

Office Market Interconnectedness and Systemic Risk Exposure

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Motivation

Research Question

- ▶ Does common systemic risk in the financial service sector lead to co-movements among financial center office markets?
 - ⇒ vulnerability/instability of financial center office markets?
 - ⇒ spatial correlation? → limited risk diversification

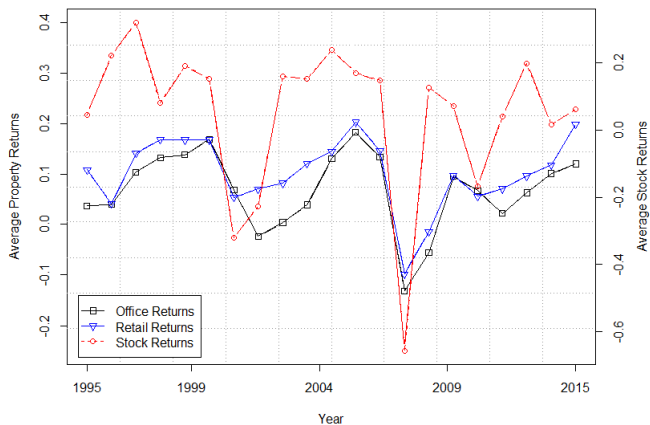
Motivation

- ▶ **Financial Centers:** Concentration of Financial Industry
 - ▶ historically built around stock exchanges
 - ▶ network effects and informational economies of scale
 - ▶ Office Market linked to Financial Market Fluctuations
 - ▶ space occupied by financial industry (Lizieri and Pain, 2014)
 - ▶ **potential channel:** employment of financial service sector
 - ▶ Systemic Risk in Financial Service Industry
 - ▶ expected capital shortfall of financial institutions (Acharya et al., 2016; Brownlees and Engle, 2016)
- ⇒ we quantify total systemic risk of financial centers
- ⇒ we compute common systemic risk between financial centers

Data

- ▶ Commercial Real Estate Market Data (from PMA)
 - ▶ annual city-level data from 1995 to 2015
 - ▶ sectors: office, retail
 - ▶ returns of 61 cities from 28 countries
- ▶ Sample Selection: 29 Financial Centers
 - ▶ existence of stock exchange (Cetorelli and Peristiani, 2013)
- ▶ Representative Price Index Returns
 - ▶ e.g., S&P 500 for New York Stock Exchange, FTSE 500 for London Stock Exchange,...

► Commercial Real Estate and Stock Market Returns in Europe



- ▶ Measuring Systemic Risk in Banking Sector

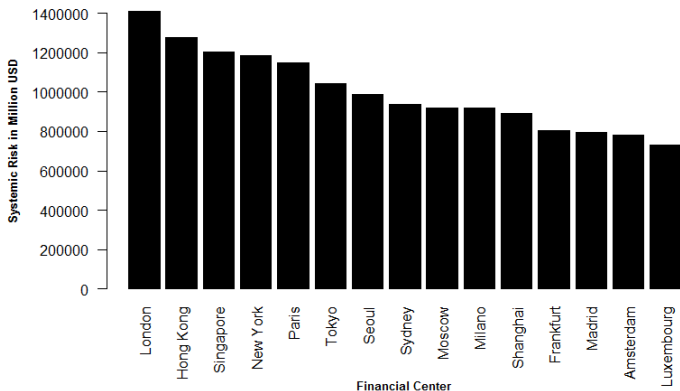
$$SRISK_{it} = E_t(\text{Capital Shortfall}_{i,t+6} | R_{m,t+1,t+6} < -40\%)$$

- ▶ Brownlees and Engle (2016): expected capital shortfall of financial institution i in period t
- ▶ 40% decline in MSCI world equity index over next 6 months
- ▶ institutions in U.S., Europe, Asia-Pacific from 2000 to 2015
- ▶ merge with SWIFT codes \Rightarrow head office locations

Data

- ▶ Measuring Systemic Risk in Banking Sector
 - ▶ **Idea:** vulnerability of financial center office market

$$SRISK_{c,t} = \sum_{l=1}^n SRISK_{lt} \text{ (for } SRISK_{lt}\% > 0 \text{)}$$



Methodology

▶ Measuring Cross-Sectional Dependence

$$r_{it} = \lambda \sum_{j \neq i} w_{ij,t} r_{jt} + X_{it} \beta + \tau_i + \varepsilon_{ij}$$

- ▶ weighted average of contemporaneous office market returns
- ▶ spatial lag λ as **systemic risk** (e.g., Blasques et al. 2016)
- ▶ **spatial weights w_{ij}** : common systemic banking sector risk
⇒ financial institution l with head offices in FCs i and j

$$w_{ij} = \sum_l 1(\text{head office}_{il} \cap \text{head office}_{jl}) \times \%SRISK_l$$

Methodology

- ▶ Identification Strategy
 - ▶ restrictions in weighting matrix
 - ▶ expected capital shortfall given hypothetical market decline
 - ▶ dotcom bubble burst 2001/2002, financial crisis 2007/2008
⇒ spatial weights $w_{ij,t} = 0$ during normal times
 - ▶ placebo test for dependence during normal times
⇒ spatial weights $w_{ij,t} = 0$ during turmoil times
 - ▶ counterfactual: retail markets (common trend)
 - ▶ channel: financial sector employment
⇒ no dependence among FC retail markets

Empirical Results

► Common Systemic Risk among FC Office Markets

	Model I			Model II			Model III		
	Office	Office	Retail	Office	Office	Retail	Office	Office	Retail
	Turmoil	Normal	Turmoil	Turmoil	Normal	Turmoil	Turmoil	Normal	Turmoil
Spatial Lag	0.335** (0.166)	0.225 (0.176)	-0.002 (0.139)	0.328** (0.154)	-0.022 (0.585)	0.022 (0.129)	0.322** (0.165)	0.261 (0.191)	0.009 (0.142)
Stock Returns	0.169*** (0.036)	0.204*** (0.037)	0.216*** (0.033)	0.125*** (0.039)	0.174*** (0.046)	0.193*** (0.038)	0.170*** (0.036)	0.201*** (0.038)	0.215*** (0.032)
log(SRISK)	-0.033*** (0.012)	-0.036*** (0.009)	-0.026*** (0.010)	-0.034*** (0.011)	-0.041*** (0.009)	-0.025** (0.010)	-0.033*** (0.012)	-0.036*** (0.009)	-0.026*** (0.010)
ΔGDP Capita	0.248*** (0.091)	0.258*** (0.094)	0.297*** (0.107)	0.213** (0.086)	0.238** (0.094)	0.285*** (0.105)	0.308* (0.160)	0.360** (0.150)	0.370** (0.181)
Term Spread	-0.587 (0.500)	-0.631 (0.492)	0.314 (0.564)	-0.421 (0.474)	-0.499 (0.507)	0.480 (0.574)	-0.584 (0.494)	-0.613 (0.480)	0.364 (0.580)
ΔCPI	-0.372 (0.610)	-0.640 (0.630)	0.159 (0.585)	-0.349 (0.579)	-0.537 (0.617)	0.213 (0.587)	-0.384 (0.606)	-0.655 (0.623)	0.195 (0.597)
ΔFloor Space	-0.701* (0.373)	-0.621* (0.375)	-0.187 (0.173)	-0.733** (0.363)	-0.774** (0.381)	-0.189 (0.173)	-0.703* (0.377)	-0.603 (0.380)	-0.190 (0.174)
ΔREIT	-0.314 (0.212)	-0.290 (0.205)	-0.793*** (0.256)	-0.322 (0.205)	-0.346 (0.215)	-0.793*** (0.255)	-0.356 (0.238)	-0.355 (0.227)	-0.847*** (0.260)
ΔPopulation	0.060 (0.121)	0.070 (0.115)	0.311 (1.076)	0.090 (0.134)	0.090 (0.136)	0.491 (1.063)	0.062 (0.122)	0.075 (0.116)	0.378 (1.056)
Correlation to MSCI	0.008 (0.082)	0.053 (0.076)	0.060 (0.065)	0.048 (0.073)	0.071 (0.087)	0.066 (0.065)	0.009 (0.082)	0.056 (0.075)	0.057 (0.066)
U.S. CMBS Spread	0.070*** (0.017)	0.082*** (0.018)	0.018 (0.016)	0.058*** (0.016)	0.078*** (0.028)	0.012 (0.016)	0.072*** (0.017)	0.082*** (0.017)	0.018 (0.016)
TED Spread				-4.528*** (0.830)	-4.779*** (1.617)	-1.512* (0.792)			
ΔGDP							-0.084 (0.202)	-0.147 (0.201)	-0.103 (0.216)
Observations	455	455	352	455	455	352	455	455	352
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pesaran CD	19.25***	12.81***	9.62***	11.72***	12.95***	7.63***	18.45***	11.84***	9.47***
Adj.-R ²	0.232	0.257	0.256	0.298	0.300	0.260	0.236	0.257	0.254

Empirical Results

► No Common Systemic Risk among Non-FC Office Markets

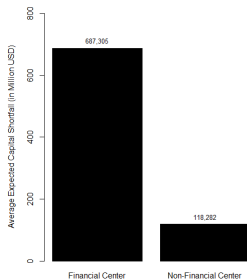
	Model I			Model II			Model III		
	Office	Office	Retail	Office	Office	Retail	Office	Office	Retail
	Turmoil	Normal	Turmoil	Turmoil	Normal	Turmoil	Turmoil	Normal	Turmoil
Spatial Lag	0.093 (0.235)	0.155 (0.111)	0.125 (0.118)	0.260 (0.219)	-0.071 (0.212)	0.252** (0.117)	0.170 (0.251)	0.163 (0.113)	0.089 (0.124)
Stock Returns	0.225*** (0.033)	0.221*** (0.029)	0.171*** (0.025)	0.147*** (0.038)	0.175*** (0.032)	0.140*** (0.030)	0.231*** (0.034)	0.233*** (0.029)	0.170*** (0.025)
log(SRISK)	-0.009*** (0.002)	-0.009*** (0.002)	-0.007*** (0.003)	-0.008*** (0.002)	-0.008*** (0.003)	-0.006** (0.003)	-0.009*** (0.002)	-0.010*** (0.002)	-0.007*** (0.003)
ΔGDP Capita	0.275*** (0.094)	0.278*** (0.089)	0.095 (0.120)	0.250*** (0.094)	0.254*** (0.093)	0.075 (0.119)	0.751*** (0.178)	0.745*** (0.176)	0.028 (0.180)
Term Spread	-2.027*** (0.511)	-2.073*** (0.489)	-0.123 (0.428)	-1.251** (0.519)	-1.444*** (0.548)	0.183 (0.426)	-1.854*** (0.526)	-1.960*** (0.478)	-0.179 (0.446)
ΔCPI	0.518 (0.714)	0.354 (0.682)	0.569 (0.737)	1.036 (0.701)	1.093 (0.758)	0.801 (0.735)	1.461** (0.696)	1.253* (0.676)	0.458 (0.729)
ΔFloor Space	-1.032*** (0.240)	-0.935*** (0.236)	-0.196 (0.207)	-0.873*** (0.241)	-0.841*** (0.239)	-0.172 (0.199)	-1.104*** (0.239)	-0.982*** (0.233)	-0.194 (0.205)
ΔREIT	-0.453** (0.192)	-0.445** (0.187)	-0.106 (0.155)	-0.493*** (0.189)	-0.470** (0.194)	-0.134 (0.159)	-0.872*** (0.249)	-0.849*** (0.245)	-0.045 (0.199)
ΔPopulation	1.208 (0.822)	0.987 (0.803)	0.854 (0.691)	1.130 (0.800)	1.039 (0.808)	0.854 (0.675)	1.028 (0.802)	0.764 (0.791)	0.880 (0.699)
Correlation to MSCI	-0.035 (0.215)	-0.045 (0.208)	-0.428 (0.341)	0.464** (0.227)	0.464** (0.244)	-0.197 (0.346)	-0.033 (0.209)	-0.048 (0.202)	-0.430 (0.341)
U.S. CMBS Spread	0.060** (0.014)	0.054*** (0.014)	0.013 (0.010)	0.044*** (0.014)	0.054*** (0.015)	0.006 (0.011)	0.053*** (0.015)	0.050*** (0.014)	0.014 (0.010)
TED Spread				-2.851*** (0.586)	-2.912*** (0.758)	-1.241*** (0.414)			
$\overline{\Delta GDP}$							-0.554*** (0.164)	-0.540*** (0.164)	0.078 (0.137)
Observations	470	470	358	470	470	358	470	470	358
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pesaran CD	14.66***	11.43***	14.32***	9.36***	10.88***	11.29***	15.205***	11.52***	14.33***
Adj.-R ²	0.304	0.312	0.227	0.336	0.329	0.242	0.318	0.326	0.225

Empirical Results

► Further Robustness

- if FC office markets exposed to common systemic risk
 - 1) effect on FC office markets (not retail) during financial turmoil
 - 2) negative effect on financial centers (not non-financial centers)

⇒ average SRISK: FC vs Non-FC



Empirical Results

1) Difference-in-Difference: Office vs Retail Market in FC

- ▶ financial turmoil periods as exogenous shock

$$r_{it} = \beta_0 + \beta_1 D_{Crisis} + \beta_2 D_{Office} + \beta_3 (D_{Crisis} \times D_{Office}) + \gamma X_{it} + \epsilon_{it}$$

	Financial Crisis 2008-2009		Dotcom Bubble Burst 2001-2002	
	Model I	Model II	Model I	Model II
constant	0.190*** (0.017)	0.271*** (0.055)	0.103*** (0.021)	0.122** (0.061)
D_{Crisis}	-0.252*** (0.039)	-0.260*** (0.039)	-0.045 (0.028)	-0.048 (0.041)
D_{Office}	0.020 (0.025)	0.023 (0.025)	-0.016 (0.028)	0.001 (0.043)
$D_{Crisis} \times D_{Office}$	-0.116** (0.052)	-0.123** (0.052)	-0.080** (0.040)	-0.097* (0.054)
log(Floor Space)		-0.003 (0.005)		-0.003 (0.006)
Observations	175	175	225	170
Adj.- R^2	0.513	0.516	0.091	0.113

Empirical Results

2) Office Markets: Financial versus Non-Financial Centers

- ▶ mean comparison during turmoil periods

	Financial Crisis 2008-2009			Dotcom Bubble Burst 2001-2002		
	Model I	Model II	Model III	Model I	Model II	Model III
constant	0.155*** (0.018)	0.198** (0.086)	0.185** (0.084)	0.101*** (0.011)	0.179** (0.085)	0.195** (0.096)
D_{Crisis}	-0.227*** (0.032)	-0.227*** (0.032)	-0.215*** (0.031)	-0.071*** (0.018)	-0.095*** (0.024)	-0.115*** (0.027)
D_{Center}	0.042 (0.026)	0.041 (0.025)	0.037 (0.025)	0.0005 (0.020)	-0.010 (0.029)	-0.017 (0.030)
$D_{Crisis} \times D_{Center}$	-0.130** (0.052)	-0.130** (0.052)	-0.117** (0.050)	-0.045 (0.030)	-0.040 (0.042)	-0.034 (0.044)
log(Floor Space)		-0.005 (0.009)	-0.004 (0.008)		-0.007 (0.010)	-0.009 (0.011)
Δ Population		0.249** (0.114)	0.349 (0.382)		0.652* (0.360)	-0.272 (0.972)
Δ CPI			-0.742 (0.576)			0.559 (0.511)
Term Spread			0.217 (1.314)			0.543 (0.600)
Δ GDP Capita			0.280* (0.150)			0.426 (0.270)
Δ REIT			-0.318 (0.224)			-0.510 (0.380)
Observations	275	275	275	398	290	279
Adj.- R^2	0.510	0.508	0.506	0.110	0.209	0.269

Conclusion

▶ Main results:

- ▶ co-movements among financial center office markets related to underlying common systemic banking sector risk
- ▶ dependence prevails conditional on effect of local stock market performance and the total expected capital shortfall of banks in the financial center
- ▶ no dependence among financial center retail markets
- ▶ no dependence among non-financial center office markets

▶ Policy implications:

- ▶ reduced diversification potential and related risk management
- ▶ financial vulnerability of international office markets in financial centers

Thank you for your attention!

Appendix

► Financial Centers: Market Coverage

City	Country	Office	Retail	Trading Platform	Stock Index
Amsterdam	Netherlands	Yes	Yes	Euronext	AEX
Athens	Greece	Yes	No	Athen Stock Exchange	ATHEX Composite
Brussels	Belgium	Yes	Yes	Euronext	Bel20
Budapest	Hungary	Yes	Yes	Budapest Stock Exchange	BUX
Copenhagen	Denmark	Yes	Yes	OMX Nordic Exchange	OMXC20
Dublin	Ireland	Yes	Yes	Irish Stock Exchange	ISEQ
Frankfurt	Germany	Yes	Yes	Deutsche Börse	DAX30
Helsinki	Finland	Yes	No	OMX Nordic Exchange	OMXH25
Hong Kong	Hong Kong	Yes	Yes	Hong Kong Stock Exchange	Hang Seng Index
Lisbon	Portugal	Yes	Yes	Euronext	PSI20
London	United Kingdom	Yes	Yes	London Stock Exchange	FTSE100
Luxembourg	Luxembourg	Yes	No	Luxembourg Stock Exchange	LUX SE General
Madrid	Spain	Yes	Yes	BME Spanish Exchange	IBEX35
Milan	Italy	Yes	Yes	Borsa Italia	FTSE MIB
Moscow	Russia	Yes	No	Moscow Exchange	MICEX Index
New York	USA	Yes	Yes	New York Stock Exchange	SNP500
Osaka	Japan	Yes	Yes	Japan Exchange Group	NIKKEI Futures
Oslo	Norway	Yes	No	Oslo Bors	OBX
Paris	France	Yes	Yes	Euronext	CAC40
Prague	Czech Republic	Yes	Yes	Prague Stock Exchange	PX50
Seoul	South Korea	Yes	Yes	Korea Exchange	KOSPI
Shanghai	China	Yes	Yes	Shanghai Stock Exchange	SE A SPI
Singapore	Singapore	Yes	Yes	Singapore Exchange	Straits Time Index
Stockholm	Sweden	Yes	Yes	OMX Nordic Exchange	OMXS30
Sydney	Australia	Yes	Yes	Australian Sec. Exchange	ASX
Tokyo	Japan	Yes	Yes	Japan Exchange Group	NIKKEI25
Vienna	Austria	Yes	Yes	Wiener Börse	ATX
Warsaw	Poland	Yes	Yes	Warsaw Stock Exchange	WIG
Zurich	Switzerland	Yes	No	SIX Swiss Exchange	SSMI

Appendix

► Descriptive Summary

City-Level	Mean	Std.Dev.	Min.	Max.	Obs.
Office Returns	0.06	0.15	-0.56	0.79	899
Retail Returns	0.09	0.13	-0.70	0.71	711
Construction Office	0.02	0.04	-0.04	0.42	914
Construction Retail	0.03	0.05	-0.02	0.68	720
Stock Returns	0.02	0.30	-1.24	1.17	435
SRISK	435398	557111	21	2745599	820
Δ Population	0.01	0.03	-0.66	0.18	911
Country-Level	Mean	Std.Dev.	Min.	Max.	Obs.
Δ GDP capita	0.05	0.10	-0.26	0.27	420
Term Spread	0.01	0.02	-0.07	0.22	420
Δ CPI	0.02	0.02	-0.05	0.19	420
Δ REITs	0.00	0.05	-0.29	0.13	420
Global Level	Mean	Std.Dev.	Min.	Max.	Obs.
U.S. CMBS Spread	0.01	0.40	-0.70	1.05	15
TED Spread	0.01	0.01	0.00	0.06	15
MSCI World Returns	0.02	0.24	-0.63	0.38	15

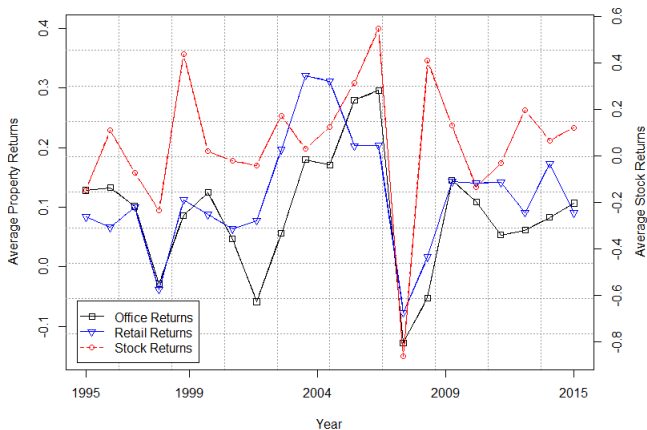
Appendix

► Commercial Real Estate and Stock Market Returns in USA



Appendix

- ▶ Commercial Real Estate and Stock Market Returns in Asia-Pacific



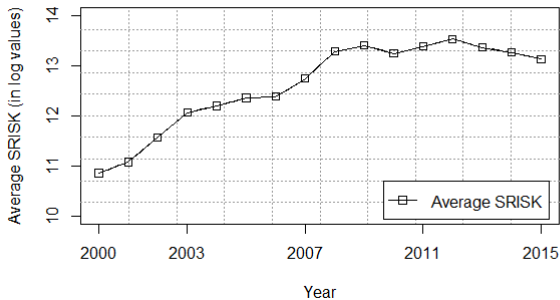
Appendix

- ▶ Measuring Systemic Risk in Banking Sector
 - ▶ financial institutions with highest SRISK (in million USD)

Institution	SRISK	Month	Year	Headquarter	Country
Royal Bank of Scotland Group PLC	186,877	11	2008	Edinburgh	United Kingdom
Mitsubishi UFJ Financial Group Inc	177,001	1	2012	Tokyo	Japan
Deutsche Bank AG	170,167	3	2008	Frankfurt	Germany
Barclays PLC	157,427	1	2009	London	United Kingdom
Bank of America Corp	154,312	4	2009	Charlotte, NC	USA
Citigroup Inc	141,770	2	2009	New York	USA
BNP Paribas SA	140,504	1	2009	Paris	France
Mizuho Financial Group Inc	140,389	11	2012	Tokyo	Japan
JPMorgan Chase & Co	126,504	2	2009	New York	USA
Credit Agricole SA	126,388	11	2012	Montrouge	France
Sumitomo Mitsui Financial Group Inc	107,646	11	2012	Tokyo	Japan
HSBC Holdings PLC	99,166	3	2009	London	United Kingdom
ING Groep NV	94,726	1	2009	Amsterdam	Netherlands
Bank of China Ltd	91,706	8	2013	Beijing	China
UBS Group AG	90,748	5	2008	Basel	Switzerland
China Construction Bank Corp	86,169	6	2013	Beijing	China
Societe Generale SA	84,762	1	2012	Paris	France
Lloyds Banking Group PLC	77,239	6	2009	London	United Kingdom
Agricultural Bank of China Ltd	75,497	7	2013	Beijing	China
Wells Fargo & Co	75,119	2	2009	San Francisco	USA

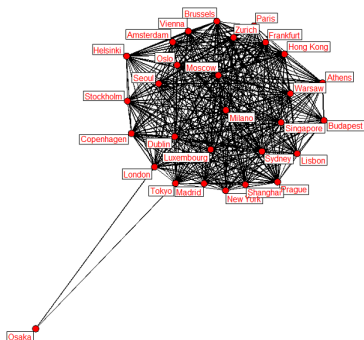
Appendix

► Time-Variation of Global Systemic Risk



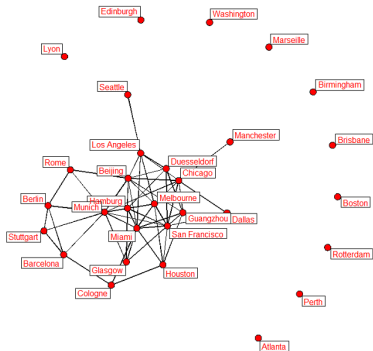
Appendix

► Interconnectedness of Financial Centers



Appendix

► Interconnectedness of Non-Financial Centers



Appendix

► SRISK: Cross-Sectional Comparison of SRISK Exposure

	Model I	Model II	Model III	Model IV	Model V
Stock Returns	0.226*** (0.031)	0.215*** (0.018)	0.143*** (0.024)	0.143*** (0.086)	0.142*** (0.024)
log(SRISK)	-0.003*** (0.001)				
Δ SRISK		-0.017*** (0.006)			
Δ GDP Capita	0.267** (0.121)	0.318*** (0.063)	0.096 (0.089)	0.090 (0.086)	0.095 (0.089)
Term Spread	-0.721** (0.329)	-0.798*** (0.280)	-1.120*** (0.320)	-1.125*** (0.311)	-1.131*** (0.318)
Δ CPI	0.715* (0.372)	0.614** (0.308)	0.676** (0.305)	0.702** (0.311)	0.678** (0.305)
Δ Floor Space	-0.643*** (0.212)	-0.724*** (0.146)	-0.500*** (0.204)	-0.490** (0.209)	-0.502** (0.205)
SRISK high			0.0005 (0.009)	0.017 (0.011)	0.0005 (0.009)
SRISK low			0.0002 (0.009)	-0.0000 (0.009)	-0.004 (0.010)
Financial Crisis			-0.172*** (0.017)	-0.143*** (0.016)	-0.179*** (0.024)
\times SRISK _{high}				-0.128** (0.051)	
\times SRISK _{low}					0.029 (0.034)
Observations	830	787	946	946	946
Adj.-R ²	0.199	0.212	0.318	0.332	0.319