Diversification, diversity and systemic risk in European banking

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Abstract

At present, capital requirements are the cornerstone of bank regulation. Such regulation aims at ensuring the solvency of individual banks. The recent financial crisis has shown up its limitations, namely, the fact that it neglects the new forms of systemic risk, together with their spillover effects, that emerged with the processes of financial globalization and the deregulation of national financial systems. As a result of these processes the interconnections between financial institutions and the homogeneity of their portfolios have significantly increased. This paper provides an empirical analysis to determine the extent to which this process has affected European banks. The analysis suggests two conclusions. On the one hand, it shows that diversity in the portfolio structure of the large European banks has markedly declined since the early 1990s. On the other hand, the analysis shows that bank size is proportional to the homogeneity of the structure of financial portfolios. Thus, in Europe, the systemic risk connected to common shocks has increased significantly, with the result that it has become more necessary to pay more attention to this aspect of bank regulation.

Introduction

The recent financial crisis has revealed the unexpected fragility of financial systems in the industrialized countries. The process of national deregulation started in the 1980s led to an intense process of consolidation of financial institutions. Consequently, both in the United States and in Europe, the degree of concentration in banking systems increased significantly.

Corresponding to the growth in the size of banks was an increased opportunity to diversify the portfolio of activities. At the same time, however, the degree of interconnection between financial institutions markedly increased.

[1] Although the paper is the result of a team effort, section 3 is by Pierluigo Morelli, section 1 by Giovanni.B. Pittaluga and section 2 by Elena Seghezza.

The greater degree of interconnection between banks on their liability side inevitably increased their exposure to forms of liquidity hoarding and to the attendant risk of contagion.

The consolidation process of banking systems favored the emergence of another form of interconnection. Deregulation, the removal of the division between the various activities of financial institutions, and increased competition contributed to the increasing homogenization of their asset portfolios. For this reason, the largest banks became progressively more exposed to the risk of common shocks.

The aim of this paper is to clarify why this risk has become ever more important and to what extent this process has affected the big European banks.

The first section shows the limits of the current system of banking regulation, which are mainly based on the Basel Accords of 1988. This system has two drawbacks. First, it pursues the stability of the individual institutions while overlooking the fact that spillover effects due to interdependence between financial institutions or between institutions and markets can invalidate the stability of the financial system as a whole. Secondly, the current system of regulation starts from the premise that there is no trade-off between the deregulation of the banking system and its stability, but rather that the two are closely complementary. In fact, deregulation has encouraged banking consolidation and the creation of big financial groups. The section shows that this has also been an intense process in Europe. On the other hand, large institutions, by being able to exploit economies of scale and scope, are seen as more stable than smaller ones, and, consequently, a highly concentrated banking system is considered more stable than a more dispersed system.

The second section shows that recently systemic risk, as traditionally understood (i.e. as a consequence of bank panics) has become less important thanks to the widespread use of deposit insurance. However, other sources of systemic risk have emerged. Crucial among these are forms of contagion caused by a lack of confidence in wholesale markets, in particular the interbank market, and common shocks (i.e. shocks that hit many institutions with a similar portfolio structure simultaneously). The possibility that common shocks cause a systemic risk is inversely proportional to the asset diversity of banks' portfolios. We demonstrate this by using a Monte Carlo simulation.

The third section provides an empirical analysis of the evolution and current importance for the European banking system of systemic risk resulting from common shocks. The correlation between the percentage changes of stock prices of big European banks and the dispersion of their ROE are deployed as measures of this risk. The section also offers an analysis of the level and trend of

systemic risk due to common shocks in relation to different dimensional categories of European banks.

The empirical analysis shows the inefficient aspects of current bank regulation, in particular with regard to capital requirements. The conclusions suggest some guidelines as to how to amend the current regulatory system in order to prevent explosive financial crises.

1. Limits of bank regulation based on taxation

The history of bank regulation shows how it has in some periods revolved around the principle of "prohibition" and at others around the principle of "taxation".

Economic theory shows that, if private costs of mistaken regulation choices are high relative to the loss of social benefits, it is better, in terms of social welfare, to resort to taxation. In the opposite case, it is better to regulate the banking industry by resorting to prohibition[2]. The choice between these two kind of regulation is, therefore, an empirical question.

An alternative explanation for the prevalence of one form of regulation over another is offered by the political economy approach. This places particular emphasis on the role of pressure coming from interest groups.[3]

Beyond the explanations for the origins of different forms of regulation, in this paper we simply acknowledge that since 1980s the process of deregulation has meant that the stability of the banking system has been pursued mainly by resorting to constraints on banks' accounts, in particular capital and liquidity requirements.

This kind of regulation meant moving beyond the principle of structural regulation that prevailed in all industrialized countries after the crisis of the 1930s. It meant overcoming the operational segmentation of financial institutions and financial markets and the recognition of the crucial importance of competition for an efficient allocation of resources.

The system of bank regulation adopted almost everywhere in the last few decades is based primarily on the assumption that systemic risk is almost exclusively the result of bank runs and bank panics, i.e. a fall in saver confidence in banks' solvency caused by the bankruptcy of one or more big

[2] See Weitzman (1974).
[3] See, among others, Kroszner and Strahan (1999).

financial institutions. Forms of deposit insurance were adopted and minimum capital requirements imposed in order to avoid the insolvency of banks, bank runs and bank panics.

In particular, deposit insurance was designed to avoid depositors' lack of confidence in the solvency of the banking system leading to self-fulfilling expectations of bank insolvency, as happens in the Diamond and Dybvig (1983) model.

The widespread resort to deposit insurance undoubtedly contributed to the fact that there had been no bank panics in industrialized countries in the period since WWII.[4]

As a result of the Basel Accords of 1988, capital requirements became the cornerstone of bank regulation. There were two main reasons for resorting to this kind of budget constraint. First, capital requirements aim at safeguarding the solvency of banks. In the case of banks, given the existence of information asymmetries and the small amounts involved in each individual deposit, creditors, i.e. depositors, face difficulties and excessive costs if they want to monitor a bank's management properly. Capital requirements safeguard the interests of retail depositors by imposing restrictions on managers' options, i.e. by limiting the assumption of risks that could compromise the bank's solvability. Secondly, capital requirements are needed to offset moral hazard from deposit insurance. As has been pointed out, "…Because banks have access to low cost funds guaranteed by the government, they have an incentive to take significant risks. If the risks pay off they receive the upside, while if they do not the losses are borne by the government."[5]

The imposition on banks of capital requirements and liquid reserves higher than the optimal ones for profit maximization implies for these institutions implicit costs higher than those that they would otherwise bear. However, it preserves their solvability.

We can, therefore, say that the system of bank regulation currently in effect is designed mainly to safeguard the stability of individual institutions through forms of implicit taxation,[6].

Moving on from the prohibition criteria upon which previous system of bank regulation was based, on the one hand, has contributed to the increasing integration of markets, and, on the other hand, has allowed financial institutions to widen their range of activities. This has favored an intense process of consolidation of banking systems in industrialized countries.

[4] The situation with Northern Rock proves beyond any doubt that inadequate coverage for deposits makes banks susceptible to a depositors' run. On this aspect, see Kay (2010).
[5] See Allen and Carletti (2010; p. 144).
[6] See Brunnermeier *et al.* (2009).

Between 2002 and 2009, the number of banks in Europe fell from 9394 to 8358. This process occurred throughout all advanced European countries (Table 1).

Tab. 1 Number of credit institutions

	2002	2009	Var
Eu27	9394	8358	-11.0%
- Germany	2363	1948	-17.6%
- France	989	712	-28.0%
- Uk	451	389	-13.7%
- Italy	821	801	-2.4%
- Spain	359	352	-1.9%
Usa	19245	15801	-17.9%
Japan	134	123	-8.2%

Source: Ecb, Oecd

The fall in the number of banks was accompanied by a significant growth in the degree of concentration of banking systems (Table 2).

Tab. 2 Concentration measures of European banking

	Herfindahl Index		Largest 5's market share	
	2002	2009	2002	2009
Eu27	520	663	38.3	44.3
- Germany	163	206	20.5	25.0
- France	551	605	44.6	47.2
- Uk	307	467	29.6	40.8
- Italy	270	353	30.5	34.0
- Spain	513	507	43.5	43.3

Source: Ecb

We can identify two separate phases in the consolidation process of European banks.[7] The period immediately after the introduction of the Euro saw a process of consolidation in the countries belonging to the single currency. This process was initially promoted by the national authorities of the countries joining the EMU with the aim of creating *national banking champions* able to face the growing cross-border competition resulting from the creation of the Euro area.

Later, the European Commission adopted initiatives directed at promoting a process of consolidating the banking system at the intra-European level. The creation of pan-European financial groups was seen as a way of achieving a greater degree of integration in the European banking system. During the 2000s, the stance of the European Commission, and in particular of the

[7] See Goldstein and Véron (2011).

Directorate General for Competition, favored a wave of mergers and acquisitions, giving rise to pan-European bank groups such as BNP Paribas, Santander and Unicredit. In 2009, there were as many as 7 Eurozone banks in the group of the 15 biggest banks in the world (Table 3).

Tab. 3 The biggest 15 banks in the world[1]

Country	Bank	Asset
FR	BNP PARIBAS	2.237.034.000
DE	DEUTSCHE BANK	1.925.655.000
UK	HSBC HDG.	1.840.309.324
UK	BARCLAYS	1.807.457.011
UK	ROYAL BANK OF SCTL.GP.	1.797.484.425
FR	CREDIT AGRICOLE	1.758.771.000
USA	BANK OF AMERICA	1.629.098.384
USA	JP MORGAN CHASE & CO.	1.387.988.454
USA	CITIGROUP	1.335.361.856
ES	BANCO SANTANDER	1.202.142.000
UK	LLOYDS BANKING GROUP	1.167.021.409
FR	SOCIETE GENERALE	1.133.684.000
SWI	UBS 'R'	1.125.470.149
ITA	UNICREDIT	944.116.000
DE	COMMERZBANK	897.750.000

[1] in terms of assets, values in billions of euros. Source: Bankscope.

The consolidation process was accompanied by a process of despecialization. Albeit with differences at the national level, a model of a universal bank thus became established – a bank that engaged in a wide range of financial activities, from commercial banking to insurance. This process is evident from the changes in the structure of the income statements and balance sheets of European banks.

As Table 4 shows, between 2000 and 2009, the share of non-interest income out of total revenues increased from 37 to 47 per cent. This demonstrates that non-traditional activities, in particular financial portfolio management and trading activities, took became particularly important in the activities of European banks, especially the largest ones.

Table 4 Non-interest income share

	1999	2006
Eu27	37.2%	46.6%
- Germany	24.2%	28.5%
- France	55.8%	74.6%
- Italy	36.8%	40.2%
- Spain	31.7%	38.1%

Source: ECB.

According to many scholars[8], the increased size and activity diversification of the leading banks would make the banking system more stable[9]. These factors, they argued, would allow:

a. better risk diversification;
b. the exploitation of scale economies;[10]
c. the diversification of activities that would lead to a more stable source of income;
d. an increase in the franchise value of the bank and, consequently, greater incentives for managers to behave prudently[11].

Therefore, the conviction had gained ground among scholars and policymakers that there is no trade-off between a high competition in banking markets, due to removal of restrictions on bank activities, and the stability of the banking system, but rather that the two are closely complementary.

In reality, the recent financial crisis has shown that the formation of mega-banks has been accompanied by new factors of instability and by the emergence of new forms of systemic risk.

On the one hand, the process of bank consolidation and growth in size have raised the problem of banks being *too big to fail*[12]; on the other hand, corresponding to a better diversification of risk by individual institutions there has been an increasing interconnection with other financial institutions and markets.[13]

Different factors have contributed to this increasing interconnection. Important among these factors were the financial innovations of the 1990s, in particular derivatives. Such innovations led banks to initiate processes of "financial engineering". Liability securitization and the placing of liabilities as derivatives in so-called shadow-banks enabled commercial banks to increase their assets excessively and to increase leverage on an anomalous scale. "*Simple leverage ratios of close to 50*

[8] See, among others, Barth *et al.* (2002).
[9] At the same time, in several papers it was argued that prohibitions and restrictions of banking activity had had negative effects on the stability of banking systems. See, among others, Barth *et al.* (2000) and Claessens *et al.* (2000).
[10] However, while some of the literature emphasizes the presence of economies of scale in the banking industry (see, for example, Diamond, 1984; Allen, 1990; Wheelock and Wilson, 2009), other authors (see, for example, Haldane, 2009, and Johnson and Kwak, 2010) stress the fact that several empirical studies (in particular, Berger and Mester, 1997, and more recently, Herring, 2010) find such economies only for banks below $100 billion in asset size.
[11] On this point, see Keeley (1990), Demsetz *et al.* (1996) and Ancharya (1996).
[12] See among others Allen and Babus (2009). For more discussion on the moral hazard problem inherent in "too big to fail", see Sterner and Feldman (2004).
[13] As Hellwig observes: "*Because of systemic interdependence, the individual bank's risk exposure cannot be ascertained by looking at the bank's assets and liabilities, on balance sheet and off balance sheet. If the bank's asset position involves a certain risk and the bank has hedged this risk by contracting with a third party, the effectiveness of the hedge depends on the third party's ability to fulfill its obligation when needed. If the risk in question is of macroeconomic dimension…the counterparty's ability to fulfill its obligation depends on how many similar contracts it has concluded with other market participants…*" Hellwig (2008; pp.59-60).

or more could be found in the US, UK, and the continent Europe, driven in part by the expansion of trading books."[14].

During the financial crisis of 2007-2008, the interconnection between financial institutions on the asset side had two perverse effects. On the one hand, by creating a climate of uncertainty about which institutions would bear the losses caused by the bursting of the real-estate bubble, it led to a fall in confidence in the banking system as a whole. On the other hand, the growing interconnection between financial institutions contributed to the increasing probability of contagion due to the insolvency of one or more institutions.

During the 2000s, the inter-connectedness between financial institutions increased, both on the asset and the liability side. First, the shadow banks, in particular money market funds, became an important source of funding for traditional banks. Second, the removal of time constraints on banking activity and the creation of universal banks promoted a significant increase in the maturity mismatching of assets and liabilities.[15] At the same time, big banks resorted increasingly to the interbanking market. In this way they improved the efficiency of their liquid reserves management and reduced their opportunity cost.[16]

Over the last 10-15 years, there has been an increase not only in inter-connectedness between financial institutions but also between these and financial markets. This has been due to the removal of constraints on banks activities and the creation of mega-banks. These mega-banks, pressed by competition and facilitated by deregulation and by financial innovations, have exploited market opportunities. Two effects have resulted from this. On the one hand, the links between financial institutions have become more numerous and frequent. The distribution of these links is highly asymmetric: it has a long tail with a small number of banks with very strong ties. On the other hand, there has been a strong tendency toward the homogenization of bank portfolios.

The overall effect of all these factors has brought about a profound change in the ways a systemic risk emerges. In the past, when bank activity was still mainly traditional in nature, systemic risk was connected to the behavior of depositors, and, as already pointed out, reflected their lack of confidence in banks' solvency. It was therefore exclusively related to the retail market and belonged exclusively to the liability side of financial institutions. With the formation of mega-banks, characterized by high levels of homogeneity in their financial portfolios, and, at least in some of them, by a strong dependence on interbank market funding, systemic risk became increasingly

[14] See King (2010).
[15] On the risks arising out of high mismatching, see Hellwig (1995).
[16] See Kay (2008).

linked to wholesale markets rather than to retail markets.[17] New forms of contagion emerged because of new forms of inter-connectedness between banks and financial markets.

This situation calls, on the one hand, for a re-examination of the causes of the instability of banking systems and, on the other hand, for an assessment of the adequacy of the current regulation system with respect to the aim of stabilizing the banking systems of the industrialized countries.

2. Systemic risk, contagion shock and common shock

Taking into account the changes in the financial system described above, de Bandt *et al.* (2009) quite rightly distinguish between a broad and a narrow definition of systemic risk.[18]

Contagion effects on financial institutions as a result of a shock on an individual bank represent a systemic risk in the narrow sense, "An example [of this risk] is one bank failure causing a failure of another bank, even though the second bank initially seemed solvent."[19] By contrast, a systemic risk in the broadest sense is a shock that affects simultaneously many financial institutions and financial markets. This kind of systemic risk is not subject to forms of contagion[20], but does threaten systemic stability.

The main international monetary institutions – such as the Financial Stability Board (FSB), the International Monetary Fund (IMF) and the Bank for International Settlements (BIS) – seem to espouse the broad concept of systemic risk. This view is shared by the ECB, which sees systemic risk as an event that "… *adversely affects a member of systematically important intermediaries or markets.*"[21] .

There are three main causes of the two forms of systemic risk:

i. The intertemporal nature and the information intensity of financial contracts. As forward contracts, financial contracts inevitably suffer from the incompleteness of markets and the existence of asymmetric information. There is, therefore, an important financial component underlying financial contracts;
ii. The structure of the balance sheets of financial institutions, particularly banks. These are characterized by maturity mismatching between assets and liabilities and by the fact that

[17] On this point, see Allen and Babus (2008) and Kay (2010).
[18] See also Bandt and Hartman (2000).
[19] See European Central Bank (2009; p. 2).
[20] For a survey, see Georg and Poschman (2010).
[21] See European Central Bank (2009).

some assets – loans – depend on private information and are subject to problems of asymmetric information;

iii. A high level of wholesale financial activity inter-connectedness.

As a result of deregulation and globalization the systemic risk factors referred to under point *iii* above are now much more important than they use to be.

The current financial systems are marked by a high degree of interdependence. On the one hand, there is now a high level of interdependence between financial markets and institutions. In particular, as seen in the previous section, banks have considerably increased their trading activity and their involvement in market trends. On the other hand, there has been an increase in the interdependence between financial institutions, both in terms of their assets and their liabilities.

The links between the institutions may be either direct or indirect. Direct links include banks' exposure to the interbank market. Institutions are interconnected in an indirect way in relation to the homogeneity of the structure of their financial portfolios and the mass of depositors.

There is now a vast literature on the implications of the interdependence between financial institutions. Large part of this literature uses *network analysis*,[22] focusing above all on the forms of contagion, and on how these can lead to the development of a systemic risk.

Two separate approaches can be found in the literature on contagion: the first looks at direct links,[23] while the second considers indirect links between banks.[24] These different approaches can be illustrated in a simplified version of Nier *et al.* (2007) and Gai and Kapadia (2010). Consider a system with N banks of the same dimension (equal to 1), labeled as $i = 1, 2, \ldots N$. Each of these banks has three kind of assets and two kinds of liabilities. Assets are interbanking loans, l_i, loans to private agents, c_i, and market bonds, b_i. Deposits, d_i, and interbanking debits, e_i, are the liabilities.

A bank is solvent if its capital, γ_i, is positive or equal to zero, i.e. if:

[1] $$\gamma_i = (l_i + c_i + b_i) - (d_i + e_i) \geq 0$$

Banks are interconnected, as in a casual network *à la* Erdòs-Rényi, on the basis of the relationships they have in the interbank market. The probability of this interconnection is p. The average number of a bank's interconnections is $z = p\ (N - 1)$: each bank is linked to z other banks. Lastly, it is

[22] For a survey of this literature see Allen and Babus (2009).
[23] This kind of approach can be found in, among others, the papers of Allen and Gale (2000), Freixas *et al*. (2000), Dasgupta (2004) and Leitner (2005).
[24] See among others Lagunoff and Schreff (2001) and Cifuentes *et al.* (2005).

assumed that l_i, γ_i, and the share of l_i out of total assets is the same for each bank. Let us now assume that a shock hits a bank and destroys a fraction f of its private loans c_i. If $f c_i = \gamma_i$, the bank fails.

The failure of this bank can affect the rest of the banking system both directly and indirectly. The failure of the bank directly affects the z creditor banks. According to Allen and Gale (2000), this type of contagion has more intense effects when networks are incomplete. A broader interconnection between banks would imply a more stable system: losses due to the insolvency of the failed bank would be spread over a wider range of institutions.

However, recent studies have shown that a higher inter-connectedness, while reducing the default risk of individual institutions, may also increase the systemic risk.[25] The direct contagion may be exacerbated by forms of indirect contagion.[26]

The first form of indirect contagion is when the failure of one bank leads other banks to forms of *liquidity hoarding*. Banks may be induced to behave this way mainly by a fall in confidence in the creditworthiness of potential partners. This can cause cascades through interconnections between banks.[27] Banks that make massive use of the interbank market for fund-raising rather than retail markets are particularly exposed to these processes.

Analyzing the origin of the recent financial crisis, Brunnermeier (2009) argues that one of its main causes can be traced back to banks' increasing use of short-term funding. Because of this, the "liquidity crunch" that occurred after the real-estate bubble burst and which became particularly intense after the failure of Lehman Brothers, had devastating effects on the stability of banks. Among those most vulnerable to the sudden drying up of liquid resources were U.S. investment banks, in other words, financial institutions that mostly raised funds on the interbank market. It is no coincidence that the recent financial crisis swept away all U.S. investment banks and that the banks which relied primarily on retail funding survived.

Liquidity problems may force some banks to sell certain assets in order to procure resources. This behavior, if the banks involved are large, may lead to a fall in the market prices of the assets sold. In this context, there may be a second form of indirect contagion. The price fall of the assets sold by the illiquid bank determines capital account losses for banks holding assets of that type. If these losses are substantial, there will be further bank failures. It is clear that the forms of indirect

[25] See among others Watts, 2002; Gai *et al*. 2007; Battiston *et al.*, 2009.
[26] See among others Haldane and May (2011).
[27] See Gai and Kapadia (2010).

contagion just described tend to affect large banks in particular, specifically banks that primarily raise funds on the interbank market, which have a broad portfolio of financial assets and which hold homogeneous assets[28].

It is true that forms of liquidity hoarding have played a crucial role in making the recent financial crisis so severe.[29] However, the ultimate origin of the crisis can be traced back to a common shock rather than to forms of contagion: indeed, following the bursting of the real-estate bubble, the non-regulated sub-prime loan market ultimately destabilized the CDS market, collapsed the securitized instrument markets and eventually induced financial institutions to engage in forms of liquidity hoarding.

The devastating effects of this common shock can be attributed to the high fragility of a complex and highly interconnected financial system.

Since the 1980s, financial globalization has led national governments to set in motion processes of deregulation. As markets became global, their degree of competition increased. This led not only to financial institutions expanding the size and range of activities, but also to the introduction of innovative instruments and strategies to offset risks, in order to meet the Basel constraints[30]. This combination of factors led to a convergence of management strategies and of the structure of financial portfolios of large banks[31]. It formed a global financial network that Haldane (2009) has appropriately described as a "monoculture".

The increasing homogeneity of large banks' financial portfolios inevitably increased their exposure to common shocks: a possible reduction in the price of certain assets (such as credit swap derivatives) would be reflected simultaneously in much of the banking system, thus threatening stability.

A Monte Carlo simulation enables us to show that a banking system whose banks have diversified portfolios but a homogeneous structure is exposed to a higher systemic risk than a system in which banks do not diversify their activities but do have different portfolio structures (Table 5).

In the simulation we assume that the first banking system is made up of nine banks perfectly specialized into nine businesses diversified according to risk-return profile. To define these different profiles we assume that the risk, expressed as standard deviation of the average return, in

[28] See Cifuentes *et al.* (2005).
[29] See Brunnermeier and Pedersen (2008) and Morris and Shin (2008).
[30] See Haldane (2009).
[31] See Acharya (2009) and Haldane (2009).

the various businesses increases linearly by 25 basis points: a minimum of one point to a maximum of three. At this point we assume that the price for risk is equal to two points (for any extra point of risk, the return requested increases by two points): considering a risk-free asset return of one point, the range of variation of returns will range from a minimum of three points (as the sum of two points to a price for risk and one point for the risk-free return) to a maximum of seven points: to summarize the risk-return profile of the various banks, we can say that the coefficient of variation of the return will range from a minimum of 33 per cent for the least risky bank to a maximum of 43 per cent for the most risky bank.

Now assume that in the alternative banking system all nine banks diversify their portfolio in the same way to obtain a return of five per cent, the average of the previous system, but with a riskiness in absolute terms equal to the lowest value found in the non-diversified system (1 per cent): hence a risk reduction of 50 per cent compared to the bank in the previous system with the same return and coefficient of variation of 20 per cent. Obviously, in this banking system the risk-return combination for each individual bank is better than that of the preceding system.

Table 5: Two banking systems

	Bank 1	Bank 2	Bank 3	Bank 4	Bank 5	Bank 6	Bank 7	Bank 8	Bank 9
				System with non-diversified banks					
Risk	1,00	1,25	1,50	1,75	2,00	2,25	2,50	2,75	3,00
Return	3,0	3,5	4,0	4,5	5,0	5,5	6,0	6,5	7,0
coeff. variation	33,3%	35,7%	37,5%	38,9%	40,0%	40,9%	41,7%	42,3%	42,9%
				System with diversified banks					
Risk	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Return	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0
coeff. variation	20,0%	20,0%	20,0%	20,0%	20,0%	20,0%	20,0%	20,0%	20,0%

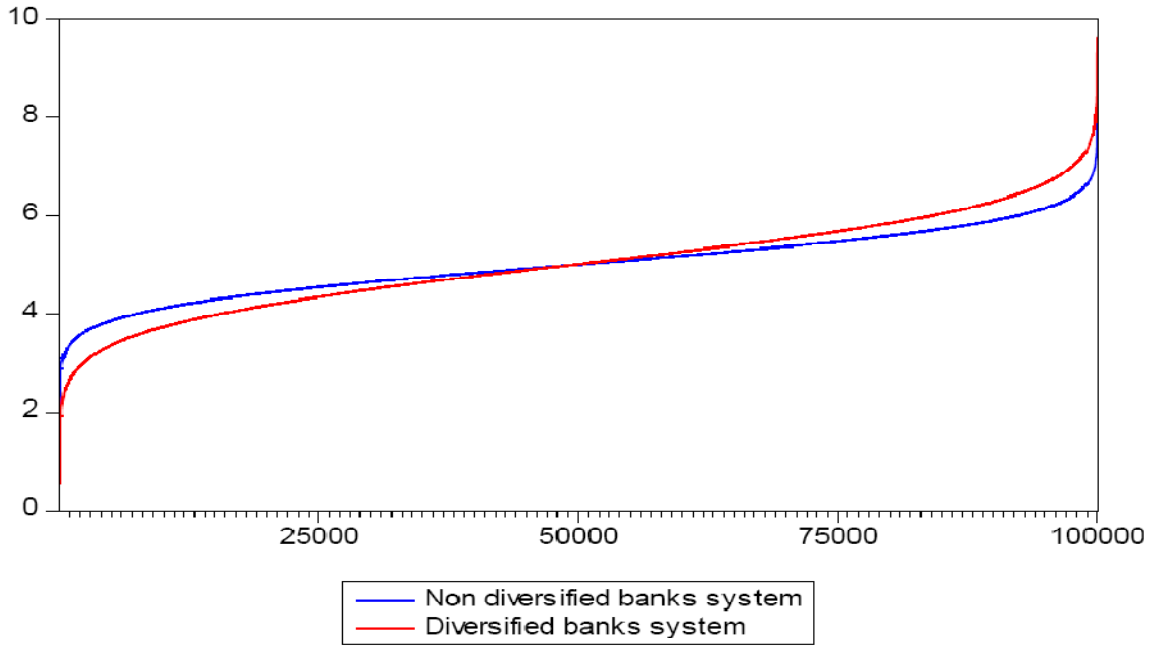
But what is the outcome at the system level? A Monte Carlo simulation based on hundreds of thousands of possible outcomes gives us the distribution of returns of the two systems shown in Figure 1 and Table 6.

Table 6. Risk -Return at the system level

	System with Non-diversified banks	System with diversified banks
Return	5.00	5.00
Maximum	7.96	9.61
Minimum	1.90	0.55
Std. Dev.	0.70	1.00
coeff. Variation	14.0%	20.0%

As Table 6 shows, the system with banks that all diversify in the same manner presents a risk-return combination worse than that where banks are completely specialized in one activity: with the same return (5 per cent), the system with specialized intermediaries has a risk of 0.7 percentage points, the one with diversified intermediaries presents a risk of 1 percentage point. In short, the latter system has fatter tails because it can earn significantly more than the previous one (9.6% vs. 8%) but also significantly less (0.6% vs. 1.9%).

Figure 1. Return distribution at the system level



3. Diversification and diversity in the European banking system

In previous sections we have seen that systemic risk tends to take different forms and emphases in relation to the characteristics of the financial systems.

In the past, when financial markets were less developed, and banks exclusively committed to traditional activities, systemic risk was concentrated in the banking system. The major financial crises of the past mainly took the form of bank panics. The failure of one or more major banks affected the confidence of depositors in the banking system as a whole thus leading to a chain reaction of bank panics and bankruptcies.

After WWII, with the introduction of deposit insurance, this source of systemic risk has been neutralized. However, in recent decades, the increased importance of markets in the intermediation of savings, their high interdependence and the introduction of poorly regulated financial innovations have led to systemic risk taking on new forms. Rather than originating in the behavior of depositors, systemic risk now results from the behavior of banks, their policy choices and the structure of their financial portfolios. Two types of interdependence become significant in this context: between the banks themselves and between financial markets and banks. Loss of confidence in some banks may lead other banks to resort to liquidity hoarding: this behaviour in turn jeopardizes the functioning of the interbank market. Liquidity hoardings can also be induced by a common shock, in other words a shock that hits all banks simultaneously, for example, when banks have homogeneous portfolios, the fall in the price of certain assets. This last example shows how the previously mentioned types of interdependence can interact, resulting in a cumulative process.

It follows that systemic risk today presents itself as the result of a mix of types of interdependence which may emerge sequentially. It cannot therefore be considered in a static way as a punctual event, which is what a banking panic ultimately is, but tends to be seen as a complex process, which can develop in different interconnected and sequential phases. Of this process, in this paper we focus exclusively on the risk attached to a common shock, i.e. to the "…*joint failure risk arising from the correlation of returns on asset side of bank balance sheets*."[32].

To what extent is the European banking system exposed to forms of systemic risk arising from common shocks? In order to answer this question we carried out an empirical analysis aimed at ascertaining how financial portfolios of large European banks are interdependent. To achieve this goal we have followed two paths. On the one hand, we refer to correlations between stock returns

[32] Acharya (2010; p. 225).

(expressed as percentage changes in stock prices per week), assuming that stock prices provide accurate information on the future prospects of companies and their risk profile; on the other, we look at the interdependence of banks financial portfolios as provided by balance sheets.

The first type of analysis is indirect because it is based on stock prices,[33] the second is more direct because it is based on profit and loss accounts of the banks. However, this does not mean that the second path is absolutely better than the first one. In fact, on the one hand, the use of a single index of profitability suffers from the usual problem of simplification and ultimately the loss of relevant information, which is not the case in evaluation by the market, which is by definition more global. On the other hand, stock price data are more easily processed in time series than is possible with bank balance sheet data. The analysis based on the two criteria set out above was related to a sample of European banks for which data are reported in Bankscope. It is important to consider the behavior of banks whose instability can have systemic implications. We have selected banks based on total assets: in particular, we have included in the sample all European (excluding Swiss) banks which had an amount of total assets greater than 100 billion euros in 2009.

Table 7. The bank sample

Country	Bank	Assets	Country	Bank	Assets
DE	LANDESBANK BL.HLDG.	143.953.000	UK	STANDARD CHARTERED	366.064.837
DE	COMMERZBANK	897.750.000	AT	ERSTE GROUP BANK	208.622.000
DE	DEUTSCHE BANK	1.925.655.000	BG	BANQUE NALE.DE BELGIQUE	101.460.500
DE	LB.HESSEN-THURINGEN GIRO	180.683.000	BG	DEXIA	608.510.000
FR	BNP PARIBAS	2.237.034.000	DK	KBC GROUP	348.047.100
FR	CIC 'A'	245.246.000	DK	DANSKE BANK	450.707.061
FR	CREDIT AGRICOLE	1.758.771.000	EL	BANK OF GREECE	138.640.300
FR	NATIXIS	538.250.000	EL	NATIONAL BK.OF GREECE	121.564.800
FR	SOCIETE GENERALE	1.133.684.000	IE	ALLIED IRISH BANKS	168.270.000
IT	INTESA SANPAOLO	649.226.000	IE	BANK OF IRELAND	179.419.000
IT	BANCA MONTE DEI PASCHI	243.354.500	PT	BANCO COMR.PORTUGUES'R'	98.387.410
IT	UBI BANCA	131.118.200		**U.S. and Swiss Banks**	
IT	BANCO POPOLARE	135.361.600	USA	BANK OF AMERICA	1.629.098.384
IT	UNICREDIT	944.116.000	USA	BB&T	106.877.550
ES	BANCO ESPANOL DE CREDITO	126.163.900	USA	CITIGROUP	1.335.361.856
ES	BANCO POPULAR ESPANOL	128.281.600	USA	JP MORGAN CHASE & CO.	1.387.988.454
ES	BANCO SANTANDER	1.202.142.000	USA	PNC FINL.SVS.GP.	180.350.650
ES	BBV.ARGENTARIA	563.072.000	USA	US BANCORP	195.200.746
UK	BARCLAYS	1.807.457.011	USA	SUNTRUST BANKS	117.618.478
UK	HSBC HDG. (ORD $0.50)	1.840.309.324	USA	WELLS FARGO & CO	844.608.453
UK	LLOYDS BANKING GROUP	1.167.021.409	SWI	CREDIT SUISSE GROUP N	874.850.211
UK	ROYAL BANK OF SCTL.GP.	1.797.484.425	SWI	UBS 'R'	1.125.470.149

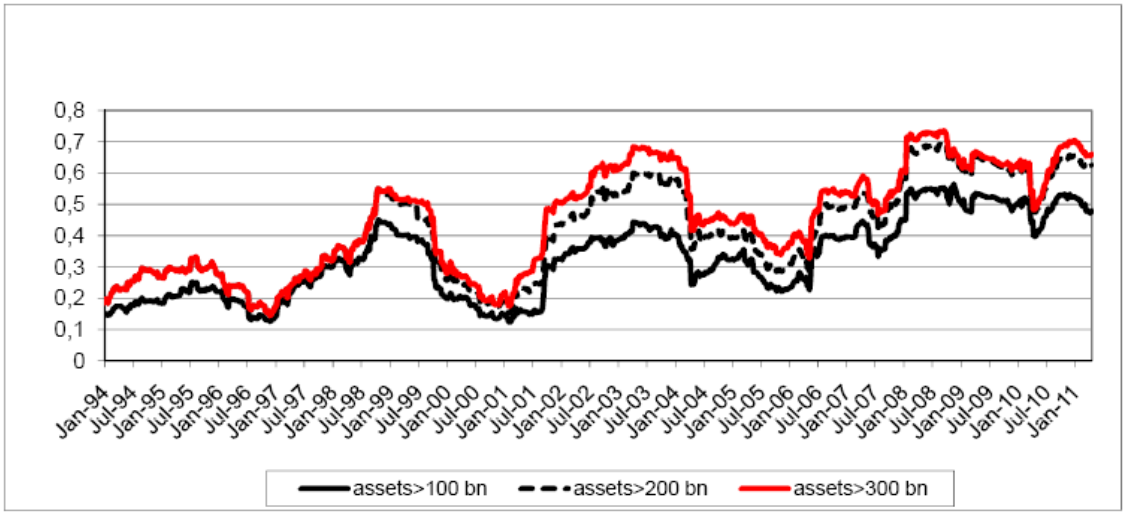
[33] We have taken as a point of reference the criterion used by De Nicolo' and Kwast (2001) to evaluate the relationship between consolidation and evolution in the degree of homogeneity of portfolio structure in the U.S. banking system.

On this basis we selected the 33 European banks listed in Table 7. In order to make comparisons between the European banking system and the rest of the world we also constructed a larger sample, including ten other banks: eight American and two Swiss.

In addition, as shown in Table 7, the banks in the sample were classified into two categories: those with assets between 100 and 200 billion euros (highlighted in red in Table 7) and those with assets between 200 and 300 billions euros (highlighted in blue in Table 7). This distinction is useful in order to determine whether there are differences in exposure to common shocks in systemic banks.

Based on the sample described above, we calculated, from 1993 until the end of 2010, the weekly return of equity prices, and then their correlations for all possible pair of banks (528 pairs in the case of the 33 European banks). The correlations were calculated on an annual moving interval (52 weeks) and the overall correlation between all the banks considered is the average of all possible combinations between banks. Based on this methodology, Figure 1 shows the weekly dynamics of the overall correlation between stock prices from January 1994 to December 2010.

Figure 1 – Correlations between banks' stock prices



Limiting our analysis to the large sample of 33 banks with assets of at least 100 billion, we can see how the correlation between stock returns starts from fairly low values (around 20 per cent) increasing gradually over time to levels higher than 50 per cent by the end of observation period.

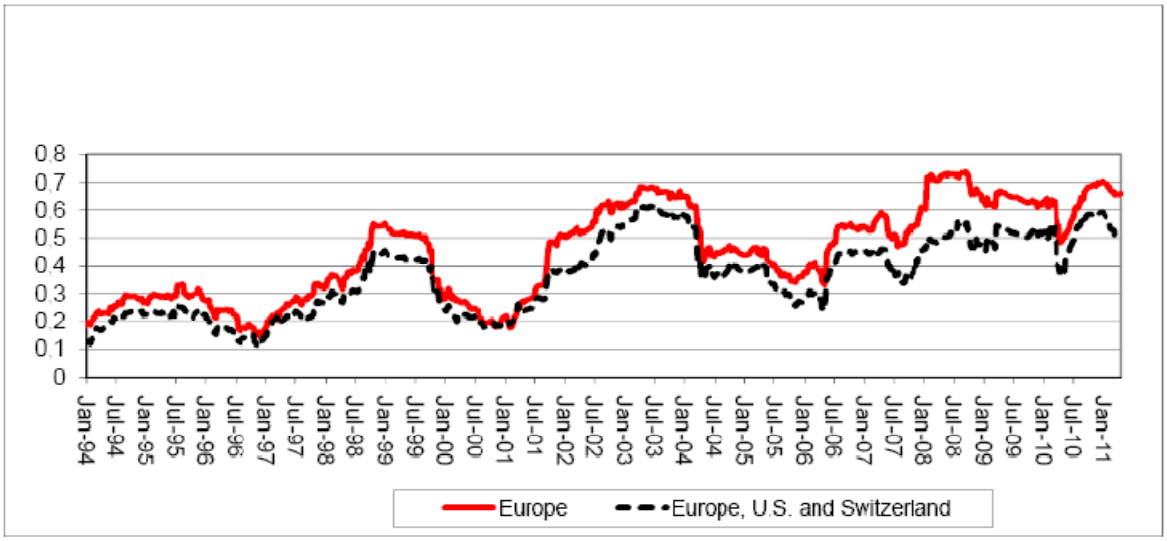
The growth trend is quite evident. In more detail we can observe a first drift in 1997 and a second one in early 2008.

Of particular importance is the fact that, if we limit the analysis to the 21 banks with more than 200 billion euros of total assets and to the 18 banks with more than 300 billion euros of total assets, the increase in correlation is more marked: the values of this correlation, which is below 30 per cent at the beginning of the period, rises to 50 per cent in late 1998, comes close to 70 per cent in mid-2003 and goes over 70 per cent in the late 2008.

From this we can draw two conclusions. First, over the past 15 years the large European banks have become increasingly exposed to common shocks: their fragility in this respect has increased significantly. Second, we can conclude that the greater the size of the banks, the higher the homogeneity of their portfolio structure. Exposure to common shocks is particularly high for banks with total assets exceeding 200 billion euros.

To verify how much the above results are valid across the world, we also considered the wide sample of banks, more precisely that which includes, besides the largest European banks, the largest U.S. and Swiss banks. Figure 2 shows the same evolution of correlation values as in Figure 1 for this larger sample of banks.

Figure 2 – Correlations between stock prices of banks with assets exceeding 300 billions



Even limiting the analysis to banks with total assets of more than 300 billion (including 18 of the original sample of European banks, seven U.S. banks and two Swiss banks), we can see that the correlation between stock returns increases over time, from the mid-1990s. However, after the financial crisis, particularly after 2007, the correlations relative to this sample present values and dynamics less buoyant than those relating solely to European banks.

This difference in behavior can be explained by the different intensity with which the crisis occurred in the United States and in Europe and, therefore, its different consequences on the structure of the financial and banking system.

In order to test the robustness of the results obtained using the first method (the one based on the correlation of stock returns), we now turn to the comparison of the dynamics of profitability indices. This second method inevitably suffers from the limitation that the indices used have a low frequency (at most quarterly). Further problems relate to the need to calculate on a consistent basis given the changes in the structure of the institutions considered (for example, the computational problems related to mergers and acquisitions).

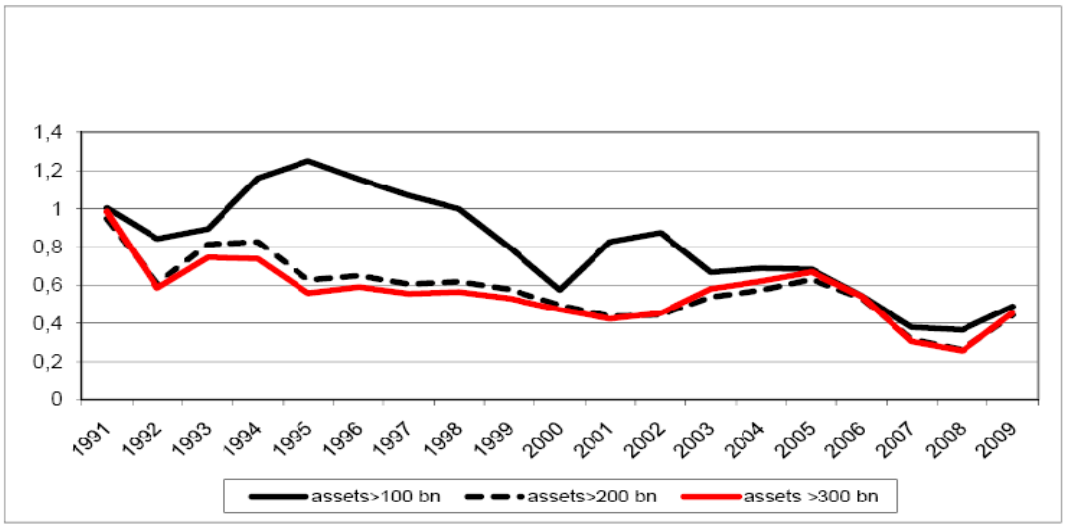
These factors mean that, first, a correlation such as that made above is hardly replicable and, second, we should refer to indices already calculated to avoid bias due to the lack of data synchronization between balance sheets and sources of profit and loss accounts.

For these reasons we carried out an analysis of the cross-section variability of the most widely used index of profitability, ROE. More specifically, with reference to the 1990-2009 period, we calculated the cross-section coefficient of variation of the ROE for the sample of banks previously selected. The assumption behind this test is that corresponding to a greater homogeneity of banks portfolios is a lower cross-section variability of the ROE. We expect, therefore, that over time the trend of the degree of variability across sectors of the ROE will decrease.

Figure 3 shows that, as expected, in recent decades the value of the cross-section variability of the ROE of the large European banks became more uniform.

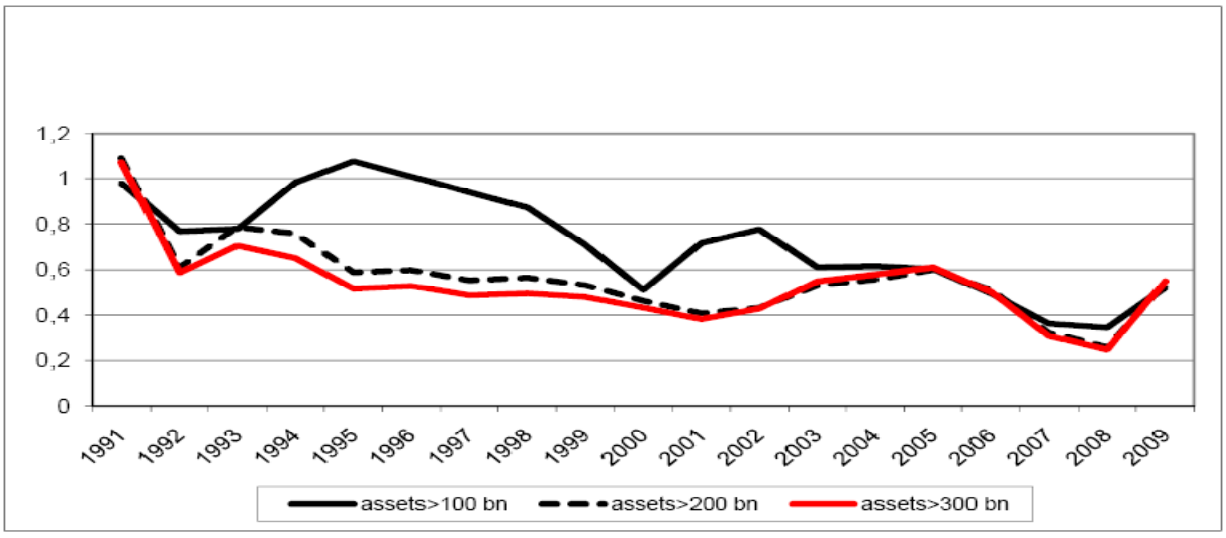
If at the beginning of the period and until the end of 1998, the variability of results was equal to the average ROE value (coefficient of variation equal to 1), within two years it took on a clear downward trend, hovering around values of 60 per cent until 2005, then decreasing again in subsequent years to levels close to 40 per cent. Also with respect to the ROE, we observe what has been seen using the correlation of stock returns, namely that uniformity between financial institutions is higher when assets rise: ROE variability for banks with total assets of more than 200-300 billion euros falls immediately, breaking through the 60 per cent barrier in 1995, reaching a 40 per cent share in 2001 and a share approaching 20 per cent in 2008.

Figure 3 – Cross section variability of the ROE for large European banks



When we consider the large sample of banks (i.e., including the American and Swiss banks), this trend is confirmed more markedly than with the correlation method.

Figure 4 - Cross-section variability of the ROE for large international banks



The empirical evidence presented in this section suggests that over the past two decades the European large banks has been characterized by an increasing homogenization of the portfolios. This process is not different from that which affected the other major banks around the world. It was more marked for banks with total assets of more 300 billions euros.

These findings show that the European banking system is increasingly exposed to the systemic risks triggered by common shocks and contagion effects (mainly via liquidity hoarding) connected to them. This inevitably calls for a rethinking of the regulatory criteria, taking into account, in a general equilibrium perspective, the interdependencies between banks and markets, and between individual banks.

Conclusions

In recent decades, more precisely since the Basel Accord of 1988, capital requirements have been the cornerstone of banking regulation. This regulatory instrument is designed primarily to protect the interests of retail depositors, forbidding bank managers from taking excessive risks, which are incompatible with the riskiness of banks. The basic principle underlying this type of regulation is that riskiness of assets determines the amount of capital required. The rules of Basel I, therefore, introduced a mapping of activities onto different risk categories. This classification was refined and perfected in the rules of Basel II. The weighted average of a bank's risk assets determines the minimum amount of capital it must hold.

The theoretical approach on which the regulatory policy of recent decades is based considers a bank and its reactions to regulatory constraints, such as capital requirements. The goal of this type of regulation is ultimately to ensure the solvency of the bank: if banks are sufficiently capitalized, the financial system as a whole is stable.

The recent financial crisis has inevitably raised questions about the principles underlying the system of regulation in force in recent decades.

In March 2008, with regard to the crisis at Bear Stearns, Christopher Cox, the Chairman of the Securities and Exchange Commission, wrote in an open letter: "…the conclusion to which these data point is that the fate of Bear Stearns was the result of a lack of confidence, not a lack of capital. When the tumult began last week, and at all times until its agreement to be acquired by JP Morgan Chase during the weekend, the firm had a capital cushion well above what is required to meet supervisory standards calculated using the Basel III standard."[34].

The case of Bear Stearns highlights the limitations of regulation based on safeguarding the solvency of individual institutions. This type of regulation, in fact, neglects the spillover effects that the

[34] See Cox (2008).

choices a bank makes may have on the payoffs of other banks and their solvency. In short it is necessary to distinguish between the riskiness of the asset and the systemic importance of the asset[35].

Measures to safeguard the solvency of individual institutions (micro-prudential dimension) may not be consistent with the preservation of the stability of the financial system (macro-prudential dimension). Hence the need to reconsider the nature of systemic risk. In general terms, the latter can be defined as an event that adversely affects systematically important financial intermediaries and markets.

The development of financial systems inevitably implies an evolution in the nature of systemic risk. In the past, when the activity of intermediaries was segmented and markets were poorly developed and interconnected, systemic risk was identified with the phenomenon of runs degenerating into bank panics. Post-WWII, the widespread use of deposit insurance has proved an effective regulatory tool for preventing this form of systemic risk.

Capital requirements are configured not only as a means of protecting the interests of retail depositors but also as a regulatory tool complementary to deposit insurance regulation. In this respect, they avert moral hazard behaviors in bank management.

Since the 1990s, financial globalization and the process of national deregulation have created the conditions for the emergence of mega-banks, namely institutions that benefit from economies of scale and scope.

The elimination of prohibitions inherited from the system of regulation that came out of the Great Depression of the 1930s has allowed the banks, on the one hand, to hold bonds and equities, and, on the other hand, to develop an intense trading activity.

The fall in importance of banks' traditional activity, such as lending to firms, in favor of activities related to markets can lead to a higher degree of homogeneity in their portfolio structures. This has inevitable consequences for systemic risk.

We have used a Monte Carlo simulation to show that, under certain conditions, a system where banks have assets that are diversified but not different is subject to a higher systemic risk than a system where banks have different but not diversified assets.

[35] See Morris and Shin (2008).

When banks' financial portfolios are homogeneous, the stability of the system can be compromised by a common shock, i.e. by a shock (e.g. a fall in the price of an asset) that simultaneously affects all financial institutions.

A shock like this can trigger cascade forms of contagion, especially forms of liquidity hoarding. Following such a reaction to a common shock, the functioning of the interbank market can be seriously compromised. This inevitably undermines the solvency of those institutions that raise funds mainly in the interbank.

The sequence just described is a stylized picture of what happened in the U.S. banking system during the 2007-2008 crisis. The European banking system was less severely affected by the crisis. However, its banks suffered quite considerable capital account losses as a result of the common shock represented by the fall in the price of credit swap derivatives.

In order to better understand how this shock affected the European banks, we conducted an empirical test to establish whether for large banks (those with assets exceeding 100 billion euros) the systemic risk due to a common shock has increased in recent years. As a measure of this risk we used the correlations between banks' stock prices and income returns, assuming that an increase in these correlations indicated an increase in systemic risk.

The results of the empirical analysis show that in the 1990s, after the process of national deregulation and the spread of credit swap derivatives, the correlation of stock prices of large European banks increased. The increase was more pronounced for larger banks. These results are confirmed by referring to the ROE. ROE dispersion of has been progressively falling since the 1990s. This process was more rapid and intense for banks with total assets exceeding 300 billion euros.

The empirical evidence just described suggests two conclusions. First, it leads us to reconsider the assumption that larger banks, by taking advantage of economies of scale and scope and being able to better diversify their portfolio, produce greater stability in the banking system. The high interconnectivity of the big European banks suggests that they are more exposed to systemic risk arising from common shocks of smaller banks. The conclusion is, then, that a diversified banking system in terms of size of banks is less exposed to common shocks.

Second, the decreased diversity of the portfolios of large banks and the increased probability of a systemic risk due to a common shock suggests the need to rethink the criteria of prudential regulation. Regulation cannot be based exclusively on safeguarding the solvency of individual

institutions, but must take into account, from a general equilibrium perspective, the spillover effects resulting from the high degree of interdependence between banks, and between banks and markets.

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