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'Too Systemically Important to Fail' in Banking

By

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Abstract

The recent financial turmoil and bailouts of a large number of banks have raised substantial policy concerns regarding banks that are considered 'Too-systemically-important-to-fail' (TSITF). In this paper, we exploit a sample of bank mergers and acquisitions (M&As) between 1997 and 2008 in nine EU economies and use an innovative setup derived from the frontier literature to capture safety net subsidy effects and evaluate their ramifications for systemic risk. We focus on three closely related phenomena: First, we use frontier methods to extract information on whether banks deliberately pay premiums for being considered TSITF. Second, we incorporate the safety net subsidies derived from the frontier methods in a probit model to assess whether they affect the probability of a bank being rescued during the recent crisis. We find that safety net benefits derived from M&A activity have a significantly positive association with the rescue probability, suggesting the moral hazard issue in banking systems pre-crisis. Third, we do not find that gaining safety net subsidies leads to TSITF bank's increased interdependence on its peer banks. From a policy perspective, the findings help understand whether banks exploit national safety nets and increase instability in the financial system.

Key words: systemic importance, systemic risk, merger and acquisition, banking

JEL Classifications: G14, G18, G21, G34

1. Introduction

Bailouts of large financial institutions, in particular banks, have always caught the attention of the public due to their high fiscal costs [1, 2]. When Continental Illinois National Bank was nationalized in the U.S. in 1984, incurring a $1.1 billion expense to the Federal Deposit Insurance Corporation (FDIC), the term 'too-big-to-fail' (TBTF) was used to justify the bailout decision in the following Congressional hearing. The same hearing also suggested that 11 of the largest U.S. banks (including Continental Illinois National Bank) would be saved using taxpayers' money [3]. Thereafter, these 11 largest banks became a convenient sample for a handful of empirical studies that examine TBTF effects in the U.S. [e.g., 4, 5, 6, 7].

It is suggested that these TBTF banks enjoy favorable treatment from market participants as they have better access to government safety nets [8]. For instance, O'Hara and Shaw [5] find that these 11 banks experienced positive abnormal stock returns on the date of publication of the Congressional hearing report, reflecting the positive perceptions of market participants for banks identified as TBTF. Previous studies also report that mergers undertaken by the largest banks not only increase these banks' market values but also offer evidence for the existence of safety net subsidies for TBTF banks [6]. Moreover, these banks tend to have lower funding costs and higher credit ratings suggesting other safety net subsidy benefits [e.g., 9, 10].

Banks can grow substantially via mergers and acquisitions (M&As) [11] and this can adversely affect financial stability. First, consolidation may help banks concentrate their activities within certain sectors/products and/or geographic locations. Overall systemic risk may increase as institutions become more interdependent due to similar business lines, investment portfolios, and common exposures. Due to such interdependence, when a large bank fails, its problems may be contagious and infect its counterparties in various sectors; in turn, this may pose a threat to the stability of the real economy. Such a possibility has been the most quoted regulatory reason justifying intervention in the bank default process although study of such spillovers has largely remained hypothetical [12]. Second, when banks engage in M&As they can become more complex (i.e., bancassurance or conglomerates) and this may lead to greater opacity posing challenges for regulators. Larger and more complex banks may find it easier to exploit regulatory loopholes without being monitored appropriately. Finally, cross-border M&As may also complicate issues further as uncertainties regarding the jurisdiction of national safety net arrangements and coordination problems between regulators may arise [13].

The recent financial crisis between 2007 and 2009 provides a timely case study for TBTF effects in EU banking. Large scale banking rescues have raised serious concerns about the social and economic costs of TBTF. Rescued banks also appear as natural candidates for a TBTF study as (presumably) their failure would have posed 'real' systemic risk to EU economies. In addition, European banking markets have experienced far-reaching structural changes over recent years as part of the process of European integration which could have exacerbated TBTF effects. These changes are reflected in greater product and geographical diversification [14, 15], and M&As between banks and other financial institutions have become commonplace [16, 17] with the emergence of bancassurance and other conglomerate structures. In particular, various pan-European banks have emerged (e.g. Dexia, Fortis and ING) and those three pan-European banks all received

government assistance of some form. A number of (forced) mega-mergers have occurred as a consequence of governments' rescuing and/or restructuring plans post-crisis [18]. While these rescue measures may well have stalled eroding consumer confidence in the financial system, they have also simultaneously reinforced concerns about TBTF.

While the term TBTF may appear a misnomer - in some cases bailed-out banks have not been particularly large [19], from a regulatory perspective a bank's systemic importance, in other words, the complexity of the business model, connectivity to others as well as size, is the main consideration in a bail-out rather than size per se [20, 21]. To avoid confusion in terminology we will use the term TSITF throughout this study, broadly encompassing TBTF and 'too-systemically-important-to-fail' institutions.

This paper contributes to the extant literature in three important ways. First, we develop an innovative approach to extract a measure of safety net subsidies from an auxiliary regression model, which examines the determinants of bank merger premiums. Previous M&A studies either fail to disentangle other incentives to consolidate (efficiency gains, enhanced market power, reduced agency costs) from potential safety net subsidies [22], or only test the safety net subsidy effects associated with size and ignore other factors that may explain such subsidies including such things as: political clout, managerial opportunism, relaxed market monitoring and organizational flexibility [12]. Our approach, however, is capable of stripping out safety net subsidy gains broadly defined in M&As. Second, while previous studies either focus on safety net subsidy gains for TSITF banks or examine the systemic risk posed by these banks, we argue that these two issues are related and need to be examined jointly as TSITF banks may exploit safety net subsidies and in turn increase systemic risk in the financial system. In this study, we examine whether gaining safety net subsidies is the channel through which TSITF banks increase their systemic importance and pose higher risk to the economy. Third, although the literature has documented a gradual increase in systemic risk in the EU over the past decade or so [11, 23, 24, 25], Kane [12] suggests that typical measures of systemic risk, namely indicators of interdependence between TSITF banks have not enabled regulators to diagnose the root cause of financial distress correctly. In other words, regulators have been unable to effectively detect the build-up of systemic risk within the financial system. We extend the literature by providing an initial step towards analyzing the relationship between the change in bivariate correlations of TSITF banks' share price returns and their gains in safety net subsidies via M&As.

This study first uses frontier modeling technique to capture safety net subsidy gains while testing motives of paying merger premiums in M&As. We find that EU acquiring banks prefer to pay a merger premium to a target if it will bring more market power; it is less cost efficient comparatively and it is located in a strong supervisory environment and concentrated market. In the second step of our analysis, we assess whether a bank that posed systemic risk during 2008 and 2009 paid merger premiums in the past to gain safety net subsidies, which are estimated from our first test. We find consistent and significant evidence that gaining safety net subsidies in the pre-crisis era via M&As increases the probabilities of being rescued in the crisis. There is also evidence that the more safety net subsidies the bank sought, the higher cost taxpayers was to pay in the recent crisis. We, however, find no evidence that safety net subsidy gains via M&A lead to increased interdependency between TSITF and other banks, which is measured by TSITF bank's share return correlations with its peers' in each country. A number of

robustness tests show that our results do not suffer from sample bias; frontier modeling is an appropriate methodology estimating safety net subsidies compared to the OLS regression and results remain consistent when banks' interdependency is measured using accounting information instead of market prices. Overall, our results help us understand how banks exploit national safety nets and increase instability in the financial systems from a policy perspective and suggest that moral hazard was deeply rooted in the EU financial systems. Echoing the recent legislation development in the US and EU that aims to end TSITF bailouts, our results also point at the direction that there should be increasingly strict rules for capital, leverage, risk management as well as permitting M&A activity as banks continue to grow in systemic importance.

The paper is organized as follows: Section 2 presents a brief review of the TSITF literature. Section 3 states our research questions and develops our hypotheses. Section 4 describes the dataset, methodology and results. Section 5 presents robustness tests. We offer concluding remarks in Section 6.

2. Literature Review

A number of studies have examined TSITF and its related issues in banking. We present an overview of the literature in *Table I*, grouped according to the type of TSITF measure employed (asset size, market capitalization, market shares, rating and so on). The more recent studies that cover the 2008-9 crises reflect on the insights gained from the crisis and consequently consider a wider range of attributes such as business complexity, wholesale banking activities, substitutability of services, in addition to size when assessing systemic importance.

[*Insert Table I here*]

One strand of the literature on TSITF uses event study approaches to examine potential effects of safety net subsidies. Kane [6] investigates a sample of 12 large U.S. banks between 1991 and 1998 and finds that these banks gain shareholder value from becoming larger via M&A activity. Pennacchi [22], however, argues that motives for mergers vary from efficiency gains to market power enhancement, agency problems and extending safety net access. Therefore, it is problematic interpreting the results from Kane [6] as safety net subsidy effects only. Instead of measuring stock returns, some other studies examine the determinants of merger premiums [e.g. 13, 29]. Some propose that acquiring banks will obtain safety net subsidies when they pay more for targets that have greater covariance with their own profitability (as well as higher profit variance) [13, 40]. These studies, however, find no evidence to support this hypothesis. Carbó et al. [41] offer some explanations for the lack of support for the idea that banks pay premiums to reap safety net benefits. They model safety net subsidies as a function of asset volatility and capital controls and find that after cross-border mergers, EU banks increase their asset volatility significantly to extract incremental safety net benefits, i.e., they become aggressive in exploiting safety net benefits post-merger. Other studies, such as [29] relate merger premiums to size change dummy variables.

They argue that the amount of premiums paid for reaching certain size thresholds reflects the perceived benefits of safety net subsidies. However, this literature only takes into account safety net subsidy benefits resulting from size increases. Also their measure of merger premiums does not control for size effect, which may bias their findings.

Another strand of the literature measures the specific benefits that TSITF banks may enjoy. Soussa [9] studies the Fitch IBCA's bank support ratings in 15 countries as an indicator of TSITF status. [1] He finds that banks tend to be rated as 1 or 2 (i.e. they are most likely to receive official support) if they are larger and issue securities. Moreover, he examines the difference between a bank's standalone ratings (Fitch IBCA's Individual Rating) and inclusive ratings (Fitch IBCA's Long-term Credit Rating) of 120 banks from six countries - reflecting the value of safety net subsidies. The results show that TSITF banks receive significant official support compared to smaller banks. Similarly, Rime [10] also analyses banks' ratings from Fitch IBCA and Moody's in 21 industrialized countries during 1999 and 2003 and finds evidence that TSITF status has a significant and positive impact on bank's standalone ratings. Carbó et al. [42] estimate differences in safety net benefits and in supervisory effectiveness for EU 15 countries (excluding Greece) and conclude by showing that banks from high-subsidy and low-restraint countries tend to conduct more cross-border M&A activities. Using the same sample and approach, Carbó et al. [41] find that there are significant differences between banks that conduct cross-border mergers and other EU banks in terms of risk taking and access to safety net subsidies. Hughes and Mester [34] find a significant negative relationship between funding costs for U.S. bank deposits and the size of the banks giving support to the existence of TSITF. Flannery and Sorescu [31] examine subordinated debenture yields of U.S. banking firms and find that smaller banks pay higher spreads. Penas and Unal [33] focus on the impact the largest banks' merger activities have on bond returns. They find a gain in bond returns and a decline in credit spread after a merger, which points to the existence of TSITF. More recently, Volz and Wedow [30] examine large banks' CDS prices in 24 countries and find that these tend to be lower if the bank is larger, implying that less market discipline can be exercised on TSITF banks.

There are many studies that address the systemic risk implications of TSITF. These measure systemic risk typically using correlations of stock returns of large financial institutions. For example, Brasili and Vulpes [23] analyze co-movements in bank risk for large European banks during the period 1994-2003. They find that EU-wide risk increased following the introduction of the Euro in 1999. Gropp and Moermann [24] report that correlations between large banks' stock price returns increased during the 1990s in the EU. Hawkesby et al. [25] report some degree of commonality in the movements in asset prices of large international financial institutions based in the UK. Hawkesby et al. [11] also find a relatively high degree of commonality for a group of selected large complex financial institutions in the U.S. and EU. However, there is a less developed literature that links consolidation to systemic risk. De Nicolo and Kwast [36] examine the impact of consolidation among large and complex banks in the U.S. on systemic risk (measured using

[1] *According to Fitch IBCA, this rating gauges a government's propensity to support a bank and of its ability to support it. A support rating ranges from 1 to 5. A rating of 1 or 2 indicates an extremely high or high propensity to receive government support, while a rating of 4 or 5 indicates a limited or very limited probability of support because of significant uncertainties about the ability or propensity of any possible provider of support to do so.*

correlations of stock returns). Their results show that despite an increase in systemic risk within the banking sector, the effects of consolidation appear to have eased in the latter half of the 1990s. On the contrary, De Nicolo et al. [43] use accounting data to calculate the aggregate Z-scores of the largest five banks in a country to measure systemic risk these banks may pose. They find evidence that level of concentration of a banking system is positively associated with systemic risk potential.

3. Research Questions and Hypotheses Development

In this section, we provide an overview of our research questions and develop our hypotheses.

3.1 Do banks pay higher M&A premiums for safety net benefits?

Acquirers often pay more than a target's 'fair value' in the consolidation process. To explain this phenomenon, previous studies mainly focus on the financial characteristics of the target, acquirer as well as the combined entity [44, 45, 46, 47]. Other motives such as market power gains, better safety net access, on the other hand, have been less examined [13, 29]. Our first hypothesis homes in on the fact that a bank can gain better access to safety net, or in other words, increase its systemic importance post-merger. By taking over various targets, a bank can become substantially larger, have a more complex business model and therefore become more interconnected with more counterparties in the financial system. To achieve this, a bank may pay a higher premium in a merger deal for safety net subsidies (as well as other benefits) it may obtain after the transaction. We formulate our first hypothesis as follows:

H1. Safety Net Subsidies Payment Hypothesis: *Merger premiums are paid for safety net subsidies in banking M&As.*

3.2 Does exploitation of safety net benefits lead to bank rescues?

To answer this research question, we first define rescued banks in the 2008-9 crises as TSITF. The identification of TSITF in our study is simple yet appropriate. During the recent crisis, there were numerous banks that were assisted by their regulators in different ways to avoid their failures. Regulators justified their rescues by stating that these banks were systemically important to the stability of the financial systems and economies [20, 21]. Moreover, in general the risk of failure is a consequence of a set of risky decisions made by banks. If we examine the pattern of behavior of those TSITF banks over ten years pre-crisis, in other words whether they exploit safety net before the crises, we may be able to discern whether there is moral hazard effect.

Among the very few formal models of TSITF in the literature, Ennis and Malek [48] show that TSITF policy creates not only a risk distortion (moral hazard) but also a size distortion, and the one distortion tends to enhance the other and vice

versa. Thus, theoretically banks would try to become larger to exploit safety net meanwhile becoming more risk taking.

We assume in our study that the amount of safety net subsidies obtained via M&As reflect the level of risk and systemic importance distortion banks seek from the transactions. More specifically, TSITF banks pay higher merger premiums so as to obtain safety net subsidies, providing them with benefits unavailable to smaller counterparts, namely, so that they cannot be adequately disciplined by the market [8]. This results in a gradual increase in moral hazard that can eventually lead to their failure. This process can eventually trigger panics, bank runs, a full-scale financial crisis and costly bank rescues [1]. We hypothesize this as follows:

H2. Safety Net Exploitation Hypothesis: *TSITF banks exploit safety net via M&As*

3.3 Does exploitation of safety net benefits have implication for interdependence between TSITF banks?

Goodhart and Huang [49] develop a model of the lender of last resort. They show that if contagion is the main concern, the central bank will have an excessive incentive to rescue banks. Therefore theoretically rescued banks pose systemic risk. In our study, TSITF banks' exploitation of safety net may result in an increase of systemic risk they pose over the time, which is measured by interdependence between TSITF bank (i.e. stock return correlations among TSITF banks). In contrast, Kane [6] addresses the concern that linkages between TSITF banks' is not a complete measure of systemic risk. Thus, we may not be able to find a significant relationship between gaining safety net subsidies via M&As and increases in systemic risk. We summarize it as the following hypothesis:

H3. TSITF Interdependence Implication Hypothesis: TSITF banks exploit safety net and in turn increase their interdependence with other TSITF banks

4. Data, Methodology and Results

4.1 Data sources

Between October 2008 and June 2009 a total of 12 EU countries provided ailing banks with various rescue packages [18, 50]. These countries include Austria, Belgium, France, Germany, Greece, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden and the UK. All countries claimed that the failure of these banks would disrupt the provision of financial services to the real economy and have dire economic and social consequences. [2] Allowing for widespread bank insolvency was not a credible policy option [50]. Consequently, these rescued banks are the natural

[2] *It has become a usual approach for banking regulators to provide support measures when handling banking crises. See for example [2, 51, 52] for detailed accounts of the regulators' responses in various countries since the 1990s.*

candidates for TSITF in this study. We, however, exclude Ireland, Luxembourg and Spain from our sample due to incomplete information. [3] We therefore have 9 EU countries (Austria, Belgium, France, Germany, Greece, Netherlands, Portugal, Sweden and the UK), which experienced 70 bank rescues during the crisis. *Table II* presents a list of rescued banks and outlines the rescue measures taken.

[Insert Table II here]

We hand-collect information on banks' M&As in nine EU countries between 1997 and 2008 from Thomson One Banker. In total, we identify 173 M&A transactions where acquirers take full control of targets (over 50% share control after a transaction). Acquirers are banks or mutual credit institutions and targets are defined as financial service providers (defined by Thomson One Banker to include banks, insurance companies, asset-management firms, credit institutions and brokerages). We abstract banks' accounting information from BankScope.

4.2 Extracting safety net subsidies in M&As

4.2.1 Regression Model

Previous studies have tested whether acquiring banks pay a higher premium to gain safety net subsidy benefits as one of the motives in M&As using ordinary least squares (OLS) regression models [e.g. 13, 29, 40]. In this study, we use frontier modeling technique borrowed from the efficiency literature to capture safety net subsidy gains in M&As. The efficiency literature defines inefficiency as departures from best practice levels (defined by a parametric or non-parametric frontier) [53]. Recently, such techniques have also been applied in other contexts in the banking literature. For example, Baele et al. [54] estimate a stochastic frontier to examine banks' 'risk inefficiency' relative to the best performing peers. This methodology is also applicable in this study and more appropriate than an OLS regression model. The underlying reason is that if we employ an array of variables that explain the primary determinants of merger premiums paid in banking, excluding the safety net subsidy motive, the unexplained amount of premiums can then be further decomposed into a random error (that incorporates measurement error and randomness of an acquiring bank's valuation of a target firm) as well as a one-sided deviation that indicates merger premiums paid to seek safety net subsidies (if any). [4] The safety net subsidies estimated by this approach are arguably a more complete measure compared to the ones by existing studies [e.g. 29], which mainly consider one aspect of systemic importance only (e.g. size). The model we use is as follows:

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[3] *Ireland had 6 banks that were rescued (Allied Irish Bank, Anglo Irish Bank, Bank of Ireland, Postbank EBS Building Society, Irish Nationwide Building Society), but these were excluded from our analysis because of limited M&A information. Spain and Luxembourg only provided state guarantees to Caja Castilla-La Mancha and capital injections into Fortis Banque Luxembourg respectively. Therefore, these two countries are also excluded.*

[4] *While including all primary determinants, the list of variables in this model cannot be exhaustive and the deviations may be explained by some missing variables to some extent. Nevertheless, the deviations are still largely explained by safety net subsidy gains other than other less important factors. One way to prove this, we remove few control variables from the model (e.g. TSUP, TCON etc.) and the deviations remain statistically consistent.*

$$PREM_{i,j} = \alpha + \beta_1 MPOW_{i,j} + \beta_2 RROA_{i,j} + \beta_3 RCIR_{i,j} + \beta_4 AGECY_{i,j} + \beta_5 TLEV_{i,j} + \beta_6 TFOC_{i,j} + \beta_7 TGROW_{i,j} + \beta_8 TSUP_j + \beta_9 TCON_j + \beta_{10} RSIZE_{i,j} + u_{i,j} + v_{i,j}$$

[1]

Equation [1] relates merger premiums to various independent variables explained in detail below. Residuals from the estimation are decomposed into a pure noise component $v_{i,j}$ and safety net subsidies $u_{i,j}$. The term $u_{i,j}$ is assumed to be strictly positive [53]. The dependent variable of *equation [1]* - PREM is bank merger premiums measured as follows:

$$PREM = \frac{deal\ value}{V \times s} - 1$$

[2]

where V is market capitalization of the target 20 days before the deal if the target was a listed company. [5] In many cases, however, the target was not publically listed or the market value is not available. Although the literature that studies bank merger premiums tend to use book values [e.g. 13, 45, 47, 55, 56], it is arguably a less accurate measure because a bank's future cash flow is not incorporated. We therefore use average market/book ratios of a target's peers (based on pre-merger asset size and return on asset ratio) to adjust target's book value of equity in the fiscal year before the deal announcement. The term s is the percentage of shares acquired in the deal.

4.2.2 Explanatory Variables

First, following Pennacchi's [22] caution about the interpretations of results from M&A event studies, we introduce three major motivations for bank M&As (excluding safety net subsidies).These incentives relate to: enhanced market power, efficiency gains and managerial agency problems. MPOW is a target's interest margin divided by the acquirer's interest margin before the merger, which measures potential market power gains from an M&A transaction [57]. In terms of the efficiency gains, we use both profit-based and cost-based ratios to capture such potential: RROA is the ratio of the target's return on assets (ROA) to the acquirer's ROA; and RCIR is the ratio of the target's cost-to-income ratio (CIR) and the acquirer's CIR. [6] Previous studies have reported that acquirers may prefer a target with efficiency potential measured with reference to either profit or cost

[5] *Market capitalization may respond to information leakage (if any) before the M&As. Therefore, merger premiums measured may not be accurate in this case. We also use companies' market capitalization 30, 40 or 50 days before the M&A announcement alternatively to calculate the merger premiums, the results, nevertheless, from the stochastic frontier model remain consistent.*

[6] *CIR is the costs of running a bank or financial firm, excluding interest expenses and loan-loss provisions, expressed as a percentage of income before loan-loss provisions.*

benchmarks [58]. AGECY is the number of shareholders of an acquiring bank. A larger number of shareholders may indicate a higher level of agency conflicts/costs. A significant and positive coefficient on this variable suggests that M&As are driven by management to seek career risk diversification [45].

The following three independent variables in *equation [1]* describe targets' characteristics: TLEV measures the levels of target's Tier 1 capital, which is the equity-to-asset ratio in the fiscal year before the M&A announcement. Most studies report a significantly negative relationship between the levels of target capital and merger premiums paid as higher levels of capital may dilute the merger premiums paid per share [e.g. 13, 44, 46, 47, 59]. TFOC indicates target firm's business focus. In this study, acquiring firms are either banks or mutual credit institutions and targets include all types of financial service providers. We use the ratio of the net interest income of the target firm to its total operating income in the year prior to the transaction to measure the extent to which the target firm is focused on traditional core banking business. We assume that acquiring banks may pay a premium if the target generates more income from fee-based business lines, which, in turn, may provide greater opportunities for diversification. Studies, however, find no strong evidence to support this hypothesis [e.g. 29, 47]. TGROW measures target's pre-merger growth. It has been suggested that acquiring banks may prefer fast-growing targets [56, 60, 61]. TGROW is the target's average assets growth rate over three years prior to the merger. [7] We use TSUP to measure the target country's supervisory strength. Evidence shows that acquirers exploit regulatory arbitrage if a target's home country has weak regulations [13, 41]. Following Buch and DeLong [62] and Hagendorff et al. [13] we compile a Supervisory Strength Index for the acquirer and target's countries based on the Barth et al. [63] database on global banking supervision. Supervisory Strength Index varies between 0 and 12 with higher scores indicating a banking system with a stronger supervisory environment and enforcement. [8]

A concentrated banking market may be appealing for an acquirer as a high level of profitability may be maintained compared to a more competitive market. Some studies have found that acquiring banks pay higher premiums to targets in more concentrated markets [44, 45]. Others, however, find no significant relationship [13, 46, 47]. [9] We measure target's market concentration using the CR3 ratio

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[7] *We also use core deposit growth rate to proxy target's growth potential as suggested by Cheng et al. [56], and find similar results.*

[8] *Target's home country's supervisory strength index (TSUP) is an equally-weighted sum of 12 components, which include: banks disclose risk management procedures; risk-weights are in line with Basle guidelines; the capital-asset ratio varies with credit risk; the capital-asset ratio varies with market risk; there is a formal definition of 'non-performing loan'; there are automatic mechanisms to sanction directors and managers; the supervisory agency can order directors/management to make provisions to cover losses; the supervisory agency can suspend the distribution of dividends, bonuses, or management fees; the latter has been enforced in the past five years; the supervisory agency can declare a bank insolvent; the agency can suspend ownership rights of a problem bank; the supervisory agency can take measures aimed at bank restructuring and reorganization.*

[9] *Note that here is a related body of literature in banking that focuses on measurement of bank competition [e.g. 64]. However, a further investigation of this matter is beyond the scope of this study and we assume that greater concentration correlates positively with less competition. We believe this is justified in our context as we only focus on a small set of predominantly large and complex institutions with fundamentally different business models from those observed in small savings and cooperative banks that operate locally.*

(TCON), which is the market share (in terms of assets) of the largest three banks in a country.

The size of the target in relation to the acquirer is also included in our model. RSIZE is defined as the ratio of the sum of the target and acquirer's asset size divided by the acquirer's assets in the year preceding the merger. The findings from the literature are mixed. Some studies find a significantly negative relationship suggesting that acquirers may prefer smaller targets so post-integration costs will be lower [40, 45, 46, 56, 59]. In contrast, a positive and significant relationship can be found in other studies, which may suggest that potential economies of scale are sought by the acquirers [29, 59].

Table III presents summary statistics of all variables in *equation [1]*. It shows that targets in EU banking M&As have an average equity-to-asset ratio of 10%. They also have considerable fee-based business. They seem to grow quickly prior to the M&A transactions and tend to have greater market power (measured by the Lerner index) compared to acquirers. Acquirers appear to be more profitable (higher ROA's) but are more inefficient (larger CIR ratios).

[Insert Table III here]

4.2.3 Results

Table IV shows the summary statistics of term $u_{i,j}$ derived from the decomposition of the error from the stochastic frontier model to capture safety net subsidies. As noted earlier, this is the part of M&A premiums not explained by traditional variables and interpreted to reflect the portion of the premium paid to gain safety net subsidies. Theoretically, term $u_{i,j}$ is non-negative. In total, we have 152 observations and the value varies from 0.24 to 2.98 with a higher value indicating a larger portion of merger premium paid for safety net benefits. According to *Table IV*, Portuguese banks paid the highest premiums (with an average score of 1.303). Belgian and French banks are behind Portugal, whereas Austrian banks paid the lowest premiums to achieve safety net benefits (with a mean value of 0.682).

[Insert Table IV here]

For completeness, we also discuss in *Table V* the results that examine the commonly used determinants of merger premiums. As can be seen, we find that market power gains seem to explain the amount of merger premiums paid. The coefficient on MPOW is strongly positive and significant. The coefficient on RCIR is positive at 5% significance level. This result suggests that EU acquiring banks prefer to take over less cost efficient targets. The coefficient on TSUP is positive and significant. This result contradicts the findings from previous studies and

suggests that EU acquirers are willing to pay a higher premium for a target located in a strong supervisory environment. Finally, TCON is also strongly positive, which is consistent with the findings from Beatty et al. [44] and Palia [45] and suggests that acquirers pay a higher premium for a target in a more concentrated market. The overall estimation of this stochastic frontier model appears to be relatively efficient in testing for the determinants of M&A premiums, as indicated by the Wald χ^2 statistics significance at the 1% level.

[Insert Table V here]

4.3 A new test for safety net exploitation of TSITF

4.3.1 Regression Model

In the second step of our analysis, we use a binomial probit model to assess whether a bank that posed systemic risk during 2008 and 2009 paid merger premiums in the past to gain safety net subsidies. We estimate the model as follows:

$$PR(TSITF_{i,j}) = \alpha + \beta_1 SUBD_{i,j} + \beta_2 SIZE_{i,j} + \beta_3 COMP_{i,j} + \beta_4 CONN_{i,j} + \beta_5 ASUP_j + \beta_6 DEP_j + \varepsilon_{i,j} \quad [3]$$

where TSITF is a dummy variable, which takes the value 1 if a bank in a banking system posed systemic risk between 2008 and 2009. These are banks that were actually rescued or supported during the crisis. Non-rescued banks as control group take the value 0.

Various banking rescue/support measures may result in different economic and social costs. For example, government capital injections may impose greater costs to taxpayers than other types of intervention such as loan guarantees etc. We therefore also estimate equation [3] as a multinomial probit regression by assuming TSITF has three outcomes 1, 2 and 3: non-rescued banks, banks receiving state guarantees and banks that were recapitalized between 2008 and 2009. [10] The explanatory variables of *equation [3]* are defined as follows:

4.3.2 Explanatory variables

SUBD are the sum of the safety net subsidies estimated from *equation [1]* (i.e.$u_{i,j}$) for an acquiring bank between 1997 and 2008. We assume that there is a higher probability that an acquiring bank that posed systemic risk (was rescued) in

[10] If a bank received state guarantees as well as capital, we classify it as 'bank that was recapitalized'. Some banks were nationalized or forced to merge with other banks as rescue measures. They were, however, too few to be included as one of the outcomes for a multinomial probit regression. As these banks meanwhile received capital injection from their governments to be nationalized or assist the merger deals, we classify these banks as 'banks that was recapitalized'.

the recent financial crisis had gained safety net subsidies via previous M&A activity. SIZE is the acquiring bank's size measure as at December 2007. The link between the size of a bank and the effect that its distress or failure will bring about is regarded as a key factor in the assessment of its systemic importance [21]. We use two separate size measures: the first is an absolute measure ABSIZE that is the natural logarithm of a bank's assets; the second measure is a market share indicator MAKSH – bank assets size divided by total assets of the banking sector. The relevance of size will also depend on a bank's complexity and interconnectedness [21]. A complex bank may simultaneously have banking, insurance and securities subsidiaries; operate internationally; and/or have exposures to broad array of financial products and markets [20, 21]. We use a variable COMP to measure a bank's complexity in December 2007, which is the natural logarithm of the number of an acquiring bank's total subsidiaries. Interconnectedness, on the other hand, measures contractual relations with other institutions. We capture these relations by observing interbank lending activities (CONN). We again use two complementary measures: the first ABCONN is the natural logarithm of an acquiring bank's total interbank deposits in December 2007. The second, RECONN is the ratio of acquiring bank's interbank deposits divided by total bank deposits (excluding its own share) in December 2007.

Finally, we include two country level control variables ASUP and ADEP. These refer to the Supervisory Strength Index (previously defined in section 4.2) and the Deposit Insurance Strength Index in 2007, respectively. The Deposit Insurance Strength Index (ADEP) is measured according to Hagendorff et al. [13] and takes a value between 0 and 3 with higher values indicating a stricter (more expensive) deposit insurance arrangement. [11] Bail-out policy is expected to vary in different countries. We control for these regulatory settings as it may be the case that in weaker regulatory environments there are more banks that may pose stability threats. *Table VI* presents summary statistics of all variables in *equation [3]* (excluding SUBD, which is shown in *Table IV*).

[Insert Table VI here]

4.3.3 Results

Table VII shows the results from the estimation of *equation [3]* using a binomial probit regression model, which analyses the probability that a TSITF bank (defined as banks that were rescued in 2008 and 2009) paid merger premiums to gain safety net subsidy benefits.

We report marginal effects of five estimations. A consistent and significant finding shows that gaining safety net subsidies in the pre-crisis era via M&As increases the probabilities of being rescued in the crisis by 0.06% to 0.9%. This therefore confirms our ***Safety Net Exploitation Hypothesis***. Furthermore, these TSITF banks are larger, more complex and interconnected than other non-TSITF

[11] *Acquiring bank's home country's Deposit Insurance Strength index (ADEP) in 2007 is an equally-weighted sum of 3 components as follows: there is an explicit deposit insurance system; deposit insurance premiums are risk-adjusted and the deposit insurance system requires co-insurance.*

banks. We also find that the regulatory regime (measured using the Supervisory Strength Index and Deposit Insurance Strength Index) has a positive and significant influence on the presence of TSITF banks. Overall, all specifications exhibit a relatively high classification accuracy. For example, the area under the receiver operating characteristic (ROC) curve is on average above 93%. [12]

[Insert Table VII here]

Table VIII shows the results from the estimation of *equation [3]* using a multinomial probit regression model instead, which analyses the probability of several outcomes of being a TSITF bank. In each estimation, TSITF = 1 (non-rescued bank) is the base outcome. We find evidence that gaining safety net subsidies tends to increase the probabilities of being recapitalized (including nationalization or a forced merger) more than that of getting state guarantees, which is both statistically and economically significant. For instance, in all five estimations gaining safety net subsidies significantly increases the possibilities of being recapitalized in the crisis by 0.14% to 0.9%. In contrast, only in 3 out of five estimations seeking safety net subsidies increases the possibilities of getting state guarantees by around 0.4% on average. This suggests that banks that gain safety net subsidies prior to the crisis tend to cost taxpayers more than other banks in our sample. Moreover, there is evidence that a strict supervisory regime and generous deposit insurance scheme are more likely to offer failing banks state guarantees rather than capital injections.

[Insert Table VIII here]

To evaluate the economic significance of the results from the probit model, we also report the predicted probabilities of being a TSITF bank in our sample in *Table IX*. When all independent variables of the first regression of *Table VII* are held constant at their means, the unconditional probability of being a TSITF bank is 0.998. We then compare the change of this probability and consider changes from the 10th percentile of several key variables of interest to the 90th percentile of the distribution of these variables. When variables controlling for acquiring bank's size and acquirer's home country's Supervision Strength Index and Deposit Insurance Strength Index in 2007 (i.e. ABSIZE, ASUP and ADEP) are all held constant at their mean, the change of predicted probabilities for a bail-out by changing safety net subsidy effects varies from about 98% to over 99%.

[Insert Table IX here]

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[12] *Receiver operating characteristic (ROC) curves are used to describe and compare the performance of diagnostic technology and diagnostic algorithms. In this study, an area of 100 under ROC curve would imply completely deterministic bail out probabilities.*

4.4 A new test for interdependence among TSITF banks

Having tested the systemic risk implications of TSITF in the second step of analysis, we re-examine this issue in a different way. We first follow the traditional approach measuring TSITF bank and peers' bivariate share return correlations in each country between 1998 and 2009 [11, 36]. Next, we estimate each TSITF bank's average correlation with its peers in each year - this measures the interdependence the TSITF bank had with other peer banks. We then take the year-on-year difference of the correlations to measure change in interdependence (systemic risk change) of a TSITF bank (variable $\Delta INDEP$). As the number of banks that are publically listed is limited, we are not able to carry out a comprehensive test. Here we only examine the correlation coefficient of $SUBD_t$ and $\Delta INDEP_{t+1}$ and assume that gaining safety net subsidies is unlikely to lead to a significant increase in interdependence increase (given reservations about the incompleteness of our systemic risk measure as noted by Kane [12].

Table X shows the results from this test. As not all TSITF banks were listed, we reduce our observations from 152 (deals with safety net subsidy effects from equation 1) to 89. On average, $\Delta INDEP$ has a 0.011 mean value. [13] The correlation coefficient between these two variables is -0.03, indicating no clear relationship. We also increase the gap from one year to two years or three years to re-estimate $\Delta INDEP$ assuming gaining safety net subsidies may affect this systemic risk measure over the medium term. Again, we cannot find any significant link. [14] These results reject our ***TSITF Interdependence Implication Hypothesis*** and show that TSITF banks that gain safety net subsidies via M&A do not appear to have any impact on interdependence with peer banks.

[Insert Table X here]

5. Robustness tests

We first re-estimate *Equation [3]* using Heckman's procedure for potential selection bias. This procedure adds a selection probit model. Its dependent variable is a dummy variable, which takes the value 1 if a bank in a banking system engaged in M&As activity between 1997 and 2008, otherwise takes the value 0. This selection model is linked to the outcome probit model by a variable called Lambda (also known as inverse mills ratio). *Table XI* shows the marginal effects of

[13] *In general, average stock price correlations for all TSITF banks in 6 EU countries (Sweden, Portugal and Netherlands are excluded due to lack of data) increase from 0.317 in 1997 to 0.395 and 0.471 in 2007 and 2008. This is consistent with findings from Brasili and Vulpes [23], Gropp and Moermann [24], Hawkesby et al. [25], Hawkesby et al. [11].*

[14] *Results of these robustness tests are not presented in the paper. They are available upon request.*

outcome probit model and selection probit model, which are consistent with our previous findings. Therefore, sample selection issue is not presented in our study.

As explained earlier we apply frontier modeling techniques to estimate *Equation [1]* to decompose the unexplained amount of premiums into safety net subsidy gains and a random error. To test the robustness of this approach, we use the ordinary least-squares (OLS) regression model instead to estimate *Equation [1]*. In this case, residuals from the OLS estimation are treated as safety net subsidy gains (with no random errors separated). We then repeat our second step analysis using the residuals from the OLS estimation as the variable SUBD in *Equation [3]*. *Table XII* shows that only in two out of five estimations gaining safety net subsidies significantly increases the possibilities of being a rescued bank in the crisis. This may be explained by the inclusion of random errors in the variable SUBD in this estimation, which in turn suggests the necessity of applying a stochastic frontier modeling technique in our study. At the same time, it does not invalidate the previous inferences.

Our test for TSITF banks' interdependence suffers from a drawback that only listed TSITF banks are examined. We therefore use all TSITF banks' balance sheet information to calculate aggregate Z-scores for each country and each year as a systemic risk indicator between 1998 and 2009. [15] This measure proxies the joint probability of failure for TSITF banks in each country and is consistent with the definition of systemic risk potential based on the strength of total interdependence among systemically important institutions [43]. We then measure the change in total interdependence ($\Delta INDEP$) by estimating the year-on-year percentage change of aggregate Z-scores and examine the correlation coefficient of $SUBD_t$ (estimated from *Equation [1]* using frontier modeling) and $\Delta INDEP_{t+1}$. [16] The correlation coefficient between these two variables is -0.108, which again shows no significant relationship.

[Insert Table XI here]

[Insert Table XII here]

6. Conclusion

There has been growing interest on how to monitor and discipline 'too-systemically-important-to-fail' (TSITF) banks so as to prevent future costly bail-outs. This paper contributes to the existing literature by addressing three highly policy-relevant and related research questions:

[15] *See De Nicolo et al. [43] for details*

[16] *The results are not shown here to preserve space they are available from the authors on request.*

1) Do banks pay higher M&A premiums for safety net benefits?
2) Does exploitation of safety net benefits explain bank rescues in the 2007-9 crises?
3) Does interdependence between TSITF banks have implications for systemic risk?

We first examine the determinants of bank merger premiums by using a frontier modeling technique to strip-out a safety net subsidy measure. In total, we identify 152 M&As where premiums are paid for safety net subsidy benefits. Acquiring banks are found to have paid higher premiums for targets that have: greater market power, less cost efficiency and are based in countries with higher concentration and tougher supervisory regimes.

Secondly, we incorporate our safety net subsidy measures in a probit model that tests for the probability of being a systemically important bank (defined as banks rescued during the recent crisis). We find that safety net subsidy benefits derived from M&A activity have a significant and positive association with rescue probability. As such direct evidence is found that merger premiums are paid to obtain safety net subsidies and have adverse systemic risk implications.

Finally, we evaluate traditional measures of systemic risk by examining the relationship between safety net subsidy effects and interdependence between TSITF banks post-merger. We do not find any significant relationship suggesting that stock price return correlations for systematically important banks are not linked to safety net subsidies. This result further questions the efficacy of using stock-return correlations as an appropriate indicator of banking sector systemic risk.

A number of robustness tests show that our results are not affected by sample selection bias; frontier technique is more appropriate than OLS regression estimating safety net subsidies and results remain consistent when banks' interdependency is measured by accounting measure instead of market information.

Our study suggests the necessity of monitoring and limiting the systemic importance of banks by discouraging them to grow excessively via M&A activity to prevent any future TSITF bailouts. It therefore contributes to the policy debates and reflects the recent legislation development in the US EU.

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Table I. Summary of TSITF studies classified by TSITF thresholds employed

TSITF threshold	List of studies	Details of thresholds
Size measured by assets	Mayer [26]	• Large banks
	Kane [6]	• the 12 largest banks in the US 1991-1998
	Spiegel and Yamori [27]	• the 10 largest banks in Japan 1995-1998
	Shull and Hanweck [28]	• the 10 largest banks in the US
	Brewer and Jagtiani [29]	• a bank's total assets exceed $100 billion in the US 1991-2004 • the largest 11 banks in the US 1991-2004
	Rime [10]	• logarithm of a bank's assets in 21 industrialized countries 1999-2003
	Volz and Wedow [30]	• a bank's monthly asset value provided by Moody's in 24 countries 2002-2007
Size measured by market capitalisation	Kane [6]	• the largest 12 banks in the US 1991-1998
	Brewer and Jagtiani [29]	• a bank's total market capitalization exceeds $20 billion in the US 1991-2004
	Volz and Wedow [30]	• a bank's market capitalization in 24 countries 2002-2007
Size measured by asset market share	Carrington [3] Sprague [4] O'Hara and Shaw [5] Flannery & Sorescu [31] Black et al. [32] Morgan and Stiroh [7]	• the largest 11 banks in the US in terms of asset market share (bank's assets/total banking assets) 1984
	Penas and Unal [33]	• a bank's assets exceed two percent of whole banking assets
	Rime [10]	• a bank's assets/total banking assets in 21 industrialized countries 1999-2003
Size is measured by the level of industrial output	Hughes and Mester [34]	• a bank's commercial and industrial loans
Systemic importance measured by rating	Soussa [9]	• a bank's Fitch IBCA Support Rating 1 or 2

- to be continued -

TSITF threshold	List of studies	Details of thresholds
Systemic importance measured by various Criteria	Todd and Thomson [35]	• a bank's interbank exposure
	De Nicolo and Kwast [36]	• 22 large and complex banking organizations in the US 1988-1999 • have significant on and off balance sheet activities • offer a broad range of products and services at the domestic and international levels • participate extensively in large value payment and settlement systems • are of substantial size
	Kaufman [19, 37, 38]	• a bank's deposits provide a large share of money supply • banks that are the largest lenders to households, businesses, and governments • banks that operate much of the payment system • banks that are closely interconnected to each other through interbank deposits and loans
	Volz and Wedow [30]	• a bank's assets/GDP in 24 countries 2002-2007
	Tarashev et al. [39]	• a financial institutions' probability of default (e.g. Moody's KMV) • degree of size concentration (e.g. liabilities/total market liabilities) • a financial institutions' exposure to common or systematic risk factors (imposing a single-common-factor structure on the Moody's KMV estimate of the institution's asset-return correlations)
	Bank of England	• size (e.g. a bank's total assets/total

	[20]	banking assets) • interconnectedness (e.g. a bank's interbank liabilities/ total banking assets)
	IMF/BIS/FSB [21]	• size (e.g. a bank's total assets and liabilities/GDP) • lack of substitutability • interconnectedness (e.g. consolidated international claims, CDS) • leverage • liquidity risks and large mismatches • complexity

Table II. **List of rescued banks in 9 EU countries between October 2008 and June 2009**

The table presents a list of banks in Austria, Belgium, France, Germany, Greece, Netherlands, Portugal, Sweden and the UK that were rescued by their own governments (Dexia's state guarantees were provided by Belgium, France and Luxembourg jointly) between October 2008 and June 2009.

Country	Name of the bank	Rescue measures
Austria	Erste Bank Group AG	State guarantees (Euro 6 billion) Recapitalisation (Euro 1 billion)
	Kommunalkredit AG	State guarantees (Euro 5.2 billion) Recapitalisation (Euro 1.2 billion) Nationalisation on 5th January, 2009
	Austrian Clearingbank AG	State guarantees (Euro 4 billion)
	Volksbanken AG	State guarantees (Euro 3 billion) Recapitalisation (Euro 1 billion)
	Raiffeisen Zentralbank AG	State guarantees (Euro 4.25 billion) Recapitalisation (Euro 1.75 billion)
	Hypo Alpe-Adria-Bank International AG	State guarantees (Euro 1.35 billion) Recapitalisation (Euro 0.9 billion)
Belgium	Dexia	State guarantees (Euro 150 billion)[a] Recapitalisation (Euro 3 billion)
	Fortis	State guarantees (Euro 150 billion) Recapitalisation (Euro 15.9 billion)
	Fortis NV/SA	Recapitalisation (Euro 9.4 billion) Nationalisation on 5th October, 2008 Acquisition by BNP Paribas
	Fortis Bank Netherlands NV	Recapitalisation (Euro 2.04 billion)
	KBC	Recapitalisation (Euro 7 billion)
	Ethias Group	Recapitalisation (Euro 1.5 billion)

France	Dexia	State guarantees (Euro 150 billion) [a] Recapitalisation (Euro 3 billion)
	Banque Fédérale des Banques Populaires	Recapitalisation (Euro 0.95 billion) Access to Euro 50 billion emergency Loans Merger with Caisse Nationale des Caisses d'epargne with Euro 5 billion capital injection
	BNP Paribas SA	Recapitalisation (Euro 2.55 billion) Access to Euro 50 billion emergency loans
	Caisse Nationale des Caisses d'epargne (CNCE)	Recapitalisation (Euro 1.1 billion) Access to Euro 50 billion emergency loans Merger with Banque Federale des Banques Populaires with Euro 5 billion capital injection

- to be continued -

Country	**Name of the bank**	**Rescue measures**
	Crédit Agricole	Recapitalisation (Euro 3 billion) Access to Euro 50 billion emergency loans
	Crédit Mutuel	Recapitalisation (Euro 1.2 billion) Access to Euro 50 billion emergency loans
	Société Générale SA	Recapitalisation (Euro 1.7 billion) Access to Euro 50 billion emergency loans
	Banque PSA Finance	Access to Euro 50 billion emergency loans
	Caisse centrale du Credit Immobilier de France	Access to Euro 50 billion emergency loans
	GE Capital SAS	Access to Euro 50 billion emergency loans
	Groupe RCI Banque	Access to Euro 50 billion emergency loans
	Societe des Paiements Pass- S2P	Access to Euro 50 billion emergency loans
Germany	Aareal Bank	State guarantees (Euro 4 billion) Recapitalisation (Euro 0.53 billion)
	Bayern LB	State guarantees (Euro 15 billion)
	HSH Nordbank AG	State guarantees (Euro 30 billion) Recapitalisation (Euro 3 billion)

	Hypo Real Estate AG	State guarantees (Euro 52 billion)
	IKB	State guarantees (Euro 5 billion)
	SdB	State guarantees (Euro 6.7 billion)
	Sachsen LB	State guarantees (Euro 2.75 billion)
	Nord LB	State guarantees (Euro 20 billion)
	Commerzbank AG	Recapitalisation (Euro 10 billion)
Greece	Agricultural Bank of Greece SA	Recapitalisation (Euro 0.675 billion)
	Alpha Bank SA	Recapitalisation (Euro 0.95 billion)
	Aspis Bank SA	Recapitalisation (Euro 0.09 billion)
	Attica Bank SA	Recapitalisation (Euro 0.1 billion)
	EFG Eurobank Ergasias SA	Recapitalisation (Euro 0.95 billion)
	General Bank of Greece SA	Recapitalisation (Euro 0.18 billion)
	Millennium Bank SA	Recapitalisation (Euro 0.065 billion)
	National Bank of Greece SA	Recapitalisation (Euro 0.35 billion)
	Piraeus Bank SA	Recapitalisation (Euro 0.37 billion)
	Proton Bank SA	Recapitalisation (Euro 0.079 billion)
Netherlands	Fortis Bank Nederland NV	State guarantees (Euro 7.85 billion) Recapitalisation (Euro 1.96 billion) Nationalisation on 3rd October, 2008
	ING Bank NV	State guarantees (Euro 11.4 billion)
	NIBC Bank N.V.	State guarantees (Euro 4.8 billion)
	SNS Bank N.V.	State guarantees (Euro 5.488 billion) Recapitalisation (Euro 0.75 billion)
	Aegon N.V.	Recapitalisation (Euro 3 billion)
	ING Groep N.V	Recapitalisation (Euro 10 billion)
Portugual	Banco Espirito Santo	State guarantees (Euro 1.5 billion)
	Banco Finantia	State guarantees (Euro 0.1billion)
	Banco Internacional do Funchal	State guarantees (Euro 055 billion)
	Banco Invest	State guarantees (Euro 0.025 billion)
	Banco Privado Portugues	State guarantees (Euro 0.45 billion)
	Caixa Geral de Depositos	State guarantees (Euro 2 billion)
	Banco Portugues de Negocios S.A	Nationalisation on 11th November, 2008
Sweden	Carnegie Investment Bank AB	State guarantees State loans (Euro 0.225 billion)
	SBAB	State guarantees
	Swedbank AB	State guarantees

	Swedbank Hypotek AB	State guarantees
	Volvofinans Bank AB	State guarantees
UK	Abbey National Plc	State guarantees
	Barclays Bank Plc	State guarantees
	HBOS	State guarantees
	HSBC Bank Plc	State guarantees
	Lloyds TSB Bank Plc	State guarantees Recapitalisation (Euro 19 billion)
	Nationwide Building Society	State guarantees
	Royal Bank of Scotland Plc	State guarantees Recapitalisation (Euro 22.9 billion)
	Standard Chartered Bank	State guarantees
	Northern Rock Plc	Nationalisation on 22nd February, 2008
	Bradford & Bingley's	Nationalisation on 29th September, 2009

(Source: Petrovic and Tutsch, 2009)

Table III. **Summary statistics of variables of *equation [1]***

Summary statistics of variables in equation [1]					
Variable	Description	Mean	Median	StDev	No. of observations
PREM	Merger premiums. See *equation [2]* for details	1.126	0.825	1.369	172
MPOW	Market power difference between two counterparties	1.868	1.389	1.838	173
RROA	Profit efficiency difference between two counterparties	1.978	1.452	1.68	152
RCIR	Cost efficiency difference between two counterparties	1.116	1.011	0.653	171
AGECY	Number of acquirer's shareholders	32	17	36.83	173
TLEV	Target's equity-to-asset ratio	0.104	0.075	0.095	173
TFOC	Target's interest income divided by its operating income	0.611	0.636	0.213	172
TGROW	Target's 3 years average pre-merger asset growth	11.90%	7.60%	0.191	168
TSUP	Target's home country Supervisory Strength Index	6.65	6	2.3	173
TCON	Target's home country banking concentration (CR3) ratio	7.6%	5.5%	0.056	173
RSIZE	Total asset of acquirer and target divided by acquirer's	1.143	1.016	0.313	173

Table IV. **A summary statistics of safety net subsidy motive in M&As**

Subsample by country	Mean	Median	Maximum	Minimum	StDev	Observations
Austria	0.682	0.574	1.678	0.286	0.389	16
Belgium	1.118	1.266	1.788	0.407	0.559	8
France	1.082	0.970	2.985	0.328	0.640	44
Germany	0.959	0.800	2.406	0.305	0.469	21
Greece	0.870	0.809	2.057	0.350	0.437	18
Netherlands	0.974	0.872	1.513	0.751	0.307	5
Portugal	1.303	1.171	1.934	0.937	0.442	4
Sweden	0.923	0.785	1.587	0.426	0.435	10
UK	0.687	0.648	1.292	0.245	0.293	26
Subsample by year						
1997	1.099	1.002	2.985	0.245	0.730	13
1998	1.080	0.835	2.454	0.403	0.687	15
1999	0.840	0.719	1.902	0.304	0.422	16
2000	0.803	0.709	1.934	0.286	0.431	15
2001	1.050	0.956	2.057	0.473	0.482	15
2002	0.750	0.652	1.312	0.506	0.247	10
2003	0.963	0.826	1.788	0.460	0.468	10
2004	1.159	1.003	2.363	0.709	0.551	8
2005	0.760	0.824	1.349	0.307	0.327	13
2006	0.831	0.643	2.186	0.409	0.526	19
2007	1.108	1.136	1.609	0.305	0.414	8
2008	0.778	0.567	1.683	0.328	0.500	10
Total sample	0.924	0.789	2.985	0.245	0.508	152

Table V. **Determinants of banking merger premiums in 9 EU countries**

The table shows the results from the estimation of *equation [1]* using a stochastic frontier model for a sample of 9 EU countries for the period of 1997 to 2008. Data are from Thomson One Banker and Bankscope. The dependent variable is PREM, which is a merger premium of each merger deal. MPOW is target's interest margin divided by acquirer's interest margin to measure the market power potential gains. RROA and RCIR measure profit and cost efficiency potential gains respectively: two variables are the ratios of target's ROA or CIR divided by acquirer's ROA or CIR respectively. AGECY is the number of the acquirer's shareholders. TLEV is the equity-to-asset ratio of the target in the fiscal year before the M&A announcement. TFOC is the ratio of the net interest income of the target firm to its total operating income the year prior to the transaction. TGROW is the target's average assets growth rate over the three years period before the merger. TCON is a target's market concentration measure using CR3 ratio the year before the merger. TSUP capture target's home country's supervisory strength. RSIZE is defined as the ratio of the sum of target's asset size and the acquirer's asset size divided by acquirer's asset in the year preceding the merger. Standard errors are in parentheses. Note: ***/**/* indicates that the coefficient estimates are significantly different from zero at 1%/5%/10% level.

Dependent variable:	**PREM**
MPOW	0.337***
	(0.117)
RROA	-0.070
	(0.066)
RCIR	0.330**
	(0.167)
AGECY	-0.070
	(0.056)
TLEV	0.171
	(0.145)
TFOC	0.043
	(0.208)
TGROW	0.294
	(0.221)
TSUP	0.671***
	(0.246)
TCON	0.310**
	(0.130)
RSIZE	-0.482
	(0.413)
Ancillary statistics	
No. of observations:	152
LR test of $\sigma_u^2 = 0$	51.92***

Table VI. **Summary statistics of variables of *equation [3]***

Summary statistics of variables in *equation [3]*							
Variable	Description	Mean	Median	Maximum	Minimum	StDev	No. of observations
ABSIZE	Size - natural logarithm of the acquirer's total assets	6.5180	6.2464	15.5787	-0.9163	2.0503	4378
MAKSH	Size – acquirer's assets divided by total banking sector assets	0.0020	0.0000	0.4588	0.0000	0.0147	4378
COMP	Complexity - natural logarithm of the number of the acquirer's total subsidiaries	1.4195	1.0986	8.4101	0.0000	1.4000	2054
ABCONN	Interconnectedness - natural logarithm of the acquirer's total interbank deposits	4.4669	4.2217	14.0480	-3.8167	2.4488	4118
RECONN	Interconnectedness - the ratio of the acquirer's interbank deposits divided by total bank deposits (excluding its own share)	0.0021	0.0000	0.5797	0.0000	0.0161	4154
ASUP	Acquirer's home country's Supervisory Strength Index	4.6548	4.0000	10.0000	4.0000	1.2613	4380
ADEP	Acquirer's home country Deposit Insurance Strength Index	1.1667	1.0000	2.0000	1.0000	0.3727	4380

Table VII. **Systemic risk implications of TSITF- a binomial probit regression analysis**

The table shows marginal effects of probit estimations of *equation [3]* using rescued banks between 2008 and 2009 as TSITF banks. Dependent variable TSITF is a dummy variable, which takes the value of 1 if bank is defined as a TSITF bank and 0 for a non-TSITF bank. SUBD is the sum of the safety net benefits from the estimation of *equation [1]* using a stochastic frontier model. ABSIZE is the natural logarithm of a bank's assets in December 2007. MAKSH is the bank assets size divided by total assets of banking sector in December 2007. COMP measures a bank's complexity in December 2007, which is the natural logarithm of the number of a bank's total subsidiaries. ABCONN is the natural logarithm of a bank's total interbank deposits in December 2007. RECONN is the ratio of a bank's interbank deposits divided by total bank deposits (excluding its own share) in December 2007. ASUP and are a bank's home country's Supervisory Strength Index and Deposit Insurance Strength Index in 2007 respectively. Standard errors are in parentheses. Country dummies are included but not shown. We apply cluster robust standard errors. Note: ***/**/* indicates that the coefficient estimates are significantly different from zero at 1%/5%/10% level.

Dependent variable:	**Pr (TSITF bank/ non TSITF bank)**				
SUBD	0.0007**	0.0092***	0.0081***	0.0006*	0.0094***
	(0.0003)	(0.0014)	(0.0017)	(0.0004)	(0.0015)
ABSIZE	0.0008***				
	(0.0002)				
MAKSH		0.0811***			
		(0.0308)			
COMP			0.0052***		
			(0.0004)		
ABCONN				0.0006***	
				(0.0002)	
RECONN					0.0777***
					(0.0280)
ASUP	0.0003***	0.0016***	0.0028***	0.0002**	0.0016***
	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0000)
ADEP	0.0002**	0.0030***	0.0014	0.0004**	0.0036***
	(0.0001)	(0.0004)	(0.0022)	(0.0002)	(0.0004)
Country dummy	Yes	Yes	Yes	Yes	Yes
Ancillary statistics					
Pseudo R^2	50.92%	36.20%	42.94%	51.36%	37.63%
Type I error	0.19%	0.16%	0.40%	0.25%	0.20%
Type II error	74.60%	84.13%	75.00%	74.19%	82.26%
Area under ROC curve	97.49%	93.02%	94.21%	97.28%	93.48%
Correctly classified	98.74%	98.63%%	97.42%	98.64%	98.58%

Observations	4378	4378	2054	4118	4,154

Table VIII. **Systemic risk implications of TSITF- a multinomial probit regression analysis**

The table shows marginal effects of multinomial probit estimations of *equation [3]* using rescued banks between 2008 and 2009 as TSITF banks. Dependent variable TSITF is a multinomial variable, which takes the value of 1 if an acquiring bank is defined as a non-TSITF bank, 2 for a TSITF bank rescued by being provided with state guarantees and 3 for a TSITF bank rescued via recapitalization including nationalization and forced mergers. In each estimation, TSITF = 1 is specified as the base outcome. SUBD is the safety net benefits from the estimation of *equation [1]* using a stochastic frontier model. ABSIZE is the natural logarithm of an acquiring bank's assets in December 2007. MAKSH is the acquiring bank assets size divided by total assets of banking sector in December 2007. COMP measures an acquiring bank's complexity in December 2007, which is the natural logarithm of the number of an acquiring bank's total subsidiaries. ABCONN is the natural logarithm of an acquiring bank's total interbank deposits in December 2007. RECONN is the ratio of acquiring bank's interbank deposits divided by total bank deposits (excluding its own share) in December 2007. ASUP and ADEP are acquiring bank's home country's Supervisory Strength Index and Deposit Insurance Strength Index in 2007 respectively. Standard errors are in parentheses. We apply cluster robust standard errors. Note: ***/**/* indicates that the coefficient estimates are significantly different from zero at 1%/5%/10% level.

Outcome	State guarantees	Recapitalization	State guarantees	Recapitalization	State guarantees	Recapitalization	State guarantees	Recapitalization	State guarantees	Recapitalization
SUBD	0.0002	0.0017**	0.0038***	0.0083***	0.0042*	0.0068***	0.0002	0.0014**	0.0040***	0.0091***
	(0.0002)	(0.0007)	(0.0014)	(0.0022)	(0.0022)	(0.0023)	(0.0002)	(0.0007)	(0.0013)	(0.0022)
ABSIZE	0.0002*	0.0012***								
	(0.0002)	(0.0003)								
MAKSH			0.0473*	0.1042***						
			(0.0263)	(0.0371)						
COMP					0.0028***	0.0045***				
					(0.0009)	(0.0010)				
ABCONN							0.0002	0.0009***		
							(0.0001)	(0.0003)		
RECONN									0.0470**	0.0905***
									(0.0214)	(0.0334)
ASUP	0.0003*	0.0003	0.0027***	0.0014	0.0039	0.0021	0.0003*	0.0004	0.0029***	0.0020
	(0.0002)	(0.0004)	(0.0006)	(0.0012)	(0.0012)	(0.0013)	(0.0002)	(0.0003)	(0.0007)	(0.0013)
ADEP	-0.0007	-0.0017	-0.0051**	-0.0032	-0.0079**	-0.0086	-0.0007	-0.0019	-0.0059***	-0.0044

	(0.0004)	(0.0015)	(0.0021)	(0.109)	(0.0034)	(0.0053)	(0.0004)	(0.0013)	(0.090)	(0.0052)
Ancillary statistics										
Observations		4378		4378		2054		4118		4154

Table IX. **Changes in predicted probabilities for TSITF**

We compute predicted probabilities for being a TSITF bank based on the simultaneous specification of our equation [3]. Variables of the first regression of *Table VII* controlling for acquiring bank's size and acquirer's home country's Supervision Strength Index and Deposit Insurance Strength Index in 2007 (i.e. ABSIZE, ASUP and ADEP) are all held constant at their mean. We report the change of predicted probabilities by changing safety net subsidy effects (i.e. SUBD) from 10th percentile to 90th percentile.

	Predicted Probabilities	
Unconditional probability for TSITF	*0.998*	
Change in SUBD	0.997	0.987
	(10th percentile: 0.336)	(90th percentile: 2.023)

Table X. **Correlation between safety net subsidy gains and interdependence change**

This table shows the correlation between TSITF bank's safety net subsidies gained in an M&A transaction and the change in interdependence with other TSITF banks in the same country.

Country	Year	TSITF bank	$SUBD_t$	$\Delta NDEP_{t+1}$
Austria	2006	Volksbanken Holding	0.409	0.002
Austria	2006	RZB AG	0.524	-0.210
Austria	2005	RZB AG	0.307	0.150
Belgium	2008	KBC Groep NV	0.407	-0.152
Belgium	2007	KBC Groep NV	1.609	-0.152
Belgium	2006	Dexia	1.038	0.008
Belgium	2005	Fortis SA/NV	0.516	0.220
Belgium	2003	ING Belgium Bank	1.788	-0.224
Belgium	2000	Dexia SA	0.563	0.116
France	2008	BNP Paribas SA	1.683	0.016
France	2007	Société Générale SA	1.027	0.059
France	2007	Société Générale SA	1.196	0.059
France	2006	Crédit Agricole SA	1.229	0.145
France	2006	Crédit Agricole SA	1.353	0.145
France	2006	Société Générale SA	0.436	0.103
France	2006	BNP Paribas SA	0.984	0.119
France	2006	Société Générale SA	2.186	0.103
France	2005	Société Générale SA	0.900	0.092
France	2005	Société Générale SA	0.645	0.092
France	2004	Société Générale SA	1.041	0.012
France	2004	Société Générale SA	2.363	0.012
France	2003	BNP Paribas SA	0.664	-0.118
France	2002	Crédit Agricole	0.587	-0.092
France	2002	Crédit Agricole SA	0.672	-0.092
France	2002	Société Générale SA	0.570	-0.097
France	2001	BNP Paribas SA	0.754	0.119
France	2001	BNP Paribas SA	0.956	0.119
France	2001	BNP Paribas SA	1.120	0.119
France	2001	Société Générale SA	0.992	0.131
France	1999	Société Générale SA	0.679	0.240
France	1998	Société Générale SA	0.407	-0.300
France	1997	Société Générale SA	2.985	0.079
France	1997	Société Générale SA	0.342	0.079

France	1997	Société Générale SA	1.011	0.079

- to be continued -

Country	**Year**	**TSITF bank**	**$SUBD_t$**	**$\Delta NDEP_{t+1}$**
Germany	2008	Deutsche Bank AG	0.481	0.138
Germany	2008	Commerzbank AG	1.381	0.169
Germany	2007	Commerzbank AG	0.305	0.169
Germany	2005	Commerzbank AG	1.162	0.169
Germany	2001	Commerzbank AG	0.851	0.023
Germany	1998	Deutsche Bank AG	2.406	-0.062
Germany	1998	Deutsche Bank AG	1.446	-0.062
Greece	2006	EFG Eurobank Ergasias SA	0.451	-0.078
Greece	2006	National Bank of Greece SA	0.643	-0.038
Greece	2006	EFG Eurobank Ergasias SA	0.648	-0.078
Greece	2006	National Bank of Greece SA	0.541	-0.038
Greece	2005	Piraeus Bank SA	0.867	0.036
Greece	2005	Alpha Bank AE	0.600	0.013
Greece	2005	Piraeus Bank SA	0.909	0.036
Greece	2003	National Bank of Greece SA	0.851	-0.093
Greece	2003	Piraeus Bank SA	1.278	-0.066
Greece	2001	Piraeus Bank SA	2.057	-0.245
Greece	2001	EFG Eurobank Ergasias SA	1.785	-0.182
Greece	2000	National Bank of Greece SA	0.574	-0.018
Greece	1999	Piraeus Bank SA	0.350	-0.582
Greece	1999	Piraeus Bank SA	0.892	-0.582
Greece	1999	Alpha Credit Bank	0.786	0.024
Greece	1998	National Bank of Greece SA	0.762	-0.007
Greece	1998	EFG Eurobank SA	0.835	0.046
Greece	1998	EFG Eurobank SA	0.832	0.046
Sweden	2007	Svenska Handelsbanken AB	1.587	0.116
Sweden	2006	Swedbank AB	0.508	-0.014
Sweden	2006	Nordea Bank AB	0.426	0.004
Sweden	2001	Nordbanken	1.299	0.143

Sweden	2001	Svenska Handelsbanken AB	1.283	0.111
Sweden	2000	Skandinaviska Enskilda Banken	0.647	0.262
Sweden	1999	Nordbanken Holding AB	0.848	-0.037
Sweden	1999	Skandinaviska Enskilda Banken	1.425	0.029
Sweden	1999	Svenska Handelsbanken AB	0.721	0.047
Sweden	1997	Swedbank	0.481	0.220

- to be continued -

Country	**Year**	**TSITF bank**	**$SUBD_t$**	**$\Delta NDEP_{t+1}$**
UK	2008	Lloyds TSB Group PLC	0.353	-0.155
UK	2007	Standard Chartered PLC	1.154	-0.107
UK	2006	Standard Chartered Bank PLC	0.445	0.147
UK	2006	HSBC Holdings PLC	0.444	0.182
UK	2006	HSBC Holdings PLC	0.775	0.182
UK	2005	Standard Chartered PLC	0.381	0.111
UK	2004	HSBC Holdings PLC	1.129	-0.066
UK	2003	HSBC Holdings PLC	0.485	-0.076
UK	2003	RBS Group PLC	1.083	-0.105
UK	2002	HSBC Holdings PLC	0.902	-0.076
UK	2002	HSBC Holdings PLC	0.618	-0.076
UK	2001	HSBC Bank PLC	0.626	0.076
UK	2000	Bank of Scotland PLC	0.969	0.199
UK	2000	HSBC Holdings PLC	0.344	0.221
UK	2000	Standard Chartered PLC	1.084	0.123
UK	2000	HSBC Holdings PL	0.523	0.221
UK	1999	Royal Bank of Scotland Group	0.629	0.013
UK	1999	Standard Chartered Bank PLC	0.304	-0.043
UK	1999	HSBC Holdings PLC	0.708	-0.176
UK	1999	HSBC Holdings PLC	0.666	-0.176
		Correlation coefficient:	-0.030	
		Significance level	77.92%	

Table XI. **Systemic risk implications of TSITF- robustness test I**

The table shows marginal effects of probit estimations of *equation [3]* using Heckman procedure. Dependent variable TSITF of the outcome model is a dummy variable, which takes the value of 1 if a bank is defined as a TSITF bank and 0 for a non-TSITF bank. SUBD is the safety net benefits from the estimation of *equation [1]* using a stochastic frontier model. ABSIZE is the natural logarithm of a bank's assets in December 2007. MAKSH is the bank assets size divided by total assets of banking sector in December 2007. COMP measures a bank's complexity in December 2007, which is the natural logarithm of the number of a bank's total subsidiaries. ABCONN is the natural logarithm of a bank's total interbank deposits in December 2007. RECONN is the ratio of a bank's interbank deposits divided by total bank deposits (excluding its own share) in December 2007. ASUP and ADEP are a bank's home country's Supervisory Strength Index and Deposit Insurance Strength Index in 2007 respectively. Dependent variable of the selection model takes the value 1 if a bank in a banking system engaged in M&As activity between 1997 and 2008, otherwise takes the value 0. Standard errors are in parentheses. Country dummies are included but not shown. We apply cluster robust standard errors. Note: ***/**/* indicates that the coefficient estimates are significantly different from zero at 1%/5%/10% level.

Dependent variable:	Pr (TSITF bank/ non TSITF bank)				
SUBD	0.0006*	0.0064***	0.0071***	0.0005	0.0069***
	(0.0003)	(0.0013)	(0.0015)	(0.0003)	(0.0009)
Lambda	-0.0018***	-0.0738** (0.0326)	-0.0390 (0.0260)	-0.0016** (0.0007)	-0.1456*** (0.0429)
	(0.0007)				
ABSIZE	-0.0002**				
	(0.0001)				
MAKSH		-0.6786*			
		(0.3745)			
COMP			-0.0133		
			(0.0125)		
ABCONN				-0.0001**	
				(0.0000)	
RECONN					-0.9738***
					(0.3328)
ASUP	0.0003**	0.0101***	0.0009	0.0002*	0.0066***
	(0.0001)	(0.0036)	(0.0013)	(0.0001)	(0.0014)
ADEP	0.0004**	-0.0083*	0.0114	0.0002	-0.0325***
	(0.0002)	(0.0045)	(0.0074)	(0.0001)	(0.0101)
Country dummy	Yes	Yes	Yes	Yes	Yes
Ancillary statistics					
Pseudo R^2	51.05%	38.60%	43.77%	51.43%	37.63%
Correctly classified	98.64%	98.72%	97.22%	98.61%	98.58%
Observations	4278	4378	2054	4037	4154
Selection Model					
Dependent variable:	Pr (acquiring bank/ non acquiring bank)				
ABSIZE	0.0002				
	(.00017)				
MAKSH		0.2518***			
		(0.0550)			
COMP			0.0048***		
			(0.0006)		
ABCONN				0.0005	
				(0.0003)	
RECONN					0.1911***

					(0.0616)

Table XII. **Systemic risk implications of TSITF- robustness test II**

The table shows marginal effects of probit estimations of *equation [3]* using rescued banks between 2008 and 2009 as TSITF banks. Dependent variable TSITF is a dummy variable, which takes the value of 1 if a bank is defined as a TSITF bank and 0 for a non-TSITF bank. SUBD is the safety net benefits from the estimation of *equation [1]* using OLS regression. ABSIZE is the natural logarithm of a bank's assets in December 2007. MAKSH is the bank assets size divided by total assets of banking sector in December 2007. COMP measures a bank's complexity in December 2007, which is the natural logarithm of the number of a bank's total subsidiaries. ABCONN is the natural logarithm of a bank's total interbank deposits in December 2007. RECONN is the ratio of a bank's interbank deposits divided by total bank deposits (excluding its own share) in December 2007. ASUP and ADEP are a bank's home country's Supervisory Strength Index and Deposit Insurance Strength Index in 2007 respectively. Standard errors are in parentheses. Country dummies are included but not shown. We apply cluster robust standard errors. Note: ***/**/* indicates that the coefficient estimates are significantly different from zero at 1%/5%/10% level.

Dependent variable:	**Pr (TSITF bank/ non TSITF bank)**				
SUBD	0.0003	0.0062**	0.0040	0.0002	0.0064**
	(0.0003)	(0.0028)	(0.0035)	(0.0002)	(0.0026)
ABSIZE	0.0006***				
	(0.0002)				
MAKSH		0.1429***			
		(0.0494)			
COMP			0.0058***		
			(0.0001)		
ABCONN				0.0003*	
				(0.0002)	
RECONN					0.1678***
					(0.0292)
ASUP	0.0002**	0.0015***	0.0024***	0.0001*	0.0016***
	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0000)
ADEP	-0.0010*	-0.0178***	-0.0139***	-0.0005	-0.0184***
	(0.0005)	(0.0022)	(0.0028)	(0.0003)	(0.0025)
Country dummy	Yes	Yes	Yes	Yes	Yes
Ancillary statistics					
Pseudo R^2	51 .00%	32.30%	41.46%	51.27%	34.66%

Type I error	0.20%	0.10%	0.50%	0.24%	0.13%
Type II error	75.00%	81.67%	73.68%	72.88%	83.05%
Area under ROC curve	97.42%	90.91%	93.92%	97.34%	91.96%
Correctly classified	98.69%	98.69%	97.27%	98.64%	98.60%
Observations	4054	4054	1868	3824	3852