The Sources of Risk Spillovers among REITs: Asset Similarities and Regional Proximity

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Regional clusters in NCREIF Property Index (NPI) 2000-2011

West Coast

South East

North East

Midwest
Related literature on spillovers among real estate

1. **Housing markets:**
   - Importance of local economic conditions for housing prices (e.g., Meen 1999, Coulson et al. 2010, Zhu et al. 2011).
   - Spatial risk spillovers and externalities in the immediate neighborhood from foreclosed properties (e.g., Harding et al. 2009)

2. **Securitized real estate markets:**
   - Chen and Liow (2006): volatility transmission among major REIT markets with spillovers being more pronounced in Asian economies
   - Elyasiani et al. (2008): shock to REIT volatility spills over to other financial institutions such as savings and loan and life insurance companies
Objectives of the paper

1. Measuring risk spillovers among single REITs using SDSVaR approach (Adams et al. 2012)
2. Explaining the variation in risk spillovers by property type, size, leverage, ..., and especially distance

Average Distance (among Properties) of two REITs:
- Essex Property Trust 9.080 miles
- Kilroy Realty Corporation

Average Distance (among Properties) of two REITs:
- Essex Property Trust 1,910 miles
- Cogdell Spencer Inc.
Identification strategy (two-step process)

1. Quantifying risk spillovers using state-dependent sensitivity value-at-risk (SDSVaR)
   - Explicitly accounts for financial condition of a company during shock exposure
   - Identifies direction and size of spillover effects from one REIT to another (no time-varying correlation)

2. Accounting for spatial characteristics of REITs’ property holdings
   - Due to their particular legal constraints and straightforward business operations REITs provide an interesting laboratory …
   - … to test how spatial proximity (risk gradient) in the underlying properties and asset similarities increase risk spillovers on stock / REIT level
The role of distance for risk spillovers

- General **stock market linkages** and **national economic shocks** affect all REITs in a similar manner (co-movements)
- **Local economic shocks** depend on proximity (sectoral and regional spillovers)
- Degree of vulnerability of a REIT to a certain shock: **balance sheet** and **financial health characteristics** (spillovers)
State-dependent sensitivity VaR: a two-stage approach

1. Compute $VaR_i$ and $VaR_j$ using EGARCH(1,1) in order to get a consistent estimate of the volatility dynamics, $h_{m,t}$:

$$VaR_m = \mu_{m,t} + z\sqrt{h_{m,t}} \quad \text{for } m = i, j$$

2. Use two-stage quantile regression to estimate the spillover effects between $VaR_i$ and $VaR_j$; the fitted values from this regression are the SDSVaR:

$$\hat{VaR}_{i,t,\theta} = \alpha_{1,\theta} + \beta_{1,\theta} \hat{VaR}_{i,t-1} + \beta_{2,\theta} \hat{VaR}_{j,t} + Z_t\gamma_\theta + \varepsilon_{i,t}$$

$$\hat{VaR}_{j,t,\theta} = \alpha_{2,\theta} + \beta_{3,\theta} \hat{VaR}_{j,t-1} + \beta_{4,\theta} \hat{VaR}_{i,t} + Z_t\gamma_\theta + \varepsilon_{j,t}$$

- where low (0.125), medium (0.500), and high (0.750) VaR quantiles describe volatile, normal, and tranquil states of the REIT market
- Note: traditional VaR only depends on its own return history and does not account for spillover effects!
Estimating risk spillovers among REITs: times-series setting

- **Data:**
  - 956 daily price observations for the period 06/01/2007 to 03/16/2011 for 74 REITs (SNL Financial Databank)
  - 16,206 times series regressions: 74 REITs x 73 (all combinations of 2 REITs) x 3 financial market states
  - VaR estimates are based on asymmetric EGARCH(1,1) model of Nelson (1991) with conditional $t$-distribution for the error terms
  - 250 days for GARCH estimation window

- **Control variables Z:**
  - Absolute price change of U.S. Composite REIT Index and VaR of RUSSELL 2000 Small Cap Index (Thomson Reuters Datastream)

- **Maximum entropy bootstrap** of Vinod and López-de-Lacalle (2009) for correct standard errors
## Descriptive statistics on estimated risk spillovers

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<th></th>
<th>Tranquil</th>
<th>Normal</th>
<th>Volatile</th>
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<tr>
<td></td>
<td>Spillover</td>
<td>Lag</td>
<td>VaR Russell</td>
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<tr>
<td>First Quartile</td>
<td>0.0058</td>
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<td>Mean</td>
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<td>Third Quartile</td>
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<td>Standard Deviation</td>
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<td>Skewness</td>
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<td>Excess Kurtosis</td>
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<td>% Significant</td>
<td>80.10</td>
<td>100.00</td>
<td>33.47</td>
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</tbody>
</table>
Explaining variation in risk spillovers: cross-sectional setting

= Cross-sectional regression, 5,402 observations, 3 regressions for financial market states

Variables:

- **Geographical distance** (great circle distance) between any combination of two REITs is computed using the Haversine (shortest distance over the earth’s surface); latitude and longitude of all 16,418 properties owned by the 74 REITs (property geodata from SNL Financial Databank)

- **Balance sheet variables** (categorical variables): stock returns and balance sheet information for 74 U.S. REITs; averages of annual values between 2007 and 2010 (SNL Financial Databank): **property type, size** (small / medium / large), **leverage** (s / m / l), **maturity mismatch** (low / medium / high), **market-to-book** (l / m / h), **market beta** (l / m / h)
Determinants of risk spillover size: non-linear regression

Non-parametric estimate of the risk gradient (second order local polynomial regression)

Marginal effects during volatile markets [%]

REITs within 62.14 miles distance radius have on average 33% higher risk spillovers than identical REITs with distance of more than 250 miles!
Determinants of risk spillover size: linear regression

- Intercept (benchmark)
  = spillover estimate for a small REIT with diversified sector focus, low leverage, low maturity mismatch, low MTB, low market beta and that receives a risk spillover from a REIT with a different property type

- REIT fixed effects to control for relevant characteristics of REIT transmitting the risk without having to model them explicitly (no panel!)
Impulse response functions for close and distant properties

**Actual Distance between Two REITs: 8.87 miles**
- Essex Property Trust
- Kilroy Realty Corporation

**Counterfactual Analysis with Distance set to 500 miles**
- Essex Property Trust
- Kilroy Realty Corporation

Change in VaR
- Essex
- Kilroy - Volatile
- Kilroy - Normal
- Kilroy - Tranquil
Summary and policy implications

General findings:

- Geographical proximity has large impact on size and persistence of risk spillovers: risk gradient and spillovers decrease nonlinearly with increasing distance and is flat for distances of more than 250 miles; within 50 miles risk spillovers are on average 43% higher
- Spillover size depends on the financial health of a REIT and are higher for firms that are large, have high leverage, and have strong market linkages (beta)

Policy implications:

- Importance of geographical diversification from the risk perspective
- Useful information for risk management decisions of RE investors, mortgage lenders, home suppliers, and policy makers…
  … on how risk spillovers increase company’s risk exposure = underestimating systemic risk among national REITs
Thank you for your attention!