Comparison between Chinese, US, and European Stock Markets

Oliver Linton
University of Cambridge

Cambridge University, July 2019

- Fundamental assumptions of human economics behaviour:
  - ▸ Individuals prefer more to less
  - ▸ Individuals dislike risk per se, ie they are risk averse
  - ▸ They act to achieve the best outcome for themselves

- Which of the following do you prefer?
  - ▸ Choice A with
    - ★ +200 with probability 1/2
    - ★ -100 with probability 1/2
  - ▸ Choice B
    - ★ +50 for sure
 - ▸ Choice C
    - ★ Nothing

- Stock markets are the most studied place for evaluating individuals preferences over risk and return
- We compare stock market indexes from around the world according to
  - ▶ Perfomance
  - ▶ Efficiency
  - ▶ Comovements
  - ▶ Volatility
- What are the implications for investors and policy makers

- The SSE Composite Index (SSEC) is a stock market index of all stocks (around 1500 A shares and B shares) that are traded on the Shanghai Stock Exchange. Foundation 15 July 1991. Market cap CN¥32.697 trillion (September 2017). CN¥12.727 trillion (free-float adjusted, September 2017)
- The S&P500 index contains 505 large cap stocks traded on NYSE, NASDAQ, Cboe BZX Exchanges. Market cap US$23.7 trillion (as of April 30, 2018). Foundation March 4, 1957
- The EURO STOXX 50 is a stock index of Eurozone stocks designed by STOXX, an index provider owned by Deutsche Börse Group. It is made up of fifty of the largest and most liquid stocks in the eurozone. Market cap €1.962 trillion (March 2016).
- The Hang Seng Index is a freefloat-adjusted market-capitalization-weighted stock-market index in Hong Kong. 50 constituent companies represent about 58% of the capitalisation of the Hong Kong Stock Exchange. HSI was started on November 24, 1969
- Nikkei 225. Tokyo Stock Exchange (TSE). Foundation 7 September 1950.
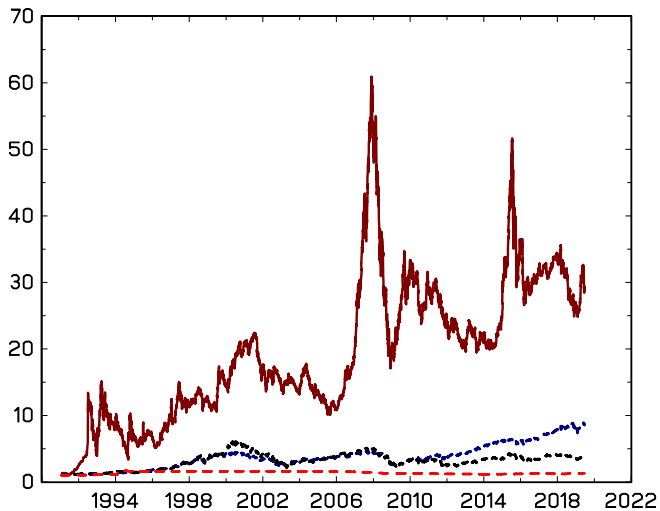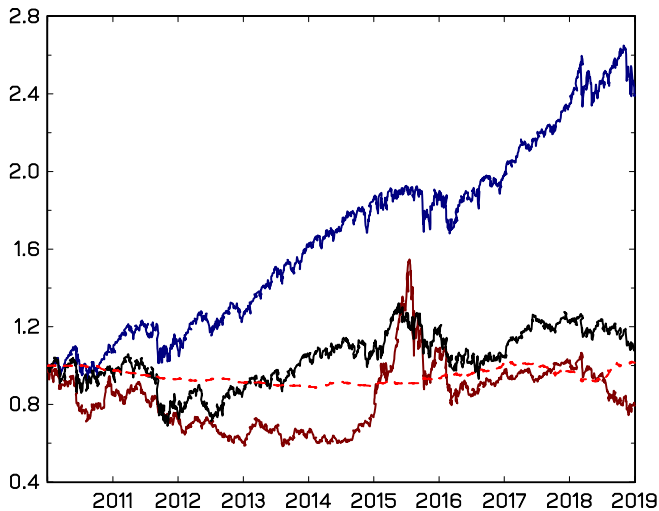
SSEC (Red), S&P500 (Blue), EStoxx (black) normalized to 1 in 1992

Rmb to Dollar Exrate
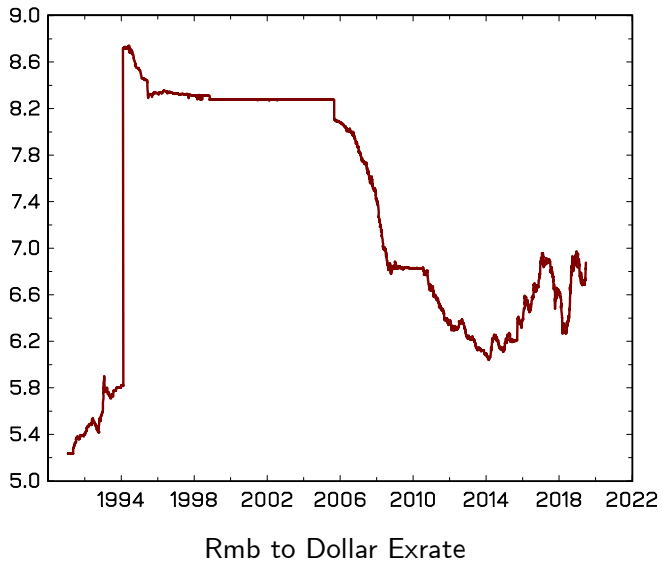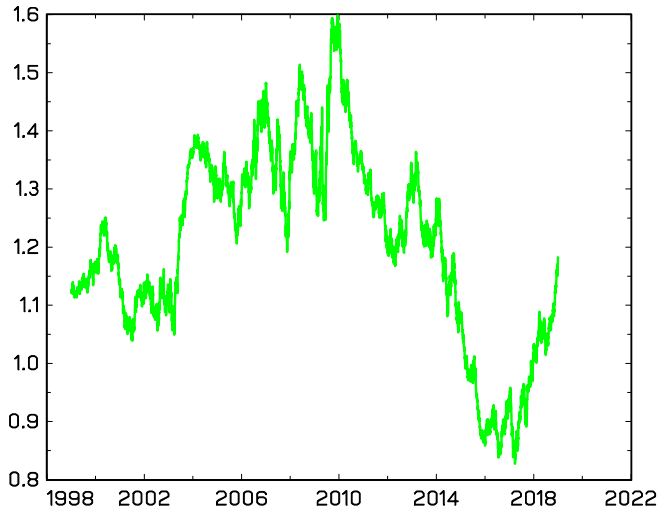
Euro Dollar exchange rate since 1999

SSEC (Red), S&P500 (Blue), EStoxx (black) normalized to 1 in 2010

Alternative Views of the Stock Market

- Markets are efficient or approximately so, participants are rational
  - ► They value future expected cash flows accurately
  - ► They would buy if the stock was undervalued and sell if it was overvalued

- Markets are inefficient, participants are irrational and have "behavioral biases"
  - ► The stock market has excess volatility, Shiller (1987)
  - ► The stock market overreacts to new information (short term contrarian), Thaler. Humans overreact in experiments, Kahneman and Tversky.
  - ► The stock market underreacts to new information (short term momentum)

Efficient Markets Hypothesis

Definition

Fama (1970, JoF): A market in which prices always fully reflect available information is called efficient (EMH)

- If prices are predictable $\Rightarrow$ opportunities for superior returns (free lunch) $\Rightarrow$ will be competed away immediately by a lot of hungry traders $\Rightarrow$ unpredictable random walk
  - If a security believed to be underpriced, buying pressure $\Rightarrow$ jump up to a level where no longer thought a bargain
  - If a security believed to be overpriced, (short-)selling pressure $\Rightarrow$ jump down to a level where no longer thought too expensive
- As a result, market forces respond to news quckly and make prices the best available estimates of fundamental values, i.e. values justified by likely future cash flows and preferences of investors/consumers

We distinguish among three forms of market efficiency depending on the information with respect to which efficiency is defined

1. **Weak form.**
   1. Information from historical prices are fully reflected in the current price;
   2. One can't earn **abnormal profits** from trading strategies based on past prices alone.

2. **Semi strong form.**
   1. All public information (past prices, annual reports, quality of management, earnings forecasts, macroeconomic news, etc.) is fully reflected in current prices;
   2. One can't earn abnormal profits from trading strategies based on public information.

3. **Strong form.**
   1. All private and public information is fully reflected in current prices;
   2. One can't earn abnormal profits from trading strategies based on all information including public and private.

Two Issues

- Test whether this theory is consistent with the data. Are there exploitable profit opportunities?
- How to compare markets according to their deviations from this theory? How efficient is the Chinese stock market compared with the US market?
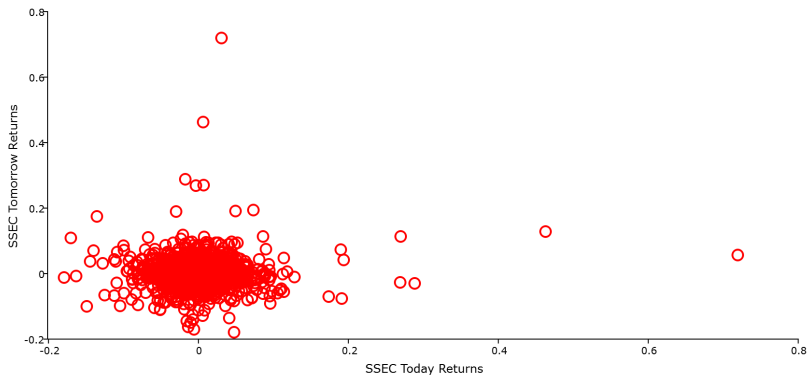
Methods we use

- We use correlation analysis for stock returns in a time series context to measure predictability
- Correlation and regression analysis were introduced by Francis Galton (Trinity College, 1844) mostly in the context of heredity

Galton's Height Data
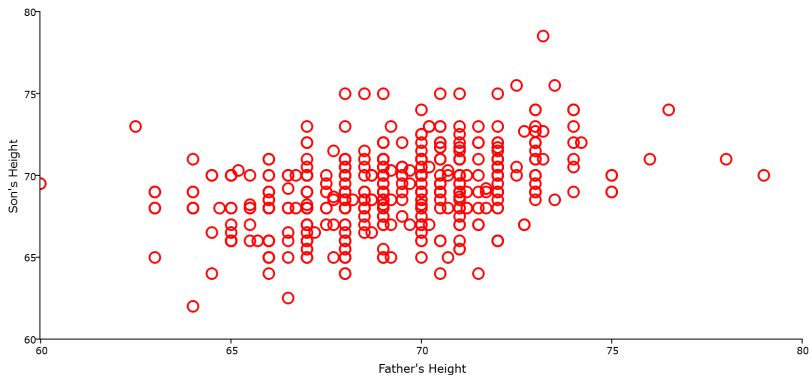
Raw correlation of 0.39

Daily Stock Returns

Raw correlation 0.03

Measure inefficiency of market by Autocorrelation and Variance Ratios of stock returns

$$\rho_k = \frac{\text{covariance}(r_t, r_{t-k})}{\text{variance}(r_t)}$$

Predict future returns r_t on day t by past returns r_{t-k}. Under EMH, $\rho_k = 0$. If $\rho_k > 0$, momentum; If $\rho_k < 0$, contrarian.
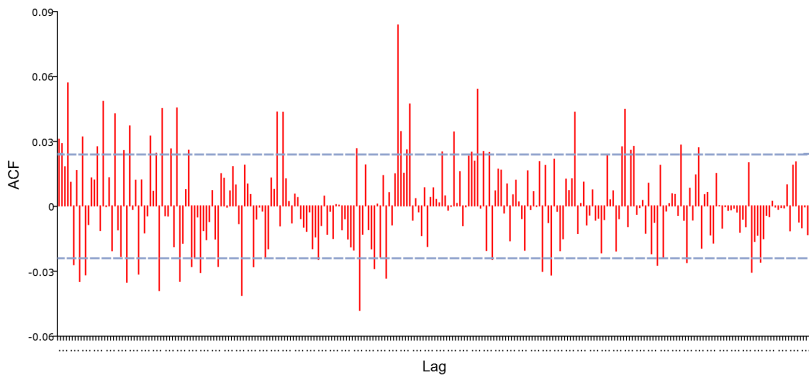Variance ratio

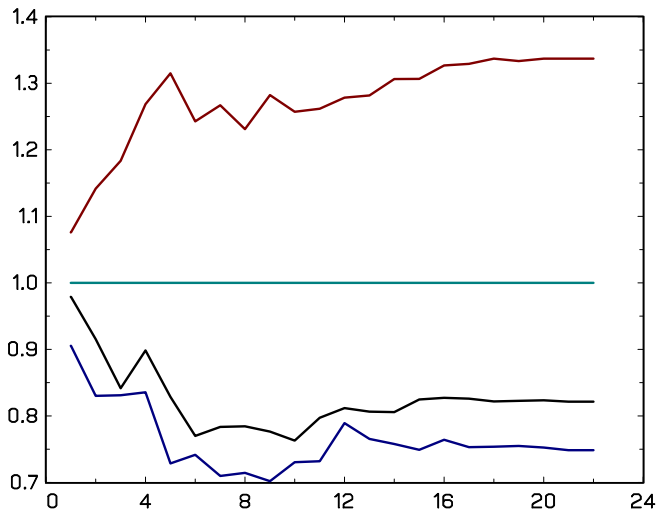$$VR_k = \frac{\text{variance(k-period returns)}}{k \times \text{variance(1-period returns)}}$$

Cumulative predictability. Under EMH, $VR_k = 1$. If $VR_k > 1$, momentum; If $VR_k < 1$, contrarian;
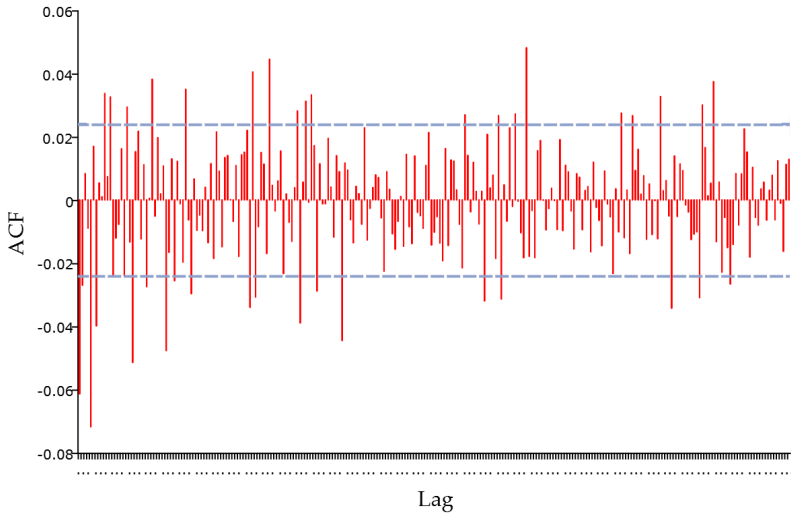
S&P500 Daily Returns

SSEC Daily Returns

Variance Ratios of SSEC (red), S&P500 (Blue), EStoxx (Black),
1991-2019

- There is some evidence of predictability
  - The S&P500 and EStoxx have short term contrarian behaviour
    - Suprisingly, EStoxx seems to have less "inefficiency" than S&P500
  - The SSEC has short term and longer term momentum
    - The magnitude is quite small at short horizons but grows to be quite large around 2 months, then declines to 6 months and then goes back up again
- Since 2010, momentum effect on SSEC has declined, while the contrarian effect on the S&P500 and Estoxx has increased.
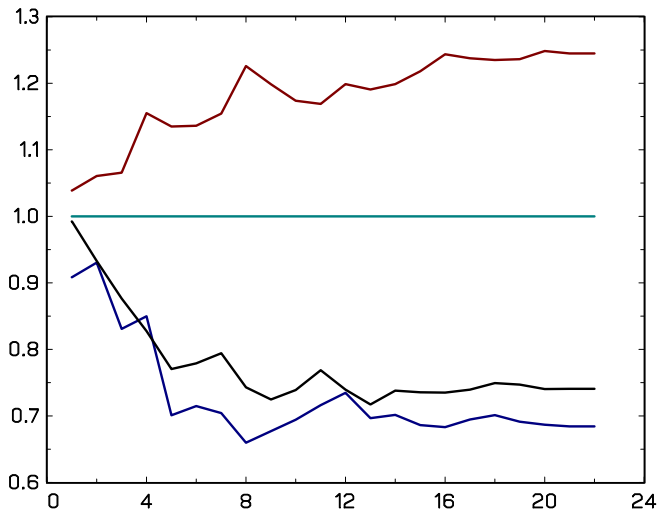
Variance Ratios of SSEC (red), S&P500 (Blue), EStoxx (Black), 2010-2019

Simple Trading Strategy for SSEC

- If $r_t > \bar{r}$ (mean value), then buy, i.e., $Q_t = +1$. If $r_t < \bar{r}$ (mean value), then sell, i.e., $Q_t = -1$. Rebalance every day at the close.
- Profit is (per day)
$$\pi_{t+1} = r_{t+1} \times Q_t$$

- For SSEC, the average profit per day (over 1991-2019) is 0.000884 (annualized 22.5%) to be compared with the mean return per day of 0.000469 (11.9%) (what you get if buy and hold). Standard deviation is around 0.0224, which is large compared to the mean return.
- More recent period, profits declined.

Cumulative Gain (not compounded)
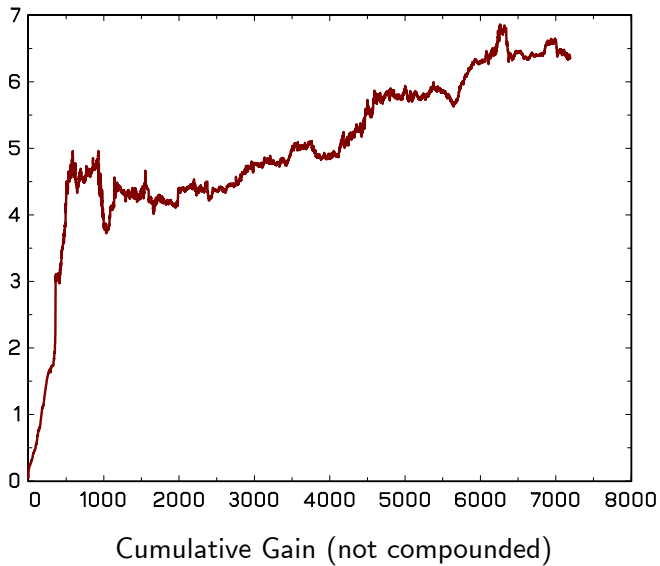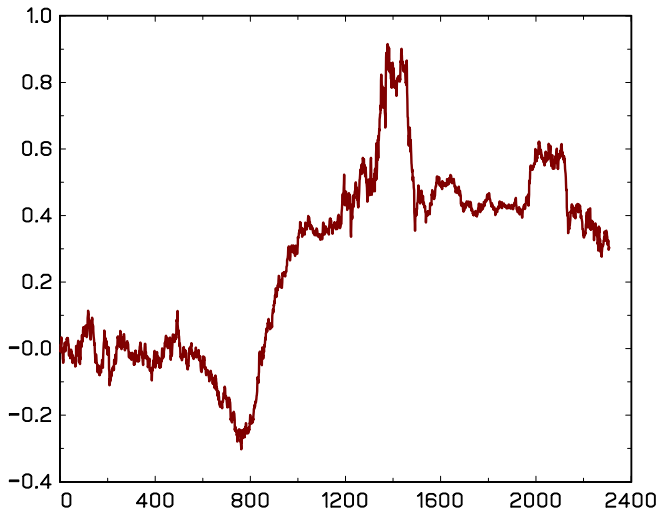
Cumulative Gain starting from 2010

# Risk Return Tradeoff and Diversification

- Aesop's fables (600BC)

    A Nightingale, sitting aloft upon an oak, was seen by a Hawk, who made a swoop down, and seized him. The Nightingale earnestly besought the Hawk to let him go, saying that he was not big enough to satisfy the hunger of a Hawk, who ought to pursue the larger birds. The Hawk said: "I should indeed have lost my senses if I should let go food ready to my hand, for the sake of pursuing birds which are not yet even within sight."

A bird in the hand is worth two in the bush

- Written in the Talmud, a record of debates among rabbis about Jewish law dating as early as 220 AD

    Let every man divide his money into three parts, and invest a third in land, a third in business, and a third let him keep by him in reserve.

- Modern finance developed this principle to propose extreme diversification in stock selection to eliminate firm specific risks, what remains is unavoidable (market wide) risk that has to be rewarded by (expected) return
- Do stock market prices move together? Individual stocks generally do move with the market.
- What about international stock market indices, do they move together? Do financial markets reflect trade flows? Common global shocks? Or do they reflect only national shocks?
- Home bias. In most countries, investors tend to favour domestic stocks. In Chinese market this is also regulated into the system.
- Can an investor benefit from holding foreign stocks?
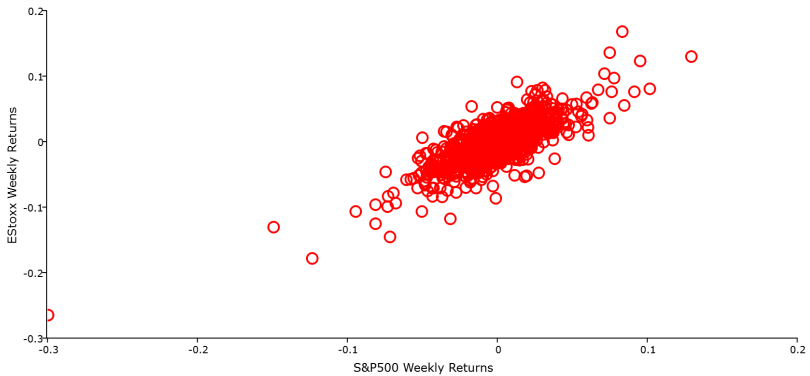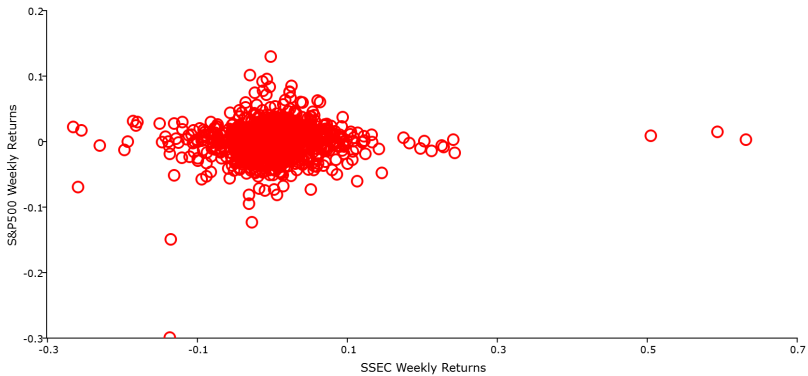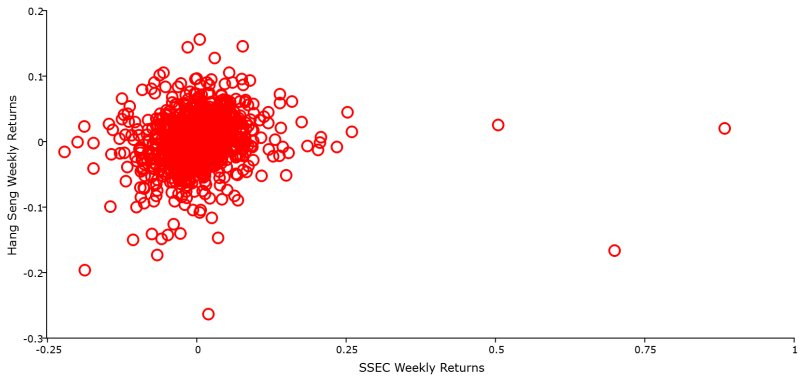
Daily returns

|	SSEC	S&P500	Estoxx	HSeng	Nikk
SSEC	1.0000	0.0239	0.0631	0.1904	0.1209
S&P500		1.0000	0.5688	0.2313	0.1968
Estoxx			1.0000	0.4020	0.3520
HSeng				1.0000	0.4960

- Low correlations partly because of time zone effects:
  - No overlap in trading hours between S&P500 and SSEC; EStoxx in the middle

Weekly returns

	SSEC	S&P500	Estoxx	HSeng	Nikk
SSEC	1.0000	0.0508	0.0890	0.1152	0.1039
S&P500		1.0000	0.7565	0.5158	0.4823
Estoxx			1.0000	0.5407	0.5108
HSeng				1.0000	0.4774

- Low correlation between SSEC and S&P500 and SSEC and EStoxx, but higher correlation between S&P500 and EStoxx. A bit of a puzzle given the trade linkages between the economies

- This is an opportunity for investors able to include all assets in their portfolio. Diversification improves the risk/return tradeoff. Diversification loves lack of correlation

Portfolio Efficient Risk Return Frontier
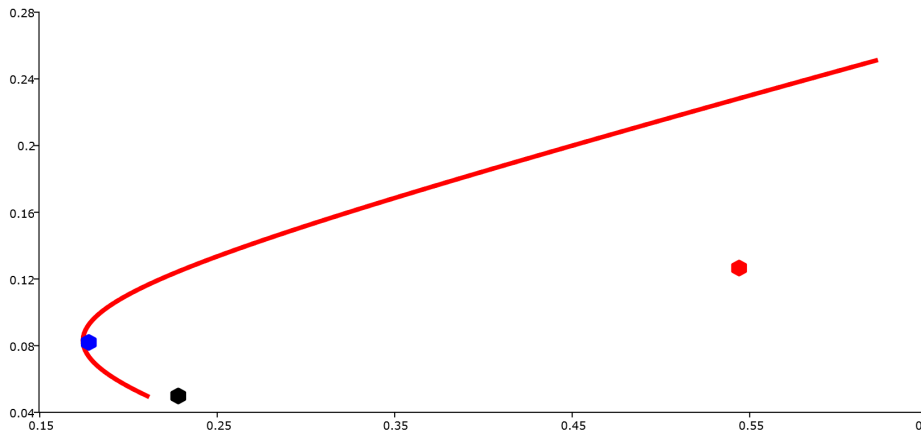
Mean against Standard Deviation (SSEC=red, S&P500=blue, EStoxx=black)

Volatility

- The extent to which prices go up and down
  - Extreme volatility bad for market confidence especially retail investors
  - Volatility can reflect upside and downside movements associated with innovation destroying value of old industries

- We measure volatility by the range of prices occurring in a day

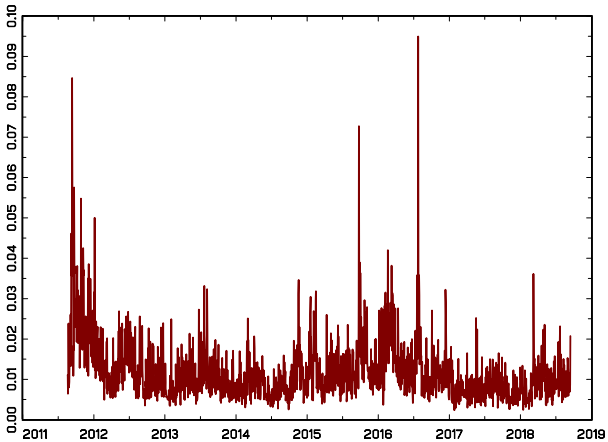$$vol = \frac{HighPrice - LowPrice}{LowPrice}$$

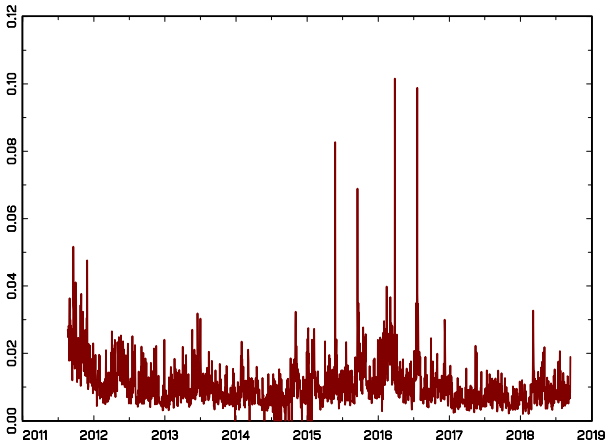Figure: FTSE100 Volatility: Median value 0.0098400810

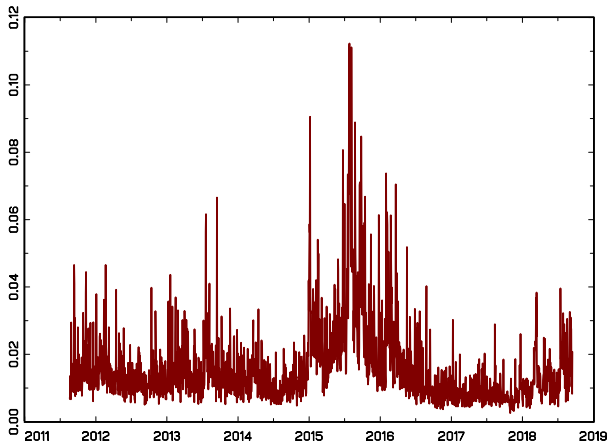Figure: FTSE Allshare Volatility: Median value 0.0088861958

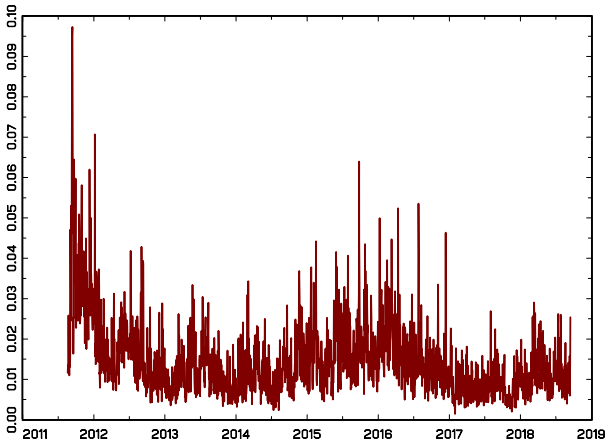Figure: Shanghai Volatility: Median Value 0.012213816

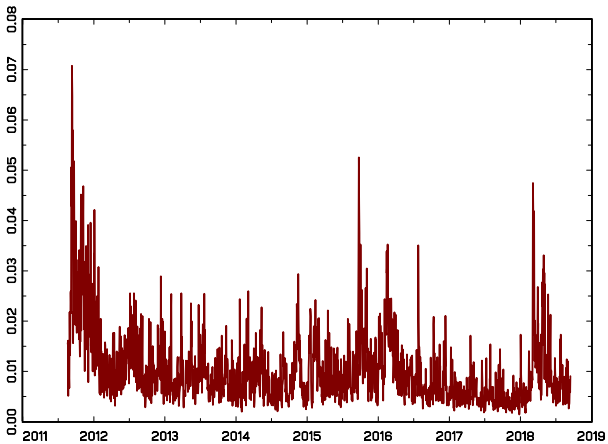Figure: DAX Volatility: Median value 0.012323353

Figure: S&P500 Volatility: Median value 0.0080660960

Further back in time
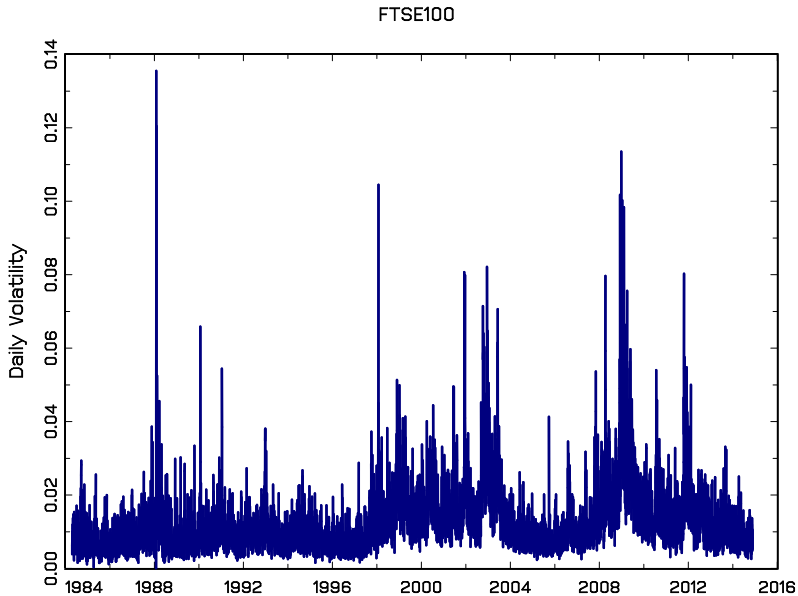
FTSE100

FTSE100 Top 20 Most Volatile days since 1984 (- means $P_C < P_O$, + means $P_C > P_O$)

Date	Volatility
19871020	0.131-
19871022	0.115-
20081010	0.112-
19971028	0.096-
20081024	0.096-
20081006	0.094-
20081008	0.094-
20080919	0.093+
20081124	0.090+
20081015	0.084-
19871019	0.081-
20020920	0.080+

Date	Volatility
20081013	0.076+
20010921	0.076-
20081029	0.075+
20110809	0.074+
20090114	0.074-
20080122	0.074+
20020715	0.071-
20081016	0.070-

S&P500 Top 20 Most Volatile (high-low/close) days since 1960

Date	Volatility
19871019	0.257-
19871020	0.123+
20081010	0.107-
20081009	0.106-
20081113	0.104+
20081028	0.101+
20081015	0.100-
20081120	0.097-
20081013	0.094+
20080929	0.093-
19871026	0.092-
20100506	0.090-

Date	Volatility
20081201	0.089+
19620529	0.089+
19871021	0.087+
20081016	0.087+
20081006	0.085-
20081022	0.085-
20020724	0.081+
19980831	0.080-

US market more volatile than UK. Both sides of Atlantic dominated by 2008 and 1987.

SSEC Top 20 Most Volatile (high-low/low) days since 1991

Date	Volatility
20150630	0.1123+
20150709	0.1111+
20150629	0.1090-
20070605	0.1071+
20070227	0.1036-
19970702	0.0996-
20080320	0.0971+
20000217	0.0961-
20080820	0.0940+
19980113	0.0917-
20141209	0.0906-
19990701	0.0901-
20070604	0.0897-
20150727	0.0889-
20150706	0.0882-
20090729	0.0882-
20081118	0.0852-
20150826	0.0847-
20070531	0.0830+
20080620	0.0822+

A lot of volatility in 2015

Conclusion

- Stock market performance should reflect future earnings. There is small and variable predictability based on past prices in all stock markets including SSEC.

  - SSEC has predominantly positive autocorrrelation (momentum), whereas S&P500 and EStoxx have predominantly negative autocorrelation (contrarian) over same period. Similar magnitude of inefficiency.

    - ★ Could be associated with microstructure issues around bid ask spread, infrequent trading or could be due to misspricing

  - Inefficiency has decreased over time. Profitability of trading strategies based on price have declined

- Big data! Lots of new sources of and types of information can be used in stock market prediction. Machine learning techniques can improve predictability and profitability short term until competed away as predicted by the Efficient Market hypothesis.

- Comovement of Chinese stock markets with other markets is remarkably low. A bit of a puzzle.
- Volatility and extreme movements are a little high and also occurring at different times from US markets
- Globalization of Rmb needs to be in parallel with globalization of stock market and incorporation of more Chinese assets into international investors portfolios