Uncertainty, Systemic Shocks and the Global Banking Sector: Has the Crisis Modified their Relationship?

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- We aim to measure systemic risk, in the global banking sector, that arises from two primary sources: an **unobservable common market shock**, previously identified in the literature as a systemic shock; and, an **uncertainty factor** in the equity market.

- Our proposal is because:
  - We consider the evolving nature of systemic risk. We provide evidence regarding the stability of the relationship between systemic shocks and the banks' responses over the last decade.
  - We undertake an empirical study of the role of equity market uncertainty, as measured by Baker et al. (2015), as a systemic factor for the banking industry.
  - We emphasize the vulnerability of each institution to systemic shocks, rather than the vulnerability of the system as a whole to the failure of one specific firm. Thus we are able to rank banks in accordance with their vulnerability to the two common shocks.

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Our methodological proposal involves combining dynamic factor models with quantile regression. We conduct the estimation in a three-step approach:

1. We construct the systemic factor.
2. We use this and the uncertainty factor provided by Baker et al. (2015) as explanatory variables in a traditional quantile regression model.
3. We test the stability of the parameters, seeking to identify changes in factor load coefficients that might be attributable to the crisis.

Let N be the number of cross-sectional units, that is, the number of financial institutions in our sample, and let T be the number of time series observations.
Our factor model can be defined as:

$$x_{it} = \lambda_{1,i} f_{1,t} + \lambda_{2,i} f_{2,t} + e_{it}$$

- $f_{1,t}$—> is an unobservable factor that impacts the N financial institutions in our sample. It can be estimated using the **first principal component** of a matrix of financial institutions' stock returns in the cross-sectional dimension (banks, insurers, others) (White, et al., 2015).
- $f_{2,t}$—> is a general financial uncertainty factor that may potentially impact the banks. Specifically, here, we use the **equity market uncertainty factor** proposed by Baker et al. (2015). These authors construct their measure of uncertainty by searching each paper in the NewsBank database looking for terms related to economic and policy uncertainty.

The model before relates the 'average' scenarios for the bank stock returns distribution to the systemic factors. However, our definition of systemic risk means we need to focus on the shocks that occur during **extreme negative scenarios.** To this end we expand our previous regression as:

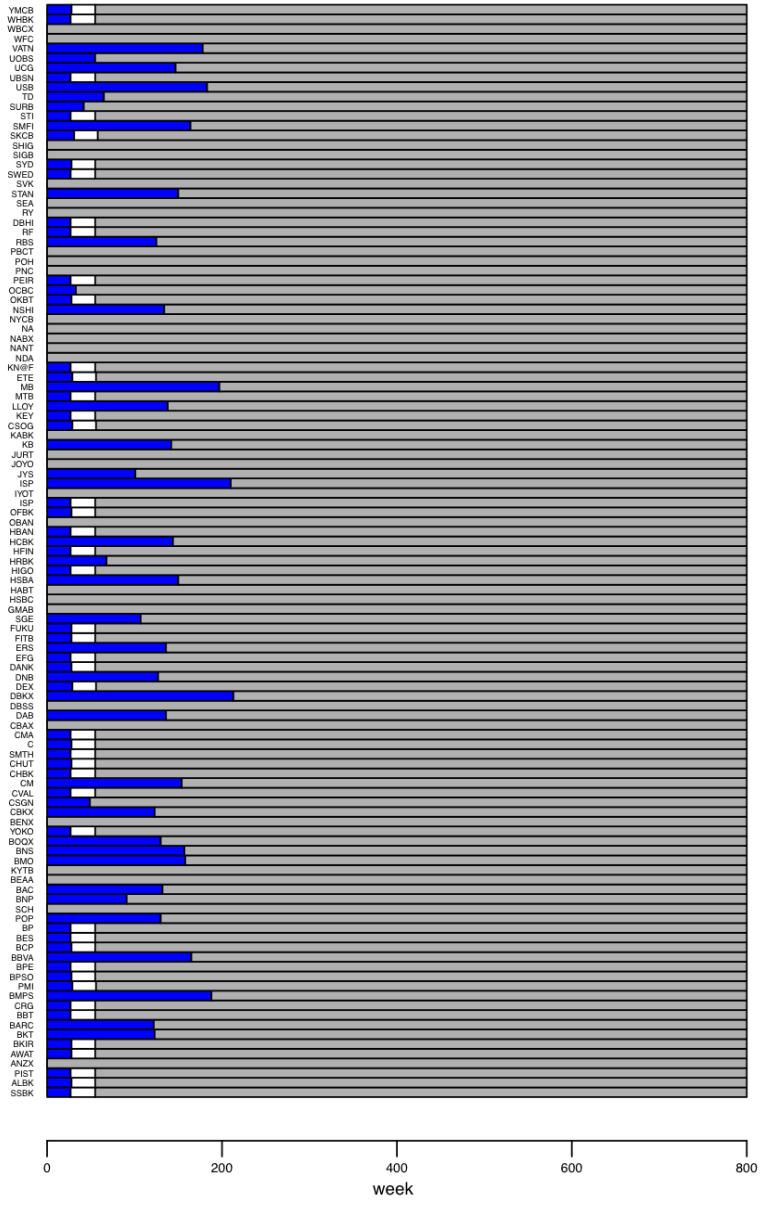
$$q_i^{\tau}\left(x_{it} \mid \mathbf{f_t}; \alpha\right) = \alpha\left(\tau\right)' \mathbf{f_t}$$

$\tau = 0.1$, therefore, the estimations are directly related to systemic risk scenarios.
$\mathbf{f_t}$ includes the two systemic factors.

- We use recent advances in the econometrics literature to test the stability of the load coefficients in the matrix $\alpha(\tau)$.
- Specifically we use a test for **multiple endogenous structural breaks** in single quantile regression coefficients, as proposed by Oka and Qu (2011). This procedure involves constructing a break estimator that is the global minimizer of the check function over all permissible break dates. Their construction is in line with the logic underpinning the traditional work by Bai and Perron (1998).
- By so doing, we are able to determine **whether the financial crisis has significantly shaped the systemic risk dynamics** in the banking industry.
- We imposed a maximum number of breaks equal to 2. Thus, while our break dates can be interpreted as the "biggest" structural changes in the sample.

- To construct the unobservable common shock affecting the financial institutions in our sample we used **113 banks, 59 insurance companies** (life, non-life and reinsurance), and **50 firms in other financial services.**
- The sample includes **weekly** closing log- returns, for each Friday, from 21 July 2000 to 20 November 2015(800 weeks in total).
- The Equity Uncertainty Index was taken from the webpage www.policyuncertainty.com.

The stable nature of systemic risk: Structural Changes in Quantile Coefficients



The stable nature of systemic risk: Structural Changes in Quantile Coefficients

- 30 of the 113 banks (26.54% of the sample) did not present any structural breaks
- 37 (32.74%) presented only one statistically significant break;
- 46 banks (40.71% of the sample) achieved the maximum number of breaks allowed (i.e., 2).
  - When structural breaks were present, they tended to **concentrate on two dates:** weeks 27-28 (26 January 2001) and week 55 (10 August 2001). The institution that houses a break date furthest from the sample origin was Deutsche Bank, with a break located at week 213 (20 August 2004).
  - We do not detect a structural change in the model's parameters at a date close to that of the global financial crisis (2007-2009).

The stable nature of systemic risk: Structural Changes in Quantile Coefficients

- The results point to the relative stability of systemic risk transmission over the last decade .
- These results are in line with previous findings in the macroeconomics literature (Stock and Watson, 2012). Shocks to the financial industry during the crisis did not give rise to effects beyond those expected prior to the crisis. On the contrary, the banks' financial returns responded in a predictable way to the same shocks (uncertainty and the common shock).

Table 3: First and Last Regime Summary Statistics of the Coefficients

	First regime			Last regime		
	α_0	α_1	α_2	α_0	α_1	α_2
Average	-0.271	0.129	-0.319	-0.366	0.145	-0.409
Std. Dev.	1.760	0.060	0.426	1.134	0.062	0.370
Median	-0.306	0.115	-0.253	-0.312	0.125	-0.365
75^{th} perc.	0.392	0.170	-0.108	0.245	0.191	-0.195
25^{th} perc.	0.392	0.170	-0.108	0.245	0.191	-0.195
Max	7.221	0.396	0.723	4.018	0.324	0.414
Min	-5.717	0.000	-2.441	-4.039	0.016	-2.184

Note: We present the summary statistics for the estimated coefficients for the first and last regimes in our sample: intercept, α_1 (τ =0.1) and α_2 (τ =0.1).

In most instances the coefficients accompanying the **uncertainty factor** display a negative sign.

Table 4: Percentage of Statistically Significant Coefficients

	First regime		Last regime	
	α_1	α_2	α_1	α_2
Total	76.99%	35.40%	99.12%	56.64%
No breaks	100.00%	56.67%	100.00%	56.67%
At least one break	68.67%	27.71%	98.80%	56.63%

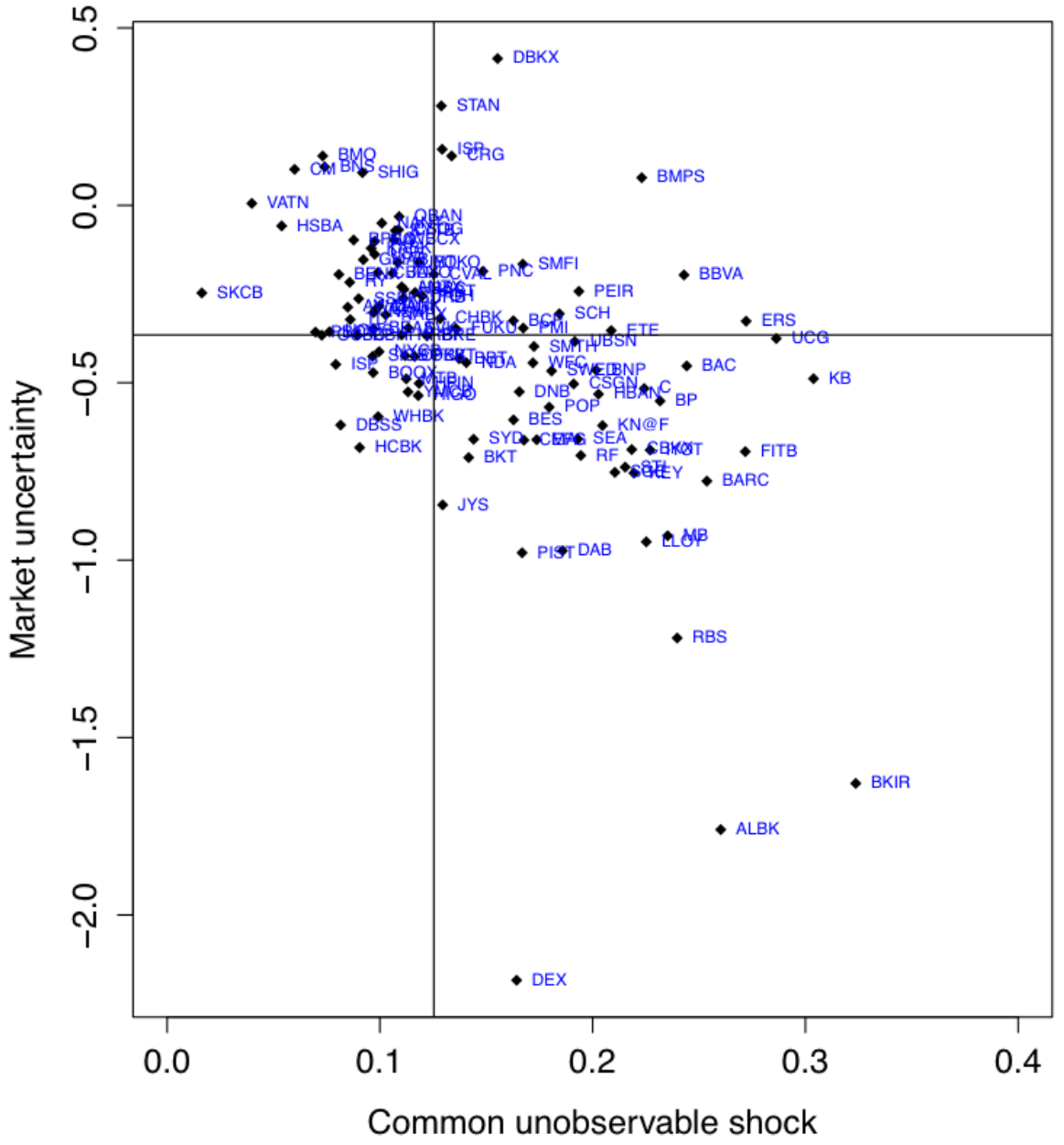
Note: We present the percentage of statistically significant coefficients at the 95% confidence level. We discriminated between banks with at least one break and banks with no breaks during the full period.

The uncertainty factor seems relatively important as a systemic factor.

- During the first regime, 35.40% of the banks respond to this factor, and the proportion increases notably during the last regime (56.64%). It could be higher.

- The impact of uncertainty on the financial returns of the global banking sector is negative. This result is novel to the literature, but it is well grounded on theoretical preconceptions concerning uncertainty:
  - Aggregate uncertainty shocks are preceded by a reduction in investment and in labor , and a deterioration in real activity. ...which in turn has obvious consequences for banking.
  - This impact on macroeconomic variables may be amplified as a result of financial market frictions.
  - In the case of financial markets, Bansal and Yaron (2004) explain how more uncertainty leads to worse long-run growth prospects, reducing equity prices. Basically, markets do not like uncertainty and after an increment in uncertainty, the discount of the expected cash flows is higher, which leads the market to reduce the price of the stock.

Ranking of systemically vulnerable financial institutions



- If we consider a shock to (log) uncertainty of **one standard deviation**, the most vulnerable institution in our sample, Dexia, would experience a reduction in the 10th percentile of 1.77 percentage points (Dexia's average weekly return during the sample was -0.33%), while the impact is practically negligible for institutions in the fourth quartile. The median impact is around -0.30 percentage points.
- The same holds for the systemic factor retrieved as an unobservable and common component of the system. In this case, the most vulnerable institution is the Bank of Ireland, and a one standard deviation shock to the systemic factor would increase its weekly VaR by 2.80 percentage points. In this case, the median impact is around 1.09 and the impact for the least vulnerable institution is around 0.18 percentage points.

- We measure systemic risk in the global banking sector attributable to two main sources: an unobservable common shock to the market, and an uncertainty factor in the equity market (in most instances, statistically significant).
- We identify regimes after conducting a recursive search for structural changes in the model's parameters. The parameters have not experienced any significant changes over the last decade, above all after and during the 2007-2009 global financial crisis.
- We interpret this as evidence of claims that during the financial crisis the economy was not affected by a new type of shock, but rather the shocks were of the same nature, albeit of an unusually high magnitude.
- We also provide a ranking of systemically vulnerable financial institutions, which serves to complement existing alternatives in the literature and allows regulators and administrators alike to identify the banks that are most vulnerable to the types of shock analyzed here.