Asset Co-movements:
Features and Challenges

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Asset Co-movements

- There are important common movements in financial data:
  - within and across U.S. asset classes (e.g., across sectors in equity space; bond/stock rotations; "risk-on/risk-off" view of markets);
  - across international markets;
  - across different parts of the joint distribution of asset returns.
- Multiple sources of these asset co-movements:
  - long-run (fundamental, structural) factors;
  - transitory (reflected in asset risk premia) factors;
  - spurious (noise, data characteristics) co-variation.
- Implications of these co-movements for
  - asset allocation and diversification benefits;
  - financial stability and macro-prudential policy.

Asset Co-movements: A Crude Taxonomy

Data Frequency	Source of Co-movement	Type of Co-movement	Effect on
Low-frequency: permanent and business cycle component	Fundamental: long-run macroeconomic, geopolitical, demographic factors	Stable: allows for reliable signal extraction (fundamental sources of risk)	Policy makers Long-term investors
Medium-frequency (roughly 1 to 3 years duration): transient factors	Fundamental & market-specific (difficult to distinguish): shorter-term macro fluctuations and political events, sentiment, changes in financial landscape	Somewhat stable: can force short-term asset reallocations and induce movements in asset risk premia	Policy (macro-prudential, stress testing) Mutual funds (active/passive)
High-frequency (daily to 1 year): short-term variations	Market-specific and spurious (observationally equivalent): propagation of shocks through the system, data noise	Largely unstable (possible spurious time-variability): a tendency to ascribe "fundamental" structure to these movements	Hedge funds

Asset Co-movements: Recent Example

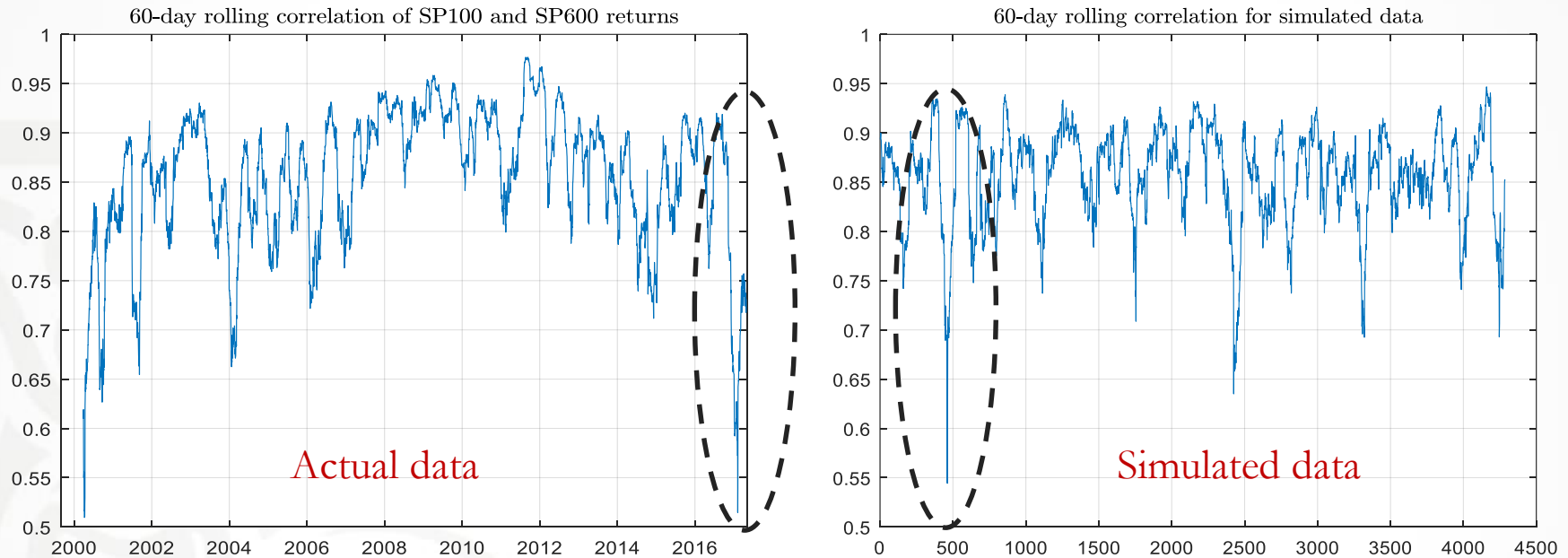

60-day rolling correlation of SP100 and SP600 returns
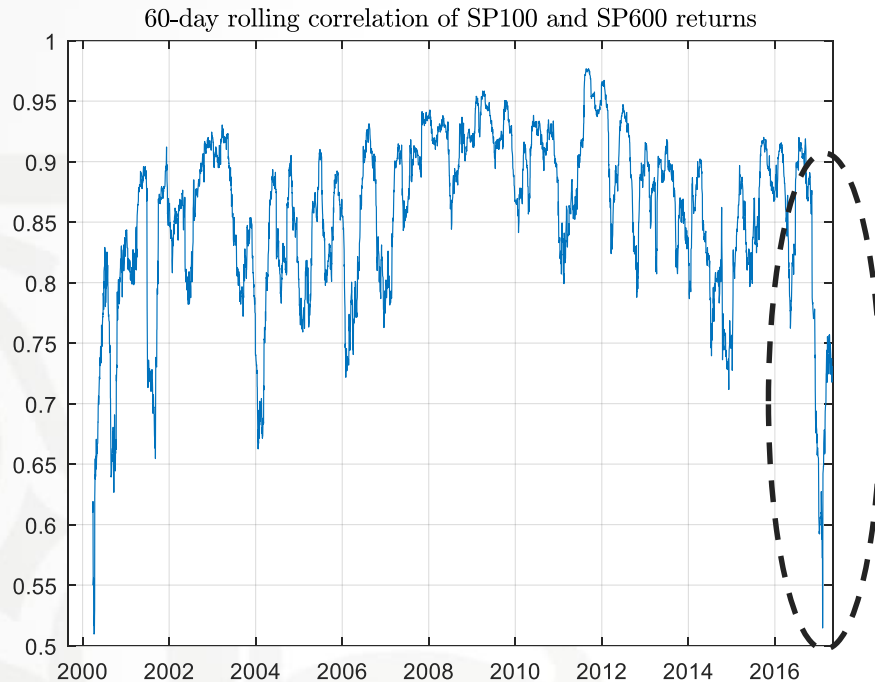
"Sectors Go Wild: S&P Correlations Crumble" (WSJ, Nov. 2016)

"Falling Correlations Spell Opportunity for Investors" (WSJ, Feb. 2017)

"Correlation Crash" (Business Insider, Jan. 2017)

- Sharp drop in the S&P100/600 return correlation since end of 2016.
- But how stable and reliable are these co-movements?
- Can we tell if they are driven by fundamental or transient factors?
- Is the time-variability of these co-movements a genuine feature or a statistical fiction?

Asset Co-movements: Recent Example

60-day rolling correlation of SP100 and SP600 returns — Actual data

60-day rolling correlation for simulated data — Simulated data

- In many cases, the transient and spurious co-movements appear observationally equivalent.

- Right graph: Similar time variation but this is <u>artificial data</u> (calibrated to S&P100/600 returns) with a <u>constant</u> correlation coefficient.

  - Overlapping estimation error may be confused with time-varying correlation.

  - Changing tail behavior can also produce time-varying correlation.
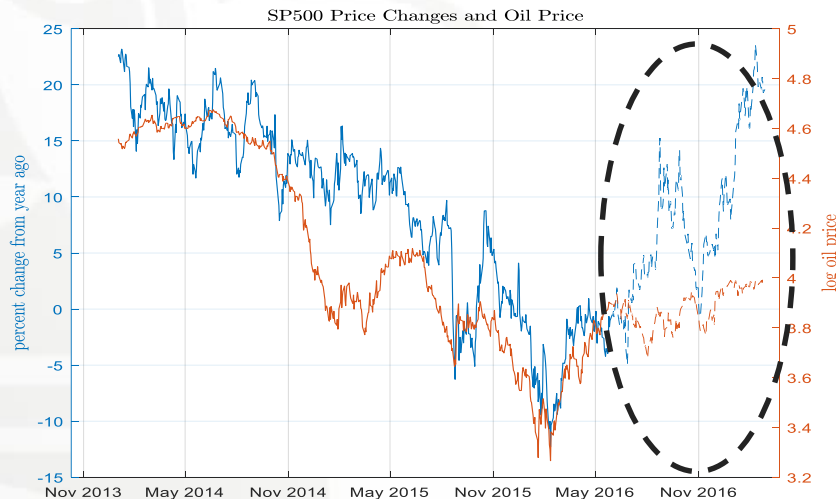
An Illustrative Example: Oil Price Co-movements
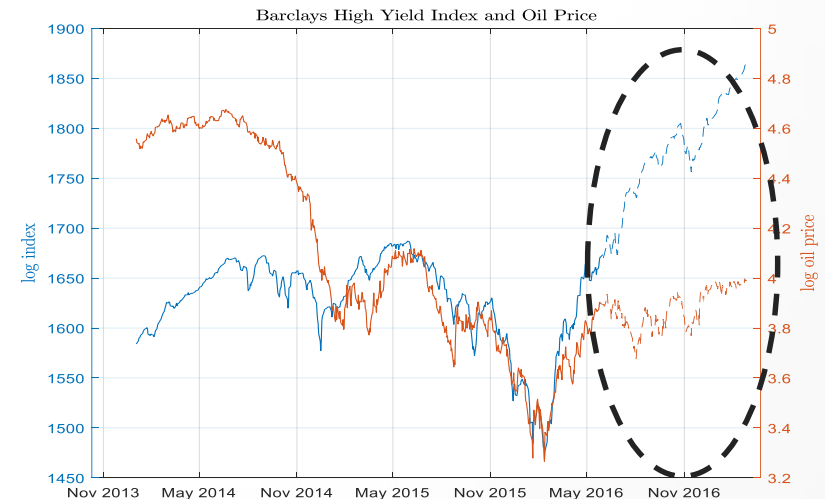

5y/5y forward breakeven inflation
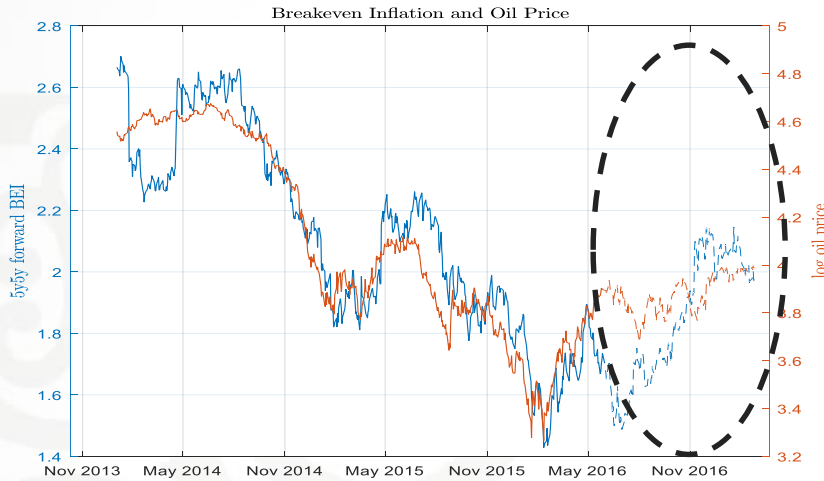
USD index (DXY)
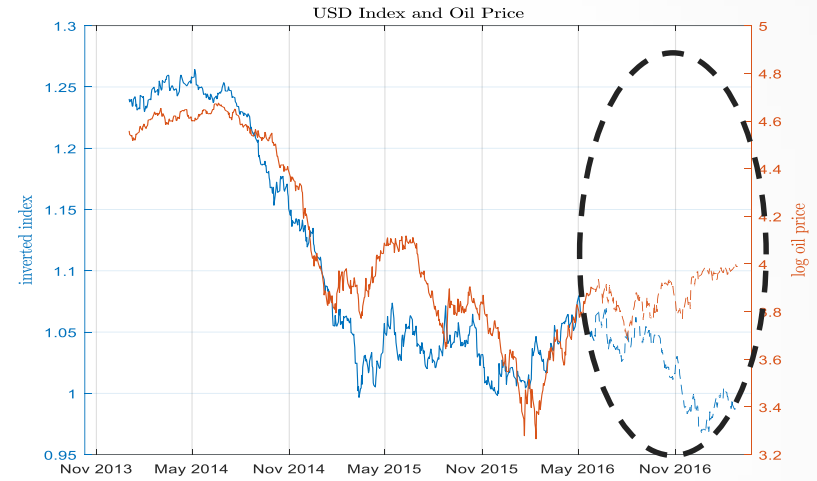
S&P 500 one-year price changes

Barclays high yield index

An Illustrative Example: Oil Price Co-movements

- Is the co-movement due to fundamental or market-specific (technical) factors? Changing market structure?

- Focus on the relationship between breakeven inflation (BEI) and oil prices.

  - Tempting to conclude that it is fundamental as the strong correlation may reflect the effect of oil prices on inflation expectations (IEs).

  - But BEI is not a clean measure of IEs as it contains other components such as liquidity & risk premia.

  - A proper decomposition reveals that despite the wide variations in BEI, long-term IEs are stable and uncorrelated with oil prices (Gospodinov, Tkac and Wei, 2016).

  - Also, a large portion of the low-frequency variation in BEI can be attributed to the inflation risk premium.

An Illustrative Example: Oil Price Co-movements

- But almost all of the short-term variation in BEI is being picked up by a "liquidity" premium (forced de-risking, liquidations, reallocations and hedging in TIPS market).

TIPS Liquidity Premium and Oil Price
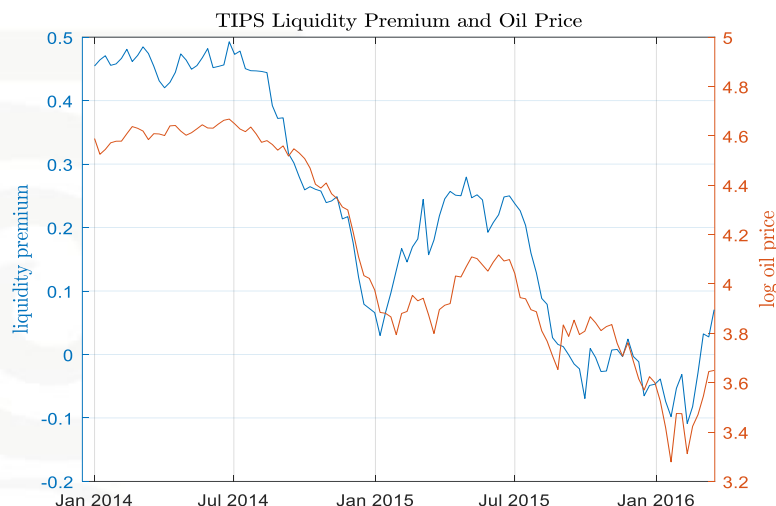
- Even if <u>mostly technical factors</u> appear to be at play, there are implications for financial stability when a highly volatile asset is the driver of the asset co-movements.

- <u>Fundamental factors</u> also cannot be ruled out:

  - There is evidence that oil and equity returns have become more sensitive to macroeconomic news (and public policy decisions) during the ZLB period (BIS, 2017).

  - There is also evidence that the transmission mechanism of propagating the oil shocks through the system has changed due to the increased role of domestic oil production (Baumeister and Kilian, 2016).

- It is also possible that part of this co-movement is purely coincidental or <u>spurious</u>.

(Mindful of) Persistence
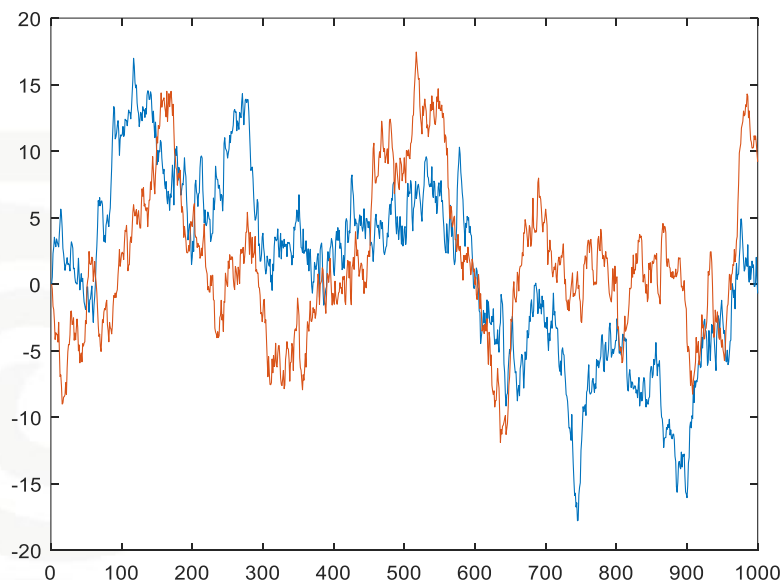
- Is there a co-movement between the two series?
- The "eye-balling" test suggests "yes" but the answer is "<u>NO</u>".
- This is a time plot of two <u>independent</u> processes.
  - Their persistence is calibrated to match the persistence in BEI and oil prices.
- The unconditional correlation between the two series is 0.36 with an even stronger correlation over sub-samples that arises from "common" local trending behavior.
- But any observed commonality is <u>completely spurious</u>.

Challenges

Some challenges in analyzing co-movements are well-known but still underappreciated and discounted:

1. Persistence in variables can mask or exacerbate time variation and can induce spurious correlation.

2. Estimation and data noise can also be confused for time variation and can impact adversely portfolio allocations.

3. Most measures of co-movement (covariance, correlation) are based on second moments:

   - dependence measures that capture information in the entire joint distribution of asset returns are still largely ignored;
   - part of the observed time variability in the second-moment statistics can be caused by movements in the higher moments (skewness, tails);
   - link between correlation and diversification has also been questioned (Roll, 2013)
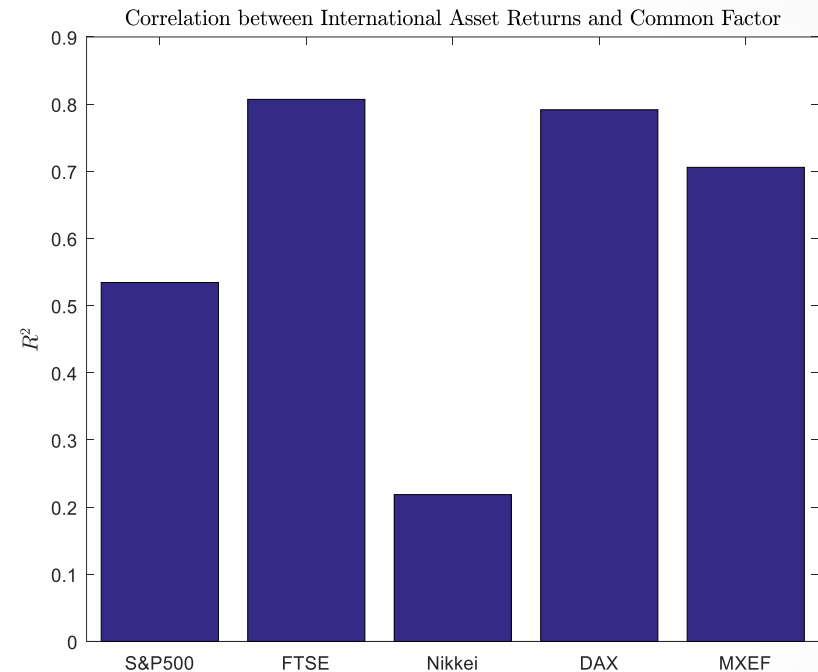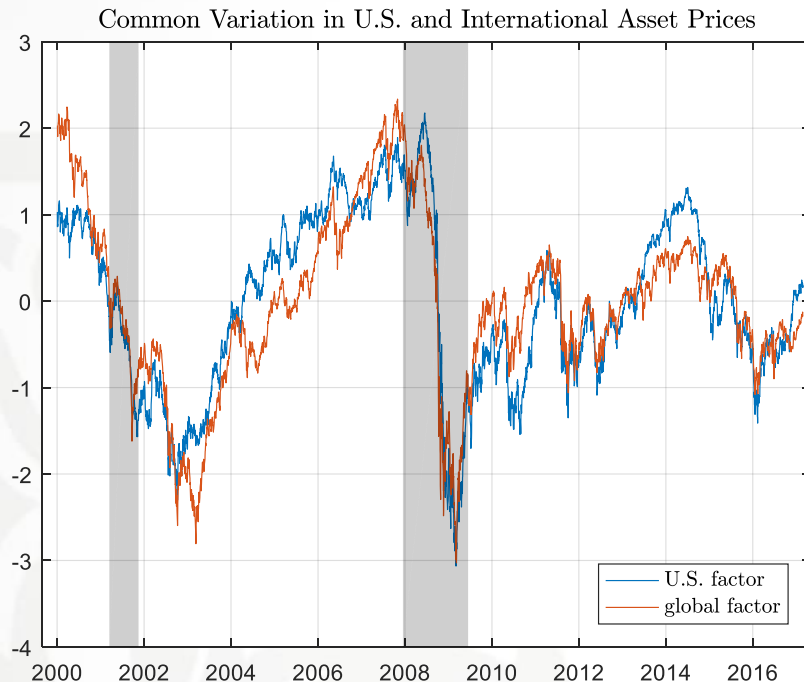
Risk Factor Extraction

- Longer-run perspective of co-movements: akin to the idea of a common factor structure in expected asset returns.
  - Cochrane (2015): "What is the factor structure of expected returns across asset classes?" is one of the "bigger" questions in finance.
  - Surprisingly, there is still tension between theory and empirical evidence on priced macroeconomic risk.
  - This is largely due to the fact that the underlying slow-moving component is overwhelmed by higher frequency noise and volatility.
- Factor analysis is a convenient tool to summarize the co-movements in a cross-section of asset returns: it uses cross-sectional information in asset returns to extract more precise signals about common variation.
- Next, I attempt to isolate common low-frequency movements in asset returns and relate them to macroeconomic and demographic factors.

Business Cycle Co-movements

Common Variation across Asset Classes

Correlation between Asset Returns and Common Factor
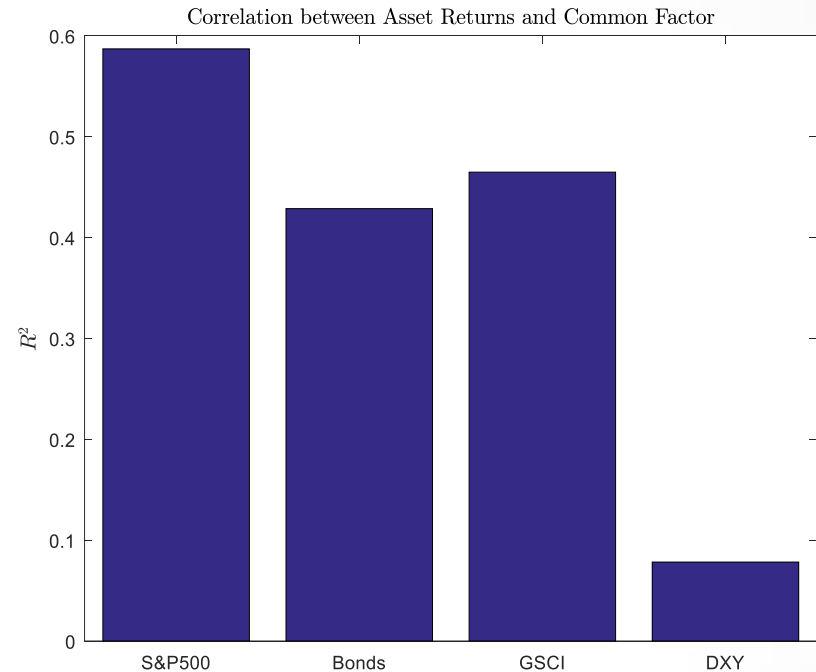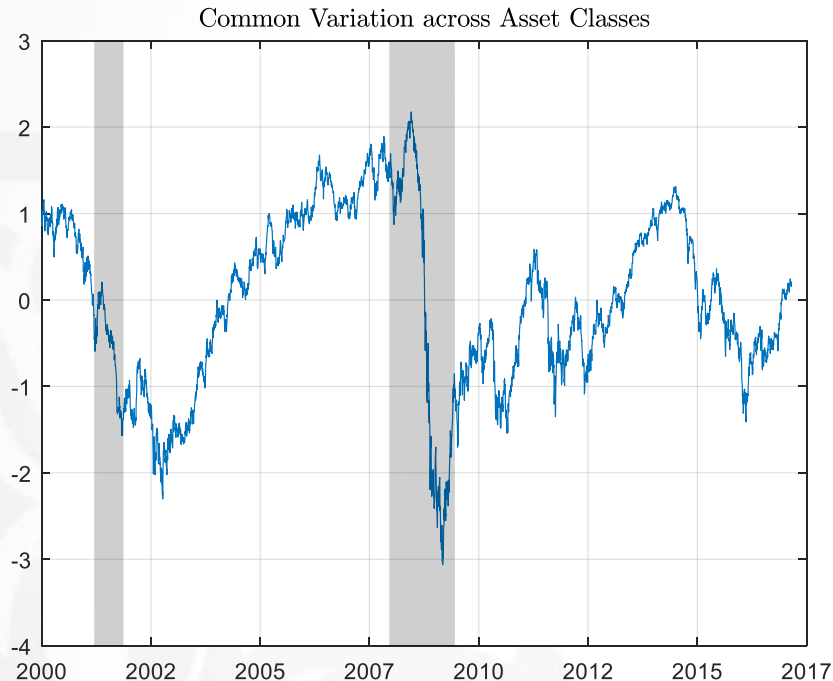
- Left graph plots common variation across asset classes with NBER recessions (shaded areas). Right graph reports the contribution of each asset to the common variation.

- Assets: equity (S&P500), bond (Barclays), commodity (GSCI), and currency (DXY) returns.

- Pronounced business cycle variation with some higher frequency cycles that are more difficult to identify.

- Large loadings on stocks, bonds and commodities.

Business Cycle Co-movements

Common Variation in U.S. and International Asset Prices

Correlation between International Asset Returns and Common Factor

- Same exercise but now with international stock returns (in USD): S&P500, FTSE, Nikkei, DAX, and MXEF (emerging markets).
- Very similar business cycle dynamics: global factor?
- It lends support to the finding of a substantial international market integration post-2000.
- Large loadings on FTSE, DAX and MXEF; a large idiosyncratic component in Nikkei.

Business Cycle Co-movements

Common Business Cycle Variation

Legend:
- U.S. asset factor
- global asset factor
- Atl/NYFed indicator
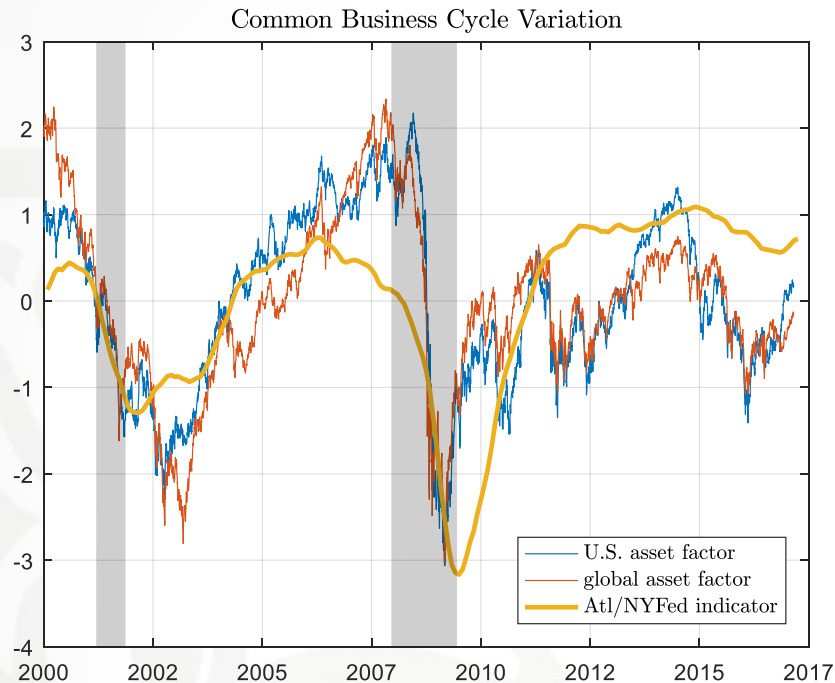
- This figure superimposes Atlanta Fed/New York Fed smoothed labor market indicator.
- It is striking how closely this business cycle indicator underlies the common dynamics in domestic and global financial asset prices.
- Importance of pinning down the business cycle component in asset returns for medium-term investment decisions and stress testing.
- Indirect evidence that macroeconomic risk matters for asset pricing.

Long Cycles and Demographics

- Is there any common variation in asset prices at even lower frequency than that of the business cycle?

- Implications for long-term investment strategies and policy analysis.

- Recent literature has established the usefulness of low-frequency demographic variables for long-horizon stock market returns
  - through their effect on savings rates and risk preferences over the life cycle.

- In fact, they may explain and predict some of the very persistent, low-frequency movements in stock market valuation ratios, such as the dividend- or earnings-price ratios.

- Annual data on stock and bond returns, valuation ratios and demographics for the period 1946-2016.

- In addition, the Census Bureau provides projections until 2060.

Long Cycles and Demographics

Common Factor in Asset Returns and Demographics
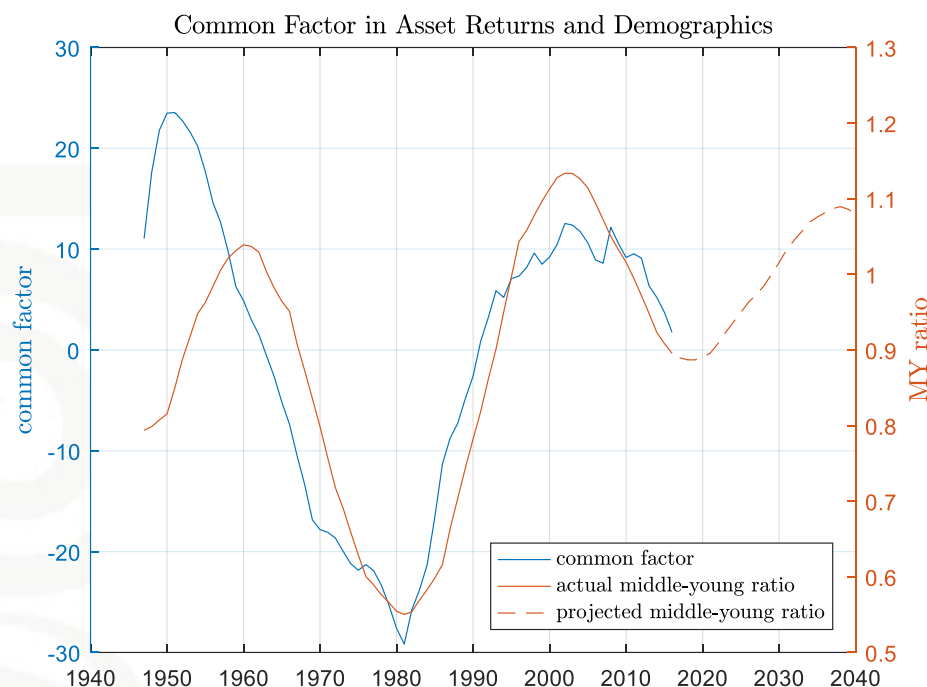
- Long-cycle common factor in asset returns and demographic dynamics.
  - a common trough in the early 1980s and a common peak in the early 2000s.
- The middle-young (MY) ratio is projected to fall until 2020 ➔ downward pressure on stock valuation ratios and interest rates due to demographic factors.
- After 2020, the MY ratio starts to increase again ➔ the downward pressure on valuation ratios & interest rates from demographics is diminished and even reversed.

Open Questions

1. What is the underlying driver of the co-movements: direction, volatility, tails?

2. Since transient co-movements are short-lived by definition, how often should portfolios be adjusted to changing correlations?
   - It takes time to determine if co-movement is real and how long it will persist.
   - There is a robustness/efficiency trade-off between fixed-weight and optimal mean-variance portfolio allocation.
   - Forward-looking vs. backward-looking approach to analyzing co-movements.

3. Effects of slowly-moving fundamentals on changing financial landscape, passive/active investment, pension funds.

4. Factor ("smart beta") investing:
   - What do we know about the dependence structure of these investment factors?
   - Spread-factors across heterogeneous asset classes can capture better multiple sources of systematic risk and span the underlying factor space (Roll, 2013).