Learning Externalities in Opaque Asset Markets:

Evidence from International Commercial Real Estate

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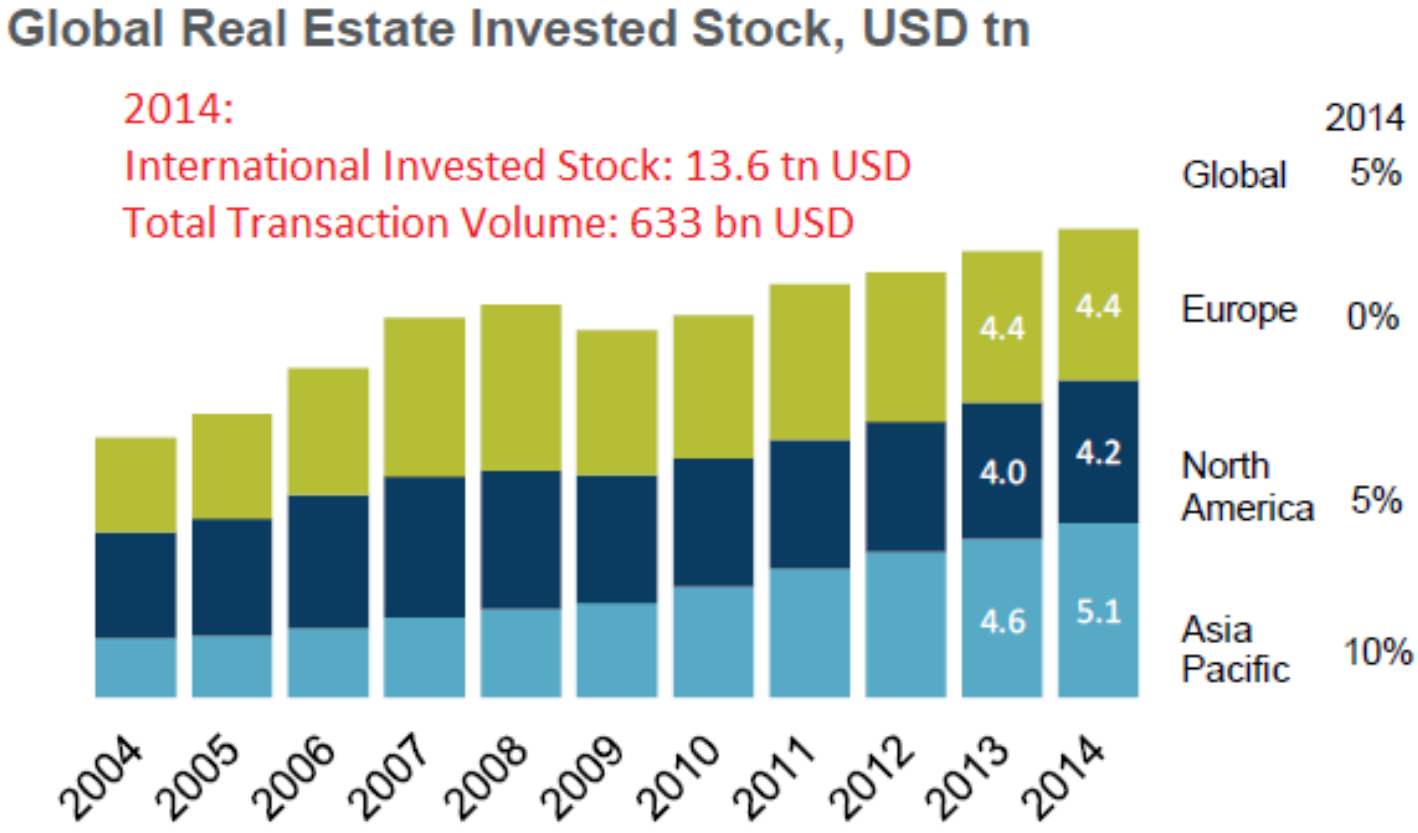
Motivation

International Commercial Real Estate (CRE) Markets

- important asset class in institutional investors' portfolio



DTZ (2015), p.3.

- capital growth unequally distributed across globe
- growth perspectives $\uparrow \Rightarrow$ property prices in emerging markets $\uparrow$

Motivation

Specific Market Microstructure:

- property market: immobile assets and trading frictions
- over-the-counter market: heterogeneous assets privately traded
- lack of transparency: limited publicly available information

$\Rightarrow$ **geographically segmented and opaque international CRE markets**

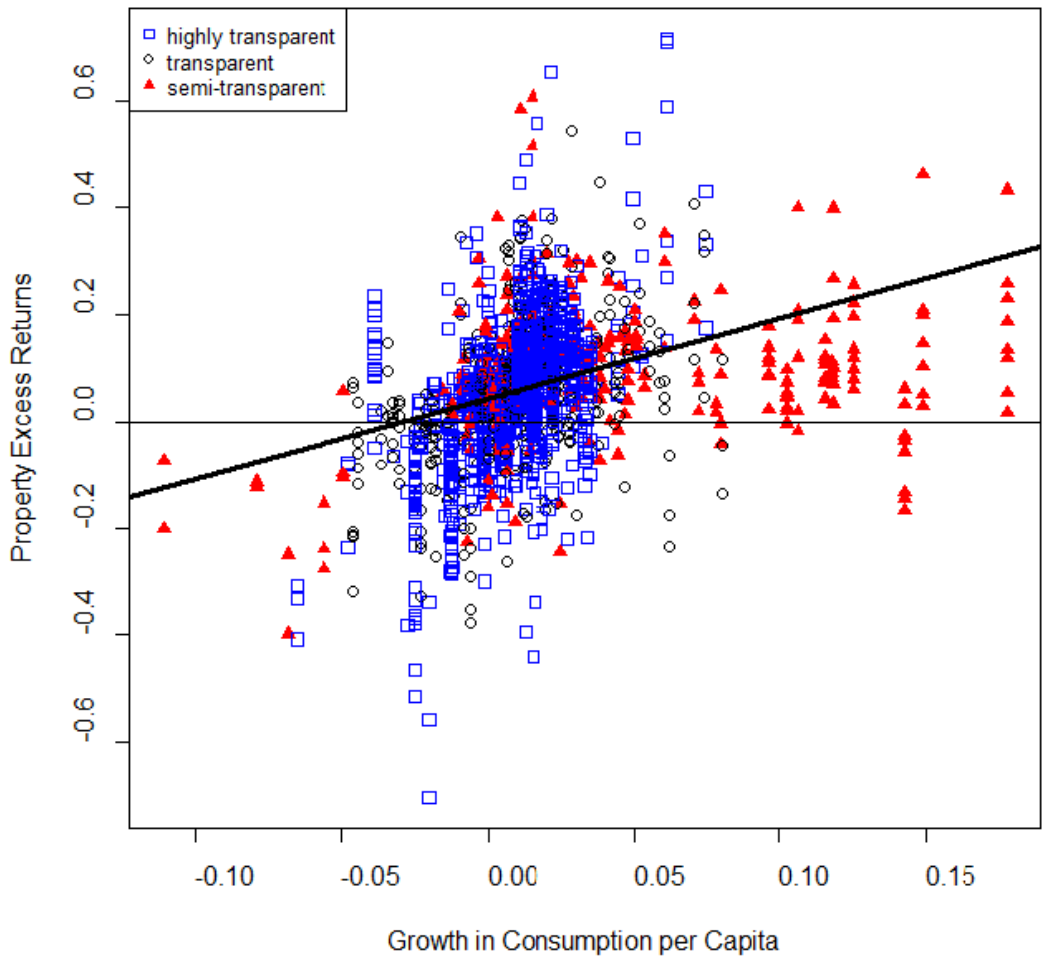
Opaque Markets: Trading Barriers for Foreign Investors

- trading with locally better informed brokers (monopoly power)
- market entry costs for less informed institutional investors
  $=$ opacity-based markup
- proximity in transparency $\uparrow \Rightarrow$ info acquisition costs $\downarrow$

$\Rightarrow$ **positive relationship between transparency differential and entry costs**

Motivation

- limited growth perspectives in liquid, mature private markets
- comparative advantage of investor from opaque market to enter similarly transparent markets (Greek vs U.S. investor)



Motivation

Central Idea:

- transparency differentials $\Rightarrow$ cross-sectional dependence
- empirically test the implications of market opacity on co-movements in excess returns
- estimate spillover effects among similarly transparent markets (learning externalities)

Main Results:

- cross-sectional dependence of segmented property markets
- co-movements in property market excess returns
- evidence of spillover effects and feedback loops

Dependence ...

- ... cannot be explained by global systematic risk!
- ... does not merely echo geographic distance!

Contribution to Literature

1. Information Transmission and Asset Pricing in OTC Markets
   - implications of search costs on asset pricing/market liquidity: *Duffie et al. (2005, 2007), Lagos & Rocheteau (2009)*
   - our focus: effect of limited transparency and connectivity in segmented markets by this trading friction

2. Learning Externalities and Ambiguity
   - information cannot be assessed with precision: *Epstein & Schneider (2007, 2008), Caskey (2009), Cao et al. (2011)*
   - information acquisition of investors to mitigate uncertainty: *Mele & Sangiorgi (2015)*

3. Panel Data Under Cross-Sectional Dependence
   - multi-factor models: *Pesaran & Tosetti (2011)*
   - spatial weighting matrix linked to economic theory: *Gibbons & Overman (2012), Corrado & Fingleton (2012)*

   $\Rightarrow$ identification of underlying economic **transmission channel**

Theoretical Framework

Bargaining Game in Decentralized Opaque Markets

- Model Adaption of Green et al. (2007)
- **Market Structure and Agents:**
  - continuum of opaque markets along transparency line d
  - two opaque markets located at d and d' with $d' \leq d$
  - fundamental property price in period t:
    $p_t(d') = m_t x_{t,d'} + \theta_{d'}$ and $p_t(d) = m_t x_{t,d} + \theta_d$
    with:
    $x_{t,d'}, x_{t,d}$ = observable state variables
    m_t = common stochastic discount factor
    $\theta_{d'}, \theta_d$ = market-specific parameters (market opacitiy)

Theoretical Framework

- trading gain of domestic broker (with local monopoly power in d) in t:

$$W_t^b = p_t(d) - v \geq 0$$

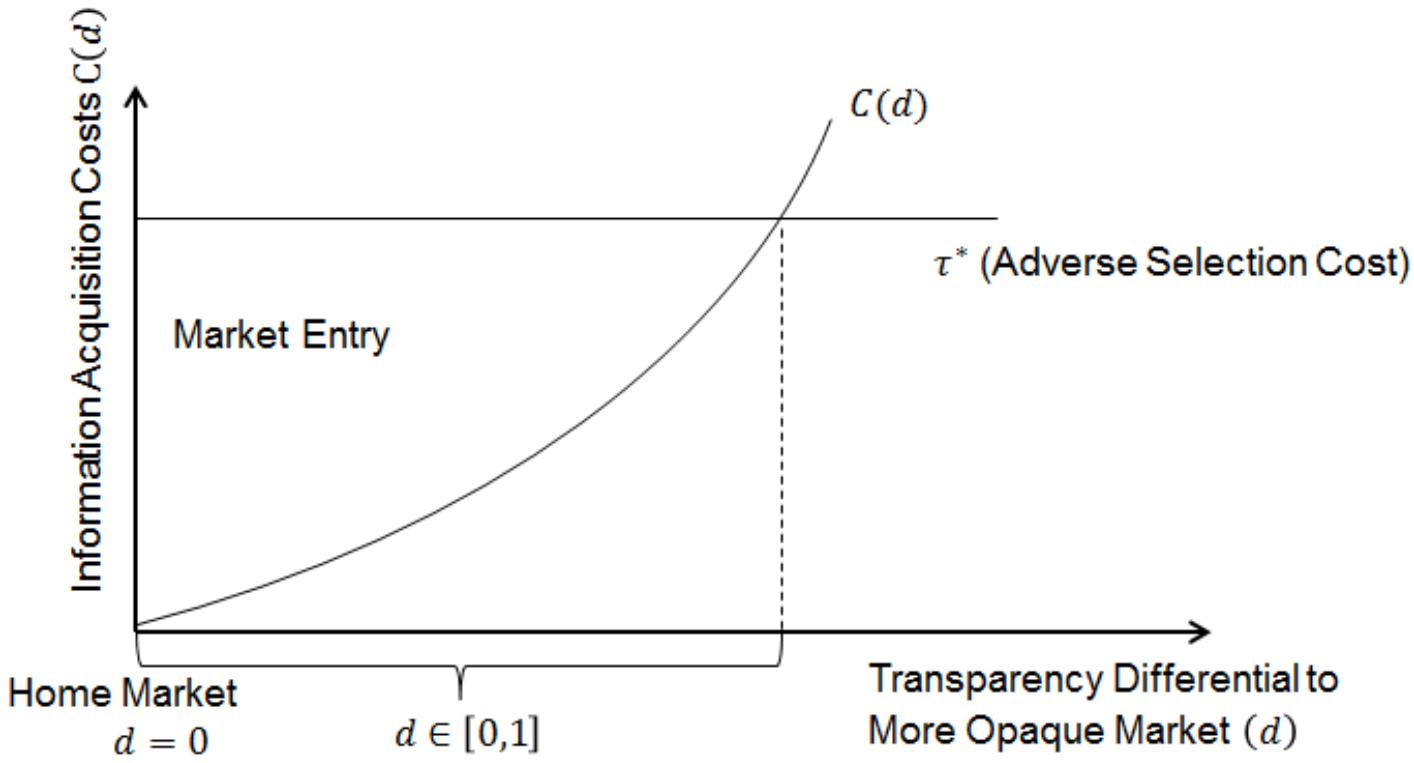
with:

opacity-based markup: $p_t(d) - v = \tau$

- $\tau = W_t^b \geq 0$
- local adverse selection cost $\tau^* \geq \tau$

Theoretical Framework

- **Information Acquisition Costs** $C(d)$:
  - increasing marginal entry costs: $\frac{\partial C(d)}{\partial d} > 0$ and $\frac{\partial^2 C(d)}{\partial d^2} > 0$
  - **market entry:**
    information acquisition costs $C(d) \leq$ adverse selection costs τ^*
  - transparency line $d \in [0, 1]$ increasing in level of opacity



Theoretical Framework

- trading gain for institutional investor i in $t+1$:

$$W^i_{t+1} = p_{t+1}(d) - C(d) - p_t(d) \geq 0$$

mean-variance utility function: $U(W) = E[W] - \frac{\delta}{2} Var[W]$

- indirect utility functions conditional on information set G_t:
  - foreign institutional investor with indirect utility:
    $U(W^i_t | G_t) = E[p_{t+1}(d)|G_t] - C(d) - p^*_t(d) - \frac{\delta}{2} Var[p_{t+1}(d)|G_t]$
  - local broker with indirect utility:
    $U(W^b_t | G_t) = E[p^*_t(d) - v|G_t] = p^*_t(d) - v$

Theoretical Framework

- **Ambiguity Aversion:**
  - expected future price $E[p_{t+1}(d)|G_t] = E[m_{t+1}x_{t+1,d}|G_t + \theta_d]$
  - parameter θ_d hindered by opacity and unknown to investor

- **Learning Externalities:**
  - for $d' \leq d$: $\theta_d \approx \theta_{d'} \pm \frac{\partial C(d)}{\partial d}$
  - interval $\theta_d \in [\underline{\theta}_d, \overline{\theta}_d]$ with lower and upper bound:

$$\underline{\theta}_d = \theta_{d'} - \frac{\partial C(d)}{\partial d} \text{ and } \overline{\theta}_d = \theta_{d'} + \frac{\partial C(d)}{\partial d}$$

  - transparency differential $d \uparrow \Rightarrow$ ambiguity $\uparrow \Rightarrow$ price range $\uparrow$:

$$E[\underline{p}_{t+1}(d)|G_t] = E[m_{t+1}x_{t+1,d}|G_t] + \theta_{d'} - \frac{\partial C(d)}{\partial d}$$

$$E[\overline{p}_{t+1}(d)|G_t] = E[m_{t+1}x_{t+1,d}|G_t] + \theta_{d'} + \frac{\partial C(d)}{\partial d}$$

Theoretical Framework

- **Bargaining Process:**
  - solution of generalized Nash bargaining product

$$p_t^*(d) \in argmax(E[p_{t+1}(d)|G_t] - C(d) - p_t^*(d) - \frac{\delta}{2} Var[p_{t+1}(d)|G_t])^{(1-d)} \cdot (p_t^*(d) - v)^d$$

subject to the following participation constraints:

$$E[p_{t+1}(d)|G_t] - C(d) - p_t^*(d) - \frac{\delta}{2} Var[p_{t+1}(d)|G_t] \geq 0$$

$$p_t^*(d) - v = \tau \geq 0$$

$$E(p_{t+1}(d)|G_t) - C(d) - v - \frac{\delta}{2} Var[p_{t+1}(d)|G_t] \geq 0$$

Theoretical Framework

- **Equilibrium Transaction Price:**

$$p_t^*(d) = (E[p_{t+1}(d)|G_t] - C(d) - \frac{\delta}{2} Var[p_{t+1}(d)|G_t])d + v(1-d)$$

  - transaction price as weighted average of indirect utility of investor and reservation value of local broker
  - for $d = 0$: $p_t^*(d)$ equals reservation value $\rightarrow$ no markup
  - for $d = 1$: trading gain of institutional investor equals zero
  - price range $p_{t+1} \in [\underline{p}_{t+1}, \overline{p}_{t+1}]$ increasing with opacity

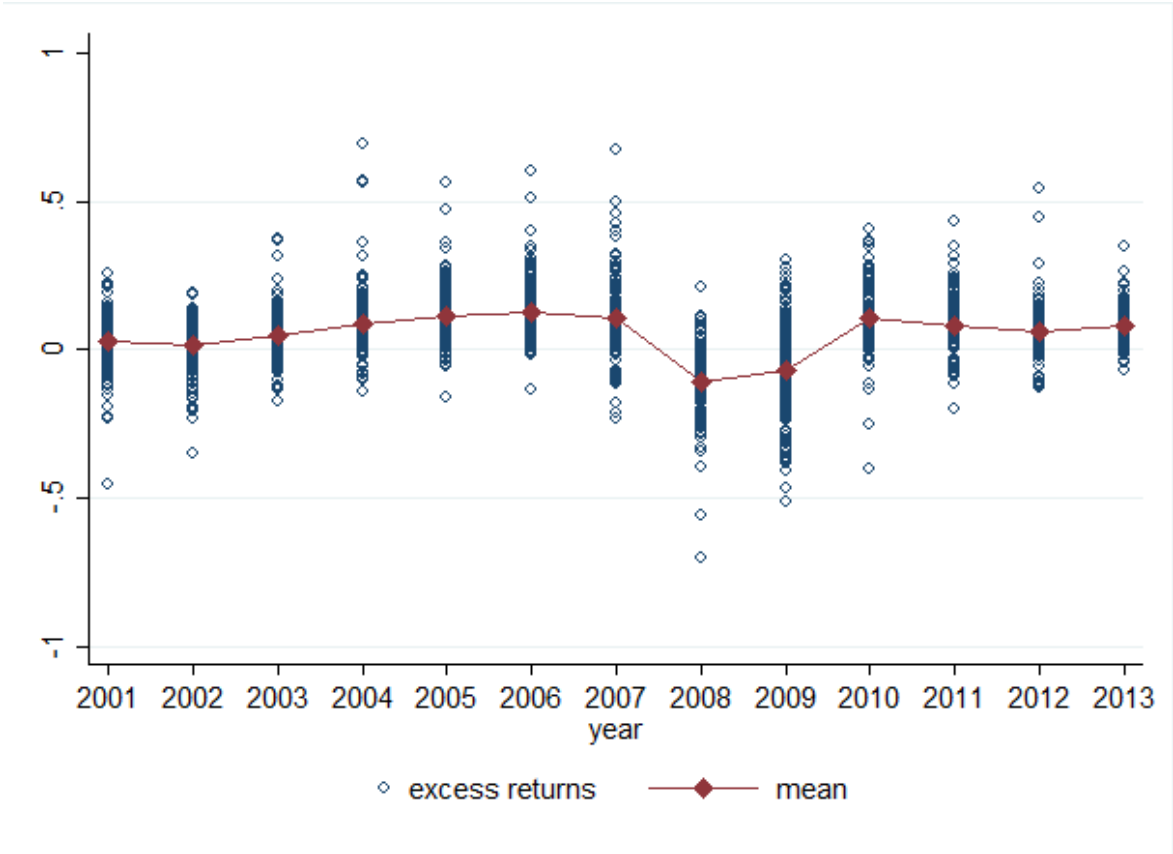
- **Implied Cross-Sectional Dependence:**

$$p_t^*(d) = (E[m_{t+1}x_{t+1,d} - m_t x_{t,d'}|G_t] + p_t(d') \pm \frac{\partial C(d)}{\partial d} - C(d) - \frac{\delta}{2} Var[p_{t+1}(d)|G_t])d + v(1-d)$$

  - from $\theta_{d'} = p_t(d') - m_t x_{t,d'}$, with $d \geq d'$ and $d', d \in [0, 1]$

Data

- **Exclusive Data from Property Market Analysis (PMA)**
  - annual total market excess returns
  - three sectors: industrial, office, retail
  - city-level data of 26 countries (USA, Europe, Asia-Pacific)
  - sample period from 2001 to 2013



Data

- **Country-Specific Fundamentals**
  - excess returns on stock market portfolio (MSCI Index)
  - growth in consumption expenditures per capita
  - expected inflation (log changes in CPI)
  - term spread (long-term GBY minus short-term interbank rates)

- **Global Systematic Risk**
  - world stock market excess returns (MSCI world index)
  - global consumption growth (from PCA)
  - TED spread (proxy for risk aversion, credit risk)
  - three-month Eurodollar rate

Data

- **Additional Control Variables**
  - changes in real exchange rate relative to U.S. dollar
  - international private market investment flows
  - funding liquidity, e.g., from equity market (REIT excess returns) and credit market (U.S. CMBS spread)
  - country-specific controls, e.g., unemployment rate, ...

- **Market-Specific Fixed-Effects**
  - control for omitted variable bias
  - control for time-invariant, heterogeneous market frictions, arising e.g., from capital controls, policy regulations, land scarcity, ...

Econometric Model

- **Spatial Model**

$$Y_{nt} = \lambda W_{nt} Y_{nt} + X_{nt}\beta + \eta_n + \varepsilon_{nt}$$

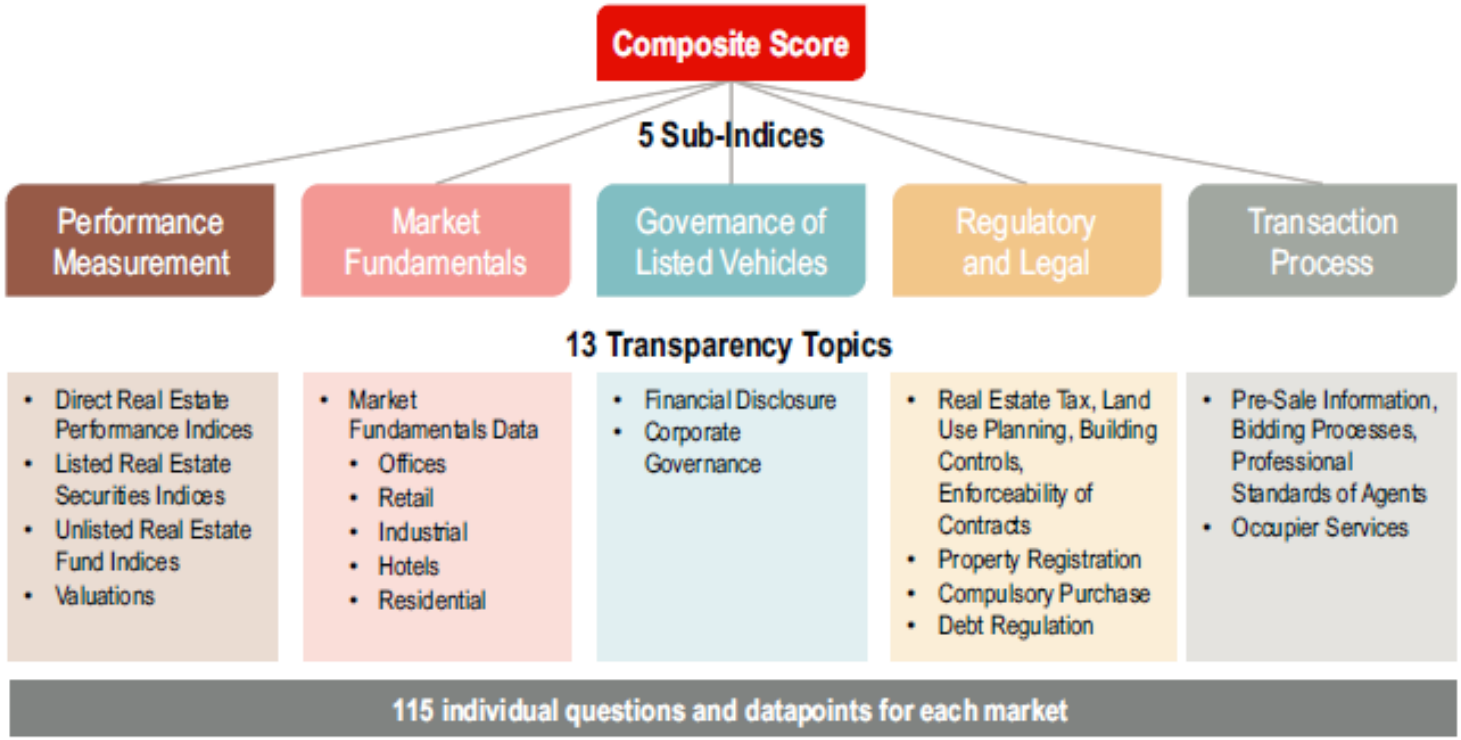
  - time-varying $n \times n$ weighting matrix W_{nt}
  - spatial HAC-robust inference

- **Weighting Matrix**
  - Jones Lang LaSalle Transparency Index:
    proxy for legal requirements, regulation, info about market, ...
  - inverse distance $w_{ij,t} = d_{ij,t}^{-1}$ between property markets i and j

$\Rightarrow$ **Implication:** Δ transparency$_{ij} \downarrow \Rightarrow w_{ij} \uparrow \Rightarrow$ spillover effect$_{ij} \uparrow$

Econometric Model

- Transparency Index Components
  (Incorporating 115 different factors)



Source: JLL, LaSalle Investment Management

Tier 1: Highly Transparent	Total Composite Score: 1.00 – 1.70
Tier 2: Transparent	Total Composite Score: 1.71 – 2.45
Tier 3: Semi-Transparent	Total Composite Score: 2.46 – 3.46
Tier 4: Low Transparency	Total Composite Score: 3.47 – 3.97
Tier 5: Opaque	Total Composite Score: 3.98 – 5.00

Econometric Model

- **Reduced-Form Specification:**

$$Y_{nt} = (I_n - \lambda W_{nt})^{-1} (X_{nt}\beta + \eta_n + \varepsilon_{nt})$$

- **Spatial Multiplier Effect:**

$$(I_n - \lambda W_{nt})^{-1} \approx I_n + \lambda W_{nt} + \lambda^2 W_{nt}^2 + \lambda^3 W_{nt}^3 + \ldots + \lambda^q W_{nt}^q$$

- **Average Impact Measures:**
  - **Average Direct Impact**
    = shock ΔX_i on y_i including spillover and feedback loop effects
  - **Average Total Impact**
    = shock ΔX_i on all other markets y_j, $i \neq j$
  - **Average Indirect Impact**
    = pure spillover effect from other markets

Empirical Results

- **Cross-Sectional Dependence in Segmented Markets**

	Model I	Model II	Model III	Model IV
SPATIAL LAG	0.557***	0.414**	0.620***	0.365**
	(0.137)	(0.173)	(0.118)	(0.172)
STOCK ER	0.073***	0.090***	0.075***	0.058**
	(0.024)	(0.028)	(0.025)	(0.023)
ΔCONSUMPTION	1.209***	1.296***	1.451***	1.305***
	(0.354)	(0.367)	(0.480)	(0.423)
ΔCPI	0.566**	0.423*	0.598*	0.308
	(0.252)	(0.252)	(0.346)	(0.341)
TERM SPREAD	0.298*	0.136	0.346	0.106
	(0.157)	(0.154)	(0.292)	(0.285)
REIT ER		0.019***		
		(0.007)		
U.S. CMBS SPREAD		0.033***		
		(0.012)		
ΔCONSTRUCTION			-0.420***	
			(0.143)	
INVESTMENT				0.085***
				(0.026)
Observations	2041	2041	880	880
Fixed-Effects	Yes	Yes	Yes	Yes
Pesaran CD	8.37***	6.73***	-0.14	0.08
Adj.-R^2	0.373	0.380	0.451	0.494

HAC s.e. *p<0.1; **p<0.05; ***p<0.01

Empirical Results

- **Spillover Effects and Feedback Loops**

	Model I	Model II	Model III	Model IV
Average Direct Impact				
STOCK ER	0.074	0.099	0.863	0.053
ΔCONSUMPTION	1.295***	1.337***	1.648***	1.366***
ΔCPI	0.609***	0.435**	0.682	0.297
TERM SPREAD	0.319	0.139*	0.385	0.109
REIT ER		0.017		
U.S. CMBS SPREAD		0.041		
ΔCONSTRUCTION			-0.471	
INVESTMENT				0.107
Average Total Impact				
STOCK ER	0.152	0.119	0.200	0.081
ΔCONSUMPTION	2.738***	2.213***	3.813***	2.081***
ΔCPI	1.285***	0.743**	1.577	0.452
TERM SPREAD	0.680	0.228*	0.891	0.167
REIT ER		0.058		
U.S. CMBS SPREAD		0.003		
ΔCONSTRUCTION			-1.089	
INVESTMENT				0.163
Average Indirect Impact				
STOCK ER	0.078	0.021	0.113	0.028
ΔCONSUMPTION	1.443**	0.875***	2.165***	0.714***
ΔCPI	0.676*	0.309	0.895	0.155
TERM SPREAD	0.361	0.088	0.506	0.057
REIT ER		-0.014		
U.S. CMBS SPREAD		0.017		
ΔCONSTRUCTION			-0.618	
INVESTMENT				0.056

Empirical Results

- **Spatial Partitioning**
  - from spatial multiplier effect

$$(I_n - \lambda W_{nt})^{-1} \approx I_n + \lambda W_{nt} + \lambda^2 W_{nt}^2 + \lambda^3 W_{nt}^3 + \ldots + \lambda^q W_{nt}^q$$

  - geometrically decaying spillover effects of local shocks

W-Order	DIRECT	INDIRECT	TOTAL
W^0	1.208	0.000	1.208
W^1	0.000	0.673	0.673
W^2	0.052	0.323	0.375
W^3	0.015	0.194	0.209
W^4	0.011	0.105	0.116
W^5	0.004	0.060	0.065
W^6	0.003	0.033	0.036
W^7	0.001	0.019	0.020
W^8	0.001	0.010	0.011
$\sum_{q=0}^{8} W^q$	1.295	1.417	2.713
AVERAGE IMPACT EFFECTS	**DIRECT EFFECT**	**INDIRECT EFFECT**	**TOTAL EFFECT**
ΔCONSUMPTION	1.295	1.443	2.738

Robustness Tests

- three estimators: GMM, 2SLS, NLS
- test for **global systematic risk:** high Pesaran CD, low adj.-R^2

Systematic Factors	Model I	Model II	Model III	Model IV	Model V
GLOBAL STOCK ER	0.155***				
	(0.012)				
ΔGOBAL CONS.		0.038***			
		(0.004)			
TED SPREAD			-5.359***		
			(0.514)		
EURODOLLAR			1.099***	1.607***	
			(0.188)	(0.195)	
U.S. REIT ER				0.273***	0.060***
				(0.016)	(0.021)
U.S. CMBS SPREAD				0.053***	0.021***
				(0.008)	(0.007)
INVESTMENT					0.143***
					(0.012)
ΔREAL XR	-0.001	-0.054	-0.015	-0.031	-0.092**
	(0.041)	(0.042)	(0.038)	(0.038)	(0.039)
Observations	1980	1980	1980	1980	1852
Fixed-Effects	Yes	Yes	Yes	Yes	Yes
Pesaran CD	125.15***	140.67***	127.09***	49.12***	16.81***
Adj.-R^2	0.085	0.064	0.077	0.252	0.316

Clustered-robust s.e. *p<0.1; **p<0.05; ***p<0.01

Robustness Tests

- sector heterogeneity: industrial, office, retail
- different data: International Property Databank (IPD)
- **different W-matrices:** political risk, geographic distance, ...

	Model I	**Model II**	**Model III**	**Model IV**	**Model V**	**Model VI**
W-Matrix	Economic Freedom	Corruption Perception	Political Risk	Country Risk	Geographic Distance	Ambiguity Aversion
SPATIAL LAG	0.694***	0.641***	0.630***	0.612***	-0.031	0.514***
	(0.108)	(0.083)	(0.066)	(0.080)	(0.367)	(0.072)
STOCK ER	0.054***	0.065***	0.064***	0.067***	0.157***	0.088***
	(0.028)	(0.017)	(0.015)	(0.017)	(0.056)	(0.013)
ΔCONSUMPTION	0.994***	1.306***	1.337***	1.291***	2.554***	1.653***
	(0.274)	(0.222)	(0.188)	(0.209)	(0.909)	(0.211)
ΔCPI	0.382	0.660***	0.697***	0.677***	1.114**	0.708***
	(0.233)	(0.245)	(0.242)	(0.245)	(0.472)	(0.247)
TERM SPREAD	0.261*	0.482***	0.484***	0.287	0.678**	0.801***
	(0.157)	(0.155)	(0.153)	(0.155)	(0.288)	(0.170)
Observations	2041	2041	2041	2041	2041	2041
Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes
Pesaran CD	2.27**	4.02***	2.85***	4.03***	53.70***	16.83***
Adj.-R^2	0.405	0.368	0.371	0.343	0.284	0.346

HAC s.e. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Conclusion

- **General Results**
  - co-movements of segmented property markets
  - transparency differentials as transmission channel
  - emergence of potential property price bubbles

- **Policy Implications**
  - counter effect to diversification potentials
  - potential instability of international property markets
  - need to establish international transparency standards
  - increase transparency to mitigate ambiguity in opaque markets

Thank you for your attention!