Bank Contagion in Europe

EUROPEAN CENTRAL BANK

Reint Gropp and Jukka Vesala

Workshop on "Banking, Financial Stability and the Business Cycle", Sveriges Riksbank, 26-28 August 2004

Research Question

- Analyse cross-border contagion among banks in the EU (to see how banking problems might spread across borders).
- Contagion is defined as transmission of idiosyncratic shocks from one bank (or a group of banks) to other banks.
- Contagion is distinguished from common shocks affecting all banks simultaneously.

Motivation

- Why do we care about contagion?
  - Asses the relative importance of contagion vs. common factors driving systemic risk.
  - Lender-of-last resort function of central banks.
  - Identification of “systemically important banks”.
- Evidence lacking on cross-border contagion and the impact of the single interbank market in euro.

This Paper

- Uses banks' distance-to-default to identify shocks to banks (default risk).
  - Concentrates on the the tail of the distribution ("large shocks") as in Bae, Karolyi - Stulz, 2003; and Gropp - Moerman, 2004.
- Proposes market-based measurement of contagion (that should capture all relevant links between banks).
- Examines spill-over effects during calm times to uncover information that may be indicative of the links in a crisis.
- Proposes a new approach to distinguish common shocks from contagion.
- Estimates the degree of cross-border contagion in the EU; also for pre- and post-euro periods.

Previous Literature

- Theoretical literature:
  - Contagion via the interbank market (Allen - Gale, 2000; Freixas, Parigi - Rochet, 2000) .
  - “Money centre” and other structures where interbank links are concentrated are susceptible to contagion.
  - Contagion arises from liquidity shocks (banks withdraw interbank deposits and/or there is a general liquidity shortage).
  - There might be contagion also in the absence of explicit financial links (Freixas, Parigi - Rochet, 2000).
- Empirical literature:
  - Simulation studies of the impact of interbank credit exposures (e.g. Furfine, 2003; Upper - Worms, 2002; Degryse - Nguyen, 2004).
  - Autocorrelation in bank failures, controlling for macro factors (e.g. Grossman 1993, Schoenmaker 1996); Survival time tests (Calomiris and Mason, 2000).
  - Reaction of stock prices to news (survey by de Bandt and Hartmann, 2001).
  - Extreme value approach (Hartmann, Straetmans - de Vries, 2004).

Identification of Shocks to Banks

- Weekly percentage change in the distance-to-default of banks during 01/1996 - 01/2003:
  - 367 weekly observations per bank.
  - 46 EU banks; 16619 observations total (4 banks: incomplete data).
- We use the negative 95^{th} percentile of the distribution in the spirit of “extreme value theory”.
- We then count the number of “coexceedances” of banks in the tail by countries to identify “candidates” of contagion events.

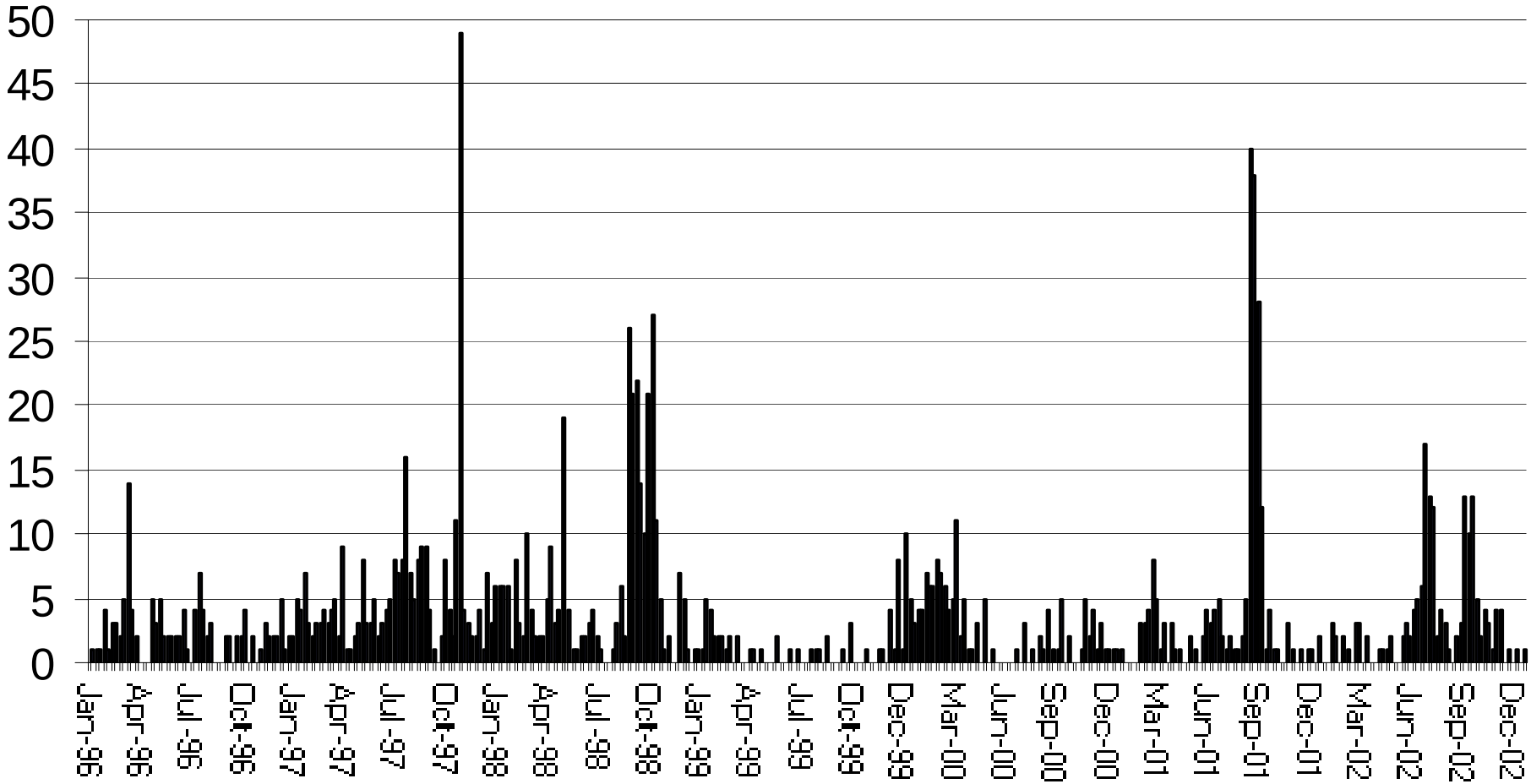
Distance-to-default (dd)

- Combined risk measure of stock returns, asset volatility and leverage.
  - Gropp, Vulpes - Vesala, 2004 show some desirable properties of this measure.
- Equals the number of asset value standard deviations (σ) above the default point.
- Calculation of *dd*s:
  - V and σ calculated from observable equity capital market value (V_E) and volatility (σ_E) using the "Merton formula", then solving for *dd*s.

Sample

	Number of banks	Number of tail events
		95th percentile
Belgium	1	17
Denmark	2	36
Finland	1	11
France	2	38
Germany	6	145
Greece	2	42
Ireland	3	46
Italy	12	215
Netherlands	1	29
Portugal	2	48
Spain	5	106
Sweden	2	27
UK	7	139
Total	46	899

Number of banks in the 95th percentile



Econometric Strategy

- 1st step: Estimate a factor model to extract common components between the number of "coexceedances", industry sector shocks and macro-variables:
  - Gives us explanatory variables, which capture the joint components of "coexceedances" and common shocks, and thus allows the identification of contagion.
- 2nd step: Estimate a multinomial logit-model:

$$\Pr[Y = j] = \frac{e^{\left[\beta_j' F_c + \gamma_j C_{dt-1} + \lambda_j F_d\right]}}{\sum_k^J e^{\left[\beta_k' F_c + \gamma_k C_{dt-1} + \lambda_k F_d\right]}}$$

j = 1,2,3…J: the number of banks in the tail simultaneously ("coexceedances"),

F_c: factors measuring common shocks in country c,

F_d: factors explaining common shocks in country d,

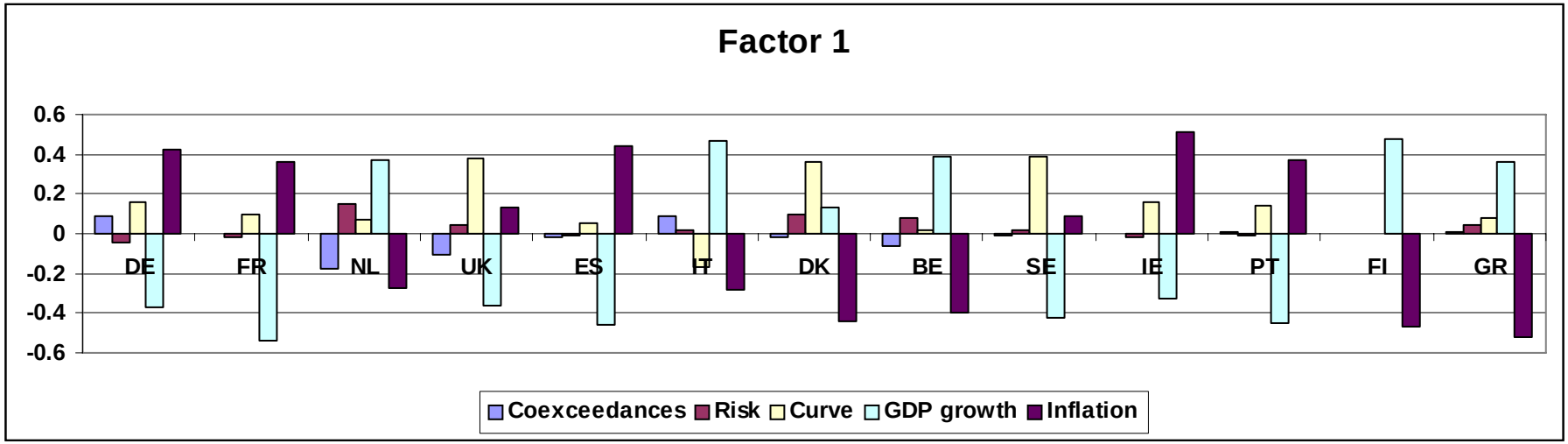
C_d: number of "coexceedances" in period t-1 in country d,

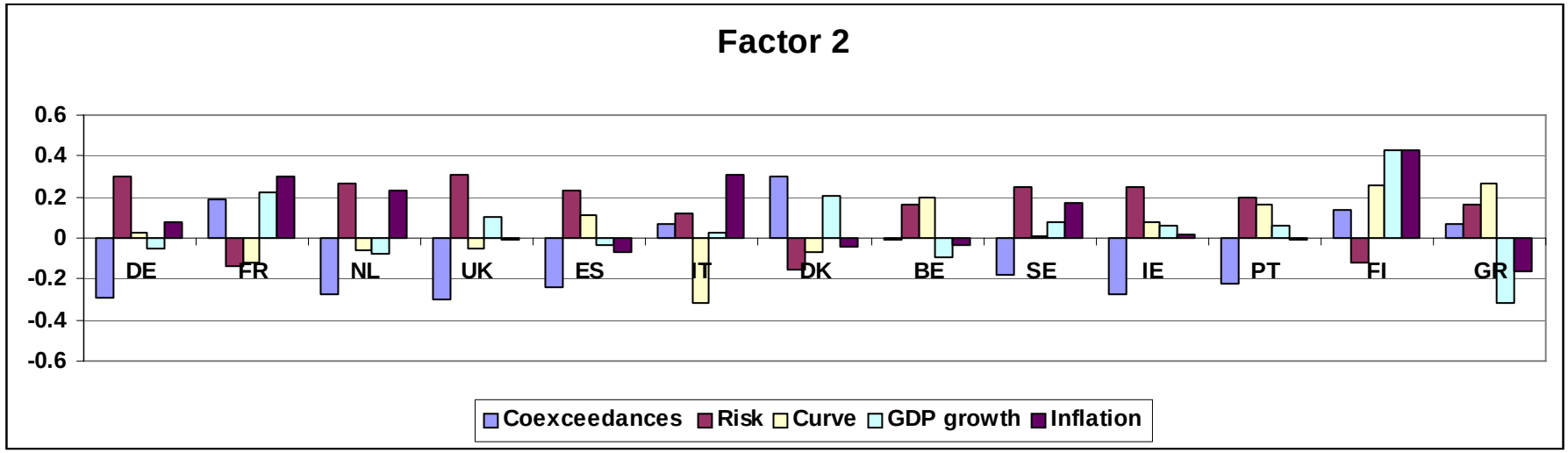
Y=0: base category (all coefficients estimated relative to the base).

Step 1: Extraction of Common Factors

- First, we calculated percentage changes in industry sector stock indexes (18 industries - NACE) and extracted one common factor for each country (common credit risk components).
- Second, we combined this factor with the number of "coexceedances"and standard macro-variables:
  - Steepness of the yield curve (10 yr. rate - 1 yr. rate) - weekly averaged of daily data,
  - Annualised quarterly GDP growth and inflation rates, imputed to weekly frequency.
- Third, from models estimated for each country, we retained two factors, which explain most of the common variance.

Factor Loadings





Step 2: Estimation of the Multinomial Logit-Model

- First, we estimated the model with only “own country” common factors, explaining the number of “coexceedances”in a country.
- Second, we added “foreign country” common factors and one-period lagged “coexceedances” from other countries.
- Explaining a high number of “coexceedances” with contagion variables would be particularly strong evidence of contagion as high numbers cannot be simulated under standard distributional assumptions (Gropp - Moerman, 2004).

Base Model Results: General

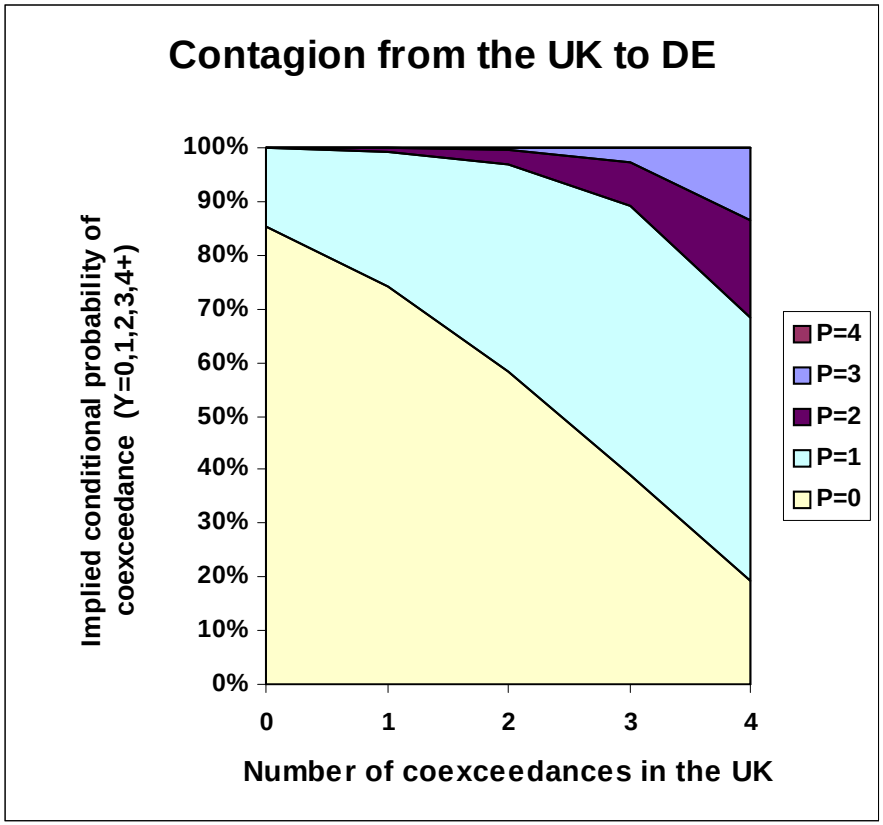
- Common factors alone explain a high proportion of the variation in "coexceedances", except for Italy and Greece:
  - Pseudo R^2 0.28 - 0.59 (Italy and Greece below 0.10).
  - Generally, Factor 2 ("credit risk") is more significant and important than Factor 1 ("macroeconomic conditions").
- Stable coefficients of common factors once contagion variables are added support exogenous contagion variables to common shocks.
- Model fit can improve considerably through the addition of foreign common shocks and contagion variables.
- Foreign common factors can be significant.

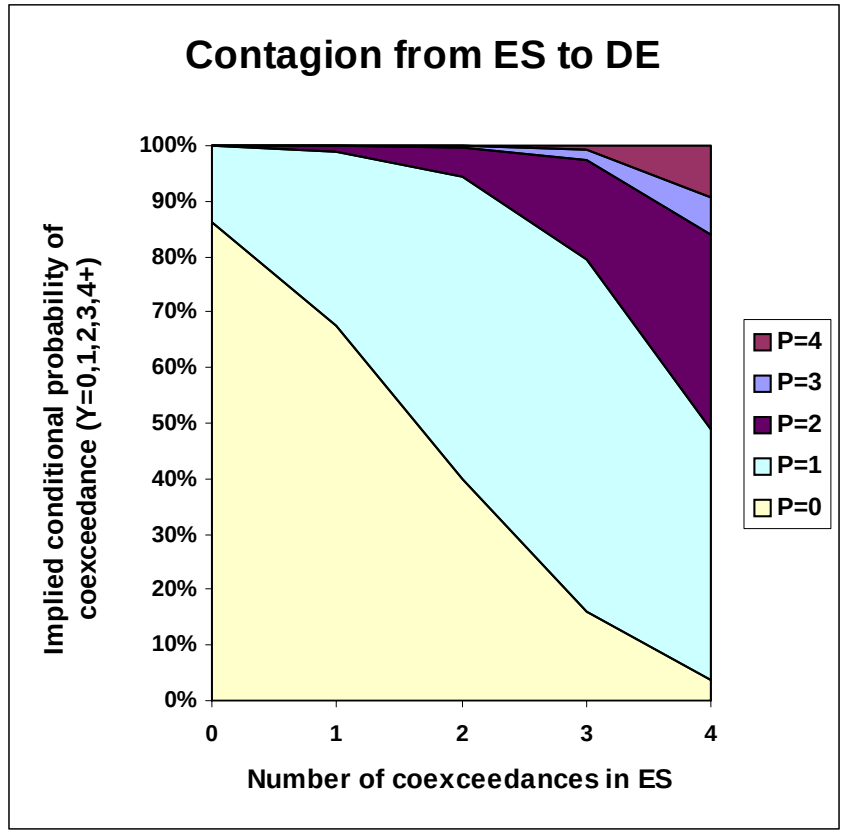
Base Model Results: Contagion Patterns

++ denotes contagion variables significant at the 1 percent level, + contagion variables significant at the five percent level. 0 denotes no contagion.

from to	**DE**	**FR**	**NL**	**ES**	**IT**	**BE**	**IE**	**PT**	**FI**	**GR**	**UK**	**DK**	**SE**
DE	/	**+**	**+**	**++**	**++**	0	++	0	0	0	++	++	+
FR	0	/	+	++	0	0	0	0	0	0	0	0	0
NL	++	++	/	++	0	0	++	0	0	0	++	++	++
ES	++	0	0	/	+	0	++	+	0	0	+	0	++
IT	+	+	0	0	/	0	++	+	+	0	+	+	++
BE	0	0	0	0	0	/	0	0	0	0	0	++	0
IE	0	0	0	+	0	0	/	0	0	0	0	0	0
PT	++	0	+	++	0	0	0	/	0	0	++	+	0
FI	0	0	0	0	0	0	0	0	/	0	0	0	0
GR	0	0	0	0	0	0	0	0	0	/	0	0	0
UK	++	0	+	++	0	0	0	+	0	0	/	0	+
DK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	/	N/A
SE	++	0	0	+	0	0	+	0	0	+	+	0	/

Marginal Effects





Extension 1: Effects of the Euro

- We split the contagion variables for pre- and post-euro time periods and re-estimated the multinomial logit-models.
- We find a clear increase in the estimated cross-border contagion after the introduction of the euro:
  - 57 statistically significant contagion coefficients for the post-euro period; 24 for the pre-euro period.
- Our results suggest that contagion has become more widespread within the euro area.
- We find slightly more contagion from non-euro area countries to the euro area in the post-euro period.

Extension 2: Interbank links as source of contagion

- Estimated contagion patterns are broadly correlated with the intensity of cross-border interbank assets/liabilities between country pairs (aggregated ECB data).
- Faster growth in EU cross-border interbank assets and liabilities than domestic assets and liabilities is in line with increased cross-border contagion after the euro.
- Using information from interbank asset or liability shares by country pairs (interacted with contagion variables) improves the precision of the coefficient estimates.
- High correlation between interbank assets and liabilities does not allow to distinguish between “credit risk” and “liquidity risk” explanations.

Extension 3: Small vs. Large Banks

- Lack of cross-border contagion to/from smaller banks would be implied by a “money centre”structure.
- The case of Italy: Our sample includes large and smaller institutions only for IT.
- We find that large IT banks are more contagious across borders, but base results of limited contagion to IT remain unchanged.
- Overall, our results support the conjecture of a “money centre” structure.

Conclusion

- We use market data to identify contagion patterns. We concentrate on large shocks (no true crises).
- We propose a method to identify contagion from common shocks.
- Our results suggest significant cross-border contagion in the EU, while some countries seem to be insulated from contagion.
- We find evidence of more cross-border contagion after the euro.
  - Interbank system is not closed for euro area countries, but includes also non-euro area EU countries (especially UK and SWE).
- We find support for the interbank market being an important channel of contagion and for “money centre” structure.