

# CHINESE REAL ESTATE SPILLOVER

Garth Mortensen, MSc Finance

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# QUESTION

- ▶ To what extent do returns and volatility in China's real estate market spillover into foreign real estate markets?
- ▶ The foreign markets will include the US, and perhaps others such as Japan. The US can serve as a global market for comparison, while Japan could serve as a regional market.


# WHY? RELEVANCE.

- ▶ China now ranks as the second largest economy in terms of GDP, with a currency that's steadily appreciating.
- ▶ As economic growth continues at an unprecedented level, China is attracting more international investors. Chinese firms are also “going-out” to invest overseas.
- ▶ Real estate is becoming increasingly internationalized, and growing in popularity in diversified strategies, (Yunus, 2009, Hatemi-J and Roca 2011).

# WHY? RELEVANCE.

- ▶ But many economists are worried about a possible bubble in China's real estate sector.
  - ▶ Government has been tweaking market controls for years, each time triggering market volatility.
  - ▶ These worries are making their way into market speculations, such as why isn't SOHO China paying salaries?
  - ▶ Vanke saw its yoy sales drop the fifth straight month in a row.
  - ▶ 16 mainland listed firms are spinning off their real estate development assets. Others who remain in the business have been drawing on heavy financing, as risks climb.

# WHY? TRANSFERABLE.

- ▶ Additionally, risk management is gaining more and more attention with time. Volatility is one major component here. GARCH has become an industry standard.
  - ▶ Increasingly severe weather, LTCM and other case studies show that fat-tailed probabilities should be applied more often. Learning to apply alternative distributions is a worthwhile exercise.
  - ▶ Other markets and asset classes show evidence of integration. This has implications on diversification.
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# CONTRIBUTION

- ▶ A good body of literature exists on developed market spillovers. The most common digressions focus on stock market spillovers to emerging markets.
- ▶ From there, the next common region under the spotlight Asia.
- ▶ However, spillover studies focused on the real estate sector, emerging markets in particular, are nearly non-existent.

# FIRST – THE STYLIZED FACTS

- ▶ Stylized facts were set out by Mandelbrot (1963):
  - ▶ 1) Price series ( $r$ ) are non-stationary. That is, they don't gravitate towards a mean. However, they are “second moment ( $r^2$ ) stationary.”
  - ▶ 2) Absence of autocorrelation in price series. That is, prices can be said to be white noise.
  - ▶ 3) Autocorrelation of  $r^2$ , meaning that past  $|r|$  affects next  $|r|$ .

# FIRST – THE STYLIZED FACTS

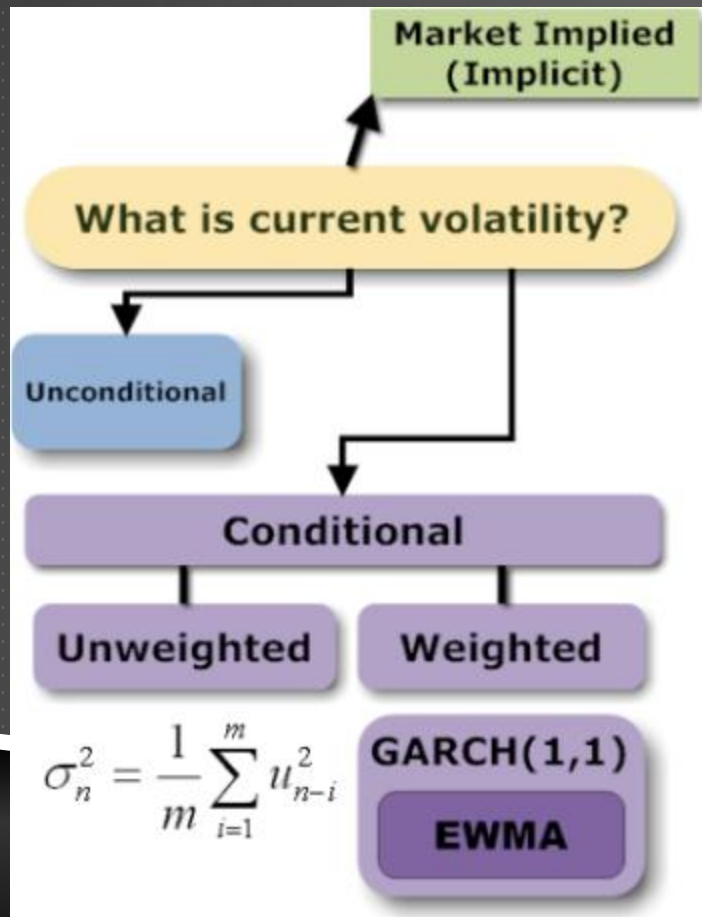
- ▶ 4) Volatility clustering (heteroskedasticity) is observable.
- ▶ 5) Fat tail distribution (non-Gaussian)
- ▶ 6) Leverage effect (Black, 1976). There are asymmetric responses to positive and negative innovations.
- ▶ \*7) Calendar effects. Certain days of the week pose more or less losses, as do holidays and seasons.



# FIRST – THE STYLIZED FACTS

- ▶ How can you account for all of these stylized facts? A quick walk through volatility model evolution (Mansfield 1999).

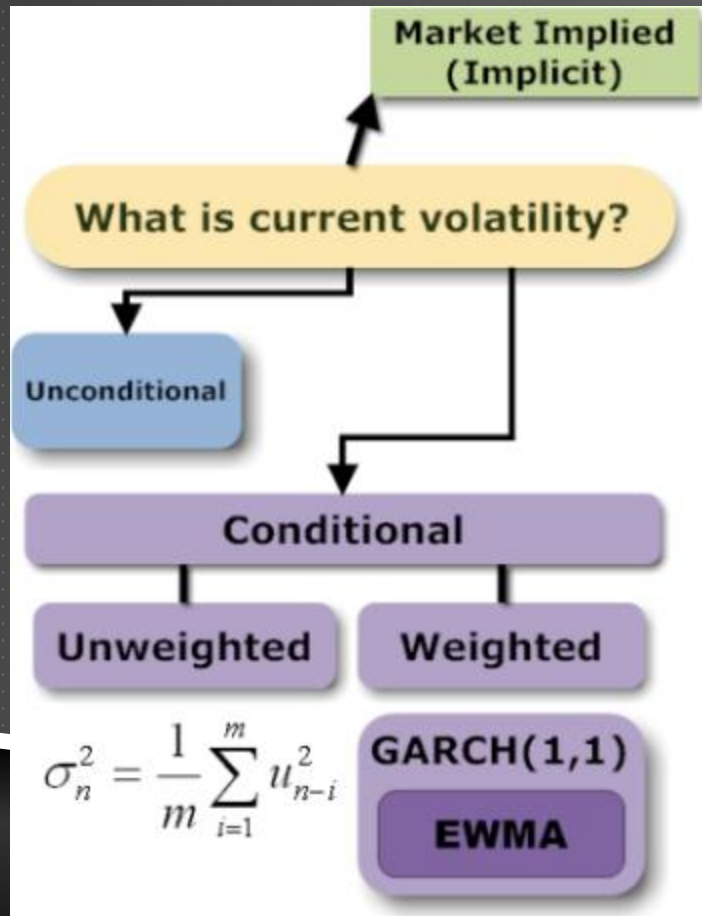
## Volatility models



- ▶ Simple measure of volatility is the standard deviation. All past events produce 1 measure of volatility.
- ▶ The next evolution called for recalculating the standard deviation on a time-basis, such as yearly or monthly.

$$\text{variance} = \sigma_n^2 = \frac{1}{m} \sum_{i=1}^m u_{n-i}^2$$

# Volatility models



- ▶ A second path was to use time-dependent (conditional) volatility series. Here, the most recent observations are used.
- ▶ First, they used simple moving averages (below).
- ▶ Later, they used exponentially weighted moving averages. These give more weight to more recent observations.

Squared Periodic Return	$U_i^2$	$U_{i-1}^2$	$U_{i-2}^2$	$U_{i-3}^2$
Weight:	$\alpha$	$\alpha$	$\alpha$	$\alpha$

Probably, this fell out of favor since there was no method to decide on how many past observations to include.

According to Longstaffe (1996) a reasonable choice for lambda is 0.94. This is the value adopted by RiskMetrics™

$$h_t = \lambda h_{t-1} + (1 - \lambda) r_{t-1}^2$$

The screenshot shows a Firefox browser window displaying the RiskMetrics RiskManager website. The address bar shows the URL [www.msci.com/products/risk\\_management\\_analytics/riskmanager/](http://www.msci.com/products/risk_management_analytics/riskmanager/). The page features the MSCI logo and the tagline "A Clear View of Risk and Return". The main heading is "RiskMetrics RiskManager", followed by the description: "A scalable framework, utilizing pricing models, analytics, and market-observable and derived risk factors for enterprise-wide risk management". Below this, there are three tabs: "Overview" (selected), "Benefits and Features", and "Demos". The "Overview" tab content includes the RiskMetrics logo and a paragraph: "RiskMetrics RiskManager provides market exposures and sensitivities across a broad range of instruments including, Commodities, Equities, Fixed Income, FX, Mortgages and Structured Credit, using multiple Value at Risk (VaR) methodologies and flexible stress-testing." At the bottom, it states: "RiskManager features powerful editing and diagnostic tools as well as a full terms and conditions database providing clients an easy-to-use portfolio construction capability." On the right side, there is a "Search" bar, an "Insights" section with a list of topics (Private Real Estate Model, European Sovereign CDS Correlation, New Basket Look-Through in RiskMetrics RiskManager 4), and a "Resources" section with a "SIGN UP FOR RISK UPDATE!" button and a list of "FACT SHEETS" (RiskMetrics RiskManager, RiskMetrics Web Services, RiskMetrics Counterparty).

Firefox

RiskMetrics RiskManager...

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MSCI A Clear View of Risk and Return

Products and Services RiskManager

# RiskMetrics RiskManager

A scalable framework, utilizing pricing models, analytics, and market-observable and derived risk factors for enterprise-wide risk management

Overview Benefits and Features Demos

 RiskMetrics RiskManager provides market exposures and sensitivities across a broad range of instruments including, Commodities, Equities, Fixed Income, FX, Mortgages and Structured Credit, using multiple Value at Risk (VaR) methodologies and flexible stress-testing.

RiskManager features powerful editing and diagnostic tools as well as a full terms and conditions database providing clients an easy-to-use portfolio construction capability.

Search

Insights

RISK MANAGEMENT

- Private Real Estate Model
- European Sovereign CDS Correlation
- New Basket Look-Through in RiskMetrics RiskManager 4

Resources

SIGN UP FOR RISK UPDATE!

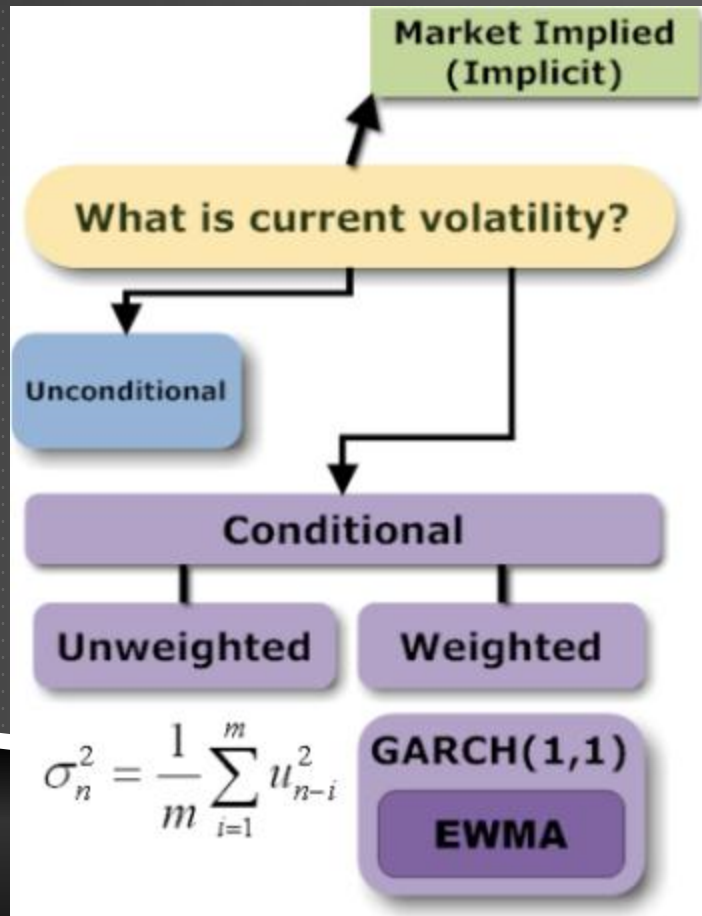
FACT SHEETS

- RiskMetrics RiskManager
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## Volatility models



The study of volatility through the 1970s assumed volatility to be constant.

In 1982, volatility studies were revolutionized by Engle's introduction of the ARCH model.

Still, a simple moving average can perform nearly just as well (Mansfield 1999).

# METHODOLOGY

Generalized ARCH (Bollerslev 1986).

The diagram illustrates the Generalized ARCH equation with three annotations pointing to its components:

- Hull Notation** (green box) points to  $\gamma V_L$ .
- Weighted Long Run Variance** (yellow box) points to  $\gamma V_L$ .
- Weighted return<sup>2</sup> "one lag" (1)** (yellow box) points to  $\alpha u_{n-1}^2$ .
- Weighted variance "one lag" (1)"** (yellow box) points to  $\beta \sigma_{n-1}^2$ .

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2$$

source: [bionicturtle.com](http://bionicturtle.com)

# METHODOLOGY

GARCH gives more weight to recent observations, and it has that nice long run variance, providing mean reversion.

In the weights, you can set the persistence, opposite of decay. This determines how quickly previous volatility shocks will dissipate and the series will revert to its long run average variance.

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2$$

# METHODOLOGY

When frequencies increase, persistence must be adjusted, with 0.94 a reasonable choice for daily returns (Longerstaey, 1996).

Thanks to its ability to model not only return linkages, but also volatility linkages, GARCH can be used in spillover analysis.

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta \sigma_{n-1}^2$$



# METHODOLOGY

## Which GARCH?

The “family” of GARCH models is vast. Some studies are solely conducted to merely list and define the most common variations (Bollerslev, 2007).

Papers have also compared the performance of GARCH variations (Hansen and Lunde, 2005, Orhan and Koksal, 2012).

With over 330 variations, 100+ of which are deemed popular, determining which model to use is a challenge. No definitive ranking is available. Results vary on dataset, chosen distribution, and more.

# METHODOLOGY

Recall certain stylized facts about market return series:

- ▶ 5) Fat tail distribution (non-Gaussian).
- ▶ 6) Leverage effect (Black 1976). There are asymmetric responses to positive and negative innovations.

Non-Gaussian Student-t distribution very often outperforms normal Gaussian distribution (Orhan and Koksal, Verhoeven and McAleer 2004).

Some variations of GARCH are geared for such asymmetry. In volatility studies, this permits negative shocks to have a stronger impact than positive shocks on the innovation process, which falls in line with observed data.

# METHODOLOGY

Popular asymmetric models in spillover analysis which handle fat-tailed error include:

BEKK-GARCH

E-GARCH

GJR-GARCH

T-GARCH

The BEKK-GARCH (Baba, Engle, Kraft and Kroner) was introduced by Engle and Kroner in 1995.

# METHODOLOGY

## BEKK-GARCH

$$Y_t = \alpha + \text{Row} Y_{t-1} + e$$

Where

$$e \mid I_{t-1} \sim N(0, H_t)$$

And

$$H_t = C'C + A'e'_{t-1}e_{t-1}A + G'H_{t-1}G + D'E'_{t-1}E_{t-1}D$$

The last part accounts for asymmetry (Kroner and Ng, 1998).

# METHODOLOGY

There is also a choice on which estimation method to employ.

Ordinary least squares is simple, but less efficient.

Maximum likelihood is more complex, but performs better.

# DATA

Most studies draw price index series from Datastream, some from Yahoo Finance.

Datastream offers a Real Estate Index, but for which countries? (Hatemi-J, Roca 2011).

Alternatively, exchange traded Real Estate Investment Trusts (REITs) may serve as data. If REITs have not been traded long enough, or if there other unknown issues, exchange traded real estate companies may serve as proxy, (Hatemi-J, Roca 2011).

# DATA

It's generally thought that daily returns can best reflect volatility spillover, (Francq, Zakoian, pg 79). Intraday returns carry excessive noise, while shocks tend to dissipate between weekly and monthly return intervals.

One published real estate spillover study drew from only 4 years of daily returns, (Bianconi and Yoshino, 2012).

Unfortunately, a number of REIT volatility studies do use monthly. *Why?* (Lee and Pai, 2010).

# DATA

Must clean out days which all markets weren't trading, such as Christmas and Spring Festival.

From a price series, return and volatility series can be easily computed.

All prices should be denominated in domestic currencies to avoid FOREX generated noise.



# SIMILAR WORKS

- ▶ **Testing stock market linkages for Poland and Hungary: A multivariate GARCH approach.** Li and Majerowska (2008).
  - ▶ Uses GARCH-BEKK to test volatility spillover from emerging markets to regional and global developed markets. Use daily stock indices 1998 to 2005.
  - ▶ Clear paper with intermediate tests to validate steps taken.
- ▶ **Global and regional spillovers in emerging stock markets: A multivariate GARCH-in-mean analysis.** Beirne, Caporale, Ghattas, Spagnolo (2010).
  - ▶ Use tri-variate GARCH-BEKK to test stock market series of 41 emerging market economies around the world.
  - ▶ Good (and much needed) outline of GARCH-BEKK spillover methodology.

# SIMILAR WORKS

- ▶ **Do bears and bulls swim across oceans? Market information transmission between greater China and the rest of the world.** Steven Shuye Wang, Michael Firth (2004).
  - ▶ Examines return and volatility spillover from four domestic Chinese markets to Tokyo, London and New York. Uses GJR-GARCH to test daily opening and closing prices between 1994 and 2001.
  - ▶ This uses a complex multi-step process in capturing spillover.
- ▶ **Are stock and real estate markets integrated? An empirical study of six Asian economies.** Tsoyu Calvin Lin, Zong-Han Lin (2011).
  - ▶ Studies integration between real estate market and stock markets between several countries.

# SIMILAR WORKS

- ▶ **Price and volatility spillovers across North American, European and Asian stock markets.** Singh, Kumar, Pandey (2010).
  - ▶ Study the linkages across the world, incorporating same-day affect. This is four-step process that reveals how complex such studies can be. It meanwhile points out some flaws in simpler models.

# SIMILAR WORKS

- ▶ **Price and volatility spillovers between the Greater China Markets and the developed markets of US and Japan. Wang and Wang (2010).**
  - ▶ Examines linkages between domestic and international stock markets. Explains the symmetries or asymmetries of each market.
  - ▶ Provide a 1 step process to find interactions, using a GJR-BEKK-GARCH model, incorporating mean and variance interactions. Great explanation on model.
  - ▶ Explain how to choose an appropriate lag.

# SIMILAR WORKS

- ▶ **Firm Market Performance and Volatility in a National Real Estate Sector.** Bianconi, Yoshino (2012).

- ▶ Daily data from 2006 to 2010 on 17 real estate companies in Brazil. This is a surprisingly small dataset compared to others. This bodes well for a Chinese real estate volatility study, since China's financial markets were well liberalized by 2006.

# SIMILAR WORKS

- ▶ **How asymmetric is U.S. stock market volatility?** Ederington and Guan (2010).
  - ▶ Tests with both asymmetric and symmetric GARCH models. Finds strong evidence of asymmetry in several applicable volatility measures. It also provides theoretical explanations.
- ▶ **REIT volatility prediction for skew-GED distribution of the GARCH model.** Lee and Pai (2010).
  - ▶ Finds that GARCH-SGED (skew generalized error distribution) outperforms GARCH-N and GARCH-ST. This serves as evidence that returns are skewed and fat-tailed in the US market.

# SIMILAR WORKS

- ▶ **Commercial Real Estate Return Performance: A Cross-Country Analysis.** Ling and Naranjo (2002).
  - ▶ Examines return performance of 600+ publically listed real estate companies in 28 countries in various manners.
- ▶ **Common factors in international securitized real estate markets.** Liow, Webb (2009).
  - ▶ Studies two Western markets and two Asian markets, using 1993-2003 data on 120 monthly stock returns, obtained from Datastream.

# SIMILAR WORKS

- ▶ **A comparison of volatility models: Does anything beat a GARCH(1,1)?** Hansen and Lunde (2001).
  - ▶ Explains the need for GARCH variation, outlines the GARCH universe.
  - ▶ Helps specify which ARCH/GARCH model to use, given distribution, estimation and performance metrics.
  - ▶ Seems as though a t-distribution GARCH or E-GARCH would be best. Unfortunately, the GARCH-BEKK model so commonly employed in spillover analysis is not included.



# SIMILAR WORKS

- ▶ **Applying VaR to REITS, a comparison of alternative methods.**  
Lu, Wu, Ho (2009).
  - ▶ Compares the performance of models ranging from EWMA to GARCH.
  - ▶ Uses 1998 to 2006 data, and explains method to select appropriate REIT series (filtering by capitalization and excluding those trading less than 9 years).

# SIMILAR WORKS

- ▶ **Does “hot money” drive China’s real estate and stock markets?** Guo and Huang (2010).
  - ▶ Paper provides explanation behind volatility in China’s real estate market, and points to similar studies.
  - ▶ Hot money found to be culprit #2. What is #1?

# CITATIONS

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