

Burden Sharing in Cross Border Banking Crises

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ABSTRACT. An important aspect in managing and addressing a cross-border financial crisis is the tax burden sharing between affected countries. Fiscal costs incurred by the rescue of a banking group may be substantial and the sharing process can generate difficult negotiations of the countries involved, leading to delays in the development of crisis management and resolution. The paper proposes to explore ex-ante mechanisms for fiscal burden sharing to overcome the coordination failure in Eastern European Countries, where foreign banks control more than 65 percent of total banking assets. We will explore several alternative methods for the distribution of fiscal burden and assess the fiscal implications of these methods of distribution. We estimate the dynamics of bank assets volatility in the case of five major listed banks in Central and Eastern European (CEE) countries. The findings indicate that there was a sharp increase in volatility at the beginning of 2009, but as of mid 2011 it is converging back to pre-crisis values. Also, the paper develops a formula for quantifying the premium a bank is expected to pay for a fund that provides recapitalization in order to allow the orderly failure in case the bank is in financial distress. The results show that the premium can be computed as the difference between the prices of two European put options. Because the mechanisms of fiscal burden sharing imply potential adverse selection and moral hazard problems, it is possible that the appropriate burden sharing mechanism for the Eastern European Countries to be a mix of ex-ante mechanisms, the composition of the mix depending on the proportion of foreign assets in total banking assets and the systemic importance of the failing bank. More specific, we will focus on the policy implications for the case when a bank is systemic in the host country, but not in the home country.

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1. Introduction

In the past few years, the European financial markets have become increasingly interrelated. The assets of bank branches and subsidiaries established in another European country grew from 2000 billion in 2002 to respectively 3000 and almost 4000 billion Euros in 2006². Cross-border banking activity in the EU is largely concentrated in a small number of large and complex financial groups with significant operations in numerous countries or even on a pan-European scale³. A number of 39 large cross-border groups⁴ owned a significant share of the total assets of approximately 8300

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² Commission Staff Working Document, Impact Assessment Accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the European Court of Justice and the European Central Bank on an EU Framework for Cross-Border Crisis Management in the Banking Sector, SEC(2009) 1389 final, 20.10.2009

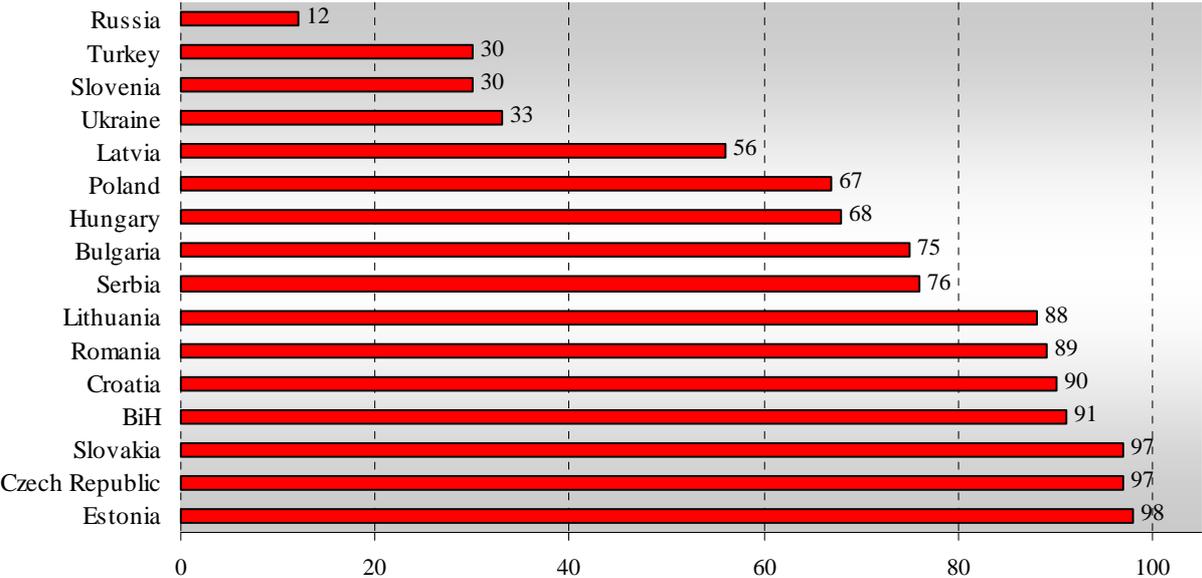
³ ECB, Financial Stability Review, December 2006, 131-139.

⁴ A mapping exercise by the BSC identified 46 banking groups with significant cross-border activity for the year 2005; European Central Bank, EU Banking Structures, October 2006,

credit institutions in the European Union (EU) in 2007⁵, with their aggregate assets representing roughly 68 percent of the total EU banking market. Foreign financial groups dominate banking markets especially in the new Member States. In Estonia, the Czech Republic and Slovakia over 92 percent of total banking assets were held by foreign-owned banks⁶.

On average, foreigners control more than 65 percent of total banking assets in sixteen transition economies in Central and Eastern Europe (Figure 1). The impact of foreign banks was positive from the beginning because: the capital brought by foreign investors decreased fiscal costs of banks' restructuring (often privatization to reputable foreign owners was the only way to decrease moral hazard problems induced by previous repetitive bailouts (Tang et al., 2000)); foreign banks brought expertise in risk management and higher culture of corporate governance, rendering banks more efficient (Bonin et al., 2005); foreign bank presence increased the competition, driving domestic banks to cut costs and increase efficiency (Claessens et al., 2001) and domestic banks have benefited from technological spillovers brought about by their foreign competitors.

Figure 1. Foreign Bank presence in 2007 (percent of total assets)



Source: CEE Region, UniCredit Group Presentation, London 18th February 2009

While the benefits of foreign ownership for banks' efficiency in transition countries seem to be proven, the impact of high foreign ownership on banking sector stability is less clear. Also, the

<<http://www.ecb.eu/pub/pdf/other/eubankingstructures2006en.pdf>>, The ECB 2010 report speaks of "43 major banking groups with significant cross-border banking activities and head offices in EU Member States"; ECB, EU Banking Structures, September 2010.

⁵ See also Ingves, Stefan, Cross-Border Banking Regulation – A Way Forward: The European Case, in: Douglas D. Evanoff, George G. Kaufmann and John R. LaBrosse (eds.), International Financial Instability, Global Banking and National Regulation, Singapore: World Scientific, 2007, 3-11.

⁶ Commission Staff Working Document

impact of home country conditions on foreign banks is more ambiguous and cannot be easily predicted. We can assume that home country experiences an economic upswing. In this situation parent banks have numerous profitable opportunities in their home countries, and can decide to allocate less capital to their subsidiaries. At the same time, high growth in the home country could make parent banks more profitable and more capable to develop their subsidiaries abroad. The situation would be reverse in case of economic slowdown in home countries, when parent banks could decide either to cut their foreign operations due to low profits at home or expand abroad for new opportunities.

Also, nowadays there are some concerns surrounding foreign banks in small countries. What if the bank is systemic in the host country, but not in the home country? What if the bank is not rescued? What if West European parent banks of the subsidiary banks in Eastern Europe are large retail banks that are also systemic in the home country? These are some very important questions that have to be taken into account when we try to have a resolution for the cross-border banking crises. Table 1 depicts this consideration by summarizing the distribution of interests among the home country and the host countries with regard to the failure of a cross-border bank.

Table 1: Summary of home country and host countries interests regarding a cross-border bank failure

Host Countries	Home country	
	Parent bank	
Branch/Subsidiary	<i>Systemic</i>	<i>Non-systemic</i>
<i>Systemic</i>	Home/host	Host
<i>Non-systemic</i>	Home	-

Source: Gruenewald, S.N. (2010)

Taking into consideration the current state of knowledge, the general objective of this Paper is to assess the impact of fiscal burden sharing in a cross-border banking crises for Eastern European Countries and the following specific objectives are to be accomplished in order to progress beyond the state-of-the-art:

- explore ex ante mechanisms for burden sharing to overcome the coordination failure in Eastern European Countries;
- assess the fiscal implications of different mechanisms for burden sharing in the region;
- analyze the policy implications for the case when a bank is systemic in the host country, but not in the home country;

2. Cross-border cooperation and burden-sharing

Banking crises have evolved throughout the world in recent decades as documented by different comprehensive studies. Linderger, Garcia and Saal (1996) report that 133 of 181 IMF members had experienced noteworthy banking distress over the period of 1980-1996. Demirguc-Kunt and Kane (2002) document 112 incidences of systemic crises in 93 countries and 51 incidences of borderline crisis in 46 countries. Caprio and Klingebiel (2003) identify 77 financial crises episodes have taken place in 72 developing countries since the mid-1990's., Laeven and Valencia (2008) report 42 systemic banking crises from 37 countries for the period 1970 to 2007.

The global financial crisis which began in August 2007 illustrates the importance of effective cross-border crisis management. The aim, the dimension and the complexity of cross-border transactions expanded at a very high pace in the years preceding the crises, while the intervention tools, resolution and techniques for handling cross-border crises have not evolved at the same pace. Many events during the crises revealed gaps in intervention tools and the actions taken to resolve cross-border institutions during the crises tended to be ad-hoc, severely limited by time constraints, and to involve a significant amount of public support. The result has been a drying up of liquidity in the banking sector and a reluctance of banks to lend to each other and to the broader economy. As the disruption of credit markets has intensified over the past two years, the financial crisis has intensified and the global economy has entered a severe recession. This raises the issue of the appropriate level (federal or national) for managing financial stability (Vives, 2001). Financial stability is currently managed at the national level. Also, the fiscal competence to deal with banking crises is a responsibility of national governments.

The absence of a multinational framework for sharing the fiscal burdens for such crises or insolvencies is, along with the fact that legal systems and the fiscal responsibility are national, a basic reason for the predominance of the territorial approach in resolving banking crises and insolvencies. National authorities tend to seek to ensure that their constituents, whether taxpayers or member institutions underwriting a deposit insurance or other fund, bear only those financial burdens that are necessary to mitigate the risks to their constituents. Thus, if no burden-sharing agreement can be reached, the most practical steps may be to recognize the strong possibility of ring fencing and implement appropriate crisis management arrangements and supervisory requirements that promote clarity and protect stakeholders. Because it is very difficult to envisage a resolution of the financial crisis and a recovery in the global economy without assured stability in the banking sector and the broader financial system, several countries have announced their intention to complement their existing support measures by providing some form of relief for impaired bank assets.

In the context of such a Community approach, the Communication from the Commission on the Treatment of Impaired Assets in the Community Banking Sector (2009) also offers more specific guidance on the application of state-aid rules to asset relief, focusing on issues such as (i) transparency and disclosure requirements; (ii) burden sharing between the State, shareholders and creditors; (iii) aligning incentives for beneficiaries with public policy objectives; (iv) principles for designing asset-relief measures in terms of eligibility, valuation and management of impaired assets; and (v) the relationship between asset relief, other government support measures and the restructuring of banks.

Although, because the European Commission acknowledges financial stability as a policy goal of the EU, pointing out that “financial stability concerns are no longer exclusively a national concern but have also become an issue of European interest”⁷, a large debate was concentrated on the cross-border banking group’s situation. In the literature there are two main ways of closing the gap between transnational banks and national resolution regimes. According to Kudrna (2011), one possibility is to shift the resolution regime up to the EU level that provides the largest possible jurisdiction matching the operations of large European banking groups. Alternatively, resolution could be shifted back to the national level, which would, however, require the cross-border banks to reorganize as a string of operationally independent national subsidiaries.

The idea of re-embedding cross-border banks in national resolution regime was presented by the UK’s Financial Services Authority at the onset of the post-crisis debate (FSA, 2009). During the debate it was presented UK’s experience when the government bore full costs of stabilizing interventions into global UK-based banks, but the benefits were spread across many of their cross-border counter-parties, and the situation when Iceland could afford neither supporting their banks, nor paying the mandatory deposit insurance to UK customers of its banks (Danielsson, 2010). This idea requires groups’ separation into operationally independent national entities. Therefore, in the event of crisis, this can be resolved solely by national authorities without any extensive cross-border cooperation and burden sharing.

But, large international banks immediately countered the idea arguing that even if the national subsidiaries were connected only by a brand name, there would still be cross-border spillovers (IIF, 2009). This concern was shared by the internal market Commissioner Michel Barnier: “we need to tread carefully, to avoid the banana skin of protectionism and to ensure that domestic politics does not gain the upper hand over European thinking. The first victim of an ‘every man for himself’ approach will be the internal market.” (Speech 10/122, 19 March 2010). Although the subsidiarization issue did not reappear in the later debates or Commission proposals, some of its

⁷ European Commission, Financial Integration Monitor, 2004, SEC(2004) 559, 18.

technical substance lingers on as the reform proposals on EU level (Commission 2010c) as well as global level (FSB, 2010). These proposals presume the compulsory introduction of recovery and resolution plans for all cross-border banks. Avgouleas et al. (2010) considers that these plans may limit the internal integration of some banking groups in order to make them 'resolvable' on national basis, without the need to engage in complex cross-border cooperation.

Because of the inadequacies of the pre-crisis framework, the Commission was emboldened to consider more ambitious reforms. Therefore, in October 2009, the Commission published the Communication on an EU Framework for Cross-border Crisis Management in the Banking Sector (COM(2009) 561/4). This document was accompanied by the Commission staff working document (SEC (2009) 1407) and impact assessment (SEC(2009) 1389). The conclusion of the Commission staff was that the EU bank resolution framework would have overall positive effect on all stakeholders (SEC (2009) 1389:40) and that the integrated approach was best suited for the 'branch-like' subsidiaries of EU cross-border banks (SEC(2009) 1407:50). This was also reflected in the consultation questions that asked for comments on desirability of the 28th regime, to which the IMF responded with the most ambitious EU level proposal to date summarized above. The October 2009's Communication was the high point for the EU level resolution proposals.

The negotiations with the Council and European Parliament regarding the European Banking Authority have revealed the political limits for post-crisis regulatory reforms. Therefore, the Communication on EU framework for crisis management in the financial sector from October 2010 (COM(2010) 579) reiterates that the "integrated framework for resolution of cross border entities by a single European body would deliver a rapid, decisive and equitable resolution process for European financial groups, and better reflect the pan EU nature of banking markets". However, it concludes that such a regime is not achievable in the absence of a harmonized insolvency regime and of a Single European Supervisory authority (Commission 2010c:12). National authorities are expected to consult and cooperate within resolution colleges that should prepare ex-ante resolution plans, but they are free to defect to unilateral action where they consider that necessary for reasons of national financial stability. The Commission plans to reassess the framework in 2014, when expected progress on some of the complementary reforms can make the shift to EU-level regime easier.

According to Avgouleas et al. (2010), when a systemically important bank gets into difficulties, the authorities come into play to manage the stability of the financial system. The drafting of resolution plans helps authorities to prepare for such times, just as banks prepare themselves with recovery plans. These resolution plans cover several options. The starting point is for the authorities to determine whether the failure of a troubled bank may have a systemic impact. If not

then the bank should be put into liquidation. But if the failure is deemed to be systemic, the detailed description of a bank's legal structure, which should be understandable after the ex ante restructuring exercise in the recovery plan, and the availability of data on the activities and assets of the various parts of a banking groups, allow the authorities to decide which parts they need to keep alive for systemic purposes and which other parts may be put into liquidation or sold. The next step supposes that authorities will first explore private sector solutions to keep the systemic parts afloat. The transfer of parts of a bank to other banks is in practice very difficult, but the more common approach is a merger of the troubled bank with another bank or a take-over.

But, the fiscal costs of resolving a banking crisis can be large. In a worldwide sample of forty banking crisis episodes, Honohan and Klingebiel (2003) find that governments spent on average 13 percent of national GDP to clean up the financial system. Therefore, the discussions regarding the burden issues are difficult as agreements for burden sharing may be signed before the occurrence of banking crises (ex ante), or during, respectively after the occurrence of banking crises (ex post). Current approaches on fiscal costs allocation are organized on two fundamental criteria:

a) The systemic importance of group entities in each country (the share of assets or deposits charitable group in need in each country, the importance of each group in the payment system in each country etc.).

b) The importance of each entity in the group (the contribution of each branches/subsidiaries to operating income flow or gross profit at group level).

Ex-post mechanisms represent current approach regarding burden sharing in the case of banking groups in difficulty. Recent experience shows that the technical mechanisms to internalize the fiscal costs are organized into three main categories:

a) Taking all the responsibilities and bear all costs related to saving a banking group as a whole by the responsible authority of the home country (Hypo Real Estate, RBS, ING, KBC);

b) Splitting the banking group in national components, which then are saved individually for each Member State (Fortis);

c) Allocating of state guarantees in consensus among concerned Member States, but the guarantees are taken individually in an amount that should not be limited to the jurisdiction of that country (Dexia).

The ex-post mechanism of a country depends mainly of the importance of the subsidiary or branch in the national banking system. Thus, if the group is a systemic both in home and host

countries, there are likely to have an agreement in order to save the ailing bank, but the time needed to get to a solution can be significantly higher due to negotiations on cost distribution key. If the group is only systemic in home / host country, there is no sufficient incentive for the burden sharing of fiscal costs and the likelihood of conflict is high.

Ex-ante mechanisms for burden-sharing among countries require prior signing agreements on the obligations of each country participating in the rescue of a systemic banking group, before the appearance of a serious emergence deficiency in the group. The success of this type of mechanism means: mutual confidence between participating countries, providing an agreement on the objectives of financial crisis management - Memorandum of Understanding (MoU - 2008), providing an agreement on how to resolve financial crisis and providing a framework for dispute mediation.

Goodhart and Schoenmaker (2006, 2009) present different types of ex-ante mechanisms and a general scheme in order to recapitalize the European banking groups in need. In this general scheme, the countries in the Union assume voluntary their participation in a share; depending on a key⁸, for example the economic power, or the capital for the European Central Bank (individual contribution is independent of any presence of an ailing banking group in that country). But, although ECB may create unlimited liquidity, its ability to absorb losses is limited by its capital. Thus, to give the ECB a credible role, its capital needs have to be underwritten by the national governments. Therefore, this is considered only an intermediary solution. In the first general mechanism discussed by Goodhart and Schoenmaker (2009), financial stability is assumed to be a truly public good which affects all participating countries. All countries then contribute according to their relative share, but there is no political support for general burden sharing (Pauly, 2009). In the second specific mechanism, financial stability is assumed only to affect those countries where a failing bank is doing business. The burden is financed directly by the involved countries according to some key reflecting the geographic spread of the business of the failing bank. Countries facing systemic disruption are asked to contribute. They will do so if the stability effects in their country exceed their contribution. To be practical, only the countries from the core supervisory college⁹ are involved in the resolution plan. A core supervisory college could for resolution purposes turn into a cross-border stability group containing the supervisors, central banks and ministries of finance from the core countries. Such cross-border stability groups are currently suggested for the EU (European Union, 2008).

⁸ Each participation, of each country, to a mechanism is given by a key variable: capital, assets, employment or income

⁹ A core supervisory college is composed of a few key supervisors that have responsibility for the primary risk-taking entities within a banking group

The other limits of the ex-ante mechanisms are: adverse selection (countries with banking system not very developed benefit more from these agreements than countries with healthy banking systems); moral hazard (the supervision authorities have no incentives to work efficient, because they know that an ailing bank has the financial support of all participating countries) and “free-rider” issue (although there are countries that do not want to participate to the fund, they can benefit from it, because the main objective of this is to assure the European financial stability).

Regarding the solutions to this issue, increased information sharing among the Member States will enforce their interdependence. Cooperative arrangements among the Member States may aid the general goal of reducing asymmetric information, i.e. the situation that certain Member States are less informed than others when determining their crisis management strategy. In the longer run, successful cooperation will increase the countries’ mutual reliance in supervisory and crisis management issues and create a “self-sustaining atmosphere of trust”¹⁰ among them (Kahan, 2002).

Therefore, the institutional design of a burden-sharing mechanism is very important and may foster the proper incentives for contributions by the country to the management of cross-border banking crises. In order to mitigate political obstacles to its contribution at the EU level, the voice that a country has could be determined according to its relative share in collective management efforts: the more a country contributes the bigger voice it has in the collective crisis management decision-making process.

By fostering cooperation among the countries, burden-sharing arrangements help reduce bailout costs and safeguards financial stability. Burden sharing thus mitigates the moral hazard problem that accompanies state support to banks in distress. However, burden-sharing arrangements itself may induce moral hazard among the countries. If a country feel insured against the large burdens that a banking crisis may create due to the contributions provided by others, they may have limited incentives to monitor market developments and become less risk averse in supervising banks within their jurisdiction. Simultaneously, other countries may be reluctant to contribute to the costs related to a cross-border bank failure that is in large part to blame on insufficient or inadequate supervision by the bank’s home and/or host country.

On the other side, Freixas (2003) shows that ex post negotiations on burden sharing lead to an under provision of recapitalizations. Countries have an incentive to understate their share of the problem in order to have a smaller share in the costs. This leaves the largest country, almost

¹⁰ Kahan (2002), “The Logic of Reciprocity: Trust, Collective Action, and Law”. The paper claims that financial crises are extraordinary events that require rigorous preparation. With financial stability being at stake, the Member States cannot risk that cooperation fails, especially as the general loss of market confidence that generally accompanies financial crises may also adversely affect the level of trust among the Member States

always the home country, with the decision whether to shoulder the costs on its own or to let the bank close and possibly be liquidated. Freixas (2003) labels this mechanism, which reflects the current arrangements in Europe, as improvised cooperation¹¹. To alleviate this problem, Goodhart and Schoenmaker (2009) consider that the key should be made a function of the assets of the problem bank in a given country and the ratio between the assets of the problem bank in that country and the total assets of that country's banking system. The small countries would then shoulder a larger share of the burden and have, accordingly, a larger share in the vote.

According to Herring (2007), burden-sharing arrangements should consider the countries' ability to bear the burdens of a cross-border banking crisis. Taking into consideration not only their fiscal resources but also their supervisory capacity, there exist considerable asymmetries among the countries. The ability-to-contribute principle would account for the feasibility of a country's contribution to collective crisis management action. The rationale for a complementary ability-to-contribute approach in designing burden sharing among the countries is twofold. On the one hand, limitations on national resources can diminish effective crisis management as a crisis could overburden a country by exceeding its capability. In these cases, a banking crisis may open out into a sovereign crisis¹². On the other hand, there are arguably reasons of equity that suggest an allocation of crisis management burdens according to the country's economic performance. Demand for financial stability may effectively rise with a country's state of economic development, creating an extra benefit that is not necessarily compensated by the benefit principle.

Therefore, because at this moment the burden-sharing agreements set on an ad-hoc basis at European level were developed the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM). According to EFSF's statute its objective is to preserve financial stability of Europe's monetary union by providing temporary financial assistance to euro area Member States in difficulty. In order to reach its objective the EFSF can issue bonds¹³ or other debt instruments on the market, to raise the funds needed to provide loans to countries in financial difficulties. Issues would be backed by guarantees given by the 16 euro area Member States of up to €440 billion on a pro rata basis, in accordance with their share in the paid-up capital of the European Central Bank (ECB). The European Financial Stability Facility is part of a wider safety net to preserve financial stability within Europe and its rating is AAA. The means of the EFSF are combined with loans of up to €60 billion coming from the European Financial

¹¹ "Improvised cooperation" is considered the situation when all the countries rely on the idea that financial stability is the goal of each country (Freixas, 2003).

¹² In the current crisis, this development can be observed especially in Ireland and Spain.

¹³ With the support of the German Debt Management Office (DMO)

Stabilization Mechanism (EFSM), i.e. funds raised by the European Commission and guaranteed by the EU budget, and up to €250 billion from the International Monetary Fund for a financial safety net up to €750 billion.

On 24 June 2011, the European Council decided to establish a permanent crisis resolution mechanism – the European Stability Mechanism (ESM). The function of the ESM is to mobilize funding and provide financial assistance, under strict conditionality, to euro area Member States. It may also exceptionally intervene in the debt primary market under the same conditionality. The ESM will assume the role of the EFSF and the EFSM in providing external financial assistance to euro area Member States after June 2013.

The ESM shareholder contribution key will be based on the ECB contribution key. Member States with a GDP per capita of less than 75% of the EU average will benefit from a temporary correction for a period of 12 years after their entry in the euro area. The temporary correction will be three quarters of the difference between GNI and ECB capital shares. The downwards compensation on those countries is redistributed among all the other countries according to their ECB key shares (Tabel 2).

Tabel 2. The ESM's shareholder contribution key

Country	ESM Key (%)
Austria	2.783
Belgium	3.477
Cyprus	0.196
Estonia	0.186
Finland	1.797
France	20.386
Germany	27.146
Greece	2.817
Ireland	1.592
Italy	17.914
Luxembourg	0.250
Malta	0.073
Netherlands	5.717
Portugal	2.509
Slovakia	0.824
Slovenia	0.428
Spain	11.904
Total	100

www.esfs.europa.eu

3. Research Methodology and Results

In order to achieve the objectives of the paper, we will explore the mechanisms of burden sharing for the Eastern European countries, in the context of the multi-country model developed by Freixas (2003) and Goodhart and Schoenmaker (2009). A bank failure involves negative externalities for two important reasons. First, it erodes the bank capital (this is the first type of contagion, when the financial shock causes the institution to fail) and second, it may lead to further contagion losses in the system (the bank is systemic in the host country, but not in the home country). On the one hand, a bank closure reduces economic welfare because there is a loss of the relationship with the bank's clients and the specific knowledge of management and risk preferences, as illustrated by Slovin et al (1999) for the cost of the Continental Illinois failure. On the other hand, the costs of such closures are more acute, because the failure may spread throughout the banking system, amplifying the negative effects on unrelated intermediaries. Freixas (2003) analyses the cost and benefits of recapitalization. The model can be applied both on a single-country and a multi-country case.

In the context of the debate regarding the establishing of ex-ante mechanisms for bank resolution it is essential for Central and Eastern European (CEE) countries to assess the volatility of bank assets in these countries. Radu, Necula and Trifan (2011) estimate the unobserved value of assets as well as the volatility for five major listed banks in Central and Eastern European (CEE) countries: Powszechna Kasa Oszczednosci Bank Polski SA (PKO) from Poland, OTP Bank Plc (OTP) from Hungary, Komerčni Banka (KOM) from Czech Republic, BRD-Groupe Societe Generale SA (BRD) from Romania, and Vseobecna Uverova Banka (VUB) from Slovakia. Annual balance sheet data for the period 2006 - 2010 was obtained from the annual reports published on the websites of the five banks. The data was transformed in EUR using exchange rate data from European Central Bank.

The authors briefly describe the methodology developed by Ronn and Verma (1986) that is vastly employed in the literature for estimating the volatility of bank assets. Following Merton (1977), it is assumed that bank's assets follow a geometric Brownian motion:

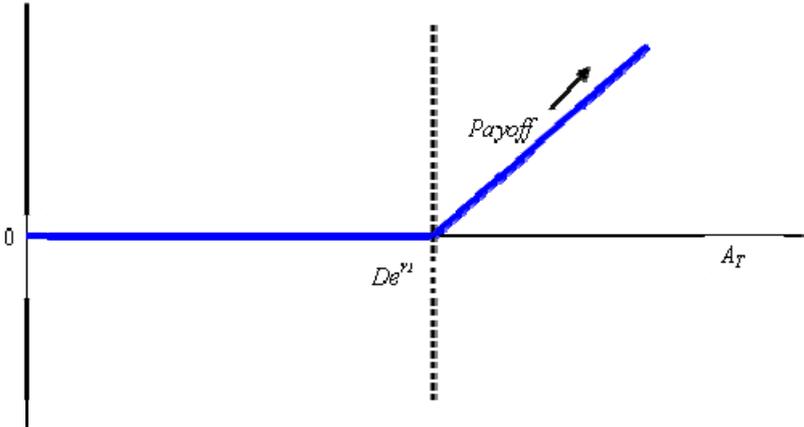
$$\frac{dA_t}{A_t} = \mu dt + \sigma dW_t \quad (1)$$

where A_t is the value of assets at time t , μ is the instantaneous expected return on assets, σ is the volatility of the assets, and W_t is a standard Brownian motion.

Merton (1974) considers a firm that issued a single zero coupon bond that promises to pay F at the maturity date T . In case of a bank, Merton (1977), analyses the situation that the debt corresponds entirely to deposits. Because most deposits are of demand type, the assumption of term debt is not strictly applicable. However, it is customary in the literature to interpret the length of time until maturity as the length until the next audit of the bank's assets, length usually chosen to be one year (Merton, 1977; Ronn and Verma, 1986; Lehar, 2005). Moreover, since it is assumed that both principal and interest on deposits are insured, the insured deposits will be riskless and, therefore, $F = De^{rT}$, where D is the current (book) value of the deposits and r is the instantaneous risk free interest rate. At maturity, the value of the bank's equity is given by $\max(0, A_T - F)$, and, therefore, it is equivalent to the payoff of a call option (Figure 2).

The value of the debt (deposits) is always $F = De^{rT}$, and the cost incurred by the deposit guarantee fund is $\max(0, F - A_T)$.

Figure 2. The payoff of the bank equity



Under these conditions, the value of the bank equity (E) can be determined as the premium of an European call option with maturity T and strike price $F = De^{rT}$, and the premium paid by the bank to the deposits guarantee fund can be determined as the premium of an European put option with maturity T and strike price $F = De^{rT}$. The options premiums are computed with the Black and Scholes (1973), formula since the underlying (the value of the bank assets) follows a geometric Brownian motion and the risk free interest rate is assumed constant.

In order to use option pricing theory in evaluating the equity and debt of banks, two unobservable variables, respectively the value of the bank assets A and the volatility of assets σ , have to be estimated. Ronn and Verma (1986), suggest using two restrictions for the identification of these two unknowns. The first relationship consist in the fact that the equity value of the bank, which is

directly observable as the market capitalization of that bank, is an European call option on the bank's assets with a strike price equal to the fructified value of deposits:

$$E = A \cdot N(d_1) - D \cdot N(d_2) \quad (2)$$

where $d_1 = \frac{\ln(A/D) + \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}}$, $d_2 = d_1 - \sigma\sqrt{T}$, and $N(\cdot)$ represents the cumulative distribution function for a standard Gaussian random variable.

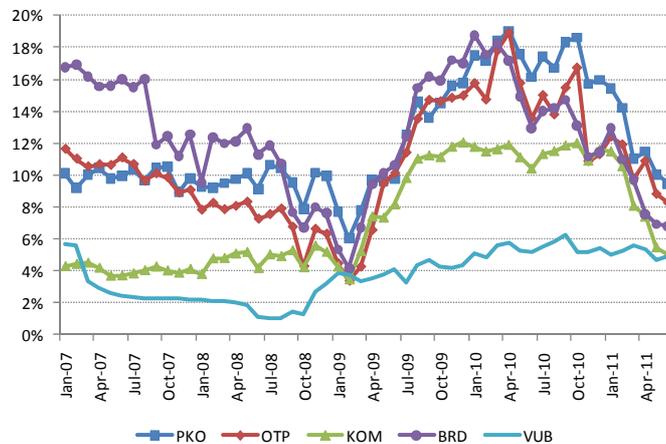
The second relationship, which can be obtained by applying Ito's Lemma to equation (2), relates the equity volatility, which is can be computed from historical stock price data, and asset volatility:

$$\sigma_E = \sigma \frac{A}{E} N(d_1) \quad (3)$$

Duan (1994) has developed a maximum likelihood framework to estimate these unobservable parameters which is consistent with the results of Merton (1977), theoretical model that equity volatility is stochastic. Since the advantage of Ronn and Verma (1986), consists in not requiring high frequency data on deposits, we decided to use this widely applied method instead of the more theoretical focused and more data demanding Duan (1994), method. Moreover, Duan (1994), points out that the sample standard deviation of stock returns, employed in the Ronn and Verma (1986), method, is not an efficient, but still a consistent, estimator for the equity volatility.

Figure 3 depicts the evolution of volatility for the assets of the five banks.

Figure 3. The dynamics of bank assets volatility



Source: Radu, Necula and Trifan (2011)

There was a sharp increase in volatility during the financial crises that propagated its effects in CEE countries at the beginning of 2009. More specifically, the volatility doubled comparative to pre-crisis estimates. However, as of 2011 it is converging back to more “normal” ranging between 4% and 8%.

Figure 4 depicts the dynamics of the value volatility of the assets of the five banks as perceived from the stock market perspective.

Figure 4. The dynamics of bank assets (index, 2007M1 = 1)



Source: Radu, Necula and Trifan (2011)

There was an accentuated decrease in the value of assets, as estimated from the market value of equity, at the end of 2008 and the beginning of 2009. However, as of the mid 2011, the assets have reached or even surpassed the pre-crisis value.

Also, Necula and Radu (2012) apply option pricing techniques in order to develop an analytical formula for the premium a bank should pay to a hypothetical *recapitalization fund* whose purpose is *to recapitalize a failing bank* in case the equity at maturity is below a threshold, denoted by E_{\min} . More specifically, the cost of the recapitalization fund is given by:

$$Cost_T^{\text{RecapFund}} = \begin{cases} 0 & , A_T > De^{rT} + E_{\min} \\ De^{rT} + E_{\min} - A_T & , De^{rT} < A_T < De^{rT} + E_{\min} \\ E_{\min} & , A_T < De^{rT} \end{cases} \quad (4)$$

The magnitude of such a premium is analyzed using five major Central and Eastern European banks. Table 3 presents the average bank assets value over the period January 2007 – December 2010, the average stock price volatility, the average bank assets volatility, and the average premium for the recapitalization fund expressed both in millions EUR and as a percentage of value of the assets.

Table 3. *Estimates for the banks in the sample*

Bank	Stock price volatility (%)	Bank assets volatility (%)	Value of bank assets (mln EUR)	Recapitalization fund premium (mln EUR)	Recapitalization fund premium (% of assets)
PKO	43.39	12.03	40,395.81	40.97	0.10
OTP	53.71	10.55	31,615.97	96.83	0.31
KOM	36.19	7.27	26,626.89	20.26	0.08
BRD	55.49	12.36	12,047.28	34.32	0.30
VUB	29.78	3.75	9,053.53	5.22	0.06

Note: All the values represent averages over the period January 2007 - December 2010

Source: *Necula and Radu (2012)*

The authors conclude that using option pricing techniques, such a premium can be computed as the difference between the prices of two European put options.

4. Policy implications

As already mentioned, the mechanisms of fiscal burden sharing imply potential adverse selection and moral hazard problems, higher fiscal costs and the free rider problem. Therefore, it is possible that the appropriate mechanism for the region assessed to be a mix of the two mechanisms that we investigate in the first part of the study, the composition of the mix depending on the systemic importance of the failing bank. More specific, we will focus on the policy implications for the case when a bank is systemic in the host country, but not in the home country. Probably in this situation the small countries would pay a bigger share of the burden and determine the home authorities not to close the failing bank. Also, these countries will seek to impose regulatory incentives on the institutions, through capital or other prudential requirements, designed to encourage simplification of the structures in a manner that facilitates effective resolution.

Another policy implication is the creation of contingency plans of all systemically important cross-border financial institutions and groups. The contingency plans should address as a contingency a period of severe financial distress or financial instability and provide a plan, proportionate to the size and complexity of the institution's and/or group's structure and business, to preserve the institution as a going concern, promote the resiliency of key functions and facilitate the rapid resolution or wind-down should that prove necessary. Such resiliency and wind-down contingency planning should be a regular component of supervisory oversight and take into account cross-border dependencies, implications of legal separateness of entities for resolution and the possible exercise of intervention and resolution powers.

5. Conclusions

Cross-border banking brings potentially many benefits, such as a more competitive banking industry and the transfer of know-how. However, because the EU's long-term objective of creating a single financial market – including an integrated banking system – has never been matched with a single legal and prudential framework, cross-border banks also pose severe problems for the regulatory and supervisory community.

Managing a cross-border crisis is a matter of common interest for all member states affected. Therefore, in the situation when a banking group has significant cross-border activities in different member states, authorities in these countries will work together to prepare themselves for bad times and for sharing a potential fiscal burden. If public resources are involved, direct budgetary net costs are shared among affected countries on the basis of “equitable and balanced criteria”.

The absence of a clear framework for dealing with the possible failure of a cross-border institution was identified before the crisis as a major shortcoming of the EU architecture. Concerns were raised both about the lack of incentives to information sharing and the lack of provisions for ex ante burden sharing. The ex ante burden-sharing mechanisms were consistently rejected by the authorities and even the suggestion of a compartmented fund to which countries would all contribute without exercising joint responsibility fell on deaf ears, although studies proved that ex-post mechanisms are not sufficient for crisis times. In the same time, although the countries confronted with the exceptional severity of the crisis and the high risks involved in the failure of a large cross-border financial institution, governments never renounced from the position that there is no European taxpayer and that all support to the banking sector has to be national.

But, because in most large developed countries, the set of systemic financial intermediaries is almost identical with the set of cross-border financial intermediaries, when there was a need for resolution in the recent crisis, e.g. Lehman, Fortis, Dexia, the Icelandic banks, the authorities, almost without exception, acted purely on the basis of narrow national interest. Moreover, when such institutions were saved the rescue was done entirely by the home country (and its taxpayers) with no contribution at all from host countries that nevertheless benefited from the absence of adverse externalities/spillovers. Even after this experience, however, the tendency in most countries seeking to introduce Special Resolution Regimes for such systemic financial institutions by new legislation has been to craft the proposed Bills as if all such resolution requirements were purely a domestic problem.

Still, Cross-border banking is to a large extent taking place in a regional context. This may not completely prevent problems related to cross-border banking from arising, but this is the only reasonable middle way between maintaining financial integration and avoiding the unduly high costs associated with managing cross-border banks in a crisis.

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