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Systemic Risk in Europe

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INTRODUCTION

Since the start of the financial crisis in 2007, it became clear that financial institutions (even the biggest ones) might default or at least require some help from the government. In the US, more than 414 institutions have defaulted between 2008 and 2011. Among the largest institutions that have been liquidated, rescued or taken over, are Bear Stearns, Merrill Lynch, AIG and Lehman Brothers. In Europe, several institutions such as Northern Rock, Fortis, and Dexia experienced similar problems. In Iceland, default of the three main banks, Glitnir, Landsbanki, and Kaupthing, and the subsequent transfer of the banks' debt to the central bank, even led to the default of the entire country. The global financial system was on the verge of collapse. Since then, there have been calls for more restrictive regulations regarding too-big-to-fail financial institutions. The G20 countries and supra-national institutions (like the Bank for International Settlements) have created an *ad hoc* commission to propose new regulations such as what the Basel Committee on Banking Supervision (2011, 2012) has suggested.

I. HOW TO MEASURE SYSTEMIC RISK?

Implementing a more restrictive regulation for too-big-to-fail institutions raises the question of how to identify these institutions. What is a systemically risky bank? Is a big bank necessarily systemically risky? What about other financial institutions like insurance companies? To answer these questions, it is necessary to give a precise definition of a systemically risky institution, and therefore of systemic risk itself. As Daniel K. Tarullo, Governor from the Federal Reserve Board of Governors, mentioned in a speech on June 8, 2009, a definition of a systemically risky institution is that its failure to meet its obligations to creditors and customers would have significant adverse consequences for the financial system and the broader economy.

Starting with this relatively general definition, identifying systemically risky institutions requires more precise criteria. In 2010, the Volatility Institute of New York University, headed by Nobel Laureate Robert Engle, has published a set of papers describing both an operational definition and a sound statistical methodology allowing the measurement of the capital requirement of financial institutions in the case of a new financial crisis. According to Acharya *et al.* (2010), systemic risk can be defined as the propensity of a financial institution to be under-capitalized when the financial system as a whole is

under-capitalized. This definition can be put into operation from an econometric point of view. One advantage of this research is that it is based on econometric modeling, and thus purely data based. The advantage of such an approach is that it does not rely on qualitative indicators provided by humans that could be either error prone or subject to political pressure. A drawback of this type of approach is that it relies on a model which itself may be incomplete.

The intuition behind those models is that they consider the balance sheet of banks and look at the conditional probability that a bank's capital does not meet the prudential requirements by becoming too small with respect to the bank's assets. This is exactly the notion that a financial institution is under-capitalized when the entire financial system is. Because those models consider the balance sheet explicitly, it implies that parameters such as bank size and leverage come into play. Furthermore, the dynamic aspect gets introduced naturally because one considers the evolution of a firm's asset over time conditional on the evolution of the entire market. More specifically, both levels of certain well-known and easily accessible balance sheet data on the one hand, and the exposure towards aggregate risk on the other hand — measured by stock returns of a market — come into play. Had one considered only the exposure towards market risk, one would have ended up with a measure in the spirit of value at risk. Similarly, only considering balance-sheet ratios would not have given the dynamic nature.

From a technical point of view, the model requires the computation of time-varying parameters and the determination of large extreme events. For the modeling of time-varying parameters, we build on the dynamic conditional correlation model. On the other hand, to correctly describe extreme events, we use the extreme-value theory and copulas to describe the joint behavior of the tails of distributions.

The synthesis of the basic model of Acharya *et al.* (2010) and Brownlees and Engle (2010) is a risk measure called SRISK which stands for systemic risk. SRISK determines the amount of money that would be required for a given institution so that this institution would again satisfy prudential requirements. One advantage of SRISK is that this measure can be added to obtain the risk of various institutions, a very elementary operation. By relating such an aggregate measure to gross domestic product, one gets an idea of how risky a certain financial industry is with respect to an entire country. The measure is therefore not only relatively easy to compute but also easy to interpret.

II. MODELLING SYSTEMIC RISK

In some recent research, Engle and Rockinger (2012) extend those initial models to allow for more risk factors in a European context. The earlier research emerged in a US context for which, given its size and importance, a US-specific factor is sufficient. For European banks, on the other hand, one may expect that they would be not only impacted by the US shocks, but also by European ones or even country-specific shocks. Conversely, it would seem obvious that European country shocks would not have similar impacts on the US economy.

Our model considers a triangular structure where we impose a causal direction on how shocks transmit from one region to another. For instance, we allow for worldwide shocks, which would impact European markets. European shocks in turn would affect specific countries. European shocks come from the fear, sometimes psychological, rather than being based on economic fundamentals that a certain group of countries might jointly face financial difficulties. Furthermore, our model also innovates by allowing for country-specific shocks and firm-specific shocks. Because of this much richer structure of shocks, we are able to describe phenomena that could not be captured by a model with just one worldwide factor. For instance, if one considers the earlier phase of the recent crisis, between 2007 and 2008, European firms were affected by the subprime crisis in the US. Then, from 2008 on, while the subprime crisis started to be effectively treated by US authorities, Europe entered a sovereign debt crisis. If one considers the co-variation between markets, one notices that the European market had less influence on the US market than during the earlier phase when the US market dictated the movements of the European market. Therefore, from a risk management perspective, the explicit modeling of a European risk factor appears to make a lot of sense. This asymmetry in which markets influence

each other brings about other questions, possibly of a political or economic nature, on how to dampen the reciprocal influences.

Without giving all the methodological details, it is useful to describe the three main characteristics of a financial institution for measuring its systemic risk:

— Its market capitalization, which reflects the size of the firm;
— Its financial leverage (the ratio of the asset value over the equity value), which measures the risk exposure of the institution;
— Lastly, the sensitivity of the stock return of the firm with respect to the evolution of the market as a whole, in case of a severe financial crisis.

In fact, high leverage in itself is not necessarily a problem, because inherently, one of the roles banks have is to take risks by lending to consumers and companies. Leverage becomes a problem if, like Greece, Spain or even the US recently, there is too much lending at an aggregate level. In this case, a bank may be under-capitalized at the worst moment, i.e., when the financial system as a whole is under-capitalized. If a bank then faces a capital shortage, it may be unable to meet its obligations to creditors and customers.

Systemic risk increases when the market cap or the financial leverage of a financial institution increases, or when the share value is more sensitive to the evolution of financial markets in case of a financial crisis.

The first two characteristics — that is, market capitalization and financial leverage — are relatively easy to measure since data is readily available. The third one, however, is not directly observable, in particular because it refers to a hypothetical financial crisis. The approach taken by our research is as follows: using the Monte-Carlo simulation of our complete model, we measure the loss of market cap in case of a deep financial crisis (a 40% decline in six months). This sensitivity is called "long-run marginal expected shortfall" (LRMES). Lastly, we measure SRISK as the capital shortage the bank would suffer to meet its obligations. An institution is said to be in capital shortage if the ratio of equity to assets falls below 8%. The 8% ratio is reminiscent of the regulatory ratio; however, the latter concerns the ratio of capital to risk-weighted assets. Even though the reason for choosing 8% is some what arbitrary, changing it does not affect the ranking of our results in a significant manner. The use of risk-weighted capital brings some worries because of the possibility that financial institutions can manipulate this ratio.

III. THE SITUATION IN EUROPE

The empirical analysis reported here results from collaboration between the Institute of Banking and Finance at the University of Lausanne, and the Volatility Institute at New York University. Our analysis covers the 196 European financial institutions with the largest market caps (at least 1 billion euro as of the end of December 2011). For our research, we worked on data starting before 1990, when available.[1]

Our measures of systemic risk are available online at http://www.crml.ch where they are updated on a weekly basis. On that website, one may also find aggregate measures at the country level. The sample includes 72 banks, 36 insurance companies, 53 financial services and 35 real estate companies. Countries with a large number of firms are the UK (45 institutions), France (22), and Switzerland (21). A first interesting result is that, overall, the aggregate systemic risk measure was about 1,284 billion euro as of the end of September 2012 and is now down to 1,163 billion euro by the end of February 2013. This number indicates the lack of capital the European financial institutions would suffer if there was a new market decline of 40% in six months. The raise of this ratio during the 2007 financial crisis is essentially due to the increase in the leverage ratio and partially due to an increase in the way firms became more dependent to global market movements.

Only banks and insurance companies show significant contributions to systemic risk. Financial services and real estate companies do not. This risk comes not only from a higher financial leverage, but also from a greater sensitivity to the evolution of financial markets. As of the end of August 2012, banks represent about 81% of total systemic risk, insurance companies 17%, and the other financial institutions have a negligible weightage. Although banks clearly rank first, insurance companies display some systemic risk. For example,

Table 1. Aggregate systemic risk measures for various countries.

	SRISK (billion €)	LRMES (%)	Leverage (ratio)	Market Cap (billion €)
France	303.94	42.34	35.11	203.34
United Kingdom	256.90	40.54	18.33	511.25
Germany	154.08	35.38	27.97	160.97
Italy	111.72	41.97	32.12	93.65
Switzerland	74.35	29.90	15.08	214.98
Spain	72.32	48.06	18.88	133.85
Netherlands	70.16	51.09	33.44	46.27
Belgium	35.77	32.01	23.39	35.46
Greece	26.89	30.38	154.72	3.37
Sweden	21.06	35.39	10.92	146.56
Denmark	17.06	30.11	21.61	25.88
Austria	11.06	30.67	16.42	30.54
Norway	7.02	31.06	16.47	25.03
Ireland	6.43	38.87	7.33	51.46
Portugal	6.39	26.32	29.77	7.21
Cyprus	4.16	24.74	37.88	2.84
Luxembourg	3.53	20.90	23.17	4.09

Note: Data as of 22 March 2013. LRMES stands for long-run marginal expected shortfall. This measures by how much the banking sector's returns drop in case of a –40% return of a worldwide index over a six-month period.

ING and AXA are ranked in the top 15 most systemically risky institutions.

It is also interesting to compare the systemic risk across countries (see Table 1). It should be noted that Greece is perceived as highly systemically risky in Europe. However, the main source of risk is the state and not the financial system. Greek banks are relatively small and therefore do not appear as systemically risky at the European level. The most risky countries are the UK, France, and Germany. The first two countries account for 50% of the total risk (27% for the UK, 23% for France), for a shortfall of about 1,000 billion euro of capital in the case of a new financial crisis. The other countries at the top of the rankings are Germany (14% of the total), Italy (8.5%), and Switzerland (7%). This ranking by country clearly reflects the weight of the largest banks in the European financial landscape, even if the sources of risk may be different from one country to the other. For instance, French, German and Italian banks have a much higher average financial leverage than institutions from the other countries. At the same time, British and French banks are more fragile because of their greater sensitivity to the evolution of financial markets.

If one considers Cyprus, a country very much in the headlines recently, one finds that the SRISK measure amounts to about 4 billion euro. This compares with a GDP of about 19 billion euro in 2011. This means that the Cypriot government might have to come up with at least 20% of GDP to get the capitalization back to appropriate levels if a financial crisis hits. It comes as no surprise that currently the country is struggling to get back on the right path. It should also be noticed that in the case of Cyprus, it does not necessarily take an exogenous shock for a country to face systemic risk. Our measure gives some guidance on what can happen if things go bad.

IV. THE SITUATION OF EUROPEAN INSTITUTIONS

The ranking of financial institutions clearly identifies highly systemically risky banks (Table 2): Deutsche Bank (93.9 billion euro), Crédit Agricole (92.4 billion euro), ahead of BNP Paribas, Barclays, Royal Bank of Scotland (RBS) and Société Générale (80, 78, 66, and 57 billion respectively). It should be noted that these six banks do not have the largest market caps in Europe, as they are well below HSBC or Banco Santander. On the other hand, they all have high financial leverage and great sensitivity to the financial markets. For instance, Crédit Agricole has a leverage of over 100, meaning that the assets of the bank are 100 times larger than its equity.

Going down the next five institutions on the list we have the first bank-insurance company, ING, which is also the most systemically risky company in the Netherlands. We also find UBS, the largest Swiss bank. UniCredit is the eighth largest systemically risky bank in Europe as of March 2013.

A last note on the implication of these systemic risk measures for financial institutions: the capital shortage in the case of a new financial crisis can be reduced in different ways. A firm can reduce its size (for instance, by selling too risky units), reduce its financial leverage (by investing less per unit of equity), reduce its risk

Table 2. Ranking of the most systemically risky firms.

	Company	Country	SRISK	LRMES	Leverage	Market Cap
1	Deutsche Bank	Germany	93.9	45.9	66.9	30.2
2	Crédit Agricole	France	92.4	48.2	112.5	16.4
3	BNP Paribas	France	79.6	55.1	37.1	51.1
4	Barclays	United Kingdom	78.1	51.9	41.6	44.0
5	Royal Bank of Scotland	United Kingdom	65.8	46.0	41.4	38.4
6	Société Générale	France	57.4	53.5	57.9	21.4
7	ING Groep	Netherlands	54.6	65.1	51.3	22.4
8	UniCredit	Italy	38.6	51.6	43.2	20.7
9	Banco Santander SA	Spain	38.4	50.0	21.4	58.9
10	Lloyds Banking	United Kingdom	36.0	35.5	28.4	40.2
11	Commerzbank AG	Germany	30.2	42.1	90.6	6.9
12	UBS	Switzerland	29.2	38.4	23.2	45.9
13	AXA	France	25.9	57.0	22.5	33.3
14	Credit Suisse Group	Switzerland	25.7	42.2	27.8	27.7
15	Intesa Sanpaolo	Italy	24.2	43.6	32.8	19.9
16	Natixis	France	22.6	37.7	53.9	9.8
17	Dexia	Belgium	22.6	59.0	4235.3	0.1
18	HSBC Holdings	United Kingdom	17.2	37.9	13.7	151.5
19	Legal & General Group	United Kingdom	16.8	39.9	37.4	11.7
20	Aviva	United Kingdom	16.6	57.6	36.7	10.7
21	Banco Bilbao	Spain	16.4	55.2	16.2	39.7
22	Danske Bank	Denmark	16.0	33.9	32.4	14.5
23	Aegon	Netherlands	14.9	56.5	37.5	9.4
24	CNP Assurances	France	14.2	32.5	47.7	7.3
25	Nordea Bank AB	Sweden	13.7	32.9	19.5	35.6

Note: Data as of 22 March 2013.

(by investing in less risky assets), or by reducing its exposure to market risk (by investing in assets that are less correlated to financial markets).

NOTE

[1] The results presented in this study are drawn from "Systemic Risk in Europe", by Robert Engle (Volatility Institute, New York University), Eric Jondeau, and Michael Rockinger (both from the Institute of Banking and Finance, University of Lausanne). See also the following website for the most recent figures: http://www.crml.ch. Both authors wish to thank Elisabeth Van Laere and Oliver Chen for their relevant comments and their help with the editing of the text.

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