How do global macro-financial shocks affect corporate sector expected default frequencies in the euro area?

September 2008
Conference organized by the IMF and the National Bank of Romania

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Motivation

- The world has become more financially integrated and firms and banks are operating on the global marketplace
- Large euro area banks are active in corporate lending in most countries in the euro area; corporate borrowers are often large firms with global exposures
- A framework linking indicators for corporate sector credit quality to a global macroeconomic model is useful:
  - For large banks to calculate their capital buffers
  - For central banks and supervisors to assess resilience at systemic level

Some Previous Literature on Macro-VARs & PDs

- Pesaran et al. (2004): Conditional loss distributions of a credit portfolio in different regions of the world
- Alves (2005) and Shahnazarian and Åsberg-Sommer (2007): Corporate sector EDFs in a macroeconomic VAR model
- Jacobson et al. (2005): Interactions between Swedish firms' balance sheets & the evolution of the Swedish economy
- Drehmann et al. (2005): Non-linear VAR for corporate sector credit risks
- Aspachs et al. (2006): Evaluates the impact of bank equity value & bank PD on output in the UK

Our approach in a nutshell

- To quantify the impact of domestic and global macroeconomic shocks on the aggregate and the sectoral EDFs of the euro area

- Combination of:

1) A structural default model (Moody's KMV based on the Merton (1974) approach)

2) An internal ECB macro-econometric model (Global VAR by Dées et al.(2007))

- Construct a linking equation to the GVAR model, which isolates the EDF from the global system

- The GVAR model + the linking equation of the EDF => Satellite GVAR model

Benefits of the Satellite approach

- Can combine a complex global macro model with a simple equation for EDFs in one country
- Isolates the credit risk assessment from the macro assessment, thus avoiding inference of complex and controversial feedbacks
- Since the macro model becomes a pure “state of the world” engine, do not need to care about cointegration relationships
- Can easily experiment with various specifications for the satellite equation (e.g. non-linearities, heterogeneity…), without messing up the features of the macro model

A Primary of Global VAR (GVAR)

- Macroeconomic policy analysis and financial risk management require taking account of the increasing interdependencies that exist across markets and countries
- Also financial stability issues need to be considered from a global perspective; this invariably means that many different channels of transmission must be taken into account
- The GVAR provides a convenient and intuitive solution to the modeling of complex high dimensional systems
- Other possibilities: structural models and common factor models

A Primary of Global VAR (GVAR)

o The GVAR approach models the interlinkages using trade-weighted observable macroeconomic aggregates and financial variables

o The GVAR is composed of individual country VARX* models in which the core domestic variables are related to country-specific foreign variables

$$x_{it} = a_{i0} + a_{i1}t + \Phi_i x_{i,t-1} + \Lambda_{i0} x^*_{i,t}$$

$$+\Lambda_{i1} x^*_{i,t-1} + \Psi_{i0} d_t + \Psi_{i1} d_{t-1} + \varepsilon_{it}$$

for $t=1,2,\ldots,T$ and $i=0,1,2,\ldots,N$.

The Satellite model for EDFs

- Formulate an equation where the endogenous variables of the GVAR are exogenous variables to the Satellite model
- The endogenous variable z_t in the Satellite model is the log transformed EDF for corporate sector *j*

$$z_{jt} = b_{j0} + b_{j1} x_t + \varepsilon_t$$

- In practice, the x_t variables in the Satellite model are logarithms of the domestic variables of the euro area block of the GVAR, expressed in first differences

Satellite-GVAR: Four steps

- 1) Estimate the GVAR
- 2) Subject the GVAR to shocks to generate impulse response functions
- 3) Separately, estimate the parameters of the Satellite model
- 4) Simulate the reactions of the endogenous variable of the Satellite model (EDFs) with the estimated parameters of the Satellite model and the shocks from the GVAR

Data

- GVAR data includes of 33 countries with the euro area comprising 8 of the 11 countries that joined in 1999
- For each country in the GVAR, the variables include GDP, CPI, Equity price, USD FX, SR & LR interest rates. Oil price is a common (global) variable for all countries. Sample period 1979 Q1-2007 Q4
- Data on aggregate and 7 sectoral corporate EDFs in the euro area 1992-2007. Source: Moody's KMV
- The most parsimonius specification of the Satellite equation includes 5 of the 7 "risk factors" (exogenous variables) from the GVAR

Representation of S-GVAR

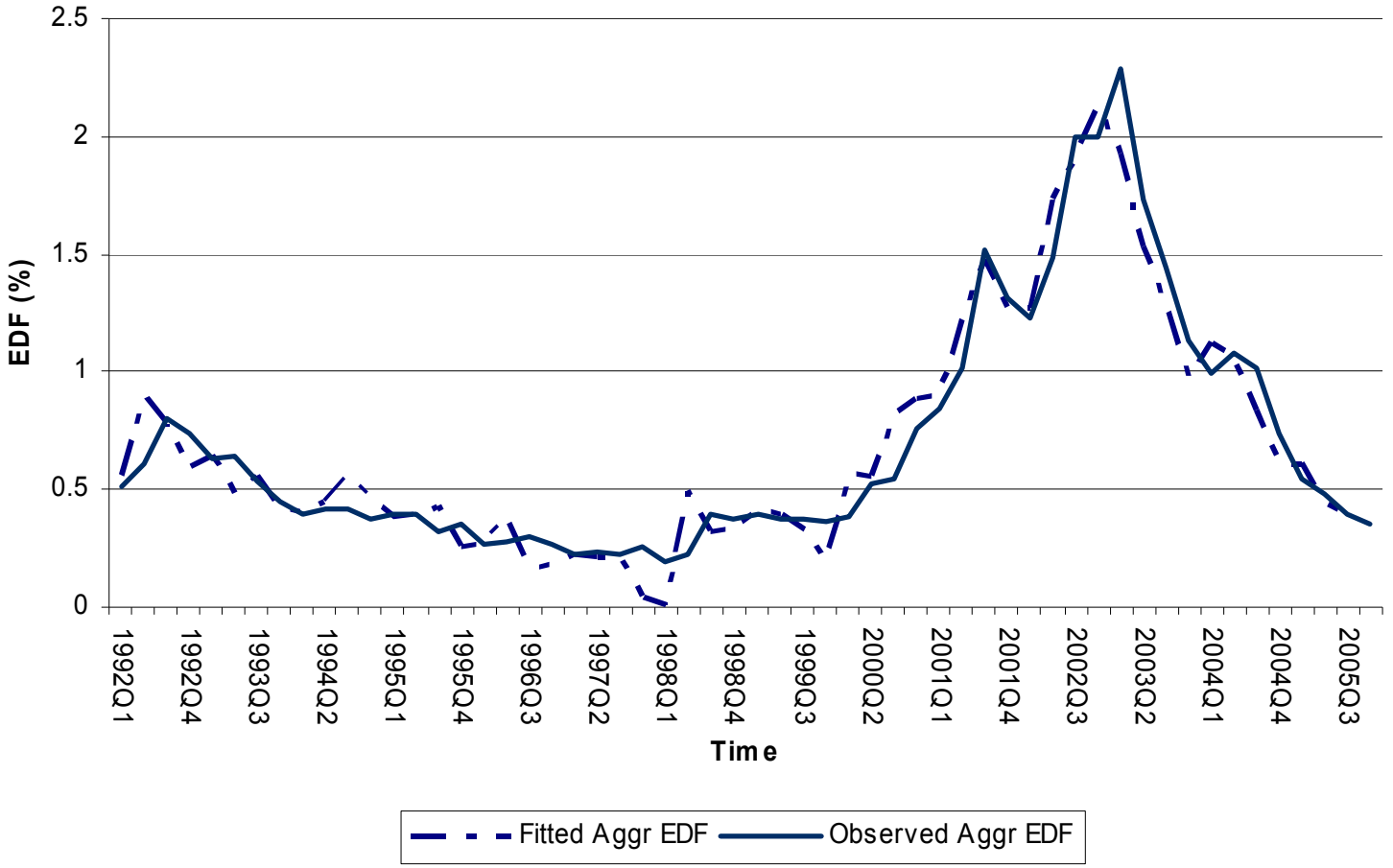
- We find Cointegration relation between the EDF and the GVAR factors.
- Engle and Granger test, Johansen trace test, and Saikkonen and Lütkepohl test.
- All tests indicate cointegration between the EDF and the factors.
- 5 factors in the S-GVAR, *i.e. GDP, CPI, Equity prices, Real exchange rate, and Short term interest rate.*
- Alternative number of factors: 4, 6 and 7.

Estimation of the Satellite model

$$LN\left(\frac{EDF_t}{1-EDF_t}\right)=\alpha+\beta_1\Delta GDP_t+\beta_2\Delta CPI_t+\beta_3\Delta EQ_t+\beta_4\Delta EP_t+\beta_5\Delta IR_t$$

		Const	GDP	INFL	EQUITY	EP	IR
Aggr	beta	0.853	-0.350	-0.054	-0.018	-0.028	-0.010
	Pval	0.000	0.040	0.823	0.020	0.077	0.228
BaC	beta	0.663	-0.285	0.161	-0.014	-0.012	-0.007
	Pval	0.000	0.006	0.268	0.003	0.198	0.146
Cap	beta	1.167	-0.465	-0.097	-0.022	-0.034	-0.011
	Pval	0.000	0.030	0.749	0.025	0.089	0.268
CCy	beta	0.679	-0.266	0.018	-0.015	-0.017	-0.006
	Pval	0.000	0.022	0.915	0.005	0.120	0.270
CNC	beta	0.520	-0.117	-0.100	-0.010	-0.012	-0.003
	Pval	0.000	0.235	0.485	0.026	0.206	0.558
EnU	beta	0.160	-0.047	0.031	-0.005	-0.002	0.000
	Pval	0.000	0.080	0.421	0.000	0.332	0.737
Fin	beta	0.168	-0.030	0.081	-0.003	-0.002	-0.001
	Pval	0.000	0.118	0.005	0.001	0.196	0.404
TMT	beta	2.385	-1.179	-0.831	-0.062	-0.135	-0.038
	Pval	0.006	0.108	0.433	0.066	0.052	0.272

Satellite model: goodness of fit



Summary: S-GVAR results

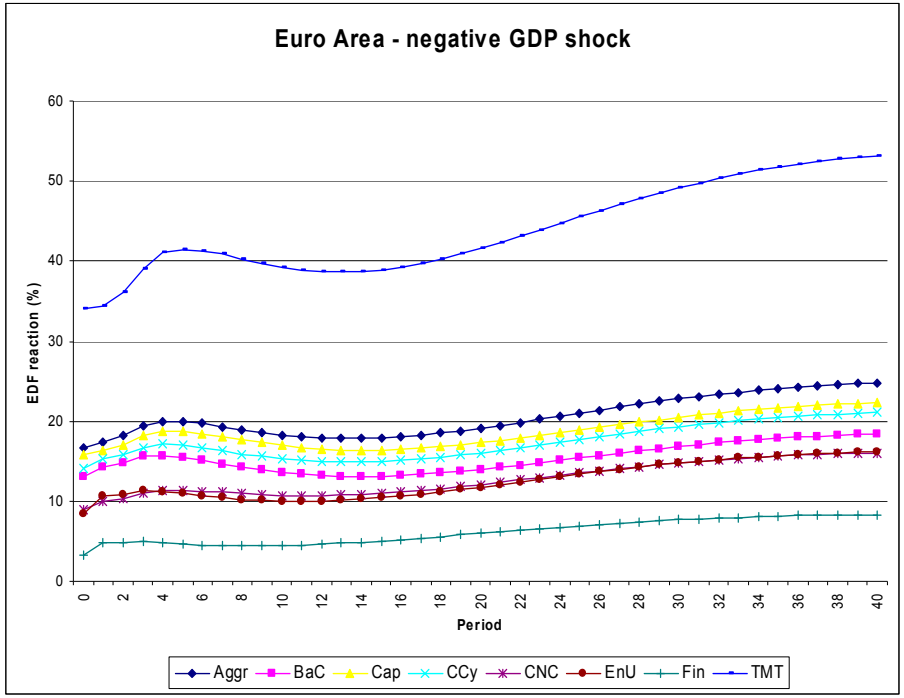
- On the aggregate Euro Area EDF level, the EDF reactions are most sensitive for shocks to:

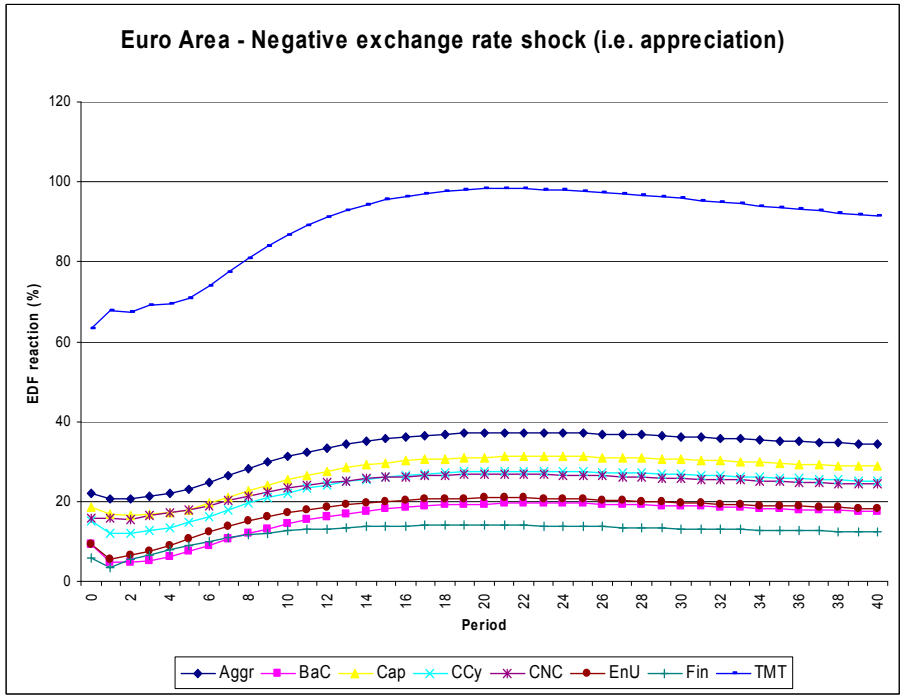
  1) Global and euro area GDP
  2) Global equity prices
  3) Interest rates (short and long)
  4) Exchange rates
  5) Oil prices

- In general, most sectoral EDFs react similarly to the benchmark (i.e., the aggregate EDF case)

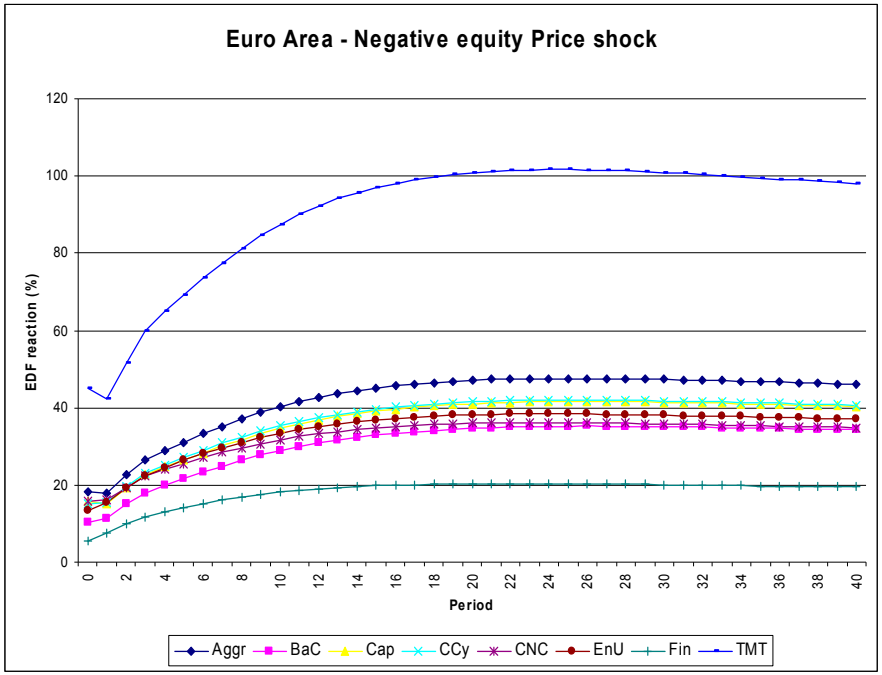
- BUT the technology sector EDF is more affected than the other EDFs in our sample period

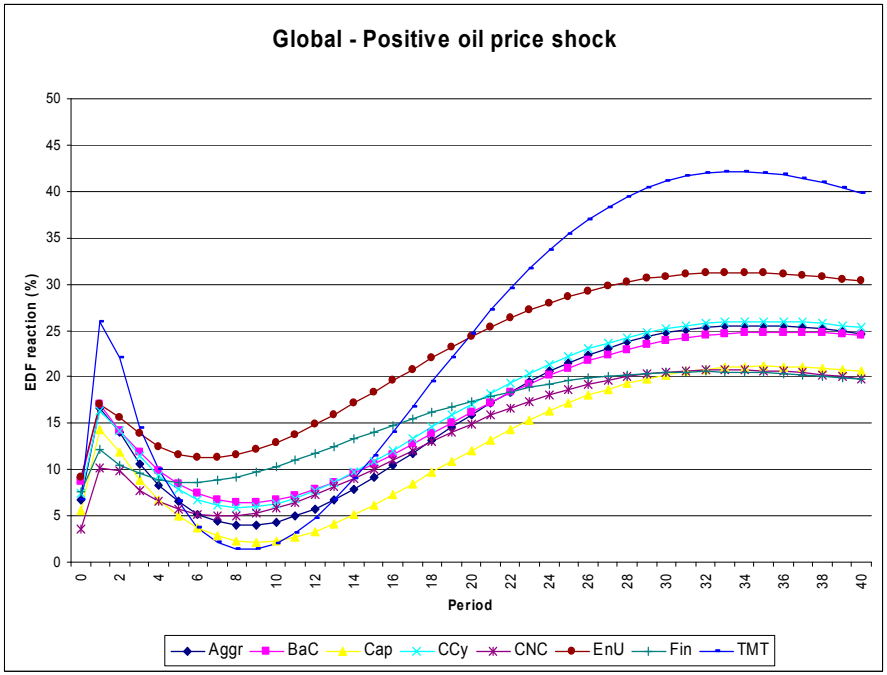
Satellite-GVAR reactions





Satellite-GVAR reactions





Future extensions

- Exploit the distribution of sectoral EDFs (instead of only median EDFs) to find out possible effects of firm *heterogeneity*
- Estimate a *non-linear* satellite equation

Application: LCBGs credit portfolio losses

- Data inputs: loan exposures, expected default rates and volatilities, and recovery rates
- Use publicly available exposure data from 9 large EU banks, and Moody's KMV Expected Default Frequencies (EDF)
- Losses estimated using the CreditRisk+ (CR+) model. This calculates the losses over a fixed one-year horizon for a given confidence interval and for a portfolio of individual exposures of which each has a low probability of defaulting

Results: a single shock scenario

- Distribution of changes in banks' portfolio Value at Risk as a percentage of Tier 1, following various macro shocks
- An useful estimate for banks' economic capital, and the distribution of losses in the banking system