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ÉTUDE SUR LA TRANSMISSION DU RISQUE DE CRÉDIT SOUVERAIN AUX BANQUES EUROPÉENNES

par

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Résumé

Dans ce mémoire, nous analysons l'impact sur les banques de l'augmentation du risque de crédit souverain en Europe. Nous procédons d'abord par une analyse de sensibilité pour comprendre la relation générale entre le risque des banques et celui des gouvernements, suivi par une analyse événementielle pour voir l'impact sur le risque bancaire d'événements ponctuels affectant le risque de crédit souverain. Nos résultats montrent une diminution de la sensibilité du risque de crédit des banques au risque de crédit souverain, au profit d'une augmentation du risque systémique. Aussi, nous démontrons que seuls les baisses de cote de crédit émises par l'agence de cotation Standard & Poor's ont un effet significatif durable sur les banques européennes. Enfin, nous estimons que le risque de crédit souverain se transmet aux banques étrangères par le biais d'une accessibilité réduite à des liquidités, et non par des pertes directes sur leurs positions en dette souveraine.

Mots-clés

Banques; Crise financière; Crise européenne; Dette souveraine; PIIGS; Risque de défaut; Stress test; Plan de sauvetage.

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Liste des abréviations

- RBS : Royal Bank of Scotland
- PIIGS : Portugal, Irlande, Italie, Grèce et Espagne
- UE : Union Européenne
- BCE : Banque Centrale européenne
- FMI : Fond Monétaire International
- MCO : Méthode des moindres carrés ordinaires
- ABE : Autorité bancaire européenne
- CDS : Credit default swap
- S&P : Standard & Poor's (agence de notation)
- PBS : Points de bases
- CAR : Rendements anormaux cumulatifs (cumulative abnormal returns)
- PIG : Portugal, Irlande et Grèce
- IMF : International monetary fund
- ECB : European central bank
- EBA : European banking authority
- GDP : Gross domestic product
- OLS : Ordinary least square
- MBS : Mortgage-backed securities
- ME : Marginal explanation
- EU : European union
- EMU : European monetary union
- BIS: Bank for international settlements
- BPS: Basis points
- RWA: Risk-weighted assets
- AFS: Available-for-sale securities
- FVO: Fair-value through profits and losses
- MME: Marked-to-market exposures
- HTM: Held-to-maturity exposures

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Note aux lecteurs

Les sections 4 et 5 du présent mémoire sont constituées de deux articles indépendants : « *Sensitivity of banks to sovereign credit risk in Europe* » et « *The impact of sovereign default risk on European banks: An event-study analysis* ». Toutes les sections de ces deux articles sont l'œuvre de l'auteur de ce mémoire, sous la direction d'Alexandre Jeanneret.

1. Introduction

Depuis le début de la crise financière, la relation entre les banques et les gouvernements a été mise à l'avant-plan. Durant les premières années de la crise, les gouvernements de plusieurs pays développés ont dû venir à la rescousse de leurs institutions financières, par le biais d'injections massives de capitaux. Plusieurs banques européennes sont même passées sous le contrôle de l'État, comme par exemple la *Royal Bank of Scotland* (RBS) et *Hypo Real Estate*.

La fin de 2009 marque un changement important dans la crise. En effet, suite à l'annonce par la Grèce d'un déficit beaucoup plus important que prévu, la santé des finances publique a pris la place de l'état du système bancaire à la tête des préoccupations des marchés financiers européens et mondiaux. Cinq pays sont rapidement identifiés comme ayant un risque de défaut élevés : le Portugal, l'Irlande, l'Italie, la Grèce et l'Espagne. Ces pays, connus sous le nom de « PIIGS[1] », sont considérés à risque pour divers raisons, dont un faible niveau de productivité, un taux de chômage élevé, un niveau élevé de dette publique et, dans certains cas, l'éclatement d'une importante bulle immobilière.

Devant l'ampleur du problème de ces pays, des plans de sauvetage ont été annoncés de concert par l'Union Européenne (UE), la Banque Centrale européenne (BCE) et le Fond Mondial International (FMI). Malgré l'utilisation de ces trois organismes supranationaux pour chapeauter les plans de sauvetage, les milliards octroyés aux PIIGS proviennent principalement des différent pays membres de la zone Euro, dont l'Allemagne et la France. L'une des principales motivations de ces pays, à part la survie du système de monnaie unique (Euro), était de sauvegarder la santé financière de leurs propres banques.

[1] Acronyme composé de la première lettre du nom de chaque pays (en anglais). Il est utilisé depuis plusieurs années par les cambistes, et a été popularisé par les médias pendant la crise financière.

En effet, la dette extérieure des PIIGS est fortement détenue par les banques européennes et un défaut sur cette dette pourrait entrainer des pertes importantes pour ces institutions.

Les événements des dernières années laissent présager l'existence d'un lien particulier entre les banques et les finances publiques. Ce lien a fortement été étudié dans le cadre des pays émergeants, puisque les dettes des pays développés étaient jusqu'à récemment considérés comme des actifs « sans risque (de défaut) ». Par exemple, Barajas et al. (2006) analysent les impacts du défaut de l'Argentine au début des années 2000.

Depuis le début de la crise, plusieurs auteurs ont commencés à s'intéresser à ce lien dans le cadre des pays développés et, comme la crise a commencé par une crise bancaire, les premières études publiées sur le sujet, dont Esjing et Lemke (2009) et Baglioni et Cherubini (2010), portaient sur l'impact du risque bancaire sur leurs gouvernements. Avec l'évolution de la crise en crise de dette souveraine, l'autre côté de la relation de causalité a commencé à être étudié, avec entre autres BIS (2011a) qui a étudié l'impact d'une hausse du risque de crédit souverain sur les institutions financières. Notre recherche ira dans ce sens, mais alors que la majorité des papiers portent sur l'impact de la hausse du risque de crédit souverain sur les banques domestiques, nous nous concentrerons sur l'impact de cette hausse sur les banques étrangères. Aussi, alors que la plupart des études agrègent les données bancaires par pays, nous travaillerons au niveau des banques individuelles.

Nous utiliserons deux méthodes distinctes pour analyser la relation entre le risque souverain et bancaire. Celles-ci sont présentées ici sous forme de deux articles distincts.

En premier lieu, nous effectuons une analyse de la sensibilité du risque bancaire au risque de crédit souverain par la technique des moindres carrées ordinaires (MCO), pour analyser la relation générale entre les deux. Malgré une forte augmentation de leur corrélation, la sensibilité du risque bancaire au risque de crédit souverain a

fortement diminué en 2010-2011. Par la suite, nous vérifions l'impact de la détention de dette souveraine des PIIGS par les banques sur leur relation au risque de crédit de ces pays. Pour ce faire, nous utilisons des données provenant des *Stress Test* effectués par l'Autorité Bancaire Européenne (ABE) en 2011. Nos résultats montrent l'absence d'impact de la détention de dette publique d'un PIIGS par les banques étrangères[2] sur leur relation au risque de crédit de ce pays, durant une crise de dette souveraine. Nous croyons que ceci est dû à la facilité de se prémunir contre les pertes sur les positions en dettes étrangères par le biais d'instruments financiers, tels les *credit default swap* (CDS).

Cela étant dit, l'importance relative de la dette agrégée des PIIGS a un impact significatif sur la relation entre les banques étrangères et le risque de crédit des PIIGS. Ceci semble être l'effet d'une réduction de la valeur des actifs (dettes souveraines) utilisable par les banques comme collatéral pour accéder à des liquidités, notamment auprès de la BCE.

Notre deuxième méthode consiste à vérifier l'impact sur le risque bancaire de divers événements affectant directement le risque de crédit souverain, par le biais d'une analyse événementielle. Nos résultats démontrent que les changements de cote de crédit émis par Standard & Poor's (S&P), une agence de notation américaine, ont un impact significatifs sur le risque de crédit des banques européennes[3]. Aussi, les grandes banques sont plus affectées par ces changements de cote de crédit que les plus petites, probablement dû à une présence internationale plus importante des grandes institutions. Pour ce qui est de la quantité de dette souveraine des PIIGS détenue, nos résultats démontrent qu'elle n'affecte pas la réaction des banques à une baisse de cote de crédit souveraine de ces pays.

[2] La description des banques utilisées est disponible dans la section Données ainsi que dans la section *Data* de chacun des articles présentées

[3] Excluant les banques domiciliées dans l'un des pays « PIIGS ».

Nous étudions aussi l'impact des plans de sauvetage des PIIGS, pour voir l'impact d'une réduction du niveau de risque de crédit souverain sur le risque bancaire. Nous trouvons un impact significatif de ces événements, mais uniquement sur les grandes banques domiciliées hors-PIIGS[4]; celui-ci est toutefois de courte durée, et s'estompe en moyenne dans les 10 jours suivants les événements. Ici encore, la détention de dette souveraine des PIIGS n'affecte pas la réaction de ces banques aux annonces de plans de sauvetages.

Globalement, nos résultats démontrent que les banques domiciliées hors-PIIGS sont sensibles à certaines variations du risque de crédit souverain. Nos résultats démontrent que la peur de perte directe sur les positions en dette souveraines des PIIGS n'est pas un canal de transmission significatif du risque de crédit souverain aux banques hors-PIIGS, ce qui va à l'encontre des conclusions de certaines études, telles Borensztein et Panizza (2009) et BIS (2011a). Par contre, nos résultats supportent une transmission de ce risque aux institutions financières par le biais d'une réduction d'accès aux mécanismes de liquidités disponibles pour les banques.

Le reste de cette étude se présente comme suit : la Section 2 fait une revue de la littérature pertinente, la Section 3 présente la méthodologie utilisée, la Section 4 présente l'article « *Sensitivity of banks to sovereign credit risk in Europe* », par Olivier Brossard (2012), la Section 5 présente l'article : « The impact of sovereign default risk on European banks: An event-study analysis », par Olivier Brossard (2012) et la Section 6 conclut le travail.

[4] La description des banques utilisées est disponible dans la section Données ainsi que dans la section *Data* de chacun des articles présentées

2. Revue de littérature

La littérature académique portant sur le lien entre les banques et les gouvernements peut être séparée en trois groupes distincts, basés sur le sens du lien de causalité qui les unit. Le premier groupe, incluant Dieckman et Plank (2010), Esjing et Lemke (2009) et Reinhart et Rogoff (2008), se concentre sur la transmission du risque de crédit bancaire vers les finances publique. Le second groupe, incluant notamment Arzeki et al. (2011), BIS (2011a) et Genaioli (2010) analyse la transmission du risque de crédit souverain au système bancaire. Finalement, une troisième branche de la recherche se penche sur l'évolution du lien entre les banques et les finances publiques, analysant du même coup les deux côtés de la relation entre banques et gouvernements.

2.1 Transmission du risque bancaire aux finances publiques

La majorité de la recherche sur les liens entre les gouvernements de pays développés et le système bancaire se penche sur ce côté de la relation. Même si plusieurs auteurs étudient ce phénomène depuis des années, nous allons nous concentrer surtout sur les recherches récentes, en lien avec la crise économique actuelle.

Esjing et Lemke (2009) analyse empiriquement l'évolution du risque de crédit souverain et bancaire en Europe entre janvier 2008 et juin 2009. En utilisant les *credit default swap* (CDS) come proxy pour le risque de crédit, ils démontrent qu'avant la chute de Lehman Brothers en septembre 2008, les changements d'écarts des CDS étaient fortement expliqués par un facteur commun : la composante non-financière de l'indice iTraxx Europe Main 5 ans tenu par Markit, un fournisseur de données financières. Ils démontrent aussi que les différents plans de sauvetage bancaire annoncés par les gouvernements d'Europe ont eu pour effet de transférer le risque privé (banques) en risque publique (gouvernements), et que ce transfert a

eu pour conséquence de réduire la sensibilité des banques au facteur commun, en contrepartie d'une augmentation de la sensibilité des gouvernements à ce même facteur. L'utilisation des CDS souverain en début de crise dans cette étude pourrait toutefois affecter les résultats, car leur marché était très peu liquide avant la chute de Lehman Brothers, tel que le mentionne Arce et al. (2011).

En utilisant des obligations gouvernementales plutôt que des CDS, Sgherri et Zoli (2009) arrivent aussi à la conclusion que les sauvetages bancaires ont affectés la relation entre les banques et leurs gouvernements. Utilisant une régression apparemment indépendante[5], ils trouvent une réduction de la valeur explicative du facteur commun pour plusieurs obligations gouvernementales européennes suivant les sauvetages bancaires effectués à la fin 2008, au profit de l'apparition d'un nouveau facteur : les coûts potentiels d'un futur sauvetage bancaire. Ce facteur serait responsable de plus de la moitié du changement d'écart avec les obligations allemandes entre septembre 2008 et mars 2009 pour l'Autriche, la Finlande, la Grèce et le Portugal. Cette réduction de l'importance du facteur commun dans le risque de crédit souverain va à l'encontre des résultats de Esjing et Lemke. (2009).

Dans une étude sur les déterminants des primes des CDS souverains, Dieckmann et Plank (2011) arrivent à des conclusions semblables. En utilisant les CDS de 18 pays européens, ils trouvent une forte corrélation entre ces CDS et l'état du système financier. Cette corrélation des CDS souverains est présente tant envers les banques locales de chaque pays qu'envers le système financier dans son ensemble, et ils la trouvent plus importante pour les pays membres de l'EURO. Ils mentionnent aussi la faible importance des facteurs domestiques dans l'explication des primes de CDS souverains en début de crise, au profit des facteurs globaux, comme le rendement de l'Euro STOXX 50 ou le rendement des obligations allemandes. Toutefois, comme dans le cas d'Esjing et Lemke (2009), leurs résultats pourraient être affectés par la

[5] *seemingly unrelated regression.*

faible utilisation de CDS souverain avant l'automne 2008, qui représente environ la moitié de leur échantillon (01/2007 – 04/2010).

Alors que les trois études précédentes se sont intéressées aux impacts des plans de sauvetage bancaires explicites, Baglioni et Cherubini (2010) s'intéressent plutôt à l'impact sur les finances publiques de la garantie implicite offerte par plusieurs pays à leur système bancaire. Ils créent une mesure tenant compte des probabilités de défaut individuelle des banques ainsi que de leurs probabilités de défaut jointes (risque systémique) et l'utilise pour voir la valeur au marché de la garantie bancaire implicite des gouvernements. En appliquant cette nouvelle mesure à la crise Européenne, ils trouvent que la quasi-totalité du risque de défaut des banques est prise en compte par leur composante systémique. Ils arrivent aussi à une valeur au marché de la garantie bancaire très proche du montant global annoncé publiquement par les différents gouvernements pour sauver leurs banques, confirmant la validité de leur mesure. Celle-ci semble toutefois beaucoup moins précise au niveau des pays individuels puisqu'en regardant leurs résultats, il semble y avoir un écart important entre leurs prédictions et les montants annoncés par les différents pays.

Ces différentes études utilisent des méthodes différentes, mais arrivent toutes à la conclusion qu'un sauvetage du système bancaire par le gouvernement engendre un transfert de risque des banques vers les finances publiques.

2.2 Transmission du risque de crédit souverain aux banques

La transmission du risque de crédit souverain aux banques était très peu étudiée avant la crise financière, et les quelques papiers qui étudiaient le phénomène analysaient la transmission dans le cadre d'un défaut par une économie émergente, comme la Russie ou l'Argentine (voir Barajas et al. (2006)). Le phénomène n'était pas étudié pour les pays développés puisque, comme le mentionne Kamalodin

(2010) : « *industrialised countries seemed to have graduated from periodic bouts of government insolvency given that they did not opt for default since the end of WWII.* » (p.4). Toutefois, depuis 2010, plusieurs auteurs ont commencés à étudier ce côté de la relation banques-gouvernements. Notre étude actuelle ira dans ce sens.

L'un des papiers les plus importants dans l'étude de la transmission du risque de crédit souverain aux banques est BIS (2011a), puisqu'il identifie les 4 canaux de transmission de ce risque de crédit aux institutions financières :

- Risque de perte directe sur la dette souveraine détenue par les banques
- Réduction de la valeur de la dette souveraine comme garantie pour obtenir des liquidités des banques centrales
- Baisse de la valeur de la garantie implicite/explicite du système bancaire par le gouvernement
- Baisse du plafond de la côte de crédit des banques, puisqu'ils mentionnent qu'une banque ne peut avoir une meilleure cote que le pays dans lequel elle est située

En plus de ces canaux de transmission, il mentionne une augmentation du co-mouvement entre les CDS bancaires et souverain durant la crise financière, confirmant les résultats de Dieckmann et Plank (2011).

La valeur théorique des canaux identifiés par BIS (2011a) est indéniable, mais les preuves qu'il utilise pour en démontrer l'importance nous paraissent faibles. Par exemple, il confirme l'importance du premier canal de transmission par une augmentation de la corrélation entre la dette souveraine détenue par les banques et leur sensibilité au risque de crédit souverain suite à la publication des résultats des premier *Stress Tests* en Europe. Toutefois, en regardant leurs résultats, on voit aussi une nette augmentation de la corrélation pour les banques domiciliés dans les pays *PIIGS*, alors que nul n'avait besoin des *Stress Tests* pour savoir qu'elles étaient fortement exposés à la dette de leur propre gouvernement. La diminution de

corrélation observée pourrait donc être due à un autre facteur. Aussi, leur choix de séparer les 2 derniers canaux est discutable puisqu'à première vue le 4^{e} canal de transmission semble être une conséquence du 3^{e}, plus qu'un canal distinct.

Le premier canal identifié par BIS (2011a), les pertes directes sur la dette souveraines, est aussi étudié dans Gennailoli et al. (2010). Ils créent un modèle pour identifier les impacts d'un défaut souverain sur la quantité de crédit offerte par les banques domestiques. Ils trouvent que les pertes sur les positions en dettes souveraines seraient très importantes, et qu'elles forceraient les banques à réduire fortement la quantité de crédit qu'elles offrent, ce qui aurait un impact négatif sur l'économie réelle. Ils mentionnent aussi que la réduction dans la quantité de crédit offerte est positivement corrélée à la quantité de dette souveraine détenue par les banques. Ils trouvent toutefois que la probabilité d'un défaut souverain est inversement proportionnelle à la quantité de dette souveraine détenue par les banques, puisque la peur des impacts potentiels d'un défaut servirait à discipliner les gouvernements. Borensztein et Panizza (2008) s'attardent aussi à l'impact d'un défaut souverain sur les banques domestiques à l'aide un vaste échantillon de banques internationales pour la période 1975-2000. Ils trouvent que les défauts souverains engendrent souvent des crises bancaires, et que l'importance de la crise bancaire dépend de la quantité de dette souveraine détenue par les banques domestiques. Sandleris (2010) va plus loin, démontrant qu'un défaut souverain envoi un tel message négatif au marché par rapport au potentiel de croissance futur de l'économie qu'il cause une importante contraction du crédit offert par les banques, même si celles-ci ne détiennent pas de dette souveraine domestique.

Alors que ces trois dernières recherches étudient les impacts d'un défaut souverain sur le bilan des banques domestiques, notre étude portera plutôt sur l'impact, pour les banques étrangères, d'une augmentation du risque de défaut souverain.

Demirgüç-Kunt et Huizinga (2010) se concentrent sur un autre canal de transmission du risque de crédit souverain aux banques : la réduction de la valeur de la garantie

publique implicite du système bancaire. Ils analysent l'importance de la taille des banques ainsi que celle des déficits gouvernementaux sur la valeur de cette garantie et trouvent que cette valeur est inversement proportionnelle à ces deux mesures. Ces résultats les poussent à conclure que « *the largest banks have become too big to save* » (Demirgüç-Kunt et Huizinga (2010), p.3).

De leur côté, Arzeki et al. (2011) se concentrent sur des événements spécifiques plutôt que d'analyser la relation entre les banques et les gouvernements sur une période complète. À l'aide d'une technique d'analyse d'événements, ils étudient les impacts des changements de cote de crédit des différents gouvernements sur les pays environnants et sur le système bancaire. Ils trouvent un impact significatif des variations de cote de crédit souveraines sur les banques, et trouvent que l'importance de cet impat dépend du type d'annonce (décote, révision pour décote future,…), de l'importance du changement de cote, du pays qui est touché par l'annonce et de l'agence de cotation qui fait cette annonce. Leur étude porte principalement sur les impacts de différents types d'annonces reliées aux cotes de crédit souveraines sur les banques. Elle ne donne toutefois aucune indication sur ce qui fait qu'une banque réagit plus qu'une autre à ces décotes. Notre recherche viendra donc compléter la leur en ajoutant cette dimension à l'équation.

2.3 Transmission bidirectionnelle du risque entre les banques et les gouvernements

Les recherches présentées précédemment s'attardent principalement sur un côté de la relation entre les banques et les gouvernements. Celles présentées ici analysent plutôt l'interrelation entre ces deux acteurs.

Alessondri et Haldane (2001) étudient l'évolution de la relation entre les banques et leur gouvernement dans le temps. En reculant jusqu'au 13è siècle, ils trouvent que les défauts souverains sont la plus importante cause de faillites bancaires à travers

l'histoire, et décrivent la direction de causalité de la relation entre ces acteurs comme un pendule, qui oscille dans le temps. Jusqu'à la crise des années 1930, ils mentionnent que la transmission du risque de crédit allait surtout des gouvernements vers les banques, puisque les banques finançaient les différentes guerres entre pays, et que la nation perdante finissait souvent par faire défaut sur sa dette. Les rôles se sont inversés durant la Grande Dépression, puisque les gouvernements sont devenus des prêteurs de dernier recours pour les banques. Ils mentionnent aussi que la crise de dette souveraine en Europe pourrait être à l'origine d'un nouveau renversement dans la relation banques-gouvernements.

Alter et Schüler (2011) trouvent aussi des renversements dans la direction de causalité entre les banques et les gouvernements mais plutôt que voir ces changements de direction sur de longues périodes, ils les voient comme des effets de courtes durées. Ils étudient les impacts des plans de sauvetage bancaires annoncés par les gouvernements et trouvent que, à court terme, ils transfèrent le risque des banques vers leurs gouvernements. Cet effet est toutefois de courte durée. Ils mentionnent que peu après l'annonce des plans de sauvetage, le risque de crédit des banques augmente puisque le poids des dettes contractés par le gouvernement pour sauver son système bancaire augmente le risque de crédit souverain, et que cette augmentation se répercute sur les banques par des pertes sur leurs positions en dettes souveraines ainsi que par une réduction de la valeur de la garantie gouvernementale implicite dont ils bénéficient. Acharya et al. (2011) arrivent à une conclusion similaire en utilisant un modèle théorique pour décrire les divers impacts des plans de sauvetage bancaires par les gouvernements. Ils trouvent aussi une réduction à court terme du risque de crédit des banques en réaction à ces plans de sauvetage, suivie d'une augmentation de celui-ci, en réponse à l'affaiblissement de la santé financière de leur gouvernement. Pour expliquer ce renversement, ils affirment qu'un gouvernement peut financer ces plans de sauvetage de deux manières : soit il augmente son taux de taxation dans les années suivantes, soit il monétise cette nouvelle dette, en diluant la valeur des obligations

gouvernementales actuellement détenues. Ils mentionnent que ces 2 options ont ultimement un effet négatif pour les banques, ce qui contribue à augmenter leur risque de crédit.

Kallestrup et al. (2012) se penchent aussi sur les interrelations entre les banques et les différents gouvernements. Ils construisent une nouvelle mesure pour estimer la valeur de la garantie gouvernementale implicite du système bancaire, et trouvent que cette mesure est responsable d'une part significative des mouvements des CDS souverains. Pour étudier l'autre côté de la relation, ils incluent aussi la dette internationale publique et privée détenue par les banques, et trouvent que l'importance de la somme de ces dettes explique une part significative des changements de primes des CDS bancaires. Comme l'interrelation entre ces acteurs peut amener un problème d'endogénéité, ils confirment que le risque de crédit bancaire affecte la prime des CDS souverains en utilisant l'importance des emprunts bancaires effectués auprès des banques centrales, plutôt que les CDS bancaires, comme proxy pour le risque de crédit. Ils justifient le choix de cette mesure par le fait que les banques se tournent vers leurs banques centrales en dernier recours, lorsqu'ils n'arrivent plus à se financer par les canaux standards.

Leur utilisation de l'importance des emprunts aux banques centrales est certainement valide en temps *normal*, par contre sa validité dans une période de crise financière est moins évidente, puisque depuis le début de la crise, le marché du financement interbancaire en Europe est complètement paralysé, ce qui force les banques à utiliser la Banque Centrale Européenne (BCE) comme prêteur de premier recours, plutôt que comme prêteur de dernier recours comme c'est habituellement le cas pour les banques ailleurs dans le monde.

2.4 Liens avec notre recherche

Nous nous penchons dans cette étude sur la seconde branche de la recherche sur les relations entre les banques et leur gouvernement, soit la transmission du risque de crédit souverain au système bancaire. Le principal apport de notre recherche est d'évaluer la transmission de ce risque de crédit sur les banques étrangères, alors que la plupart des papiers actuels traitent de ses impacts sur les banques domestiques. Ce choix de se concentrer sur les banques étrangères nous permet aussi d'éviter le problème d'endogénéité entre les CDS des banques et ceux des États. En effet, considérant que le marché interbancaire en Europe est bloqué depuis le début de la crise, il serait peu probable qu'une banque étrangère affecte significativement le risque de crédit d'un pays d'Europe[6]. Aussi, alors que plusieurs des études actuelles agrègent les banques au niveau national, nous nous penchons sur les impacts du risque de crédit souverain sur les banques individuelles, pour tenter de voir ce qui causent certaines d'entre elles d'être plus affectés que d'autres par une variation de ce risque.

[6] Si ce marché fonctionnait normalement, une banque pourrait affecter le risque de crédit d'une banque domiciliée dans un autre pays en faisant défaut sur un prêt inter-institution. La détérioration de la santé financière de cette banque pourrait éventuellement nécessiter un sauvetage de la part de son gouvernement, ce qui aurait un impact sur le risque de crédit de ce gouvernement.

3. Méthodologie

Le but principal de cette recherche est d'analyser la transmission du risque de crédit souverain aux banques étrangères durant la crise de dette souveraine Européenne. Nous tenterons aussi de voir si l'importance de la dette souveraine détenue par ces banques affecte cette transmission de risque de crédit gouvernemental. Des quatre canaux de transmission significatifs identifiés par BIS (2011a), seuls les deux premiers peuvent s'appliquer aux banques étrangères :

- Pertes directes sur les positions en dettes souveraines
- Réduction de la valeur des actifs pouvant être donnés en garantie pour accéder aux liquidités des banques centrales

Nous nous attardons donc sur ceux-ci tout au long de cette recherche. Tel que mentionné précédemment, l'utilisation des banques étrangères permet aussi d'éviter le problème d'endogénéité mentionné par Kallestrup et al. (2012), entre les CDS bancaires et souverains.

Pour arriver à nos fins, nous utilisons deux méthodes complémentaires qui nous permettent d'analyser dans un premier temps le lien général qui unit les banques et leur gouvernement durant la crise, et dans un deuxième temps la réaction des banques à certains événements précis affectant le risque de crédit souverain. Le reste de cette section fait un survol des deux méthodes utilisées dans cette recherche. Quant aux méthodologies détaillées, elles sont incluses dans chacun des articles présentés.

3.1 Données utilisées

Nous utilisons les variations journalières de primes de CDS bancaires et souverains Européens avec une maturité de 5 ans comme proxy pour leur risque de défaut respectif. Ces instruments sont fortement utilisés dans la littérature académique, comme par exemple Jorion en Zhang (2006), Baglioni en Cherubini (2010) et

Demirgüç-Kunt et Huizinga (2010), parce qu'ils sont moins affectés par les problèmes de liquidités que les obligations, et qu'il s'agit de contrats standardisés. En effet, comme l'achat d'obligations gouvernementales demande un important investissement initial, leur prix a probablement été affecté par les problèmes de liquidités qui ont touché les marchés financiers durant la crise. Le rendement des obligations comporte donc une composante qui reflète la disponibilité de liquidités sur le marché.

La prise d'une position sur un CDS, elle, ne nécessite aucun investissement initial, mais plutôt le versement d'une prime semi-annuelle. Leur rendement n'est donc pas affecté par la disponibilité de liquidités sur le marché. En plus, les CDS ont été créés pour isoler le risque de crédit des autres composantes des obligations, ce qui en fait des candidats de choix pour mesurer ce risque.

Les deux méthodes utilisent les variations des primes de ces CDS; la variation est toutefois calculée différemment pour chacune. Pour notre première méthode, nous utilisons la variation de la prime journalière des CDS en niveaux, semblable à ce qui est fait dans la littérature. La seconde méthode utilise plutôt le pourcentage de variation journalier des primes de ces CDS, plutôt que la variation elle-même. Cette méthode nous semble plus juste puisque nous devons agréger les données de plusieurs banques, et que les variations journalières des différentes banques vont de quelques points de base (pbs) pour certaines grandes banques à plusieurs dizaines de pbs pour celles les plus risquées. L'utilisation des variations en niveau aurait donc pour effet de surpondérer fortement certaines banques dans nos résultats.

Les données sur l'exposition des banques aux dettes souveraines européennes proviennent des *Stress Tests* publiés par l'Autorité Bancaire Européenne (ABE) en juillet 2011.

3.2 Méthode 1 – Analyse de sensibilité

Notre première méthode a pour but d'évaluer la sensibilité des banques étrangères au risque de crédit souverain durant la crise européenne, et de voir l'impact de la composition du portefeuille de dette souveraine détenu par les banques dans cette relation. Pour voir l'impact de l'évolution de la crise financière en crise souveraine sur cette relation, nous séparons notre échantillon en deux sous-périodes. La première couvre les premières années de la crise (crise bancaire, 2008-2009), et la seconde couvre l'évolution de cette crise en crise de dette souveraine en Europe (2010-2011).

Nous utilisons la méthode des Moindres Carrés Ordinaires (MCO) pour voir la sensibilité des banques au risque de crédit souverain à l'aide de la régression suivante :

$$CDS_i = a + \beta_{SOV\,i,c} * CDS_{SOV\,c} + \beta_{NFin_i} * CDS_{N-fin} + \epsilon_{i,c} \quad (1)$$

Dans laquelle CDS_i représente la variation journalière des CDS de la banque *i*, $CDS_{SOV\,c}$ représente tour-à-tour les variations journalière des CDS du Portugal, de l'Irlande, de l'Italie, de la Grèce et de l'Espagne et $\beta_{SOV\,i,c}$ est la sensibilité de la banque *i* à la variation des primes de CDS du pays *c*. CDS_{N-fin} représente les variations journalières du iTraxx Europe Non-Financial 100, pour contrôler pour les mouvements généraux du marchés, et β_{NFin_i} représente la sensibilité de la banque *i* à ces mouvements de marchés.

Une fois la sensibilité $\beta_{SOV\,i,c}$ de chaque banque à chacun des 5 PIIGS établie, nous vérifions la présence d'un lien entre cette sensibilité et la dette souveraine détenu par les banques à l'aide l'équation suivante :

$$\hat{\beta}_{SOV\,i,c} = a + \gamma_{DEBT\,i,c} * DEBT_{i,c} + \epsilon_{i,c} \quad (2)$$

Où $DEBT_{i,c}$ représente le pourcentage de dette souveraine du pays *c* détenu par la banque *i* par rapport à l'ensemble de son portefeuille de dette souveraine et $\gamma_{DEBT\,i,c}$ représente la sensibilité du coefficient $\hat{\beta}_{SOV\,i,c}$ à $DEBT_{i,c}$. Les résultats de cette équation nous donneront l'importance de la détention de dette souveraine dans la sensibilité d'une banque au risque de crédit souverain.

Nous répétons l'analyse précédente en considérant les PIIGS comme un groupe, plutôt qu'en analysant chacun séparément. Pour évaluer l'impact de la détention de dettes agrégées des PIIGS, nous modifions l'équation 2 pour inclure l'ensemble de la dette des PIIGS détenu par chaque banque :

$$\hat{\beta}_{PIIGS_i} = \sum_c \hat{\beta}_{SOV\,i,c} * w_c \qquad (3)$$

$$\hat{\beta}_{PIIGS_i} = a + \gamma_{PIIGS\_DEBT\,i} * \sum_c DEBT_{i,c} + \epsilon_i \qquad (4)$$

Où w_c utilisés représentent le poids relatif de la dette de chacun des PIIGS détenue par les banques de notre échantillon[7] et $\gamma_{PIIGS\_DEBT\,i}$ représente la sensibilité globale de la banque *i* à la dette combinées des PIIGS.

Après avoir trouvé l'importance de la dette souveraine dans la détermination de la sensibilité des banques au risque de crédit souverain, nous vérifions l'impact des pertes potentielles pour les banques à l'issue de différent scénario pour voir si ces pertes potentielles affectent la relation des banques envers le risque de crédit souverain. Cette dernière section nous permet entre autres de tenir compte de la santé financière actuelle des banques.

Les banques séparent leur dette souveraine en deux portefeuilles selon que cette dette est conservée à long terme (portefeuille bancaire) ou à court terme

[7] Portugal 5,52%, Irlande 2,31%, Italie 41,93%, Grèce 12,05%, Espagne 38,19%

(portefeuille d'échanges), et les règles comptables diffèrent quant à la façon de les comptabiliser selon le portefeuille. En effet, la dette détenue dans le portefeuille bancaire n'a pas à être ajustée au prix du marché alors que celle détenue dans le portefeuille d'échange doit l'être.

Pour pouvoir les comparer efficacement, nous commençons par ajuster la valeur des dettes du portefeuille bancaires rapportés dans les Stress Tests de l'EBA, basé sur la méthode de Queen (2011). En gros, celle-ci consiste à trouver la valeur d'une obligation souveraine à la date des Stress Test, trouver son écart de prix par rapport à sa valeur nominale, et appliquer cet écart aux positions détenus dans le portefeuille bancaire des institutions financières. Cette méthode vient donc ramener la valeur des positions du portefeuille bancaire à leur valeur au marché, les rendant directement comparable aux positions du portefeuille d'échange.

Une fois cet ajustement effectué, nous modifions l'Équation 4 pour voir les effets de pertes potentielles selon différents scénarios, plutôt que les effets des positions en dettes souveraines elles-mêmes :

$$\hat{\beta}_{PIIGS_i} = a + \gamma_{LOSS_i} * \begin{cases} L_i/T_i \\ L_i/SE_i \\ NC_i \end{cases} + \epsilon_i \qquad (1)$$

où $L_i$représente les pertes potentielles en appliquant celles-ci aux expositions du portefeuille bancaire ainsi qu'au portefeuille d'échange, T_i représente le capital de tier-1 détenu par la banque *i* à la date de référence des tests bancaires de l'EBA, SE_i représente la valeur totale du portefeuille de dette souveraine de la banque *i* et NC_i représente les capitaux que la banque *i* devra trouver pour respecter le ratio de capital réglementaire du protocole de Bâle III, soit 6% de ses actifs pondérés par le risque. Finalement, γ_{LOSS_i} représente tour-à-tour la sensibilité de $\hat{\beta}_{PIIGS_i}$ pour la banque *i* à chacune de ses trois mesures.

3.3 Méthode 2 – Analyse Événementielle

Cette section utilise une technique d'analyse événementielle pour mesurer l'impact sur le risque de crédit bancaire d'événements affectant le risque de crédit souverain. Comme à la section précédente, nous analysons aussi l'impact de la quantité de dette souveraine détenue par les banques sur cette relation. En utilisant l'impact d'événements exogènes sur les CDS bancaires, nous évitons les problèmes d'endogénéité entre les CDS bancaires et souverains, ce qui nous permet de nous concentrer sur un seul côté de la relation entre ces acteurs, soit la transmission du risque provenant des pays vers les banques.

Les événements testés sont, dans un premier temps, les réductions de cotes de crédit souveraines des PIIGS, pour voir l'impact sur les banque d'une augmentation du risque de crédit souverain et, dans un deuxième temps, les annonces de plan de sauvetage des PIIGS par les autres membres de Union Européenne et le FMI, pour voir l'impact d'une diminution du risque de crédit souverain sur les banques.

Nous utilisons une version restreinte d'un modèle développé par Elton et al. (1995), qui s'apparente à la méthode du modèle de marché telle que décrite dans Campbell et al. (1997) et Craig MacKinlay (1997) pour mesurer les effets anormaux des différents événements testés sur les variations journalières des CDS. Il s'agit ici de trouver les rendements anormaux des CDS bancaires dans les 5 jours précédant et 5 jours suivant les différents événements à tester.

La première étape de cette méthode consiste à trouver la relation entre les variations des CDS bancaires et les mouvements de marchés en étudiants leur évolution sur une période de 120 jours avant l'événement par la méthode MCO :

$$\begin{aligned} R_{i,t} &= \alpha_{i,e} + \beta_{i,e} * X_t + \varepsilon_{i,t,e} \\ E[\varepsilon_{i,t,e}] &= 0 \qquad Var[\varepsilon_{i,t,e}] = \sigma_{i,e}^2 \end{aligned} \tag{2}$$

Où $R_{i,t}$ est la variation du CDS de la banque *i* au temps *t*, X_t représente le rendement du marché au temps t et $\beta_{i,e}$ représente la sensibilité des CDS de la

banque *i* aux mouvements du marché dans les 120 jours précédant l'événement *e.* Une fois la valeur des constantes $\alpha_{i,e}$ et $\beta_{i,e}$ trouvées pour l'événement *e*, nous pouvons calculer les rendements *normaux* de chaque banque $E(R_{i,t}|\, X_t)$, si l'événement n'avait pas eu lieu avec :

$$E(R_{i,t}|\, X_t) = \hat{\alpha}_i + \hat{\beta}_i * X_t \qquad (3)$$

En comparant ces rendements *normaux* avec les rendements observés, nous arrivons à trouver les rendements anormaux associés à l'événement testé et, en cumulant ces rendements, nous obtenons finalement nos rendements anormaux cumulés (CAR):

$$AR_{i,t} = R_{i,t} - E(R_{i,t}|\, X_t) \qquad (4)$$

$$CAR_{i,t} = \sum_{t=1}^{T} AR_{i,t} \quad where \quad -5 \leq t \leq 5 \qquad (1)$$

Ces CAR de chaque banque et de chaque événement sont finalement agrégés pour voir l'impact moyen du type d'événement testé sur les banques. Nous séparons ensuite les banques en quatre quartiles basés sur leur détention de dettes souveraines, pour voir l'impact de cette détention sur la relation entre le risque de crédit des banques et celui des états souverains.

Avec ces deux méthodes, nous devrions avoir une bonne vision de la transmission du risque de crédit souverain au système bancaire, ainsi que de l'impact de la quantité de dette souveraine détenue par les banques sur cette relation.

4. Article 1 - Sensitivity of banks to sovereign credit risk in Europe

SENSITIVITY OF BANKS TO SOVEREIGN CREDIT RISK IN EUROPE

Olivier Brossard

November 2012

Abstract

This paper looks at the impact of the rise in sovereign credit risk in Europe on financial institutions, using OLS regressions and newly available data on banks' sovereign debt holdings. We find that the co-movement between foreign banks and sovereign credit risk is on the rise; however, the sensitivity of the former to the later actually decreased during the European sovereign debt crisis. We argue that the reduction in value of collaterals available to banks to access their central bank's liquidities is an important transmission channel of sovereign credit risk to the banking system. The fear of direct losses on sovereign debt holdings, in contrast, is not a significant transmission channel.

4.1 Introduction

The last few years have been very hard on financial markets. The major losses suffered by financial institutions on both sides of the Atlantic forced governments to inject massive amounts of money to recapitalize their banks. Some institutions, like United Kingdom's Northern Bank, Franco-Belgium's Dexia and Hypo Group Alpe Adria, the Austrian branch of a German bank, had to be outright nationalized. Public finances around the world were being used as banks lifesavers.

During the fall of 2009, just when the market though the worst was over and the economy would finally get back on track, Greece shocked the world by announcing a hidden deficit. This marked the start of the second wave of the financial crisis, evolving from a banking crisis to a sovereign debt one. In the early months of this newly developed sovereign debt crisis, the focus was on 3 small economies: Portugal, Ireland and Greece (collectively known as the 'PIG' countries), which were considered the riskiest Euro-area countries. These 3 countries were joined in the spotlight by the much larger Italy and Spain, to complete the 'PIIGS'. The other Euro members along with the International Monetary Fund (IMF) and the European Central Bank (ECB) responded to this crisis by announcing different bailouts for the most troubled countries. The motivation behind these bailouts was in part their desire to save the Euro, but also their fear that a PIIGS default would cause huge losses for their own banks, since they held massive amount of the PIIGS's sovereign debt. The European Banking Authority (EBA) even commissioned two rounds of stress tests[8] to assess the possible impact on banks of a prolonged sovereign crisis.

Looking at those events, it's easy to understand that a link exists between banks and sovereigns' credit risk. This link has been studied in the past in the case of emerging

[8] The first round was actually commissioned by the Committee of European Banking Supervisors (CEBS), an independent advisory group which was replaced by the EBA on November 24th 2010.

economies, like Argentina[9], but not in the case of developed countries like the PIIGS, since a sovereign default by an advanced economy was considered very unlikely[10].

With the crisis of the late 2000s, however, academic interest on the impact of a sovereign default by an advanced economy grew rapidly, and many papers are starting to be published on the subject. Since the financial meltdown started as a banking crisis, most of the early papers, including Esjing and Lemke (2009) and Sgherri and Zoli (2009), focused on the impact of banking system bailouts on governments' finances. As the crisis evolved into a sovereign debt crisis, a few papers, like Arzeki et al. (2011) and BIS (2011a) started to look at the other direction of causality, namely the impacts of a rise in sovereign credit risk on banks' own credit risk. This paper goes in this direction, but while most previous studies focused on domestic banks, this paper looks at the impacts of a rise in sovereign credit risk on foreign banks' default risk. We also analyse the link between foreign banks' sensitivity to sovereign credit risk and their holdings of sovereign debt using newly available sovereign exposure data from the EBA's latest round of stress tests.

Following in BIS (2011a) and Alter and Schüler (2011), we use 5 years credit default swap (CDS) premia as a proxy for both sovereign and banks' credit risk. CDS don't have as much historical data as some other proxies used in the literature, like sovereign credit ratings (Arezki and al. (2011)) or a country's fiscal balance relative to its gross domestic product (GDP) (Demirgüç-Kunt and Huizinga (2010)), but daily observations are available, which is a huge advantage. Our sovereign exposures come from the EBA's 2011 bank stress tests, which we modify using a method based on Queen (2011) to account for the different treatment of sovereign exposures held in banks' trading and banking books.[11]

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[9] See Barajas et al. (2006) among others.

[10] Kamalodin (2010) notes that the last sovereign default by an industrialized country was Japan in 1942.

[11] Differences between banks' banking and trading books are explained in the Scenario Analysis section.

Using an ordinary least square (OLS) regression, we find that although banks and each PIIGS CDS co-movement increased, the sensitivity of foreign banks' credit risk to peripheral Europe's sovereign credit risk actually decreased during the sovereign debt crisis. We then proceed to look at the presence of a relation between banks' sovereign debt holdings and their sensitivity to sovereign credit risk. We find that banks' holdings of each individual PIIGS's public debt have no impact on their sensitivity to sovereign credit risk, with the exception of Italian debt held by foreign PIIGS-based banks[12] in a period of low sovereign credit risk. Even this relation, however, disappears when sovereign credit risk starts to rise, as was the case in 2010-2011. When looking instead at aggregate PIIGS sovereign debt exposures, we find a relation between those exposures and NON-PIIGS-based banks' sensitivity to sovereign credit risk. Here again however, this relation is only significant when sovereign credit risk is at a relatively low level. We believe the absence of significant results obtained after the start of the sovereign debt crisis to be caused, among other things, by the ECB's flexibility on the assets acceptable as collateral to access its marginal lending facility[13].

Finally, we calculate the potential losses banks would suffer on their sovereign debt holdings based on different scenarios to see if those potential losses have an impact on banks' sensitivity to sovereign credit risk. As with the sovereign exposures themselves, we find those potential losses have a significant impact on NON-PIIGS banks' sensitivity to sovereign credit risk, but only during periods of low sovereign credit risk.

Overall, we show that sovereign credit risk does spillover on banks' own credit risk, but not through a fear of direct losses on their sovereign debt holdings, going against Borensztein and Panizza (2009) and BIS (2011a), who find the fear of direct loss on debt holdings to be an important transmission channel of sovereign credit

[12] Bank sub-samples explained in Data section.
[13] Banks can obtain liquidity from the ECB against high-quality collateral, including sovereign debt.

risk to the banking system. Our results instead supports the collateral/liquidity channel identified in BIS (2011a) as the main transmission channel of sovereign credit risk to banks during the present sovereign debt crisis.

The remainder of our paper is as follows. Section 2 describes the present academic literature on the subject. Section 3 presents the general methodology and data used in the paper, Section 4 is an analysis of the links between sovereign and banks' credit risk, Section 5 looks at the influence of sovereign debt holdings on a banks' sensitivity to sovereign credit risk, Section 6 analyses the impact on the relation between banks and sovereign CDS of potential losses on sovereign debt holdings based on different scenarios and Section 7 adds concluding remarks.

4.2 Literature review

In this section, we briefly look at the literature related to the interaction between financial institutions and sovereign states. Although this subject has been studied for many years[14], we focus mostly on the recent literature.

This paper is related to two main strands of the literature: the evolution of the direction of causality between sovereign state and banks and the analysis of the different transmission channels of sovereign credit risk to financial institutions. We also briefly go over the main papers looking at the other direction of causality, where banks' default risk is transmitted to sovereign states.

[14] Pre-2008 related literature is mostly about emerging market.

4.2.1 Evolution of the relationship between banks and sovereign states

Alessondri and Haldane (2001) look at the relationship between a bank and its sovereign state over the last 800 years, and find their fate to be closely linked together. They argue that banks and their home states do affect each other, but the direction of causality between them is mostly a one-way street, changing direction following key events through history. They point out that in the early days of banking, the direction of causality was mostly from sovereigns to banks since banks were financing wars, and the losing country often ended up defaulting on its loans. The Great Depression, however, turned tables around, with governments taking on huge debt to support their troubled financial institutions. They also argue that the recent sovereign debt crisis in Europe might lead to a new turnaround, with direction of causality going once again from sovereigns to banks.

Alter and Schüler (2011) also find a reversal in the link between banks and sovereign states, but instead of seeing the direction of causality move from one side to the other over the centuries, they see it as a short term effect. They look at the effects of a government's decision to bailout its banking system and find that, in the short-term, the link goes from banks to their sovereigns, as governments take on massive amounts of debts to support their troubled banks. Soon after, however, they find a reversal in their relation, as banks ultimately suffer from the weakening of their government's balance sheet as a consequence of the bailouts, through a reduction in the value of both their sovereign debt holdings and of their implicit government's guarantee. Acharya et al. (2011) come to similar conclusions using a theorical model to look at the impact of banking system bailouts. They find the short term effect of the bailouts beneficial for banks. In contrast, they find that, in the long term, weaker government finances feeds back to the banking sector, negatively affecting banks' balance sheets. They argue that governments can finance those bailouts

through both higher future taxation and dilution of the value of existing debt, and show that both of these channels end up having a negative effect on banks.

Kallestrup el al. (2012) also look at the direction of causality as a two-way street. They use data on both sovereign and private debt held by banks and find these debt holdings to be significant in explaining banks CDS spread movements. To look at the effects banks have on their sovereign state's finances, they build a measure of the size of the implicit and explicit government's guarantee of their banking sector and find it to be a significant factor in explaining sovereign default risk. They address the possible endogeneity problem between banks and sovereign CDS by using the amount of liquidity borrowed by banks from their central bank as a proxy for banks' credit risk, since they argue that banks borrow more from their central bank in bad times. Although we mostly agree with their reasoning on this point, the use of central bank funding as its flaws. Since the interbank lending market in Europe is completely frozen as a reaction to the financial crisis, European banks increasingly use the ECB as a lender of first resort and not as a lender of last resort as is usually the case for central banks around the world. Considering this, we believe that even though their metric is certainly valid in *normal times*, it could bias results when applied during the European crisis.

4.2.2 Transmission channels of sovereign risk to banks

BIS (2011a) examines the correlation between sovereigns and banks CDS, and find that it has been quite high since late 2009. They also find that banks with high exposure to the PIGS[15] have their CDS premia co-move strongly with those of the PIGS[16]. The main contribution of their paper, however, is the identification of the four main channels of contagion through which sovereign credit risk affect banks

[15] Portugal, Ireland, Greece and Spain. They do not look include Italy.

[16] That strong co-movement between banks and sovereign CDS is also reported in Baglioni and Cherubini (2010).

funding. The first one is direct losses on banks' sovereign debt holdings which affect their profitability, therefore raising both their credit risk and funding cost. Second, a rise in sovereign credit risk lowers the value of collateral that can be used to access wholesale funding through central banks[17]. Third, if a bank's home state's credit rating drops, it usually lowers that bank's credit rating at the same time, which in turn raises its funding costs, and therefore also raises its credit risk. Finally, higher sovereign credit risk reduces the benefits that financial institutions get from implicit and explicit state guarantee. They also looked at other channels of transmission but find them either non-significant or impossible to study. Of the four transmission channels found by BIS (2011a), we focus in this paper on the two that can affect foreign banks, namely losses on holdings of sovereign debt and reduction of the value of sovereign bonds available as collateral to access the ECB's liquidity facility.

Borensztein and Panizza (2008) study the different costs of a sovereign default, and find a very important negative effect on the defaulted country's domestic banking system, especially if these banks, on aggregate, hold large amounts of the defaulted debt. Looking at the last 200 years of sovereign defaults, they find that sovereign default often leads to domestic banking crisis, hinting that sovereign credit risk does spillover on domestic banks. Our paper attempt to see if sovereign risk is also transmitted to foreign banks. This transmission of sovereign credit risk to banks is also studied in Arzeki et al. (2011). Using an event study methodology, they find that sovereign credit rating news does spillover to foreign banks, with the magnitude of the impact on banks depending on the rating agency issuing the downgrade, the type of rating announcement and the country being downgraded. While they show which ratings have the most effect on banks, they do not look at which banks are more impacted by rating changes.

[17] The ECB applies a haircut to sovereign securities given as collateral to access its liquidity facility. An up to date list of eligible securities and valuation haircuts can be found at: www.ecb.int/paym/coll/assets/html/list.en.html

Gennaioli et al (2010) look at banks' role as an intermediary in the transmission of sovereign credit risk to the real economy. They build a model to analyse the impacts of sovereign defaults, and find that they weaken banks' balance sheets, causing a decline in private credit. They find the scale of this contraction linked to the amount of the defaulted sovereign debt held by domestic banks, which is compatible with the first two transmission channels identified in BIS (2011a). They also find that the probability of default of a country is negatively related to its public debt, meaning that advanced countries, who usually issue a lot more debt than emerging ones, have lower probabilities of default. When they do default, however, the effects are a lot more important than in the case of a country with a smaller public debt.

Demirgüç-Kunt and Huizinga (2010) focus on the value of governments' implicit guarantee of their banking system. Using an international sample of financial institutions going from 1991 up until the crisis of 2008, they find that a bank's size as well has the amount of debt issued by its home government are negatively correlated to the value, for banks, of a government's implicit guarantee. In their words, « the largest banks have become too big to save » (Demirgüç-Kunt and Huizinga (2010), p.3).

4.2.3 Impact of the health of the banking system on governments

Many authors studied the other side of the equation, with causality going from banks to sovereign states. Using a seemingly unrelated regression, Sgherri and Zoli (2009) estimates that around 70% of the changes in spread of Greek government bonds between January 2003 and March 2009 is due to the market's concern about its financial sector instability, and the potential impacts of an eventual banking system bailout. Gerlach and al. (2010) goes in the same direction, and find that an important part of the recent euro-area sovereign spread over German Bunds is due

to the expected probability and cost of further financial sectors bailout. Baglioni and Cherubini (2010) looks at the cost a government would have to bear if it had to mark-to-market its implicit guarantee of its banking system and find this implicit liability to be very important in the case of the PIIGS. Lastly, Esjing and Lemke (2009) studied the impacts of bank bailouts using an event study methodology, and found them to cause a temporary private-to-public risk transfer.

4.3 Methodology

Our goal in this paper is to look at the impacts of sovereign credit risk on banks' own credit risk. Out of the four important transmission channels of sovereign credit risk to the banking system identified in BIS (2011a), only two can apply to foreign institutions, namely direct losses on sovereign debt holdings and reduction of collateral value to access central banks' liquidity facility; we therefore focus on these two transmission channels throughout this paper.

We propose to split the global financial crisis of the late 2000s in two distinct periods. In the early years (2008-2009), a collapse in the mortgage-backed-securities (MBS) market caused huge losses to banks around the world, forcing governments and central banks to step in to support their financial institutions. Throughout this paper we refer to this sub-period (2008-2009) as the "banking crisis". The second part of the crisis started shortly after Greece announced its fiscal problems, near the very end of 2009. In the months that followed, fear of a sovereign default by one of the PIIGS became one of the main concerns of investors around the world. We refer to this second sub-period (2010-2011) as the "sovereign debt crisis". Intuitively, the link between banks and their home states should be different during a banking crisis, where governments step in to bail out their banking system, than it is during a sovereign debt crisis, where we expect the

rise in sovereign default risk to affect banks. Throughout this paper, we analyse results of the banking crisis and the sovereign debt crisis separately.

As mentioned in Kallestrup el al. (2012), there is a potential endogeneity problem between banks and sovereign CDS. To fix this problem, we focus our analysis on foreign banks, since it would be hard to picture a bank significantly affecting the credit risk of a foreign country[18]. We can therefore assume that any relation we find between foreign banks and sovereign CDS show the impacts of changes in sovereign credit risk on foreign banks CDS, and not the opposite. We start by looking at the relation between banks and sovereign CDS to see if sovereign credit risk has a significant impact on banks' default risk. We then link these results to banks' sovereign debt holdings to see if they affect banks' relation to sovereign credit risk. To finish, we look at the potential losses a bank would incur in case of a sovereign default to see if it those losses affect a bank's sensitivity to sovereign credit risk.

4.4 Data

Following Alter and Schuler (2011), Baglioni and Cherubini (2010) and Demirguc-Kunt and Huizinga (2010), we use 5-years CDS premia to proxy for both banks' and sovereign credit risk, since they are the most liquid, and they constitute the majority of the CDS market. We use the entire collection of European banks daily CDS spread available on Bloomberg for the period ranging from January 1st 2008 to September 21th 2011, dropping data where the BID-ASK spread is wider than 15%. We do the same for the PIIGS countries and the iTraxx Europe Non-Financial 5 years sub-index (iTraxx Non-Financial) daily CDS. From these CDS observations, we compute the

[18] This bank-to-foreign-government relation is possible since banks often lend to each other. Financial problems in bank A could therefore spillover to a foreign financial institution (bank B) through the interbank lending market, and cause bank B to seek a government bailout to cover these loses, ultimately affecting the government's credit risk in bank B's country. That being said, considering that the interbank market in Europe is almost completely frozen since the beginning of the crisis, we should not be affected by this potential bank-to-foreign-government link.

difference in CDS spread between 2 business days, which gives us our CDS changes. Missing data are interpolated. We end up with a total of 50956 daily banks CDS changes, 4480 daily sovereign CDS changes and 922 iTraxx Non-Financial CDS changes. It's important to note that these variations in CDS levels (CDS changes) are not equal to the return an investor would get by taking a position in a CDS contract.

The bank-level data we use comes from EBA's 2011 bank stress tests and cover 90 European banks (around 70% of the European banking market). We have CDS observation on 39 out of the 90 stress-tested banks, and every test linking bank characteristics and CDS data uses only these 39 banks. The name of these banks as well as some of their characteristics can be found in Table 1 and 2.

<Table 1 and 2 go about here>

EBA's stress tests were made public on July 15th 2011, but the data they include is reported as of December 31st 2010.

Throughout this paper, we refer to sub-samples of banks using the following terminology:

- PIIGS-based banks: Portuguese, Irish, Italian, Greek and Spanish banks, as stated in EBA's stress test results.
- Foreign PIIGS-based banks: Every PIIGS-based banks except those headquartered in country "A" while we look at the effect of sovereign credit risk of that country.
- NON-PIIGS banks: Every banks in our sample that cannot be considered a "PIIGS-based banks" as per the previous definition.

4.5 Correlation and Beta study

We first start by looking at the correlation between banks and sovereign CDS changes, looking at the banking crisis (2008-2009) and the sovereign crisis (2010-

2011) separately. Our methodology here is similar to BIS (2011a), but while their paper aggregates bank information at the national level, ours uses bank-level data. Results are shown in Figure 1.

<Figure 1 goes about here>

Looking at the banking crisis period, we get a correlation coefficient of 0.2266 between sovereign credit risk and banks' credit risk when using the NON-PIIGS-based banks sub-sample, and a coefficient of 0.2426 using foreign PIIGS-based banks. As for 2010-2011, the correlation coefficient rises to 0.3847 for NON-PIIGS-based banks, and 0.3775 for foreign PIIGS-based banks. Also, we see that results for both sub-samples of banks are not statistically different from each other during both 2008-2009 and 2010-2011. This high degree of correlation points toward an important systemic component in the credit risk during the sovereign debt crisis.

Looking at the evolution of the co-movement between banks' and sovereign credit risk, we see that it rose for both sub-samples of banks from 2008-2009 to 2010-2011, but this rise is only statistically significant for NON-PIIGS-based banks.

The correlation coefficient shows us whether or not banks' and governments credit risk move in the same direction. However, we can't conclude looking at correlation alone if foreign governments affect banks or if they both react to a common external factor, as mentioned in Esjing and Lemke (2009). Further analysis is needed to understand whether or not there is a causality link between them.

To look at banks' sensitivity to sovereign credit risk, we propose to regress banks CDS changes to those of the PIIGS sovereign CDS, controlling for market movements.

Following Esjing and Lemke (2009), we choose the Markit iTraxx Europe Non-Financial 5-years CDS index (iTraxx Non-Financial), an equally weighted sub-index of

Markit's iTraxx Europe Main index which tracks the 100 most liquid investment grade non-financial CDS[19], as our proxy for general market risk.

We run an OLS regression using the following specifications:

$$CDS_i = a + \beta_{SOV\,i,c} * \ CDS_{SOV\,c} + \beta_{NFin_i} * \ CDS_{N-fin} + \ \epsilon_{i,c} \qquad (1)$$

Where CDS_i is bank *i*'s CDS changes, $CDS_{SOV\,c}$ is in turn Portugal, Ireland, Italy, Greece and Spain's changes in CDS premia, $\beta_{SOV\,i,c}$ is bank *i*'s sensitivity to country *c*'s CDS premia and CDS_{N-fin} is the changes in spread levels of the previously mentioned iTraxx sub-index, to control for the effect of market-wide credit risk movements. Finally, $\beta_{NFin_i}$is bank *i*'s sensitivity to changes in this iTraxx sub-index. The results from this regression should help us see whether banks and governments' solvency affect each other or if they are simply both affected in similar ways by a common exogenous factor like the general state of the economy. An increase in $\beta_{SOV\,i,c}$ in the sovereign debt part of the crisis would reinforce the notion that the health of sovereign states is an important factor in assessing banks' credit risk. A decrease in sensitivity, on the other hand, could indicate that banks are most affected by the health of public finances during a banking crisis than they are during a sovereign debt crisis.

We run this regression separately for the banking crisis years (2008-2009) and for the sovereign crisis ones (2010-2011), to see if there is a difference in sensitivity in those two periods. The results from the Equation 1 are shown in Figure 2

<Figure 2 goes about here>

We see a significant reduction in banks' sensitivity[20] to the PIIGS's credit risk in 2010-2011 compared to 2008-2009 for both sub-samples of banks. This counter

[19]For more information on Markit's European CDS index: indices.markit.com/download/Products/guides/Markit_iTraxx_Europe_S13_Rulebook.pdf

intuitive finding shows us that even though the co-movement between banks and sovereign CDS increased during the sovereign crisis, the sensitivity of the former to the latter actually decreased, pointing in the direction of a common factor explaining the rise in co-movement seen in the previous figure.

Another interesting result is that both sub-samples of banks seem more sensitive to the risk of the two bigger countries (Italy and Spain) than to the CDS of the smaller but riskier PIG, even if the world's attention has mostly been on the fate of the PIG during our sample's timeline (See Annex 1 for a graphic from Google Trends). In fact, the country at the forefront of the news during 2010-2011, Greece, is also the country to which foreign banks are the least sensitive. Also, as in the previous figure, results from both sub-samples of banks are not significantly different from each other in either period.

Figure 3 goes further, looking at the marginal explanation of the PIIGS CDS over the market proxy in our regression. This is done to see the relative importance of sovereign credit risk in our regression (Equation 1). If its relative importance is high, it would indicate that removing sovereign credit risk from our regression would strongly affect the goodness-of-fit of our model.

To achieve this, we first run a regression using Equation 1, and compute the R-square. We then re-run the same regression but forcing $\beta_{SOV\,i,c} = 0$ to get the R-square of the regression using only the iTraxx. Marginal explanation ($ME_{i,c}$) of PIIGS *c*'s CDS changes in explaining bank *i*'s CDS changes is then given by:

$$ME_{i,c} = 1 - \left(\frac{R^2_{i,c}\ using\ iTraxx\ only}{R^2_{i,c}\ using\ PIIGS\ and\ iTraxx} \right) \qquad (2)$$

[20] 95% confidence level.

<Figure 3 goes about here>

Looking at Figure 3, the marginal explanation $ME_{i,c}$ of PIIGS's credit risk is very similar for both sub-samples of banks in 2008-2009, at 0.5949 and 0.6218 for foreign PIIGS-based and NON-PIIGS-based banks respectively. The similarity seen here is probably due to the very high correlation between sovereign CDS of members of the European Union (EU), as implied in Levy et al. (2011)[21].

Looking at 2010-2011, we see very different results for each bank sub-samples, with marginal explanation of PIIGS's credit risk dropping to 0.2351 for NON-PIIGS-based banks. In contrast, it stays relatively stable for PIIGS-based ones, at 0.6515. The different reaction of each sub-sample of banks seen here could be due to the very different amount of PIIGS sovereign debt they hold, with PIIGS-based banks holding a median of 84.2% of their total sovereign exposure in PIIGS sovereign debt compared to only 5.9% for NON-PIIGS-based banks.

Our results in the last two figures can be interpreted as a reduction of the importance of sovereign credit risk in assessing NON-PIIGS-based banks' default risk.

As a robustness test, we re-run the same regression (Equation 1) using a 6-months rolling window instead of fixed 2-years periods. These results should help us understand the evolution of the Beta coefficients over our whole sample period as well as to see if our previous sample separation (2008-2009 vs. 2010-2011) makes sense. Again, we look at NON-PIIGS-based and PIIGS-based banks separately since we showed in the previous figures that they could react differently to changes in sovereign credit risk. Considering, however, that both sub-samples of banks had similar sensitivity to the PIIGS's credit risk for 2008-2009, we expect both PIIGS-based and NON-PIIGS-based banks to show similar results during those years.

[21] They concludes that « Sovereigns within geographical or economic groups tend be highly correlated. » (Levy et al. (2011), p.17)

Figure 4 shows the results of Equation 1 using a 6-months rolling window to plot the average sensitivity of banks CDS to the PIIGS's sovereign credit risk.

<Figure 4 goes about here>

Looking at Figure 4 we see that up until the beginning of 2010, both sub-samples of banks had very similar sensitivity to the PIIGS's credit risk. We see a drop in sensitivity early in the crisis when governments were massively bailing out their financial institutions, starting with the Irish government at the end of September 2008 up until January 2009 (shaded area in the graphic). This drop in sensitivity only lasts a few months, however, with sensitivity of banks CDS to the PIIGS credit risk rising back near their pre-bailouts level a few months later.

Based on Alter and Schüler (2011), a banking system bailout causes a temporary private-to-public risk transfer which lowers banks' credit risk following a government-funded bailout, at the price of an increase in sovereign credit risk. They found this impact to be short-lived, however, with banks' sensitivity to sovereign credit risk quickly returning to its pre-bailout level. This means that for a short period of time, banks and sovereign CDS, which are usually positively correlated, move in opposite directions, only to revert back to a positive correlation afterwards. The evolution of the sensitivity of PIIGS-based banks during 2008-2009 is compatible with this private-to-public risk transfer. As for NON-PIIGS-based banks, we mentioned earlier that Euro-area sovereign CDS are highly correlated, which could explain why their sensitivity to PIIGS's credit risk is very similar to those of PIIGS-based banks during the banking crisis.

Following Greece's fiscal deficit announcement near the end of 2009, we see the sensitivity to PIIGS's credit risk of both sub-samples of banks drop near zero. PIIGS-based banks' sensitivity to PIIGS credit risk slowly starts to climb in early 2010. In contrast, NON-PIIGS-based banks' sensitivity to these risks stays very low during 2010-2011, with an average beta coefficient of 0.099. The stability and low magnitude of the sensitivity of NON-PIIGS banks to the PIIGS's credit risk could be

due to those banks hedging PIIGS-related credit risk using CDS contracts. PIIGS-based banks on the other hand cannot economically cover their (mostly domestic) PIIGS debt considering it represents the vast majority of their total sovereign exposure. This could explain their higher sensitivity to the credit risk of the PIIGS during the sovereign debt crisis.

Overall, our results in this section show that prior to the evolution of the crisis into a sovereign debt crisis, both sub-samples of banks had similar sensitivity to PIIGS CDS, explained by a strong correlation between CDS of countries in the European Monetary Union (EMU). PIIGS-based banks' sensitivity to the PIIGS stayed relatively high in 2010-2011. On the other hand, NON-PIIGS-based banks' sensitivity to these risks was significantly lower during the sovereign debt crisis than it was in 2008-2009.

4.6 Determinants of bank's sensitivity to sovereign CDS

The previous section looked at banks' sensitivity to the credit risk of the PIIGS across time, whereas this one presents a cross-sectional analysis looking at the relation between banks' holdings of sovereign debt and their sensitivity to sovereign credit risk.

The composition of banks' sovereign debt holdings have long been a closely guarded secret. Analysts could only make educated guesses based on aggregated data mostly compiled by supranational agencies like the Bank for International Settlements (BIS). It is no longer so, thanks to the EBA. Their recent round of bank stress tests contained a detailed list of banks' sovereign exposures, which we use to analyse the impacts of a rise in sovereign credit risk on banks' balance sheets.

The Stress Tests had a no-sovereign default assumption, and therefore only took into consideration banks trading book exposures since most of the banking book is

not usually marked-to-market[22]. This grossly underestimates the potential losses since, as Blundell-Wignall and Slovik (2010) noted, 83% of the total European sovereign exposures of the tested banks is held in their banking book[23]. We improve on EBA's analysis by including data from both books since a default by at least one of the PIIGS (probably Greece) is a very real possibility.[24] Also, a rise in sovereign credit risk affects the value of the collateral available to banks to access the ECB's liquidity facility, even under a no-sovereign default assumption. We then use this bank-level data to see if these sovereign debt holdings have an impact on a banks' sensitivity to sovereign credit risk.

To test the relation between banks' sovereign debt holdings and their sensitivity to sovereign credit risk, we propose the following regression:

$$\hat{\beta}_{SOV\,i,c} = a + \gamma_{DEBT\,i,c} * DEBT_{i,c} + \epsilon_{i,c} \qquad (3)$$

Where $\hat{\beta}_{SOV\,i,c}$is bank *i*'s sensitivity to the sovereign credit risk of country *c*, as calculated in the previous section using Equation 1 and $DEBT_{i,c}$ is the relative amount of sovereign debt of country *c* held by bank *i*. In the following figures, this variable will be proxied by different ratios of relative sovereign debt exposure, with various data taken from EBA's stress test results. A $\gamma_{DEBT\,i,c}$ significantly different than 0 in this equation would indicate that the amount of sovereign debt held by a bank helps explain its sensitivity to sovereign credit risk.

To look at the relation between banks' holdings of PIIGS debt and their sensitivity to the sovereign credit risk of the PIIGS, we calculate their correlation coefficient. The significance levels of our correlation coefficients in this section are expressed as the

[22] A good explanation of the difference between a banks trading and banking book can be found in Blundell-Wignall and Slovik (2010), p.6

[23] See Scenario Analysis section for an explanation of the difference between banks' trading and banking books.

[24] A bank's default would also cause the banking book exposures to be liquidated at fair value.

probability of having a correlation different than zero, using a T-test with N-2 degree of freedom where N is the number of banks used in the sub-sample.

Figure 5a, 5b and 5c show the results of Equation 3 using different sub-samples of banks. Graphics from Figure 5a uses all foreign banks, whereas those of figure 5b and 5c show results using NON-PIIGS-based banks and foreign PIIGS-based banks, respectively. The upper part of these figures shows results for the banking crisis; the bottom part, on the other hand, shows them for the sovereign debt crisis period.

<Figure 5a goes about here>

Looking at 2008-2009's results, we see that foreign banks' sensitivity to sovereign credit risk is not significantly correlated to their holdings of each PIIGS's debt. This holds for every PIIGS except Ireland, where we see a significant correlation coefficient of 0.623 (t-statistic of 3.906) between holdings of Irish debt and sensitivity to Ireland's credit risk. This could be due to Ireland being the first of the PIIGS to see an abnormal rise in its credit risk following its explicit guarantee of its banking system in September 2008, which caused Ireland to become the riskiest PIIGS during 2008-2009, with an average CDS spread of 195 basis points (bps) during this period[25].

As for 2010-2011, we only see a significant correlation between banks' holdings of Greek and Irish sovereign debt and their sensitivity to these countries' credit risk.

Looking at the Greek debt graphic, we see that a lot of banks are very sensitive to Greece's credit risk even if they hold almost none of its sovereign debt. Considering that PIIGS' sovereign CDS spreads are highly correlated together[26], these could be other PIIGS-based banks whose sensitivity to their domestic sovereign's credit risk translates into a seemingly high sensitivity to Greece's credit risk.

[25] Greece was the second riskiest PIIGS during this period, with an average CDS spread of 123bps.
[26] Average correlation coefficient of 0.837 between Greek CDS spreads and each other PIIGS' CDS spread

To control for this high degree of correlation, the next figures re-do these graphics separating NON-PIIGS-based banks (figure 5b) from foreign PIIGS-based ones (figure 5c).

<Figure 5b goes about here>

The upper part of this figure shows no relation between sovereign debt holdings of NON-PIIGS banks and PIIGS's credit risk during the banking crisis, which is similar to what we got in the previous figure using the whole sample of foreign banks. One exception is the holdings of Portuguese debt, which is significantly correlated to NON-PIIGS banks' sensitivity to Portugal's sovereign credit risk. With a significant $\gamma_{DEBT_{i,Portugal}}$ of 5.81 (t-statistic of 1.917), it shows that an increase of one percentage point in a bank's Portuguese sovereign debt holdings relative to its total sovereign exposure increases its sensitivity to Portugal's sovereign credit risk ($\beta_{SOV_{i,Portugal}}$) by 0.0581 points. Of all the five PIIGS sovereign debt, however, banks in this sub-sample are the least exposed to Portuguese debt, with a median exposure of only 0.55% of their total sovereign debt portfolio, which means that even though statistically significant, this relation is not economically significant.

The results we get during the sovereign debt crisis sub-period are very similar to what we got in figure 5a, except that Greece's significant relation disappears, leaving only the relation between holdings of Irish sovereign debt and sensitivity to Ireland's credit risk as statistically significant for banks of this sub-sample, with a $\gamma_{DEBT_{i,Ireland}}$ of 3.636 (t-statistic of 3.195). That being said, considering that these banks' sensitivity to Ireland's credit risk is very small, with a median $\beta_{SOV_{i,Ireland}}$ coefficient of 0.035, and that the average size of banks' holdings of Irish debt is only 0.15% of their total sovereign exposures, this relation is not economically significant.

Figure 5c uses the same methodology as Figure 5a and 5b, but this time using only PIIGS-based foreign banks. Looking at the results from this figure, the reader should

remember that, as previously mentioned, PIIGS CDS spreads are highly correlated, with an average correlation coefficient of 0.910 between them for 2008-2009 and 0.826 for 2010-2011. This could affect the results we see in the next figure, since a bank could show a very high sensitivity to country A when its actual sensitivity is to country B.

<Figure 5c goes about here>

Using only foreign PIIGS-based banks, we see that during 2008-2009, both Ireland and Italy's debt had a significant impact on banks' sensitivity to these countries' sovereign credit risk. In Ireland's case, we see a significant correlation coefficient of 0.948 (99% confidence level). As previously mentioned, this could be due to Ireland's explicit guarantee of its banking system in the fall of 2008. With a significant $\gamma_{DEBT_{i,Ireland}}$of 7.883 (t-statistic of 6.627), it shows that an increase of one percentage point in a bank's Irish debt holdings relative to its total sovereign exposure increases its sensitivity to sovereign credit risk ($\beta_{SOV\,i,Ireland}$) by 0.079 points. Here again, however, of all the PIIGS credit risk, banks from this sub-sample are least sensitive to Ireland's, with a median Beta coefficient of only 0.125. This makes the relation between a bank's Irish debt holdings and its sensitivity to Ireland's credit risk hardly economically significant.

In Italy's case, we see a significant correlation coefficient of 0.677 (90% significance level) between foreign PIIGS-based bank's holdings of Italian debt and their sensitivity to Italy's credit risk. Foreign PIIGS-based banks hold more Italian debt than they hold any of the other PIIGS's debt. Paired with those banks relatively high sensitivity to Italy's credit risk during 2008-2009 (average $\beta_{SOV\,i,Italy}$ of 0.340), it seems that foreign PIIGS-based banks' Italian debt holding significantly affects their sensitivity to Italy's credit risk, with a significant $\gamma_{DEBT_{i,Italy}}$of 2.414 (t-statistic of 2.056).

As for 2010-2011, we see no significant relation in any graphics except in Greece's case, with a statistically significant correlation coefficient of 0.507 (90% significance level) between PIIGS-based banks' Greek debt holdings and their sensitivity to Greece's default risk. The very low sensitivity coefficient of foreign PIIGS-based banks to Greece's credit risk (median $\beta_{SOV\,i,Greece}$ of 0.006), however, prevents this relation from being economically significant.

The previous analysis focused on the relation between banks and each one of the PIIGS individually, whereas the remainder of this section looks at all five PIIGS has a group. We look at the PIIGS as a group for two main reasons. First, each PIIGS's fate seems interconnected. From the beginning of the crisis, the Market looked at the Euro-member's reaction to each PIIGS' woes as a test of their willingness to help each other in times of needs. If one of the PIIGS was allowed to disorderly default on its debt, it would send a strong message to the market about the lack of political will to save the Euro. In turn, this could raise the other PIIGS' bonds spread to unsustainable levels, eventually leading them to default on their own debt. Second, our event list aggregates events affecting each of the PIIGS since we don't have enough to separate them based on their target country.

We modify Equation 3 to look at aggregate PIIGS debt exposure:

$$\hat{\beta}_{PIIGS_i} = \sum_c \hat{\beta}_{SOV\,i,c} * w_c \qquad (4)$$

$$\hat{\beta}_{PIIGS_i} = a + \gamma_{PIIGS\_DEBT\,i} * \sum_c DEBT_{i,c} + \epsilon_i \qquad (5)$$

Where $\hat{\beta}_{PIIGS_i}$ is a weighted average of bank *i*'s sensitivity to the each of the PIIGS's sovereign credit risk, as calculated in the previous section using Equation 1. Weights w_c used are the relative weight of each PIIGS's external debt held by banks in our sample.[27] A significant $\gamma_{PIIGS\_DEBT\,i}$ obtained from Equation 5 would indicate that

[27] Portugal 5.52%, Ireland 2.31%, Italy 41.93%, Greece 12.05%, Spain 38.19%

the aggregate amount of PIIGS's sovereign debt held by a bank has a significant impact on its sensitivity to PIIGS's sovereign credit risk.

From here on, the y-axis on every figure is a weighted average of banks' sensitivity to all five PIIGS. Again, the weights used are the relative size of each PIIGS's external debt held by banks in our sample. The graphics from figure 6 to 8 are separated by sub-periods, with the top graphics showing results during 2008-2009 and bottom ones showing them for 2010-2011. We use two different measures of relative PIIGS's debt exposure in these figures, the first one being PIIGS debt relative to total sovereign exposure and the second one being PIIGS debt relative to a bank's regulatory capital. Since sovereign debt is often used by banks as collateral to access the ECB's liquidity facility, and the haircut applied by the ECB depends on the credit-worthiness of the sovereign issuer of the debt, our first measure should help us focus on the impact of changes in sovereign credit risk on a bank's access to the ECB's funds. This measure shows the impact of a rise in sovereign credit risk on banks' liquidity, even when no actual sovereign default is expected in the near future. Considering that a bank's regulatory capital is only affected when it suffers an actual loss, our second measure, PIIGS debt held by a bank relative to its regulatory capital, should help us understand the impact of direct losses on a bank's sovereign debt holding, since it shows consequences of such a default on a bank's financial health[28].

Figure 6 shows the results of Equation 5, restricting the sample to NON-PIIGS banks.

<Figure 6 goes about here>

During 2008-2009, we see a significant relationship between NON-PIIGS banks' PIIGS debt exposure as a percentage of total sovereign exposures, and their sensitivity to PIIGS credit risk. In contrast, no significant relation is found using our second

[28] Hypo Real Estate Holding (DE) is removed from NON-PIIGS banks sub-sample when using this measure since it holds 362% of PIIGS debt/Tier-1 Capital, compared with a median of 14% for the other banks in this sub-sample.

measure of relative PIIGS-debt exposure. The significant correlation coefficients we get using our first measure of relative PIIGS debt exposure suggests that sovereign debt holdings does have a significant impact on these banks' sensitivity to sovereign credit risk during the banking crisis. As for the lack of significant impact of our second measure, we have to remember that prior to the end of 2009, no-one ever talked about a possible default by any Eurozone country since a default by an advanced economy was considered a thing of the past. Sovereign credit risk in this sub-period was relatively low, with an average CDS spread of 107bps for the PIIGS. This could explain why we see no relation between debt holding relative to regulatory capital and sovereign credit risk.

During 2010-2011, we see no significant relation using either of our relative PIIGS debt exposure measures. The sovereign debt crisis was characterised by an important rise in sovereign credit risk, with average PIIGS CDS spread rising from 107bp in 2008-2009 to 475bp in 2010-2011. Default by at least one of the PIIGS had therefore become a very real possibility[29], which probably lead most banks to seek default protection to cover their expositions. Also, on May 3rd 2010, the ECB suspended its minimum credit rating requirement for Greek debt, which meant that Greek debt could still be used by banks as collateral to access the ECB's liquidity facility, even though they were now considered junk bonds. These could explain our lack of significant relation between banks' sovereign debt holdings and their sensitivity to the PIIGS credit risk during the sovereign debt crisis.

This figure also shows that NON-PIIGS banks' size, as proxied by their risk-weighted assets[30] (RWA) does not affect their sensitivity to sovereign credit risk. This could be a result of different factors. Both small and large banks could be sensitive to PIIGS credit risk, but for different reason. Small banks' sovereign exposures are usually less diversified than bigger banks', which could make them very sensitive to the

[29] Greece's average CDS spread is 1,017bps during 2010-2011.

[30] Risk-weighted-assets are, as its name implies, a banks' assets weighted according to their risk. It's used to calculate the different capital adequacy ratios required by banks' regulatiors.

PIIGS credit risk. Bigger banks, on the other hand, tend to have a stronger international presence than smaller ones, and could be sensitive to the PIIGS sovereign's credit risk through their foreign subsidiary. Testing these hypotheses, however, is outside the scope of this paper.

We do not show the results of Equation 5 using our PIIGS-based banks sub-sample. In banks of this sub-sample, domestic debt represents a median of 96.7% of aggregate PIIGS debt exposure, making our measures act as a ratio of banks' domestic debt exposure relative to their sensitivity to an index of the 5 PIIGS. Considering this distortion of our measures, we chose to restrict our analysis to NON-PIIGS banks from here on.

Our results in this section show that, on average, NON-PIIGS banks' sovereign debt holdings don't significantly affect their sensitivity to sovereign credit risk during a sovereign debt crisis. The only exception would be the amount of Irish debt held by NON-PIIGS banks, which has a significant impact on these banks' reaction to changes in Ireland's credit risk. In periods where sovereign risk is at a relatively low level, as was the case in 2008-2009, we show that the aggregate amount of PIIGS sovereign debt held by banks, as a percentage of their total sovereign exposure, does affect their relation to the PIIGS' sovereign credit risk. Our results also show that banks' sizes, as proxied by their RWA, don't have an impact on their sensitivity to sovereign credit risk. As for PIIGS-based banks, although we did find some statistically significant relations between holdings of PIIGS debt and sensitivity to sovereign credit risk, they were in most cases with countries to which the PIIGS are barely sensitive to in the first place, making most of these relations economically non-significant.

4.7 Scenario analysis

The previous section looked at the relation between banks' sovereign debt holdings and their sensitivity to sovereign credit risk. This one goes one step further and looks at the impact of potential losses on these holdings on banks' sensitivity to sovereign credit risk. This enables us to take into consideration the different level of default risk of each PIIGS as well as the present financial health of the banks since one of our measures looks at how much capital banks would need to raise following a sovereign default to meet the mandatory capital requirement. The main drawback, however, is that the haircuts applied to banks sovereign debt holdings are arbitrary. Our first potential losses scenario is based on the latest round of European banks' stress tests.

The 2011 stress tests improve on last year's version by disaggregating banks sovereign exposures by maturity, and by giving a detailed picture of banks' banking and trading books exposures. This distinction is important since accounting rules state that although trading book exposures need to be marked-to-market, banking book exposures do not, since they are usually held until maturity. Considering that EBA's stress test methodology states that securities should be reported by the banks at their accounting value, trading book exposures shown in stress test results are already marked-to market while most of the banking book exposures is reported at acquisition price[31].

EBA's stress test results separate the amount of sovereign debt held by banks as Available-For-Sale (AFS) as well as the amount held as Fair-value through profit and losses (FVO) from the net banking book exposures. We refer to the trading book, the AFS's, the FVO's and the derivative exposures as Marked-to-Market exposures (MME) since, according to EBA (2011b), they should all be marked to market in

[31] All exposures in EBA's Stress test are given as of December 31st 2010.

similar ways. The balance of the banking book positions are treated as Held-to-Maturity (HTM), as mentioned in EBA's methodology.[32]

As previously mentioned, EBA's methodology is based on a no-default assumption; accordingly, they only apply their haircuts on banks' trading book exposures. Those haircuts represent the potential additional impact of their « adverse macroeconomic scenario » on sovereign bond prices, compared to what they were at the starting point of the exercise[33]. Consequently, we need to apply these haircuts directly to the market value of banks' sovereign debt positions, as of December 30th 2010.

This is easy for MME exposures since, as previously mentioned, they are reported at their fair market value as of the end of 2010. HTM exposures, on the other hand, are reported by banks at acquisition price. To be able to calculate the potential losses on these exposures using EBA's haircuts, we first estimate their fair value as of December 31st 2010, using a method based on Queen (2011).

Following their approach, we find the average fair value of similar sovereign bonds on the market as of December 31st 2010. We then compute the implied haircuts required to go from our HTM bonds' acquisition prices to the value of the similar bonds we found on the market. Finally, we apply these calculated haircuts to HTM exposures to get their fair value as of December 30th 2010. Here is our detailed methodology:

For simplification, we suppose HTM securities were acquired at par (100). We start by looking at the market price of a benchmark sovereign bond for each country and each maturity set as of December 31st 2010[34]. We use benchmark bonds since we

[32] 2011 EU-Wide Stress Test: Methodological Note (Version 1.1), p.24.
[33] See Annex 4 of EBA Stress Test methodology, p.3 as well as Example 1, p.4.
[34] Benchmark bond yields as of December 30th 2010 come from Bloomberg. Bonds with maturity of 1 year or less are considered zero-coupons. To find the other coupon rates we use ECB's list of eligible collateral and calculate the average coupon rate of on the run sovereign bonds of each PIIGS as of the end of 2010, grouping maturities for when equal or longer than 5 years. The average coupon of 4 to 6 years maturity bonds are used as 5-year coupon, the average of 8 to 12 years for 10

(continues on the next page)

do not have detailed bond information such as coupon rates and expiry dates. The *fair value haircuts* on HTM ($H_{HTM\,c,m}$) for country *c* and maturity *m* is given by:

$$P_{c,m} = 100 * \left(1 - H_{HTM_{c,m}}\right) \quad (6)$$

$$H_{HTM\,c,m} = -\left(\frac{P_{c,m}}{100} - 1\right) \quad (7)$$

Where $P_{c,m}$is the market price on December 31st 2010 of a sovereign bond issued by country *c* and of maturity *m*. Bank *i*'s losses resulting from haircuts on sovereign bonds, L_i, is then given by:

$$MM_{HTM\,c,m,i} = HTM_{c,m,i} * (1 - H_{HTM\,c,m}) \quad (8)$$

$$L_i = \sum_c \sum_m \left(MM_{HTM\,c,m,i} + MME_{c,m,i}) * H_{c,m}\right) \quad (9)$$

Where $HTM_{c,m,i}$ and $MME_{c,m,i}$ are respectively HTM and MME exposures taken from EBA's stress tests, and $MM_{HTM\,c,m,i}$represents marked-to-market HTM exposures. The haircuts $H_{c,m}$we use are in turn EBA's 2011 stress test's adverse scenario (revised in mid-2011) and a set of arbitrary haircuts.

The losses by themselves don't tell us much since their importance depends on a few bank-specific data, like their regulatory capital and their RWA. To see the impact of those losses on bank *i*'s regulatory capital C_i we use:

$$C_i = T_i - L_i \quad (10)$$

Where T_i is bank *i*'s Tier-1 Capital prior to the haircuts, as reported in the results of the recent Stress tests. One could argue that banks' profits should be included in this calculation since they are their first line of defense against losses but since bank profits would probably be strongly affected by the state of the economy following a PIIGS default, we chose not to include them.

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years coupon and average of 13 to 30 years are used to calculate the 15 years coupon. Pairing these maturity, coupons and yield, we find the benchmark bond prices as of December 30th 2010. Missing values are interpolated. One exception is Greek bond prices which come directly from Greece's central bank website.

Finally, we use C_i as calculated in Equation 10 to look at how much money banks would need to raise to achieve a minimum Tier-1 capital ratio of 6% of their RWA with:

$$NC_i = \max(0, (0.06 * RWA_i) - C_i) \qquad (11)$$

Where $RWA_i$is bank *i*'s Risk Weighted Assets, as reported in EBA's stress test and NC_i is the new capital that it would need to raise to achieve a minimum Tier-1 capital ratio of 6%, to comply with Basel III rules once they come in effect[35]. The results from this section should help us see if the fear of direct losses on sovereign debt holding is an important sovereign credit risk transmission channel.

The following figures look at the impact of potential losses on banks' PIIGS debt holdings on their relation to sovereign credit risk. We calculate 3 different measures to better understand the impact of these potential losses:

- Potential losses applied to both MME and HTM sovereign exposures relative to banks' tier-1 capital, to look at the impact of such losses on a bank's financial stability.
- Potential losses applied to both MME and HTM sovereign exposures relative to banks' total sovereign exposures, to look at the impact of such losses on a bank's access to its central bank's liquidity facility.
- Amount of capital a bank would need to raise following losses applied to HTM and MME exposures to reach Basel III's new capital rule (6% Tier-1 capital ratio)

These calculations are performed based on EBA's 2011 Stress test Adverse Scenario (haircuts taken from EBA's revised methodological notes published on June 9th 2011).

[35] Under Basel III, minimum Tier-1 capital will gradually increase from 4.5% to 6% between January 2013 and January 2015. See BIS (2011b).

We modify Equation 5 to replace aggregate PIIGS debt exposure by our 3 previously mentioned measures of potential losses:

$$\hat{\beta}_{PIIGS_i} = a + \gamma_{LOSS_i} * \begin{cases} L_i/T_i \\ L_i/SE_i \\ NC_i \end{cases} + \epsilon_i \qquad (12)$$

Where $\hat{\beta}_{PIIGS_i}$ is, as in Equation 5, a weighted average of bank *i*'s sensitivity to the each of the PIIGS sovereign credit risk, $L_i$is bank *i*'s losses on both HTM and MME exposures as calculated in Equation 9, T_i is bank *i*'s Tier-1 capital, SE_i is bank *i*'s total sovereign exposures and NC_i is the capital bank *i* would need to raise to achieve a 6% Tier-1 capital ratio, as calculated in Equation 11. γ_{LOSS_i} is, in turn, bank *i*'s sensitivity to each of the 3 measures described above.

A significant γ_{LOSS_i} obtained using one of the potential losses measure in Equation 12 would indicate that that measure of potential losses has a significant impact on banks' sensitivity to PIIGS credit risk.

Figure 7 show the results of Equation 12 using only NON-PIIGS banks.

<Figure 7 goes about here>

Looking at the upper row (2008-2009), we see that potential losses relative to banks' Tier-1 capital ratio don't have a significant impact on banks' sensitivity to sovereign credit risk. This result is not surprising considering that sovereign debt of developed economies were considered risk-free assets during that period. When looking at potential losses relative to total sovereign exposures, however, we get a significant γ_{LOSS_i} of 2.078 (t-statistic of 1.775), meaning that an increase of 1 percentage point in relative potential losses increases banks' sensitivity to sovereign credit risk by 2.078 percentage points. This is consistent with our previous explanation that a bank's credit risk is sensitive to sovereign default risk during periods of low

sovereign default risk, since a rise in such a risk affects the value of the collateral available to banks to access liquidity facilities.

Looking at 2010-2011's results, we see that the sensitivity of NON-PIIGS-based banks to sovereign credit risk is not affected by either of our measures of relative potential losses. As for potential losses relative to banks' total sovereign exposures, the non-significant result obtained is consistent with our previous explanation of central banks relaxing their credit standards during the credit crisis. Also, NON-PIIGS banks' access to liquidities would not suffer much from those potential losses, considering that they represent on average only 1.27% of a bank's total sovereign exposures.

The graphics on the right look at the relation between the amounts of capital banks would need to raise following the previously calculated losses on both their sovereign exposures. It shows that only 2 NON-PIIGS banks would need additional capital to meet the required 6% Tier-1 capital ratio under the new Basel III rules. It's hard to conclude on anything based on only 2 banks; then again, the simple fact that we have so few banks whose financial health would be directly compromised by a PIIGS default helps reinforces our earlier argument that direct losses on sovereign debt holdings is not a significant transmission channel of sovereign credit risk to NON-PIIGS banks during the present sovereign debt crisis.

Since EBA's adverse scenario's haircuts have been criticised as being too low, we redo these test using higher haircuts. We replace $H_{c,m}$ in Equation 9 with a 50% haircut across maturities for the riskier countries (PIG), and a 25% haircut across maturities for the bigger but safer Italy and Spain and recalculate Equation 9 to 12. New results from Equation 12 are available for NON-PIIGS banks in Figure 8.

<Figure 8 goes about here>

Overall, the correlation coefficients we get in this figure are similar to those obtained using EBA's haircuts. We see that only potential losses as a percentage of total sovereign exposures has a significant impact on banks' sensitivity to sovereign

credit risk, and only during the banking crisis years. The magnitude of the γ_{LOSS_i} obtained here, however, is smaller than what we got using the stress tests' haircuts, which is a sign that the market's expectations are closer to EBA's scenario than to ours.

We can also see in this figure a statistically significant relation between our measure of capital shortfall and NON-PIIGS banks' sensitivity to sovereign credit risk, with a γ_{LOSS_i} of -9.80e-005 (t-statistic of 4.223). Although we expected this coefficient to be positive, it could be affected by multiple factors, like our choice of haircuts as well as the fact that it's based on only 4 data-points. Considering these shortcomings, we cannot conclude based on this result alone that potential capital needs is an important determinant of NON-PIIGS banks' sensitivity to sovereign credit risk.

Globally, we see that during 2008-2009, potential losses on sovereign debt did have an impact on NON-PIIGS banks' sensitivity to sovereign credit risk, through the liquidity/collateral transmission channel identified in BIS (2011a). In contrast, direct losses on sovereign debt holdings did not seem to have a significant impact on banks' relation to sovereign credit risk, probably due to the risk-free status held by advanced economies' debt during this period. As for 2010-2011, we saw no relation between relative potential losses and banks' sensitivity to sovereign credit risk.

4.8 Conclusion

Our results show a strong co-movement between NON-PIIGS banks and the PIIGS sovereign credit risk since the beginning of the sovereign debt crisis. In contrast, we show that those banks' sensitivity to sovereign credit risk actually decreased significantly during this period compared to where it was in 2008-2009. We also show that foreign banks' sensitivity is much higher to the bigger but safer countries' sovereign credit risk (Italy and Spain) than it is to the much smaller but riskier PIG,

pointing in the direction that the market fears contagion to other countries is a bigger treat than the short term probability of direct losses on banks' sovereign debt's holdings.

In fact, taken individually, the relative amount of each PIIGS' sovereign debt had no economically significant impact on banks' sensitivity to sovereign credit risk with the exception of Italian debt held by PIIGS-based foreign banks. Aggregate PIIGS exposure, on the other hand, had a significant impact on NON-PIIGS-based banks' sensitivity to sovereign credit risk, but only in periods of low sovereign credit risk. Overall, our results suggests that even though two of the four transmission channels of sovereign credit risk to banks identified in BIS (2011a) can apply to foreign banks, only one, the collateral/liquidity channel seems to be a significant transmission channel of sovereign credit risk to NON-PIIGS banks. As for the fear of direct losses on sovereign debt holdings, it seems insignificant in periods of low sovereign credit risk and easily coverable when such a risk rises.

This being said, one of the main consequences of the late 2000s credit crisis will be the re-pricing of risk, with most countries' sovereign debt losing their risk-free status for good. This might cause the fear of direct losses to become an important transmission channel once the sovereign debt market stabilises in Europe.

4.9 References

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4.10 Figures and Tables

Table 1 – Banks' sovereign debt exposures. This table contains data about banks' sovereign debt exposure as of December 31st 2010. All numbers are the author's calculations based on data from EBA's stress test 2011 results except Total sovereign exposure which is taken directly from EBA's data. Banks name and country code are also taken from the Stress tests.

Bank Name	Bank's Home Country	Debt exposure relative to banks total sovereign exposure					Total Sovereign Exposure (million €)	Aggregate PIIGS Exposure (million €)
		Portugal	Ireland	Italy	Greece	Spain		
Erste Bank Group (EBG)	AT	0,39%	0,15%	2,21%	1,27%	0,51%	27248	1232
Raiffeisen Bank International (RBI)	AT	0,01%	0,00%	1,96%	0,01%	0,01%	22863	455
DEUTSCHE BANK AG	DE	0,17%	0,45%	7,59%	1,35%	2,06%	93634	10884
COMMERZBANK AG	DE	1,10%	0,03%	11,27%	3,43%	3,53%	89742	17363
Landesbank Baden-Württemberg	DE	-0,44%	0,02%	3,46%	1,49%	0,40%	40104	1977
Bayerische Landesbank	DE	0,00%	0,04%	0,96%	0,28%	1,26%	52704	1335
Hypo Real Estate Holding AG, München	DE	1,20%	0,11%	17,41%	0,00%	8,28%	41000	11070
WestLB AG, Düsseldorf	DE	-0,03%	1,25%	3,53%	1,06%	2,39%	31052	2545
DANSKE BANK	DK	0,34%	2,73%	2,92%	0,01%	0,93%	11989	830
BANCO SANTANDER S.A.	ES	3,74%	0,00%	0,24%	0,18%	43,10%	96986	45840
BANCO BILBAO VIZCAYA ARGENTARIA S.A. (BBVA)	ES	0,62%	0,00%	3,74%	0,12%	51,23%	104331	58125
BANCO DE SABADELL, S.A.	ES	1,23%	0,52%	0,00%	0,00%	98,25%	7425	7425
CAJA ESPAÑA DE INVERSIONES, SALAMANCA Y SORIA, CAJA DE AHORROS Y MONTE DE PIEDAD	ES	0,36%	0,00%	0,00%	0,00%	99,64%	7584	7584
BNP PARIBAS	FR	1,08%	0,24%	11,63%	2,49%	1,94%	213071	37033
CREDIT AGRICOLE	FR	1,49%	0,22%	15,34%	0,92%	3,91%	66416	14527
SOCIETE GENERALE	FR	1,05%	0,62%	4,08%	4,09%	3,35%	65278	8608
ROYAL BANK OF SCOTLAND GROUP plc	GB	0,21%	0,38%	4,02%	0,95%	0,37%	113543	6734
HSBC HOLDINGS plc	GB	0,18%	0,04%	1,04%	0,32%	0,22%	312229	5631
BARCLAYS plc	GB	1,67%	0,48%	4,09%	0,15%	7,55%	72524	10103
LLOYDS BANKING GROUP plc	GB	0,00%	0,00%	0,05%	0,00%	0,20%	31189	79
ALPHA BANK	GR	0,00%	0,00%	0,00%	90,15%	0,00%	6157	5550
ALLIED IRISH BANKS PLC	IE	2,36%	49,40%	7,92%	0,39%	3,25%	10306	6526
BANK OF IRELAND	IE	0,00%	84,28%	0,77%	0,00%	0,00%	3879	3299
INTESA SANPAOLO S.p.A	IT	0,10%	0,16%	81,98%	0,89%	1,06%	70868	59665
UNICREDIT S.p.A	IT	0,06%	0,06%	53,78%	0,62%	2,12%	89346	50617
BANCA MONTE DEI PASCHI DI SIENA S.p.A	IT	0,60%	0,00%	96,44%	0,01%	0,85%	33216	32520
BANCO POPOLARE - S.C.	IT	0,00%	0,00%	96,79%	0,72%	0,00%	12149	11845
UNIONE DI BANCHE ITALIANE SCPA (UBI BANCA)	IT	0,00%	0,00%	97,30%	0,24%	0,00%	10405	10148

Table 1 – (Continued)

Bank Name	Bank's Home Country	Debt exposure relative to banks total sovereign exposure					Total Sovereign Exposure (million €)	Agregate PIIGS Exposure (million €)
		Portugal	Ireland	Italy	Greece	Spain		
ING BANK NV	NL	0,83%	0,12%	6,74%	0,91%	2,09%	83738	8945
RABOBANK NEDERLAND	NL	0,18%	0,13%	0,93%	0,81%	0,33%	46511	1105
SNS BANK NV	NL	0,00%	2,13%	10,41%	0,64%	0,78%	7324	1023
CAIXA GERAL DE DEPÓSITOS, SA	PT	81,82%	0,29%	0,07%	0,60%	2,47%	7982	6803
BANCO COMERCIAL PORTUGUÊS, SA (BCP OR MILLENNIUM BCP)	PT	69,41%	2,53%	0,59%	8,66%	0,00%	8398	6818
ESPÍRITO SANTO FINANCIAL GROUP, SA (ESFG)	PT	38,59%	0,00%	0,00%	4,42%	0,78%	6998	3064
Banco BPI, SA	PT	54,39%	3,95%	13,56%	4,53%	0,00%	7163	5475
Nordea Bank AB (publ)	SE	0,00%	0,00%	0,27%	0,00%	0,18%	35381	162
Skandinaviska Enskilda Banken AB (publ) (SEB)	SE	0,42%	0,00%	0,91%	0,36%	0,27%	31642	620
Svenska Handelsbanken AB (publ)	SE	0,00%	0,00%	0,00%	0,00%	0,00%	21561	0
Swedbank AB (publ)	SE	0,00%	0,00%	0,00%	0,00%	0,00%	2796	0

Table 2 – Banks key characteristics. This table contains data about banks' balance sheets as of December 31st 2010. Risk-weighted-assets (RWA) and Tier-1 Ratio are taken directly from EBA's Stress tests 2011, whereas the last three columns are the author's calculations based on EBA's data. Banks name and country code are also taken from the Stress tests results.

Bank Name	Bank's Home Country	RWA (million €)	Tier-1 Ratio	Sovereign exposure / Tier-1 Capital	PIIGS debt Exposure / Tier-1 Capital	PIIGS debt Exposure / Total Sovereign Exposure
Erste Bank Group (EBG)	AT	128470	8,34%	254,2%	11,5%	4,5%
Raiffeisen Bank International (RBI)	AT	100974	7,65%	296,0%	5,9%	2,0%
DEUTSCHE BANK AG	DE	467396	6,73%	297,7%	34,6%	11,6%
COMMERZBANK AG	DE	318105	7,24%	389,8%	75,4%	19,3%
Landesbank Baden-Württemberg	DE	136483	6,70%	438,4%	21,6%	4,9%
Bayerische Landesbank	DE	131835	8,08%	494,8%	12,5%	2,5%
Hypo Real Estate Holding AG, München	DE	24283	12,58%	1342,0%	362,3%	27,0%
WestLB AG, Düsseldorf	DE	59764	7,34%	707,6%	58,0%	8,2%
DANSKE BANK	DK	144035	10,57%	78,8%	5,5%	6,9%
BANCO SANTANDER S.A.	ES	626921	7,19%	215,3%	101,7%	47,3%
BANCO BILBAO VIZCAYA ARGENTARIA S.A. (BBVA)	ES	319547	8,66%	377,0%	210,1%	55,7%
BANCO DE SABADELL, S.A.	ES	56503	6,27%	209,7%	209,7%	100,0%
CAJA ESPAÑA DE INVERSIONES, SALAMANCA Y SORIA, CAJA DE AHORROS Y MONTE DE PIEDAD	ES	25266	7,18%	418,1%	418,1%	100,0%
BNP PARIBAS	FR	686949	8,31%	373,5%	64,9%	17,4%
CREDIT AGRICOLE	FR	557395	8,39%	142,0%	31,1%	21,9%
SOCIETE GENERALE	FR	418651	6,78%	230,1%	30,3%	13,2%
ROYAL BANK OF SCOTLAND GROUP plc	GB	667709	7,22%	235,4%	14,0%	5,9%
HSBC HOLDINGS plc	GB	1002244	8,81%	353,5%	6,4%	1,8%
BARCLAYS plc	GB	595739	7,74%	157,3%	21,9%	13,9%
LLOYDS BANKING GROUP plc	GB	520087	7,92%	75,7%	0,2%	0,3%
ALPHA BANK	GR	49692	9,19%	134,9%	121,6%	90,2%
ALLIED IRISH BANKS PLC	IE	111267	1,18%	786,6%	498,1%	63,3%
BANK OF IRELAND	IE	80705	5,89%	81,6%	69,4%	85,0%
INTESA SANPAOLO S.p.A	IT	353062	7,53%	266,5%	224,3%	84,2%
UNICREDIT S.p.A	IT	514409	6,98%	248,8%	140,9%	56,7%
BANCA MONTE DEI PASCHI DI SIENA S.p.A	IT	111281	5,14%	580,9%	568,7%	97,9%
BANCO POPOLARE - S.C.	IT	96560	5,52%	227,7%	222,1%	97,5%
UNIONE DI BANCHE ITALIANE SCPA (UBI BANCA)	IT	96225	6,77%	159,7%	155,7%	97,5%

Table 2 – (Continued)

Bank Name	Bank's Home Country	RWA (million €)	Tier-1 Ratio	Sovereign exposure / Tier-1 Capital	PIIGS debt Exposure / Tier-1 Capital	PIIGS debt Exposure / Total Sovereign Exposure
ING BANK NV	NL	366922	8,87%	257,1%	27,5%	10,7%
RABOBANK NEDERLAND	NL	247093	11,78%	159,7%	3,8%	2,4%
SNS BANK NV	NL	23057	7,31%	434,3%	60,7%	14,0%
CAIXA GERAL DE DEPÓSITOS, SA	PT	78810	7,75%	130,6%	111,4%	85,2%
BANCO COMERCIAL PORTUGUÊS, SA (BCP OR MILLENNIUM BCP)	PT	63618	4,83%	273,2%	221,8%	81,2%
ESPÍRITO SANTO FINANCIAL GROUP, SA (ESFG)	PT	74543	5,85%	160,5%	70,3%	43,8%
Banco BPI, SA	PT	26838	7,63%	349,9%	267,5%	76,4%
Nordea Bank AB (publ)	SE	212930	9,27%	179,2%	0,8%	0,5%
Skandinaviska Enskilda Banken AB (publ) (SEB)	SE	89200	11,02%	321,8%	6,3%	2,0%
Svenska Handelsbanken AB (publ)	SE	105712	8,21%	248,4%	0,0%	0,0%
Swedbank AB (publ)	SE	84558	9,06%	36,5%	0,0%	0,0%

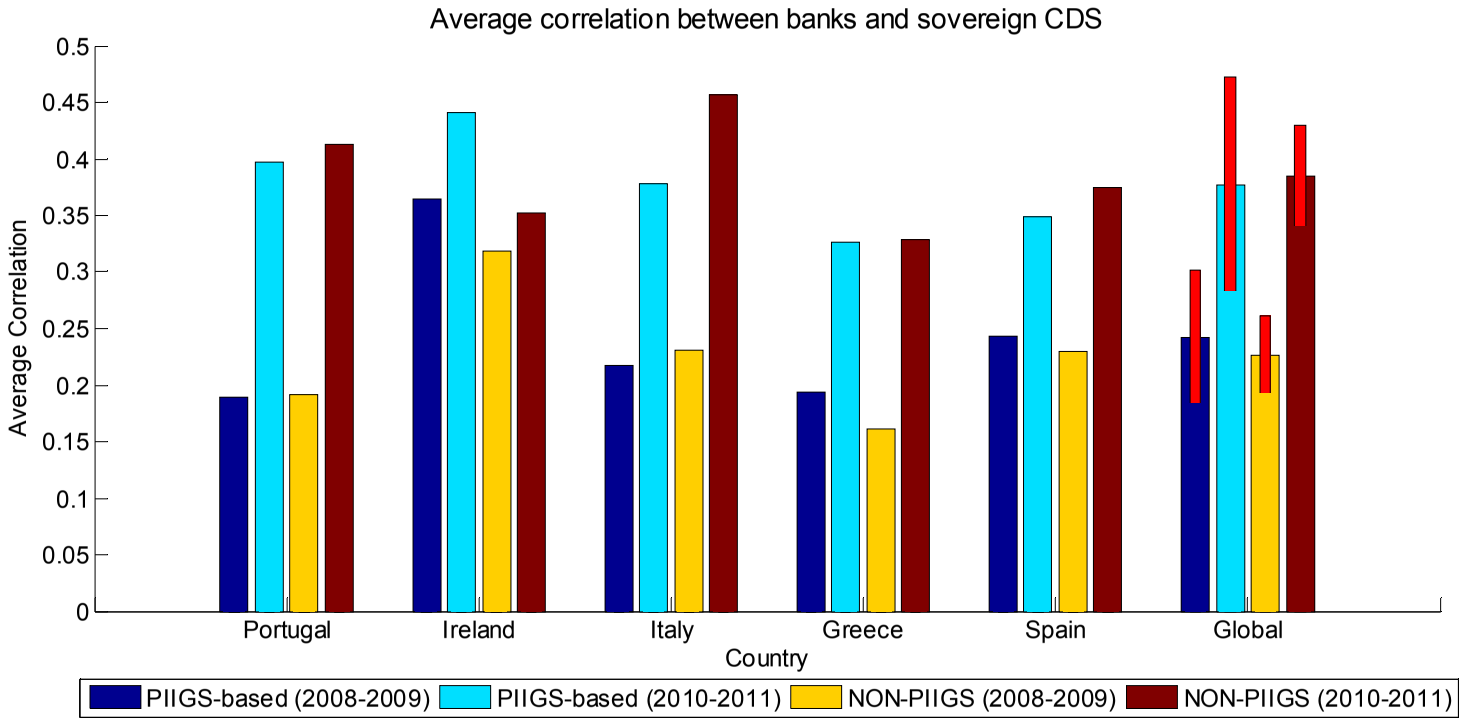


Figure 1 –Correlation between banks and sovereign CDS. This figure shows the average correlation between banks CDS and sovereign CDS of each PIIGS countries, separating foreign PIIGS-based banks from NON-PIIGS-based banks. Thin lines in the Global portion show 95% confidence interval.

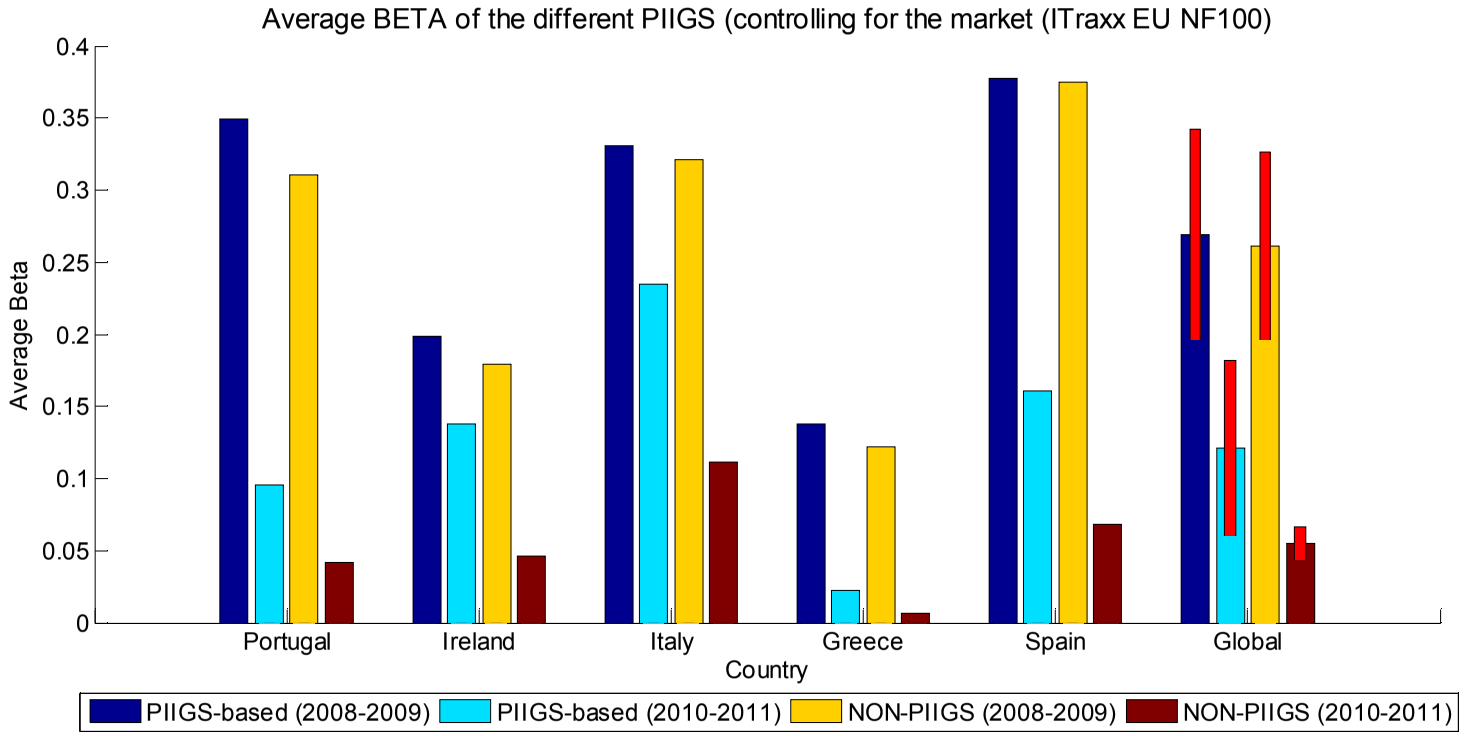


Figure 2 – Sensitivity of banks CDS to sovereign credit risk. This figure shows the evolution of the sensibility of banks CDS to sovereign credit risk, controlling for market-wide movements using the ITraxx Europe Non-Financials 100 as a market proxy. We separate foreign PIIGS-based banks from NON-PIIGS-based banks. Thin lines in the Global portion show 95% confidence interval.

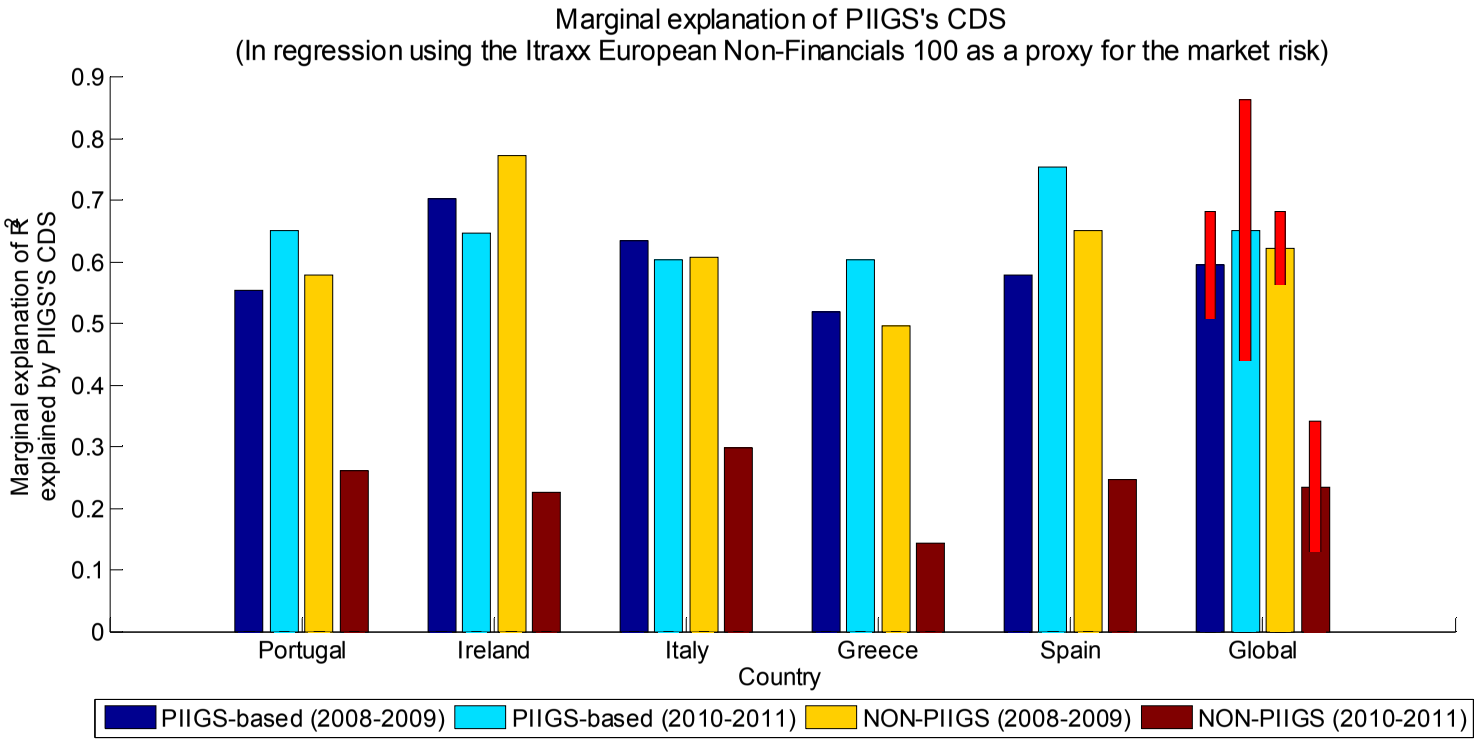


Figure 3 – Marginal explanation of PIIGS CDS. This figure shows the marginal explanation of the PIIGS's CDS over market-wide movements (ITraxx Europe Non-Financials 100 used as a market proxy). See results section for formula used to achieve these results. We separate foreign PIIGS-based banks from NON-PIIGS-based banks. Thin lines in the Global portion show the 95% confidence interval.

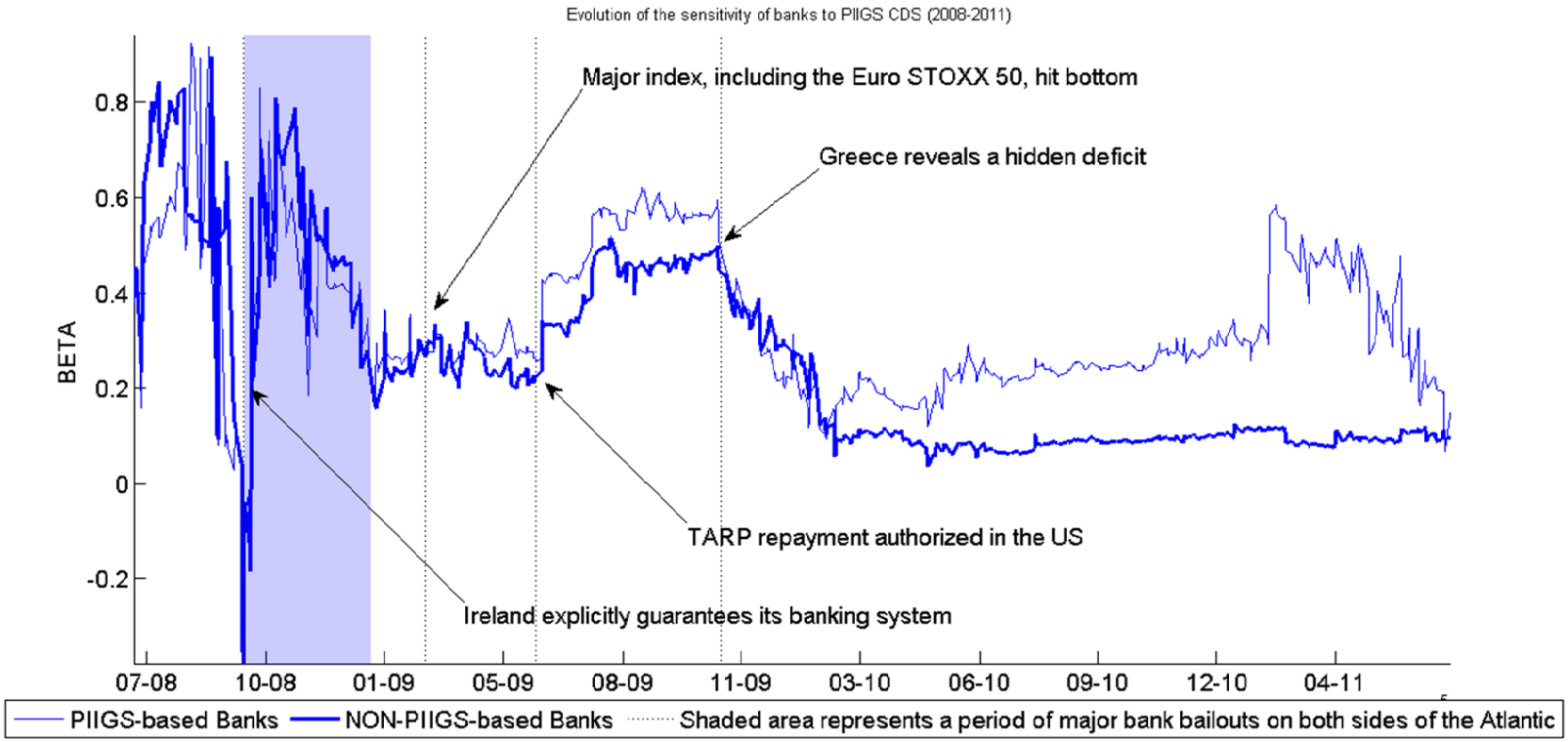
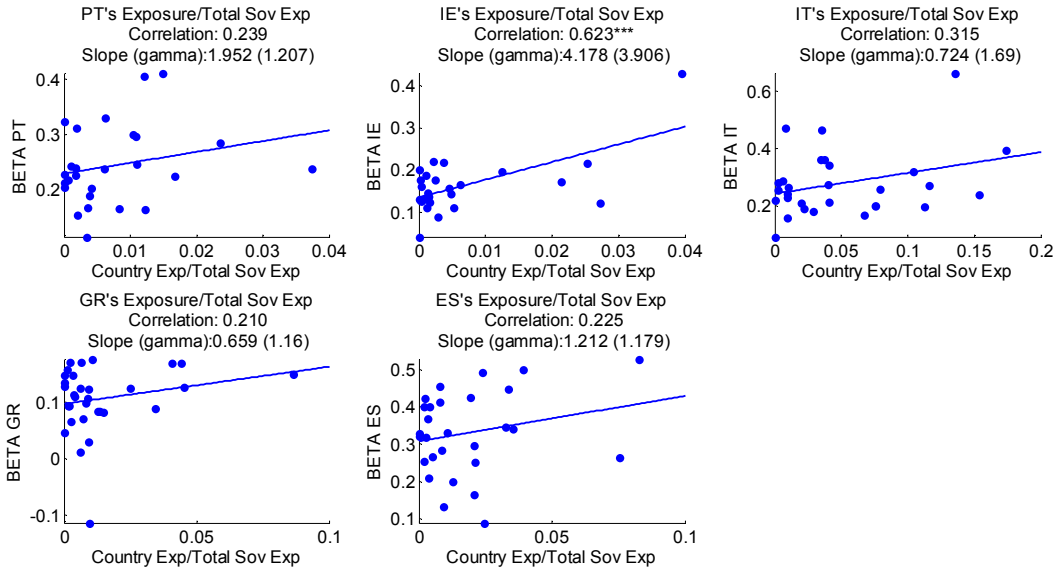


Figure 4 – Evolution of the sensitivity of banks CDS to PIIGS CDS. This figure shows the evolution of banks CDS's average sensitivity to the PIIGS CDS using a 6 months rolling window. Dotted lines represent key events of the financial crisis. The shaded area represents a period of multiple bank bailouts on both sides of the Atlantic.

Banking crisis (2008-2009)



Sovereign debt crisis (2010-2011)

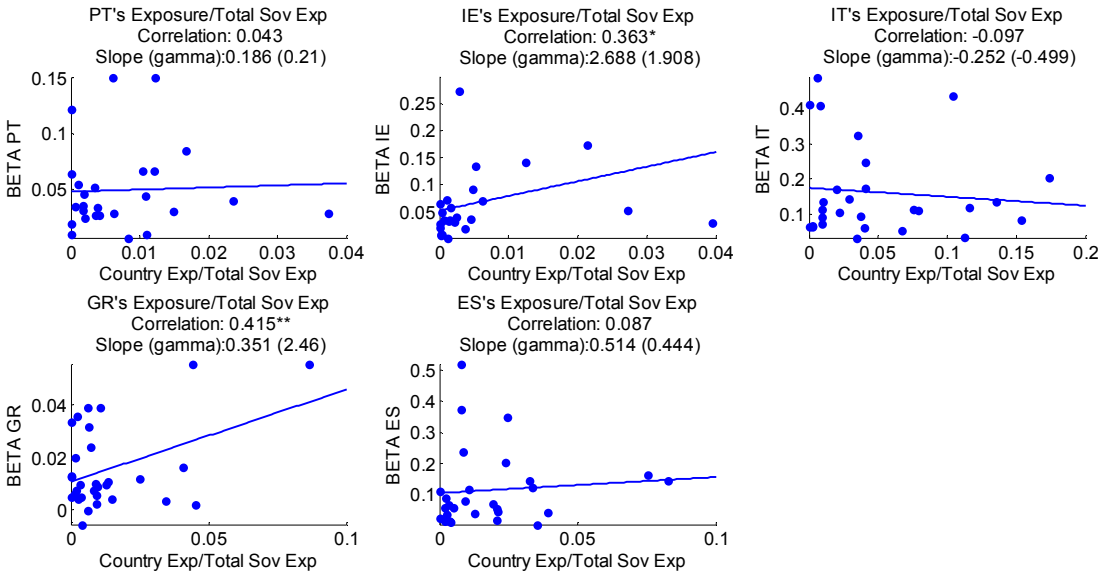
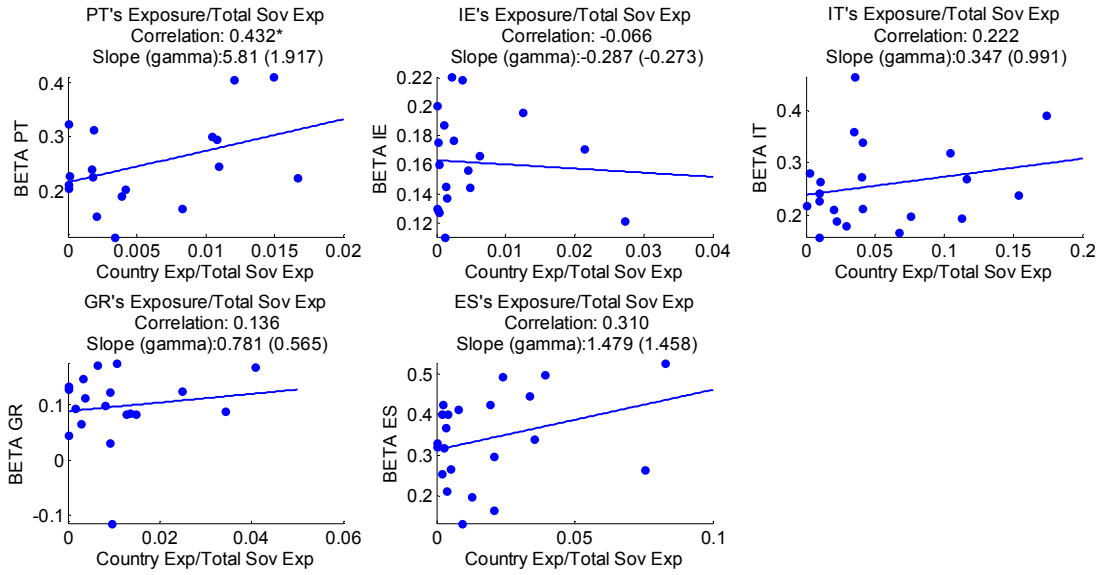


Figure 5a – Relation between sovereign exposure and sensitivity to sovereign credit risk. This figure shows the evolution of the link between banks' sovereign exposure and their sensitivity to the PIIGS's credit risk. Each graphic excludes domestic banks. Graphics separated by sub-periods, with top graphics showing results during 2008-2009 and bottom ones showing them for 2010-2011. The stars next to the correlation show its significance level, with *, ** and *** meaning significant at the 90%, 95% and 99% confidence level, respectively. The number in parenthesis next to the slope (γ) is the t-statistic.

Banking crisis (2008-2009) NON-PIIGS banks only



Sovereign debt crisis (2010-2011) NON-PIIGS banks only

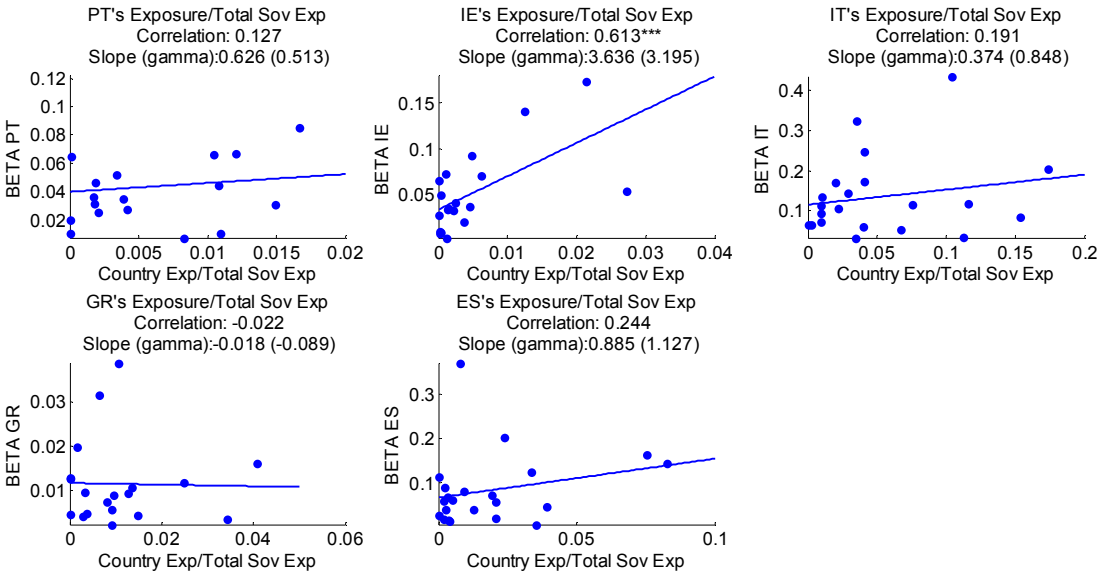
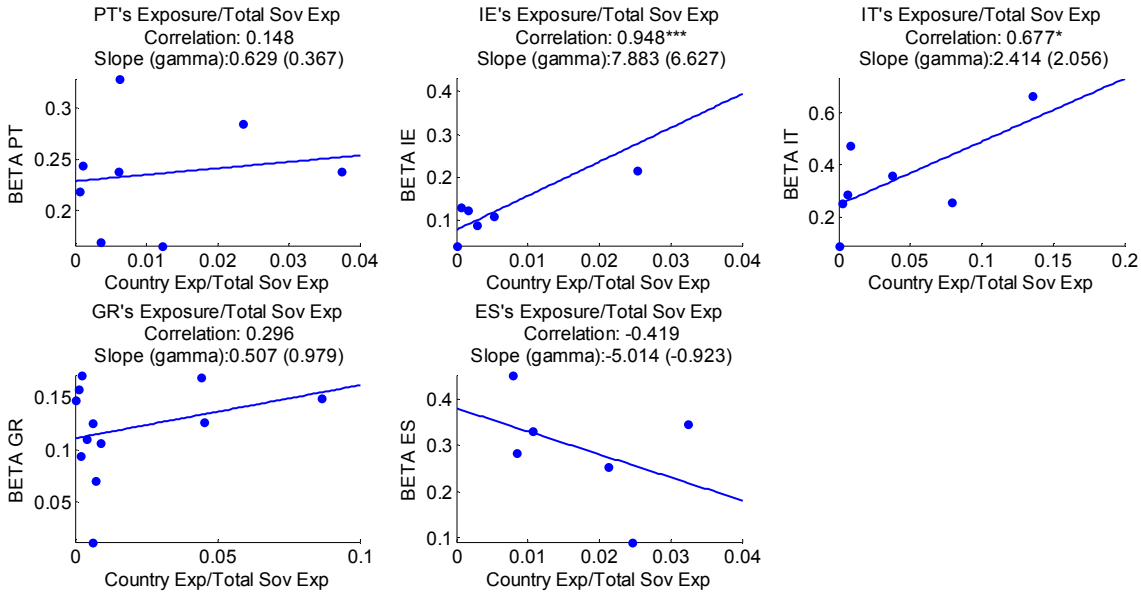


Figure 5b – Relation between sovereign exposure and sensitivity to sovereign credit risk. This figure shows the evolution of the link between banks' sovereign exposure and their sensitivity to the PIIGS's credit risk. Each graphic excludes PIIGS-based banks. Graphics separated by sub-periods, with top graphics showing results during 2008-2009 and bottom ones showing them for 2010-2011. The stars next to the correlation show its significance level, with *, ** and *** meaning significant at the 90%, 95% and 99% confidence level, respectively. The number in parenthesis next to the slope (γ) is the t-statistic.

Banking crisis (2008-2009) PIIGS-based banks only



Sovereign debt crisis (2010-2011) PIIGS-based banks only

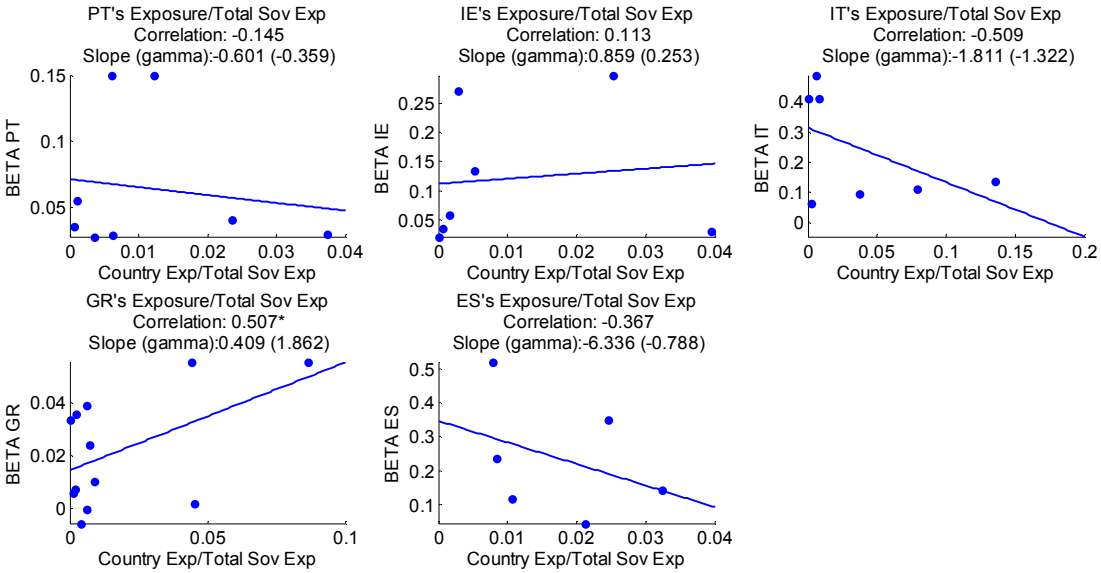


Figure 5c – Relation between sovereign exposure and sensitivity to sovereign credit risk. This figure shows the evolution of the link between banks' sovereign exposure and their sensitivity to the PIIGS's credit risk. Each graphic includes only foreign PIIGS-based banks. Top graphics shows results during 2008-2009 and bottom ones shows them for 2010-2011. The stars next to the correlation show its significance level, with *, ** and *** meaning significant at the 90%, 95% and 99% confidence level, respectively. The number in parenthesis next to the slope (γ) is the t-statistic.

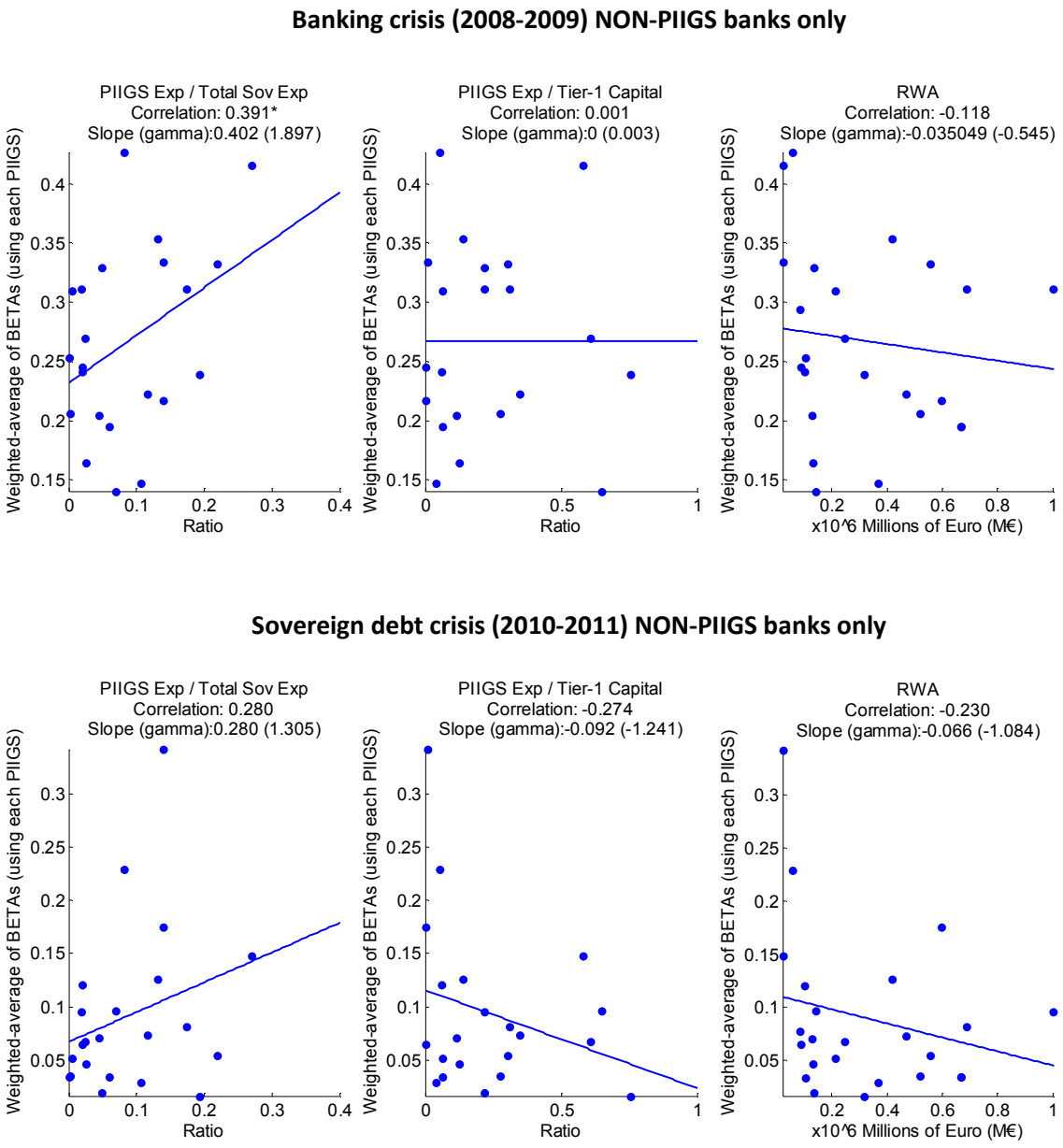
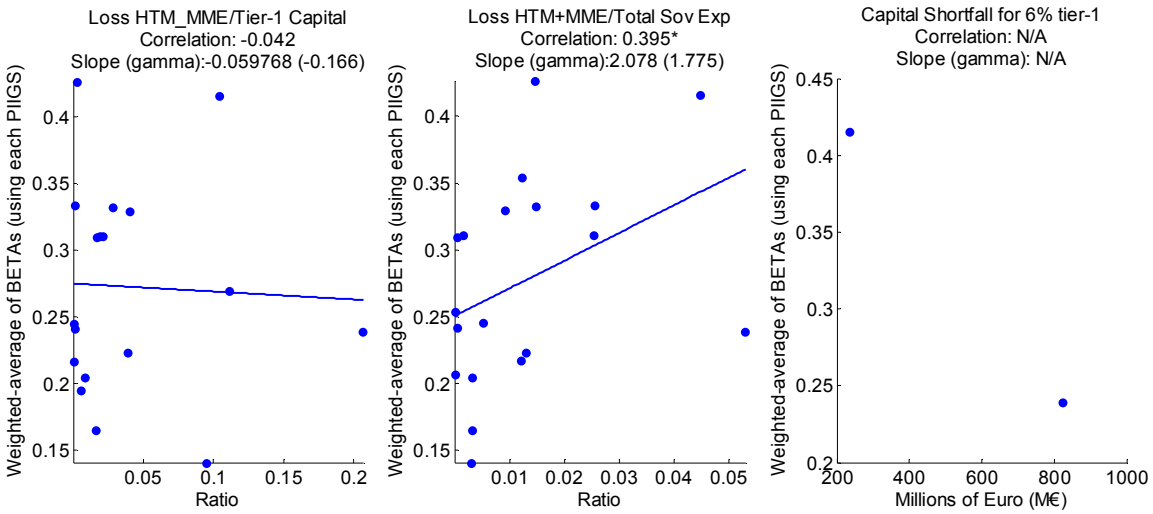


Figure 6 – Relation between aggregate sovereign exposure and sensitivity to sovereign credit risk. This figure shows the evolution of the link between sensitivity to PIIGS credit risk and different bank-level characteristics and ratios. The Y-axis is the weighted average of banks' sensitivity to each PIIGS sovereign credit risk. The weights used are the relative amount of external debt of each of the PIIGS held by banks in our sample: Portugal 5.52%, Ireland 2.31%, Italy 41.93%, Greece 12.05%, Spain 38.19%. The stars next to the correlation coefficient show its significance level, with *, ** and *** meaning significant at the 90%, 95% and 99% confidence level, respectively. The number in parenthesis next to the slope (γ) is the t-statistic.

EBA's 2011 Stress Test Adverse Scenario

Banking crisis (2008-2009) NON-PIIGS banks only



Sovereign debt crisis (2010-2011) NON-PIIGS banks only

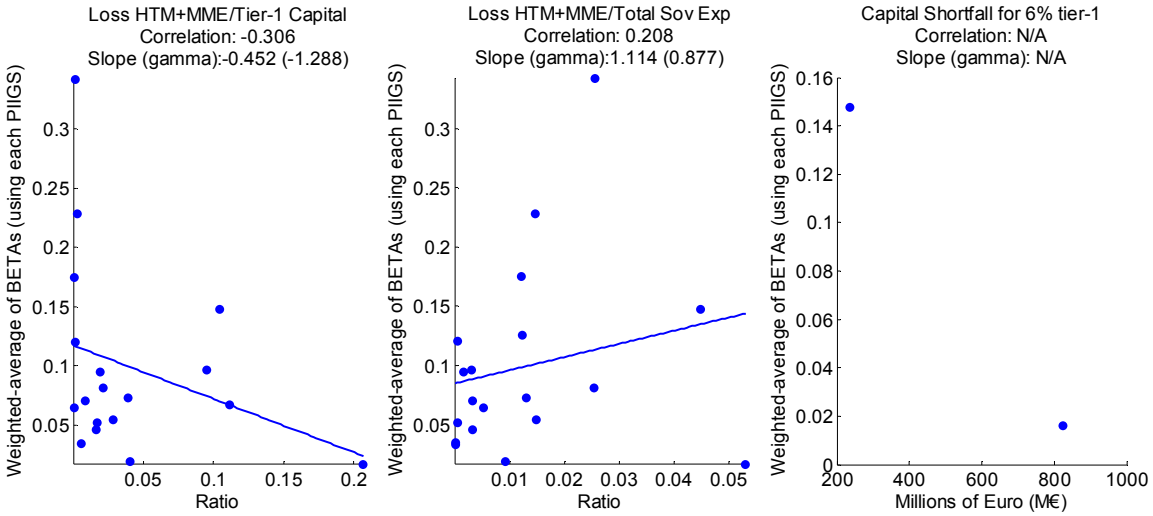
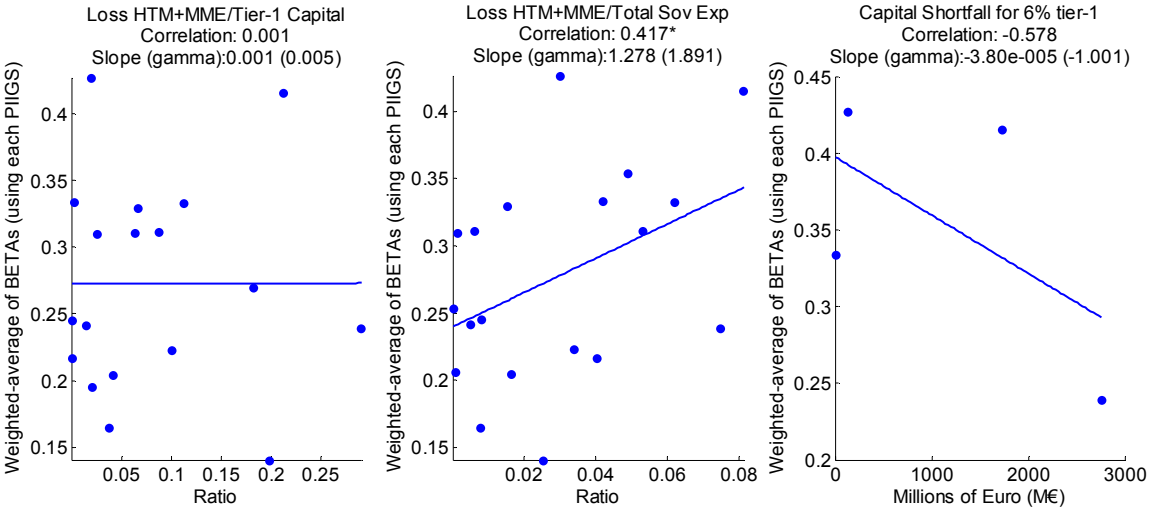


Figure 7 - Relation between potential losses on sovereign exposures and sensitivity to sovereign credit risk (EBA's haircuts). This figure shows the evolution of the link between sensitivity to PIIGS credit risk and different measures of potential losses based on the EBA's Stress test results. The Y-axis is the weighted average of banks' sensitivity to each PIIGS sovereign credit risk. The weights used are the relative amount of external debt of each of the PIIGS held by banks in our sample: Portugal 5.52%, Ireland 2.31%, Italy 41.93%, Greece 12.05%, Spain 38.19%. The stars next to the correlation coefficient show its significance level, with *, ** and *** meaning significant at the 90%, 95% and 99% confidence level, respectively. The number in parenthesis next to the slope (γ) is the t-statistic.

Arbitrary 50% haircuts for the riskier PIG and 25% for Spain and Italy's debt

Banking crisis (2008-2009) NON-PIIGS banks only



Sovereign debt crisis (2010-2011) NON-PIIGS banks only

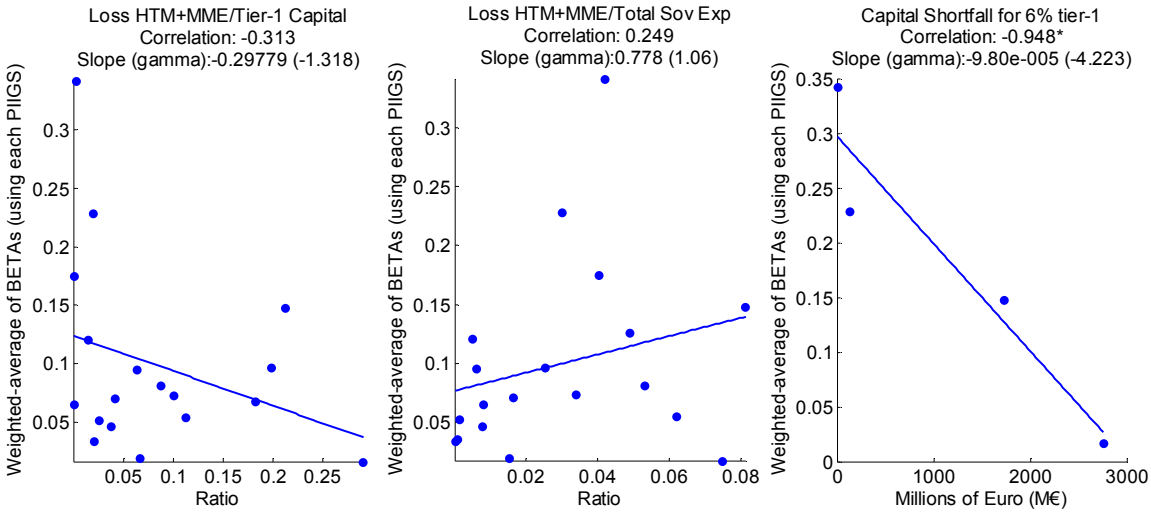
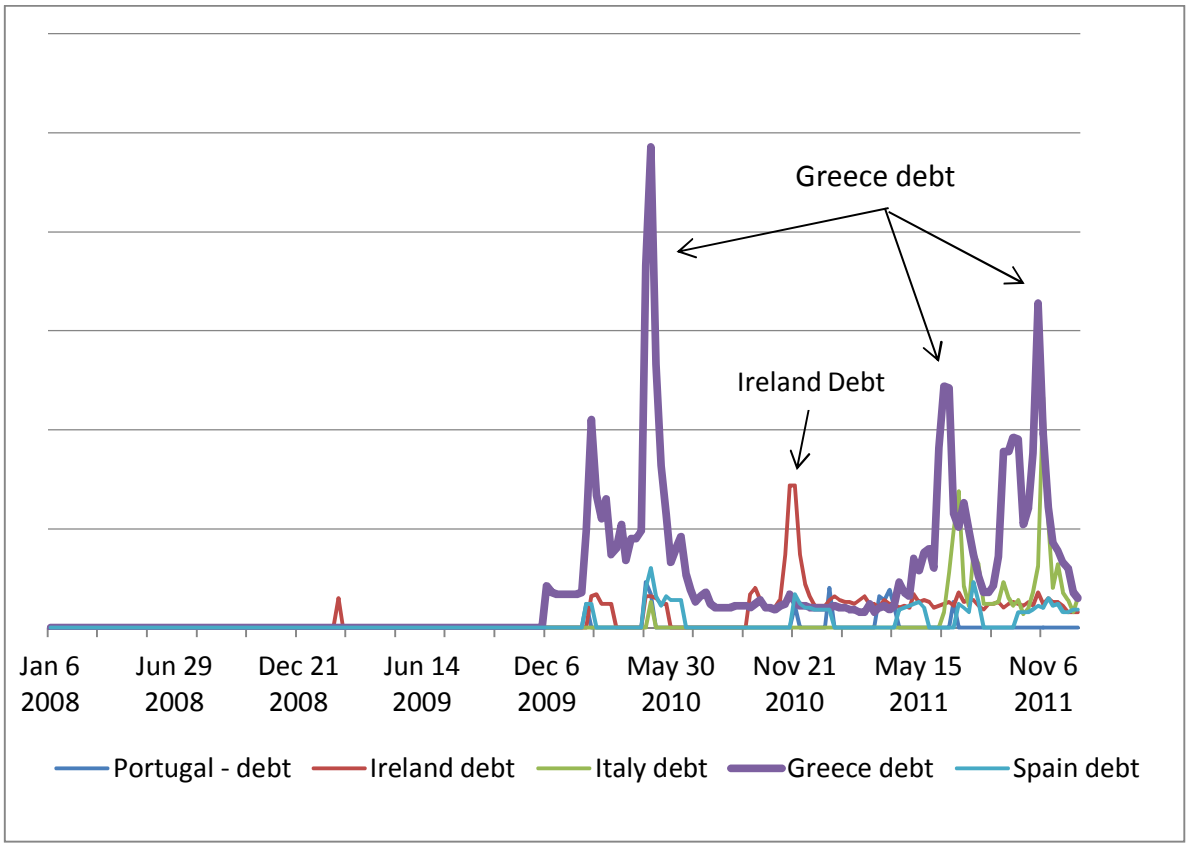


Figure 8 - Relation between potential losses on sovereign exposures and sensitivity to sovereign credit risk (Arbitrary haircuts). This figure shows the evolution of the link between sensitivity to PIIGS credit risk and different measures of potential losses based on arbitrary haircuts. The Y-axis is the weighted average of banks' sensitivity to each PIIGS sovereign credit risk. The weights used are the relative amount of external debt of each of the PIIGS held by banks in our sample: Portugal 5.52%, Ireland 2.31%, Italy 41.93%, Greece 12.05%, Spain 38.19%. The stars next to the correlation coefficient show its significance level, with *, ** and *** meaning significant at the 90%, 95% and 99% confidence level, respectively. The number in parenthesis next to the slope (γ) is the t-statistic.

4.11 Annexes

Annex 1 – Relative importance of each PIIGS throughout the crisis. This graphic shows the relative number of times the tested keywords have been searched on Google's search engine between January 2008 and December 2011. This is used as a proxy of the relative importance of each of the 5 PIIGS's problems during the crisis. Unreported graphics using the words *crisis* and *default* instead of *debt* next to the country name showed similar results. The thickest line represents results for "Greece debt". Source of Data: Google Trends



For more info on Google Trends, see: http://support.google.com/trends/?hl=en-US

5. Article 2 - The impact of sovereign default risk on European banks : An event-study analysis

THE IMPACT OF SOVEREIGN DEFAULT RISK ON EUROPEAN BANKS: AN EVENT-STUDY ANALYSIS

Olivier Brossard

November 2012

Abstract

This paper looks at the impact of sovereign rating downgrades as well as sovereign bailouts on European financial institutions. Using an event study technique, we find that sovereign rating downgrades issued by Standard and Poor's raise banks' credit risk; downgrades issued by other agencies, however, do not, once controlling for market-wide effects. Also, we find that sovereign bailouts have no lasting abnormal effect on banks. Finally, we look at banks' sovereign debt holdings and find that they do not affect their reaction to either type of sovereign events.

5.1 Introduction

The past few years have seen major changes in the way we look at sovereign credit risk. Some major developed countries lost their perceived risk-free status and others, like Greece, dropped even further and are on the brink of default[36]. Understanding the effects of the recent increase in sovereign risk has thus become a very important issue.

As BIS (2011) points out, financial institutions can act as a transmission belt between the health of public finances and the real economy, making its impact on banks a primary concern of an eventual sovereign default. Even though some of the recent papers that looked at the impact of sovereign events did look at the banking sector, most of them focused solely on their impact on governments' own credit risk. The few that did look at those events' impact on the banking sector focused mainly on one specific event, such as Esjing and Lemske (2009), who found a major shift in banks' relation to sovereign credit risk around the first round of bailout announcements, in late 2008. We improve on the actual literature by looking at the effect on banks' credit risk of different sets of key events throughout the sovereign crisis using a standard event study methodology based on Campbell et al. (1997) and an adaptation of Elton et al. (1995)'s bond returns' model. We also look at the impact of different bank characteristics on their sensitivity to these sovereign events using newly available data from the European Banking Authority (EBA)'s stress tests.

Using Credit Default Swap (CDS) data, we look at the impact on banks' credit risk of both sovereign rating news and bailout announcements affecting Portugal, Ireland,

[36] UPDATE: Greece officially defaulted, according to Moody's default definition, on March 9th 2012. For more information, see MOODYS (2012).

Italy, Greece and Spain (commonly known as the PIIGS[37]), from the end of 2009 until the fall of 2011.

Our results indicate that, overall, banks do react to sovereign rating downgrades from Standard and Poor's (S&P), but not to those of the other main rating agencies. We also show that, contrary to popular belief, banks' sovereign debt holdings are not an important determinant of their reaction to sovereign credit rating downgrades. We do find, however, that a bank's size, as proxied by its Risk-Weighted-Assets (RWA), does have an impact on its reaction to sovereign credit rating news from S&P, with bigger banks being more affected than smaller ones. We find the importance of size however to be limited to banks headquartered outside the PIIGS countries (NON-PIIGS banks[38]).

We also look at the impact of sovereign bailout announcements on banks' credit risk, and find that only the biggest NON-PIIGS banks are significantly affected by them, once controlling for market-wide movements. We argue that this is due to the fact that bigger banks tend to have stronger international presence than smaller ones, making them more sensitive to the financial health of their neighbours. Also, the significant impact on those banks' credit risk only last a few days, with their CDS quickly rising back to their pre-bailout level. This hints that the market doesn't believe the bailouts to be sufficient to fix the recipient country's difficulties.

Overall, our results suggest that the fear of direct losses on their sovereign debt holdings is not an important determinant of banks' sensitivity to sovereign credit risk. They do however support that markets fear the indirect effects of a sovereign default, including the possible contagion to other countries. These results contrast with some of the previous studies. We believe these differences in results to be

[37] PIIGS is a popular term in the media referring to Portugal, Ireland, Italy, Greece and Spain. These 5 European countries face particular fiscal problems, and are deemed to be the Euro-members facing the highest risk of default.
[38] Sub-samples of banks explained in the Data section.

caused by banks hedging their sovereign credit risk in a sovereign debt crisis; something they do not necessarily do in *normal* times.

The remainder of our paper is as follows: Section 2 describes the present literature on the subject, Section 3 presents the data used in the paper, Section 4 describes our methodology, Section 5 shows our main results, Section 6 presents our robustness tests, Section 7 gives a brief view of some of the limitations of our paper and section 8 adds concluding remarks.

5.2 Literature review

The academic literature on the interrelation between sovereign states and banks is split into three main groups based on the direction of causality of the relation. The first group, which includes Dieckman and Plank (2010), Esjing and Lemke (2009) and Reinhart and Rogoff (2008) among others, looks at the transmission of banks' credit problems to sovereign governments. The second group, which includes Arzeki et al. (2011), BIS (2011) and Gennaioli et al. (2010) among others, looks at it the other way around, and study the impacts of sovereign credit risk on financial institutions. The last group look at the direction of causality as a dynamic factor, evolving over time. Our paper goes in the second category, looking at the transmission of sovereign credit risk to the banking sector.

5.2.1 From Banks to Sovereign

Reinhart and Rogoff (2008) look at the last 200 years of financial crisis and find that they weaken public finances considerably, with public debt being on average 86% higher three years after a banking crisis compared to its pre-crisis level. Although they do not quantify the impact of bank bailouts on governments, they show that

periods of high banking crisis occurrence tend to be also prone to sovereign debt crisis.

The link between public finances and financial institutions is also studied in Baglioni and Cherubini (2010). They use CDS data from European countries and banks to look at the cost governments would incur if they had to mark-to-market their implicit guarantee of financial institutions and find that implicit liability from potential bank bailouts is huge for peripheral Europe countries like Portugal, Ireland, Greece and Spain. Dieckmann and Plank (2011) come to a similar conclusion about a private-to-public risk transfer when a sovereign bails out its banking system. Their paper also looks at the effects of being in a monetary union, and they find that sovereign credit risk of countries in unions such as the EURO display a higher degree of correlation than countries outside the union. They also point out that member countries are more sensitive than non-members to the health of the financial system as a whole. Our paper attempts to see if this cross-border contagion also exists in the transmission of sovereign credit risk to banks.

Esjing and Lemke (2009) look at the impacts of bank bailouts on both banks and sovereigns early in the crisis (2008-2009). As in the previously mentioned papers, they find a transfer of risk form banks to public finances after a bank bailout, but find it to be only a short term effect, with both banks and sovereign CDS rising in the long run. They argue that these bailouts lead to a structural break in the correlation between banks and sovereign credit risk, and that they raise governments' sensitivity to the probability of future bailouts, proxied by the Non-Financial component of the iTraxx Europe Main 5 years CDS index.

Sensitivity to a common factor is also studied in Sgherri and Zoli (2009). Using a seemingly-unrelated regression, they find that even though global credit risk still explains the majority of the evolution of European 10-years sovereign bonds at the beginning of the crisis, financial markets seemed to be increasingly concerned about

the health of the national banking industry, especially in countries like Greece and Portugal.

5.2.2 From Sovereign to banks

The literature looking at this side of the equation was very sparse before the financial crisis, and the few papers that analysed it focused mainly on emerging markets[39] since sovereign default in advanced economies was considered a thing of the past. In the words of Kamalodin (2010), « industrialised countries seemed to have 'graduated' from periodic bouts of government insolvency given that they did not opt for a default since the end of WWII. » (p.4)[40]. Our paper, along with a growing number of researches, focus on this direction of causality, namely the impact of sovereign credit problems on the banking sector.

BIS (2011) identifies the main transmission channels used to transfer sovereign credit risk to the banking system:

- Direct losses on banks' sovereign debt holdings
- A rise in the haircuts imposed on sovereign bonds to access central banks' liquidity facitilies.
- Drop in value of implicit and explicit state guarantee of banks / Sovereign downgrades often leads to banks rating downgrades[41]

Using 5-years CDS data, they find a rise in the co-movement of banks and sovereign credit risk during the financial crisis. They also explain the role of banks as intermediary between the state of government finances and the real economy.

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[39] Good examples are Barajas et al. (2006) and Perry and Serven (2002) , who analyses the impacts of Argentine's default in 2002.

[40] Based on Kamalodin (2010), the last sovereign defaults from advanced economies were Germany (1939), Austria (1940) and Japan (1942) .

[41] BIS (2011) treats these 2 as two separate channels.

The intermediary role of banks in the transmission of public problems to the economy is also studied in Gennaioli et al (2010). They build a model to test the impact of a public default on private credit, and find that such a default would weaken the balance sheet of banks, ultimately causing a decline in private credit. They argue that even though the contraction of private credit is bigger when banks holds more public debt, a bigger public debt holding by banks also reduces the probability of public default, since the potential impacts of such a default disciplines the government. Borensztein and Panizza (2008) also look at the impact of a sovereign default on its domestic banking system. They found that even though sovereign default often leads to banking crisis, banking crisis, on the other hand, don't seem to be an important cause of sovereign defaults. Using a large sample of international data from 1975 to 2000, they also find that a sovereign default has a very important negative impact on that country's domestic banking system, especially if its banks have large holdings of the defaulted debt. Sandleris (2010) goes even further, arguing that a sovereign default sends such a negative message about the prospects of the economy that it would causes a credit crunch in the real economy, even if domestic banks didn't hold any of its sovereign debt.

Using an international sample, Demirgüç-Kunt and Huizinga (2010) look at the impact of both bank size and government's deficit on banks share prices and CDS spreads. They find that a bank's market-to-book ratio is negatively related to its size and that its CDS spread is negatively related to the size of its home government's deficit. These findings help them argue that « the largest banks have become too big to save » (Demirgüç-Kunt and Huizinga (2010), p.3). Whereas the previously mentioned papers mostly looked at the general relation between banks and their sovereign, Arzeki et al. (2011) focus on specific sovereign events, and their impacts on financial institutions. Using an event study technique, they look at the impact of sovereign credit rating downgrades on banks and find their effects to be significant, and that their magnitude depends on the type of announcement, the country being downgraded and the rating agency issuing the downgrade.

5.2.3 Causality as a two-way street

Alessondri and Haldane (2001) look at the evolution of the link between banks and their sovereign governments. Looking as far as the 13th century, they find that sovereign default is the single most important cause of bank failures, and describe the direction of causality between banks and states as a « pendulum », with specific turning points in history. They argue that prior to the 1930s the direction of causality was mostly from sovereign to banks as they were financing wars, and the defeated countries often defaulted on war-loans. Since the Great Depression, States became lenders of last resort for banks, reversing the direction of causality. They also argue that a new reversal is taking place with the European sovereign crisis. Alter and Schüler (2011) come to a similar conclusion by studying the relationship between default risk of European states and banks' credit risk. Looking at the effects of government's bank bailout schemes, they find that before the bailouts, the direction of causality was mostly from banks to sovereign. After the bailouts, they find that causality reversed, and banks are now sensitive to sovereign credit risk, with banks receiving the biggest state help being the most sensitive to sovereign problems. While they look at bank bailouts, our paper instead focuses on sovereign rating news and sovereign bailouts.

Acharya et al. (2011) build a model to analyse the impacts of a government's decision to bail out its banking sector. They argue that governments can finance those bailouts by emitting new debt, therefore diluting existing bondholders and raising sovereign credit risk. This rise in sovereign risk then feeds back to the banking sector by reducing the value of their sovereign bonds as well as lowering the value of the government implicit or explicit guarantee of its banking sector. They also point out that this new debt must sooner or later be reimbursed through higher taxation, leading to under-investment problems in the economy. They test this two-way feedback using European banks CDS during the financial crisis and find that a

bank bailout transfer risk from the private sector to its government in the short term, but in the long run it causes both banks and sovereign risk to rise.

Kallestrup el al. (2012) also look at the relation between banks and their sovereign as a two-way street. They put together data on foreign public and private sector exposures of banks with CDS data to construct risk-weighted measures of banks cross-country exposures. They find these cross-border exposures to be highly significant in explaining banks CDS behavior. To look at the reciprocal effect from banks to sovereigns, they build a measure of the size of the implicit and explicit government guarantees of their banking sector, and find it to be significant in explaining the dynamics of sovereign credit risk.

These last few papers clearly show that the fate of banks and their sovereign are interrelated, with both actors impacting each other through various channels; a regression to analyse their impact on each other would therefore suffer from an endogeneity problem. To overcome this problem we suggest an analysis of the impact of exogenous events using an event study technique, to concentrate on one direction of causality, namely the impact of changes in sovereign credit risk on financial institutions.

5.3 Data

Following Jorion and Zhang (2006), Baglioni and Cherubini (2010) and Demirguc-Kunt and Huizinga (2010), we take 5-year CDS premia for both Sovereign and banks CDS as they are the most liquid and they constitute the majority of the CDS market. We start with the entire collection of European banks[42] daily CDS spread available on Bloomberg for the period ranging from January 1st 2008 to September 21th 2011, dropping data where the BID-ASK spread is wider than 15%, giving us 58,065 daily

[42] CDS data is available on Bloomberg for 64 European banks.

banks observations. We also take PIIGS's daily sovereign CDS observatioins over the same period on Bloomberg, dropping those with BID-ASK spread wider than 15% which leaves us with 4,508 daily observations. Daily values for the iTraxx Europe Main 5 years CDS Index (iTraxx Main) are also taken from Bloomberg, for a total of 941 observations.

From these CDS observations, we compute the log-difference of CDS spread between 2 business days, and drop the results when no data was available to compute a return in the 3 days prior to the observation. We use the log-difference of CDS spreads instead of the change in level because we deal with a wide variety of CDS levels, ranging from a few basis points (bps) to more than 1,000 bps, and using the average change in levels would greatly overweight the riskiest banks compared to safer ones. The reader should note that although we call it a *CDS return* throughout the paper this measure is not equal to the rate of return achieved by holding a position in the CDS contract. We end up with a total of 50,956 daily banks CDS returns, 4,480 daily sovereign CDS returns and 922 iTraxx Main CDS returns.

Our bank-level data on sovereign exposures come from the European Banking Authority (EBA)'s 2011 Stress Test results[43] and cover 90 European banks (around 70% of the European banking market). These Stress tests were published on July 15th 2011, but the information they include is accurate as of December 31th 2010.

We drop from our sample banks for which we have CDS information but that did not take part in EBA's stress test, which leaves us with our final sample of 39 banks. This sample should include all the bigger, more important banks, leaving aside smaller, less systemically important ones. The name of these banks as well as some of their characteristics can be found in Table 1 and 2.

<Table 1 and 2 go about here>

[43] Complete 2011 stress-tests results available on EBA's website at http://www.eba.europa.eu/EU-wide-stress-testing/2011/2011-EU-wide-stress-test-results.aspx

Throughout this paper, we refer to sub-samples of banks using the following terminology:

- PIIGS-based banks: Portuguese, Irish, Italian, Greek and Spanish banks, as stated in EBA's stress test results.
- NON-PIIGS banks: Every banks in our sample that cannot be considered a "PIIGS-based banks" as per the previous definition.

5.3.1 Events used

We focus on 2 main types of events, namely credit rating news by one of the three major rating agencies: Standard & Poor's, Moody's and Fitch as well as sovereign bailout announcements. We choose to restrict our study to these events since they are both directly related to sovereign credit risk and because the sign of their impact on sovereign credit risk is intuitively clear.

To make our list of events, we start by looking at major sovereign events from both of our categories between January 2009 and the end of 2011, which gives us 44 events[44]. A few of these events are only a few days or less apart, which would make it hard to separate the impacts of each individual events. To go around this problem, when we see events of the same category spaced less than 4 days apart, we keep the first one and discard all subsequent events in that 4 days window. We apply the same methodology for events from different categories spaced less than 4 days apart but instead of keeping the first one and discarding the rest, we give priority to the positive event (bailout announcements), discarding the others. This only happens once in March 2009.

This brings us down to our final list of 34 events. We separate these events in 2 groups based on their potential impact on the banking sector. Following BIS (2011),

[44] Complete list of events used is available in Annex 1.

sovereign rating downgrades should negatively affect banks since it can cause direct losses on their debt holdings and diminish their value as collateral to access ECB's liquidity. Sovereign bailouts on the other hand are treated as positive events for banks since they lower the possibility of default by the bailed-out entity, potentially increasing both its bonds' value as well as their collateral value for banks, improving their financial position and therefore lowering their default risk.

5.4 Methodology

Our goal in this paper is to look at the effect of events affecting sovereign credit risk on banks' own credit risk. We use sovereign credit rating downgrades to look at the impact on banks of negative sovereign events, and sovereign bailouts by either other countries or supranational agencies to study the impacts of positive sovereign events on them. Looking at exogenous events should help us measure the impact of changes in sovereign default risk on banks, without the endogeneity problems that would come with the use of standard regression techniques.

5.4.1 Overview of the method used

We use a standard event study method, as described in Campbell et al. (1997) and Craig MacKinlay (1997), to look at the effects of key sovereign events on European banks' credit risk. This method consists in looking at the abnormal returns of a security during a given period of time (event window) around specific events. The abnormal returns *AR* are given by:

$$AR_{it} = R_{it} - E(R_{it} | X_t) \quad (1)$$

Where R_{it} is bank *i*'s observed CDS return during period t and $E(R_{it} | X_t)$ is the expected return had the event studied not taken place during that period (normal

return). X_t can be, amongst other options, a constant return (*constant mean return model*) or the market return (*market model*[45]). If the studied events don't have a significant impact on the securities tested, we should see that:

$$AR_{it} \sim N(0, \sigma^2(AR_{it})) \quad (2)$$

Equation (2) is our null hypothesis (H_0), whereas H_1 is that the relation above does not hold.

5.4.2 Detailed methodology

We look at banks 5-year daily CDS returns over a 10-days window [-5, 5], where the studied event happens at time 0. The choice of CDS instead of bonds to measure the evolution of credit risk is motivated by Berndt and Obreja (2009) and Demirgüc-Kunt and Huizinga (2010) who argue that even though they can both be valid proxies of default risk, bond spreads integrate a bigger liquidity component than CDS, which could affect our results. CDS contracts are also easy to compare since they are standardized contracts. As in Afonso and al. (2011), we use a relatively short event window (10 days) to minimize contamination from other events that could have affected banks CDS returns but, while they chose only a 2 days window, we prefer going with a 10 days window to make sure we see the whole impact of the events. Our window is centered on the events to see whether or not they were anticipated by the market, as well as if there was a lag between the event announcements and the impacts on banks. The estimation window is the 120 days starting 10 days before our event window to reduce contamination risks [-135,-15]. The choice of estimation window comes from Campbell et al. (1997), who mention 120 days as a good estimation window using daily data. The choice of buffer length is arbitrary.

[45] Assumes a linear relation between the R_{it} and X_t

Since these choices could affect our final results, we test alternative specifications in our Robustness Tests section.

To compute our normal returns, we propose to use a restricted form of a model developed by Elton et al. (1995). This version of their model, which they call « index-1 » is as follow:

$$R_{Bond_t} - Rf_t = \alpha + \beta * R_{BondMkt_t} + \varepsilon_t \quad (3)$$

Where R_{Bond_t} is the tested bond's return at time t, Rf_t is the risk-free rate at time t and $R_{BondMkt_t}$ is a proxy of the general bond market's return at time t.

Based on Hull et al. (2004)'s observation, holding a long position in a bond as well as a purchasing a corresponding CDS is very similar to holding a risk-free bond, therefore:

$$R_{Bond_t} - CDS_t \cong Rf_t \quad (4)$$

Where CDS_t is the spread of a 5-year CDS at time t. Substituting Equation 4 in Equation 3 gives us:

$$CDS_t = \alpha + \beta * (CDSMkt_t + Rf_t) + \varepsilon_t \quad (5)$$

Where $CDSMkt_t$ is a proxy of the general CDS market's spread at time t.

Most of the recent literature uses the rate of German bunds as their proxy for the European risk-free rate. During the recent crisis, however, the whole concept of sovereign debt being risk-free was put into question. Fear of a collapse of the Euro, the austerity plans as well as the growing possibility of a prolonged recession in Europe meant that even Germany began having trouble to find buyers for its

sovereign debt[46]. Even considering these added risks, however, German bunds have been hovering at record low rates since the beginning of the crisis. For these reasons, we choose to set the risk-free rate at 0. This gives us our final model, which is very similar to Campbell et al. (1997)'s market model.

The reader should note that the unrestricted form of Elton et al. (1995)'s model uses 5 other factors on top of general bond market risk, including a countries' gross domestic product, general stock market's returns as well as unexpected changes in the country's consumer price index. This being said, when they used all 6 factors, general bond market returns alone still explained almost 72% of their tested bonds' returns. Also, as Campbell and al. (1997) noted, this simple (market) model provides good results, and they find limited gains from using more elaborate, multifactor models.

We modify Equation 5 to use our CDS returns instead of CDS spreads, and run the following OLS regression for each event *e* and each bank *i*:

$$\begin{aligned} R_{i,t} &= \alpha_{i,e} + \beta_{i,e} * X_t + \varepsilon_{i,t,e} \\ E\left[\varepsilon_{i,t,e}\right] = 0 \qquad & Var\left[\varepsilon_{i,t,e}\right] = \sigma_{i,e}^2 \end{aligned} \tag{6}$$

Where $R_{i,t}$ is bank *i's* observed CDS return at time *t* and X_t is the iTraxx Europe Main 5 years index return at time *t*. We choose this CDS index as our market proxy since, as argued in Berndt and Obreja (2009), it is the most widely traded and liquid CDS index. Aslo, Esjing and Lemke (2009) find that the non-financial component of this CDS index explains the majority of the variation in corporate CDS spreads early in the crisis. Our use of the market model requires us to make the hypothesis that there is a linear relationship between banks' CDS changes and the iTraxx Main changes. Such hypothesis is also implied in Kallestrup et al. (2012), who use various domestic and global variables (including both the financial and non-financial

[46] On November 23rd 2011, Germany could only sell 3.9 Billion out of the 6 Billions Euros worth of debt on offer

components of the iTraxx Main index) in an OLS regression to explain variations in CDS spreads.

The constants $\alpha_{i,e}$ and $\beta_{i,e}$ obtained here are then used to calculate the normal returns $E(R_{i,t}|\, X_t)$ during the event window using:

$$E(R_{i,t}|\, X_t) = \hat{\alpha}_i + \hat{\beta}_i * X_t \qquad (7)$$

By using the observed banks CDS returns as well as the normal banks CDS returns calculated in Equation (7), and using them in Equation (1), we are able to calculate the abnormal return of bank *i* at time *t* ($AR_{i,t}$).

$$AR_{i,t} = R_{i,t} - E(R_{i,t}|\, X_t) \qquad (8)$$

These abnormal returns are then aggregated through time across the event window for each banks *i* using:

$$CAR_{i,t} = \sum_{t=-5}^{5} AR_{i,t} \qquad (9)$$

These Cumulative Abnormal Returns $CAR_{i,t}$ are then aggregated cross-sectionally across banks using:

$$\overline{CAR_t} = \frac{1}{N}\sum_{i=1}^{N} CAR_{i,t} \quad where \quad -5 \leq t \leq 5 \qquad (10)$$

Finally, by running a regular T-test, we should be able to see whether or not the banks in our sample were abnormally affected by sovereign events, after controlling for market-wide movements. We calculate the mean and variance to be used in our T-test using:

$$\overline{CAR_i} = \frac{1}{N}\sum_{i=1}^{N} CAR_{i,t} \quad (11)$$

$$\sigma^2(\overline{CAR_i}) = \frac{1}{N^2}\sum_{i=1}^{N}(CAR_{i,t} - \overline{CAR}_t)^2 \quad (12)$$

Using this method, we should be able to get a clear idea of the market's reaction to different sovereign event types on the credit risk of banks. By ranking banks' results from Equation 9 in quartiles based on different bank-level data, we should be able see what make a bank more sensitive to the type of event studied.

5.5 Results

Figure 1 shows the evolution of banks' CDS spreads compared to the evolution of both the iTraxx Main and the Euro STOXX 50[47].

<Figure 1 goes about here>

One of the first things we see in this figure is that banks' credit risk is much more volatile than the general market's. Looking closer at banks' CDS spreads, we see that they rose at the beginning of the crisis up until the spring of 2009, which coincides with the time the Euro STOXX 50 index bottomed out[48]. Banks' credit risk then started to drop as everyone though the worst was over and the world economy would finally get back on track; only to rise again around the beginning of 2010 when the credit crisis started to evolve in a sovereign debt crisis shortly after Greece unveiled its fiscal problems. We also see in this figure that banks CDS spread spikes up from time to time; however, they usually drop back to their pre-spike level shortly after, hinting that they are strongly affected by some key events, but that those effects are short-lived. Comparing the evolution of banks CDS and the iTraxx

[47] The Euro STOXX 50 is a stock index comprised of 50 blue-chips from 12 Eurozone countries.
[48] The Euro STOXX 50 is widely used in finance as a proxy for the overall Eurozone stock market. It hit a low of 1765.49 in March 2009, a level it had not seen since December 1996.

Main in this figure leads us to two main observations: First, we see that these short term spikes in banks' credit risk are often accompanied by an inverse response in the iTraxx Main index, hinting at an inverse reaction from banks and the general economy to some key events. Second, we see an overall upward trend from both series, pointing toward either a generalised rise in credit risk in Europe since the beginning of the financial crisis or to a re-pricing of the credit risk by the market.

Now that we looked at the evolution of banks and the iTraxx Main CDS spread over our sample period, we move on to the event study itself, to see whether or not sovereign events significantly affected banks' credit risk.

5.5.1 Negative sovereign events

Figure 2 compares the average cumulative observed returns to the average cumulative abnormal returns (CAR) of banks surrounding sovereign rating downgrades by one of the three main credit rating agencies.

<Figure 2 goes about here>

The upper portion of this figure shows the average cumulative observed CDS returns around our tested events. It shows a significant 1.53% average cumulative CDS returns over the event window, with a peak at 2.54% two days after the downgrades. The lower portion of this figure shows the average cumulative abnormal returns of banks CDS, controlling for market-wide movements in credit risk using the iTraxx Main index as our market proxy. Controlling for economy-wide movements gives us an average CAR for banks CDS of 0.90% over the event window, with a peak of 1.38% after 4 days.

This statistically significant CAR shows that banks, on average, are more affected than the aggregate market by a drop in sovereign creditworthiness.

5.5.1.1 Banks ranked according to certain key characteristics

Figure 3 to 5, are done in the same way as figure 2, but instead of showing the average of all 39 banks in our sample, we rank them in quartiles using different bank-level data. Banks from the first quartile are those with the lowest amount of the tested data while banks from the 4th are those with the highest. Since we are using 39 banks, the first 3 quartiles are comprised of 10 banks each and the 4th quartile is comprised of 9 banks. For simplification, we only show the average CAR of banks from 1st and 4th quartile, to see if the characteristic used for ranking banks has an effect on their response to sovereign rating downgrades.

Figure 3a ranks banks using their aggregated PIIGS sovereign debt exposure relative to their Tier-1 capital[49]. This ratio, which was also used in BIS (2011), is a measure of the impact of a potential default by one of the PIIGS on a bank's financial stability. Banks with a very low ratio should not see their stability threatened by direct losses following a PIIGS debt write-down. Banks from the 4th quartile, on the other hand, should see a much stronger impact.

<Figure 3a goes about here>

Looking at the top graphic, we see a 3.83% cumulative observed CDS returns for banks of the 4th quartile, which is more than triples the peak cumulative return of 1.27% we see in banks with the lowest relative PIIGS debt exposure. The bottom part of this figure shows banks' average CAR, ranking banks using the same metric. We see a significant positive CAR of 2.12% after four days followed by a slightly lower CAR of 1.66% by the end of the event window for banks with the highest

[49] Tier-1 capital is the core capital used by banks to support their operations. It is mostly comprised of equity and retained earnings and is used by regulatory authorities to verify the financial health of a bank. A complete definition of Tier-1 capital is available at www.BIS.org

relative PIIGS exposure. Banks with the lowest exposure, on the other hand, show no significant abnormal effect over the event window.

Since most banks invest a large portion of their total sovereign exposure in their own country's debt[50], it's no surprise that all banks forming the 4th quartile of this graphic (highest exposure) are based in one of the PIIGS (mostly Italian and Spanish banks). Considering that PIIGS-based banks hold a median of 210% of their Tier-1 capital in PIIGS sovereign debt, compared to a median of only 18% for NON-PIIGS banks, they could react very differently to sovereign rating news. To see their respective reaction, we re-do the bottom graphic of Figure 3a separating PIIGS-based and NON-PIIGS-based banks. The results are available in Figure 3b.

<Figure 3b goes about here>

The top graphics show similar results for NON-PIIGS banks of both quartiles, with last day CAR of 1.25% and 0.32% for banks with the lowest and highest exposure, respectively. Only the average CAR of banks with the lowest exposure, however, is statistically significant. Although the average CAR of banks of the 4th quartile is not statistically significant, the very large confidence intervals observed in this graphic is a sign that banks from this quartile have very different reactions to our tested events. Individual graphics of CAR for each bank from this quartile are found in Annex 2. What caused them to have different reactions to sovereign downgrades, however, is outside the scope of this paper.

The bottom graphics of Figure 3b, using only PIIGS-based banks, shows similar results, with a significant 1.73% last day CAR for banks of this sub-sample with the lowest relative exposure to PIIGS debt, and a non-significant -0.53% last day CAR for banks with the highest exposure. Similar to our results of the previous sub-sample, we get a wide confidence interval in our results for PIIGS-based banks of the 4th quartile, hinting that some of them do react to sovereign rating downgrades, albeit

[50] See BIS (2011) or EBA's Stress Test 2011 for domestic sovereign debt holding by European banks.

not because of their sovereign exposures. Individual graphics of CAR for each bank from this quartile are found in Annex 2.

Overall, this figure shows that banks with the highest PIIGS debt exposure, as a percentage of their Tier-1 capital, are not significantly more affected by sovereign rating news than banks with lower PIIGS-debt exposure.

Figure 4a and 4b also rank banks based on their relative PIIGS-debt exposure, but this time it's as a proportion of their total sovereign exposure. This measures the importance of PIIGS's debt in each banks' global sovereign debt portfolio. This ratio is important since banks usually use their sovereign debt holdings as collateral to access central banks' liquidity, as shown in BIS (2011). Considering the ECB applies a haircut to sovereign debt given as collateral by banks based on the creditworthiness of the issuer, banks holding a higher proportion of PIIGS debt, as a percentage of their total sovereign debt portfolio, could see an important reduction in their access to central bank's funds following a PIIGS rating downgrade. This ratio should therefore help us see if the reduction of access to central bank's liquidity has an impact on banks' reaction to sovereign credit rating downgrades.

<Figure 4a goes about here>

Looking at the average banks' observed CDS returns (upper graphics), we see a much stronger reaction to sovereign downgrades from banks with the highest relative PIIGS exposure, with a peak of 3.53% 2 days after the downgrades, compared to a peak of 1.20% at the same time for least exposed banks. Controlling for market-wide movements, we see a significant CAR of 1.59% for the most exposed banks, and a non-significant 0.4% from the least exposed ones.

This seems to point toward PIIGS debt exposure, as a percentage of banks' total sovereign exposure, having a significant impact on banks' reaction to sovereign downgrades. Considering however that every bank in the 4^{th} quartile (most exposed) are PIIGS-based institutions, and that each banks of the 1^{st} quartile are

NON-PIIGS ones, the impact seen here could be due to something else than banks' relative PIIGS-debt exposure.

To get a better view of the impact of this ratio on banks' reaction to sovereign credit downgrades, we separate banks in sub-samples based on the location of their headquarters. Results are available in figure 4b.

<Figure 4b goes about here>

Results from this figure are very similar to what we got in figure 3b, which is not surprising considering both figures rank banks based on their relative PIIGS exposure. We do get some differences, however, with *only* 50% of 4th quartile NON-PIIGS banks and 66% of 4th quartile PIIGS-based banks from figure 3b being also in the 4th quartile in this figure. The only statistically significant result in this figure is from the least exposed NON-PIIGS banks, with a positive average CAR of 1.61% 5 days after the downgrades.

Taken together, the results from Figures 3a, 3b, 4a and 4b show that banks with higher relative PIIGS debt holdings from both of our sub-samples do not have significantly stronger reactions to sovereign credit downgrades than the least exposed banks. Looking at our sub-sample of NON-PIIGS banks, this could be caused by banks hedging their sovereign debt exposure. In contrast, the same explanation cannot hold for PIIGS-based banks since it would be economically impossible for them to hedge their PIIGS exposure considering the sheer size of those exposures.

In PIIGS-based banks, domestic exposure represents a median of 81.6% of their PIIGS debt exposure. This means that even the least exposed of those banks are strongly exposed to PIIGS debt. Also, 56.3% of our PIIGS-based banks are Italian or Spanish banks while only 11.1% of our downgrades are for these countries[51].

[51] All are Spain downgrades.

Therefore, we believe our results using relative PIIGS debt for this sub-sample to be affected by the inadequacy of the measure itself when applied to PIIGS-based banks.

We turn our attention to banks' size. Considering that bigger banks usually have a larger share of their operations in foreign countries than smaller ones, they could be more affected than smaller banks by the fate of their neighbors.

Figure 5a and 5b look at the impact of bank sizes, as proxied by their risk-weighted assets (RWA)[52].

<Figure 5a goes about here>

Looking at the upper portion of the figure shows a relatively strong initial reaction from banks of both quartiles, with observed CDS returns peaking at 3.40% and 2.89% after two days for banks of the smallest and biggest banks, respectively.

Looking at the bottom portion of the figure, we see that both the smallest and biggest banks show a statistically significant reaction to sovereign credit rating news. There are, however, clear differences between the results of each quartile. The 1st quartile graphic shows that the average abnormal reaction of smaller banks rises steadily from 0 to 1.53% in the first 7 days of the window, which is consistent with a gradual increase in credit risk as opposed to a reaction to a specific event. Bigger banks, on the other hand, show a sudden CAR increase around the event dates, with a peak of 2.62% four days after the events, and an end-of-window CAR of 1.79%.

This figure is also characterised by large confidence intervals in the 1st quartile, hinting that these banks have diverse reactions to sovereign rating downgrades. Out of the 10 banks of the 1st quartile, 7 are based in one of the PIIGS countries. The effect seen here is therefore probably not due to bank size, but simply due to PIIGS-based banks, which are mostly smaller than NON-PIIGS ones, being more

[52] Risk-weighted-assets is a measure of a bank's assets weighted by their relative risk. It is used by regulatory authorities and banks to calculate various capital adequacy ratios.

sensitive to the fate of the PIIGS than other banks. In Figure 5b, we re-do these graphics looking at the CAR of NON-PIIGS banks and PIIGS-based banks separately.

<Figure 5b goes about here>

We see a significant last day CAR of 1.89% for larger NON-PIIGS banks, with a peak at 2.64% after 2 days, compared to a significant[53] 1.13% last day CAR and a peak of 1.44%, after 4 days, for smaller ones. In the bottom graphics, PIIGS-based banks show no significant CAR for both quartiles.

This figure shows that the largest banks are not significantly more affected by sovereign rating downgrades than their smaller counterparts, after controlling for economy-wide effects.

5.5.1.2 Events separated by rating agency

Figure 6 and 7 focuses on the different rating agencies, to see if banks react in a similar way to rating changes from all 3 major agencies (Standard & Poors (S&P), Fitch and Moody's).

<Figure 6 goes about here>

Figure 6 shows the average CDS spread of banks in our sample as well as the iTraxx Main Index around sovereign credit rating downgrades, separated by rating agency. The short term effect of a downgrade is very similar across agencies. The 3 upper graphics show a clear rise in banks CDS spread immediately after a downgrade is issued by each rating agency; the long terms effects of these downgrades, however, are very different depending on the issuing agency. Looking at the bottom 3 graphics, we see that banks CDS are still above their pre-sovereign downgrade level 50 days after a downgrade by S&P. Looking at Fitch's results we see a bump in

[53] The lower bound of the confidence interval is 0.02%

banks CDS levels in the days around the downgrades, but no lasting change in the overall trend of banks' credit risk. This is compatible with Arzeki et al. (2011), who found that Fitch sovereign rating changes did not spillover on financial institutions. Moody's long term result shows that banks CDS are still above their pre-downgrade level 50 days after a downgrade, but that doesn't seem caused by the downgrades themselves since banks CDS merely seem to follow an upward trend over the entire 100-days window.

Another interesting result shown in this figure is the relationship between the iTraxx Main index and banks CDS around sovereign rating downgrades. Similar to what we saw in figure 1, we see an inverse relationship between them in the short term paired with a positive trend for both of them in the long run. This short term inverse relationship is compatible with Demirgüç-Kunt and Huizinga (2010), who argue that a country with weaker public finances can spend less money on bank bailout and Acharya et al. (2011) who claim that new sovereign debt issued to bail out banks must ultimately be repaid through higher taxes on all firms.

The short term drop in the iTraxx could therefore be caused by a perceived drop in the ability of the government to bail out its banking sector following the rating downgrades, reducing at the same time the chances of a tax hike for all firms. A test of this hypothesis, however, is beyond the scope of this paper.

<Figure 7 goes about here>

Figure 7 shows the cumulative abnormal returns of banks CDS around downgrades, separated by rating agencies. S&P sovereign rating downgrades trigger the most important response by banks CDS, with a significant average CAR of 3.74% 5 days after the events. Fitch downgrades, on the other hand, cause no abnormal reaction from banks in the 3 days following the events. We do see a significant CAR of -1.85% by the end of the event window, but considering the number of days it takes after the downgrades to get a significant results as well as the important clustering of events during our period, this result is probably caused by something else than

Fitch's downgrades. As for Moody's downgrades, we get no significant CAR from banks in our sample.

Overall, we show that sovereign rating downgrades don't abnormally affect banks, after controlling for market-wide movements. One exception is S&P's sovereign rating news, which does lead to an abnormal response in banks' credit risk. The fact that S&P's rating news are the only one to cause a significant CAR for banks CDS is surprising, since S&P's rating announcements do not seem any different than those of the other 2 agencies, as they are not always the first (or last) to issue a downgrade. The absence of significant CAR from Fitch's downgrades is compatible with Norden and Weber (2004) and Arzeki et al. (2011), and could be due to the fact that Fitch is much smaller than the other two agencies, with around 15% of the market, compared to a combined market shares of 80% for the other 2 agencies[54]. As for Moody's, the overall upward trend in banks CDS spreads seen around their downgrades could be affecting our results.

5.5.2 Positive events

Figure 8 to 11 are similar to Figure 2 to 5, but this time using sovereign bailout news instead of sovereign credit rating downgrades. Since sovereign rating changes are decided unilaterally by private corporations (the rating agencies), there is always the possibility that information about a possible future downgrade could leak a few days prior to the actual rating announcements. Sovereign bailouts, on the other hand, are usually decided behind closed doors in scheduled meetings by officials from various governments and supra-national agencies. These meetings are usually followed fairly quickly by a press conference announcing the results of the discussions. Although the market can guess at the results of these meetings before

[54] See Economist (2007)

hearing the actual press conferences, it is unlikely that actual bailout information would leak in the days before their official announcements. Because of this, we look at both the impact of the announcement itself in this section (t=0 to t=5) and the impact over the entire 10 days window (t=-5 to t=5). A dotted line is included in the graphics of this section to show the level of the average CAR the day of the bailout announcements.

Figure 8 shows the average observed banks CDS return and the average banks CAR around sovereign bailout dates.

<Figure 8 goes about here>

Looking at both graphics, we see a strong rise in banks' credit risk in the days before the bailout. This could be due to one of two things. First, banks could be affected by the worsening economic conditions that led to the actual bailouts. Second, they could be reacting to news leakage about the bailouts. As previously mentioned, however, this explanation is less likely than the first one.

After the announcements themselves, banks' average CAR declines by 1.6% over 2 days, before climbing back to their pre-bailout level by the end of the event window.

The market's reaction to the bailouts therefore hints that it does not believe the announced bailout to be sufficient to fix the affected country's problem. It also shows that whatever impact the sovereign bailouts could have on banks was already mostly priced in banks CDS before the announcements. This limited response to sovereign bailouts by banks is odd since saving their own banks was one of the main motivations of foreign countries for participating in the bailout of their neighbors.

The rest of this subsection looks at the impacts of different bank-level data on their reaction to sovereign bailouts.

5.5.2.1 Banks ranked based on certain key characteristics

Figure 9 and 10 are similar to Figure 3 and 4, but using sovereign bailouts as our events. Banks are ranked based on their relative PIIGS debt exposure.

<Figure 9 and 10 goes about here>

Figure 9 ranks banks based on their PIIGS debt exposure as a percentage of their Tier-1 capital. The top portion shows very strong cumulative observed returns by the most PIIGS-exposed banks over the entire window. The reaction to the announcements themselves, however, is not statistically significant. Looking at the bottom part of the figure, we see no abnormal reaction from banks with the lowest relative PIIGS exposure. As for the most exposed banks, their average CAR declines by 2.23% over 2 days, before rising back to their pre-bailout level by the end of the window.

Figure 10, on the other hand, ranks banks based on their PIIGS debt exposure as a percentage of their total sovereign exposure. Looking at this figure, we see that banks from both quartiles show no significant CAR in reaction to the sovereign bailouts.

Both figures are very similar, showing no significant abnormal effect from sovereign bailouts announcements on banks of any quartile. This shows that banks' holdings of sovereign debt don't affect their reaction to sovereign bailouts. Re-doing these graphics separating PIIGS-based and NON-PIIGS banks would show similar results (unreported).

The next figures, 11a and 11b, rank banks based on their size, as proxied by their RWA.

<Figure 11a goes about here>

Looking at the top portion of this figure we see that banks CDS of both quartiles have similar cumulative observed returns, with a sharp decline around the bailout announcements quickly followed by an increase in observed returns.

Controlling for market-wide movements, we see that the behavior of banks from both quartiles is very similar prior to the events themselves. Bigger banks, however, show a sharper decline in CAR following bailout announcements, with a significant 2.93% drop for banks of the 4th quartile two days after the events compared to a 1.91% drop for smaller banks. Looking at the whole post-events window, however, we see that banks of both quartiles show no significant abnormal reaction to the bailouts.

The next figure separates NON-PIIGS-based banks from PIIGS-based ones.

<Figure 11b goes about here>

Looking at the upper graphics, we see that only the biggest NON-PIIGS based banks have a significant reaction to the downgrades, with a short term decline of 3.67% in these banks' average CAR. This decline, however, only last a few days, with those banks' average CAR going back to their pre-bailout level 10 days after the events[55]. This short-lived effect on banks' credit risk is probably due to the fact that the reduction in the credit risk of the bailed out country is achieved at the expense of a rise in its rescuers' sovereign credit risk. This rise in the rescuers' sovereign credit risk is then transmitted to their domestic banks through the channels identified in BIS (2011). Foreign banks can also suffer from this since while they can easily hedge a rise in the credit risk of a few select countries, it would not be economical for them to cover themselves against a generalized rise in Eurozone sovereign credit risk[56].

[55] Annex 3 contains the NON-PIIGS banks' portion of figure 11b, re-done using a ±20 days event window

[56] Most of the bailout money pledged by the ECB, the European Union (EU) and the International Monetary Fund (IMF) comes from the Eurozone members.

Smaller NON-PIIGS based banks as well as both subsets of PIIGS-based banks in this figure show no significant abnormal reaction to sovereign bailouts.

Overall, we see that most banks benefited from sovereign bailouts, but only the biggest NON-PIIGS banks saw their credit risk abnormally lowered by those events once controlling for market-wide movements. The short term effects of the bailouts are similar in most figures, with a significant abnormal reduction in NON-PIIGS banks credit risk in the two days following the announcements. This decline in credit risk, however, only last a few days, and quickly rises back to its pre-bailout level. Also, their holdings of PIIGS debt don't seem to be an important factor in these banks' reaction to sovereign bailouts.

5.6 Robustness Tests

Table 3 and 4 contain alternative specifications to test the robustness of our results to parameter changes. We first look at the robustness of our results using sovereign credit rating downgrades and then using sovereign bailout announcements. We finish by looking at the impact on our results of using only S&P's rating announcements.

5.6.1 Negative sovereign events

Table 3 sums up the results obtained varying the length of the buffer zone, the estimation window and the market proxy[57] in our event study.

<Table 3 goes about here>

[57] One important fact to note is that the alternate market proxies, the ITraxx Europe Financial Index 5 years (ITraxx Financial) and the ITraxx Europe Non-financials 5 years (ITraxx Non-Financial), are both components of the ITraxx Main Europe 5 years Index (ITraxx Main).

This table shows that, using the iTraxx Main as our market proxy, our results are robust to a change in buffer length as well as a change in the length of the estimation window, both in terms of magnitude and significance levels.

We also look at the impact of varying the market proxy. Using the iTraxx Europe 5 years non-financial CDS sub-index (iTraxx Non-Financial), as in Esjing and Lemke (2009), instead of the iTraxx Main index as our market proxy, we get different significance levels and a lower magnitude.

The use of the iTraxx Europe 5 years Financial CDS sub-index[58] (iTraxx Financial) as a market proxy also gives us different significance levels in our results, as well as a smaller magnitude, when compared to our main results. Since the iTraxx Financial is comprised of various financial institutions including banks and insurance company, this shows us that on average, banks are not significantly more sensitive to sovereign shocks than other financial institutions over our event window.

Overall, our results are robust to parameter changes in our event study. Using a different market proxy, however, could affect our results.

In a previous section we found that banks CDS were only significantly affected by S&P's sovereign downgrades. We redo figure 3 to 5 using only S&P's downgrades to see if our results were affected by the inclusion of Moody's and Fitch's rating changes. It turned out they were mostly not affected as each figure came out very similar, with the exception of banks ranked by their RWA, which gave different results. Only this last figure is reported.

<Figure 12 goes about here>

Figure 12 shows a strong positive CAR for the biggest NON-PIIGS banks, with an economically and statistically significant average CAR of 8.49% at the end of the

[58] The use of the financial component of the iTraxx Main index as a market proxy is included to see if banks have a stronger reaction to our events than other financial institutions.

event window. The two French banks included in this quartile, Crédit Agricole and BNP Paribas, are those with the highest CAR, at 11.36% and 12.67%, respectively. Also, the effect seen here last much beyond our ±5 days event window, with an average CAR still above its pre-downgrade level 20 days after S&P issued its rating change[59].

The bottom portion of the figure shows results obtained using only PIIGS-based banks. We see no significant relation between these banks' size and their reaction to sovereign rating changes.

This confirms that the biggest NON-PIIGS banks are significantly affected by sovereign credit downgrades issued by S&P. Their holding of sovereign debt, however, is not an important determinant of their reaction to such downgrades.

5.6.2 Positive sovereign events

Table 4 reports the same alternate specifications as table 3, but using sovereign bailout announcements instead of sovereign credit downgrades as tested events.

<Table 4 goes about here>

This tables shows that our results are robust to changes in the buffer length, both in terms of magnitude and significance levels. The length of the estimation window, however, seems to affect the magnitude of our results, with longer windows giving higher magnitudes. For example, going from a 60 to a 180 days estimation window raises the last day CAR by an average of 3.00 percentage points (σ: 0.10%). This is probably caused by a change in the relation between banks CDS and our different market proxies during the credit crisis.

[59] See Annex 3

As for a change in the market risk proxy, we get similar results using the iTraxx Main and the iTraxx Non-Financial, both in terms of significance levels and magnitude. In contrast, the use of the iTraxx Financial gives us lower magnitudes on most specification, hinting that banks are not more affected by sovereign bailouts than other financial institutions, like insurance companies.

Overall, the results we get are robust to some specification changes. The use of a different estimation window, however, could substantially affect our results.

5.7 Limitations of our methodology

One of the main limitations of our event study is linked to the important clustering of sovereign events in our sample period. During key periods, as in the fall of 2010, important sovereign events happened almost on a daily basis. Also, sovereign events of opposite effects, like a rating downgrade quickly followed by a bailout, are often very close together making it hard to separate the effect of each event. We try to attenuate the effects of these limitations by discarding events too close to each other and by using a smaller estimation window. A recent controversy about the definition of a credit event could also have affected the sovereign CDS spreads during our sample period[60].

Another potential problem comes from the fact that we use static bank-level data with a dynamic credit risk measure. The bank characteristics and sovereign exposures we use are those reported in EBA's 2011 stress test, which are basically a snapshot of the banks' situation as of December 31st 2010, but these characteristics and exposures could have evolved significantly over our sample period. As an example, Royal Bank of Scotland, a British bank, reports an almost 60% lower exposure to PIIGS debt in 2011 compared to its previous Stress Test disclosure (2010

[60] In a CDS contracts, payouts are triggered when certain pre-defined credit events happens.

round of tests reported exposure as of December 31st 2009). The reader should keep these limitations in mind while looking at our concluding remarks.

5.8 Conclusion

This paper uses an event study methodology to look at the link between different sovereign credit events and banks' credit risk. Our results show that, on average, sovereign credit rating downgrades issued by Standard & Poor's abnormally raise banks' default risk. Downgrades issued by Moody's and Fitch, on the other hand, have no significant effect on banks' credit risk, once controlling for market-wide movements.

Also, separating banks based on their holdings of PIIGS sovereign debt, we find that the relative size of such holdings doesn't have an economically significant impact on their reaction to sovereign downgrades. This contrasts with the recent academic literature, like Gennaioli et al. (2010), who name banks direct holdings of sovereign debt as one of the main transmission channels of sovereign credit risk to banks. We believe this absence of significance in our results to be caused by banks hedging their sovereign credit risk during a sovereign debt crisis. This could explain why our results are different than what is found in the literature since banks don't necessarily protect themselves against sovereign default risk in *normal* times.

In contrast, banks' size does seem to affect NON-PIIGS banks reaction to sovereign downgrades issued by Standard and Poor's, which could be a result of bigger banks being sensitive to other countries' fate through their international subsidiaries.

We also look at the impact of sovereign bailouts by other countries or supranational agencies and find that they do initially lower the credit risk of the biggest NON-PIIGS banks. Smaller banks also benefit from these bailouts but not significantly more than other firms. Again, we believe this relation to be caused by bigger banks having

a bigger international component than smaller ones, making them sensitive to the financial health of their neighbours. That being said, the decline in banks' credit risk is short-lived, and it quickly rises back to its pre-bailout level. Also, their holdings of sovereign debt have little impact on banks' reaction to sovereign bailout announcements.

Overall, our results hint that the market fears the indirect effects of a sovereign default much more than it fears the losses caused by the default itself. Even though a default by one of the PIIGS could have important consequences on the European banking system, our results show that the contagion will probably not spread via direct losses on banks' sovereign PIIGS debt holdings.

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5.10 Figures and Tables

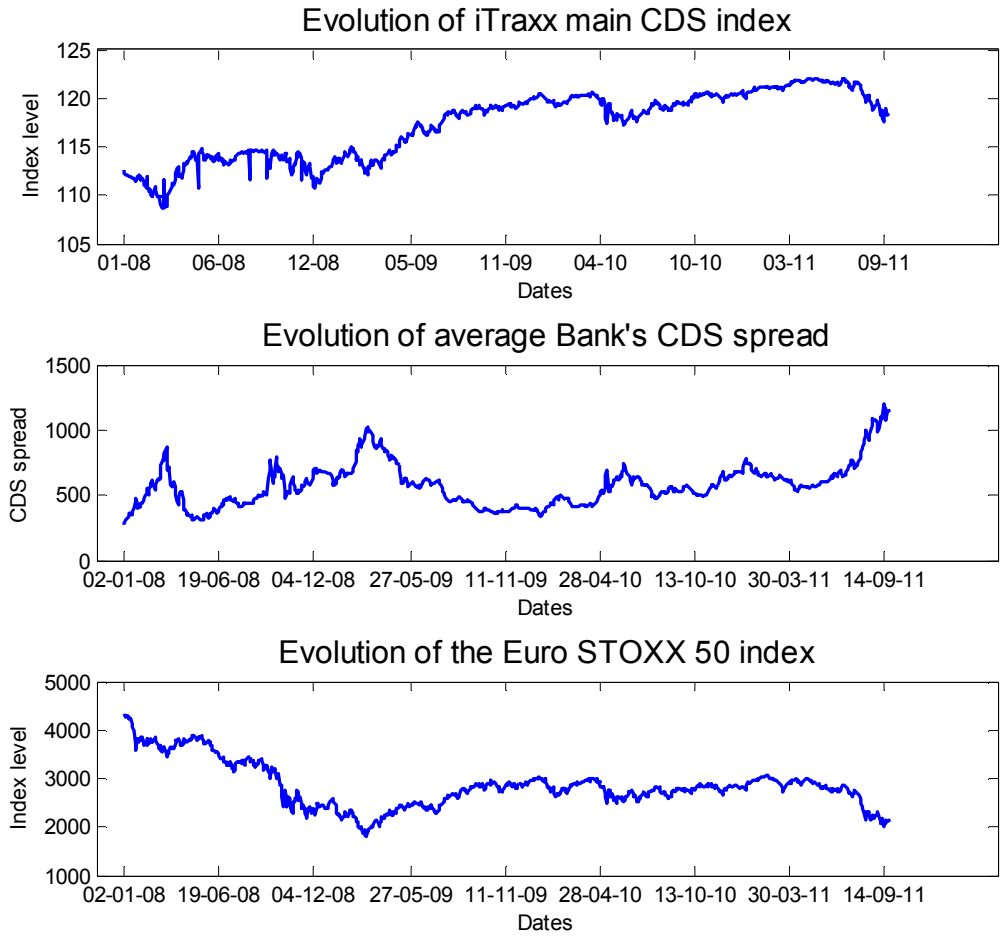


Figure 1 – Evolution of Banks CDS, iTraxx Main index and Euro STOXX 50 index over our sample period. This figure shows the evolution of the iTraxx Europe main 5 years CDS Index, the simple average of Banks CDS spreads and the Euro STOXX 50 from January 2008 to September 2011.

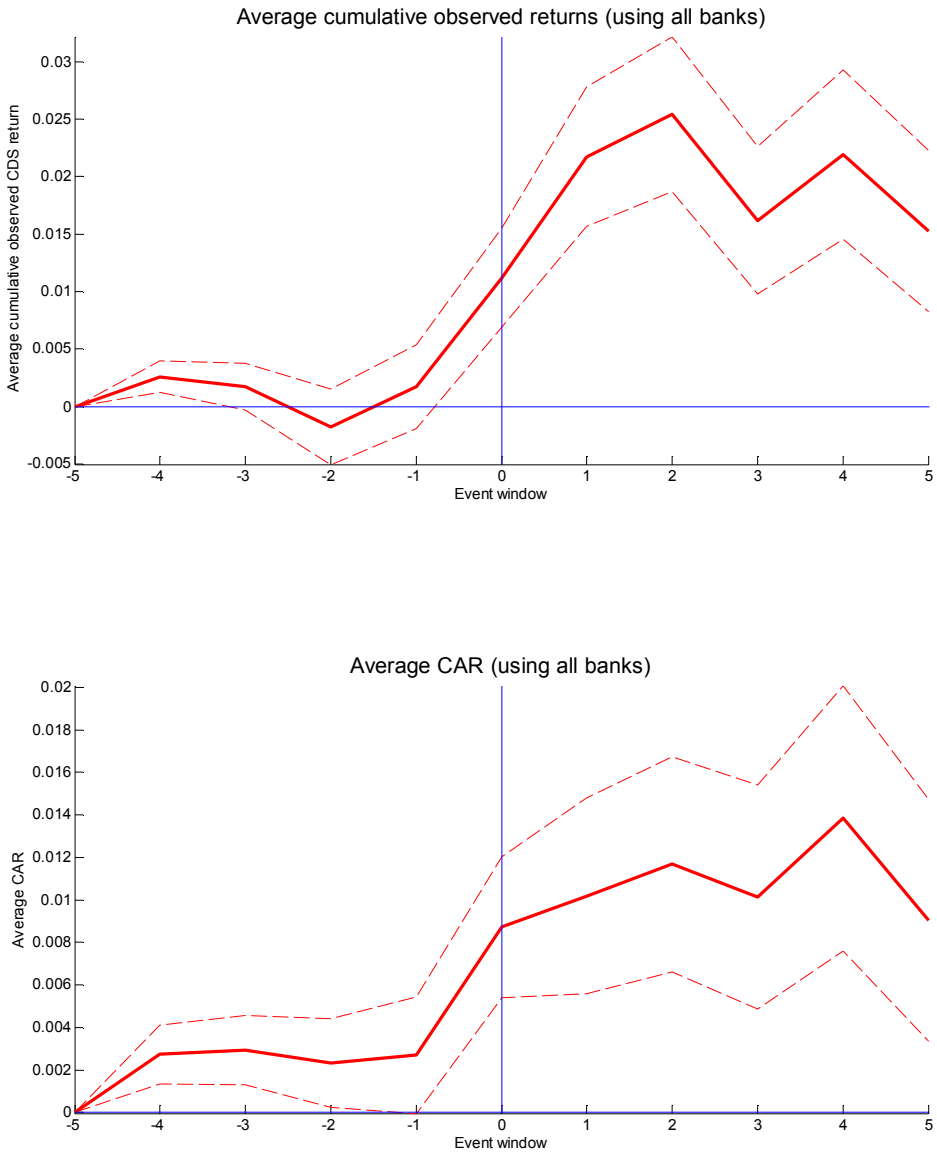


Figure 2. Observed returns vs CAR around sovereign rating downgrades (All Banks). This figure shows the reaction of banks CDS to sovereign credit rating downgrades. The top portion shows banks average observed returns around the downgrades. The bottom portion looks at the average abnormal returns of banks CDS around sovereign rating downgrades, controlling for market wide movements. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

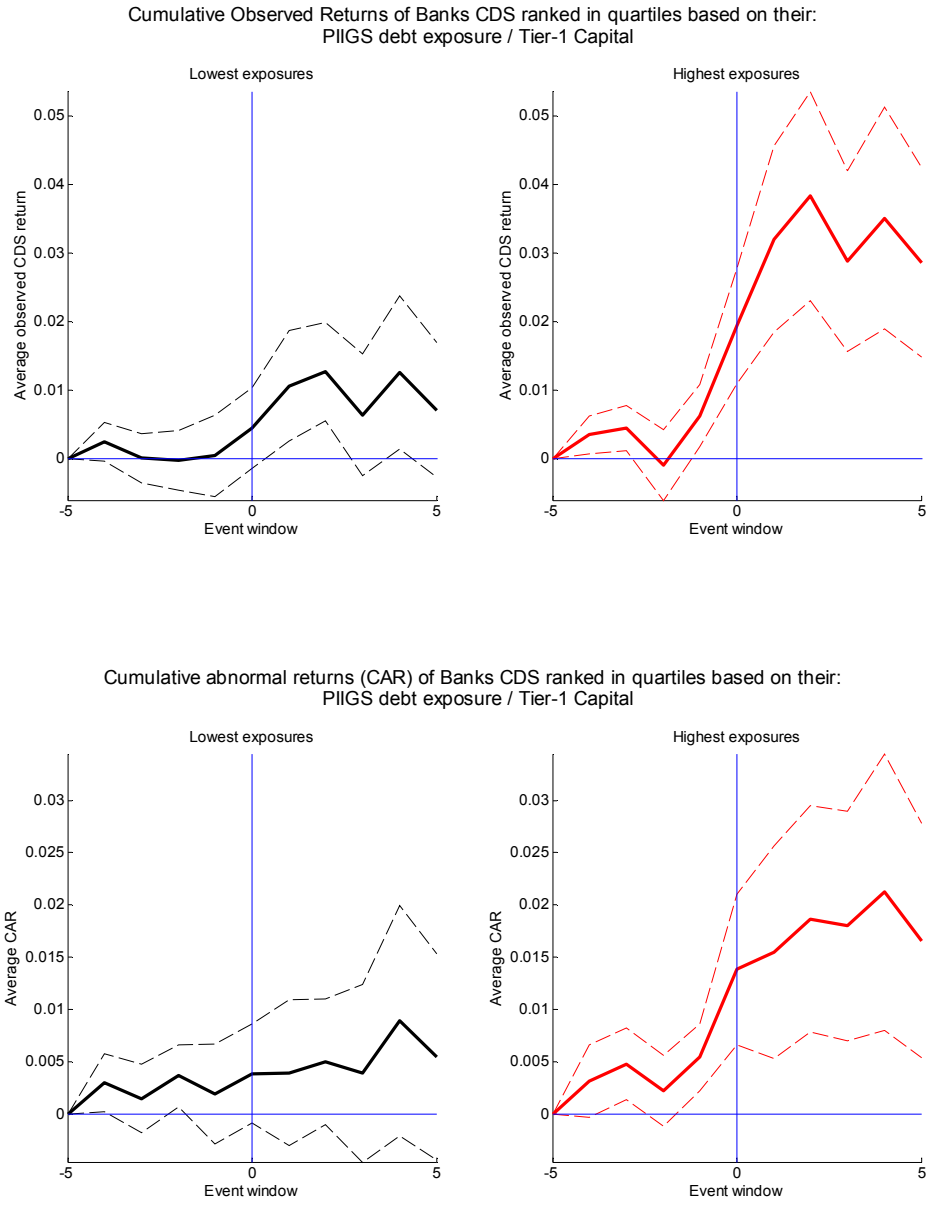
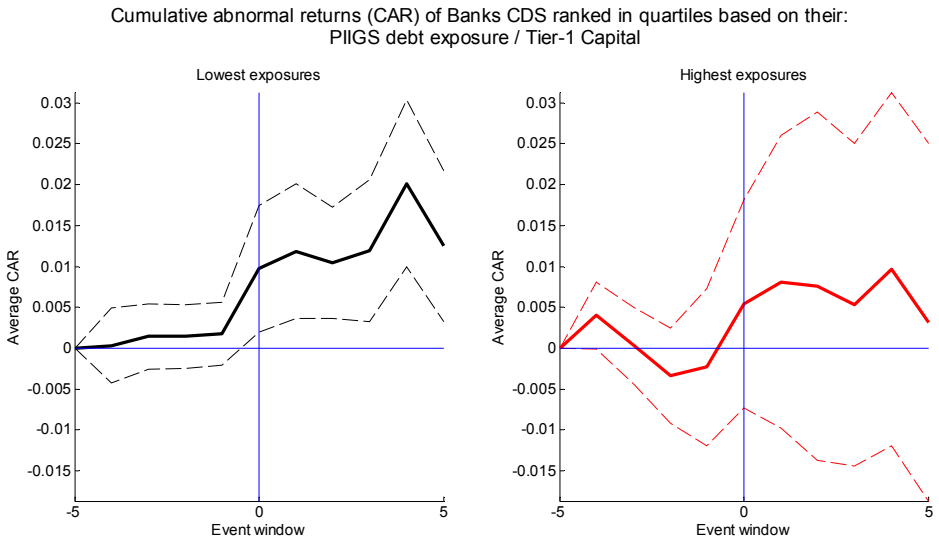


Figure 3a. Observed returns vs CAR around sovereign rating downgrades, ranked by banks' PIIGS exposures relative to their tier-1 capital. This figure shows the reaction of banks CDS to sovereign credit rating downgrades, separating banks in quartiles based on their aggregate PIIGS debt exposure relative to their Tier-1 Capital. The top portion shows banks average observed returns around the downgrades. The bottom portion looks at the average abnormal returns of banks CDS around sovereign rating downgrades, controlling for market wide movements. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

CAR using NON-PIIGS banks only



CAR using PIIGS-based banks only

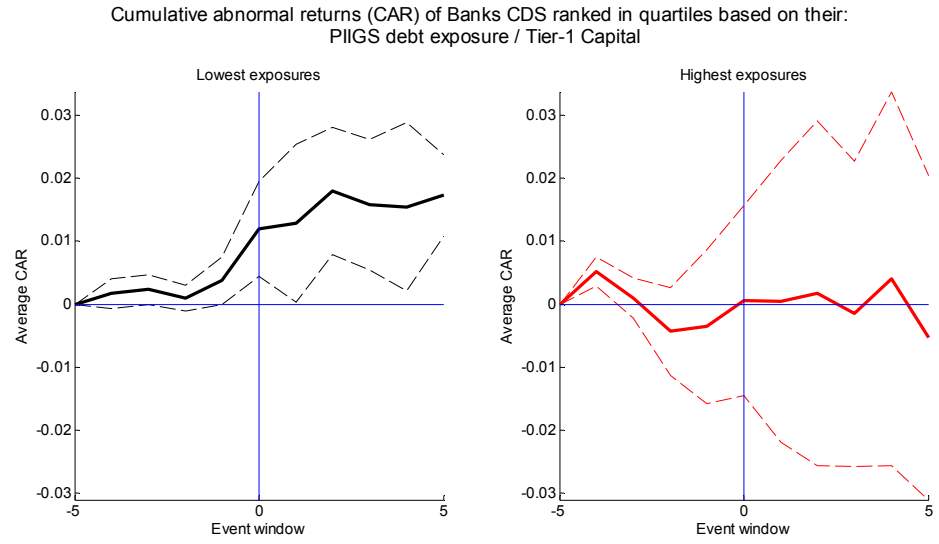


Figure 3b. Banks' CAR around sovereign rating downgrades, ranked by banks' PIIGS exposure relative to their tier-1 capital. This figure shows the reaction of banks CDS to sovereign credit rating downgrades, separating banks in quartiles based on their aggregate PIIGS debt exposure relative to their Tier-1 Capital. The top portion shows the average abnormal returns of NON-PIIGS banks CDS around sovereign rating downgrades, controlling for market wide movements. The bottom portion looks at the same reaction, but using only PIIGS-based banks. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

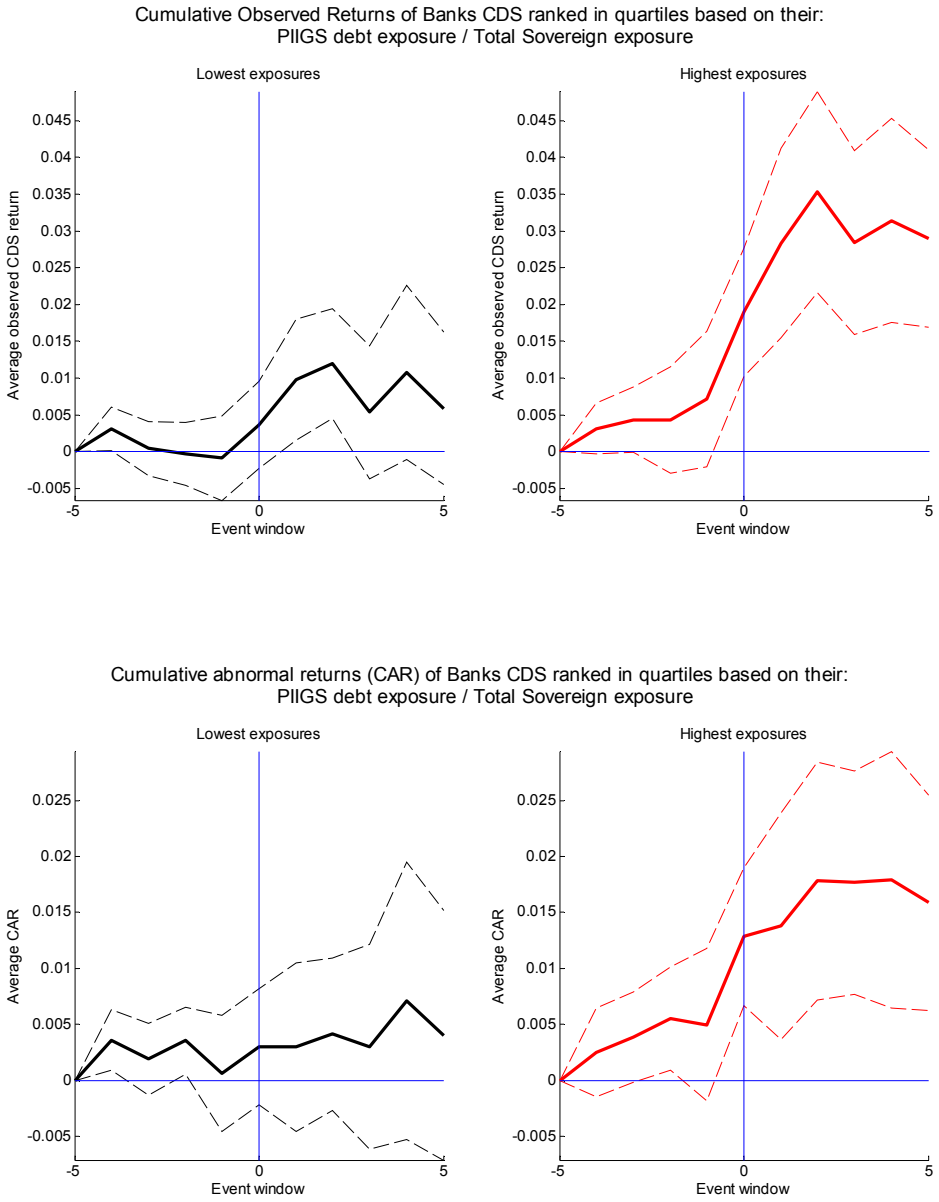
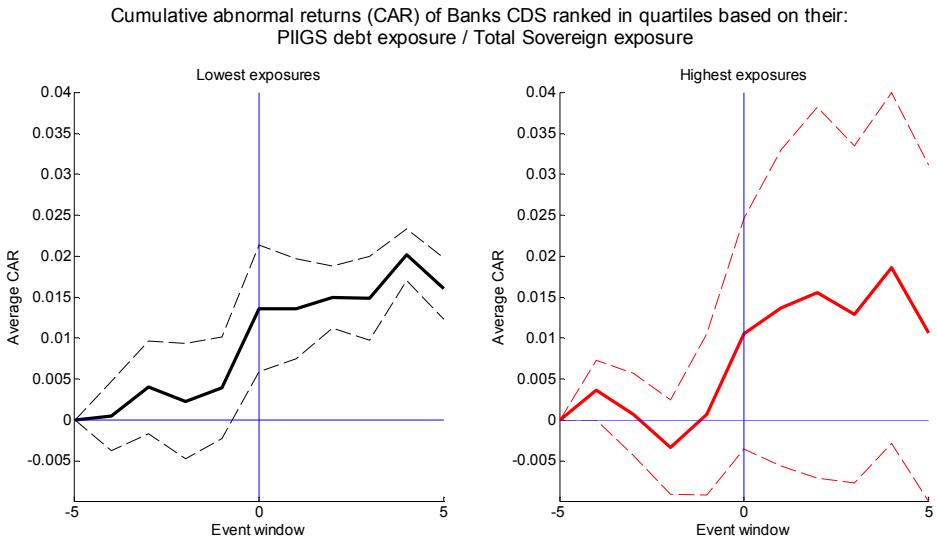


Figure 4a. Observed returns vs CAR around sovereign rating downgrades, ranked by banks' PIIGS exposure relative to total sovereign exposure. This figure shows the reaction of banks CDS to sovereign credit rating downgrades, separating banks in quartiles based on their aggregate PIIGS debt exposure relative to their total sovereign exposures. The top portion shows banks average observed returns around the downgrades. The bottom portion looks at the average abnormal returns of banks CDS around sovereign rating downgrades, controlling for market wide movements. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

CAR using NON-PIIGS-based banks only



CAR using PIIGS-based banks only

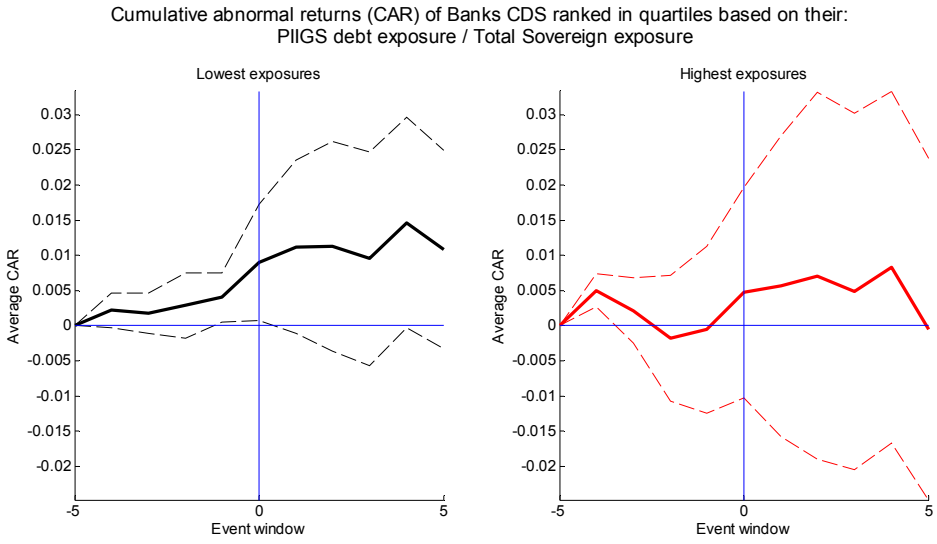


Figure 4b. Banks' CAR around sovereign rating downgrades, ranked by banks' PIIGS exposure relative to their total sovereign exposure. This figure shows the reaction of banks CDS to sovereign credit rating downgrades, separating banks in quartiles based on their aggregate PIIGS debt exposure relative to their total sovereign exposure. The top portion shows the average abnormal returns of NON-PIIGS banks CDS around sovereign rating downgrades, controlling for market wide movements. The bottom portion looks at the same reaction, but using only PIIGS-based banks. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

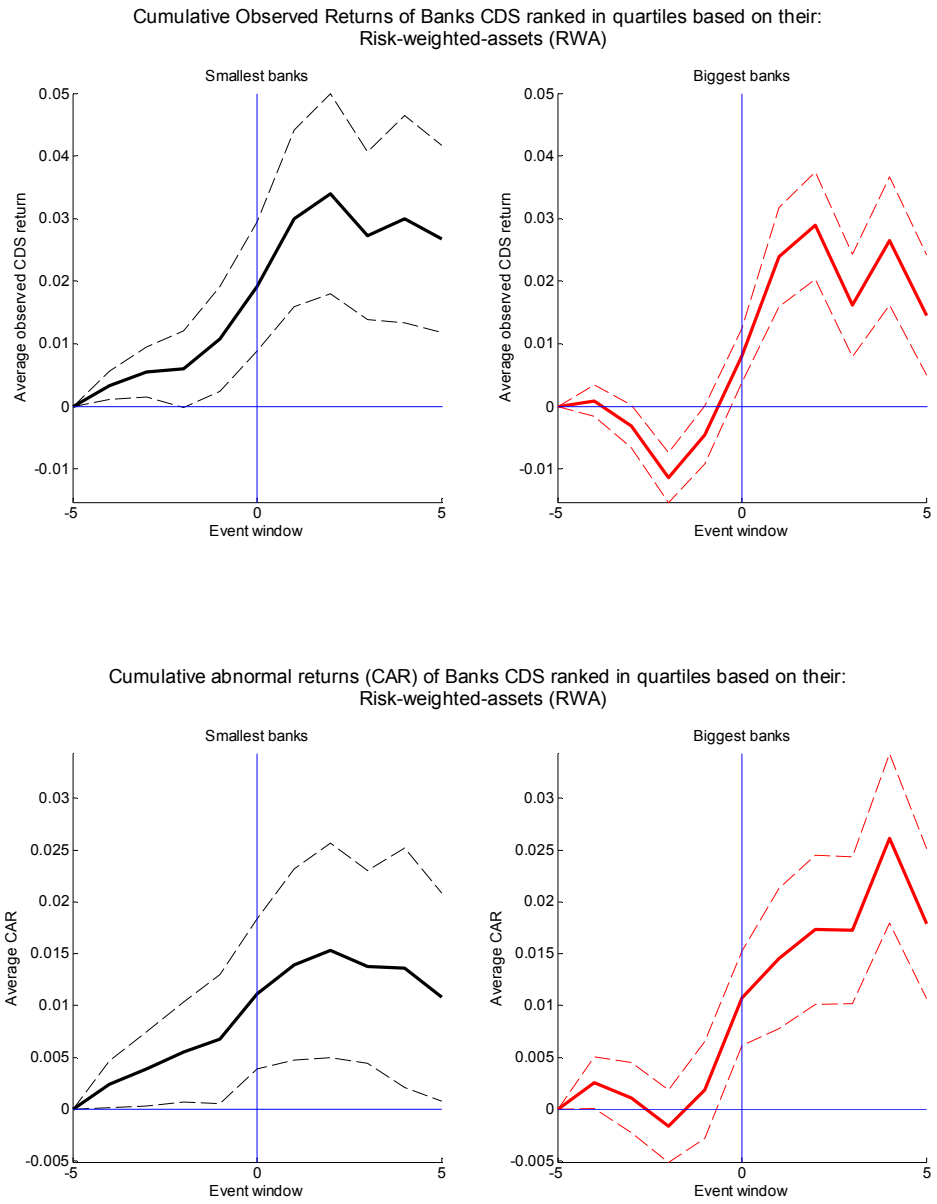
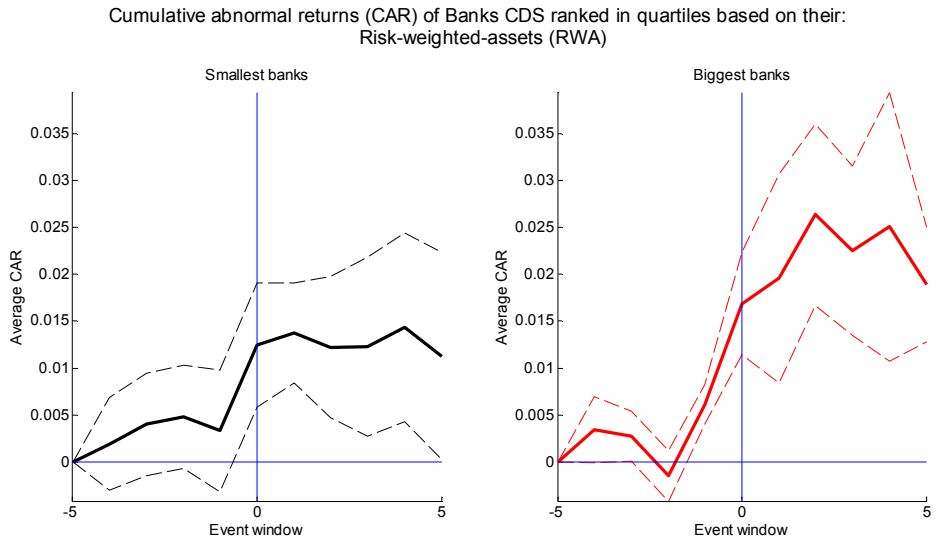


Figure 5a. Observed returns vs CAR around sovereign rating downgrades, ranked by banks' RWA. This figure shows the reaction of banks CDS to sovereign credit rating downgrades, separating banks in quartiles based on their Risk-Weighted-Assets (RWA The top portion shows banks average observed returns around the downgrades. The bottom portion looks at the average abnormal returns of banks CDS around sovereign rating downgrades, controlling for market wide movements. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

CAR using NON-PIIGS-based banks only



CAR using PIIGS-based banks only

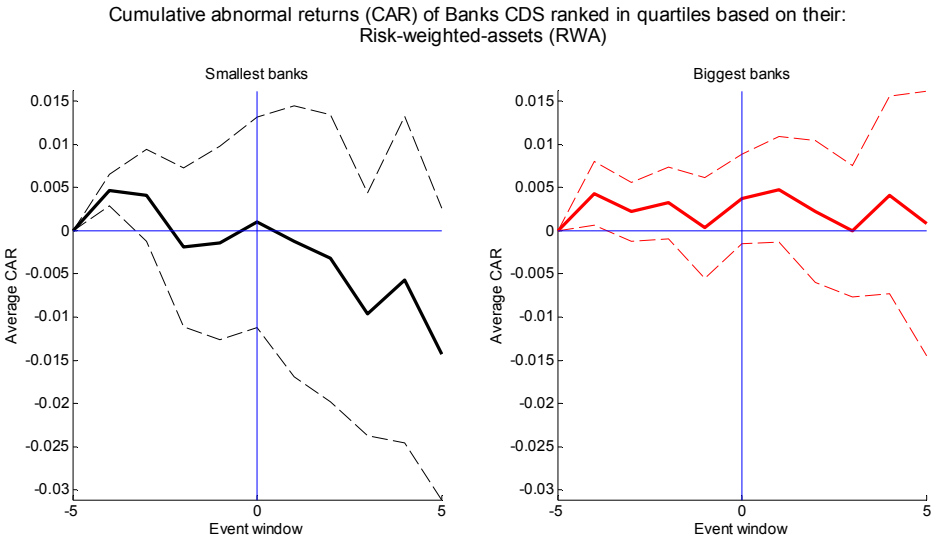


Figure 5b. Banks' CAR around sovereign rating downgrades, ranked by banks' RWA. This figure shows the reaction of banks CDS to sovereign credit rating downgrades, separating banks in quartiles based on their Risk-Weighted-Assets (RWA). The top portion shows the average abnormal returns of NON-PIIGS banks CDS around sovereign rating downgrades, controlling for market wide movements. The bottom portion looks at the same reaction, but using only PIIGS-based banks. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

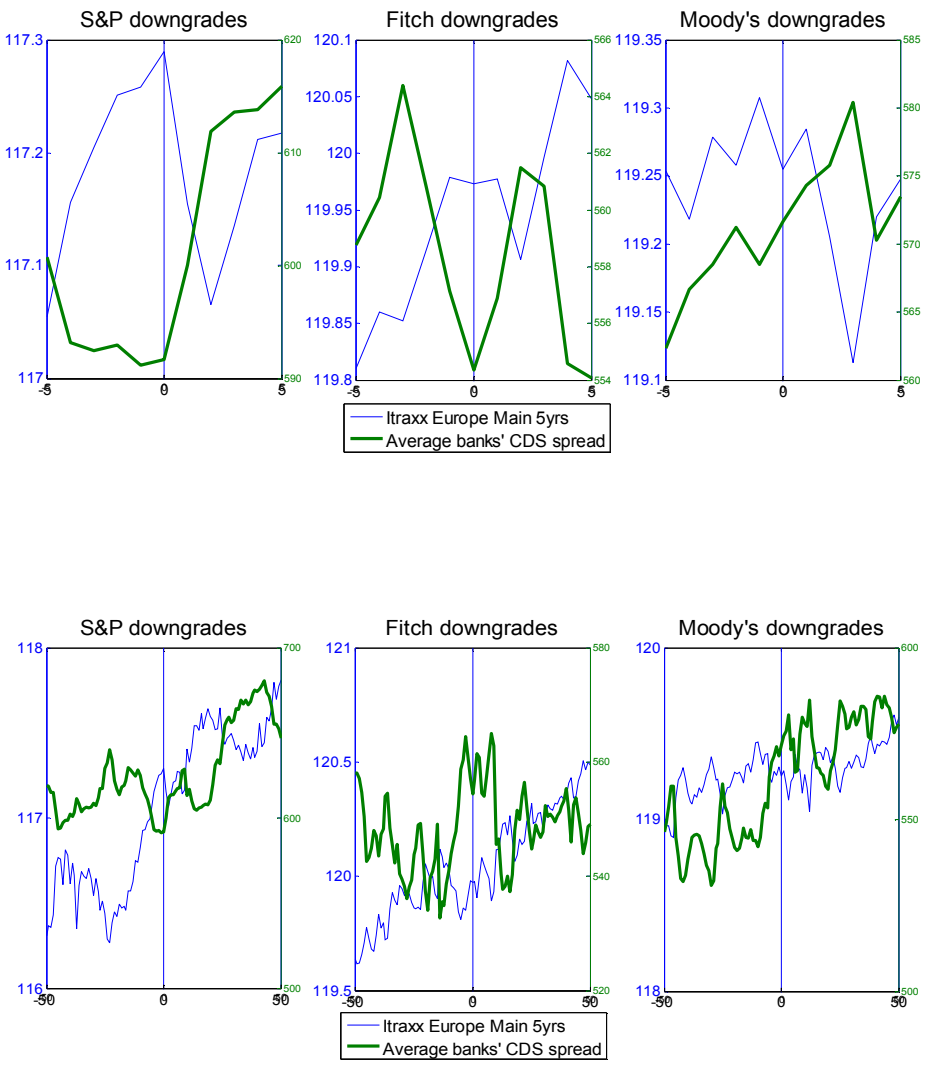


Figure 6 – Evolution of banks CDS spreads around sovereign rating downgrades. This figure shows the evolution of the average observed banks CDS spread as well as the evolution of the iTraxx Europe Main 5 years CDS Index around sovereign credit rating downgrades, separated by the agency which issued the downgrades. The upper 3 graphics uses a 10-days event window to focus on the direct effet of the downgrades. The bottom 3 use a 100-days window to see if the events had a lasting effect (windows centered on event date).

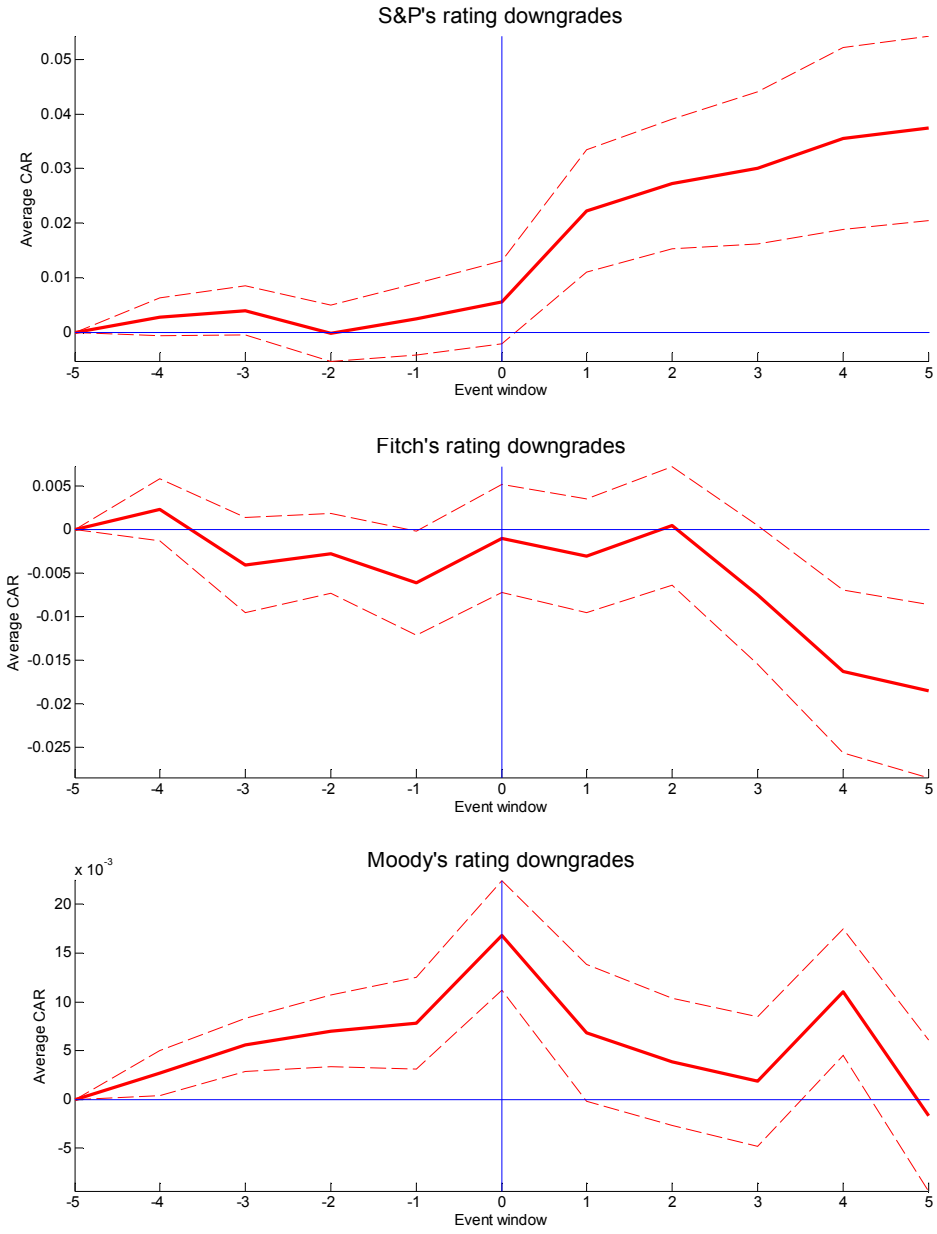


Figure 7 – Banks' CAR around sovereign rating downgrades, separated by rating agencies. These figures show the average abnormal returns of banks CDS around sovereign rating downgrades, separated by the rating agency who issued the downgrades. The first graphic shows Standard & Poor's (S&P) downgrades (9 events), the second one shows Fitch's downgrades (6 events) and the last one show Moody's downgrades (11 events). Event window goes from 5 days before the downgrades to 5 days after them.

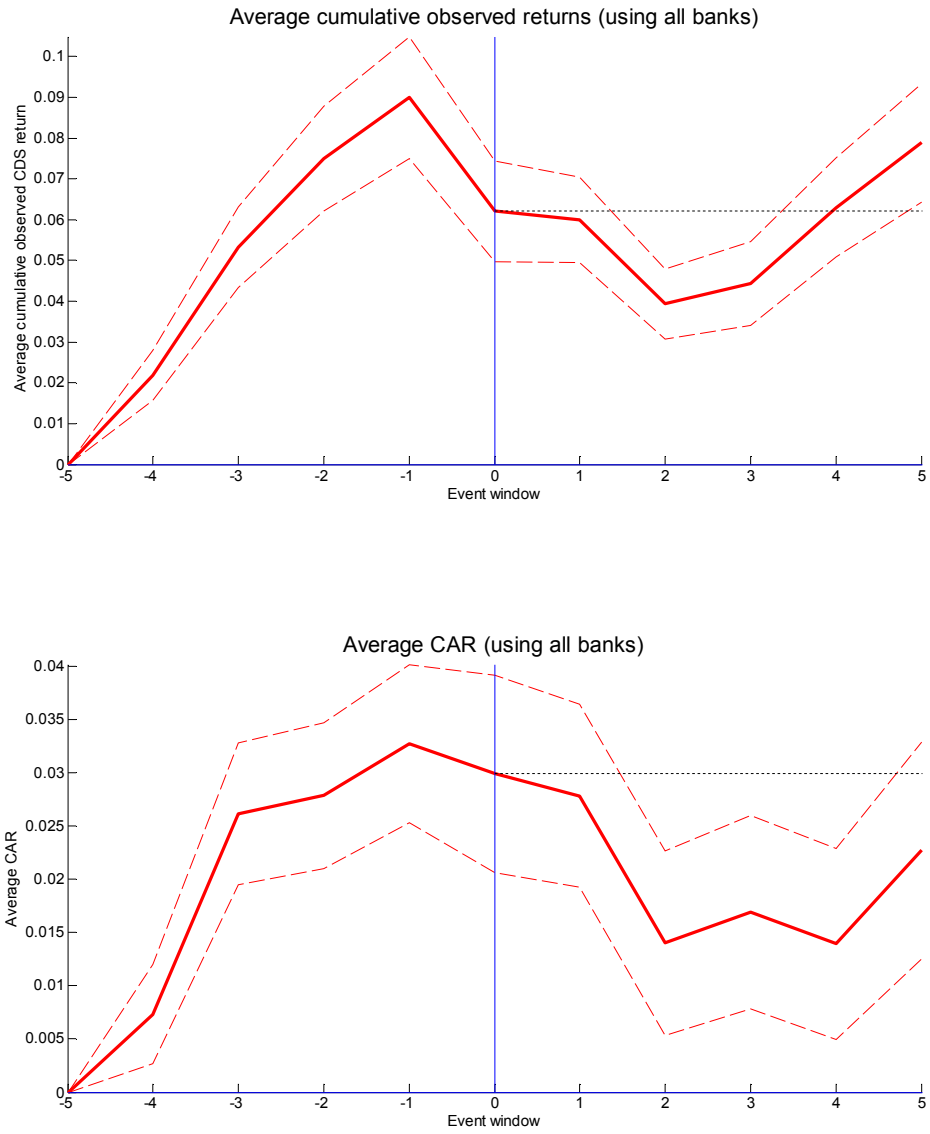


Figure 8. Observed returns vs CAR around sovereign bailouts (All Banks). This figure shows the reaction of banks CDS to sovereign bailout announcements. The top portion shows banks average observed returns around the sovereign bailouts. The bottom portion looks at the average abnormal returns of banks CDS around those events, controlling for market wide movements. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the bailout announcements to 5 days after them.

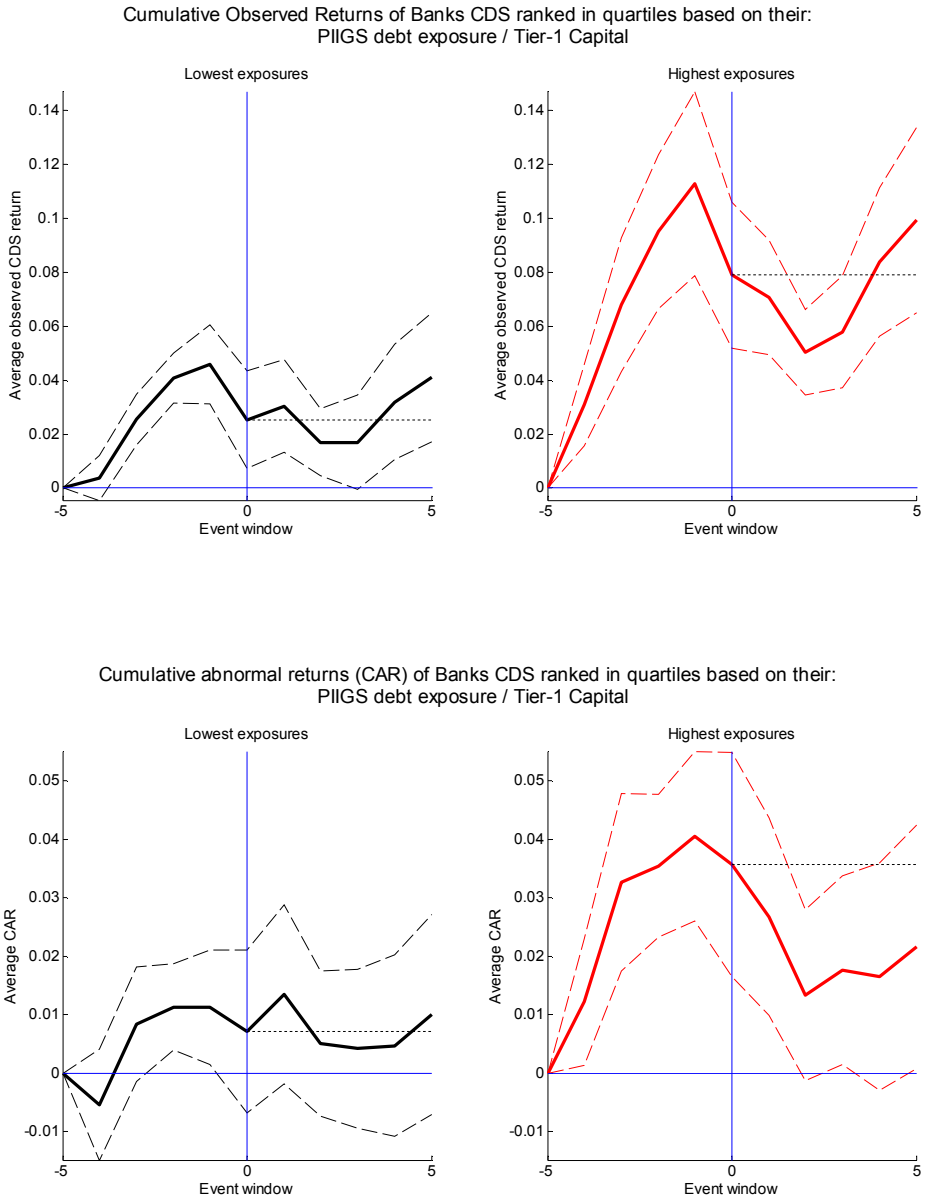


Figure 9. Banks' CAR around sovereign bailouts, ranked by banks' PIIGS exposure relative to their tier-1 capital. This figure shows the reaction of banks CDS to sovereign bailout announcements, separating banks in quartiles based on their aggregate PIIGS debt exposure relative to their Tier-1 Capital. The top portion shows banks average observed returns around the sovereign bailouts. The bottom portion looks at the average abnormal returns of banks CDS around those events, controlling for market wide movements. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the bailout announcements to 5 days after them.

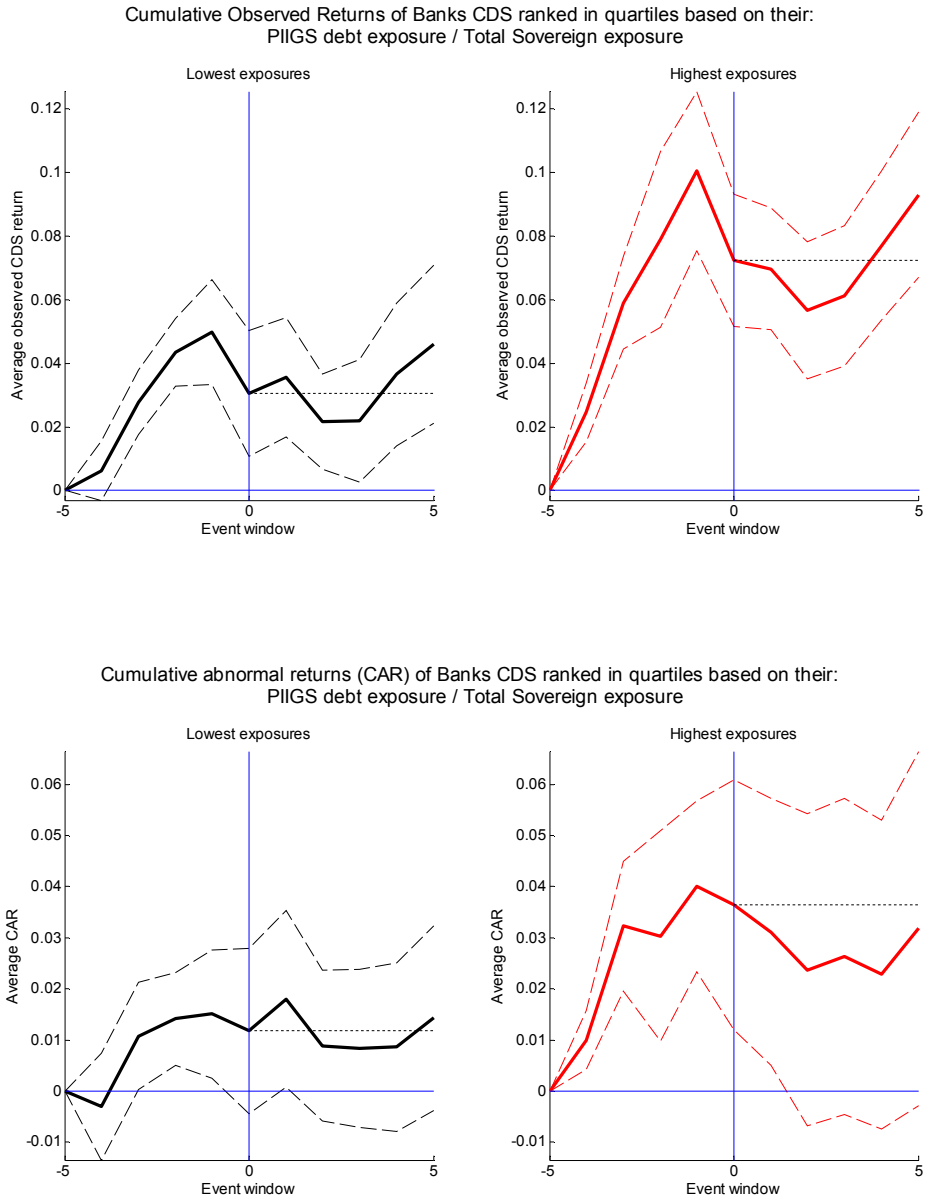


Figure 10. Banks' CAR around sovereign bailouts, ranked by banks' PIIGS exposure relative to their total sovereign exposure. This figure shows the reaction of banks CDS to sovereign bailout announcements, separating banks in quartiles based on their aggregate PIIGS debt exposure relative to their total sovereign exposures. The top portion shows banks average observed returns around the sovereign bailouts. The bottom portion looks at the average abnormal returns of banks CDS around those events, controlling for market wide movements.The dashed lines show the 95% confidence interval. Event window goes from 5 days before the bailout announcements to 5 days after them.

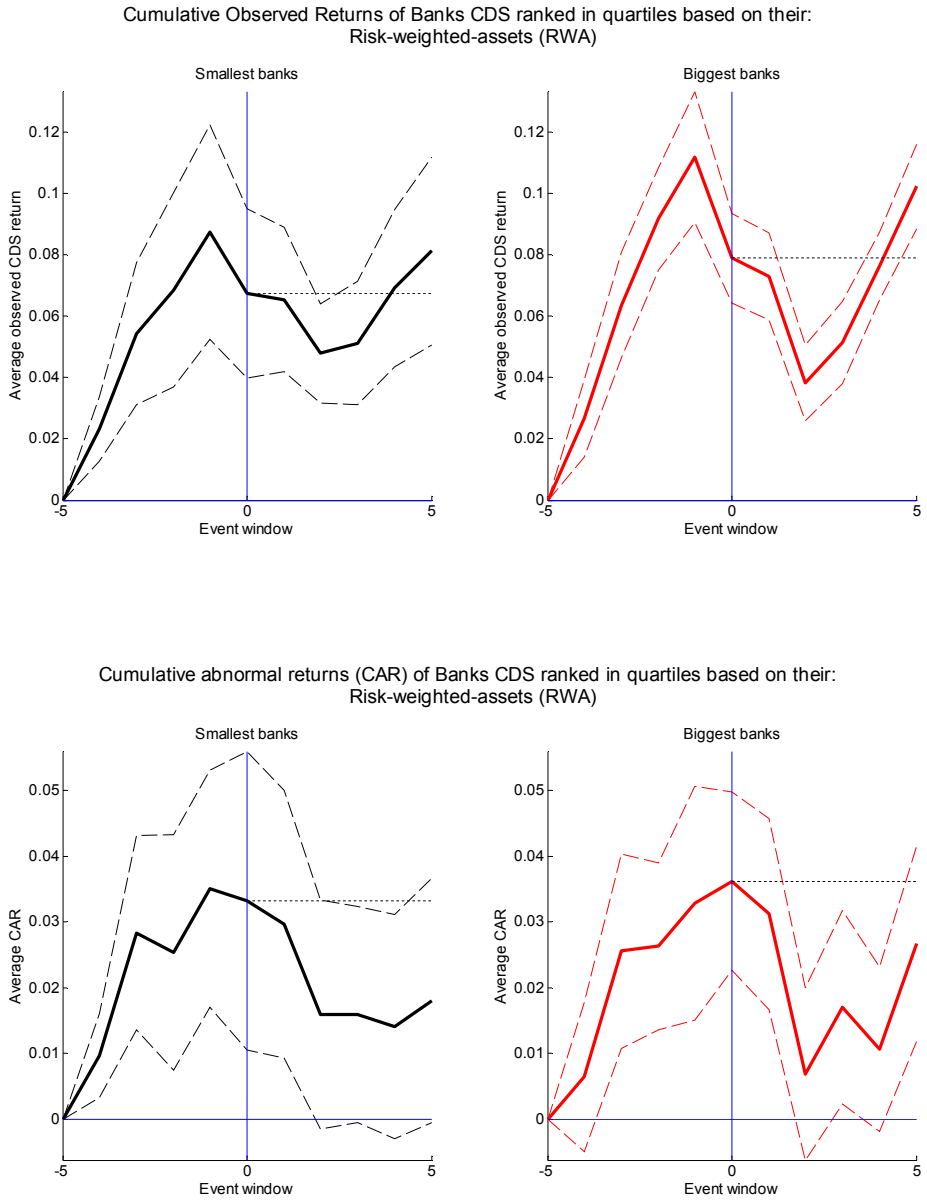
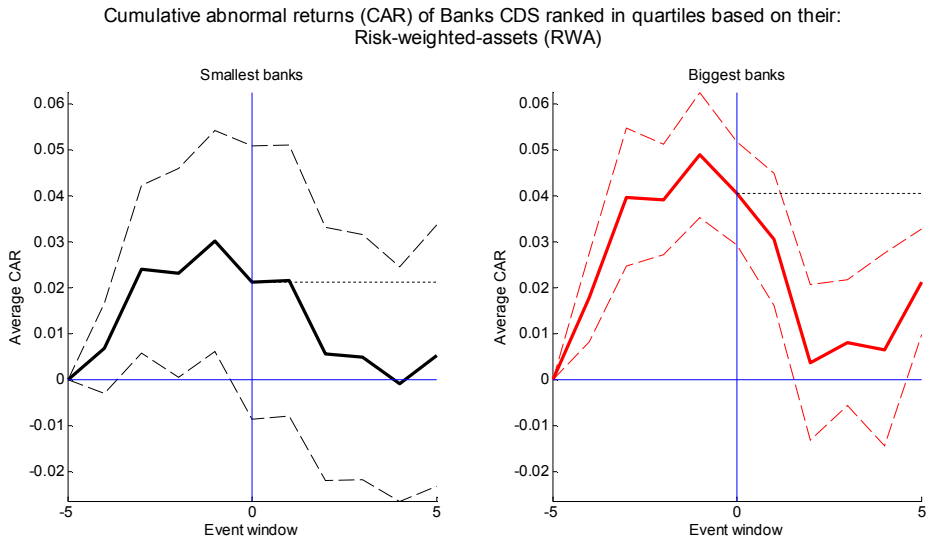


Figure 11a. Banks' CAR around sovereign bailouts, ranked by banks' RWA. This figure shows the reaction of banks CDS to sovereign bailout announcements, separating banks in quartiles based on their Risk-Weighted-Assets (RWA). The top portion shows banks average observed returns around the sovereign bailouts. The bottom portion looks at the average abnormal returns of banks CDS around those events, controlling for market wide movements. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the bailout announcements to 5 days after them.

CAR using NON-PIIGS-based banks only



CAR using PIIGS-based banks only

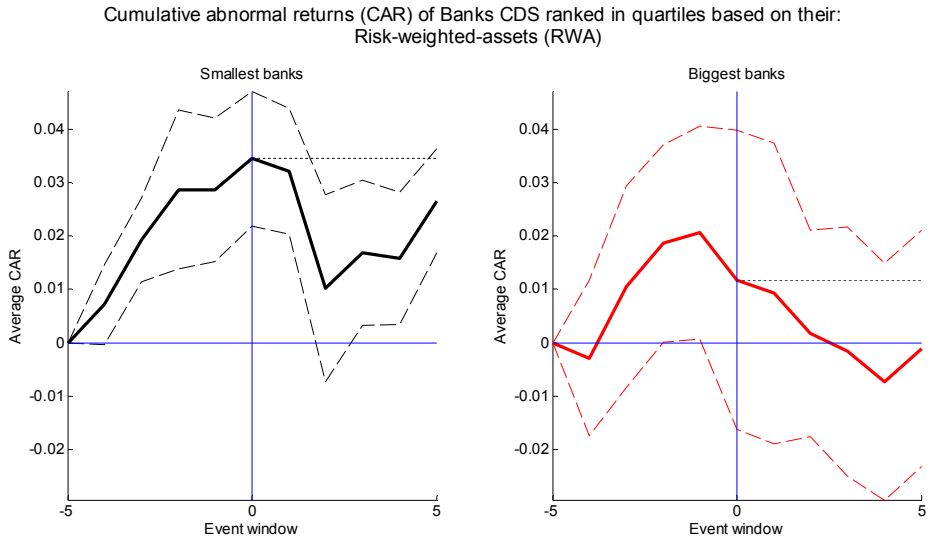
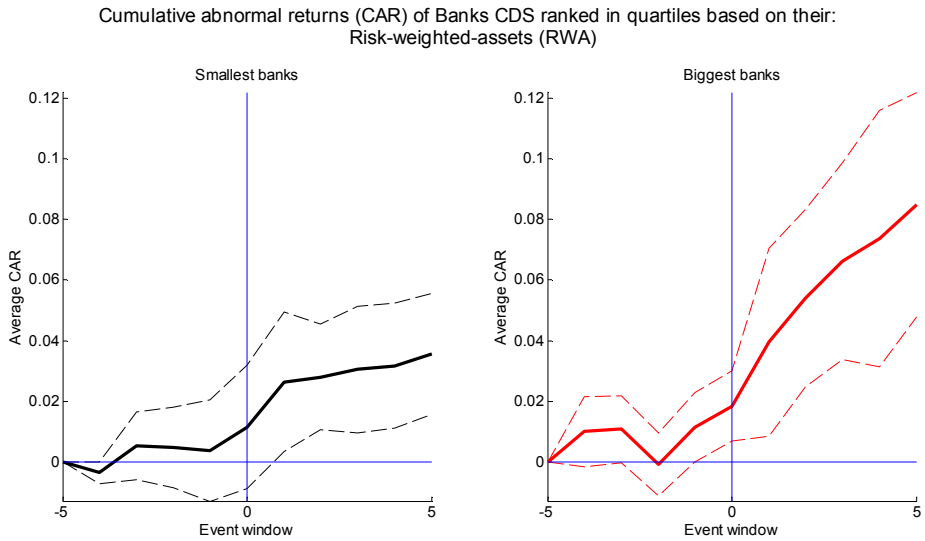


Figure 11b. Banks' CAR around sovereign bailouts, ranked by banks' RWA. This figure shows the reaction of banks CDS to sovereign bailout announcements, separating banks in quartiles based on their Risk-Weighted-Assets (RWA). The top portion shows the average abnormal returns of NON-PIIGS banks CDS around sovereign bailout announcements, controlling for market wide movements. The bottom portion looks at the same reaction, but using only PIIGS-based banks. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the bailout announcements to 5 days after them.

CAR using NON-PIIGS-based banks only



CAR using PIIGS-based banks only

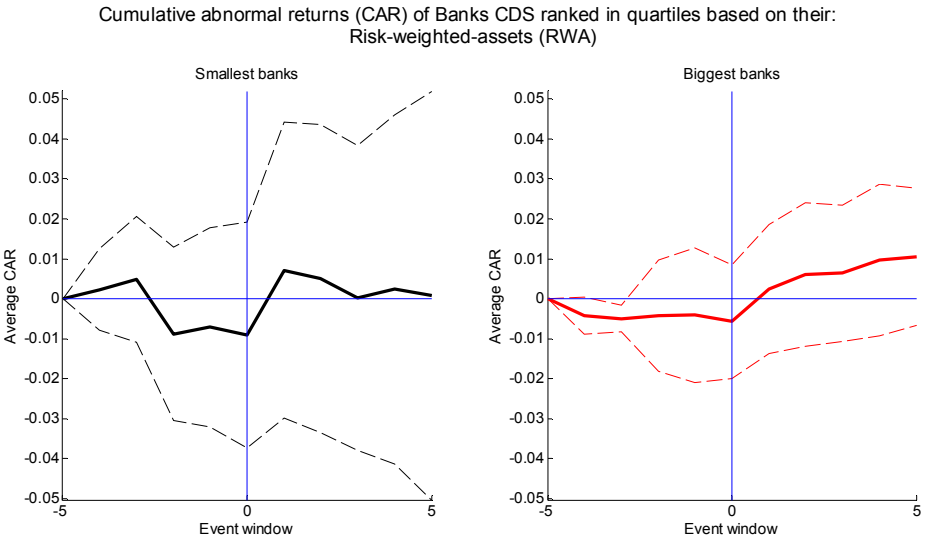


Figure 12. Banks' CAR around sovereign rating downgrades issued by S&P, ranked by banks' RWA. This figure shows the reaction of banks CDS to sovereign credit rating downgrades issued by S&P, separating banks in quartiles based on their Risk-Weighted-Assets (RWA). The top portion shows the average cumulative abnormal returns of NON-PIIGS banks CDS around sovereign rating downgrades, controlling for market wide movements. The bottom portion looks at the same reaction, but using only PIIGS-based banks. The dashed lines show the 95% confidence interval. Event window goes from 5 days before the downgrades to 5 days after them.

Table 1 – Banks' sovereign debt exposures. This table contains data about banks' sovereign debt exposure as of December 31st 2010. All numbers are the author's calculations based on data from EBA's stress test 2011 results except Total sovereign exposure which is taken directly from EBA's data. Banks name and country code are also taken from the Stress tests.

Bank Name	Bank's Home Country	Debt exposure relative to banks total sovereign exposure					Total Sovereign Exposure (million €)	Aggregate PIIGS Exposure (million €)
		Portugal	Ireland	Italy	Greece	Spain		
Erste Bank Group (EBG)	AT	0,39%	0,15%	2,21%	1,27%	0,51%	27248	1232
Raiffeisen Bank International (RBI)	AT	0,01%	0,00%	1,96%	0,01%	0,01%	22863	455
DEUTSCHE BANK AG	DE	0,17%	0,45%	7,59%	1,35%	2,06%	93634	10884
COMMERZBANK AG	DE	1,10%	0,03%	11,27%	3,43%	3,53%	89742	17363
Landesbank Baden-Württemberg	DE	-0,44%	0,02%	3,46%	1,49%	0,40%	40104	1977
Bayerische Landesbank	DE	0,00%	0,04%	0,96%	0,28%	1,26%	52704	1335
Hypo Real Estate Holding AG, München	DE	1,20%	0,11%	17,41%	0,00%	8,28%	41000	11070
WestLB AG, Düsseldorf	DE	-0,03%	1,25%	3,53%	1,06%	2,39%	31052	2545
DANSKE BANK	DK	0,34%	2,73%	2,92%	0,01%	0,93%	11989	830
BANCO SANTANDER S.A.	ES	3,74%	0,00%	0,24%	0,18%	43,10%	96986	45840
BANCO BILBAO VIZCAYA ARGENTARIA S.A. (BBVA)	ES	0,62%	0,00%	3,74%	0,12%	51,23%	104331	58125
BANCO DE SABADELL, S.A.	ES	1,23%	0,52%	0,00%	0,00%	98,25%	7425	7425
CAJA ESPAÑA DE INVERSIONES, SALAMANCA Y SORIA, CAJA DE AHORROS Y MONTE DE PIEDAD	ES	0,36%	0,00%	0,00%	0,00%	99,64%	7584	7584
BNP PARIBAS	FR	1,08%	0,24%	11,63%	2,49%	1,94%	213071	37033
CREDIT AGRICOLE	FR	1,49%	0,22%	15,34%	0,92%	3,91%	66416	14527
SOCIETE GENERALE	FR	1,05%	0,62%	4,08%	4,09%	3,35%	65278	8608
ROYAL BANK OF SCOTLAND GROUP plc	GB	0,21%	0,38%	4,02%	0,95%	0,37%	113543	6734
HSBC HOLDINGS plc	GB	0,18%	0,04%	1,04%	0,32%	0,22%	312229	5631
BARCLAYS plc	GB	1,67%	0,48%	4,09%	0,15%	7,55%	72524	10103
LLOYDS BANKING GROUP plc	GB	0,00%	0,00%	0,05%	0,00%	0,20%	31189	79
ALPHA BANK	GR	0,00%	0,00%	0,00%	90,15%	0,00%	6157	5550
ALLIED IRISH BANKS PLC	IE	2,36%	49,40%	7,92%	0,39%	3,25%	10306	6526
BANK OF IRELAND	IE	0,00%	84,28%	0,77%	0,00%	0,00%	3879	3299
INTESA SANPAOLO S.p.A	IT	0,10%	0,16%	81,98%	0,89%	1,06%	70868	59665
UNICREDIT S.p.A	IT	0,06%	0,06%	53,78%	0,62%	2,12%	89346	50617
BANCA MONTE DEI PASCHI DI SIENA S.p.A	IT	0,60%	0,00%	96,44%	0,01%	0,85%	33216	32520
BANCO POPOLARE - S.C.	IT	0,00%	0,00%	96,79%	0,72%	0,00%	12149	11845
UNIONE DI BANCHE ITALIANE SCPA (UBI BANCA)	IT	0,00%	0,00%	97,30%	0,24%	0,00%	10405	10148

Table 1 – (Continued)

Bank Name	Bank's Home Country	Debt exposure relative to banks total sovereign exposure					Total Sovereign Exposure (million €)	Agregate PIIGS Exposure (million €)
		Portugal	Ireland	Italy	Greece	Spain		
ING BANK NV	NL	0,83%	0,12%	6,74%	0,91%	2,09%	83738	8945
RABOBANK NEDERLAND	NL	0,18%	0,13%	0,93%	0,81%	0,33%	46511	1105
SNS BANK NV	NL	0,00%	2,13%	10,41%	0,64%	0,78%	7324	1023
CAIXA GERAL DE DEPÓSITOS, SA	PT	81,82%	0,29%	0,07%	0,60%	2,47%	7982	6803
BANCO COMERCIAL PORTUGUÊS, SA (BCP OR MILLENNIUM BCP)	PT	69,41%	2,53%	0,59%	8,66%	0,00%	8398	6818
ESPÍRITO SANTO FINANCIAL GROUP, SA (ESFG)	PT	38,59%	0,00%	0,00%	4,42%	0,78%	6998	3064
Banco BPI, SA	PT	54,39%	3,95%	13,56%	4,53%	0,00%	7163	5475
Nordea Bank AB (publ)	SE	0,00%	0,00%	0,27%	0,00%	0,18%	35381	162
Skandinaviska Enskilda Banken AB (publ) (SEB)	SE	0,42%	0,00%	0,91%	0,36%	0,27%	31642	620
Svenska Handelsbanken AB (publ)	SE	0,00%	0,00%	0,00%	0,00%	0,00%	21561	0
Swedbank AB (publ)	SE	0,00%	0,00%	0,00%	0,00%	0,00%	2796	0

Table 2 – Banks key characteristics. This table contains data about banks' balance sheets as of December 31st 2010. Risk-weighted-assets (RWA) and Tier-1 Ratio are taken directly from EBA's Stress tests 2011, whereas the last three columns are the author's calculations based on EBA's data. Banks name and country code are also taken from the Stress tests results.

Bank Name	Bank's Home Country	RWA (million €)	Tier-1 Ratio	Sovereign exposure / Tier-1 Capital	PIIGS debt Exposure / Tier-1 Capital	PIIGS debt Exposure / Total Sovereign Exposure
Erste Bank Group (EBG)	AT	128470	8,34%	254,2%	11,5%	4,5%
Raiffeisen Bank International (RBI)	AT	100974	7,65%	296,0%	5,9%	2,0%
DEUTSCHE BANK AG	DE	467396	6,73%	297,7%	34,6%	11,6%
COMMERZBANK AG	DE	318105	7,24%	389,8%	75,4%	19,3%
Landesbank Baden-Württemberg	DE	136483	6,70%	438,4%	21,6%	4,9%
Bayerische Landesbank	DE	131835	8,08%	494,8%	12,5%	2,5%
Hypo Real Estate Holding AG, München	DE	24283	12,58%	1342,0%	362,3%	27,0%
WestLB AG, Düsseldorf	DE	59764	7,34%	707,6%	58,0%	8,2%
DANSKE BANK	DK	144035	10,57%	78,8%	5,5%	6,9%
BANCO SANTANDER S.A.	ES	626921	7,19%	215,3%	101,7%	47,3%
BANCO BILBAO VIZCAYA ARGENTARIA S.A. (BBVA)	ES	319547	8,66%	377,0%	210,1%	55,7%
BANCO DE SABADELL, S.A.	ES	56503	6,27%	209,7%	209,7%	100,0%
CAJA ESPAÑA DE INVERSIONES, SALAMANCA Y SORIA, CAJA DE AHORROS Y MONTE DE PIEDAD	ES	25266	7,18%	418,1%	418,1%	100,0%
BNP PARIBAS	FR	686949	8,31%	373,5%	64,9%	17,4%
CREDIT AGRICOLE	FR	557395	8,39%	142,0%	31,1%	21,9%
SOCIETE GENERALE	FR	418651	6,78%	230,1%	30,3%	13,2%
ROYAL BANK OF SCOTLAND GROUP plc	GB	667709	7,22%	235,4%	14,0%	5,9%
HSBC HOLDINGS plc	GB	1002244	8,81%	353,5%	6,4%	1,8%
BARCLAYS plc	GB	595739	7,74%	157,3%	21,9%	13,9%
LLOYDS BANKING GROUP plc	GB	520087	7,92%	75,7%	0,2%	0,3%
ALPHA BANK	GR	49692	9,19%	134,9%	121,6%	90,2%
ALLIED IRISH BANKS PLC	IE	111267	1,18%	786,6%	498,1%	63,3%
BANK OF IRELAND	IE	80705	5,89%	81,6%	69,4%	85,0%
INTESA SANPAOLO S.p.A	IT	353062	7,53%	266,5%	224,3%	84,2%
UNICREDIT S.p.A	IT	514409	6,98%	248,8%	140,9%	56,7%
BANCA MONTE DEI PASCHI DI SIENA S.p.A	IT	111281	5,14%	580,9%	568,7%	97,9%
BANCO POPOLARE - S.C.	IT	96560	5,52%	227,7%	222,1%	97,5%
UNIONE DI BANCHE ITALIANE SCPA (UBI BANCA)	IT	96225	6,77%	159,7%	155,7%	97,5%

Table 2 – (Continued)

Bank Name	Bank's Home Country	RWA (million €)	Tier-1 Ratio	Sovereign exposure / Tier-1 Capital	PIIGS debt Exposure / Tier-1 Capital	PIIGS debt Exposure / Total Sovereign Exposure
ING BANK NV	NL	366922	8,87%	257,1%	27,5%	10,7%
RABOBANK NEDERLAND	NL	247093	11,78%	159,7%	3,8%	2,4%
SNS BANK NV	NL	23057	7,31%	434,3%	60,7%	14,0%
CAIXA GERAL DE DEPÓSITOS, SA	PT	78810	7,75%	130,6%	111,4%	85,2%
BANCO COMERCIAL PORTUGUÊS, SA (BCP OR MILLENNIUM BCP)	PT	63618	4,83%	273,2%	221,8%	81,2%
ESPÍRITO SANTO FINANCIAL GROUP, SA (ESFG)	PT	74543	5,85%	160,5%	70,3%	43,8%
Banco BPI, SA	PT	26838	7,63%	349,9%	267,5%	76,4%
Nordea Bank AB (publ)	SE	212930	9,27%	179,2%	0,8%	0,5%
Skandinaviska Enskilda Banken AB (publ) (SEB)	SE	89200	11,02%	321,8%	6,3%	2,0%
Svenska Handelsbanken AB (publ)	SE	105712	8,21%	248,4%	0,0%	0,0%
Swedbank AB (publ)	SE	84558	9,06%	36,5%	0,0%	0,0%

Table 3 – Robustness to parameter changes (Sovereign rating downgrades). This table reports the effect on post-event cumulative abnormal returns (CAR) of a change of parameters. Events used are sovereign credit rating downgrades. Grayed zone show the specification used in our main tests for comparaison.

* designate a significant CAR from the start of the window until X days after the events, using a 95% confidence interval

¤ designate a significant CAR, but looking only at the CAR after the actual event, from T=0 (event announcement) to T= X, using a 95% confidence interval

				CAR at T=X days after the events				
EVENTS	**MARKET PROXY**	**BUFFER (days)**	**ESTIMATION WINDOW (days)**	**T=1**	**T=2**	**T=3**	**T=4**	**T=5**
Negative events (downgrade)	**iTraxx Europe Main Index (5 years)**	0	120	0.0077*	0.0089*	0.0080*	0.0116*	0.0068*
		5	120	0.0103*	0.0118*	0.0111*	0.0150*	0.0104*
		20	120	0.0109*	0.0126*	0.0101*	0.0138*	0.0088*
		10	60	0.0139*	0.0163*	0.0160*	0.0201*¤	0.0175*
		10	120	0.0102*	0.0117*	0.0101*	0.0138*	0.0090*
		10	180	0.0152*	0.0176*	0.0146*	0.0187*	0.0142*
	iTraxx Europe Financial Index (5 years)	0	120	0.0017	0.0050*	0.0047	0.0050	0.0024
		5	120	0.0033	0.0069*	0.0072*	0.0077*	0.0052
		20	120	0.0026	0.0058*	0.0066*	0.0069*	0.0044
		10	60	0.0060*	0.0106*	0.0110*	0.0124*	0.0103*
		10	120	0.0030	0.0063*	0.0067*	0.0071*	0.0047
		10	180	0.0090*	0.0123*	0.0124*	0.0133*	0.0109*
	iTraxx Europe non-Financial Index (5 years)	0	120	0.0037	0.0070*	0.0021	0.0053	-0.002¤
		5	120	0.0066*	0.0104*	0.0054*	0.0090*	0.0017
		20	120	0.0074*	0.0116*¤	0.0050	0.0086*	0.0012
		10	60	0.0116*	0.0154*	0.0116*	0.0152*	0.0103*
		10	120	0.0066*	0.0104*	0.0046	0.0080*	0.0007
		10	180	0.0116*	0.0167*¤	0.0104*	0.0147*	0.0079*

Table 4 – Robustness to parameter changes (Sovereign bailouts). This table reports the effect on post-event cumulative abnormal returns (CAR) of a change of parameters. Events used are sovereign bailouts. Grayed zone show the specification used in our main tests for comparaison.

* designate a significant CAR from the start of the window until X days after the events, using a 95% confidence interval

¤ designate a significant CAR, but looking only at the CAR after the actual event, from T=0 (event announcement) to T= X, using a 95% confidence interval

				CAR at T=X days after the events				
EVENTS	**MARKET PROXY**	**BUFFER (days)**	**ESTIMATION WINDOW (days)**	**T=1**	**T=2**	**T=3**	**T=4**	**T=5**
Positive events (bailouts)	**iTraxx Europe Main Index (5 years)**	0	120	0.0259*	0.0117*¤	0.0139*¤	0.0097*¤	0.0177*¤
		5	120	0.0277*	0.0138*¤	0.0165*¤	0.0132*¤	0.0217*
		20	120	0.0338*	0.0194*¤	0.0223*¤	0.0215*¤	0.0315*
		10	60	0.0232*	0.0093*¤	0.0098*¤	0.0016¤	0.0072¤
		10	120	0.0279*	0.0140*¤	0.0170*¤	0.0140*¤	0.0227*
		10	180	0.0356*	0.0220*¤	0.0266*¤	0.0274*¤	0.0384*
	iTraxx Europe Financial Index (5 years)	0	120	0.0185*	0.0110*¤	0.0077¤	0.0021¤	0.0059¤
		5	120	0.0181*	0.0119*¤	0.0087¤	0.0020¤	0.0052¤
		20	120	0.0222*	0.0161*¤	0.0136*¤	0.0077¤	0.0116*¤
		10	60	0.0127*	0.0062¤	-0.0006¤	-0.012*¤	-0.011*¤
		10	120	0.0176*	0.0122*¤	0.0089¤	0.0014¤	0.0042¤
		10	180	0.0238*	0.0185*¤	0.0174*¤	0.0132*¤	0.0183*¤
	iTraxx Europe non-Financial Index (5 years)	0	120	0.0322*	0.0127*¤	0.0145*¤	0.0139*¤	0.0223*¤
		5	120	0.0359*	0.0166*¤	0.0188*¤	0.0202*¤	0.0299*
		20	120	0.0414*	0.0219*¤	0.0244*¤	0.0284*¤	0.0397*
		10	60	0.0335*	0.0136*¤	0.0144*¤	0.0112*¤	0.0185*¤
		10	120	0.0361*	0.0168*¤	0.0192*¤	0.0212*¤	0.0313*
		10	180	0.0427*	0.0250*¤	0.0295*¤	0.0356*¤	0.0478*

5.11 Annexes

Annex 1 – List of key sovereign events. This annex lists the key sovereign events used in this paper. Some events had to be removed due to their close proximity to other events. See data section for details

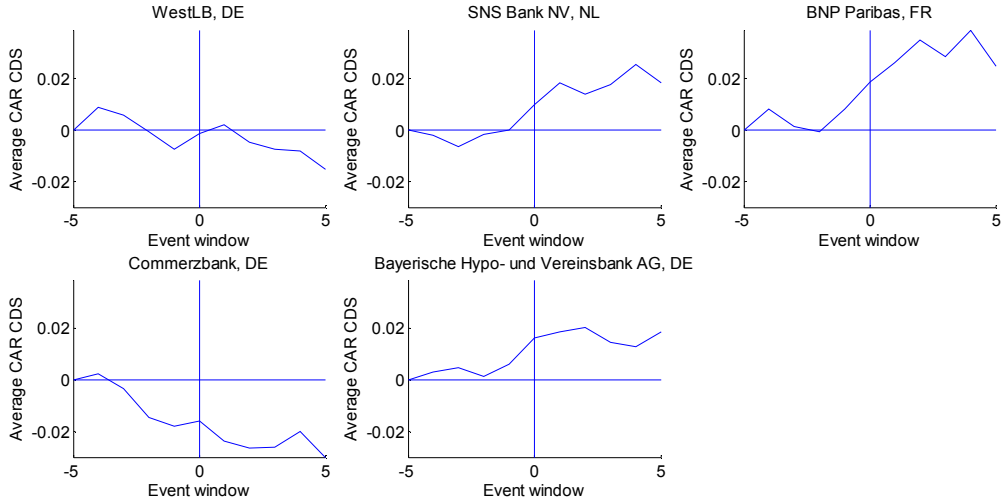
Date	Events	Agency	Type of event	Removed
2009-01-09	Negative outlook on Ireland	S&P	Negative	
2009-01-12	Negative outlook on Spain	S&P	Negative	X
2009-01-13	Negative outlook on Portugal	S&P	Negative	X
2009-01-14	Downgrade of Greece	S&P	Negative	
2009-01-19	Downgrade of Spain	S&P	Negative	
2009-01-21	Downgrade of Portugal	S&P	Negative	X
2009-02-25	Negative outlook on Greece	Moody's	Negative	
2009-03-30	Downgrade of Ireland	S&P	Negative	
2009-06-08	Downgrade of Ireland	S&P	Negative	
2009-10-29	Negative outlook on Portugal	Moody's	Negative	
2009-11-04	Downgrade of Ireland	Fitch	Negative	
2009-12-08	Downgrade of Greece	Fitch	Negative	
2009-12-09	Negative outlook on Spain	S&P	Negative	X
2009-12-16	Downgrade of Greece	S&P	Negative	
2009-12-22	Downgrade of Greece	Moody's	Negative	
2010-02-09	Germany and EU consider loan guarantee for Greece	---	Positive	
2010-02-11	EU President announce deal to help Greece	---	Positive	X
2010-03-15	EMU agrees to help Greece	---	Positive	
2010-03-18	Greece's president ask EU leaders for 'standby loans'	---	Positive	X
2010-03-24	Downgrade of Portugal	Fitch	Negative	X
2010-03-25	EU Leaders for joint help with the IMF to bailout Greece	---	Positive	
2010-04-11	Details of the EU-IMF plans are made public	---	Positive	
2010-04-22	Downgrade of Greece	Moody's	Negative	
2010-04-23	Greece officially asks to be bailed out	---	Positive	X
2010-04-27	Downgrade of Greece and Portugal	S&P	Negative	
2010-04-28	Downgrade of Spain	S&P	Negative	X

Annex 1 – (Continued)

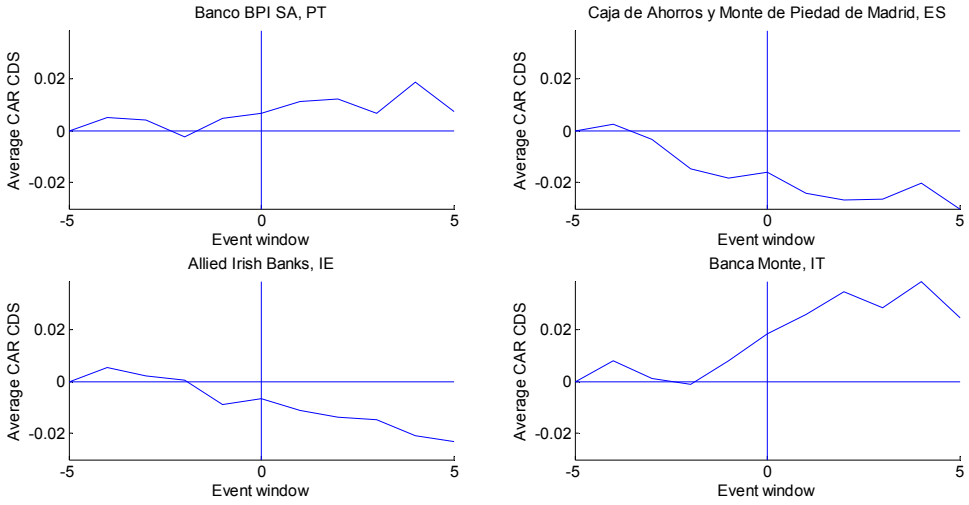
Date	Events	Agency	Type of event	Removed
2010-05-05	Portugal under review for downgrade	Moody's	Negative	
2010-05-09	EU agrees on a 750 billion euros rescue fund (EFSF)	---	Positive	
2010-05-29	Downgrade of Spain	Fitch	Negative	
2010-06-14	Downgrade of Greece	Moody's	Negative	
2010-07-13	Downgrade of Portugal and Ireland	Moody's	Negative	
2010-08-24	Downgrade of Ireland	S&P	Negative	
2010-09-30	Downgrade of Spain	Moody's	Negative	
2010-10-06	Downgrade of Ireland	Fitch	Negative	
2010-11-28	EU bails out Ireland	---	Positive	
2011-01-14	Downgrade of Greece	Fitch	Negative	
2011-03-02	Downgrade watch on Portugal and Greece	S&P	Negative	
2011-03-07	Downgrade of Greece	Moody's	Negative	
2011-03-24	Downgrade of Portugal	Fitch	Negative	
2011-03-29	Downgrade of Portugal and Greece	S&P	Negative	
2011-04-05	Downgrade of Portugal	Moody's	Negative	
2011-04-06	Portugal asks to be bailed out	---	Positive	X
2011-04-15	Downgrade of Ireland	Moody's	Negative	
2011-05-17	Portugal agrees with EU and IMF to a 78B Euro bailout	---	Positive	

Annex 2 – CAR of selected banks around sovereign downgrades. These graphics show the cumulative abnormal return of banks CDS around sovereign rating downgrades. The banks represented are those that make the forth quartile of Figure 3b (Banks with the highest relative PIIGS exposure as a percentage of their Tier-1 capital). Event windows (10 days) are centered on the actual date of the events' announcements.

CAR of selected NON-PIIGS banks around sovereign downgrades

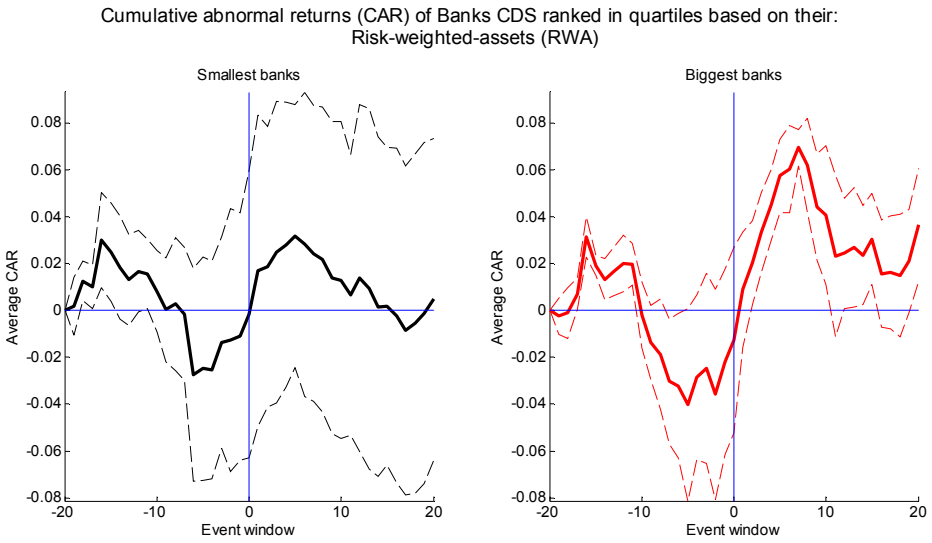


CAR of selected PIIGS-based banks around sovereign downgrades

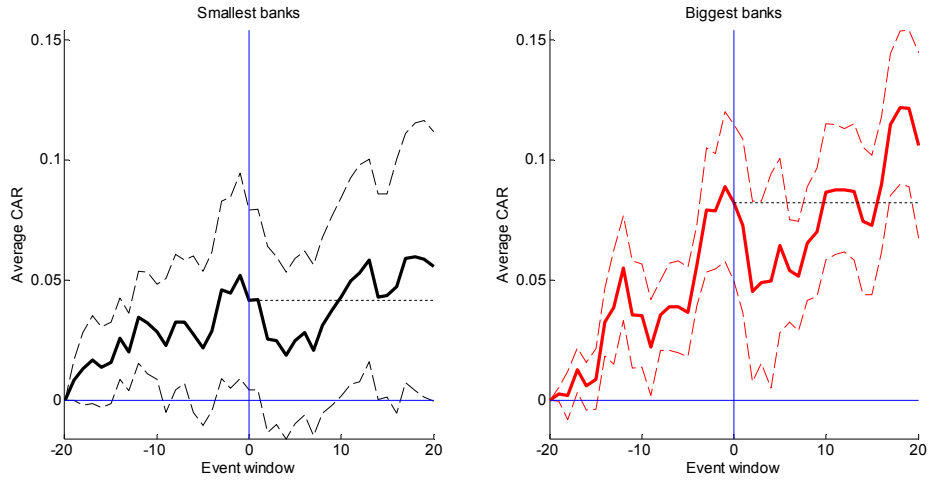


Annex 3 –NON-PIIGS Banks' CAR around sovereign events, ranked by banks' RWA (±20 days event window. This figure shows the reaction of NON-PIIGS banks CDS to sovereign events, separating banks in quartiles based on their Risk-Weighted-Assets (RWA). The top portion looks at banks reaction to sovereign credit rating downgrades issued by S&P while the bottom one looks as their reaction to sovereign bailouts. The dashed lines show the 95% confidence interval. Event window goes from 20 days before the bailout announcements to 20 days after them.

Events used: Sovereign credit downgrades by S&P



Events used: Sovereign bailouts



6. Conclusion

Dans cette étude, nous avons analysé les impacts sur le système bancaire européen de l'augmentation du risque de défaut souverain en Europe. Pour ce faire, nous avons d'abord analysé la dynamique de la relation entre le risque de crédit des banques et celui des gouvernements. Ensuite, nous avons porté notre attention sur l'impact de divers événements ponctuels affectants le risque de crédit souverain sur le risque de crédit des banques.

Nos résultats démontrent que, globalement, la sensibilité des CDS bancaire au risque de crédit souverain a fortement diminuée durant la crise de dette souveraine, au profit d'une augmentation de la sensibilité au risque systémique. Certains événements affectant le risque de crédit souverains ont toutefois un impact sur le risque bancaire, comme les diminutions de cote de crédit émises par Standard & Poor's. Les annoncent de plan de sauvetage des PIIGS ont aussi un impact sur le risque de crédit des banques, mais celui-ci ne dure que quelques jours.

Nos résultats démontrent aussi que le lien entre les banques étrangères et le risque de crédit souverain ne dépend pas de la quantité de dette souveraine détenue par les banques durant une crise de dette souveraine. Le potentiel de perte sur cette dette a toutefois un impact significatif sur leur relation, mais seulement lorsqu'on applique cette perte sur la portion de dette détenue dans le portefeuille d'échange des banques. Nous croyons que ceci n'est pas dû à une peur de perte directe sur leurs positions puisque les banques peuvent facilement couvrir les risques de défaut souverain par l'achat d'instruments financiers, tel les CDS. Nos résultats sont toutefois compatibles avec un impact de la réduction de la valeur de la dette pouvant être donné en garantie pour obtenir des liquidités de la Banque Centrale Européenne. Un défaut de l'un des PIIGS pourrait avoir un impact majeur sur l'économie européenne et mondiale mais, contrairement à la croyance populaire, la contagion ne devrait pas passer par la dette souveraine des PIIGS détenue par les banques.

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