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Abstract

In this paper we investigate the interdependence of the sovereign default risk and banking system fragility in two major emerging markets, China and Russia, using credit default swaps as a proxy for default risk. Both countries' banking industries have strong ties with their governments and public sector, even after a series of significant reforms in the last two decades. Our analysis is built on the case studies of each country's two biggest banks. We employ bivariate vector autoregressive (VAR) and vector error correction (VECM) framework to analyse the short- and long-run dynamics of the chosen CDS prices. We use Granger causality to describe the direction of the discovered dynamics. We find evidence of a stable long-run relationship between sovereign and bank CDS spreads in the chosen time period. The more stable relationship is found in cases, where biggest state-owned universal banks in emerging markets are closely managed by the government. But the fragility of those banks does not directly affect the state of public finance. However, in cases, where state-owned banks directly participate in large governmental projects, the banking fragility may result in deteriorations of state funds, while raising the risk of sovereign default.

JEL classification codes: **G18, G21**
Keywords: **sovereign default risk, bank default risk, CDS, emerging markets, risk transfer, financial stability**

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1. Introduction

During the recent financial crisis, which started in the US and has quickly spread to Europe and the rest of the World, extraordinary measures were taken by central banks and governments to prevent a collapse of the financial sector. Support packages from governments and monetary authorities during the global financial crisis have reached unprecedented levels, resulting in severe deteriorations of public finance. These actions combined with the cyclical deterioration of fiscal positions and discretionary fiscal expansions have led to a substantial pick up in debt to GDP ratios in many countries (Tagkalakis, 2014). Moreover, certain effects of taking such measures on the interdependence of the financial and sovereign sectors were unknown or even neglected until the followed Eurozone sovereign debt crisis.

If the concern about the connectivity between sovereign default risk and bank fragility started to grow in developed countries only after the crisis, the same connectivity is historically presumed for developing countries, where the biggest banks are mainly state-owned and largely participate in state-initiated investment projects. At the same time, since main channels through which sovereign risk can have an impact on financial institutions (such as asset holding channel and collateral channel) are significantly smaller in developing countries than in European countries due to significantly lower public debt, the two-way nexus problem does not seem to be that apparent and straightforward anymore.

In the literature, the sovereign/bank dependence was addressed only for the biggest European economies, but should definitely be considered for a larger group of countries to collect broader systematic evidence. In this paper, we are aimed to analyse the sovereign default – bank fragility nexus on the world's biggest emerging markets – China and Russia. We assume that the increase/decrease in Chinese and Russian sovereign default risk should cause the change in the default risk of domestic banks in the same direction and vice versa. However, the intensity of this direct linkage changes over time with effects of seemingly successful "survival" of the global financial crisis, followed by the domestic credit expansion with higher risks to facilitate higher rates of economic growth. We generally consider that the possible problems of growing housing bubble and non-performing loans in China and political risks and economic instability in Russia can easily affect the stability of the banking system and, consequently, increase the sovereign default risk, even when the government debt remains comparatively low.

Our study contributes to, at least, two strands of literature. First, it supplements the literature that investigates the interconnectivity between sovereign default risk and bank stability and its development during financial crisis. Second, it is linked to the literature addressing government's role in state-owned banks and its effects on the banking sector.

Tied to the first strand of literature, the mutual jeopardy of sovereign default risk and banking system fragility has been proven valid in various empirical studies, such as Demirgüc-Kunt and Huizinga (2010), Ejsing and Lemke (2011), Dieckmann and Plank (2011), Alter and Schüler (2012) and Bruyckere et al. (2013), which are mostly based on European data and usually focus on one direction of the studied risk transfer. Direct interconnectedness of balance sheets of governments and banks and financial market reactions to the announcements or implementations of government bailout and other state guarantee programs are the main methods to analyse the two-way interaction between the banking and public sectors. Among other interesting approaches to analyse this problem, König et al. (2014) employ a global-game approach to show the importance of balance sheet transparency when trying to use bank debt guarantees as a costless measure to prevent unwilling bank runs. Unfortunately, required balance sheet transparency is definitely not present in emerging markets, making the problem of moral hazard significantly higher than in developed countries.

Within the second strand of literature, the importance and performance of state-owned banks is a long-lasting debate. Both theoretical and empirical literature in developing countries suggests a negative impact of state ownership on bank performance (Bonin et al., 2005; Jiang et al., 2009; Zhang et al., 2013), which is more significant on profit efficient rather than on cost efficient side. Cornett et al. (2010) finds that state-owned banks operate less profitably, hold less core capital, and had greater credit risk than privately owned banks. Contrary to such findings, Shen et al. (2013) found that unless government-owned banks are required to purchase a distressed bank due to some political factors, their performances are at par with that of private banks. Extensive research of the phenomena on the Brazilian banking system suggests that state banks are able to outperform both foreign and private domestic banks (Tecles and Tabak, 2010), but the governmental control over banks also leads to significant political influence over the real decisions of funded firms (Carvalho, 2014). On average, the efficiency advantages of foreign banks compared with domestic banks tend to outweigh the possible disadvantages in many developing and transitory countries (Berger, 2007).

We add to existing literature by quantifying the relationship of the interdependence of the sovereign default risk and its domestic banks in emerging markets on the example of China and Russia as one of the world's most expanding economies. Methodologically, we show the direction of the relationship proving great interconnectedness of Chinese and Russian government and their domestic banking sector. We show that sovereign default risk defines state-owned bank fragility in emerging markets and that state-owned banks could have a significant impact on the sustainability of public finance.

The paper is organized as follows. In Section 2 we describe the feedback loops between government activity and financial stability. Section 3 discusses the problems in public finance and banking system of the studied countries. Section 4 presents data and methodology. In Section 4 discuses the main results and Section 5 concludes.

2. Sovereign - banks contagion channels in emerging markets

Given the historical evidences from developing countries of sovereign distresses leading to financial tensions and banking crises resulting in sovereign defaults, it is of great importance to better understand the feedback loops between government activities and overall financial stability. Risk transmission between banks and sovereigns can arise from several important sources: (1) bank holdings of possibly risky sovereign debt, (2) explicit and implicit state guarantees to banks, and (3) spillovers from sovereign spreads into bank borrowing costs. The risk sources institute four main channels of contagion, through which deterioration in the state's creditworthiness can potentially affects banking system stability and vice versa (BIS, 2011). Let's consider these four contagion channels in the studied emerging markets:

- asset holding channel;
- collateral channel;
- rating channel;
- guarantee channel.

First, increases in sovereign risk may affect banks through their direct holding of sovereign debt. Any loose on banks' portfolios weaken banks' balance sheets and increases the risk of default at the same time. If securities are denominated at a market value, any fall in prices would have a direct impact on banks' profits, equity and leverage. Holdings of domestic government bonds as a percentage of bank capital tend to be larger in countries with high public debt. In advanced economies, banks often have sizeable exposures to the home sovereign and generally have a strong home bias in their sovereign portfolios. Banks can also hold some amount of foreign country debt. Financial markets are broadly aware of the risk arising from foreign claims as countries that held a large claim in Greece, Ireland, Portugal and Spain experienced their CDS premium to co-move close to CDS premium of those countries (Sgherri and Zoli, 2009). Banks also participate in over-the-counter (OTC) derivatives markets, where governments participate to adjust the interest rate or currency composition of their outstanding debt. On the other direction of asset holding channel, bank fragility increases when bank directly follows owner's requirements and is ought to invest in government projects, such as infrastructure projects, profitability of which is usually highly questionable.

Table 1. Investor Base for General Government Debt in the Studied Countries, end-2012

Holders of Government Debt	China	Russia
Domestic central bank	10%	4%
Domestic bank	89%	36%
Domestic nonbank	Not significant	42%
Foreign official sector	Not significant	1%
Foreign nonbank	Not significant	13%
Foreign bank	Not significant	4%

Source: Arslanalp and Tsuda (2014)
Note: Government debt indicates general government gross debt. Domestic banks are depository corporations residing in the country (IFS definition). Foreign banks are BIS reporting banks and bank branches residing outside the country. Foreign official sector includes foreign official loans and foreign central bank holdings as reserve assets. Foreign nonbanks and domestic nonbanks are imputed from external and total debt.

Table 1 provides a breakdown of the estimated holdings of the government debt in the studied emerging markets at the end of 2012. It is clearly evident that banks are the key holders of domestic government bonds in both Russia and China, which they typically hold to its maturity. In China banks are almost the sole investor in government bonds with their unchanged position during the last few post-crisis years, while in Russia the investor base is much more diversified. Given the state ownership of major bank, this contagion channel is evidently very important for both countries in both directions. Moreover, since the secondary corporate bond market in both countries is underdeveloped, the authorities determine the risk-free cost of capital in the sovereign bond market. In the primary market, the bond prices are set below the clearing level of demand and supply and they are priced off the regulated one-year deposit rate. As the secondary market is very thin, the banks are guaranteed a return and the central government can use them to finance its fiscal expansion.

Second channel implies contagion when there is a reduction in the value of the collateral that banks can use to obtain wholesale funding and central bank refinancing. Sovereign securities are used by banks as collateral to secure wholesale funding from central banks, private repo markets and issuance of covered bonds, and to back OTC derivative positions. When the price of sovereign bond falls, the value of the collateral automatically falls as well. Central banks often use government bonds as collateral in provision of their liquidity transactions which are typically conducted through repurchase agreements or secured transactions. Another market which is very sensitive to risk perception is private repo market. And last, sovereign debt is widely used as collateral in covered bonds issuances.

In both studied countries, the repo market is largely used. In China's OTC market, according to Asian Development Bank (2012), covered bond collateral repo accounts for over 97% of total repo market in terms of trading volume with the most actively traded repos being in the 1-day and 7-day categories, which account for over 90% of repo transactions. Policy bank bonds, central bank paper, medium-term notes and government bonds are the four most traded repos in the interbank bond market. In Russia, almost half of the collateral in their repo market were corporate bonds, followed by 30% government bonds and 22% stocks (NSMA, 2010).

Contagion through rating channel happens when downgrade in country rating also translates to home country banks. It has direct negative effect on the cost of banks' debt and equity funding. Sovereign rating often represents a ceiling for the rating of domestic banks. Even considering the critic against rating agencies practices, ratings of emerging markets are one of the main criteria for global investors. Williams et al. (2013) analyse the effects of sovereign rating changes on the credit ratings of their domestic banks in detail. They found that sovereign rating upgrades (downgrades) have strong effects on bank rating upgrades (downgrades). Interestingly enough, the emerging market bank ratings were less likely to follow sovereign rating downgrades during the recent financial crisis period.

As the final channel of contagion, bank fragility increases, when the government faces difficulties and has little chance to provide guarantees for a bank in trouble. Especially after the Lehman Brothers collapse, the US and European governments started to provide explicit guarantees for banks in order to prevent a failure. However, the worsening of sovereign fiscal position in the Eurozone reduced the value of both implicit and explicit guarantees. When a financial institution faces liquidity issues of any sort, it may cause a contagion process affecting public sector. Sovereign default risk significantly rises when state might intervene to prevent bank bankruptcy. In emerging markets, this contagion channel is also particularly important, given the state ownership of biggest banks, which insures the stability of domestic banking sector, but also raises banks' level of moral hazard.

To summarize, it is this particular private-to-public risk transfer that adjusts the probability of sovereign default, on one hand, and lowers the default risk of financial institutions, on the other. The main consequence of the risk transfer from the private sector to sovereign treasuries has been an increased interdependence of banks and countries, causing negative feedback loops between their financial conditions. Acharya et al. (2011) model this feedback mechanism in detail.

The two-way interaction between banks and public sector is closely related to the liquidity problem. Uncertainty following sovereign distress induces a run on banks' deposits or a collapse of the interbank market and, as a result, pushes banks to reduce lending. Cantero-Saiz et al. (2014) analyse how sovereign risk influences the loan supply reaction of banks to monetary policy. They confirmed that sovereign risk plays an important role in determining loan supply from banks, however the evidence was significant only for monetary restriction regimes and not for expansions. As a solution to the studied problématique, Paries et al. (2013) show that central bank liquidity policy (through full allotment policy) has a potential to be successful in stabilizing the spiralling feedback loops.

3. Problems in public finance and banking sectors of China and Russia

Since we established that the contagion of default risks can run in both directions, the events in main risk transfer channels can be triggered in times of sovereign distress or systemic banking crisis (Acharya et al. 2011, Gray, 2009 and IMF, 2010).

The probability of sovereign distress in the studied countries is smaller than in many developed countries, but should be considered unstable. China sustained the global financial crisis better than most countries due to a large government stimulus program. This stimulus, however, was mainly in the form of off-budget infrastructure spending and thus not visible in the headline fiscal data. Zhang and Barnett (2014) analyse the augmented fiscal deficit and debt in China finding out that both are considerably higher than the headline government data suggest.

In recent history, Russia already went through a sovereign default crisis. In Moody's Report (2009) in-depth case study of Russian financial system during the 1998 crisis, still relevant country-specific institutional and political factors have a great influence on the magnitude of sovereign crisis spillovers into the corporate sector. The Russian public debt level is extremely dependent on oil prices, as proven by Danilova (2012). This is a threat to the stability of government securities market which remains exposed to the financial markets conditions. Arakelyan and Nestmann (2011), while addressing the issue of high corporate and bank debt in Russia, highlight the fact that the government owns a large part of corporate and bank assets. State support to Russian quasi sovereigns has also increased liabilities of the Russian federal government. At the same time, current debt policy of Russia is seemingly aimed at upgrading of Russia's credit ratings and ensuring its solvency.

Recent studies indicate that currently the biggest threat to banking system stability in China is shadow banking. According to the Financial Stability Board report (2013), the growth of shadow banking in China was 42% in 2012. Li and Hsu (2013) examine China's shadow banking in detail and identify potential risk of liquidity shortage and bankruptcy risk. Thomson Reuters (2014) research of the shadow banking in China points out the risk of the shadow banking bubble, endangering China's financial system stability as a whole. Economists are also concerned about continuous slowdown of Chinese economic growth and the fact that Chinese government in its war against non-performing loans had caused the growth of default risk (because of government's direct lending to troubled banks with high NPL ratio). Even if official statistics tells the story of low NPL ratios (Table 2), it is hard to deduce if the non-performing loan problem was successfully resolved or just professionally hidden. Moreover, since the government still plays a predominant role in bank lending policies and still aimed to accommodate higher rates of economic growth resulting in growing bubble in the construction sector and housing market, the problem of non-performing loans may suddenly reappear.

Table 2. Non-performing Loans in China and Russia, % of total gross loans

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
China	22,4	29,8	26	20,4	14,2	8,6	7,1	6,2	2,4	1,6	1,1	1	1	1
Russia	7,7	6,2	5,6	5	4,1	3,6	2,4	2,5	3,8	9,5	8,2	6,6	6	6

Source: WorldBank, 2013

In Russia, on the other hand, non-performing loans problem also tends to be underestimated due to non-compatible NPL definition used by the Central Bank of Russia (Table 2). At the same time, the Russian banking system is heavily regulated, which significantly reduces the competition in the banking market. According to Anzoategui et al. (2010), the banking system remains the least competitive among BRIC countries, even though it includes more than thousand commercial banks. Within Russia, large state-owned banks exert more market power than the smaller and privately owned institutions.

4. Data and Methodology

Due to limited availability of information to formulate direct numerical representation of contagion channels, we consider credit default swap prices as a proxy of credit default risk. To describe it briefly, the CDS is a derivatives contract that hedges the default risk of an underlying state or company that it references by transferring it to a third party on a bilateral basis. Traditionally, CDS spreads represent the fair insurance price for the credit risk of a company or sovereign default risk of a state, and have been used as an indicator to measure the counterparty risk. Ammer and Cai (2007) examine the relationships between credit default swap (CDS) premiums and bond yield spreads for nine emerging market sovereign borrowers.

They found no equilibrium in the short-run but significant long-turn relationship. Therefore, CDS spreads represent long-term risks in emerging markets alongside with short-term adjustments to market risks.

To study the nexus between sovereign default risk and bank fragility in emerging markets, we consider five-year credit default swaps for the People's Republic of China (PRC) and Russian Federation to represent sovereign default probabilities and credit default swaps for two big banks in each country to represent "too-big-to-fail" part of the banking system and its probability of default. We include four banks (Table 3) in our study, for which extensive CDS data are available:

- Bank of China – one of the China's Big Four banks, the second biggest lender in the country;
- China Development Bank – one of the three China's policy banks, responsible for raising funding for large infrastructure projects;
- Sberbank - the largest bank in Russia and Eastern Europe and the third largest in Europe;
- VTB bank – one of the leading universal banks in Russia, especially in financing government investment activities, such as Sochi Olympic Games or FIFA World Cup.

The data are collected from Bloomberg. Bloomberg reports CMA data, which compiles prices quoted by dealers in the privately negotiated market. We have chosen five-year spreads as the benchmark since they are generally considered the most liquidly traded and therefore offer more accurate barometer of risk appetite. The sample data consists of weekly prices from January 24th, 2003 till April 25th, 2014 for sovereign CDS; the time range of bank CDS is given in Table 3.

Table 3. Basic Characteristics of Studied Banks, end-2013

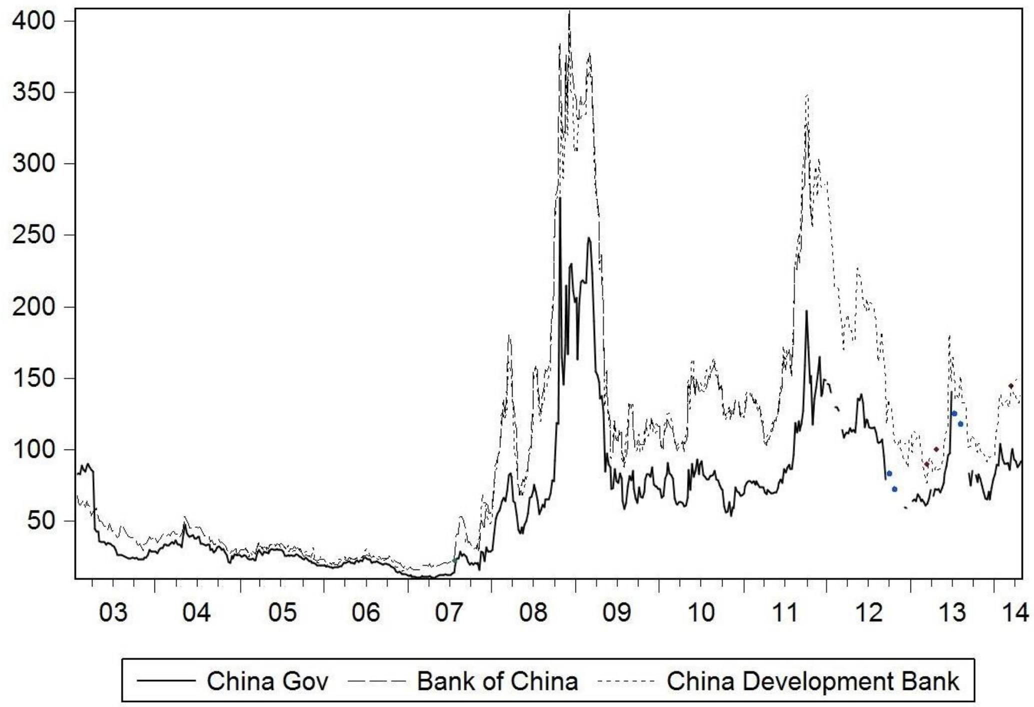
Bank	**Ownership**	**Total Assets (bil. US dollars)**	**Market Share (% of country's total banking assets)**	**CDS data availability**
Bank of China	State	2229,95	9,58	January 2003 – October 2011
China Development Bank	State	1206,69	5,11	January 2005 – December 2006, October 2007 –April 2014
Sberbank	State	486,40	28,6	October 2009 – March 2014
VTB	State/Private	262,05	15,41	August 2005 – March 2014

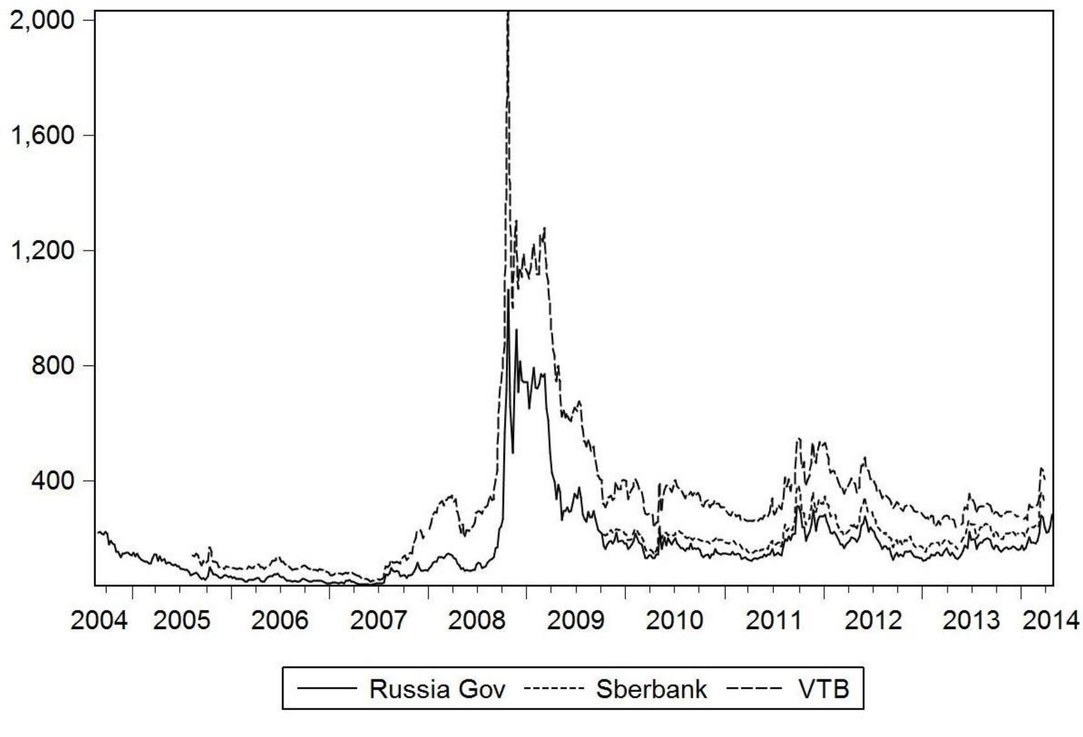
Source: Bloomberg

Figure 1 describes data in levels. Casual observation of levels implies that each CDS series appears to be non-stationary and that CDS spreads in each country tend to move together over time without a trend. The differences of chosen variables seem to vary over a constant level of zero, although there are few large outliers, which should be accounted for in the model. From the inspection of properties of data seen in first differences (not reported here due to space constraints, but available on request), it is indicated that the assumption of multivariate normality might be accepted with minor changes of the model in order to obtain better specification and robustness of further analysis.

There are two approaches to analyse the sovereign/bank dependence: direct (contingent claim analysis) and indirect (through financial market reactions). Bank-by-bank framework of contingent claims analysis uses balance sheet data plus high-frequency market data in a way that measures risk exposures and can capture key risk transmission and feedbacks with the sovereign in real time (Gray and Malone, 2012). Contingent claim analysis represents a generalization of the option-pricing theory and, thus, is forward-looking by construction, providing a consistent framework based on current market conditions rather than on purely historical experience. Indirect approach usually accounts for interdependencies between sovereign and bank CDS spreads with the apparatus of financial econometrics (such as Alter and Schüler, 2012 or Alter and Beyer, 2014).

Figure 1. Level series of studied government and bank CDS





Source: Bloomberg

To analyse the dynamics of the long- and short-run interdependencies between selected CDS price series, we employ bivariate vector autoregressive (VAR) and vector error correction (VECM) framework. Such framework allows for testing and interpreting cointegration relation between studied series. To further illustrate the entire dynamics between the CDS spreads and describe the direction of the discovered dynamics, we consider Granger causality tests. The study employs cointegration analysis and follows theoretical formations and research design suggestions described in Johansen (1996) and Juselius (2006).

Cointegrated VAR analysis should be employed with great caution, since several conditions have to be met to achieve trustworthy and credible results. Following Granger (1986) and Engle and Granger (1987), variables are called cointegrated if they have a common stochastic trend. To check the stochastic non-stationarity of the data the unit root is required. We conduct standard Augment Dickey-Fuller (1981) unit root test (ADF), which constructs a parametric correction for higher-order correlation by assuming that the y_t time series follows an *AR(p)* process with p lagged difference terms and both with and without constant α_0:

$$\Delta cds_t = \alpha_0 + \gamma cds_t + \beta_1 \Delta cds_{t-1} + \cdots + \beta_p \Delta cds_{t-p} + \varepsilon_t, \text{ where } \gamma = -(1 - \sum_{i=1}^{p} \alpha_i) \quad (1)$$

Alternatively, we use non-parametric Phillips-Perron (PP) test relaxing the ADF test assumption of identically distributed errors. The test is robust with respect to unspecified autocorrelation and heteroscedasticity in the disturbance process of the test equation (1). The parameter of interest in both regressions is γ (if $\gamma = 0$, the series contain unit root). The result of the t-test is compared to appropriate critical values.

We employ both Engle-Granger and Johansen procedures to find the common trend in the bivariate time series, which is based on the vector autoregressive (VAR) model of the form:

$$\begin{pmatrix} cds\_sov_t \\ cds\_bank_t \end{pmatrix} = \Pi_1 \begin{pmatrix} cds\_sov_{t-1} \\ cds\_bank_{t-1} \end{pmatrix} + \Pi_p \begin{pmatrix} cds\_sov_{t-p} \\ cds\_bank_{t-p} \end{pmatrix} + \mu_0 + \phi D_t + \varepsilon_t, \quad (2)$$

The deterministic components might include a vector of constant terms, μ_0, and D_t contains impulse dummy variables explaining extraordinary effects. The lag p is determined by several criteria: sequential modified LR test statistic, Final prediction error, Akaike, Schwarz and Hannan-Quinn information criteria.

In the Engle-Granger two step method two time series are cointegrated, when the linear combination of them is stationary. Johansen cointegration technique is based on two test statistics to determine the number of cointegrating vectors (the rank of the matrix) namely the trace statistic and the maximum eigenvalue statistic, which are computed for the null hypothesis of no cointegration as:

$$LR_{tr}(r|k) = -T \sum_{i=r+1}^{k} \log(1 - \lambda_i), \quad (3)$$

$$LR_{max}(r|r+1) = -T \log(1 - \lambda_i) = LR_{tr}(r|k) - LR_{tr}(r+1|k) \quad (4)$$

Trace statistic tests the null hypothesis of *r* cointegrating relations against the alternative of *k* cointegrating relations, where *k* is the number of variables in the system for *r =0,1,2…k-1*. The maximum eigenvalue statistics tests the null hypothesis of *r* cointegrating relations against the alternative of *r+1* cointegrating relations for *r =0,1,2…k-1*. The null hypothesis of no cointegration is rejected, if the rank of the coefficient matrix is at least 1.

The third step of our investigation is based on Granger Representation Theorem. If the variables in the VAR model, which represents the long-run dynamics between indices, are found to be cointegrated, when there must exist an associated error-correction model, which can be built by imposing the number of cointegration relations previously identified as restrictions:

$$\begin{pmatrix} \Delta cds\_sov_t \\ \Delta cds\_bank_t \end{pmatrix} = \Pi \begin{pmatrix} cds\_sov_{t-1} \\ cds\_bank_{t-1} \end{pmatrix} + \Gamma_1 \begin{pmatrix} \Delta cds\_sov_{t-p} \\ \Delta cds\_bank_{t-p} \end{pmatrix} + \varepsilon_t, \quad (5)$$

where $cds_{j,t}$, with $j \in \{sov, bank\}$ refers to log $CDS_{j,t}$, i.e. the logarithmized CDS series of the country or bank. $\Delta cds_{j,t}$ denotes the difference between $cds_{j,t}$ a $cds_{j,t-1}$. $\Pi = \begin{pmatrix} \alpha_{cds\_gov} \\ \alpha_{cds\_bank} \end{pmatrix} (\beta_{cds\_gov} \quad \beta_{cds\_bank})$ represents long-run changes of the system and Γ_1 denotes transitory adjustments with γ-coefficients potraying the short-run dynamics. Note that β_{sov} is normalized and only β_{bank} is estimated. The loading coefficient α measure the speed of adjustment with which a particular CDS would adjust to the long-run relationship.

As the last step, we employ Granger causality test to identify the causality sense between CDS series (causality implies a chronological ordering of movements of the series). If we denote the first analysed series (its first differences) as $I_{1,t}$ and the second series as $I_{2,t}$ the Granger causality model takes the following form:

$$\Delta I_{1,t} = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, \Delta I_{1,t-i} + \sum_{j=1}^{q} \beta_j \, \Delta I_{2,t-j} + \varepsilon_t \quad (6)$$

Wald's test for joint significance of the parameters β_j is performed to evaluate the null hypothesis that $I_{1,t}$ does not Granger cause $I_{2,t}$.

Table 4. Results of ADF and PP tests

	Test	China	Bank of China	CDBC	Russia	Sberbank	VTB
levels	ADF (with intercept)	-1.599	-0.445	-1.030	-1.725	-2.373	-1.396
	ADF (with trend and intercept)	-2.833	-1.939	-1.184	-2.379	-2519	-1.576
	PP (with intercept)	-1.574	-0.776	-1.192	-1.854	-2.414	-1.538
	PP (with trend and intercept)	-2.813	-2.159	-1.469	-2.494	-2.607	-1.760
first differences	ADF (with intercept)	-25.571	-20.191	-20.592	-22.109	-14.331	-20.019
	ADF (with trend and intercept)	-25.581	-20.246	-20.581	-22.120	-14.310	-19.996
	PP (with intercept)	-25.511	-20.489	-20.731	-22.132	-14.378	-20.095
	PP (with trend and intercept)	-25.523	-20.516	-20.718	-22.140	-14.356	-20.072

Note: MacKinnon critical values are 3.4443 and -2.8676 for 1% and 5% level of significance respectively

5. Results and Discussion

The logarithms of the chosen CDS series are tested for unit roots using the Augment Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The p-values used in the test are MacKinnon one-sided p-values. Several ADF test are calculated in levels and in the first differences with inclusion of constant or constant and trend (Table 4). The results of the ADF unit root test show that at logarithm levels all CDS prices are non-stationary series with a deterministic trend. However, the ADF tests performed at first differences suggest that data are stationary, hence all variables are first-order integrated series or *I(1)*.

Having confirmed that studied CDS spreads can be characterized as integrated series with order one, we first examine the long-run relations among selected pairs of CDS prices. Vector Autoregressive model of series pairs indicate the appropriate lag order, which is selected by three criteria: LR test statistic, Schwarz Information Criterion and Hannan-Quinn Information Criterion (Table 5). For all of time series pairs, the lag order of two is chosen.

Table 5. Lag length determination

Lag	AIC	SC	HQ
	China – Bank of China		
0	1.904536	1.922799	1.911734
1	-4.406774	-4.351984	-4.385180
2	-4.451943	-4.360627*	-4.415952*
3	-4.453224	-4.325381	-4.402836
4	-4.454685*	-4.290315	-4.389900
	China – China Development Bank		
0	1.370655	1.393376	1.379713
1	-3.873735	-3.805573	-3.846564
2	-4.004933	-3.891328*	-3.959647*
3	-4.008726*	-3.849680	-3.945326
	Russia - Sberbank		
0	-3.243347	-3.211256	-3.230371
1	-5.746662	-5.650387	-5.707734
2	-5.864491	-5.704032*	-5.799609*
3	-5.855758	-5.631116	-5.764925
4	-5.875988*	-5.587163	-5.759202
	Russia – VTB		
0	1.272725	1.292645	1.280613
1	-4.621356	-4.561596	-4.597693
2	-4.696315	-4.596715*	-4.656876*
3	-4.702317	-4.562877	-4.647103
4	-4.690424	-4.511144	-4.619434
5	-4.710318*	-4.491198	-4.623552

Note: * indicates lag order selected by the criterion

The residual analysis is conducted to determine whether chosen model specification is statistically well-specified, or in other words, to check the assumption of the error terms being independently normally distributed (results are summarized in Table 6). It is worth mentioning that valid statistical inference is sensitive to violation of certain assumptions, such as autocorrelated or skewed residuals and parameter inconstancy, and robust to violation of others, such as residual heteroskedasticity or excess kurtosis.

The better specified model includes several dummies, allowing for further application of the proposed methodology. Model dummies signify three substantial events on the Chinese and Russian banking markets. All dummy variables are substantial at 9% significance level (later discussed in Table 8). For example, for the pair Chinese sovereign – Bank of China CDS, dummies are found to highlight and explain important changes in the Chinese banking system. First dummy (April 2003) corresponds to Chinese government extra-ordinary measures to resolve the issue of bank non-performing loans. Up to the end of 2003 the four major financial asset management corporations had disposed of 301.4 billion yuan of NPLs excluding the conversion of liabilities to equities, recovering 101.3 billion yuan including 67.5 billion yuan of cash (Ye, 2003). Second dummy (November 2007) relates to the sudden effects of the global financial crisis on Chinese financial markets through diminishing liquidity on the interbank market. As a result, Chinese stock indexes lose over 60% between November 2007 and September 2008. Third dummy (October 2008) illustrates China’s central bank measures on handling domestic economic slowdown (growth of the Chinese economy fell to 6,8% in the fourth quarter of 2008 from 13% in 2007). China's central bank cut both interest rate and reserve requirements and released 4 trillion yuan special stimulus package in an effort to boost domestic economy and avoid deflation.

Table 6. Multivariate misspecification tests

Test	Model without dummies	Model with dummies
China – Bank of China		
Residual autocorrelation LM(1)	$\chi^2(4)$ =6.5868 [0.159]	$\chi^2(4)$ =26.506 [0.000]
Residual autocorrelation LM(2)	$\chi^2(4)$ =5.4125 [0.247]	$\chi^2(4)$ =13.249 [0.011]
Test for normality (skewness)	$\chi^2(2)$ =50.900 [0.000]	$\chi^2(2)$ =3.3666 [0.186]
Test for normality (kurtosis)	$\chi^2(2)$ =1133.3 [0.000]	$\chi^2(2)$ =209.09 [0.000]
China –China Development Bank		
Residual autocorrelation LM(1)	$\chi^2(4)$ =12.437 [0.014]	$\chi^2(4)$ =22.411 [0.000]
Residual autocorrelation LM(2)	$\chi^2(4)$ =10.927 [0.027]	$\chi^2(4)$ =9.6214 [0.047]
Test for normality (skewness)	$\chi^2(2)$ =77.418 [0.000]	$\chi^2(2)$ =3.2911 [0.193]
Test for normality (kurtosis)	$\chi^2(2)$ =2258.7 [0.000]	$\chi^2(2)$ =294.84 [0.000]
Russia – Sberbank		
Residual autocorrelation LM(1)	$\chi^2(4)$ =15.179 [0.004]	$\chi^2(4)$ =16.447 [0.002]
Residual autocorrelation LM(2)	$\chi^2(4)$ =19.184 [0.001]	$\chi^2(4)$ =13.669 [0.008]
Test for normality (skewness)	$\chi^2(2)$ =25.722 [0.000]	$\chi^2(2)$ =3.3454 [0.187]
Test for normality (kurtosis)	$\chi^2(2)$ =92.693 [0.000]	$\chi^2(2)$ =15.232 [0.000]
Russia - VTB		
Residual autocorrelation LM(1)	$\chi^2(4)$ =10.429 [0.034]	$\chi^2(4)$ =14.138 [0.002]
Residual autocorrelation LM(2)	$\chi^2(4)$ =10.396 [0.034]	$\chi^2(4)$ =10.614 [0.082]
Test for normality (skewness)	$\chi^2(2)$ =167.31 [0.000]	$\chi^2(2)$ =0.7490 [0.687]
Test for normality (kurtosis)	$\chi^2(2)$ =2578.3 [0.000]	$\chi^2(2)$ =113.28 [0.000]

Note: p-values are denoted in brackets

For the pair Russian sovereign – VTB CDS, dummies are found to highlight and explain important changes in the Russian banking system. First dummy (October 2005) corresponds to Russian government extra-ordinary measures to finance VTB’s acquisition of Moscow Narodny and other former Soviet foreign trade banks from the Central Bank of Russia. The Russian government approved a capital increase of 37.5 billion rubles in state-owned VTB. Second dummy (July 2007) relates to the sudden takeover of Slavneftebank in Belarus, later renamed VTB Belarus. VTB was the first Russian bank to offer an initial public offering (IPO), raising $8 billion in what became the largest international banking IPO at the time. Third dummy (August 2008) illustrates the RTS Index fall down by 6,5% as a reaction to the conflict in Georgia. This fact provides ample evidence of how nervous international markets reacted during these turbulent times. Following these events the devaluation pressure on the ruble increased. Up to this point, Russian banks had not yet experienced liquidity shortages.

For the model including dummies, we cannot reject the null hypothesis of no first or second order autocorrelation, while model residuals are found to be normally skewed. Now we can assume the robustness of results of cointegration tests. The Engle-Granger cointegration test requires individual variables to be non-stationary, which was established previously (Table 1). Significant coefficients of the individual variables in the cointegrating regression (Table 8) alongside with stationary residuals from the cointegrating regression indicate strong cointegration of studied CDS series. Johansen test of rank determination also signals the existence of cointegration. Both trace test and maximum eigenvalue test suggests the cointegration rank of the model to equal one (Table 7).

The results of the error-correction model specification are summarized in Table 8. The α-coefficients in the cointegration relations indicate the adjustments of default risks to long-term equilibrium between them. The adjustment of both sovereign and bank CDS spreads are found for China Development Bank and VTB bank. It means that the relationship between bank fragility and sovereign default risk is not stable over time with frequent adjustments. The α-coefficients in the relations of Chinese state and Bank of China suggests that the bank spread do not adjust to any deviations from the long-run equilibrium, while the sovereign CDS adjusts at a rate of $\alpha_{cds\_gov} = -0{,}06$ to changes in the Bank of China spreads. At the same time, model results signify that bank risks adjust to short-term dynamics of sovereign CDS spreads. The most stable relationship is found for the pair Russian Federation – Sberbank, where no short-term adjustments or short-term dynamics is discovered.

Table 7. Rank Determination (results of Johansen cointegration test)

Test	Null Hypothesis	Alternative hypothesis	Eigenvalue	Test statistic	5% critical value	p-value
			China – Bank of China			
Trace	**r=0**	r>0	0.0393	18.415	12.321	0.0042
	r≤1	r>1	0.0004	0.1657	4.1299	0.7363
Maximum eigenvalue	**r=0**	r=1	0.0393	18.249	11.225	0.0025
	r=1	r=2	0.0004	0.1657	4.1299	0.7363
			China – China Development Bank			
Trace	**r=0**	r>0	0.0405	16.162	12.321	0.0109
	r≤1	r>1	0.0015	0.5998	4.1299	0.5000
Maximum eigenvalue	**r=0**	r=1	0.0405	15.562	11.225	0.0082
	r=1	r=2	0.0015	0.5998	4.1299	0.5000
			Russia – Sberbank			
Trace	**r=0**	r>0	0.0731	16.949	12.321	0.0078
	r≤1	r>1	0.0000	0.0006	4.1299	0.9874
Maximum eigenvalue	**r=0**	r>0	0.0732	16.949	11.225	0.0045
	r≤1	r>1	0.0000	0.0006	4.1299	0.9874
			Russia - VTB			
Trace	**r=0**	r>0	0.0381	16.880	12.321	0.0081
	r≤1	r>1	0.0014	0.6091	4.1299	0.4963
Maximum eigenvalue	**r=0**	r>0	0.0381	16.271	11.225	0.0060
	r≤1	r>1	0.0014	0.6091	4.1299	0.4963

Table 8. Results of cointegration analysis (VEC model estimation output)

Cointegration relations	α_{cds_gov}	α_{cds_bank}	β_{cds_gov}	β_{cds_bank}
China – Bank of China	**-0.0593** **(0.0056)**	-0.0271 (0.1623)	**1 (0.00)**	**-0.9055** **(0.0157)**
China – CDBC	**-0.0786** **(0.0301)**	**-0.0075** **(0.0289)**	**1 (0.00)**	**-0.9044** **(0.0106)**
Russia – Sberbank	-0.2339 (0.1217)	0.0089 (0.0952)	**1 (0.00)**	**- 0.9601** **(0.0021)**
Russia – VTB	**-0.0906** **(0.0261)**	**-0.0341** **(0.0216)**	**1 (0.00)**	**-0.8735** **(0.0071)**

Note: p-values are denoted in brackets. Significant results are highlighted in bold.

Error-correction terms	Δcds_sov_t	Δcds_bank_t
China – Bank of China		
Δcds_sov_{t-1}	0.0440 (0.4519)	**0.1812 (0.0007)**
Δcds_bank_{t-1}	0.0064 (0.9269)	-0.0531 (0.4041)
D_t (11.04.2003)	**-0.5923 (0.0000)**	0.0348 (0.6716)
D_t (16.11.2007)	**0.5829 (0.0000)**	**0.6258 (0.0000)**
D_t (24.10.2008)	**-0.6874 (0.0000)**	**-0.2692 (0.0000)**
R-squared	0.3324	0.1621
China – China Development Bank		
Δcds_sov_{t-1}	-0.3083 (0.0585)	0.1954 (0.0561)
Δcds_bank_{t-1}	0.2926 (0.0652)	-0.0832 (0.0626)
D_t (24.10.2008)	0.8613 (0.0937)	-0.0004 (0.0900)
D_t (08.05.2009)	-0.3886 (0.0927)	-0.4600 (0.0890)
D_t (21.06.2013)	0.0484 (0.0929)	0.4405 (0.0893)
R-squared	0.3052	0.1747
Russia – Sberbank		
Δcds_sov_{t-1}	-0.0217 (0.1501)	0.3231 (0.1174)
Δcds_bank_{t-1}	-0.1347 (0.1617)	-0.3532 (0.1264)
D_t (07.05.2010)	0.4393 (0.0813)	0.3985 (0.0636)
D_t (23.09.2011)	0.3724 (0.0818)	0.3861 (0.0639)
D_t (14.03.2014)	0.2668 (0.0821)	0.3368 (0.0641)
R-squared	0.2488	0.3609
Russia – VTB		
Δcds_sov_{t-1}	0.1518 (0.0804)	0.2984 (0.0667)
Δcds_bank_{t-1}	-0.2880 (0.0936)	-0.3491 (0.0776)
D_t (14.10.2005)	0.3661 (0.0856)	0.2886 (0.0710)
D_t (27.07.2007)	0.4872 (0.0852)	0.4684 (0.0706)
D_t (19.09.2008)	0.3165 (0.0855)	0.4178 (0.0709)
R-squared	0.2456	0.3024

Note: p-values are denoted in brackets. Significant results are highlighted in bold.

In order to test short-run linkages between selected stock markets we conduct Granger tests for intertemporal causality. Table 9 shows the results of Granger Causality/Block Exogeneity Wald tests. It estimates the chi-squared value of coefficient on the lagged endogenous variables. The hypothesis in this test is that the lagged endogenous variables do not "Granger cause" the dependent variable. Tests of Granger causality indicate that changes in sovereign CDS spreads in each case Granger-cause changes in bank CDS spreads at the 1% significance level in the observed time period. Such causality supports the theory of sovereign-bank risk transmission. More interesting results are obtained for the causality of bank CDS spread changes on sovereign CDS prices. Default risk of the biggest bank in each country (namely, Bank of China and Sberbank) does not affect state's credit default risk. But, the fragility of banks, greatly involved in various governmental projects (namely China Development Bank and VTB bank), has an impact on the sustainability of public finance.

Table 9. Results of Granger-causality tests

Independent variable	Dependent variable	$\chi^2(2)$ statistic	p-value
China	*Bank of China*	**13.017**	**0.0015**
China	*CDBC*	**28.629**	**0.0000**
Russia	*Sberbank*	**7.9907**	**0.0184**
Russia	*VTB*	**21.067**	**0.0000**
Bank of China	*China*	1.5201	0.4676
CDBC	*China*	**18.381**	**0.0001**
Sberbank	*Russia*	1.5998	0.4494
VTB	*Russia*	**14.914**	**0.0006**

Note: Significant results are highlighted in bold.

5. Concluding remarks

As a result of ever growing interconnectivity in the financial sector, financial stability became a public good when its provider cannot exclude any party from its benefits and any party should not influence its state. As a result, the interdependence between the financial and public sector has started to be one of the major concerns of regulators and policy makers. Our main goal was to test this relationship in emerging markets on the example of baking sector of China and Russia in the time period from 2003 to 2014. We use sovereign and bank CDS as a proxy for modelling default risks.

The long-term relationship between sovereign default risk and bank fragility is established in four different cases. The stability of such relationship is considerably different in two types of cases. The more stable relationship between bank fragility and sovereign default risk is found in cases, where biggest state-owned universal banks in emerging countries are closely managed by the government. However, the fragility of such banks does not directly affect the state of public finance. But, in cases, where state-owned banks directly participate in large governmental, usually infrastructure projects, the banking fragility may result in deteriorations of state funds, while raising the risk of sovereign default. Therefore, the successful completion and return on investments in big infrastructure projects directly influences not only the stability of participating banks, but the sovereign default risk as well. Any significant changes of sovereign credit risk will significantly affect the banking market in China and Russia in a long run. Even if Chinese and Russian public sector are nowadays considered to be one of the most stable in the world with low amounts of state debts, the problems in banking sector could raise sovereign default risks. As a recent example, when one of the Chinese major financial institutions China Credit Trust Co. was in danger of default in the beginning of 2014, interbank lending rates started to rise, thus, pressuring sovereign default rates.

Our findings suggest that some country-specific risk factors influence the pricing of emerging markets sovereign debt instruments. This contradicts some of the previous findings in this area, such as Fender et al. (2012), whose found that the price of sovereign debt in emerging market is based on global and regional risk premium, rather than country-specific risk factors.

References

Acharya, V., Drechsler, I., Schnabl, P. 2013. A Pyrrhic victory? Bank bailouts and sovereign credit risk. *NBER Working Paper Series*, No. 17136.

Alter, A., Schüler, Y.S. 2012. Credit spread interdependencies of European states and banks during the financial crisis. *Journal of Banking & Finance*, vol. 36, No. 1, pp. 3444-3468.

Ammer, J. and Cai, F. 2007. Sovereign CDS and bond dynamics in emerging markets: does the cheapest-to-deliver option matter? *FED International Finance Discussion Papers*, No. 912.

Anzoategui, D., Pería, M. and Melecky, M. 2010. Banking sector competition in Russia. *Policy Research Working Paper*, No. 5449.

Arakelyan, M. and Nestmann, T. 2011. *Russia's quasi-sovereign debt*. Deutsche Bank Research. Retrieved from: http://www.dbresearch.com/MAIL/DBR_INTERNET_EN-PROD/PROD0000000000269066.pdf

Arslanalp and Tsuda (2014). Tracking global demand for emerging market sovereign debt. *IMF Working Paper*, No. 39.

Asian Development Bank. 2012. *Bond Market Guide.* Retrieved from: http://www.adb.org/sites/default/files/pub/2012/asean3-bond-market-guide.pdf

Berger, A. N., 2007. International Comparisons of Banking Efficiency. *Financial Markets, Institutions and Instruments*, Vol. 16, No. 1, pp. 119-144.

BIS. 2011. The impact of sovereign credit risk on bank funding conditions. *Committee on the Global Financial System Papers*, No. 43.

Bonin, J. P., Hasan, I. and Wachtel, P. 2005. Bank performance, efficiency and ownership in transition countries. *Journal of Banking and Finance*, Vol. 29, No. 1, pp. 31–53.

Bruyckere, V., Gerhardt, M., Schepens, G. and Vennet, R.V. 2013. Bank/sovereign risk spillovers in the European debt crisis. *Journal of Banking & Finance*, vol. 33, No. 1, pp. 4793-4809.

Maria Cantero-Saiz, M., Sanfilippo-Azofra, S., Torre-Olmo, B. and López-Gutiérrez, C. 2014. Sovereign risk and the bank lending channel in Europe. J*ournal of International Money and Finance*, vol. 47, No. 1, pp. 1-20.

Carvalho, D. 2014. The real effects of government-owned banks: evidence from an emerging market. *The Journal of Finance*, Vol. 69, No. 2.

Central Bank of China. 2003. *Annual Report 2003, Chapter II. Financial Development*. Retrieved from: http://www.cbc.gov.tw/ct.asp?xItem=26964&ctNode=776&mp=2.

Cornett, M., Guo, L., Khaksari, S. and Tehranian, H. 2010. The impact of state ownership on performance differences in privately-owned versus state-owned banks: An international comparison. *Journal of Financial Intermediation*, Vol. 19, No. 1., pp. 74-94.

Danilova, E. 2012. Fiscal policy, public debt management and government bond markets: issues for central banks. *BIS Papers*, No. 67.

Demirgüc-Kunt, A. and Huiuinga, H. 2010. Are banks too big to fail or too big to save? International evidence from equity prices and CDS spreads. *CEPR Discussion Papers*, No. 7903.

Dieckmann, S. and Plank, T. 2011. Default risk of advanced economies: an empirical analysis of credit default swaps during the financial crisis. *Review of Finance*, vol. 6, No. 14, pp. 903–934.

Eichler, S. 2014. The political determinants of sovereign bond yield spreads. *Journal of International Money and Finance*, Forthcoming.

Ejsing, J. and Lemke, W. 2011. The Janus-headed salvation: Sovereign and bank credit risk premia during 2008–2009. *Economics Letters*, vol. 110, pp. 28–31.

Engle, R.F., Granger, C.W. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica,* vol. 55, pp. 251-276.
Fender, I., Hayo, B., Neunkircher, M. 2012. Daily pricing of emerging market sovereign CDS before and during global financial crisis. *Journal of Banking & Finance*, vol. 36, No. 1, pp. 2786-2794.
FSB. 2013. *Global shadow banking monitoring report 2013*. Financial Stability Board. Retrieved from: http://www.financialstabilityboard.org/publications/r_131114.pdf.
Gonzales-Garcia, J. and Grigoli, F. 2013. State-owned banks and fiscal discipline. *IMF Working Paper*, No. 206.
Granger, C.W. (1986). Developments in the Study of Cointegrated Economic Variables. *Oxford Bulletin of Economics and Statistics*, vol. 3, pp. 213-228.
Gray, D. F. 2009. Modeling financial crises and sovereign risks. *Annual Review of Financial Economics*, No. 1, pp. 117-144.
Gray, D. F. and Malone, S.W. 2012. Sovereign and Financial-Sector Risk: Measurement and Interactions. *Annual Review of Financial Economics*, vol. 4, pp. 297-312.
Jiang, C., Yao, S. and Zhang, Z. 2009. The effects of governance changes on bank efficiency in China: A stochastic distance function approach. *China Economic Review*, Vol. 20, No. 1, pp. 717–731.
Johansen, S. (1996). *Likelihood-based Inference in Cointegrated Vector Auto-Regressive* Models, Oxford University Press.
Juselius, K. (2006). *The Cointegrated VAR Model: Methodology and Applications,* Oxford University Press.
IMF. 2010. Global *Financial Stability Report – sovereigns, funding, and systemic liquidity*. Washington DC.
König, P., Anand, K., Heinemann, F. 2014. Guarantees, transparency and the interdependency between sovereign and bank default risk. *Journal of Banking & Finance*, Forthcoming.
Li, J. and Hsu, S. 2013. Shadow banking in China: institutional risk. *Political Economy Research Instituce Working Paper*, No. 334.
Moody's, 2009. *Moody's Global Credit Policy Report*. Retrieved from: https://www.moodys.com/sites/products/DefaultResearch/2007400000573849.pdf
NSMA. 2010. *1st repo market survey in Russia. Russian Repo Council*. Retrieved from: http://www.icmagroup.org/assets/documents/Market-Info/Repo-Market-Surveys/Russian-Repo-Surveys/1st%20Russian%20Repo%20survey.pdf
Paries, M.D., Faia, E. and Palenzuela, D.R. 2012. Bank and sovereign debt risk connection. *SAFE Working Paper Series*, No. 7.
Sgherri, S., and Zoli, E. 2009. Euro area sovereign risk during the crisis. International Monetary Fund, *IMF Working Papers*, No. 09/222.
Shen, CH., Hasan, I. and Lin, Ch. 2013. The government's role in government-owned banks. *Bank of Finland Research Discussion Paper*, No. 13.
Tagkalakis, A. 2014. Financial stability indicators and public debt developments. *Bank of Greece Working Paper,* No. 179.
Tecles, P. L. and Tabak, B. M. 2010. Determinants of bank efficiency: The case of Brazil. *European Journal of Operational Research*, Vol. 207, No. 3, pp. 1587-1598.
Thomson Reuters Accelus. 2014. *Chinese shadow banking: understanding KRIs and risk scenarios*. Retrieved from: http://accelus.thomsonreuters.com/sites/default/files/GRC00715_0.pdf
Ye, Y. *(2003). The Way of Dealing with Non-performing Loans and Its Effects on Macro-statistics in China.* Retrieved from: https://www.imf.org/external/np/sta/npl/eng/2003/051603a.pdf.

Williams, G., Alsakka, R. and Gwilym, O. 2013. The impact of sovereign ration actions on bank ratings in emerging markets. *Journal of Banking & Finance*, Vol. 37, No. 1, pp. 563-577.
Zhang, J., Jiang, Ch., Qu, B., Wang, P. 2013. Market concentration risk-taking, and bank performance: evidence from emerging economies. *International Review of Financial Analysis*, vol. 30, No. 1, pp. 149-157.
Zhang, Y. and Barnett, S. 2014. Fiscal vulnerabilities and risks from local government finance in China. *IMF Working Paper*, No. 4.