XIV Annual Inflation Targeting Seminar of the Banco Central do Brasil

May 10-11, 2012

Session III: Financial Markets During Economic Crises

Mike Leahy

Federal Reserve Board

GLOBAL CRISES AND EQUITY MARKET CONTAGION

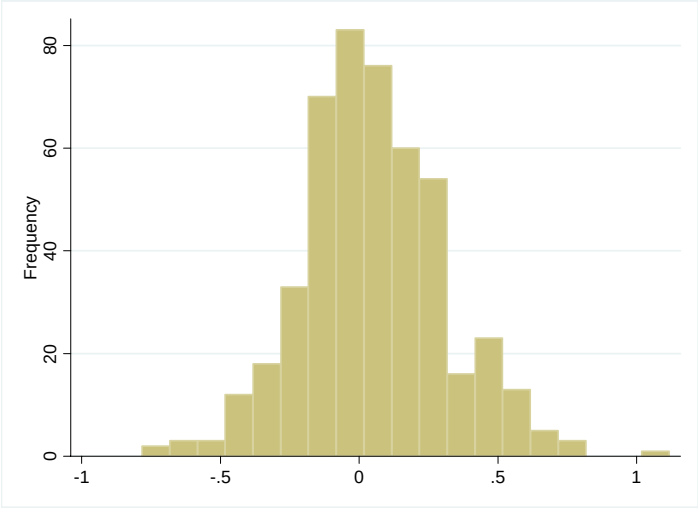
Geert Bekaert
Michael Ehrmann
Marcel Fratzscher
Arnaud J. Mehl

GLOBAL CRISES AND EQUITY MARKET CONTAGION : I

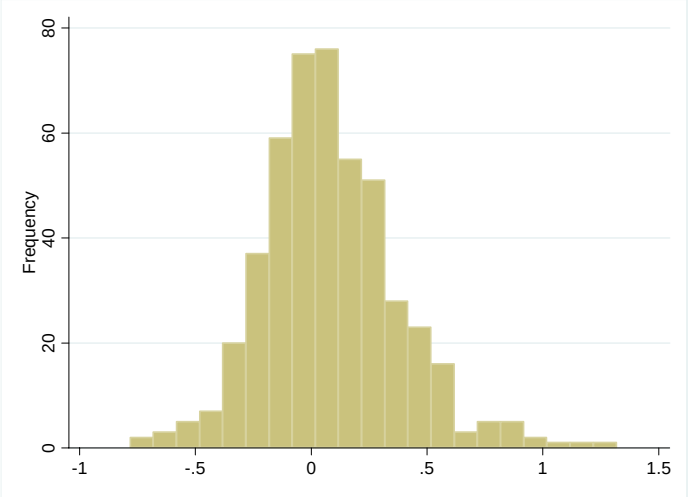
Findings

- Small amounts of systematic contagion from U.S. and global equity markets
- Large amounts of domestic contagion
- Variation across countries and across sectors within countries

A. Contagion from the global financial sector



B. Contagion from US market



C. Contagion from domestic market

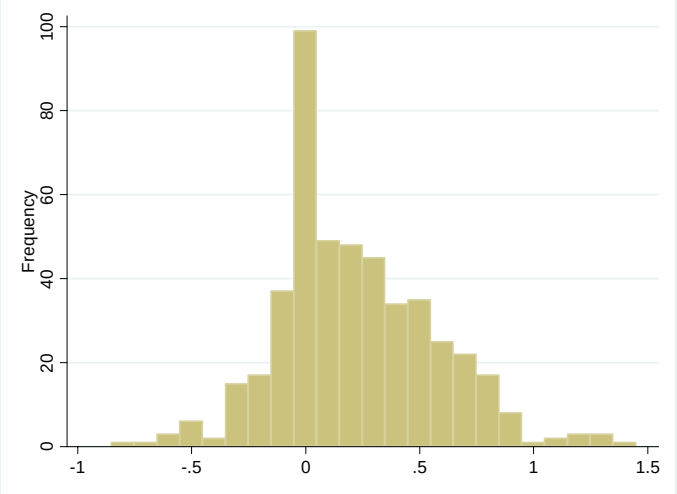


Figure 3: Distribution of Contagion Coefficients. The figures show the distribution of the contagion coefficients $\gamma_{\iota,0}$ from the estimation of (13)-(14) across all 415 equity portfolios from the factor model.

Table IV: Predicting Crisis Returns

The table shows total actual equity market returns over the entire crisis period (Aug. 2007 – March 2009) against the fitted total returns from the interdependence model (see Table II for explanations) and against the fitted total returns from the contagion model (see Table VI). Portfolio returns in the table are averaged within countries. Countries are ranked according to actual equity market returns during the crisis. The model parameters shown are from the contagion model.

			Interdepend. Model		**Contagion Model**		***Model parameters (contagion model)***						
	Actual returns		**Fitted returns**		**Fitted returns**								
Country	returns	*rank*	returns	*rank*	returns	*rank*	$\beta_{i,0}^{G}$	$\beta_{i,0}^{U}$	$\beta_{i,0}^{D}$	$\gamma_{i,0}^{G}$	$\gamma_{i,0}^{U}$	$\gamma_{i,0}^{D}$	$\eta_{i,0}$
Serbia	-85.6	*1*	-57.6	*2*	-73.6	*1*	0.090	0.043	0.630	-0.039	0.247	0.007	-0.804
Ukraine	-77.9	*2*	-35.3	*20*	-72.3	*2*	0.213	0.153	0.233	0.182	0.101	0.606	-0.356
Romania	-77.3	*3*	-31.7	*28*	-66.5	*4*	0.213	0.145	0.228	0.106	0.205	0.483	-0.677
Bulgaria	-74.2	*4*	-50.3	*6*	-65.9	*5*	0.158	0.047	0.199	0.283	0.253	0.534	0.190
Slovenia	-71.9	*5*	-30.8	*30*	-58.3	*11*	0.287	0.059	0.385	-0.024	0.119	0.444	-0.400
Poland	-69.5	*6*	-52.3	*4*	-65.2	*6*	0.436	0.493	0.416	0.278	0.320	0.428	-0.031
Iceland	-67.7	*7*	-46.4	*8*	-62.9	*8*	0.304	0.143	0.442	-0.104	0.046	0.044	-0.363
Russia	-66.2	*8*	-43.4	*11*	-57.7	*12*	0.187	0.261	0.285	0.328	0.282	0.361	0.112
Latvia	-64.3	*9*	-39.9	*13*	-61.5	*10*	0.188	0.063	0.343	0.088	0.134	0.126	-0.432
Estonia	-64.3	*10*	-45.8	*9*	-64.2	*7*	0.322	0.215	0.286	0.089	0.239	0.518	-0.168
Turkey	-64.1	*11*	-70.6	*1*	-69.8	*3*	0.671	0.644	0.823	0.363	0.116	0.018	0.168
Croatia	-63.9	*12*	-39.1	*14*	-48.3	*17*	0.248	0.059	0.324	0.028	0.287	0.499	0.105
Lithuania	-61.4	*13*	-36.6	*18*	-53.3	*14*	0.165	0.073	0.407	0.119	0.055	0.310	-0.236
Ireland	-61.3	*14*	-30.4	*33*	-48.0	*18*	0.498	0.421	0.343	-0.108	0.141	0.049	-0.643
New Zealand	-60.2	*15*	-52.2	*5*	-62.2	*9*	0.388	0.356	0.641	0.061	0.175	0.164	-0.267
Norway	-60.1	*16*	-30.6	*31*	-49.0	*16*	0.453	0.453	0.569	0.021	0.364	0.177	-0.244
Hungary	-59.6	*17*	-53.6	*3*	-55.9	*13*	0.544	0.562	0.559	-0.046	0.129	0.226	0.088
Italy	-55.5	*18*	-35.9	*19*	-43.1	*21*	0.434	0.682	0.495	0.134	0.164	0.288	-0.097
Egypt	-54.2	*19*	-13.0	*48*	-11.2	*49*	0.153	0.060	0.326	0.268	-0.143	0.529	0.270
Korea	-52.9	*20*	-44.8	*10*	-45.4	*19*	0.491	0.558	0.613	0.062	0.251	0.210	0.178
Portugal	-52.1	*21*	-32.8	*25*	-36.1	*26*	0.424	0.373	0.580	0.048	0.148	0.211	-0.051
Czech Republic	-52.1	*22*	-47.8	*7*	-50.4	*15*	0.569	0.295	0.563	0.005	0.125	0.107	-0.003
Brazil	-51.2	*23*	-37.0	*17*	-44.7	*20*	0.391	0.834	0.605	0.104	0.411	0.173	-0.038
Sweden	-51.0	*24*	-33.9	*23*	-37.8	*23*	0.561	0.700	0.404	-0.014	0.325	0.419	-0.018
Finland	-49.7	*25*	-25.4	*37*	-38.8	*22*	0.451	0.572	0.366	-0.059	0.280	0.453	-0.162
Thailand	-48.8	*26*	-19.2	*41*	-37.0	*24*	0.398	0.273	0.521	0.171	0.162	0.250	-0.354
France	-47.1	*27*	-32.6	*26*	-33.0	*28*	0.651	0.829	0.535	-0.068	0.182	0.328	-0.021
UK	-43.9	*28*	-26.9	*35*	-27.5	*32*	0.525	0.612	0.508	0.048	0.182	0.378	0.009
Argentina	-42.2	*29*	-3.8	*53*	-13.6	*47*	0.232	0.362	0.406	0.203	0.165	0.238	-0.226
China	-42.2	*30*	-38.6	*15*	-36.6	*25*	0.053	-0.015	0.702	0.036	-0.276	0.124	0.047
Spain	-41.6	*31*	-19.6	*40*	-24.2	*37*	0.518	0.615	0.486	0.067	0.183	0.357	-0.025
Netherlands	-40.5	*32*	-32.3	*27*	-25.1	*35*	0.505	0.928	0.430	0.058	0.001	0.227	0.157
Denmark	-40.5	*33*	-21.2	*39*	-31.1	*29*	0.537	0.424	0.310	0.092	0.269	0.377	-0.088
India	-40.4	*34*	-14.2	*47*	-24.3	*36*	0.252	0.417	0.627	0.234	-0.006	0.265	-0.058
Colombia	-39.8	*35*	-42.6	*12*	-23.4	*39*	0.220	0.284	0.621	0.149	0.264	0.225	0.651
Singapore	-39.7	*36*	-35.0	*22*	-24.2	*38*	0.735	0.591	0.568	-0.286	0.026	0.316	0.181
Indonesia	-39.2	*37*	-28.4	*34*	-26.6	*33*	0.587	0.358	0.662	0.051	-0.011	0.230	0.091
Germany	-37.8	*38*	-35.1	*21*	-29.1	*30*	0.646	0.962	0.553	-0.090	-0.099	0.163	0.047
Belgium	-35.7	*39*	-30.6	*32*	-26.5	*34*	0.550	0.461	0.497	0.004	0.183	-0.019	0.043
UAE	-35.6	*40*	-14.5	*46*	-6.7	*52*	-0.017	0.002	0.143	0.204	-0.178	0.422	0.451
Chile	-35.1	*41*	-17.7	*44*	-22.2	*41*	0.298	0.470	0.622	0.019	0.162	0.314	-0.065
Taiwan	-34.9	*42*	-32.9	*24*	-28.7	*31*	0.399	0.323	0.686	-0.064	0.155	0.116	0.116
Hong Kong	-33.7	*43*	-12.9	*49*	-22.3	*40*	0.442	0.489	0.487	0.219	0.249	0.442	-0.160
Mexico	-33.2	*44*	-37.0	*16*	-33.2	*27*	0.391	0.769	0.609	-0.044	0.074	0.087	0.109
Austria	-33.1	*45*	-31.0	*29*	-17.1	*44*	0.507	0.396	0.544	0.091	0.201	0.171	0.251
Qatar	-32.1	*46*	-3.4	*54*	2.4	*54*	0.046	-0.018	0.341	0.010	-0.041	0.373	0.148
Australia	-31.8	*47*	-26.2	*36*	-21.3	*42*	0.479	0.457	0.631	-0.075	0.122	-0.013	0.078
Switzerland	-30.8	*48*	-25.4	*38*	-15.8	*45*	0.580	0.644	0.461	0.043	0.146	-0.016	0.201
Japan	-30.6	*49*	-19.1	*42*	-17.4	*43*	0.553	0.293	0.753	0.010	0.062	0.054	0.010
Luxembourg	-27.4	*50*	-17.7	*43*	-6.7	*51*	0.339	0.194	0.149	0.172	0.281	0.327	0.265
Israel	-21.7	*51*	-17.3	*45*	-14.0	*46*	0.197	0.338	0.594	-0.047	0.077	0.272	0.118
Canada	-19.1	*52*	-3.9	*52*	-10.6	*50*	0.206	0.346	0.246	-0.066	-0.155	0.105	-0.161
Malta	-13.8	*53*	-10.2	*51*	-12.2	*48*	-0.096	0.020	0.324	-0.017	-0.053	0.179	0.066
Tunisia	-9.7	*54*	-10.5	*50*	-6.6	*53*	0.232	0.024	0.554	0.031	0.051	0.083	-0.078

Table VII: Correlation Patterns across Contagion and Interdependence Parameters

The table shows the correlation coefficients across the estimates of the various contagion and interdependence coefficients for the 415 portfolios in the sample, based on the following model:

$$R_{i,t} = E_{t-1}[R_{i,t}] + \beta_{i,t}' F_t + \eta_{i,0} CR_t + e_{i,t} \quad (13)$$

$$\beta_{i,t} = \beta_{i,0} + \gamma_{i,0} CR_t \quad (14)$$

P-values are shown below the correlation coefficients in smaller figures and italics. Standard errors are based on the cross-sectional distribution of the coefficients.

	Contagion			Interdependence			Other
	γ_0^G	γ_0^U	γ_0^D	β_0^G	β_0^U	β_0^D	η_0
Contagion							
γ_0^G	1						
γ_0^U	0.121 *0.013*	1					
γ_0^D	0.212 *0.000*	0.493 *0.000*	1				
Interdependence							
β_0^G	-0.273 *0.000*	-0.027 *0.590*	-0.210 *0.000*	1			
β_0^U	-0.153 *0.002*	-0.203 *0.000*	-0.302 *0.000*	0.620 *0.000*	1		
β_0^D	-0.077 *0.119*	-0.276 *0.000*	-0.524 *0.000*	0.319 *0.000*	0.389 *0.000*	1	
Other							
η_0	0.092 *0.061*	0.099 *0.045*	0.092 *0.063*	-0.018 *0.713*	0.012 *0.813*	-0.038 *0.438*	1

GLOBAL CRISES AND EQUITY MARKET CONTAGION : I

The return factors—R_t^U, R_t^G, R_t^D—are orthogonalized.

- R_t^G is orthogonal to R_t^U
- R_t^D is orthogonal to R_t^U and R_t^G
- Does order of orthogonalization influence the results?
    - Domestic factor is purged of influences that are idiosyncratic to the other factors; what's left should be domestic
    - Domestic factor may be purged of some influences that are of domestic origin—to the extent that domestic factors are reflected in the global or U.S. returns.
    - Does orthogonalization affect the variance of R_t^D?

Table VI: Contagion and Interdependence

The table shows the estimates of the following model:

$$R_{i,t} = E_{t-1}[R_{i,t}] + \beta_{i,t}' F_t + \eta_{i,0} CR_t + e_{i,t} \quad (13)$$

$$\beta_{i,t} = \beta_{i,0} + \gamma_{i,0} CR_t \quad (14)$$

The table reports estimates of the unweighted average degree of contagion and interdependence across all portfolios in the sample. The critical value of a χ^2 (1)-distributed variable is 3.84 (6.63) at the 5% (1%) level. The model is estimated allowing for errors to be clustered by country. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Benchmark	
	coef	*st.err.*
Contagion		
γ_1^G	0.056 ***	*0.013*
γ_1^U	0.133 ***	*0.015*
γ_1^D	0.249 ***	*0.016*
Interdependence		
β_1^G	0.368 ***	*0.012*
β_1^U	0.397 ***	*0.016*
β_1^D	0.491 ***	*0.014*
Other		
η_1	-0.038	*0.025*
Test statistics		
Full Sample		
ECTEST	27.78	
EXCOR	0.06	
ECDIAG	459.73	
Crisis Period		
ECTEST	0.00	
EXCOR	0.01	
ECDIAG	335.94	
Observations	322216	
R-squared	0.310	

GLOBAL CRISES AND EQUITY MARKET CONTAGION : II

Findings

- Many instruments were rejected.
- A few were supported.
- The paper concludes that
    - The globalization hypothesis is rejected
    - The wake-up call hypothesis is supported
    - Government policies can influence the degree of contagion.

GLOBAL CRISES AND EQUITY MARKET CONTAGION : II

Simple model with instruments:

$$R_{i,t} = E_{t-1}\left[R_{i,t}\right] + \beta_{i,0}^{U} R_t^{U} + \beta_{i,0}^{G} R_t^{G} + \beta_{i,0}^{D} R_t^{D}$$
$$+\beta_{i,1}^{U}{}' Z_{i,t-k} R_t^{U} + \beta_{i,1}^{G}{}' Z_{i,t-k} R_t^{G} + \beta_{i,1}^{D}{}' Z_{i,t-k} R_t^{D}$$
$$+e_{i,t}$$

Expanded (contagion) model:

$$R_{i,t} = E_{t-1}\left[R_{i,t}\right] + \beta_{i,0}^{U} R_t^{U} + \beta_{i,0}^{G} R_t^{G} + \beta_{i,0}^{D} R_t^{D}$$
$$+\gamma_{i,0}^{U} CR_t R_t^{U} + \gamma_{i,0}^{G} CR_t R_t^{G} + \gamma_{i,0}^{D} CR_t R_t^{D}$$
$$+\eta_{i,0} CR_t + e_{i,t}$$

Full model (contagion model with instruments):

$$R_{i,t} = E_{t-1}\left[R_{i,t}\right] + \beta_{i,0}^{U} R_t^{U} + \beta_{i,0}^{G} R_t^{G} + \beta_{i,0}^{D} R_t^{D}$$
$$+\beta_{i,1}^{U}{}' Z_{i,t-k} R_t^{U} + \beta_{i,1}^{G}{}' Z_{i,t-k} R_t^{G} + \beta_{i,1}^{D}{}' Z_{i,t-k} R_t^{D}$$
$$+\gamma_{i,0}^{U} CR_t R_t^{U} + \gamma_{i,0}^{G} CR_t R_t^{G} + \gamma_{i,0}^{D} CR_t R_t^{D}$$
$$+\gamma_{i,1}^{U}{}' Z_{i,t-k} CR_t R_t^{U} + \gamma_{i,1}^{G}{}' Z_{i,t-k} CR_t R_t^{G} + \gamma_{i,1}^{D}{}' Z_{i,t-k} CR_t R_t^{D}$$
$$+\eta_{i,0} CR_t + \eta_{i,1}{}' Z_{i,t-k} CR_t + e_{i,t}$$

Table XI: Channels of Contagion and Interdependence

The table shows the estimates for the contagion parameters γ and the interdependence parameters β from the full model (1)-(4), following the encompassing approach of variable selection described in the text. This means that a variable is kept in the model if either the interdependence coefficient or the contagion parameter of a particular variable is statistically significant. The column labeled "Interdecile" shows the difference in the respective interdependence and contagion coefficients for a portfolio with the determinant at its 90th percentile compared a portfolio at its 10th percentile. The critical value of a χ^2 (1)-distributed variable is 3.84 (6.63) at the 5% (1%) level. The standard errors are clustered by country. ***, **, and *, indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Contagion			**Interdependence**		
	coef	*std. err.*	Interdec.	coef	*std. err.*	Interdecile
Global channel						
Trade integration global	0.120	*0.284*	0.150	0.167 ***	*0.051*	0.209
Current account	-1.429 **	*0.686*	-0.239	-0.193	*0.120*	-0.032
Debt guarantees	-0.366 *	*0.191*	-0.366			
Deposit guarantees	-0.327 *	*0.196*	-0.327			
Risk aversion - VIX	-0.846 ***	*0.222*	-0.159	0.515 ***	*0.084*	0.097
Credit risk - TED spread	-0.878 ***	*0.097*	-0.749	0.787 ***	*0.092*	0.671
US channel						
Trade integration global	-0.182	*0.181*	-0.227	0.274 ***	*0.032*	0.341
Financial integration global	-0.711 ***	*0.121*	-0.591	-0.015	*0.017*	-0.013
Sovereign rating	-0.596 **	*0.283*	-0.596	-0.228	*0.512*	-0.228
Debt guarantees	-0.251 **	*0.120*	-0.251			
Credit risk - TED spread	-0.515 ***	*0.059*	-0.440	0.646 ***	*0.051*	0.551
Domestic channel						
Trade integration global	-0.045	*0.138*	-0.056	0.252 ***	*0.021*	0.315
FX reserves	-0.391 ***	*0.161*	-0.113	0.398 ***	*0.058*	0.115
Current account	-1.021 **	*0.470*	-0.171	-0.155 ***	*0.060*	-0.026
Deposit guarantees	-0.444 ***	*0.169*	-0.444			
Credit risk - TED spread	-0.472 ***	*0.034*	-0.403	0.485 ***	*0.029*	0.414
Test statistics						
Full Sample						
ECTEST	15.90					
EXCOR	0.05					
ECDIAG	420.47					
Crisis Period						
ECTEST	0.01					
EXCOR	0.01					
ECDIAG	312.49					
Observations	281567					
R-squared	0.332					

GLOBAL CRISES AND EQUITY MARKET CONTAGION : II

Globalization

- Important for the transmission of shocks but not important for contagion?

Wake-up call

- Does this hypothesis explain contagion or the end of contagion?

ENDOGENOUS CONTAGION

CONTAGION IN CDS, BANKING, AND EQUITY MARKETS

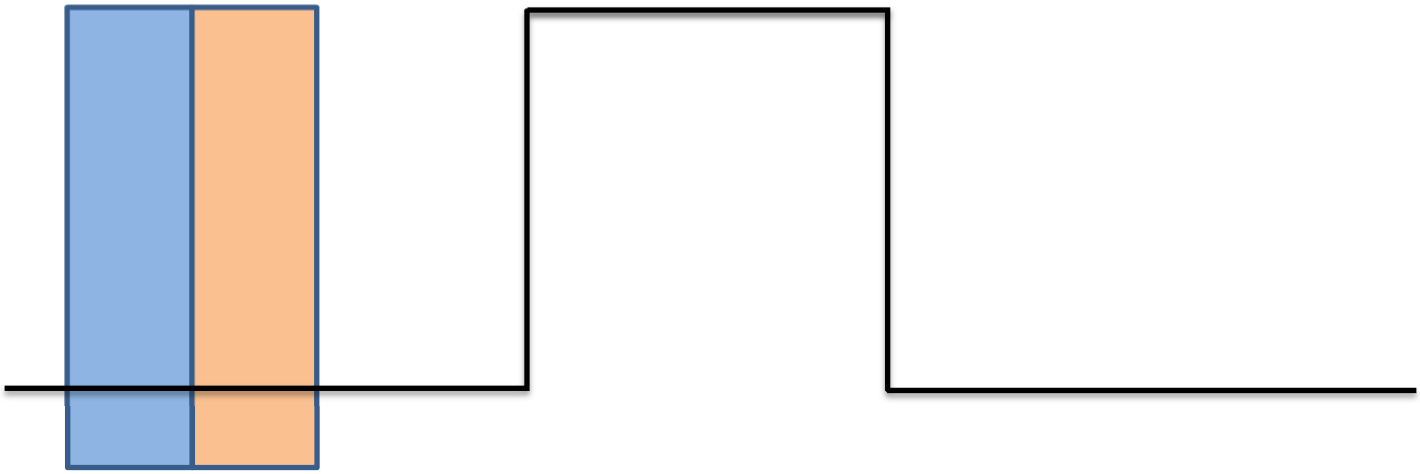
Benjamin Tabak
Mauricio Medeiros Junior
Rodrigo de Castro Miranda

ENDOGENOUS CONTAGION

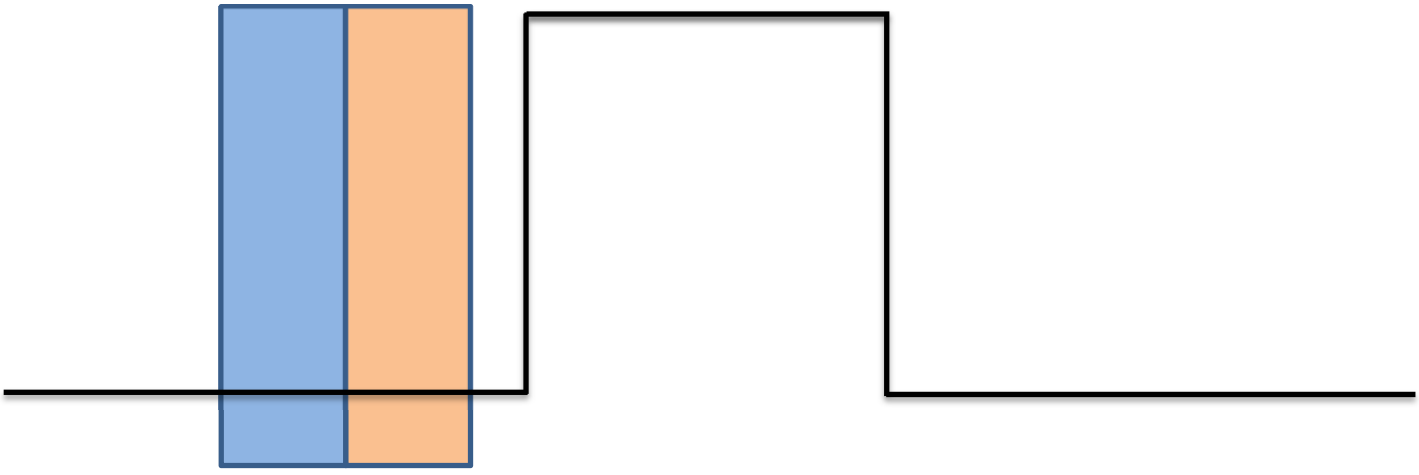
Contributions

- Provides a systematic method to identify periods of contagion
- Interesting application to markets for equities and credit default swaps
- Provides ways to calibrate the scope and intensity of the contagion over time

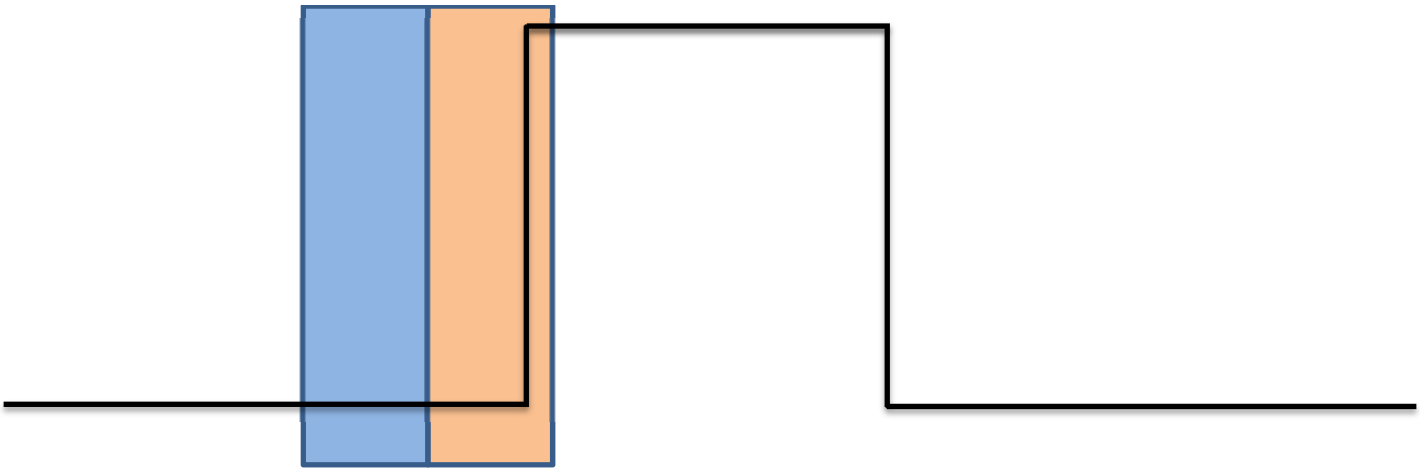
No contagion



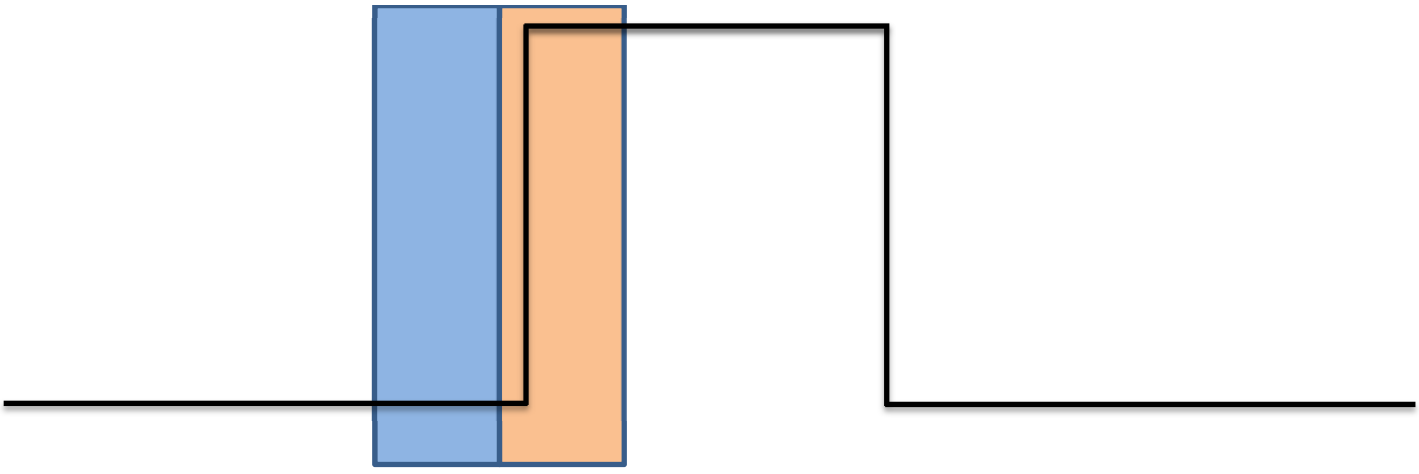
No contagion



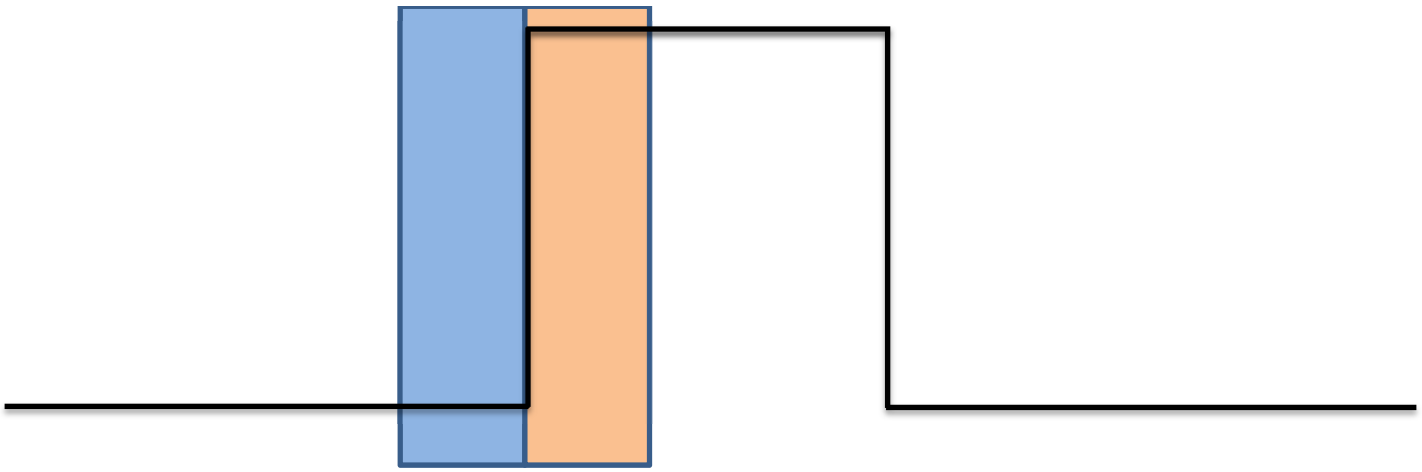
No contagion?



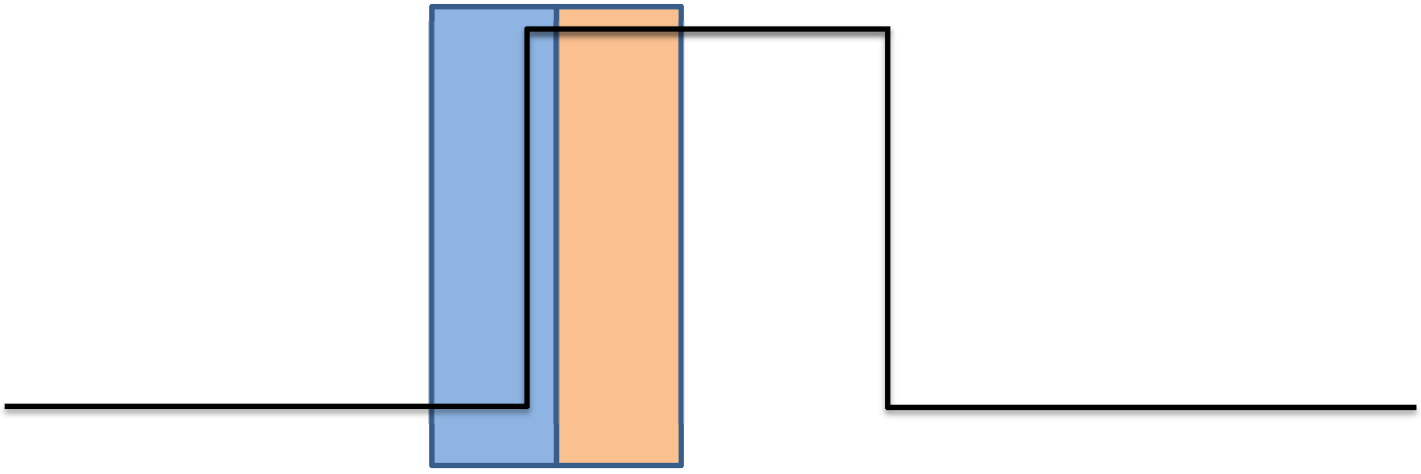
Contagion



Contagion



Contagion



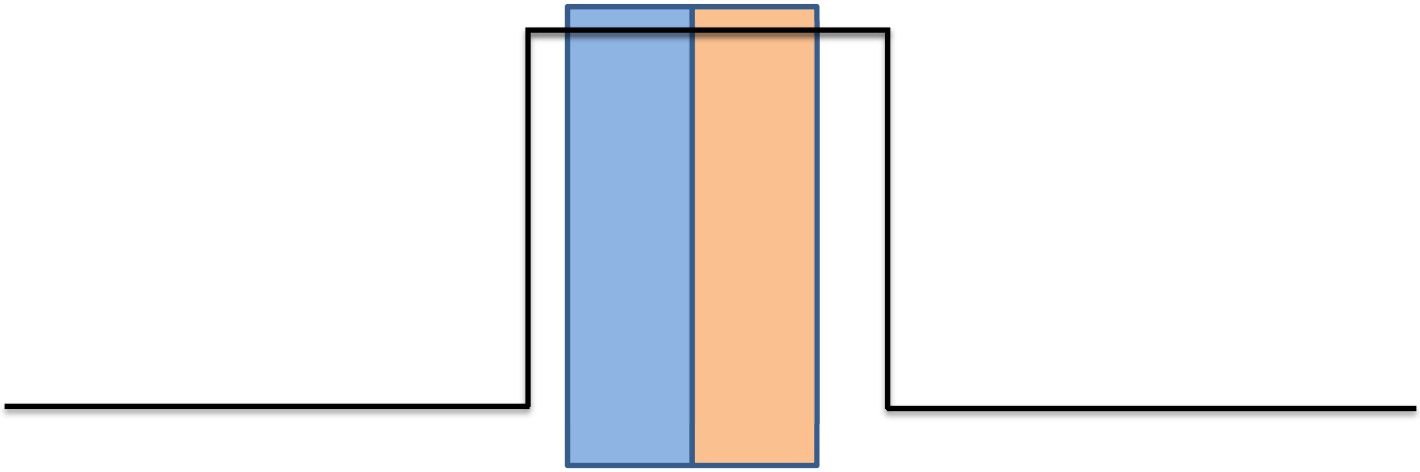
ENDOGENOUS CONTAGION

Contagion is defined as an increase in cross-market linkages.

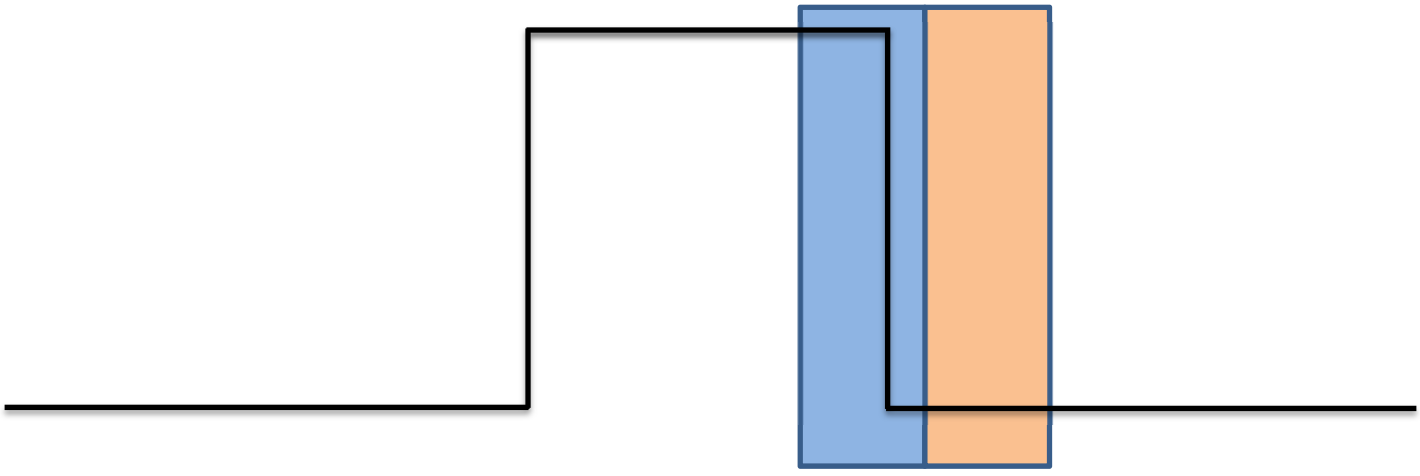
In practice, the methodology adheres to definition by imposing conditions:

- Correlation test: correlation of crisis-period residuals must be greater than correlation of pre-crisis-period residuals
- Co-skewness test: volatility of crisis-period residuals must be greater than volatility of pre-crisis-period residuals
    - parallel treatment would call for requiring an increase in co-skewness, not volatility.

No contagion?



?

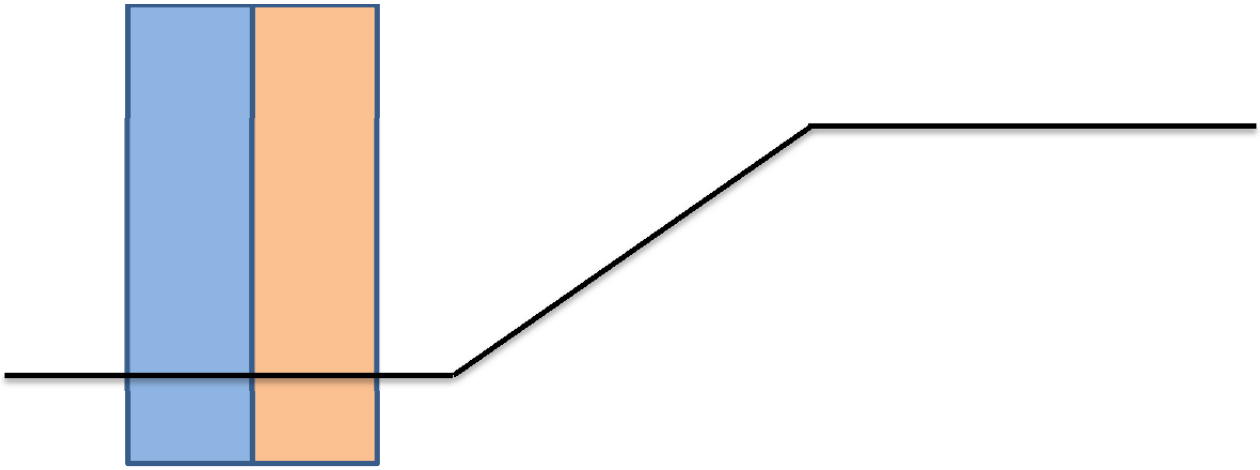


ENDOGENOUS CONTAGION

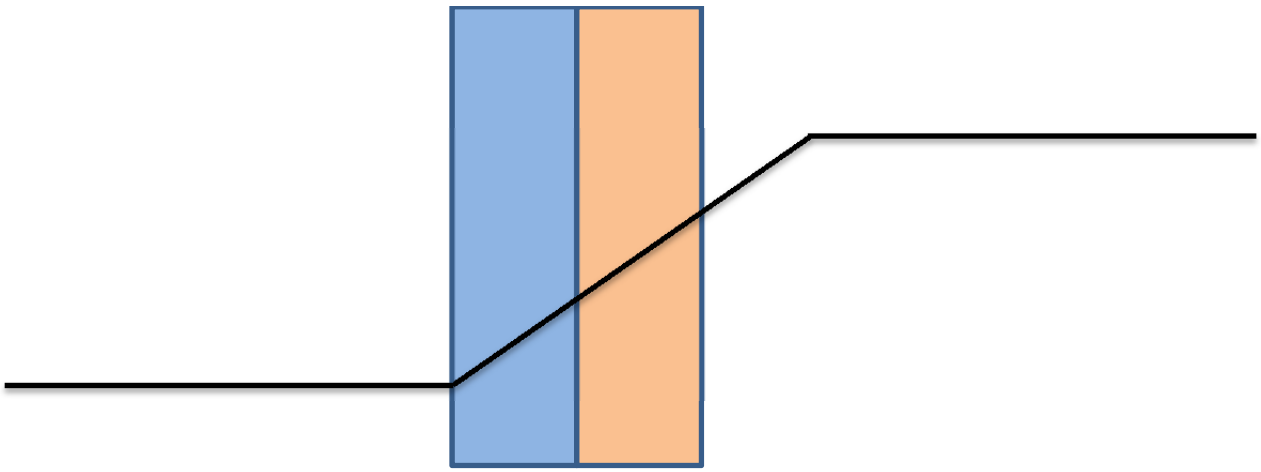
How precise is the methodology?

- Method identifies startings and endings to the day
  - High incidence of zero medians (holiday problem?)
  - Would weekly data be acceptable?

No contagion



Contagion?



ENDOGENOUS CONTAGION

How precise is the methodology?

- Method identifies startings and endings to the day
  - High incidence of zero medians (holiday problem?)
  - Would weekly data be acceptable?
- Understanding of precision of this methodology may be enhanced by Monte Carlo experiments to determine influence of
  - Size of contagion window
  - Intensity of contagion (size of break)
  - Duration of break
- Find examples in which methodology dominates arbitrary approaches commonly used

ENDOGENOUS CONTAGION

Scope and Intensity Measures

- More emphasis on ability of method to gauge scope and intensity
- Chart showing the number of countries meeting criteria for contagion over time
- For Brazil, chart showing the test statistic values over time
    - Dating would be less dependent on arbitrary choice of level of significance

Thank You