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Price Competition, Efficiency and Riskiness in Investment Banking

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Abstract

The recent financial crisis has shown that the stability of the investment banking industry plays a key role for the soundness of the financial system as a whole. Our paper examinesthe inter-temporal relationshipsbetween price competition, cost efficiency and riskiness for a sample of investment banks inten large developed countries over 2000-2008.We show that price competition is rather limited in investment banking worldwidethus implying the existence of colluding oligopolies.We also find thatalthough investment banks' stability was granted by relatively low competitive pressures, banks appeared prone to take more risk thus giving some support to the competition-stability view for the investment banking industry.

JEL classification: D2, D24, G24.

Keywords: Investment Banking;Price Competition; Risk; Capital; Efficiency.

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1. Introduction

Until the 2007 financial crisis, the investment banking industry underwent remarkable transformations and enjoyed a prolonged period of prosperity. The process of deregulation and improvements in technology hadcontributed to the integration of investment and commercial banking and generally encouraged greater competitive pressures in the financial services sector.As the industry became more contestable, firms were increasingly driven by efficiency and profit maximizing motives. Many of them developed as large full-service institutions (oftenby further consolidating) seeking new income sources,as commissions gained from their traditional securities business declined. Presumably,this led to greater (and possibly excessive) risk-taking activities and exposures, including proprietary trading and dealing with complex financial securities. As observed by Gapper (2008) the catch was that investment banks 'were taking what turned out to be life-threatening gambles and they did not have sufficient capital'. Post-crisisthe need to restore confidenceand to commit to a safer and sounder banking sector has resulted in a new wave of policy debates. Among the key concernsis the effectiveness of financial regulation, particularly in relation to capital adequacy rules.[1]

In this paper we uncover new evidence on the relationshipsbetween competition, efficiency and risksfor a sample of investment banks operating in ten developed countries over 2001-2008. The issue of competition for investment banks is not straightforward due to the very nature of theirbusiness that implies that firms compete both in terms of price and relationships. Some

[1] For decades legislation failed to create a framework for regulating investment banks. In 2004, for instance, the US Securities and Exchange Commission (SEC) created a voluntary regulation program known as the Consolidated Supervised Entities (CSE) program. However the program proved largely ineffective due to the lack of any statutory authority, and to the banks' ability to opt out of any CSE instruction.

authors (e.g. Petersen and Rajan, 1994) observed that the importance of these latter often justifies the *need*for greater market power in this sector. It should not surprise then if one of the distinctive features that has characterized the industry for decades has been the stability of the level of concentration against increases in the market's relative size. As explained in Hayes et al. (1983) and Anand and Galetovic (2006), for decades a pyramidal structure has prevailed,with an oligopoly of large similar-sized 'bulge bracket' firms at the apex. A second layer of the pyramid, on the other hand,is composed by afew medium-sized banks and a large number of small banks.In this study we focus on one specific form of competition, which is the price competition because of the difficulties in measuring client-firm relationships. Anand and Galetovic (2006) observe that these latter are typically embodied in human capital that can move between firms taking these relationships with them.

Given the above, and despite its importance and potential implications, competition in investment banking markets has largely been overlooked. In a similar way, efficiency studies have mainly focused on the retail banking sector. Examples of recent studies that haveconsideredthe impact of competition on retail banks' risks and efficiency are e.g. Boyd and De Nicolò(2005); De Nicolò and Lucchetta(2009); Casu and Girardone (2009); Fiordelisi et al. (2011). A parallel literature has exploredthe impact of capital (Gropp and Heider, 2010) and business models (Scott and Dunkelberg, 2010; Berger et al., 2010) on commercial banks' risks.As far as we are aware, however, empirical studies on these topics for the investment banking industry are limited (see Radic et al. 2011).

We aim to fill this gap in the literature by trying to answerthe following research questions: dohigh competition and/or cost inefficiencies increase investment banks' insolvency (and capital) risks? Or, conversely, do investment banks' insolvency risk and capitalization levels lead to higher price competition and/or lower cost efficiencies? Answers to these questions are expected to help unfold important insights in relation to the competition-fragility versus competition stability-puzzle in investment banking(see Section 2 for more details).

Methodologically, the first step of our analysis requires the estimation of bank-specific cost efficiency scores and competition levels for a large data set of investment banksoperating in the ten leadinginvestment banking sector worldwide (Australia, Canada, France, Germany, Ireland, Italy, Japan, Switzerland, the UK and the US). The period under analysis includes two years into the financial turmoil as it covers 2001-2008. Next, we examine the inter-temporal relationships between the variables of interest, i.e. it aims to test the direction of causality, if any,among them. Estimates are obtained using panel data and Generalized Methods of Moments (GMM) so that to control for endogeneity and for country-specific effects. We conjecture that greater competition could precede greater exposures on the part of the banks and greater efficiency levels. In a similar vein, increases in bank risks may temporally precede a decline in efficiency related to higher costs of dealing with more problematic (non-performing) assets. On the other hand, low levels of efficiency could lead banks to try to boost returns by lowering their operating standards, such as the less intensive monitoring of risk-taking, or lower capitalization levels.

Our results indicate that competition is very limited in investment banking worldwide and in each of the country analysed: overall, the Lerner index is relatively high, thus suggesting less competitive conditions in the investment banking industry, implying existence of colluding oligopoly.Second, we show that the investment banks' stability, over the period analyzed, was granted by low competitive pressure and, in this environment, banks were prone to take more risks. These findings are important because they provide some support that the 'competition-stability' paradigm holds for the investment banking industry.Finally our findings broadly indicate support to the need to impose capital requirements for investment banks in order to reduce their risks.

The remainder of the paper is structured as follows. Section 2 reviews the main literature and sets out the research hypotheses. Section 3 discusses the data and methodology. Section 4discusses the results and Section 5concludes.

2. Literature Review: A Brief Overview

Over the 1990s the deregulation process that was carried out in the banking sectors of most developed countries was embeddedin the idea that stimulating competition and increasing contestability in banking was the way forward to better quality of provision and sustainable growth. More competition in banking was expected to foster efficiency, stimulate innovation and boost international competitiveness. Recent studies (Claessens and Laeven, 2004), however, have suggested that the view that competition is unambiguously good is more naïve in banking than in other industries. One of the main problems, as demonstrated by the recent subprime crisis, is represented by the costsfor thesociety should things go unexpectedly wrong. It follows that, in the aftermath of the 2007 financial turmoil, understanding the relationship between competition, efficiency and riskiness has become particularly relevant in banking.

The literature on (commercial) bank competition and performance is generally well established although early studies focus on structural measure of competition (e.g. concentration ratios) to infer the competition levels. Overall, existing US studies do not suggest unambiguously positive– or negative – relationships (Demirgüç-Kunt and Levine, 2000). Furthermore, there are conflicting results on the impact of increased bank concentration – through M&As – on efficiency, deposit rates and bank profitability (Berger and Humphrey, 1992; Pilloff, 1996). Based on European banking data, more recently Casu and Girardone (2006) and Weill (2005) find an inverse relationship between competition (proxied by the Panzar- Rosse H Statistics) and efficiency. They find little evidence that banking system concentration negatively relate to competitiveness but suggest that the most efficient banking systems are also the least competitive. Maudos and Fernandez de Guevara (2007) examine the relationship between market power (proxied by the Lerner index) and cost efficiency and their results also indicatea negative relationship between competition and cost efficiency in the European banking sectors.

Concerning the relationship between bank competition and stability, at least empirically, the literature is less developed(see for comprehensive reviews, Dick and Hannan, 2010; and Casu et al., 2011).The theoretical approaches identify two views:the 'competition-fragility'view (Allen and Gale, 2004; Carletti, 2008) that argues that competition leads to more fragility. The argument goes that in uncompetitive markets, banks earn monopoly rents resulting in higher profits, capital ratios and charter values. This makes them better placed to withstand demand- or supply-side shocks and discourages excessive risk-taking. Conversely, the alternative approach, labelled as'competition-stability' view (Boyd and De Nicolo', 2005), argues against less competition claiming that the considerable market power of only a few banks will cause them to raise the interest rate on loans, which will adversely select the firms with risky projects, with a negative impact on the stability of the banking system. The standard economic argument for the positive influence of competition on firms' performance is that the existence of monopoly rents gives managers the potential of capturing some of them in the form of slack or inefficiency (Nickell et al., 1997).

In this context, Schaecket al.(2009)assess the relationship between efficiency, competition and soundness in Europe and the U.S. banking industries finding that increases in market power precede increases in cost efficiency. Fiordelisi et al. (2011) examine the causality between bank efficiency, capital and riskfor a sample of European commercial banks and showthat lower bank efficiency causes higher bank risk and that increases in bank capital precede cost efficiency improvements.

While the studies reviewed above focus on commercial/ retail banking, as far as we are aware there is a lack of studies specifically on the investment banking industry. The analysis of the link between competition, efficiency and risks in this sector is not less important than in commercial banks as shown by the recent credit turmoil, generated (among the various reasons) by the insolvency of various investment banks. Our paper is the first to attempt to fill this gap by providing empirical evidence about the inter-temporal links between investment banks' performances and the industry competition.

3. Methodology and data

3.1 Data sample

We analyze worldwide professional service firms (investment banks and securities house) operating in the following ten developed countries (Australia, Canada, France, Germany, Ireland, Italy, Japan, Switzerland, the U.K. and the U.S.) over 2001-2008. The data used in the empirical analysis was drawn from two different sources: International Bank Credit Analysis Bankscope

Database and the World Development Indicators of the World Bank.Table 2 reports the breakdown by country of the number of observations and asset size of the banks included in the sample. Overall, our sample comprises 1,196 observations. The US banks are the biggest on average by asset size, whereas Switzerland has the largest number of institutions in total.

<Insert Table 1 here>

3.2 The GMM model

We rely on Granger causality techniques to investigate the relationship between investment bank risks, efficiency and price competition as this approach allows us to test unique time-ordered and signed relationships among pairs of variables.[2] While Granger causality tests have a number of limitations,[3] this approach has been widely used to analyze inter-temporal relationships in the economic literature (e.g. Jaeger and Paserman, 2008; Assenmacher-Wesche and Gerlach, 2008) as well as in retail banking studies (e.g. Fiordelisi et al., 2011, Fiordelisi and Molyneux, 2010; Casu and Girardone, 2009; Williams, 2004; Berger and DeYoung, 1997).

Specifically, in order to disentangle the inter-temporal relationships between bank capital, efficiency and risk, we estimate the following four equations:

$$IR_{,t} = f(IR_{i,lag}, CAP_{i,lag}, CE_{i,lag}, LER_{i,lag}, Z_{j,t}) + \varepsilon_{i,t} \quad (1)$$

[2]Granger's (1969, p. 428) notion of causality states that "… $y_t$is causing $x_t$if we are better able to predict $x_t$using all available information than if the information apart from $y_t$had been used". Granger's suggestion to regress $x_t$on its own lags and a set of lagged y_t has become a standard procedure. If lagged y_t provides a statistically significant explanation of x_t, y_t "Granger" causes x_t.
[3] Granger-testing does not prove economic causation between two variables but identifies gross statistical associations.

$$CAP_{i,t} = f\,(IR_{i,lag}\,,\ CAP_{i,lag}\,, CE_{i,lag}\,,\ LER_{i,lag},\ Z_{j,t}\,) + \varepsilon_{i,t} \tag{2}$$

$$CE_{i,t} = f(IR_{i,lag}\,,\ CAP_{i,lag}\,, CE_{i,lag}\,,\ LER_{i,lag},\ Z_{j,t}\,) + \varepsilon_{i,t} \tag{3}$$

$$LER_{i,t} = f(IR_{i,lag}\,,\ CAP_{i,lag}\,, CE_{i,lag}\,,\ LER_{i,lag},\ Z_{j,t}\,) + \varepsilon_{i,t} \tag{4}$$

where the *i*subscript denotes the cross-sectional dimension across banks, *t* denotes the time dimension, *IR* is the variable accounting for investment bank insolvency, *LER* is the variable accounting for competition in the investment bank industry,*CAP*is capital over assets, *CE* is the cost efficiency scores.Finally, the Z_js(for j=1,…,4)are control variables and $\varepsilon_{i,t}$is the error term.

The main empirical question that this study aims to verify is to provide evidence that can help us speculate on the competition-fragility versus the competition-stability puzzle in investment banking. More specifically, the two main hypotheses explained above will be tested as follows:

- H_1 (competition-fragility) *Declines in the industry competition temporally precede increases in banks' cost efficiency and risks.*
- H_2 (competition-stability) *Greater industry competition temporally precedes increases in banks' cost efficiency, increases in capital and decreases in risks.*

Focusing on the specific questions above, equation (1) tests whether changes in bank capital, cost efficiency and price competition temporally precede variations in the insolvency bank risk measures. Equation (2) assesses whether changes in cost efficiency, bank insolvency risk and competition temporally precede variations in bank capital. Equation (3) investigates if changes in bank risk, capital and competition temporally precede variations in cost efficiency; and equation (4) considers whether cost efficiency, capital and risks temporally precede changes in competition.

Following Fiordelisi et al. (2011), Williams (2004) and Berger and DeYoung (1997), we also examine the validity of several other hypotheses, namely that: (1) reductions in cost efficiency temporally precede increases in banks' risk due to operational, market and reputational problems (bad management hypothesis). (2) Increasesin cost efficiency temporally precede increases in banks' risk and equity capital (cost skimping hypothesis). (3) Increases in risks temporally precede falls in banks' cost efficiency (bad luck hypothesis); and,lastly, (4) Declines in bank capital temporally precede increases in banks' risks (moral hazard hypothesis).

We estimate autoregressive models with three lags *AR (3)* for the risks,efficiency and competition variables.[4] Following Casu and Girardone (2009), Granger causality is assessed as the joint test of the null hypothesis that the three lags are equal to zero. If the probability is less than 10%, then the null hypothesis that *x* Granger causes *y* is rejected at the 10% significance level. We also assess the 'long-run effect' of *x* over the *y* by testing for the restriction that the sum of all lagged coefficients is zero; a rejection of the restriction implies that there is evidence of a long-run effect of *x* on *y*.

The introduction of a lagged dependent variable among the predictors creates complications in the estimation as the lagged dependent variable is correlated with the disturbance (even under the assumption that $\varepsilon_{i,t}$ is not itself correlated). To tackle this problem, we use the Generalized Method of Moments (*GMM*) estimators developed for dynamic panel

[4] We tested several specifications in terms of the number of lags. Unlike Berger and DeYoung (1997) and Williams (2004) we resort to three lags which seem economically reasonable given the (annual) frequency of our data.

models Arellano and Bover (1995) and Blundell and Bond (1998). Specifically we use the two-step system GMM estimator with Windmeijer (2005) corrected standard error.[5]

3.3 Variables definition

Investment banks' risks (*IR* and *CAP*) are proxied by insolvency risk and the level of capitalization respectively. Insolvency risk (*IR*) is computed by using the z-scores that essentially measure the bank's distance from default (Boyd et al., 1993). It is obtained as the ratio between a bank's return on assets plus equity capital/total asset divided by the standard deviation of the return on assets. Higher values indicate that a bank is less likely to default.The investment banks' capitalization levels(*CAP*) are proxied by the ratio of total equity to total assets, *E/TA*.Lower levels of *CAP* suggest greater agency problems between shareholders and managers and higher-risk bank strategies.

The other variable of interest is cost efficiency (*CE*).It is estimated by using aparametric stochastic cost frontier[6](the methodological details are outlined in the Appendix) that implies the characterization of the production process of investment banks and thus the definition of their inputs and outputs. This is particularly challenging since there are only a handful of studies focusing on investment banks' efficiency. Similarly to Radic et al. (2011), we posit that investment banks' inputs are the price of labor calculated as personnel expenses over total assets (P_1); the price of physical capital, measured as other administrative expenses plus other operating expenses over total fixed assets (P_2); and plus one additional input - price of funds measured as interest expenses over total funds (P_3). On the other hand, and despite the multi-output nature of the investment banking business,

[5] The estimated asymptotic standard errors of the efficient two-step GMM estimator are severely downward biased in small samples and so we correct for this bias using the method proposed by Windmeijer (2005).
[6] The parametric Stochastic Frontier Approach (SFA) was originally proposed by Aigner et al., (1977) and Meeusen and Van den Broeck (1977).

we define total assets (Q_1) as one single output. By doing so we assume that the flow of services produced by an investment bank is proportional to its total assets.Finally, to account for the time effect, we include a quadratic time trend (T) variable in the function. The methodology used is the Battese and Coelli's (1992) time-varying stochastic frontier approach for panel data with firm effects which are assumed to be distributed as truncated normal random variables, and are also permitted to vary systematically with time (see also Battese and Coelli, 1993; and Coelli et al., 2005). The final specification is as follows:

$$\begin{aligned} \ln TC_{it} &= \alpha_0 + \alpha_1 \ln Q_1 + \sum_{j=1}^{3} \beta_j \ln P_j + \frac{1}{2}[\delta_1 \ln Q_1 \ln Q_1 + \sum_{j=1}^{3}\sum_{i=1}^{3} \gamma_{ij} \ln P_j \ln P_i] + \\ &+ \sum_{j=1}^{3} \rho_{1j} \ln Q_1 \ln P_j + t_1 T + \frac{1}{2} t_{11} T^2 + \theta_{ti} T \ln Q_1 + \sum_{j=1}^{3} \psi_{tj} T \ln P_j + \varepsilon_{it} \end{aligned} \tag{5}$$

where $TC$is the sum of personnel expenses, other administrative expenses, other operating expenses and price of funds; α, β, δ, γ, ρ, t, θ, ψ are coefficients to be estimated; and ε_{it} is a two-components error term $\varepsilon_{it} = u_{it} + v_{it}$ where v_{it} is a two-sided error term.[7]

The choice of defining one single output in the cost function is conveniently justified by the use of the Lerner index ofMonopoly Power (*LER*), as e.g. inShaffer (1993); Berg and Kim (1994); Angelini and Cetorelli(2003); Fernandez de Guevara et al. (2005); and Casu and Girardone (2009). The Lerner Index represents the extent to which market power allows firms to fix a price above marginal cost (*MC*). This latter is derived from equation (5) above as follows:

[7] The $v_{it}$are assumed to be independently and identically normal distributed with zero mean and variance $\sigma_v^2$and independent of $u_{it} = \{u_i exp[-n(t-T)]\}$ where u_{it} is a one-sided error term capturing the effects of inefficiency and assumed to be half-normally distributed with mean zero and variance and n is an unknown parameter to be estimated capturing the effect of inefficiency change over time. We apply the common restrictions of standard symmetry and homogeneity in prices to the translog functional form.

$$MC_{it} = \frac{TC_{it}}{Q_{it}}\left(\alpha_1 + \delta \ln Q_{it} + \rho_j \ln Q_{it} + \theta_t T + \varepsilon_{it}\right) \quad (6)$$

Marginal costs derived from equation (5) are used to calculate the Lerner index:

$$LERNER = \frac{p_{it} - MC_{it}}{p_{it}} \quad (7)$$

where$p$ is the price of output Q and is calculated as total revenue (interest plus non-interest income) divided by total assets. LERNER=0 it indicates perfect competition, while LERNER=1 indicates monopoly.

Finally, we control for several macroeconomic variables commonly used in the efficiency literature (e.g. Salas and Saurina, 2003; Yildirim and Philippatos, 2007; Brissimis et al., 2008) that may influence the relationship among risk-capital-efficiency-competition. These include annual real GDP growth (Δ*GDP*), to take account of business cycle effects; inflation rate (*INF*) to control for the stance of monetary policy; the stock market capitalization (MCLC) to proxy the importance of capital markets in each domestic financial system; and lastly return on assets (ROA), to control for the bank profitability. A summary of the variables used for the empirical investigation is provided in Table 2.

<Insert Table 2 here>

4. Results

Figure 1 reports our mean costefficiency estimates by year for each of the investment banking industry of the ten countries under study.The range of efficiency levels appears to be wider than existing studies on retail banks (e.g. Hughes and Mester, 2008, Berger 2007, Goddard et al., 2007, Berger and Humphrey 1997). Specifically,mean cost efficiency estimates range between 47% (Australia) and 95% (Canada). The efficiency scoresfor banks operating in European countries over the whole sample period appear typically lower than those for their non-European counterparts. Furthermore, Ireland (75.25%), France (74.97%) and Germany (73.47%) exhibit significantly higher scores compared to Italy (49.76%), Switzerland (49.79%) and UK (40.88%).The low results for these two latter countries are likely due to the inclusion of 2007 and 2008 data in the sample.

<Insert Figure 1 here>

We also measureinvestment banks'market power by computing the Lerner index. The greater the values for *LER*, i.e. the market power reflected by the bank ability to set price above marginal costs,the lower the competition faced by a bank. Figure 2 shows the mean values for the estimated Lerner index and marginal costs over the sampled period. We show that competition is very limited in investment banking worldwide and in each of the country analysed.The Lerner index ranges between 79.21% in Germany and 94.95% in Ireland: overall, it is very high, thus suggesting low competitive conditions in investment banking, implying existence of colluding oligopoly.Namely, the investment banking sectors in Ireland and Italy seem to report the highest market power and Germany and the US the lowest, although still relatively high compared to commercial banking. It is not surprising that these results differfrom those reported in previous studies (Fernandez de

Guevara et al., 2005; Casu and Girardone, 2009; Jiménez et al. 2010; Liu et al. 2010) dealing with commercial banks where competition is generally found to be greater.

<Insert Figure 2 here>

The next stage is to estimate a panel GMM model in order to examine the causality, if any, between the two measures of bank risks (insolvency and capitalization), cost efficiency levels and the Lerner index. We report the results from the models specified in equations (1)-(4) in Table 3. As described in Section 3, three lags have been employed for insolvency risk (IR*),* equity capital (*CAR*), cost efficiency (*CE*) and competition (*LER*). For each variable the Granger causality is also tested over the period for pairs of variables.

<Insert Table 3 here>

Our evidenceshows that investment banks' market power (*LER*) negatively Granger-cause the investment bank insolvency (*IR*) in model 1: estimated coefficients at time t-2 and "between t-1 and t-3" are found to be negative and statistically significant at the 10% confidence level or less. This result supports the competition-fragility assumption (see H_2inSection 2.1) that posits that a market power increase (corresponding to lower competition levels) is associated to a lower bank's distance to default. We also provide evidence of a positive reverse causation between risk and market power (model 4): an increase in insolvency risk temporally precedes an increase in market power (a decrease in competition). Overall, our results show that, over the period analyzed, the investment banks' stability was granted by low competitive pressures and, in this environment, banks were prone to take more risks.

In addition, results from Model (4) confirm that market power increases (showing lower competition)at *t*-2 and at (*t*-1*;t*-3)temporally precede equity capital reductions: this suggest that, over the period analyzed (2001-2008), the stability of the investment banking mostly relies on low competitive pressures rather than on the investment banks' capital adequacy.

These results indicatethe importance of focusing our analysis on the inter-temporal relationship between risk and capital. Over the period analyzed (200-2008), investment banks heavily invested in high-risk mortgage backed securities (MBSs) in a deregulated environment (legislation regulating securities, like the Graham-Leach-Liley Act, failed to create a mechanism for regulating investment banks) being thus exposed to the effect of the housing market downturn. The U.S. Securities and Exchange Commission attempted to face this problem establishing the Consolidated Supervised Entities (CSE) program, i.e. a voluntary system by which investment banks could decide to comply with minimum capital requirements and leverage limitations. From one side, our result shows a positive inter-temporal causation between risk and equity capital: insolvency risk increases temporally precedecapital level increases andthis is consistent with the initial application of the CSE program.Nevertheless and more interestingly, we show a reverse negative causation between bank capital at time *t-1*and insolvency risk at time *t*.This supportsthe 'moral hazard' hypothesis (Jeitschko and Jeung, 2005), over the period analyzed showing that lower capital levels were inter-temporally linked to higher risk levels. According to this hypothesis bank managers have incentives to take on more risk particularly when the level of bank capital is low (or banks are more inefficient). The moral hazard could arise in the presence of informational frictions and the existence of 'agency problems' between bank managers and owners, for example, when managers take-on risks that are borne entirely by the shareholders.[8] Better capitalised banks, in contrast, may have less moral hazard incentives and will likely adopt cost reducing practices (e.g. shareholders may be more active in controlling bank costs or capital allocation).Overall, our results support the importance to impose capital requirements to investment banks supporting that the proposal for a Basel 3 Capital Accordis needed in strengthening capital requirements in order to reduce their probability of default.

Empirical findings for model 1 also show that cost efficiency increases [at *t-2* and at (*t-1;t-3*)] temporally precede insolvency risk increases supporting a cost-skimping hypothesis (Berger and DeYoung, 1997). This posits a trade-off between short-term cost efficiency and future risk-taking due to moral hazard considerations. Our evidence suggests thatinvestment banks appearto be more cost efficient as they devote fewer resources to screening and monitoring. As a result, the bank insolvency risk remains unaffected in the short run, but it increases in the medium term.

5. Conclusions

We study the inter-temporal relationships between developments in bank efficiency, risk, capital and competition in the worldwide investment banking. We use a large data set of banks from the ten most developed investment banking industries (Australia, Canada, France, Germany, Ireland, Italy, Japan, Switzerland, the U.K. and the U.S) covering the period 2001 to 2008.

[8]Bank managers may also have incentives to exploit flat rate deposit insurance schemes.

We show that competition is very limited in investment banking worldwide and in each of the country analysed: overall, the Lerner index is relatively high, thus suggesting less competitive conditions in the investment banking industry, implying existence of colluding oligopoly.Second, we show that the investment banks' stability, over the period analyzed, was granted by low competitive pressure and, in this environment, banks were prone to take more risks. These findings are important because they provide some support that the 'competition-stability' paradigm holds for the investment banking industry.

Finally, our findings broadly indicate support to the need to impose capital requirements for investment banks in order to reduce their risks.

Table 1:

Sample description

In this table, we report the number of professional service firms (investment banks and securities house) operating in ten developed countries (Australia, Canada, France, Germany, Ireland, Italy, Japan, Switzerland, the U.K. and the U.S.) analyzed in this paper. * Data are in USD million.

Country	**Number of observations by year and total**									**Tot. assets of the average bank***
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**Total**	
Australia	4	3	3	9	9	8	8	5	49	12,217,772.3
Canada	3	3	3	4	4	5	5	3	30	15,967,139.4
France	5	2	4	5	6	6	5	3	36	6,701,853.4
Germany	12	12	13	14	13	15	17	3	99	11,544,862.1
Ireland	6	6	5	7	6	7	4	2	43	38,593,756.8
Italy	3	3	2	4	7	10	10	5	44	2,306,059.9
Japan	22	19	18	24	28	27	25	6	169	27,855,958.7
Switzerland	54	47	48	50	50	48	48	4	349	20,215,079.8
UK	15	15	14	25	34	41	30	13	187	30,686,169.2
USA	24	28	28	27	26	24	21	12	190	86,217,566.5
Total	148	138	138	169	183	191	173	56	1196	

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Table 2:

Summary of Variable Definitions and Sources

In this table, we define the variables used in the empirical analysis and the data sources.

Variable name	Acronym	Description
Dependent Variables[a]		
Lerner Index	LER	It is an indicator of the degree of market power, and a well-established measure of competition in the banking literature. LERNER=0 it indicates perfect competition, while LERNER=1 indicates monopoly.
Insolvency Risk	IR	$IR=(1+ ROE)/ST.DEV_{ROE}$
Level of Capitalization	CAP	CAP is calculated as equity over assets.
Cost Efficiency	CE	CE is a measure of banking cost efficiency obtained using the Stochastic Frontier Approach.
Macroeconomic variables[b]		
ΔGDP	GDP	The growth in Gross Domestic Product.
Inflation rate	INFL	It is the rate of inflation, calculated the by log difference of GDP deflator.
Market capitalization	MCLC	It is the total domestic stock market capitalization divided by GDP.
Bank-Specific Profitability[a]		
Return on Assets	ROA	ROA= Pre-tax profits/total assets.

Sources: [a] Fitch IBCA's Bankscope Database (authors' estimates). [b] World Development Indicators, World Bank.

Figure 1

Estimated Investment Banks' Efficiency Scores by Country (2001-2008)

In this table, we report the mean cost efficiency levels by countries estimated by using a parametric stochastic cost frontier (the methodological details are outlined in the Appendix). Investment banks' inputs are the price of labor calculated as personnel expenses over total assets (P_1); the price of physical capital, measured as other administrative expenses plus other operating expenses over total fixed assets (P_2); and price of funds measured as interest expenses over total funds (P_3). On the other hand, and despite the multi-output nature of the investment banking business, we define total assets (Q_1) as one single output. The methodology used is the Battese and Coelli's (1992) time-varying stochastic frontier approach for panel data with firm effects which are assumed to be distributed as truncated normal random variables, and are also permitted to vary systematically with time.

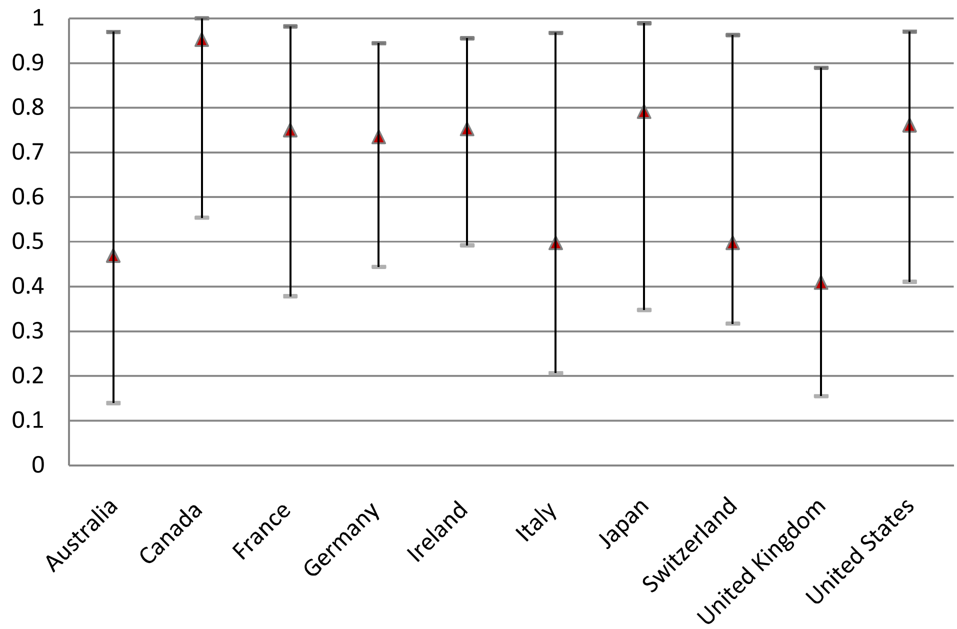

Figure 2

Lerner Index and Marginal Costsin the

Investment Banking Industry by Country (2001 -2008)

In this figure, we report mean estimates by country of the Lerner index ofMonopoly Power (*LER*). The Lerner Index represents the extent to which market power allows firms to fix a price above marginal cost (*MC*). This latter is derived from equation $MC_{it} = \frac{TC_{it}}{Q_{it}}\left(\alpha_1 + \delta \ln Q_{it} + \rho_j \ln Q_{it} + \theta_t T + \varepsilon_{it}\right)$ where the Marginal costs derived from equation (5) are used to calculate the Lerner index as follows: $LERNER = \frac{p_{it} - MC_{it}}{p_{it}}$ where *p* is the price of output *Q* and is calculated as total revenue (interest plus non-interest income) divided by total assets. LERNER=0 it indicates perfect competition, while LERNER=1 indicates monopoly.

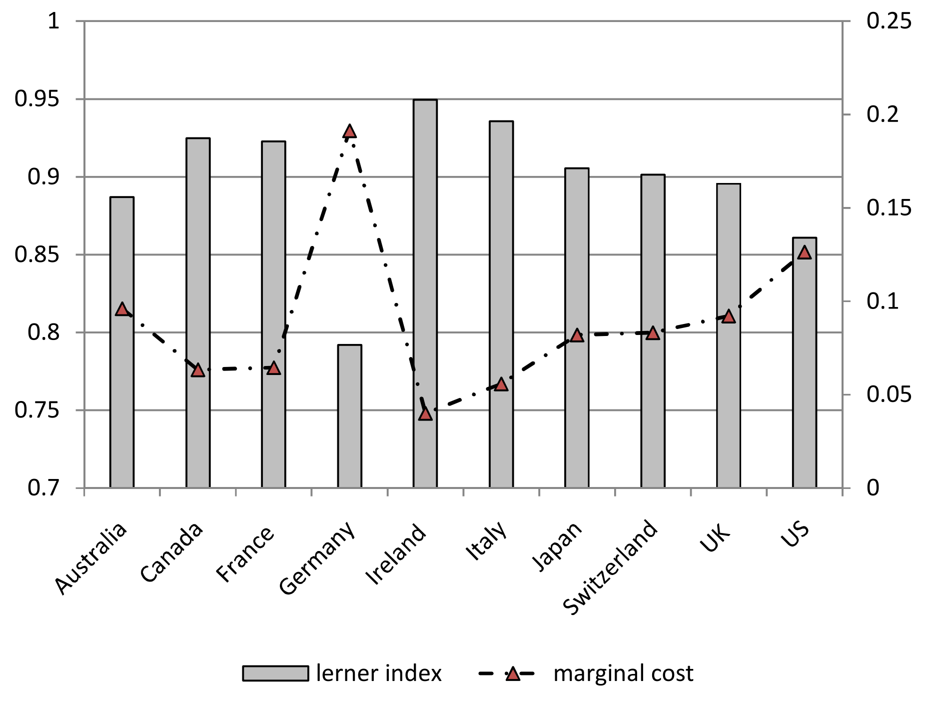

Table 3:

Dynamic Panel Data Estimations: Two-Step GMMmodel

In this table, we reports results for the estimation of models from (1) to (4) to disentangle the inter-temporal relationships between bank capital, efficiency and risk.We estimate autoregressive models with three lags *AR (3)* for the risks, efficiency and competition variables. We use the two-step *GMM* estimators developed by Blundell and Bond (1998) with Windmeijer (2005) corrected standard error (reported in brackets). The variables $IR_{t-1,t-3}$, $CAP_{t-1,t-3}$, $CE_{-1;t-3}$, $LER_{t-1,t-3}$,are the estimated coefficients for the test that the sum of lagged terms (for insolvency risk, bank capital, Lerner index and cost efficiency, respectively) is equal to zero. A significance level lower than 10% enables to reject the null hypothesis of no causality from *x* to *y*. A coefficient > 0 implies a positive causation from *x* to *y*; a coefficient < 0 indicates a negative causation from *x* to *y.* The Sargan/Hansen test of over-identifying restrictions for the GMM estimators: the null hypothesis is that instruments used are not correlated with residuals and so the over-identifying restrictions are valid. Arellano-Bond (AB) test for serial correlation in the first-differenced residuals. The null hypothesis is that errors in the first difference regression do not exhibit second order serial correlation. The symbols *, **, and *** represent significance levels of 10%, 5% and 1% respectively.

		(1)y=IR_t	**(2)y=CAP_t**	**(3)y=CE_t**	**(4)y=LER_t**
	IR_{t-1}	0.5992***	-0.4601	-0.0362	0.5901
Insolvency risk		[0.0774]	[0.6255]	[0.0228]	[0.6935]
	IR_{t-2}	0.4355***	-0.0649	0.0533*	0.2577
		[0.0712]	[0.5440]	[0.0283]	[0.6048]
	IR_{t-3}	-0.0296	0.7680	-0.0284*	-0.0510
		[0.0619]	[0.6595]	[0.0170]	[0.6932]
	$IR_{t-1;\,t-3}$	1.0050***	0.2430*	-0.0114	0.7968***
		[0.0125]	[0.1443]	[0.0091]	[0.2830]
Level of capitalization	CAP_{t-1}	-0.0106*	0.6775***	0.0013	-0.1338
		[0.0063]	[0.1181]	[0.0019]	[0.1006]
	CAP_{t-2}	0.0014	-0.2158**	-0.0006	0.2003**
		[0.0048]	[0.0921]	[0.0034]	[0.0808]
	CAP_{t-3}	-0.0015	0.1919**	0.0011	-0.2960***
		[0.0043]	[0.0901]	[0.0019]	[0.1078]
	$CAP_{t-1;\,t-3}$	-0.1071	0.6537***	0.0018	-0.2295*
		[0.0075]	[0.1186]	[0.0039]	[0.1372]
Cost efficiency	CE_{t-1}	-0.0753	0.0565	5.6603***	-0.9373
		[0.0478]	[0.3881]	[0.1530]	[0.6155]
	CE_{t-2}	0.1731*	-0.5230	-8.3127***	1.8789
		[0.1031]	[0.8028]	[0.3090]	[1.4683]
	CE_{t-3}	-0.0874	0.3209	3.6473***	-0.9094
		[0.0558]	[0.4527]	[0.1564]	[0.8992]
	$CE_{t-1;\,t-3}$	0.0105*	-0.1456*	0.9948***	0.0322
		[0.0057]	[0.0859]	[0.0033]	[0.1200]
Lerner index	LER_{t-1}	0.0053	-0.0509	0.0027	0.7295***
		[0.0079]	[0.1294]	[0.0030]	[0.1526]
	LER_{t-2}	-0.0176**	-0.2741*	0.0000	0.1936
		[0.0079]	[0.1456]	[0.0020]	[0.1638]
	LER_{t-3}	0.0000	0.0328	-0.0002	-0.1609
		[0.0051]	[0.0774]	[0.0020]	[0.1299]
	$LER_{t-1;\,t-3}$	-0.0122*	-0.2923**	0.0025	0.7623***
		[0.0071]	[0.1238]	[0.0042]	[0.1832]
Macro variables	ΔGDP	0.0075**	-0.0729**	0.0017*	0.1069*
		[0.0033]	[0.0306]	[0.0010]	[0.0559]
	INF	-0.0092***	0.0483**	0.0025	-0.0407
		[0.0023]	[0.0216]	[0.0016]	[0.0330]
	MCLC	0.0052***	-0.0003	-0.0028	-0.0764**
		[0.0017]	[0.0260]	[0.0018]	[0.0342]
Profitability	ROA	0.0089**	0.0706	-0.0028*	0.2465*
		[0.0038]	[0.0661]	[0.0016]	[0.1311]
	CONST	-0.0011	0.0366	0.0008	-0.0311
		[0.0032]	[0.0473]	[0.0016]	[0.0668]
	Observations:	452	452	452	452
	Hansen test,2nd step, $\chi^2(128)$	121.69	129.32	97.27	95.99
	AB test AR(1)	-2.98***	-2.62***	-0.67	-1.99***

AB test AR(2)	-0.81	1.23	0.55	-0.34

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