Measuring changing market expectations
of bank resolution regimes
using credit default swaps and news flow data

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ABSTRACT

Several jurisdictions are planning to or have already introduced new laws that aim to reduce the need for government support when financial institutions are threatened with insolvency. These rules imply a greater risk of default and losses for senior bond holders who may see their claims written down or converted to equity. We use the CDS-implied probability of default for bond holders to assess the impact of market expectations of new resolution regimes in a panel regression of 27 globally systemically important banks (G-SIFIs) over eleven countries. We control for the risk of default not associated with the resolution regime. Using the frequency of Bloomberg news articles on resolution-related topics, we find that market expectations of resolution regimes increased the CDS-implied probability of default over the period 2007 to 2012. Increased sovereign default probability also contributed to the rise of bank default risk.

1 - Background and motivation

During the global financial crisis, after the disorderly bankruptcy of Lehman Brothers in 2008, a number of governments provided support to financial institutions whose size and interconnectedness increased the probability that their potential failure would have resulted in considerable repercussions for their financial systems and the real economies. During this period and its immediate aftermath, senior bond holders of these systemically important financial institutions (SIFIs) did not absorb any direct losses or experience any forced conversions to equity stakes in the face of large write-downs on bank balance sheets.[1] In many cases, a key factor in the decisions to provide extraordinary support to these "too-big-to-fail" institutions was the lack of a legal framework for the timely resolution of complex SIFIs through orderly liquidation or recapitalisation by writing down portions of debt-holders' positions or converting them to equity stakes (i.e. bailing-in debt-holders). Since the initial stages of the financial crisis, a number of different jurisdictions have adopted laws to provide for one or more of these resolution tools - including the UK Banking Act 2009, US Dodd-Frank Act and the EU's planned Single Resolution Mechanism.

Taken at face value, these regimes should make it more likely that senior bond holders incur losses. Further, the change in regulatory frameworks should therefore be reflected in the pricing of their bonds and associated derivatives that reference these SIFIs, particularly credit default swaps (CDS). The extent to which this shift in market pricing is actually occurring is a very relevant question for those responsible for implementing these regulatory regimes. For example, if bond markets have priced in a low probability of losses then an unexpected bail-in for one SIFI will result in a new precedent that would see the sudden re-pricing of debt for other SIFIs, with a shock to funding costs as a result. However, such contagion would be more limited if the risk of a bail-in was already priced into the bonds of all SIFIs.

As such, the central question that this paper seeks to address is – *has progress on resolution regimes across countries started to affect market pricing of CDS contracts that reference senior bonds*? We conclude that these changes have indeed impacted market pricing in CDS contracts. These conclusions are based on panel regressions using the components below:

1) A set of banks that are defined by the Financial Stability Board (FSB) as being global SIFIs as of 2011.
2) A dependent variable that measures market expectations of potential default probabilities for senior bonds: Moody's KMV CDS-implied default probability
3) An indicator of changes in market awareness of information on shifting resolution regimes: Bloomberg Trend news flow
4) Control variables, i.e. other measures of default that are not likely to be affected by the resolution regime:
    a. Moody's KMV equity-implied default probability per bank
    b. Moody's KMV index of investment-grade CDS implied-default probabilities per country
    c. Moody's KMV sovereign CDS-implied probability of default
    d. The S&P 500 implied volatility index (VIX)

After a brief literature review, we discuss each of these in more detail in Section 3, present our main results in Section 4 and discuss a number of robustness checks in Section 5, before ending with our estimate of the change in market based default probability due to the reform of resolution regimes.

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[1] This is not to say that debt-holders did not (temporarily) experience any valuation or mark-to-market losses stemming from credit market weakness and forced selling.

2 – Related Literature

Unlike our study, many of the studies in this area focus specifically on the implicit subsidy that banks receive through the perception of a government backstop. Consequently many papers use funding rates rather than CDS. A typical approach is to compare institutions that are deemed systemically important, often based on a size threshold, to other smaller financial institutions – such as Araten & Turner (2012) who focus on G-SIFIs; as well as Acharya, Anginer and Warburton (2013); Hindlian, Lawson, Murillo, Sadan, Strongin and Subramanian (2013); Jacewtiz and Pogach (2013). Another approach uses rating agencies' assessments of government support, or the "systemic uplift" embedded in ratings, to see if it has an impact on funding costs. Examples include Ueda and Mauro (2013) and Noss and Sowerbutts (2012).

Our study has more in common with two other strains of the literature. The first looks at the changes in market rates after an event that should have influenced perceptions of the likelihood of government support (in practice these are mainly historical bail-outs) - including O'Hara and Shaw (1990); Morgan and Stiroh (2005); Balasubramian and Cyree (2011); Veronesi and Zingales (2010); Acharya, Anginer and Warburton (2013). Our study also looks at the change in market rates based on events, effectively analysing the entire cluster of significant events rather than simply comparing rates before and after each event. Our proxy for changing perceptions in this respect is the Bloomberg news flow variable.

The second strain of the literature that has similarities with our study uses differences between equity and CDS implied default rates. As noted above, equity holders have historically not received government support while bond holders have, thus potentially reducing the cost of buying downside protection through credit default swaps. One can use the difference as a measure of expectations of government support across the capital structure, under the assumption that there are no other factors at play. Examples of this type of study include Li, Qu and Zhang (2011) and Schweikhard and Tsesmelidakis (2011). We use CDS-implied default probability as our dependent variable, while using equity implied probability of default (PD) as only one control of several variables that is used to capture a broad range of drivers of default probability. We use our news flow variable to identify changes in perceived default probability related specifically to change in resolution regimes.

3 – General approach and variables used

In this section we provide a brief justification for the use of each component of our regressions and a description of the data.

The FSB 2011 list of G-SIFIs
We focus our analysis on banks that have been designated as G-SIFIs by the FSB and, as such, are highly likely to be considered critical financial institutions by markets. The Financial Stability Board (FSB) designated a list of banks as Global Systemically Important Financial Institutions (G-SIFIs) in 2011. This list is decided on through consultation with regulatory officials from a wide set of countries, including those in which these institutions are based, and have been deemed systemic to the global financial system, not just domestically. As such, it represents the most authoritative list available. Table 1 gives a list of the banks we use in our dataset, grouped per country. We exclude Dexia and Banque Populaire CdE due to data limitations, even though they are on the original FSB list.

Table 1: Global Financial Crisis and Resolution Regime Timeline (2007 – 2011)

China	France	Germany
Bank of China	BNP Paribas	Commerzbank
	Group Credit Agricole	Deutsche Bank
	Societe Generale	

Spain	Sweden	Switzerland
Santander	Nordea	Credit Suisse
		UBS

Italy	Japan	Netherlands
Unicredit Group	Mitsubishi UFJ FG	ING Bank
	Mizuho FG	

United Kingdom	United States	
Barclays	Bank of America	JPMorgan Chase
HSBC	Bank of New York Mellon	Morgan Stanley
Llyods Banking Group	Citigroup	State Street
Royal Bank of Scotland	Goldman Sachs	Wells Fargo

Moody's KMV CDS-implied probability of default
We use Moody's KMV CDS-implied 1-year ahead probability of default (CDS-PD) to gauge changes in the market perception of the risk that senior bondholders may face losses. A CDS essentially provides insurance against losses from default and the CDS-spread measures the cost of this insurance. A resolution regime that would increase the expected losses for senior creditors would thus require higher CDS spreads. The Moody's KMV methodology translates the CDS spreads into a market implied expectation of default. See Dwyer, Li, Qu, Russel and Zhang (2012) for a detailed description of the Moody's KMV methodology. Notably, this approach explicitly aims to measure default probability separately from loss given default (LGD), which is why this study focuses solely on default probabilities.
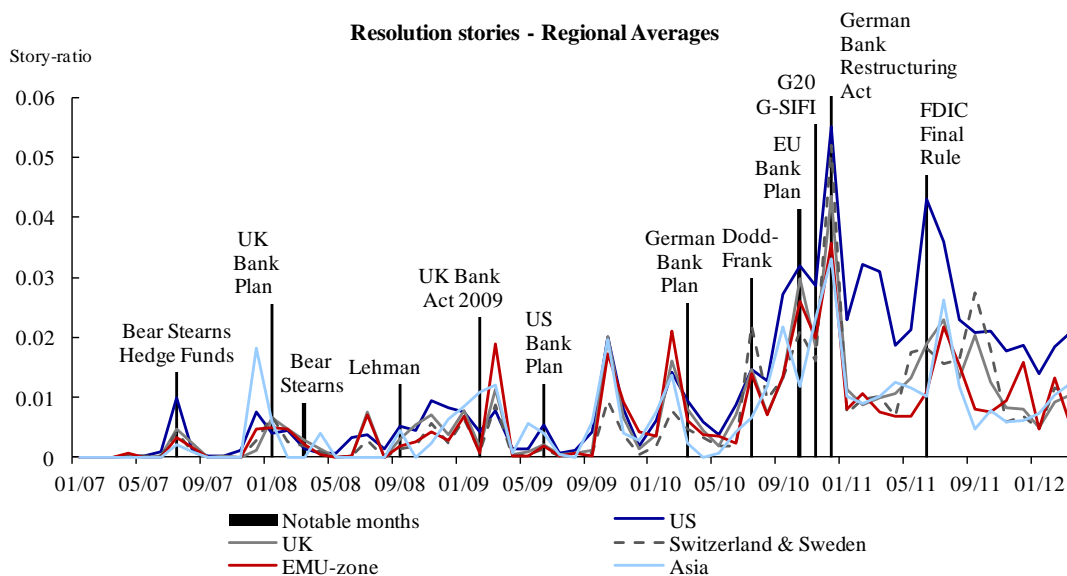
Bloomberg Trends news flow
Changing market perceptions in the face of changes to regulatory structures are difficult to measure. One approach to identifying changes in resolution regime would be to use the dates of regulatory changes for events studies or as a dummy variable in a regression. Table 2 lists a number plausible dates that have likely affected market perceptions. However, in this case it is difficult to argue that the passing of this legislation or even the initial proposals were "news" to the markets. It is highly likely that markets responded before then as there were public discussions among policy makers and legislators about the need for such reforms and these were reported in the press and the newswires.

Table 2: Global Financial Crisis and Resolution Regime Timeline (2007 – 2011)

Date	Label in Figure 1	Description
2007 July	Bear Stearns Hedge Funds	Bearn Stearns announces substantial losses in sub-prime hedge funds
2008 January	UK Bank Plan	UK government proposes bank special resolution regime against the background of impending nationalization of Northern Rock
2008 March	Bear Stearns	Bearn Stearns takeover facilitated by Federal Reserve
2008 September	Lehman	Lehman failure intensifies financial crisis and leads to string of government support measures for financial institutions in the US and Europe
2009 February	UK Banking Act	UK passes Banking Act 2009
2009 June	US Bank Plan	Obama administration proposes bank reform
2010 March	German Bank Plan	German government announces key points of bank reform
2010 July	Dodd-Frank	Dodd-Frank Act signed
2010 October	EU Bank Plan	European Commission announces plans to develop EU financial crisis response regime
2010 November	G20 G-SIFI	G20 endorses development of international regulatory and resolution framework for globally systemically important financial institutions
2010 December	German Bank Restructuring Act	German parliament passes Bank Restructuring Act
2011 June	FDIC Final Rule	FDIC announcing final rules for Dodd-Frank bank resolution authority after public consultation

We capture the changing information available to markets by using Bloomberg Trends to measure the frequency that Bloomberg news articles referenced specific keywords. Bloomberg terminals are widely used by traders in the financial markets, making measures of its news flow highly relevant to the information impacting participants in the bank bond and CDS markets (we also replicated our work using Google Trends, which measures the number of searches to resolution regime related keywords, but did not get significant results; see Hellerstein and Middeldorp (2012) for a review of studies using internet search data). We divide the number of articles with resolution related terms *and* the name of a G-SIFI bank by the frequency of articles by all the news stories specific to that institution (for the larger banks there are almost a million articles per bank over the stated period). This allows us to construct a complete panel with individual time-series per bank. See the Appendix for more details. Figure 1 shows the un-weighted average of news story ratios for banks by region. Notably, the news related to resolution regimes is elevated both before and after relevant events.

Figure 1: Relative frequency of resolution regime related stories per region

Source: Bloomberg Trends

Control variables
While we include a primary explanatory variable that is specific to resolution regimes, we still want to control for other drivers of default probability that are not related to resolution regimes. To do so, we use the following control variables:

Moody's KMV equity-implied default probability per bank
Equity holders across a number of G-SIFIs experienced large losses or were heavily diluted around many of the government interventions during the crisis. As equity-holders are the most junior in bank capital structures, they are the first to incur losses. As such, default probabilities calculated on the basis of equity prices and implied volatility are less likely to be affected by changes in resolution regime, but rather capture a range of broader risks that affect default probability. The Moody's KMV methodology builds on the Merton (1974) model and is described in more detail in Munves, Smith and Hamilton (2010).

Moody's KMV index of investment-grade CDS implied-default probabilities per country
Average CDS-implied PDs of all investment-grade companies are likely to be insensitive to changes in resolution regimes, while capturing country-specific drivers of default risk.

Moody's KMV sovereign CDS-implied probability of default
While a shift in a resolution regime reflects a change in the government's willingness to provide support, it's also possible that, because of fiscal stress, governments become less able to support a troubled bank. To capture this, we include sovereign CDS-PDs per country.

The S&P 500 implied volatility index (VIX)
Global perception of market risk is generally well reflected in the VIX.

4 - Results

We present two main approaches to identifying the effect of expected changes in resolution regime. The first is a straightforward regression of the bank CDS-PDs on the factors described above. The second involves interacting the Bloomberg news variable to analyse how change in resolution regime affects the sensitivity of CDS-PDs to equity PDs. Based on the first results we calculate total estimates of the impact of expectations of resolution regimes. We perform a number of regressions to check the working of our model in the next section.

Table 2: Estimated coefficients for two main regressions

(27 banks in 11 countries over 58 months)	(1) Δ CDS PD	(2) Δ CDS PD
Δ Equity PD	0.051 ***	-0.090 ***
Δ Investment Grade CDS PD Country Index	0.983 *	0.967 *
Δ Equity Option Implied Volatility Index (VIX)	0.003 *	0.001
Δ Sovereign CDS PD	0.860 **	0.789 **
Bloomberg Resolution Stories per Bank Story		
… Δ > 0 (t-1)	0.805 **	
… Cumulative × ΔEquity PD		1.057 **

*P-value < 0.1 **P-value < 0.05 ***P-value < 0.01 according to panel standard errors robust to country clusters

The regression results shown in column (1) of the table are based on a bank fixed effects panel regression. Due to persistence in the variables used, which could result in spurious regression results, we model all series in changes. The control variables, the Equity PD, the investment grade CDS-PD index, the VIX and sovereign CDS-PD have the expected signs and are all significant. In regression (1) we only include the increases in the news flow because a decline in the number of articles does not necessarily imply that the likelihood of resolution authority has declined (and indeed declines are not significant if included separately in the regressions). We find that lagging the news indicator one period improves significance. Unlike some types of public announcements that are observed by a large number of market participants simultaneously, news on resolution regime changes only represented a few percent of the total news volume for banks. Furthermore, the interpretation of the news is not clear cut and subject to disagreement. It is therefore plausible that market expectations did not shift concurrent with the news flow.

Another way of approaching the problem is to examine the responsiveness of CDS-PDs to Equity PDs. The intuition is that under resolution regimes the changes in default expectations of senior bond holders should become increasingly sensitive to risk events that traditionally impact only equity holders. To put it another way, the higher the Bloomberg story ratio the stronger the relationship should be between CDS-PDs and Equity PDs. The main difference in this specification is that we multiply the change in the Equity PD by the cumulative Bloomberg story ratio.

In this treatment, relying on the same intuition as above, we sum ratio over every month to date, so that the variable only rises over time. The results are shown in column (2). The investment grade CDS-PD index has a similar coefficient as in column (1) while the VIX is no longer significant. Regarding the variables with the Equity PD, there are two things to note. First, the fact that the coefficient on the stand alone Equity PD (top of column) is negative reflects the introduction of the same variable through the interacted term and is not meaningful by itself. Second, the Bloomberg cumulative story ratio (bottom of column) is positive and significant, suggesting that more resolution news results in more sensitivity of CDS-PD to Equity-PD, as was postulated.

5 - Robustness

We run several supplementary regressions to test our assumptions, variables and the underlying model.

Table 3: Estimated coefficients for three variable checks and one alternate regressions

	(1) Δ Equity PD	(2) Δ Equity PD	(3) Δ CDS PD	(4) Δ CDS Spread
Δ Bank Equity Implied Volatility	0.007 *	-	-	0.554 ***
Δ Bank Equity Book to Price Ratio	0.622 **	-	-	19.092 ***
Δ Sovereign CDS PD	-	0.966	-	
Δ CDS Spread	-	-	0.004 ***	-
Δ CDS Regional Investment Grade Index	-	2.625 *	-	0.566 ***
Δ Equity Option Implied Volatility Index (VIX)	-	0.006 *	-	
Δ > 0 Bloomberg Resolution Stories per Bank Story (t-1)	-	-1.414	-	176.374 **

*P-value < 0.1 **P-value < 0.05 ***P-value < 0.01 according to panel standard errors robust to country clusters

1) Checks to see if the Moody's equity PDs are driven by market prices similar to those that are inputs to their model. We see that the Moody's equity PD is indeed sensitive to changes in the implied volatility of the individual bank share options and the inverse of the equity price to book value ratio.
2) Checks that the equity implied default probabilities are not driven by the factors that we use to identify the impact of government support (namely sovereign CDS-PD) or the change in resolution regime (namely the Bloomberg stories). These are both insignificant, as expected, increasing our confidence that these factors are related to the willingness and ability to provide support rather than more general measures of default risk.
3) Confirms that the Moody's CDS-PDs are indeed statistically significantly related to the market CDS spreads from which they are derived.
4) Replicates the main model (except Sovereign CDS-PD) on market prices to test that the basic results are not an artefact of the Moody's methodology. The equity PDs are replaced by the same variables as in column (1). The CDS-PD investment grade index is replaced by a regional (not country-by-country) CDS spread index. All the variables are highly significant, suggesting that a model using only market prices would have a similar interpretation as our main model. The exact coefficient on the news variable and the resulting estimates of the total impact of changes in resolution regimes, which we present in the next section, are obviously still dependent on the Moody's methodology. However, the result here suggests that the direction of the effect, and thus the conclusion that expected changes in resolution regime do impact CDS in the expected direction, are not dependent on the Moody's approach to calculating CDS-implied default probabilities.

Estimates of the impact of the change in resolution regime

The regression results suggest that CDS spreads and CDS-PDs derived from them are sensitive to changes in resolution regimes. We can use the Bloomberg variable and its regression coefficient to generate an estimate of the total effect of (anticipated) changes in resolution authority: on average, from June 2007 to March 2012, the model suggests an 18 basis point increase in default probability. Based on the relationship with sovereign CDS-PDs, the deteriorating ability of some governments to protect bond holders has resulted in an additional 21 basis point increase in default probability. Together these two estimates explain about a third of the level of CDS-PDs on March 2012.

Table 4: Increase in CDS-default probability and share of March 2012 level (%-point)

	CDS-PD March 2012	Bloomberg	Share	Sovereign	Share	Total	Share
Average	0.83	0.18	21	0.07	8	0.25	30
US	0.35	0.18	52	0.00	0	0.18	52
EU	1.18	0.18	15	0.14	12	0.32	27

The Bloomberg news based estimated increase in default probability is about the same for the US and the EU, which is not a surprise given that the overall increase in Bloomberg news in both regions are similar. This may either result from similar timing of resolution related events, as reflected in the labels in the chart, or a weakness in the news based approach, or some combination of the two. The estimates based on sovereign CDS implied default probability are different across the two regions in plausible ways, with the increase in the EU being much bigger. It is notable that in the US the *willingness* of the government to provide assistance (based on the Bloomberg news ratio) explains a larger portion of CDS implied default probability than in the EU where it is the *ability* of the government to intervene (based on Sovereign CDS implied default probability) that explains a larger portion.

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Appendix - Bloomberg Trends News Flow Calculations

The Bloomberg function "TREND" allows one to download data about the number of stories with particular terms per unit of time, in this case per month. "BANK" on the left axis of Figure A1 refers to the number of stories related to either just the search term "bank" or the name of the bank listed in the legend (where different variations of the name were used if applicable). The other terms on the left scale are combined with the term "bank" or the name of the specific bank. So the yellow line next to "BANK" refers to the total number of stories about UBS while the black line next to "INSOLVENCY LAW" refers to the total number of stories for all banks related to that search term over all months in the sample. The scale is logarithmic. We sum all the stories with the keywords per bank per month and then divide by the total number of stories in that month for that bank. The resulting ratios per bank are shown in Figure A2
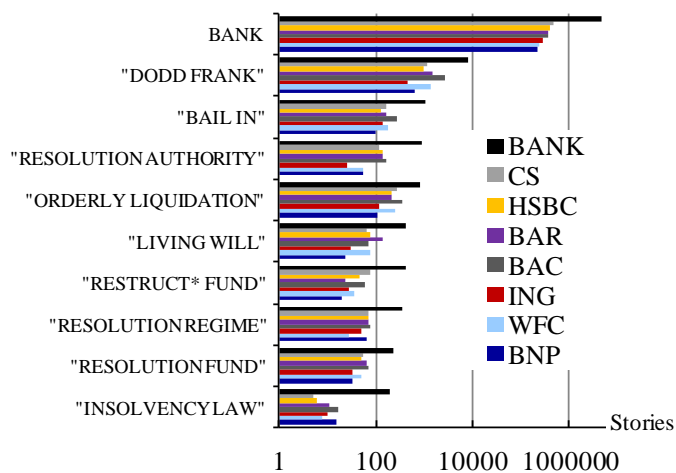
Figure A1: Frequency of banking resolution related news articles

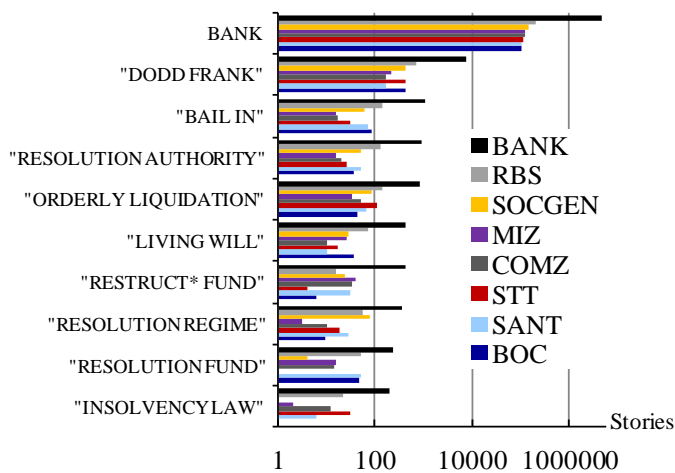Bloomberg resolution keyword stories (1)
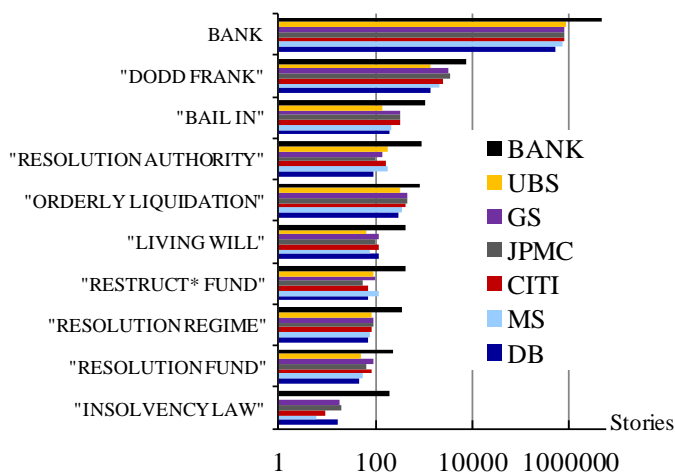
Source: Bloomberg

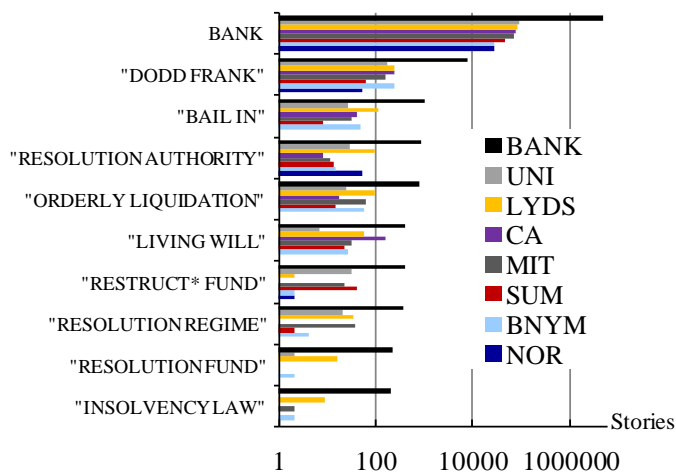Bloomberg resolution keyword stories (2)

Source: Bloomberg

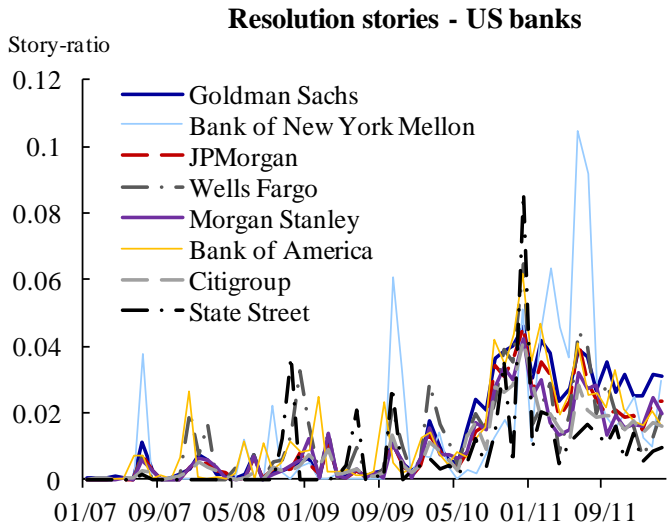Bloomberg resolution keyword stories (3)

Source: Bloomberg
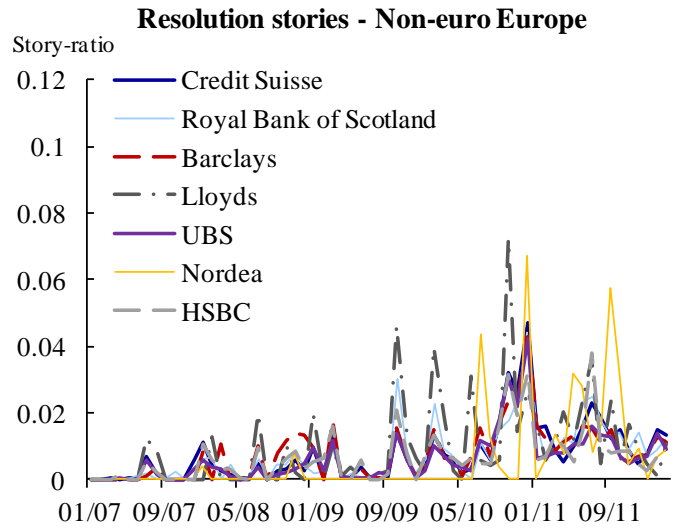

Bloomberg resolution keyword stories (4)

Source: Bloomberg

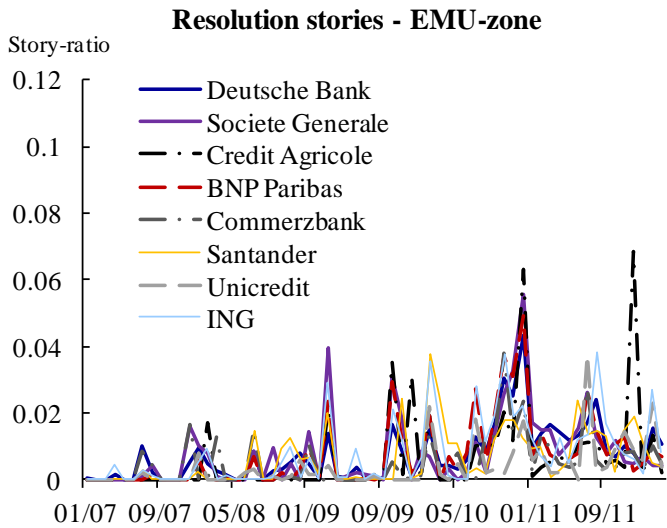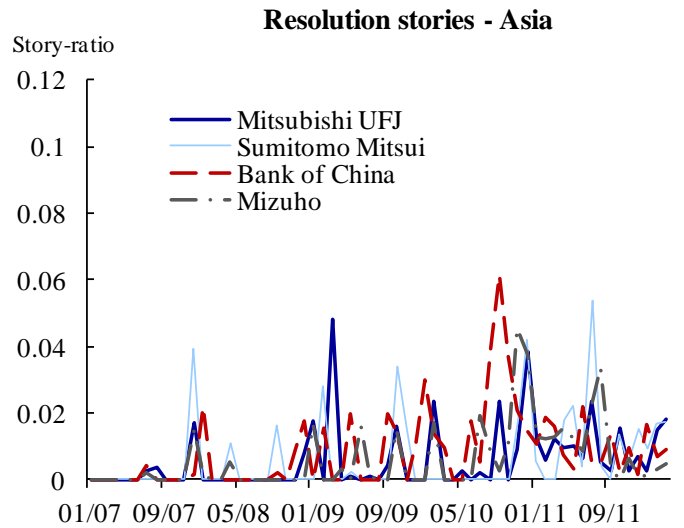**Figure A2: Frequency of banking resolution related news articles**

Resolution stories - US banks

Story-ratio

Legend:
- Goldman Sachs
- Bank of New York Mellon
- JPMorgan
- Wells Fargo
- Morgan Stanley
- Bank of America
- Citigroup
- State Street

Source: Bloomberg Trends

Resolution stories - Non-euro Europe

Story-ratio

Legend:
- Credit Suisse
- Royal Bank of Scotland
- Barclays
- Lloyds
- UBS
- Nordea
- HSBC

Source: Bloomberg trends

Resolution stories - EMU-zone

Story-ratio

Legend:
- Deutsche Bank
- Societe Generale
- Credit Agricole
- BNP Paribas
- Commerzbank
- Santander
- Unicredit
- ING

Source: Bloomberg trends

Resolution stories - Asia

Story-ratio

Legend:
- Mitsubishi UFJ
- Sumitomo Mitsui
- Bank of China
- Mizuho

Source: Bloomberg trends