


UNIVERSITEIT GENT

FACULTY OF **ECONOMICS**
**AND BUSINESS ADMINISTRATION**

# Bank/Sovereign Risk Spillovers during the European Debt Crisis

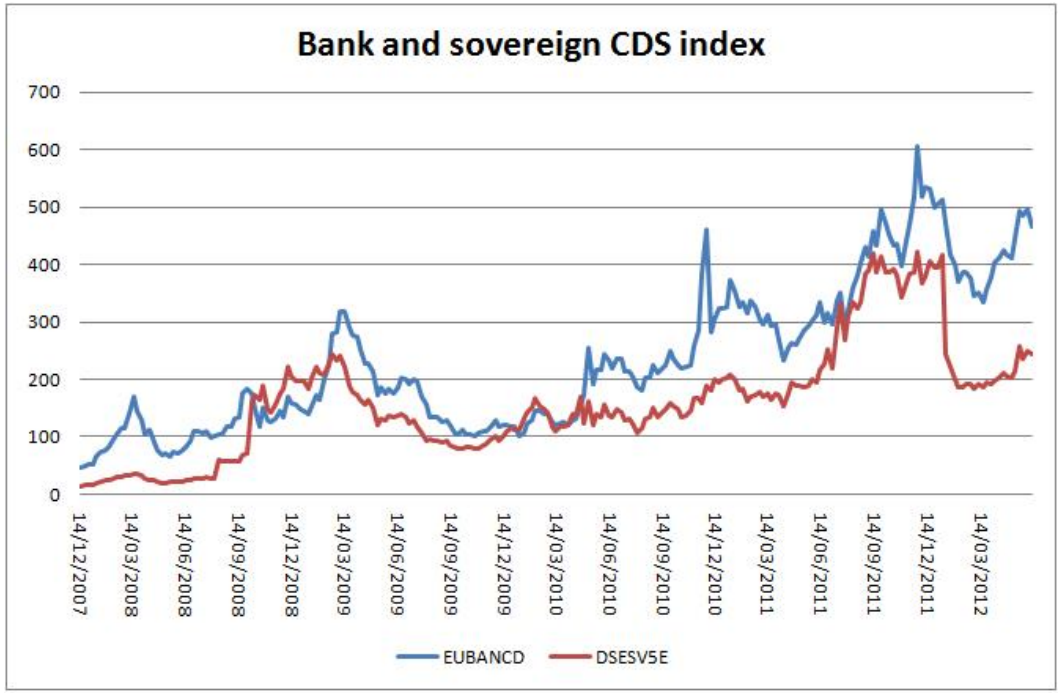
Valerie De Bruyckere, Maria Gerhardt ,Glenn Schepens ,Rudi Vander Vennet

National Bank of Belgium, 2012 Colloquium

October 11th

# Motivation

1. Since the start of the financial crisis, **strong interconnection** between bank credit risk and sovereign credit risk



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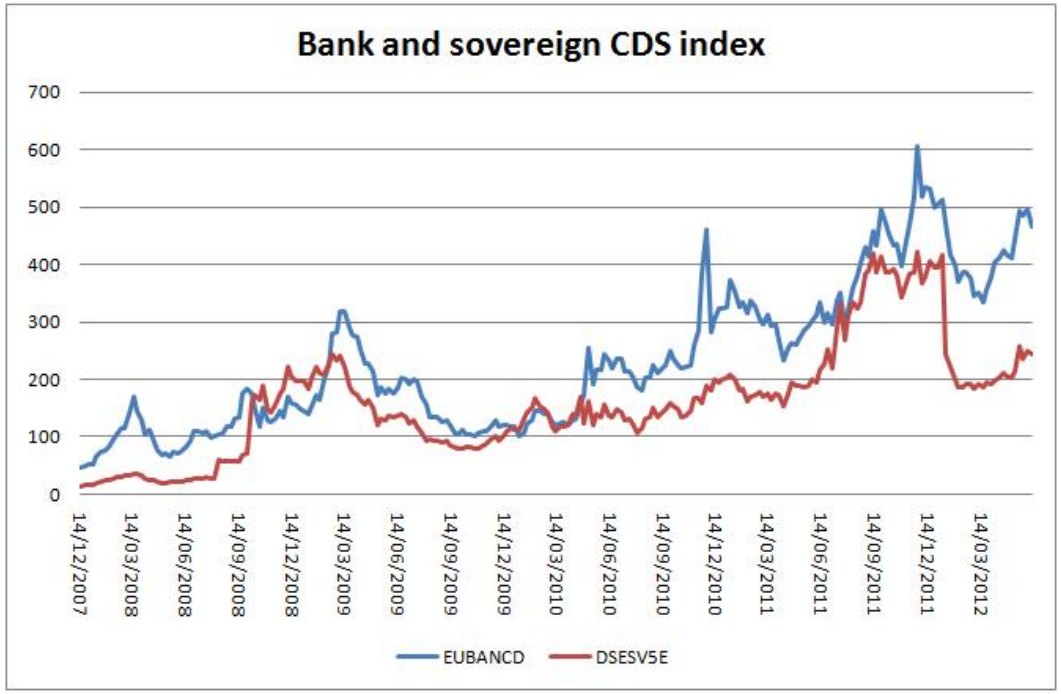


- Large underlying heterogeneity
  Yearly correlation of a bank with its home country in our sample ranges between -0.35 and 0.68
- Cross-border crisis
  In contrast to previous sovereign debt and financial crises

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2. Four main risk **transmission channels** (BIS, 2011)
   - Asset holdings channel (see, e.g. Angeloni and Wolff, 2012)
   - Collateral channel
   - Guarantee channel (see, e.g. Demirguc-Kunt and Huizinga, 2011)
   - Rating channel (see, e.g., Arezki et al.,2011)

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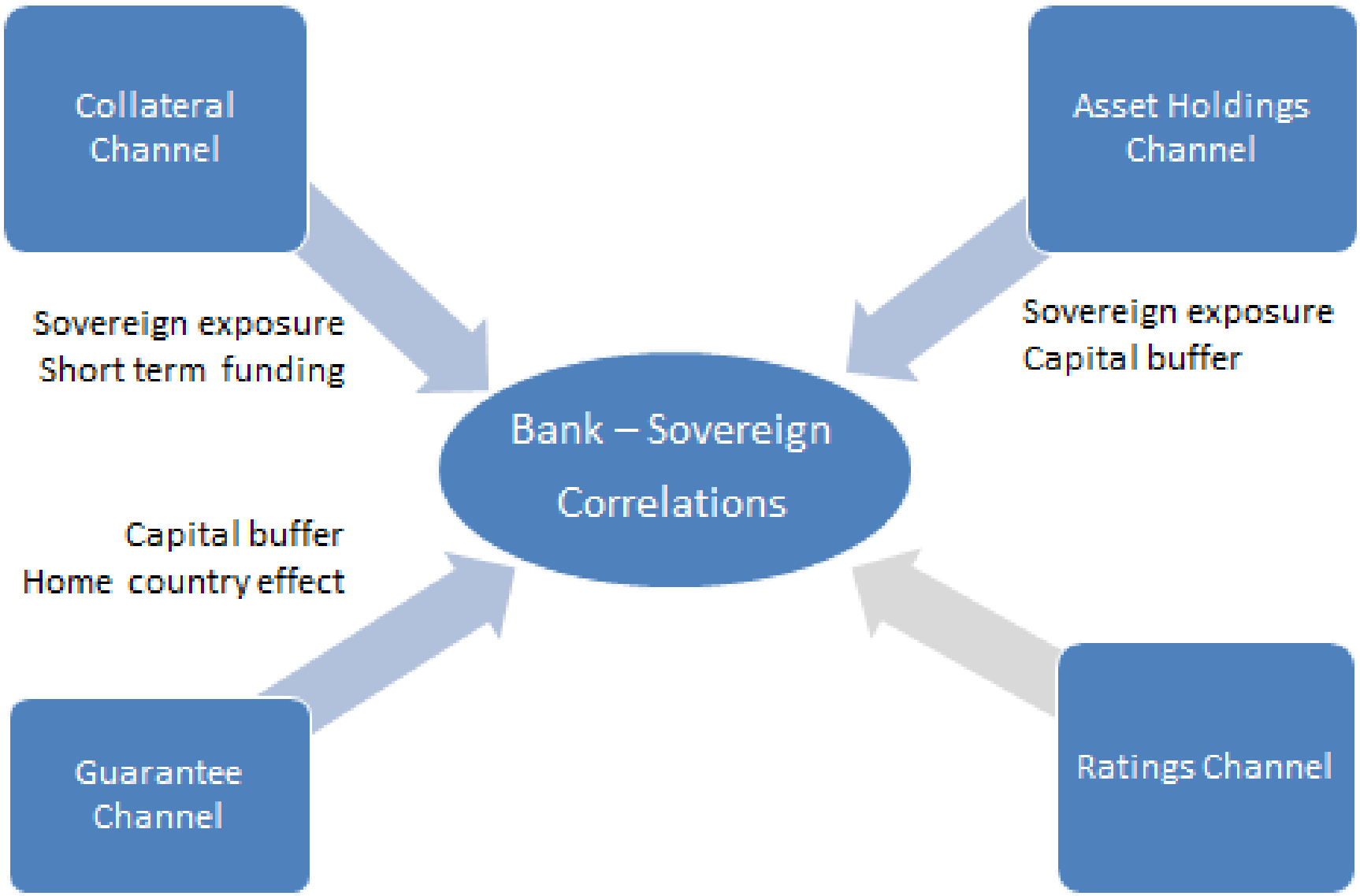
Collateral Channel
Asset Holdings Channel
Sovereign exposure
Short term funding
Sovereign exposure
Capital buffer
Bank – Sovereign Correlations
Capital buffer
Home country effect
Guarantee Channel
Ratings Channel

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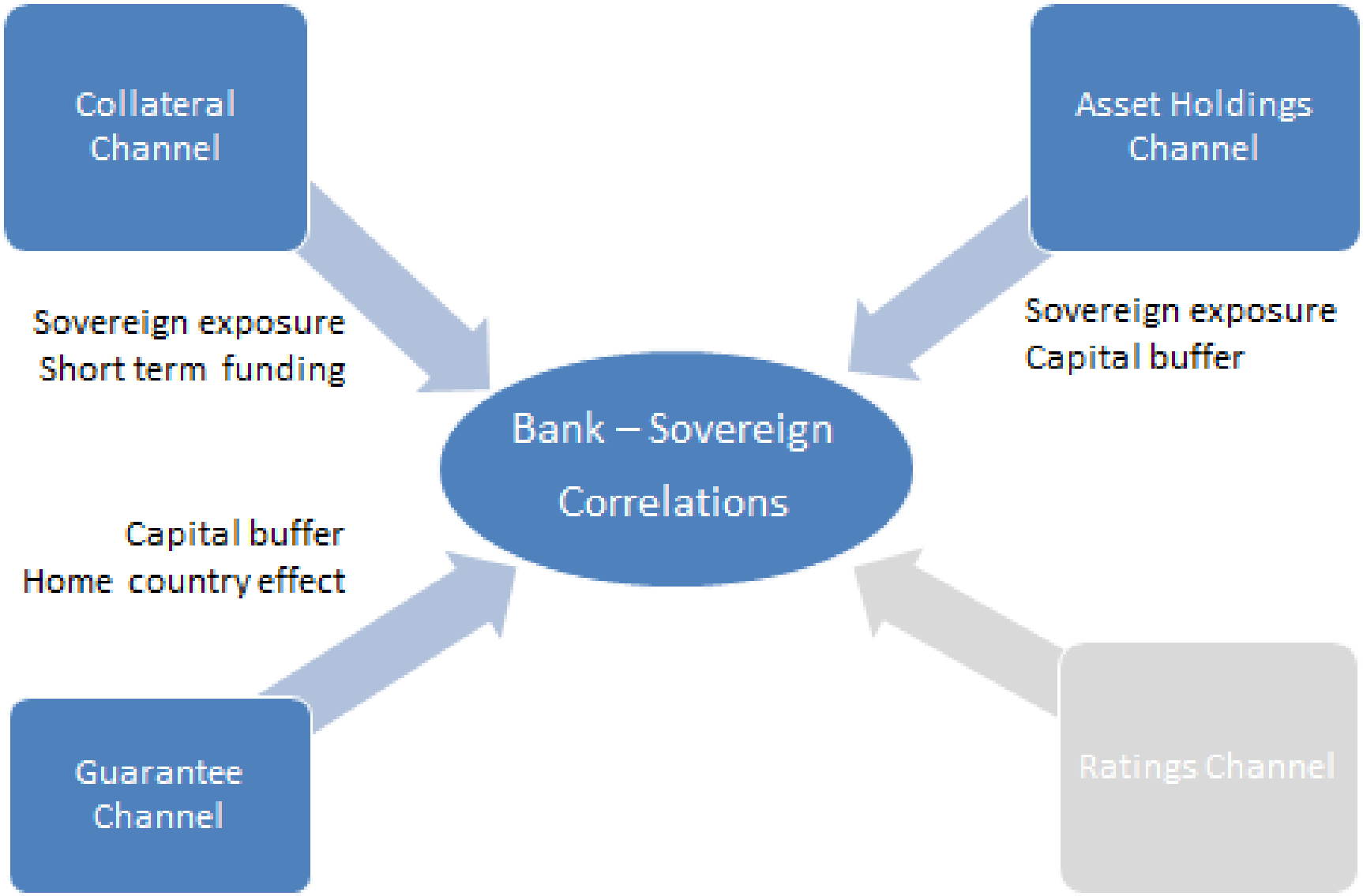
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3. Lively **policy debate** on how to reduce this interconnectedness (e.g. banking union)

4. However, **limited theoretical and empirical evidence** on credit risk spillovers between banks and sovereigns and how to explain them

# This paper

Investigates credit risk contagion between banks and sovereigns in Europe

1. Do we find **evidence** of credit risk spillovers?
2. Which **characteristics** influence the intensity of risk spillovers?

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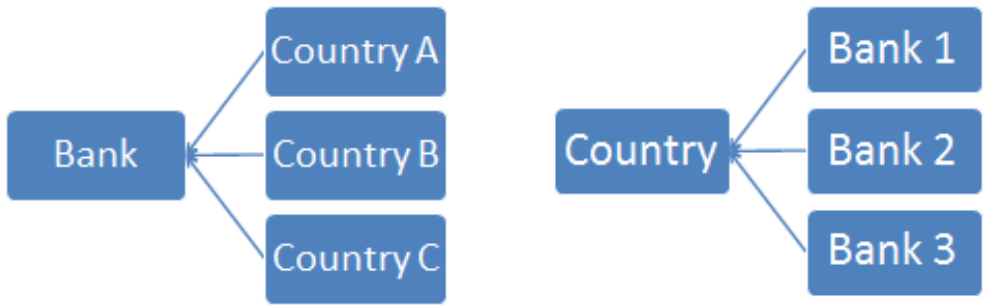
Investigates credit risk contagion between banks and sovereigns in Europe

1. Do we find **evidence** of credit risk spillovers?
2. Which **characteristics** influence the intensity of risk spillovers?
   - Home bias?
   - Bank-specific and country-specfic determinants
   - Interplay between bank business models and sovereign risk
   - We exploit the fact that we have multiple observations for each bank/country at each point in time



# Main Findings

- Significant evidence of **increased contagion** between banks and countries during the recent crisis
- Strong **home country bias** (guarantee channel)
- High **capital** buffers lead to less intense spillovers (asset holdings channel)
  - One standard deviation increase in Tier 1 ratio reduces the excess bank-country correlation from 17% to around 14%
  - One standard deviation increase in Tier 1 ratio reduces the impact of a standard deviation increase in sovereign credit risk on bank-country correlation with 35%
- Lower reliance on **short term funding** also decreases spillover intensity (collateral channel)
- Higher **debt-to-GDP ratios** increase the level of contagion
- Higher **sovereign debt holdings** lead to higher excess correlations (asset holdings channel)

# Sample

- 15 European countries: Italy, Ireland, Spain, Germany, UK, Portugal, Greece, Belgium, Sweden, Norway, Denmark, Austria, the Netherlands, France, Switzerland
- 53 European banks
- Measure of credit risk: 5-year CDS spreads (Bloomberg, CMA)
- 2006 Q1 - 2011 Q3
- Quarterly bank balance sheet data from Worldscope
- Country-specific characteristics from various international sources (e.g. Eurostat, Oxford Economics)
- Sovereign exposure from the EBA stress tests (July 2010 and July 2011)

# Measuring contagion

- Bekaert et al. (2005)

"We define contagion as excess correlation, that is, correlation over and above what one would expect from economic fundamentals."
Linear factor model for bank credit risk:

$$\Delta CDS_{b,t} = \beta_b F + \varepsilon_{b,t}$$

Linear factor model for sovereign credit risk:

$$\Delta CDS_{c,t} = \beta_c F + \varepsilon_{c,t}$$

Correlation between bank and sovereign credit risk:

$$\begin{aligned} E[\Delta CDS_{b,t} \Delta CDS_{c,t}^{'}] &= E[(\beta_b F' + \varepsilon_b)(\beta_c F' + \varepsilon_c)'] \\ &= \beta_b E[F'F]\beta_c' + E[\varepsilon_b \varepsilon_c'] \end{aligned}$$

# Common Factors

Three potential determinants of bank-sovereign correlations:

1. exposure to common factors
2. correlation between the common factors
3. correlation between unexplained CDS spread changes $=$"*contagion*"

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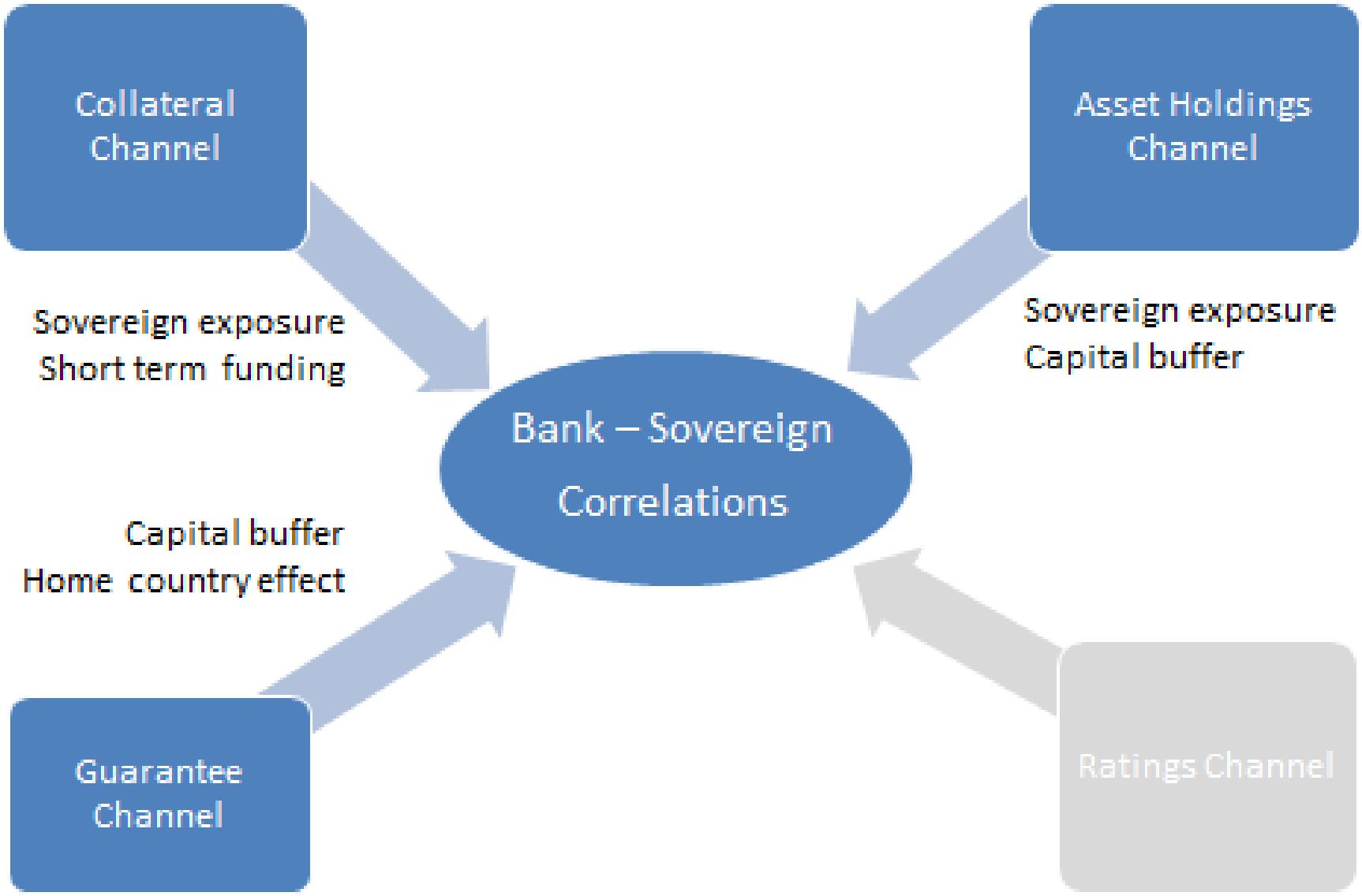
| | 2006 | | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **coef** | **% sign** | **coef** | **% sign** | **coef** | **% sign** | **coef** | **% sign** | **coef** | **% sign** | **coef** | **% sign** |
| **MARKET** | -0.0436 | 0.00% | -0.2865 | 0.00% | 0.0669 | 6.52% | -0.2347 | 0.00% | -0.1503 | 3.77% | -0.2918 | 0.00% |
| **ITRAXX** | 0.0402 | 13.64% | 0.7490 | 96.77% | 0.6365 | 91.30% | 0.4010 | 86.27% | 0.4400 | 92.45% | 0.4772 | 84.91% |
| **VSTOXX** | -0.0065 | 0.00% | -0.0784 | 0.00% | 0.0705 | 8.70% | -0.0735 | 0.00% | -0.0022 | 5.66% | -0.0572 | 0.00% |
| **TERM** | 0.0217 | 4.55% | 0.0485 | 6.45% | -0.0784 | 0.00% | 0.0080 | 5.88% | 0.0126 | 18.87% | 0.0232 | 32.08% |
| **# banks** | 22 | | 31 | | 46 | | 51 | | 53 | | 53 | |
| **adj. R** | 0% | | 32% | | 33% | | 18% | | 32% | | 29% | |

# Measuring contagion



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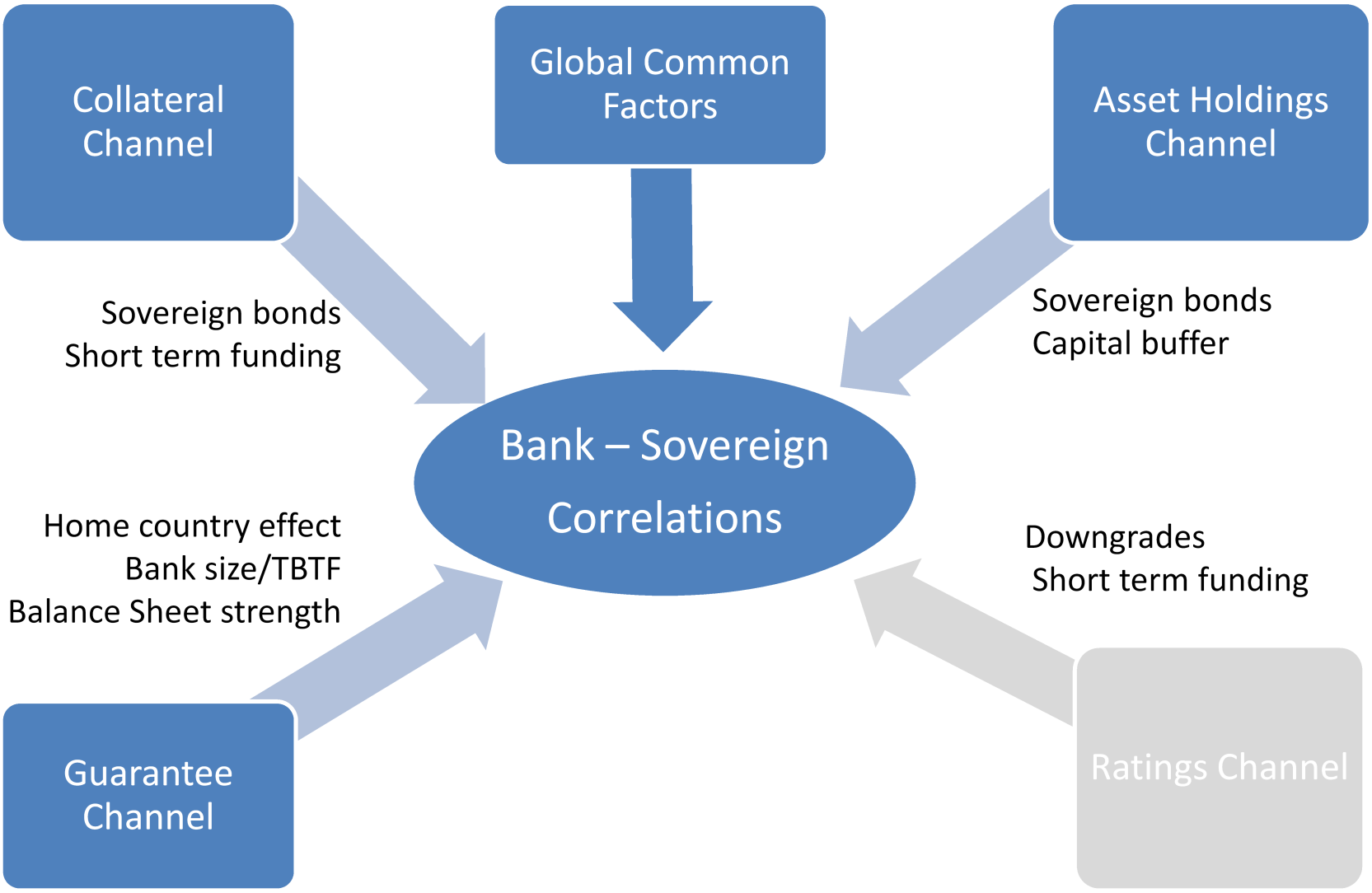

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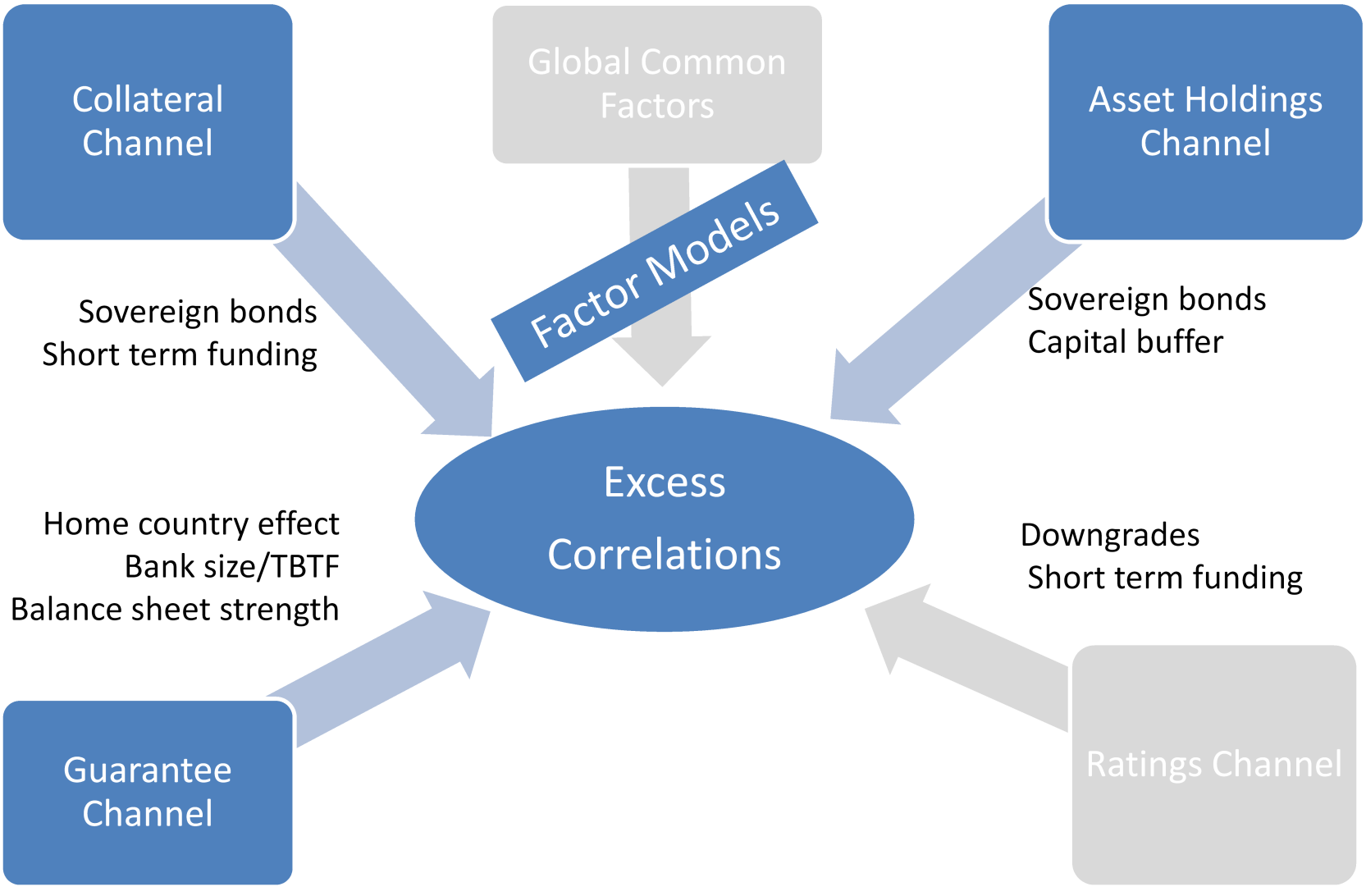

# Contagion - Results

| BASE YEAR: 2007 | | | |
|---|---|---|---|
| HOME | | | |
| | significant | total | % significant |
| 2007 | | Base year | |
| 2008 | 3 | 14 | 21% |
| 2009 | 12 | 14 | 86% |
| 2010 | 9 | 14 | 64% |
| 2011 | 5 | 14 | 36% |
| FOREIGN | | | |
| | significant | total | % significant |
| 2007 | | Base year | |
| 2008 | 45 | 172 | 26% |
| 2009 | 130 | 172 | 76% |
| 2010 | 108 | 172 | 63% |
| 2011 | 67 | 172 | 39% |

# Explaining contagion

Three specific questions:

1. Is there a **home country bias**?
   - Bailout probability
   - Sovereign bond exposure
   - Fiscal consolidation

# Home-country effect

| VARIABLES | (1) Full sample Excess Correl. | (2) non-GIIPS Excess Correl. | (3) GIIPS Excess Correl. |
|---|---|---|---|
| Home Dummy | 3.203*** | 2.407*** | 4.469*** |
| | (0.584) | (0.815) | (0.974) |
| Constant | 15.51*** | 15.55*** | 15.97*** |
| | (0.188) | (0.143) | (0.0808) |
| Observations | 7224 | 6997 | 2737 |
| R-squared | 0.635 | 0.635 | 0.663 |
| Bank-Time FE | YES | YES | YES |
| cluster | bank | bank | bank |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

- Correlation with home country is stronger than average correlation with other countries

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2. Which **bank characteristics** matter for the intensity of contagion?
   - We analyze the impact of bank size, capital buffers, funding structure, asset structure, income diversification and sovereign bond holdings

# Bank Characteristics - country FE

| VARIABLES | (1)<br>Excess Correl. | (2)<br>Excess Correl. | (3)<br>Excess Correl. |
|---|---|---|---|
| Size | 1.441** | 1.369** | 0.0384 |
| | (0.632) | (0.650) | (0.710) |
| Size x Home | | 0.926 | |
| | | (2.642) | |
| Tier 1 Ratio | -1.110* | -1.230** | -3.078*** |
| | (0.604) | (0.621) | (0.788) |
| Tier 1 x Home | | 1.108 | |
| | | (2.467) | |
| Loan to Assets ratio | -0.527 | -0.491 | -1.681** |
| | (0.622) | (0.637) | (0.840) |
| Loan to Assets ratio x Home | | -0.531 | |
| | | (2.639) | |
| Funding risk | 1.802*** | 1.907*** | 1.841*** |
| | (0.405) | (0.420) | (0.547) |
| Funding risk x Home | | -1.144 | |
| | | (1.547) | |
| Income diversification | 0.109 | 0.152 | 1.291* |
| | (0.522) | (0.542) | (0.664) |
| Income diversification x Home | | -0.576 | |
| | | (2.003) | |
| EBA Country Exposures | | | 0.652 |
| | | | (1.083) |
| Constant | 17.38*** | 17.39*** | 19.16*** |
| | (1.34e-07) | (0.0242) | (0.361) |
| Observations | 3016 | 3016 | 1349 |
| R-squared | 0.788 | 0.788 | 0.700 |
| Home–Foreign-Time FE | YES | YES | YES |
| cluster | Home–Foreign-Time | Home–Foreign-Time | Home–Foreign-Time |

# Bank Characteristics - country FE

- Banks with larger capital buffers have lower excess correlations with sovereigns
  - A one standard deviation increase of the Tier 1 ratio decreases excess correlations with 1.1-3.3 percentage points
  - Similar impact when using alternative capital ratio
- Banks with a low portion of short term debt exhibit lower correlations
  - A one standard deviation decrease of the short term debt ratio lowers excess correlations with 1.8 percentage points
- Retail orientation and income diversification become significant from 2010 onwards, change in risk perception
- No difference in impact for home country compared to other countries

# Bank Characteristics - bank FE

| VARIABLES | (1) Excess Correl. | (2) Excess Correl. | (3) Excess Correl. | (4) Excess Correl. | (5) Excess Correl. |
|---|---|---|---|---|---|
| Sovereign CDS spread | 1.756** | 1.471* | 1.446* | 1.952** | 1.419* |
| | (0.777) | (0.842) | (0.839) | (0.779) | (0.835) |
| Sovereign CDS spread _Squared | -0.723*** | -0.630*** | -0.598*** | -0.698*** | -0.586*** |
| | (0.148) | (0.157) | (0.162) | (0.150) | (0.161) |
| EBA Country Exposures | | 1.478*** | 1.240*** | | 1.243*** |
| | | (0.323) | (0.351) | | (0.356) |
| Sovereign CDS x | | | 0.801* | | 0.848* |
| EBA Country Exposures | | | (0.443) | | (0.453) |
| Sovereign CDS x | | | | -0.716** | |
| Tier 1 ratio | | | | (0.302) | |
| Sovereign CDS x | | | | -0.140 | -0.211 |
| Funding risk | | | | (0.313) | (0.273) |
| Sovereign CDS x | | | | -0.178 | 0.493 |
| Loan to Assets ratio | | | | (0.429) | (0.511) |
| Sovereign CDS x | | | | -0.0429 | 0.0261 |
| Income Diversification | | | | (0.393) | (0.494) |
| Sovereign CDS x | | | | 0.193 | -0.341 |
| Size | | | | (0.353) | (0.364) |
| Home dummy | 2.750*** | | | 2.662*** | |
| | (0.855) | | | (0.852) | |
| Sovereign CDS x | 5.488*** | | | 5.396*** | |
| Home | (1.394) | | | (1.394) | |
| Sovereign CDS x | | | | | -0.948** |
| (T1+T2) Capital ratio | | | | | (0.464) |
| Constant | 17.91*** | 19.08*** | 19.01*** | 17.98*** | 19.00*** |
| | (0.167) | (0.111) | (0.130) | (0.171) | (0.128) |
| Observations | 3016 | 1349 | 1349 | 3016 | 1349 |
| R-squared | 0.677 | 0.577 | 0.579 | 0.678 | 0.581 |
| Bank-time FE | YES | YES | YES | YES | YES |
| cluster | Bank-time | Bank-time | Bank-time | Bank-time | Bank-time |

# Bank Characteristics - bank FE

- Excess correlations become stronger as sovereign spreads are higher
- Impact of a rise in CDS spreads is higher for home country banks
- A higher capital ratio can form a buffer for this effect
  - A bank with a Tier 1 ratio of one standard deviation above the average ratio gets a 1.23 percentage points higher excess correlation when the sovereign CDS spread increases by one standard deviation,whereas the excess correlation of a bank with an average Tier 1 ratio increases with 1.95 percentage points
- Higher bond portfolio exposures lead to a higher excess correlations
- Higher bond portfolio exposures lead to a stronger impact of an increase in CDS spreads

# Explaining contagion

Three specific questions:

1. Is there a **home country bias**?
   - Bailout probability
   - Sovereign bond exposure
   - Fiscal consolidation
2. Which **bank characteristics** matter for the intensity of contagion?
   - We analyze the impact of bank size, capital buffers, funding structure, asset structure, income diversification and sovereign bond holdings
3. Which **country characteristics** matter for the intensity of contagion?
   - We analyze the impact of a country‘s fiscal position and the stance of the business cycle

# Country Characteristics

| VARIABLES | (1) Excess Correl. | (2) Excess Correl. | (3) Excess Correl. |
|---|---|---|---|
| Home dummy | 2.884*** | 2.707*** | |
| | (0.897) | (0.939) | |
| Debt to GDP | 1.144*** | 0.953*** | 0.911*** |
| | (0.222) | (0.238) | (0.272) |
| Debt to GDP x | | 2.245** | |
| Home dummy | | (0.883) | |
| Government Revenues | -0.159 | -0.185 | 1.422*** |
| | (0.275) | (0.290) | (0.387) |
| Government Rev enues x | | -0.679 | |
| Home dummy | | (0.895) | |
| Bank sector size | -0.0174 | -0.0169 | 0.442 |
| | (0.241) | (0.248) | (0.332) |
| Bank sector size x | | -0.270 | |
| Home dummy | | (1.011) | |
| Economic Sentiment | 1.564*** | 1.458** | 0.962 |
| | (0.568) | (0.568) | (0.662) |
| Economic Sentiment x | | 0.965 | |
| Home dummy | | (1.111) | |
| EBA exposure | | | 0.0934*** |
| | | | (0.0179) |
| Constant | 17.13*** | 17.12*** | 16.82*** |
| | (0.0755) | (0.0737) | (0.343) |
| Observations | 3016 | 3016 | 1349 |
| R-squared | 0.668 | 0.669 | 0.563 |
| Bank-Time FE | YES | YES | YES |
| cluster | Bank-Time | Bank-Time | Bank-Time |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

# Country Characteristics

- Banks are stronger correlated with countries with higher debt-to-GDP ratios
- Home-country bias still holds, even when controlling for a set of country-specific factors
- Higher debt-to-GDP ratios reinforce home-country bias
  - Excess correlation of a bank in a country with a debt-to-GDP ratio in the 90th percentile is twice as high as the excess correlation of a bank in a country with an average debt-to-GDP ratio
- Higher government revenues positively related to higher excess correlations from 2010 onwards

# Conclusions

- Significant evidence of **increased contagion** between banks and countries during the recent crisis
- Strong **home country bias**
- High **capital** buffers lead to less intense spillovers
  - One standard deviation increase in Tier 1 ratio reduces the excess bank-country correlation from 17% to around 14%
- Lower reliance on **short term funding** also decreases spillover intensity
- Higher **debt-to-GDP ratios** increase the level of contagion
- Higher **sovereign debt holdings** lead to higher excess correlations

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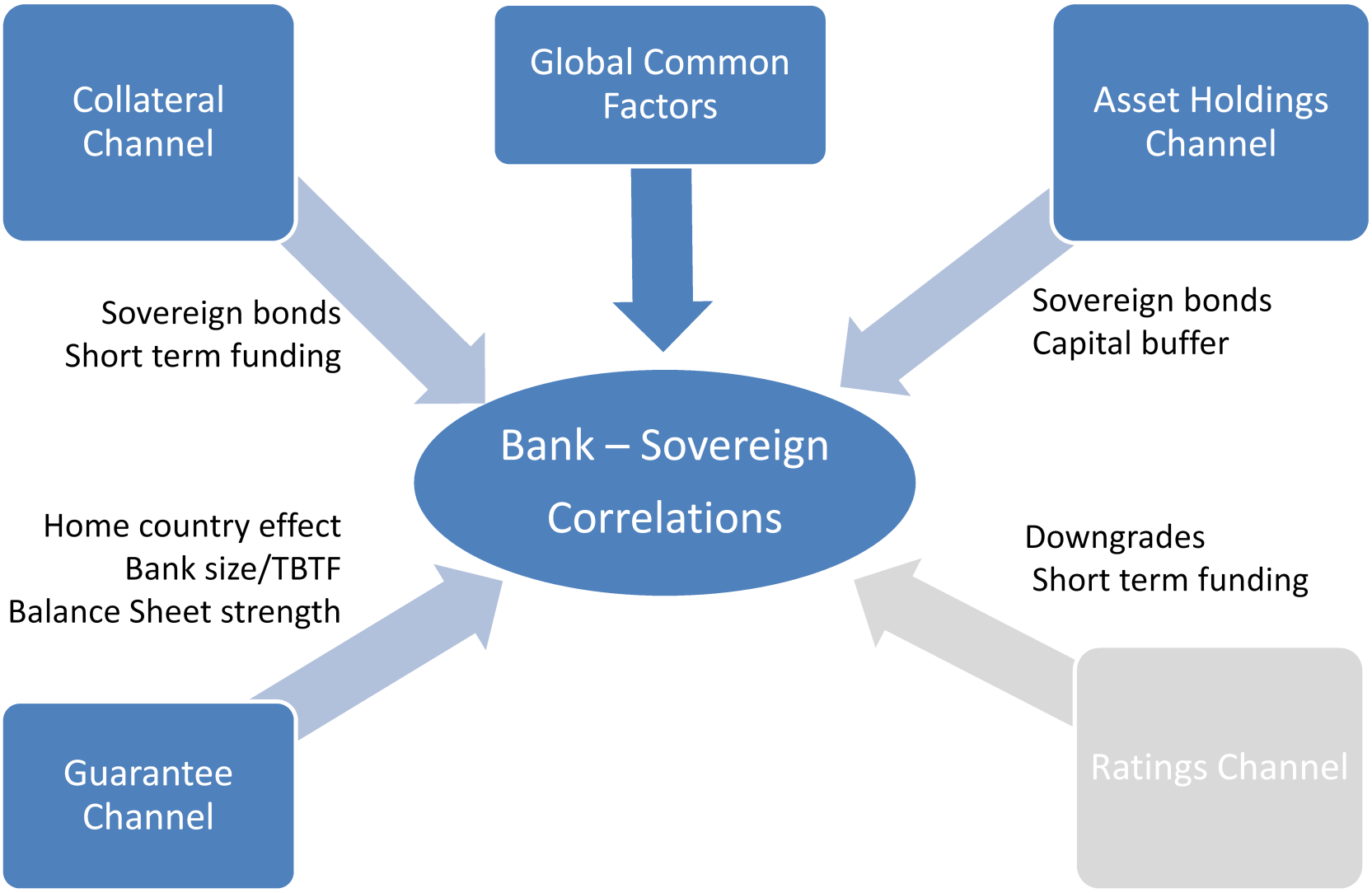

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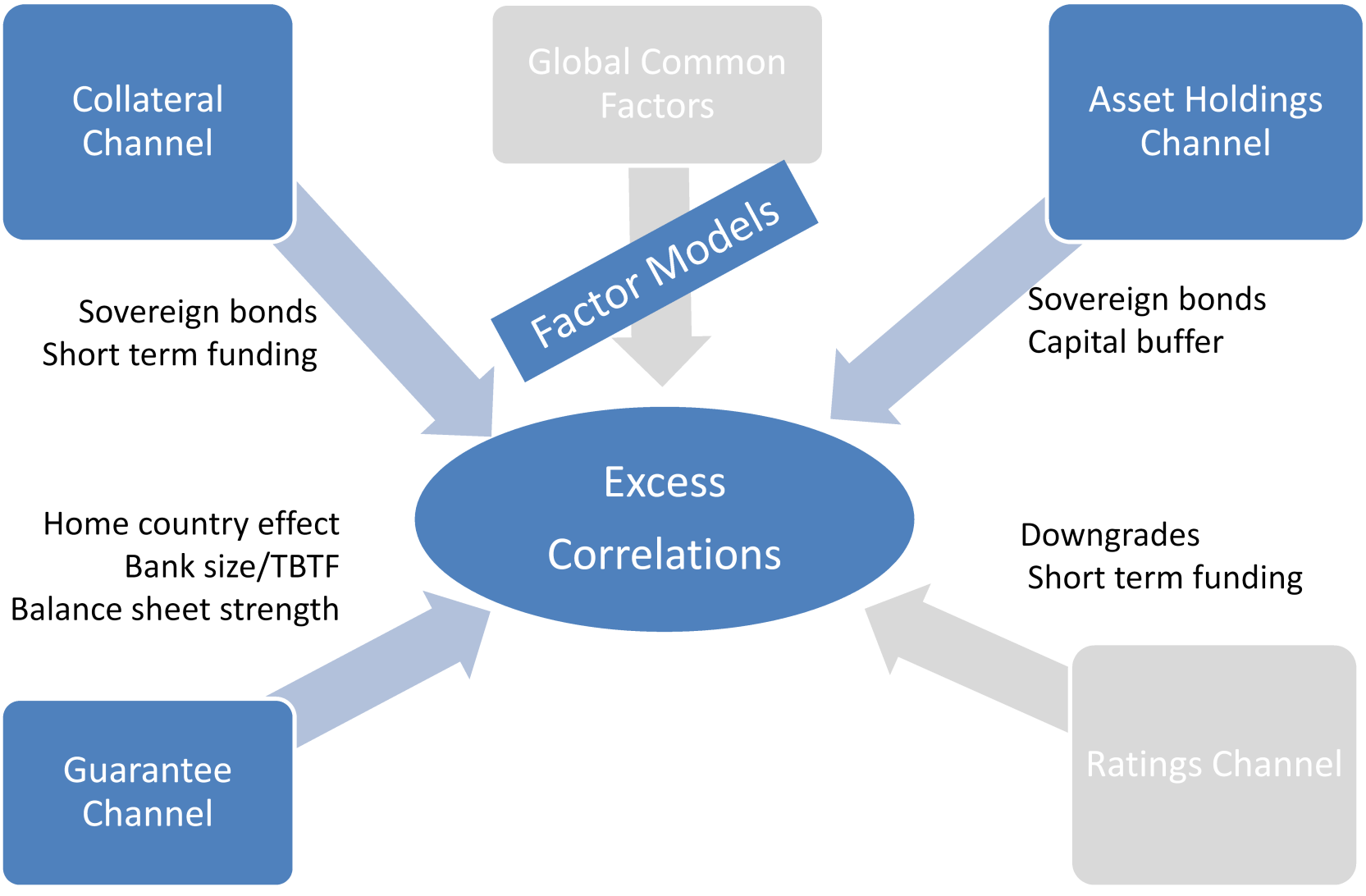

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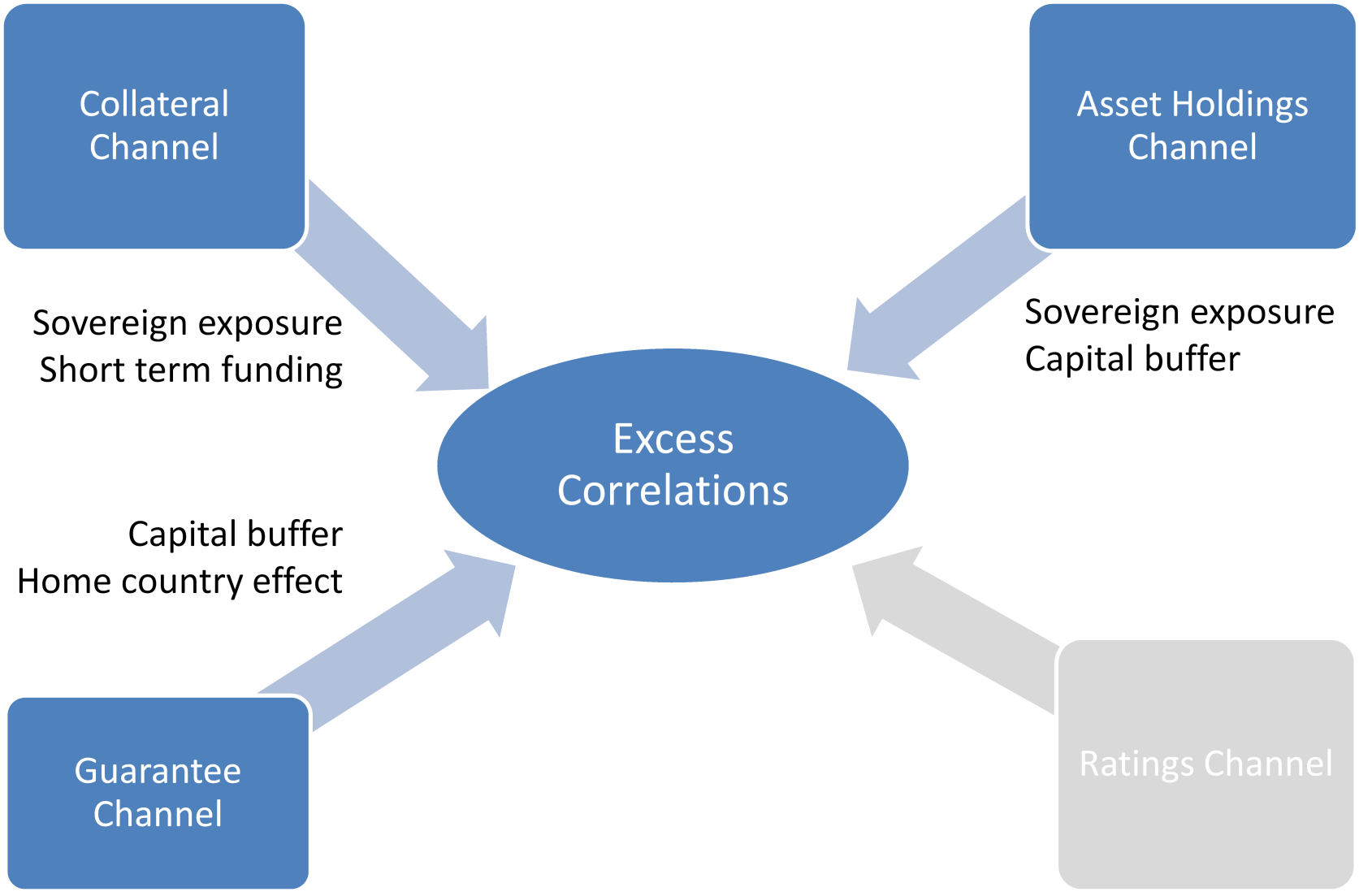


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