refereed literature, namely a presentation of the panel data models, either static and above all dynamic, and the estimation methods (EGLS or GMM), among others.

In another section it presents a meta-analysis of the empirical results found by the different authors and papers for different countries and periods of data. Besides this it lists the variables and types of data used in the empirical applications and presents a synthetical discussion of the results.

This paper fills a gap in the banking risk literature since it presents a meta-analysis of the published results using different samples of countries, banks, methods and data-periods in a moment that we can identify almost as the end of the first financial crisis after the creation of the European euro-group.

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