Time-Varying International Correlations: Do World Markets Still Serve as a Hedge?

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1. Background

- Most active asset managers focus on state-of-the art statistical models to forecast asset returns.

- While some have implemented variance modeling, little attention has been paid to covariances.

- It is common for historical averages to be used in top-down asset allocation routines.
1. Background

- Generally, it is true that asset allocation weights are less sensitive to errors in variances and covariances than to errors in the expected returns.

- However, it does not make any sense to ignore the predictability in either the variances or covariances.

- Incorporating the predictability in any of these measures should improve asset allocation performance.
This paper has the following goals.

1. Analyze whether correlations are time-varying.

2. Detail how correlations change through time.
   - Do correlations behave differently in bull and bear markets?
   - Do correlations depend on the stage of the business cycle?
   - What drives changing correlations: Volatility or covariance?

3. Present forecasting models for correlations.

4. Develop new metrics for characterizing correlations.

5. Evaluate the hedging ability of world markets for the U.S. dollar investor.
2. Definitions

The unconditional correlation is

$$\rho_{ij} = \frac{\text{Cov}[r_i, r_j]}{\sigma_i \sigma_j}$$

As a result, there are three possible sources of time-varying correlations:

(a) Covariance
(b) Variance of $r_i$
(c) Variance of $r_j$


Considerable evidence that covariances of asset classes are time-varying, e.g. Harvey (1989).
The conditional correlation is

\[ \rho_{ij,t} = \frac{\text{Cov}_{t-1}[r_{it}, r_{jt}]}{\sigma_{i,t}\sigma_{j,t}} \]

\[ \rho_{ij,t} = \frac{E_{t-1}\{ (r_{i,t} - E_{t-1}[r_{i,t}]) (r_{j,t} - E_{t-1}[r_{j,t}]) \}}{\sqrt{E_{t-1}\{ (r_{i,t} - E_{t-1}[r_{i,t}])^2 \}} \sqrt{E_{t-1}\{ (r_{j,t} - E_{t-1}[r_{j,t}])^2 \}}} \]

- Conditional correlation allows for expectations to depend on information at \( t - 1 \).

- Conditional correlation is the forecasted correlation, based on information at \( t - 1 \), for the next period.
2. Definitions

Which correlation measure should be used?

- Our preliminary analysis will focus on moving-window unconditional correlations.

- Given that a typical asset managers' evaluation period is 1-5 years, the realized correlation over that future period will directly impact the portfolio performance.

- We will try to characterize and forecast this measure.
3. Previous Evidence

It has long been known by practitioners that correlations change through time.

- Kaplanis (1988) successfully fitted univariate time-series models to correlations.

- Longin and Solnik (1994) fit a multivariate GARCH model with the restriction that conditional correlations are constant.

  → They reject the restriction using a set of MSCI countries.

- Harvey (1994) rejects the hypothesis that correlations are constant in emerging markets.
Unresolved Questions:

1. Why do correlations change?

2. Is there a link between correlations and the business cycle?

3. Is correlation linked to market integration?
Increased correlation does not necessarily imply increased market integration.

- It is possible for two countries’ markets to be completely integrated –
  - Free access to both markets by both countries’ nationals.
  - A project with same risk commands the same expected return in both countries.

  -and have zero correlation (or arbitrary correlation) between their equity returns.

- Different sectoral mixes in the two countries will determine the correlation.

- Nevertheless, striking evidence in Harvey (1994): Brazil, Korea, Mexico and Thailand’s correlations with world returns have more than doubled in the past 10 years.
5. Characterizing correlation

United States: Three Year Correlations

United States: Five Year Correlations

<table>
<thead>
<tr>
<th>Canada</th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Japan</th>
<th>U.K.</th>
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5. Characterizing correlation

Canada: Five Year Correlations

France: Five Year Correlations

Germany: Five Year Correlations

Italy: Five Year Correlations

Japan: Five Year Correlations

United Kingdom: Five Year Correlations
5. Characterizing correlation

Argentina

Brazil

Chile

Greece

India

Korea

Mexico

Thailand

Beta

Correlation

Correlation w/o Oct. 1987
Is correlation symmetric?


- Usual story is leverage. As the market declines, the firm’s leverage increases, thereby increasing its risk.

- Hence, the impact of bull versus bear markets may impact the variances (denominator) as well as the covariance (numerator).

- Popularly believed that global equity correlation increased after the 1987 crash.

⇒ Is this increased correlation just a result of the crash or is it a more general phenomena?
We detail evidence of *semi-correlation* [correlation measured separately in up markets and down markets]

1. G-7 correlations increase (often by a factor of 2) when returns in both countries are negative.

2. This result is robust to omitting the October 1987 observation.

3. In some countries, there are dramatic changes. In Germany:

   → bull correlation=8%
   → bear correlation=52%
This is not just a volatility effect
Unfortunately for investors, correlation is highest when it is most needed.

- With negative U.S. returns, one would hope for offsetting foreign returns.

- However, if correlation is not symmetric, portfolio performance will deviate from expectations.

- Should we use the semi-moments in asset allocation?
Evidence, e.g. Schwert (1989), that volatility is affected by the business cycle.

- We offer new evidence that correlation changes in different stages of the business cycle.

- We divide data by NBER definitions of turning points.

- We also divide data by CIBCR business-cycle definitions for each country.
7. Correlation and the business cycle

Returns Performance and the Business Cycle
MSCI Countries

Returns Performance and the Business Cycle
Unhedged IFC Countries

Returns Performance and the Business Cycle
Longer-Sample Unhedged IFC Countries

Returns Performance and the Business Cycle
Global Unhedged Fixed Income

Note: COL, IND, KOR, MAL, NGR, PAK, PHI, POR, TUR, VEN have only 6 months for recession correlation measurement.
7. Correlation and the business cycle

Correlations in Recessions and Expansions
U.S. Equity vs. Other G-7 Countries

Country
- [ ] Expansions
- [ ] Recessions

Erb, Harvey & Viskanta: Correlation
7. Correlation and the business cycle

Correlations and the Business Cycle
U.S. Equity vs. Unhedged MSCI Countries

Correlations and the Business Cycle
U.S. Equity vs. Unhedged IFC Countries

Correlations and the Business Cycle
U.S. Equity vs. Longer-Sample Unhedged IFC Countries

Correlations and the Business Cycle
U.S. Equity vs. Global Unhedged Fixed Income

COL, IND, KOR, MAL, MDG, NAM, PH, POR, TUR, VEN have only 3 months for recession correlation measurement.
7. Correlation and the business cycle

Volatility and the Business Cycle
MSCI Countries

Volatility and the Business Cycle
Unhedged IFC Countries

Volatility and the Business Cycle
Longer-Sample Unhedged IFC Countries

Volatility and the Business Cycle
Global Unhedged Fixed Income

Erb, Harvey & Viskanta: Correlation
7. Correlation and the business cycle

Covariance and the Business Cycle
MSCI Countries

Covariance and the Business Cycle
Unhedged IFC Countries

Covariance and the Business Cycle
Unhedged IFC Countries

Covariance and the Business Cycle
Global Unhedged Fixed Income

COL, IND, KOR, MAL, NIG, PAK, PHI, POR, TUR, VEN have only 6 months for recession correlation measurement.
If correlations move with the business cycle, this implies some degree of predictability.

- To some degree, the business cycle is predictable.

- To a large extent, we know what phase of the business cycle we are in.

- Doesn’t make sense to use a historical correlation as a forecasted correlation if we are emerging from a recession and entering a recovery.
7. Correlation and the business cycle

Straightforward to build a forecasting model.

- Use variables to forecast correlations which are known to be related to ex ante information about the stage of the business cycle.

(a) Lagged returns in both countries

(b) Lagged dividend yields in both countries

(c) Lagged term structure in both countries

(d) Allow for persistence by including lagged correlation.
7. Correlation and the business cycle
Consider two new metrics:

**Direction:**

*Proportion of times U.S. equity loss countered by foreign asset gain.*

**Coverage:**

*Proportion of times foreign asset gain exceeds U.S. equity loss.*

▷ These are nonparametric measures.

▷ Answers the hedging question directly. High direction and coverage ratios imply good hedging performance.
Emerging markets provide better hedges.
8. Hedging using world markets

Proportion of Times Fixed Income Gain and U.S. Equity Loss
Full Sample: No Currency Overlay

Proportion of Times Fixed Income Gain Exceeds U.S. Equity Loss
Full Sample: No Currency Overlay
9. Do world markets still serve as a hedges

Proportion of Times Foreign Gain and U.S. Equity Loss
Recent Experience

Proportion of Times Foreign Gain Exceeds U.S. Equity Loss
Recent Performance
9. Do world markets still serve as a hedges
9. Do world markets still serve as a hedges
10. Currency overlays

![Proportion of Times Fixed Income Gain and U.S. Equity Loss Recent Performance: Currency Overlay Implications](image)

![Proportion of Times Fixed Income Gain Exceeds U.S. Equity Loss Recent Performance: Currency Overlay Implications](image)
11. Conclusions

- It is well known that correlations change. Our contribution is to characterize how and why correlations change.

- Correlations are higher in bear markets and this result is robust to excluding the October 1987 observations.

- Correlations are higher in recessionary periods.

- Covariance, rather than the variances, is the term influencing changes in correlations.

- Correlations can be predicted with variables which capture ex ante information about the business cycle.

- World markets are natural hedges for a U.S. investor. However, some markets are more attractive than others.

- Recent experience shows that the diversification benefits of world markets are still intact.
Do World Markets Still Serve as a Hedge?

By MARY ROWLAND

One of the many arguments for investing abroad is that stock markets in different parts of the world tend to hit their peaks and valleys at different times because of varying economic conditions. It follows, then, that an American can hedge against a decline here by having money in Europe, the Pacific Rim, Latin America or elsewhere.

The market crash of October 1987 seemed to turn that theory on its head. When the Dow Jones industrial average dropped 508 points in one day, stock markets around the world fell. Once again, in the first and second quarters of this year, the stock market slump in the United States stretched to most parts of the world.

Not surprisingly, these worldwide downdrafts have prompted researchers to look again at the relation between United States and foreign markets and to ask whether investing abroad actually does provide a cushion against bear markets here.

Some financial advisers believe the benefits of diversification abroad have been blunted. "International markets have become more correlated with the U.S. market, particularly in down markets," Peter L. Bernstein, a consultant in New York, said. He cited two countries that have historically been most out of step with the United States. Bernstein says, are Japan and Italy. Those two stock markets have certainly done very well this year. At the end of June, the Japanese market was up 34.41 percent in dollar terms, and the Dow was down 3.44 percent. The Italian market was up 21.12 percent, and most of Europe was down about 4 percent.

A number of studies have looked for a long-term trend of more correlation between domestic and foreign markets as the economy moves from one of many nations to a global economy. Correlation measures whether investments move together or against each other.

"Perfect positive correlation of 100 percent means that two things always move in lockstep," said Campbell R. Harvey, associate professor of finance at the Fuqua School of Business at Duke University. "Perfect negative correlation means that two things move in opposite directions." Investors look for negative correlation because it provides a hedge and reduces the volatility of a portfolio.

Most researchers say they can find no long-term trend toward increased correlation among world markets. "We recently did some work on the correlation of the monthly returns on the index of U.S. and foreign markets," said Christian Wignall, chief investment officer of G.T. Global funds in San Francisco, which manages $20 billion in assets. "We wanted to find out if the correlation has risen or fallen over the past 24 years. The answer is very clearly no."

Mr. Wignall and others concede, however, that the correlation varies over time. "Our view is that in short-term periods of global stress or trauma, it is not unlikely that global markets will behave like the U.S.," said George Murnaghan, vice president of Rowe Price-Fleming International, which manages international funds for T. Rowe Price, the mutual fund company based in Baltimore.

Some studies support that point, indicating that the correlation is much greater when markets are volatile, which is precisely when investors would like to see a low correlation. Professor Harvey, who teaches global asset allocation and portfolio management, and Claude Érard and Tadas Viskanta, both of the First National Bank of Chicago, found in a recent study that the correlations between two stock markets are greater in bear markets. Their survey looked at the Group of Seven nations: the United States, Britain, France, Germany, Italy, Japan and Canada.

Even with the 1987 market crash excluded, the point holds true, Mr. Harvey said. In fact, the correlation in down markets is nearly double the correlation in up markets, the study found. For example, the correlation between the United States and German markets when both are rising is only 9 percent. But the correlation when both are falling is 52 percent.

What we've found is that in down markets, the correlation is much higher, which works against you," Mr. Harvey said. This is exactly the opposite of what an investor wants from diversification. Ideally, when the United States market declines, other markets would rise.

Still, most advisers say that international investing provides an important opportunity to diversify. "You still have to be exposed to global markets whether it is an up or a down cycle," Mr. Bernstein said. "There are many opportunities you will miss if you do not have the exposure."

And, over the long term, putting international stocks in a portfolio will both increase returns and reduce volatility. "When you put somewhere between 30 to 40 percent of a U.S. portfolio in international stocks, you both increase the rate of return and decrease volatility," said Mark Holowesko, director of global equity research for the Templeton Funds in Nassau, the Bahamas.

There are other reasons to invest abroad, too. Particularly now, the best values may be outside the United States. "The feeling among most money managers is that U.S. markets are still overvalued and that the values today lie abroad," said Neil Litvack, executive vice president of marketing at Fidelity Investments.

Furthermore, even though many markets moved in tandem during the first half of the year, the exceptions were notable. "Japan represents 40 percent of the world market outside the U.S. and its major index is up more than 30 percent," Mr. Wignall said. "That's pretty effective diversification."

Finally, the emerging markets do not yet move in sync with the American stock market, the professionals said. That may be little consolation to investors whose domestic holdings have dipped this year and whose emerging markets holdings have plummeted. Still, "the correlation here is zero or negative," Mr. Harvey said, based on a separate study conducted of emerging markets and the United States market. "These markets provide a good hedge against the U.S. market."