Short-Term and Long-Term Market Inefficiencies and Their Implications[1]

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"In the long term, we are all dead." ---Keynes

I. About Efficient Market Hypothesis:

a. Thesis

"Do we know that financial markets are efficient?" Since the summary work by Fama (1970) decades ago, this debate remains contentious but during the process yields in-depth knowledge on how financial markets work. In a sequel work in 1991, Fama concluded, "In brief, the new work says that returns are predictable from past returns, dividend yields, and various term-structure variables. The new tests thus reject the old market efficiency-constant expected return model that seemed to do well in the early work."

However, the mounting evidence of stock market anomalies and return predictabilities doesn't stop people from questioning the validity of active portfolio management and change the heart of hardcore efficient market believers. Any empirical studies have to simplify the complicated world of financial markets and impose one form of valuation model or another. To further complicate the matter, we are dealing with an open system with countless variables and players in an evolving world bestow on this issue an ever-changing nature. On the other hand, the ways that different kinds of efficient market hypotheses are set up (weak form, semi-strong form, strong form, and specific formulations) make refuting them beyond statistical doubt an arduous if not impossible task. The naiveté of null hypothesis and the high threshold of rejecting it are strongly in favor of the so-called null hypothesis of market efficiency instead of alternative hypotheses like "stock returns are predictable in such and such a fashion and volatilities are clustering with the expected returns changing over time."

For example, Poterba and Summers (1988) show that for most tests of random walk hypothesis, the Type II error rate would be between 0.85 and 0.95 if the Type I error rate were set at the conventional 0.05 level. In other words, if one gives the benefit of doubt to the null hypothesis and only falsely reject it 5% of the time, one would reject the alternative hypothesis at least 85% of the times even if the alternative hypothesis were true. To put the null and alternative hypotheses on equal footing and minimize the sum of Type I and Type II errors, they suggest a 0.40 significance level for the variance-ratio test used in their study. We can possibly reduce both Type I and Type II errors by increasing the sample size. The more information in the sample, the greater is the ability of the

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test statistic to reach the correct decision. Many studies of efficient market hypothesis use U.S. market data since the beginning of 19th century or even go back as far as 18th century. However, as the market today is significantly different from the market hundreds of years ago, such studies may suffer from structural changes and irrelevancy for the market today. Researchers frequently test the same hypothesis in foreign markets, probably with shorter history, to corroborate conclusions drawn in the U.S. in the first place. This alleviates the conflict of statistical accuracy from large sample size versus relevancy of distant past if we were to draw conclusions only based on longer U.S. history of stock markets.

b. Antithesis

"Do we really know that financial markets are efficient?" Summers (1986) provides at least an alternative form of null hypothesis. In a simulation of market dynamics, Summers proves that even though market valuations frequently differ by more than 30%, spread across a few years assuming AR(1) process for the error term, the actual first-order daily autocorrelation is only -0.008--too minuscule to indicate any degree of market inefficiency. In order to have a 50% chance of rejecting the efficient market hypothesis, it would be necessary to have data for just over 5000 years--far beyond the life expectation of any of us in this field of study! In essence, in inefficient markets where prices take long temporary swings away from fundamental values, autocorrelations of short-horizon returns can give the impression that long-term mean reverting components of prices are of no consequence when in fact they account for a substantial fraction of the variation of returns.

Using a variance ratio test on a long history of U.S. markets and 17 foreign markets, Poterba and Summers (1988) demonstrate that stock returns are positively autocorrelated over short horizons and negatively autocorrelated over longer horizons. By decomposing stock prices into a random walk component and a transitory component, their research shows that, for the U.S., the transitory component accounts for more than half of the monthly return variance. The authors further suggest that noise trading instead of changing expected return is the likely reason for the transitory component in stock prices. As market and fundamental values diverge, at a certain point, stock prices will revert to their mean and induce negative autocorrelations if “erroneous” market moves are eventually corrected. Consequently, for long-term investors, the stock market may be less risky than it appears to be when the variance of single-period returns is extrapolated using the random-walk model.

In a similar study of the U.S. market during the 1926-85 period, Fama and French (1988a) decompose stock prices into permanent and temporary components. Large negative autocorrelations for return horizons beyond a year suggest that predictable price variation due to mean reversion accounts for a large fraction of 3-5 year return variance. Predictable variation is estimated to be

about 25% of 3-5 year return variances for large-cap portfolios and 40% for small-cap portfolios.

Since late 1970s, researchers have discovered many anomalies (Basu 1977, Fama and Schwert 1977, DeBondt and Thaler 1985, Keim and Stambaugh 1986, Campbell 1987, Fama and French 1988b, Lo and MacKinlay 1988, Lakonishok, Shleifer and Vishny 1994, Chan, Jegadeesh, and Lakonishok 1996, etc.). These anomalies largely contradict early forms of efficient market hypothesis. Where there is no uniform stock valuation model, it seems that stock returns are predictable from macroeconomic variables (such as interest rate and credit spread), value factors (such as price-to-earnings ratio and price-to-book ratio), as well as price momentums and return reversals.

c. The informational content of stock prices

Most investors would agree that markets cannot be fully efficient as informational asymmetry exists and there are costs associated with arbitraging and speculative activities (Grossman and Stiglitz 1980). The relative information/noise content in the market depends on the nature of information flow, the sophistication of trading techniques and investment strategies, and the institutional setup of the investment industry. By and large, information flows in the market fall into the following categories: macroeconomic news, firm-specific news, and news affecting investors' risk appetites (such as war and contagion during financial crisis). Alternatively, information flow can be classified based on their impacts on expected cash flows, time-varying expected returns, and shocks to expected returns.

In reality the degree of market efficiencies varies across asset classes, markets, and return horizons. Usually the degree of efficiency is higher for large-cap stocks with sufficient analyst coverage than for less covered small-cap stocks. Countries with better disclosure rules and more sophisticated institutional setups tend to have higher market efficiencies. Markets are usually more efficient for short-term returns than for long-term returns. For example, most studies on short-term returns found that the predictable variation of returns accounts for only a small part of total return variation (usually less than 3%). Fama and French (1988) study shows that the predictable component can be as high as 25-45% for stock returns over 3-5 year horizons.

Roll (1988) finds that a large part of variation in U.S. stock returns is firm-specific, which seems to imply the existence of either private information or occasional frenzy unrelated to concrete information. Durnev, Morck, Yeung, and Zarowin (2001) find that greater firm-specific stock return variation, measured relative to total variation, is associated with more informative stock prices and thus implies a higher degree of market efficiency. Morck, Yeung, and Yu (1997) show that the degree of co-movement in U.S. stock prices has declined more or less steadily

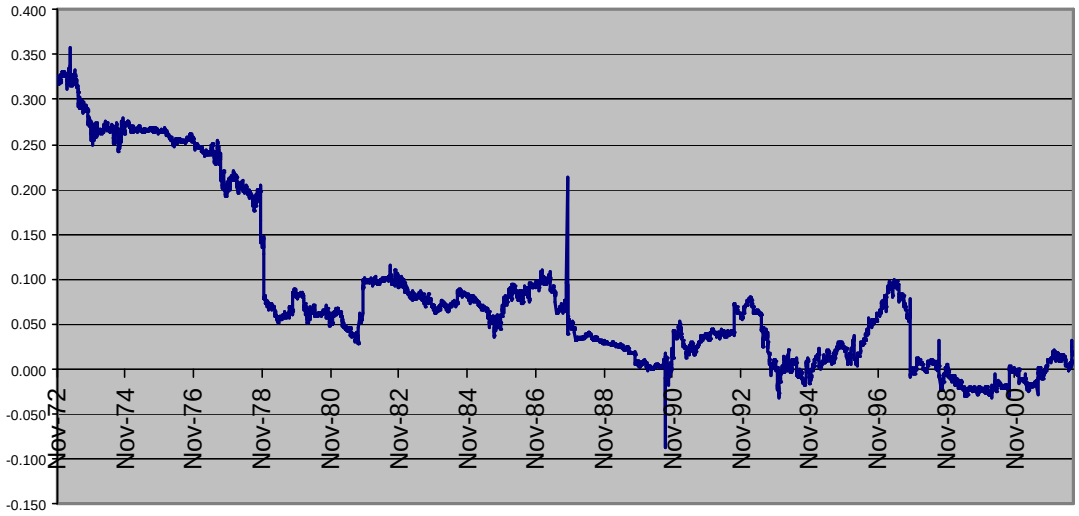
through the 20th century, which is consistent with increasing market efficiencies in the U.S.

II. Short- and Long-Term Market Efficiencies

Investment professionals have long been battling market efficiencies with varying investment styles and strategies to exploit specific forms of market inefficiencies. While some firms are more contrarian and long-term-focused, other firms may be momentum-driven and have much higher turnovers. In the article entitled *"Time is of the Essence"* in the June 10, 2002 issue of *Pensions and Investments,* several professors and practitioners debated the validity of market efficiency in the short run and the long run. "The stock market is becoming more efficient over the short term and less efficient over the long term, some investment experts say."

With quick dissemination of information in the markets along with modern technology making short-term trading more efficient, and development of more sophisticated short-term trading techniques, the stock market is getting more liquid over time with ever increasing emphasis on short-term performances. The competition on short-term trading, along with decreasing transaction costs, means daily return autocorrelations must drop too. Chart 1 produces the first-order autocorrelations of the S&P 500 index using three-year daily returns starting in December 1969. As can be seen, the first-order daily autocorrelations in the U.S. stock market follow roughly a stepwise decreasing function, dropping from the high of 0.30 in the early 70s, to eventually near zero in the most recent years.

Chart 1. Three-year Rolling Window First-order Daily Autocorrelations
S&P 500 Index Returns: 1972-2002



As Shiller (1981) mentioned, short-term stock market volatilities are too high to be justified by long-term economic fundamentals. In the long term, stock markets have to reflect economic growth, corporate profitability, and changes in business conditions, which to a certain degree have predictable patterns and fluctuate around some trend lines. In the short term, on the other hand, many people trade based on little information or on information that is of no predictive power. For those who are smart enough to conjure up some mathematical formulas and decipher financial market anomalies, they tend to be overconfident about their ability to forecast and accordingly take great risk for return maximization. The collapse of Long-Term Capital Management is a great irony of short-term speculation and an illusion of modern financial engineering (Lowenstein 2000).

Financial markets are not of mathematical precisions or irrefutable physical laws. In statistical analysis, it is almost impossible to accept the null hypothesis with full confidence, as any good financial models or market hypotheses always have exceptions. Those exceptions or three-sigma events have occurred more frequently than normal distribution tends to suggest. To complicate the matter further, structural changes or changing means in stock returns could put even the most robust statistical analyses or most sophisticated models into question. As one cannot have an instantaneous stable market environment and sufficient independent observations encompassing possibly all scenarios, the short-term and long-term market efficiencies are two completely separate issues. In the short-term, market efficiency is about news, changing risk aversion, liquidity and transaction costs. In the long-term, it is about valuation, growth and cost of capital.

To further illustrate this point, we can compare the short-term versus long-term market demands for stocks. For buy and hold investors (like traditional institutional investors and long-term retail investors), the average holding periods are usually a few years. However, as hedge funds and retail investors are more short-term driven and tend to trade with market momentum and sentiment, the average market turnover rates are usually much higher than traditional institutional investments. This will be especially true in highly speculative sections of the market such as technology stocks in the late 1990s. Chart 2 produces the average turnover rates for NYSE and NASDAQ stocks between 1976-2001. One can see that NASDAQ tends to have higher turnover rates than NYSE as there are more speculative investors in NASDAQ stocks. Starting in the late 1990s the turnover rates for NASDAQ stocks have been on average over 200% meaning average holding periods of less than half a year. If we take into consideration derivatives trading, the actual speculative activities should be even more intensive during this period.

Chart 3 is the average first-order return autocorrelations of MSCI country indices for different holding periods. The average autocorrelations are slightly positive for short holding periods (one month, three months and six months). Over longer

holding periods, the autocorrelations become negative and gradually decrease to around –0.25 for multiple-year holding periods. This largely confirms the studies by Poterba and Summers(1988) and Fama and French (1988a).

Chart 2. Dollar-Weighted Annual Turnover Rate on NYSE and Nasdaq

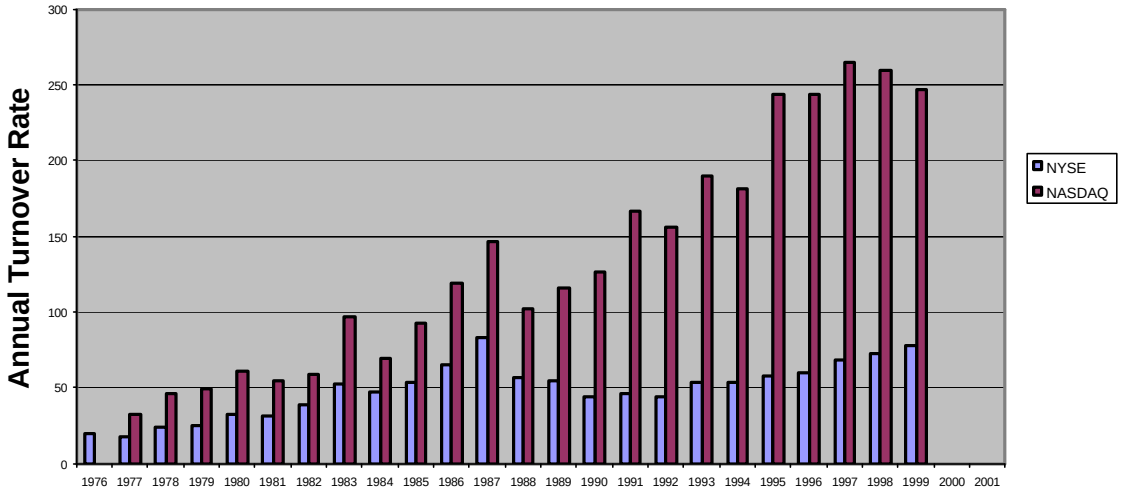
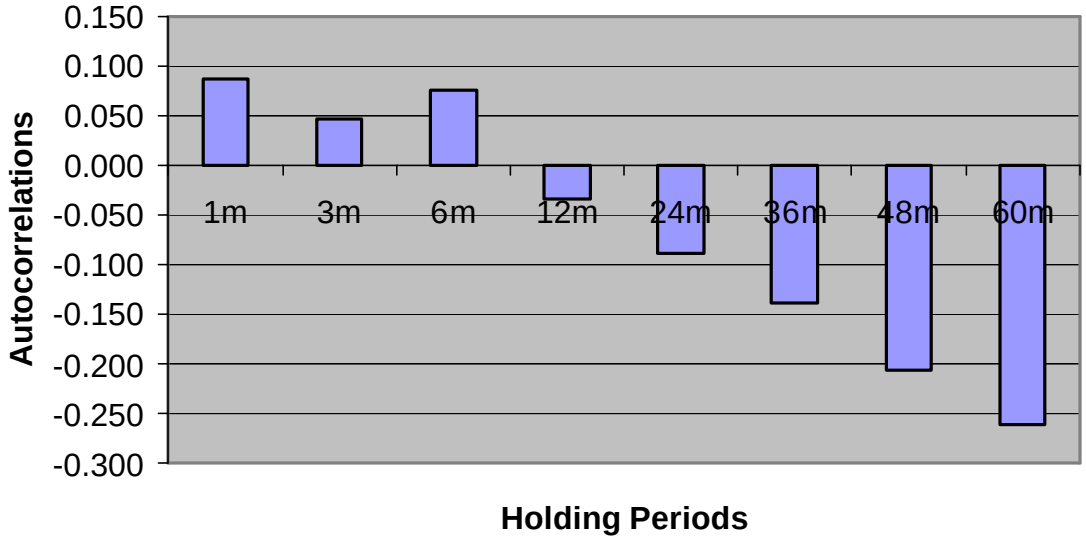


Chart 3. First-order Autocorrelations of MSCI Country Index Returns
18 Developed Market Average: 1969-2001



The article, "*Time is of the Essence*," also listed several reasons for increased market efficiency in the short term: increased information flow and coverage, modern trading technology and the development of hedge funds and derivatives markets, business pressure for fund managers to focus on short-term performance, etc. On the other hand, greater use of specialized mandates by pension funds and less research and implementable ideas on long-term investing create long-term market inefficiencies. When all the speculative liquidity dries up and noisy trades wane out, one will find out that different asset classes and stocks do follow their own drumbeats marching in different directions in the long run.

Behavioral finance theory has offered further insights on market inefficiency and investor overreactions in the long term. Investors' overconfidence about the precision of private information and their ability to forecast leads to short-term price momentum, excess volatility, and eventual mean reversion. DeBondt and Thaler (1985) show that based on CRSP data between 1926 and 1982, the previous "losing" stocks have earned about 25% more than the previous "winners" thirty-six months after portfolio formation. Lakonishok, Shleifer, and Vishny (1994) argue that market participants appear to have consistently overestimated future growth rates of glamour stocks relative to value stocks. Accordingly, value strategies produce higher returns than glamour strategies in the long term with an average annual spread around 10%. Using conventional measures of risk, value strategies appear to be no riskier either.

The notion that stock returns are more explainable and predictable in the long term is also supported by Fama and French (1988b), Fama (1990), Cochran, DeFina, and Mills (1993). As expected returns are positively autocorrelated (Fama and Schwert 1977, Keim and Stambaugh 1986, Fama and French 1987), the variance of expected returns grows more than proportionately with the return horizon. The residual variance, on the other hand, grows less than proportionately with the return horizon due to negative autocorrelation in actual returns. The R-squared, which is the ratio of expected return variance to the total return variance, will rise with the return horizon.

In an ideal world stock markets should reflect past and present information and even correlate with future economic activities that are yet known, as stock markets help allocate economic resources and serve as a leading indicator of real economic activities. Based on Fama's study, the combined effect of variables that proxy for expected returns, expected return shocks, and shocks to expected cash flows accounts for 58% of the variance of annual stock returns. Future production growth rate itself explains 6% of the variance of monthly returns on a NYSE value-weighted portfolio. The proportion rises to 43% for annual returns. Such high information/noise ratios are comforting in that stock markets indeed play a significant positive role in servicing the U.S. economy. How much of it is contemporaneous and how much of it can be predicted can

shed light on the issue of market efficiency and provide us some guidance on profitable investment opportunities.

The 58% explainable return variation ratios set up realistic upper bounds for investment research. It also shed lights on the relative effectiveness of short-term and long-term investment strategies, as the R-squared from regression analysis increases with the return horizon. As shorter-term returns are much more noisy than longer-term returns, information is spread over several periods and can better be captured when longer-horizon returns are regressed on related financial and economic variables. Based on the fundamental law of active management (Grinold 1989), to achieve equal value-added, one could either trade frequently based on short-term forecasts and hopefully accumulate enough profits over time or focus on economic fundamentals and profit from long-term market inefficiencies.

R-squared of 58% for annual returns is roughly equal to R-squared of 4.8% for monthly returns. This is probably an upper bound for short-term return models (3% according to Fama and French 1988a). However, as expected returns are positively correlated and model alphas tend to have overlapping information from month to month, a monthly model with R-squared 4.8% will not deliver as well as an annual return model with R-squared of 58%.

The relative model efficacies across different holding periods have important implications for portfolio management. While most quantitative models in practice are to forecast monthly or quarterly returns and portfolio rebalancing usually takes place on similar frequencies, the actual turnover rates vary across portfolios depending on target tracking errors and transaction cost assumptions. The resulting average stock holding periods can range from a few months to a few years. It is therefore essential for a low turnover strategy to focus more on long-term return forecasting, and to make sure that long-term models produce better results than alternative short-term models in the end.

III. The Term Structure of Correlations

As stock returns are positively autocorrelated in the short term, but become negatively autocorrelated in the long term, the actually correlations among individual stocks and asset classes also vary with holding periods. Wang (1999) explains that as first-order autocorrelations change with return periods, usually being the closest to zero for monthly and quarter returns, correlations among stocks and equity markets should be the highest for monthly and quarterly returns and gradually decrease as the holding period extends to multiple years. For example, using Morgan Stanley Capital International country indices for 1970-1998, the average monthly and quarterly correlations among 18 developed markets (in local currencies) are 0.41 and 0.47 respectively. The average correlation decreases to 0.34 for two-year holding periods and 0.33 for three-year

holding periods. The correlations for 4-year and 5-year holding periods are 0.36 and 0.38 respectively.

Stocks and world equity markets are more correlated in the short term (monthly or quarterly) than in the long term. In the short term, people infer from the movement in one stock or one market clues in other stocks and markets, with investors' change in risk appetites affecting all stocks and markets. As the return period extends, the noise term and the correlation due to misinterpretation of information and common risk tolerance give way to the slowly building trends in individual stocks or markets along with their respective economic fundamentals and financial market characteristics.

However, there are some further issued Wang (1999) fails to address. First, the analysis is based on local returns. The same analysis using US dollar returns fails to show a declining term structure of correlations. This may be due to the common currency movements. It is not clear which analysis is more relevant for global investors. Second, the short history (29 years) makes correlation estimations for long-term returns highly unreliable. Third, while the author proves that return autocorrelations lead to the term structure of correlations, the actual fundamental reasons are not clear. One hypothesis is that correlations of fundamental economic forces such as business cycles drives stock market correlations for long holding periods. For example, the correlations among European markets remain high even for multiple-year holding periods, and the actually pair-wise correlations resemble closely the pair-wise business cycle correlations.

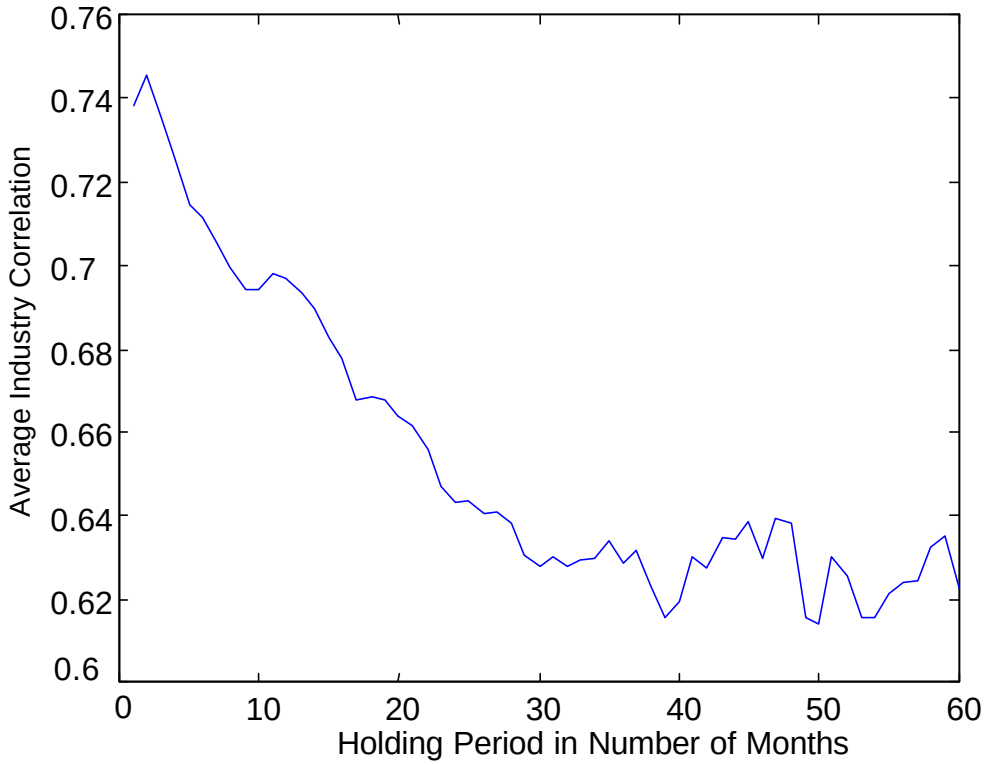
To further address those issues, it is important to control the currency and business cycle variable by focusing on different asset classes within a market. It is also important to collect much longer history to render the correlation coefficients for multiple-year returns more reliable. It thus becomes natural to focus on the long-term equity market correlations within the U.S. market.

Different industries or sectors respond differently to cyclical movements in the economy and have distinctive economic fundamentals in the long term. Using 12 market capitalization weighted U.S. industry portfolio data[2] between July1926 and December 2002, chart 4 produces the average correlations for return horizons from one month to five years[3]. The 12 industries are consumer non-durables, consumer durables, manufacture, energies, chemicals, business equipments, telecommunications, utilities, shops, healthcares, money, and others. The average industry correlations are 0.74 for monthly and quarterly returns and steadily decrease with holding periods. For 3-year and 5-year holding periods, the average correlations are 0.63 and 0.62 respectively. Using 48 U.S. industries based on narrower industry classifications, excluding 8

[2] Data is from Professor French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library).
[3] For holding periods longer than one month, data is simulated with different starting months to come up with a representative average correlation for the whole period.

industries without early data, the average correlations are 0.63 and 0.65 for monthly and quarterly returns. The average correlation drops to 0.50 for 3-year holding periods and 0.49 for 5-year holding periods.

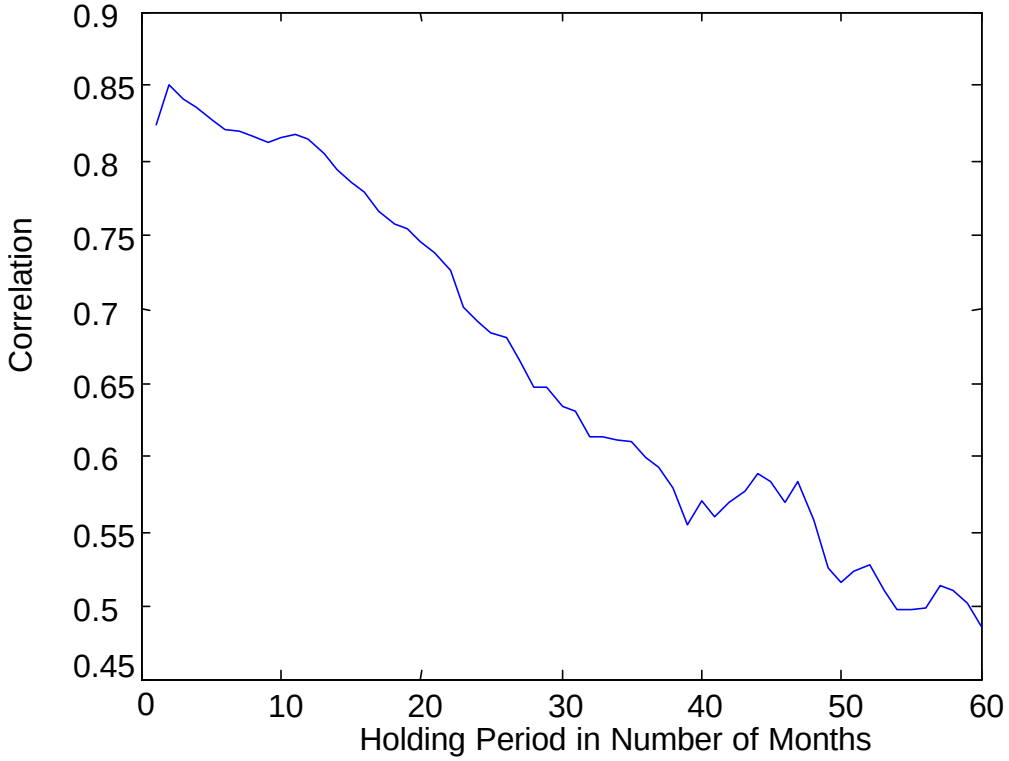
Chart 4. U.S. 12 Average Industry Portfolio Correlations
July 1926-December 2002



Another interesting example is the correlation structure of U.S. large-cap and small-cap indices. Large-cap and small-cap stocks have different degrees of market efficiencies and typically respond differently to the same business cycle and monetary policies (Jensen, Johnson, and Mercer 1997, Burnie and Kim). Using size portfolios[4] based on top 30% companies and bottom 30% of NYSE and Nasdaq companies and market capitalization weighting them, chart 5 shows that the correlation between large cap and small cap portfolios have a clearly decreasing trend with return horizon. The correlation is 0.83 and 0.85 respectively for monthly and quarterly returns. It drops to 0.60 for 3-year holding periods and 0.48 for 5-year holding periods.

[4] Data is from Kenneth French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library).

Chart 5: Correlation Structure of U.S. Large and Small Cap Portfolios
July 1926-December 2002



IV. Conclusions

The issue of market efficiencies has far-reaching implications for investment policies and strategies. With the increasing information flows and deployment of modern technology, the confluence of academic research and investment practice, and large liquidity and many investment shops competing, the search for and exploration of market anomalies have become elusive. If we take into consideration transaction costs, taxes, management fees, and slippages in the investment process, consistently adding value in the long term versus peers and benchmarks is a goal few can achieve.

However, the degree of market efficiency varies depending on the market circumstances. For example, with the collapse of technology stocks in 2000, fear overtook investors and liquidity quickly dried up in most markets around the world, which eventually creates an environment for more market inefficiencies and potential for active managers outperforming passive indexes. Also, small-cap stocks are generally less efficient than U.S. large-cap stocks. Fama and French (1988) demonstrate that the predictable component of stock return variation is 40% for small-cap stocks versus 25% for large-cap stocks. Therefore, the issue

of market efficiency cannot be taken in a blind fashion and has to be studied actively and discriminatively.

Stock markets have different behaviors in the short term and the long term. In the short term, all stocks react to similar imminent economic forces and reflect investor risk appetites. In the long term some companies will disappear and fall into oblivion while others may prosper and last several human lifetimes. Much of the short-term effects fade away in the long term with only a few macro themes and economic forces remain intact. It is only with historical perspective does it become clear which are the secular trends and which are just whims and fantasies of markets. As shown by the term structure of correlations, the positive correlations among stocks or different asset classes tend to decrease with investment horizon, which highlights the diverging business realities and economic forces among companies, industries, and countries. Some structural issues in the fund management industry create its own fallacies. For example, with more and more money invested in index funds or S&P 500 companies, the index premium has increased over the past decade, creating a new anomaly, which may eventually lead to the underperformance of passive investing. With fund managers focusing on short-term performance and under business pressure, some long-term market inefficiencies and differences remain under-exploited.

Financial markets have very complicated dynamics. As Fisher Black (1986) pointed out, “Noise causes markets to be somewhat inefficient, but often prevent us from taking advantage of inefficiencies… Most generally, noise makes it very difficult to test either practical or academic theories about the way that financial or economic markets work. We are forced to act largely in the dark.” After decades of intensive research on market efficiencies, we are at a stage to recognize that there is no simple answer to the question of market efficiency. In the short term, with abundant capital and sophisticated investors and investment technologies, stock markets move at an ever increasing pace and efficiency. In the long term, however, fundamental differences exist among companies, industries, and countries, which are not always recognized or reflected in stock prices. There could be behavioral and institutional reasons for long-term market inefficiencies as well. Understanding the nature of market efficiency and the driving forces of short-term and long-term dynamics will enable us to have realistic expectations of investment returns and develop philosophies and policies supportive of effective research and successful investment management.

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The Theorem of No Trading

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- Theorem: If players are all rational and for profits, there would be no trade taking place
  - Most investors are reasonably rational. Irrationality as narrowly defined by behavior finance usually is rational in a larger context. Overreaction is a sudden change of risk appetite
  - Most investors trade for profit in the short-term. There is no compelling reason an investor to trade today instead of tomorrow other than risk-returns concerns

- Corollary: for every trade, there is a buyer and a seller. One is smarter than the other
  - The fact trading still takes place means the theorem must be wrong

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Management

Alternative explanations

- Why markets exist:
  - There are noise traders and informed traders
  - Buyers and sellers have different investment horizons
    - IBM price goes from $100 to 80 in a day and to 120 in a year, a short-term sell and long-term buy

- Implications:
  - Both buyer and seller could be right: think twice before you trade
  - It is impossible to perfectly time the market
  - We always leave money on the table

Acadian Asset Management

If only I were Newton:

- The long-term return is the integral of the short-term return

$$R(T) = \int_0^T r(t)dt$$

- If one could trade instantaneously without transaction costs, the total return would be astronomical:

$$A(T) = \int_0^T |r(t)|dt$$

- Mathematics ? statistics ? finance

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Separation of the long and short terms

- Long-term stock returns are not the integral of short-term returns
  - Stock price is not a differentiable function: missing out a few days could make a big difference
  - Geometric mean and mathematical mean are different: no sufficient statistics to connect the short term and long term
  - Transaction costs weigh in for continuous rebalancing

- The drivers of stock market returns are different
  - In the long-term stock market converges to the fair value
  - In the short-term stock market reacts to news and is affected by risk appetites
  - It is difficult to find global maximum/minimum, impossible to perfectly time the market

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Chart 1. Three-year Rolling Window First-order Daily Autocorrelations
S&P 500 Index Returns: 1972-2002

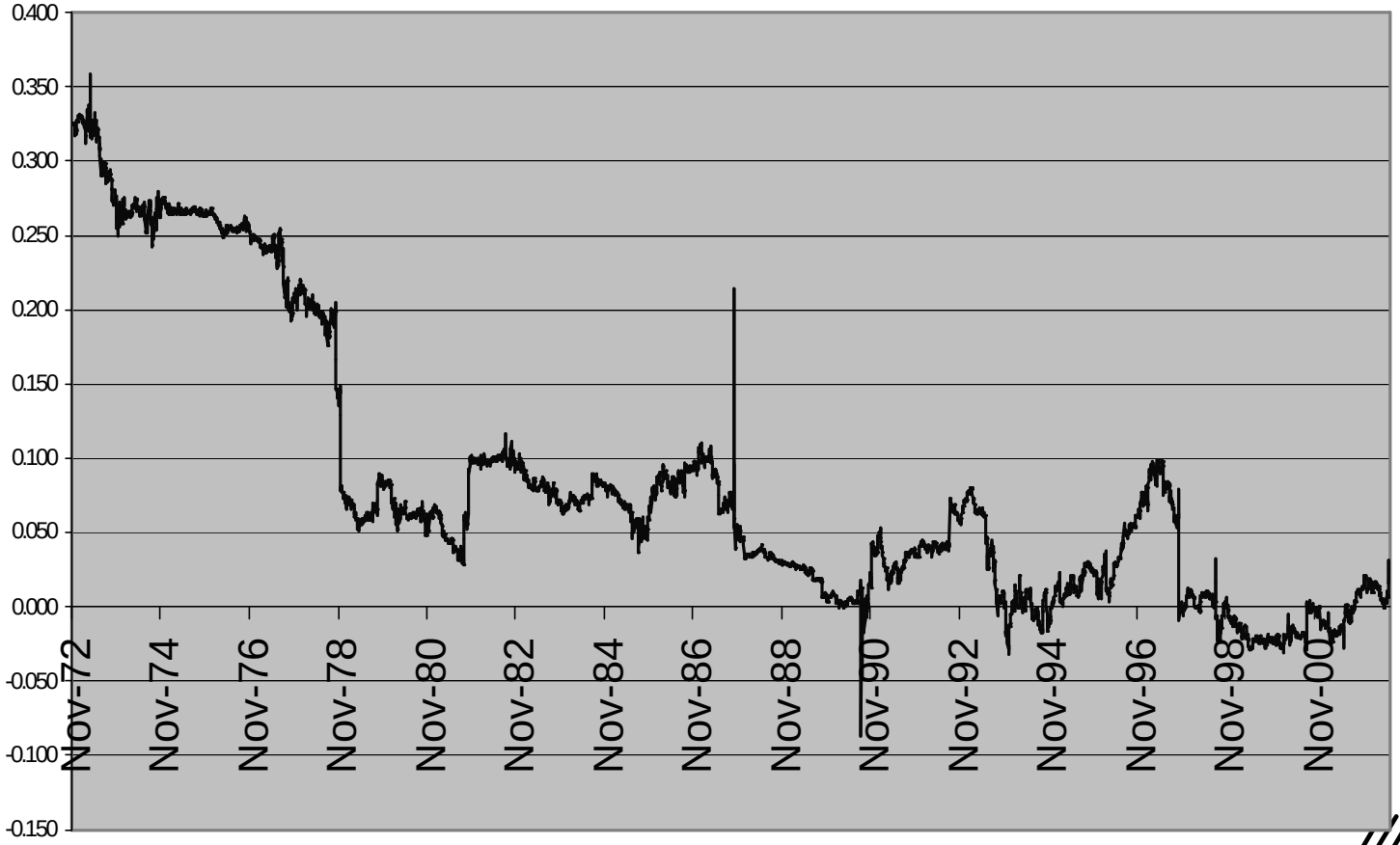

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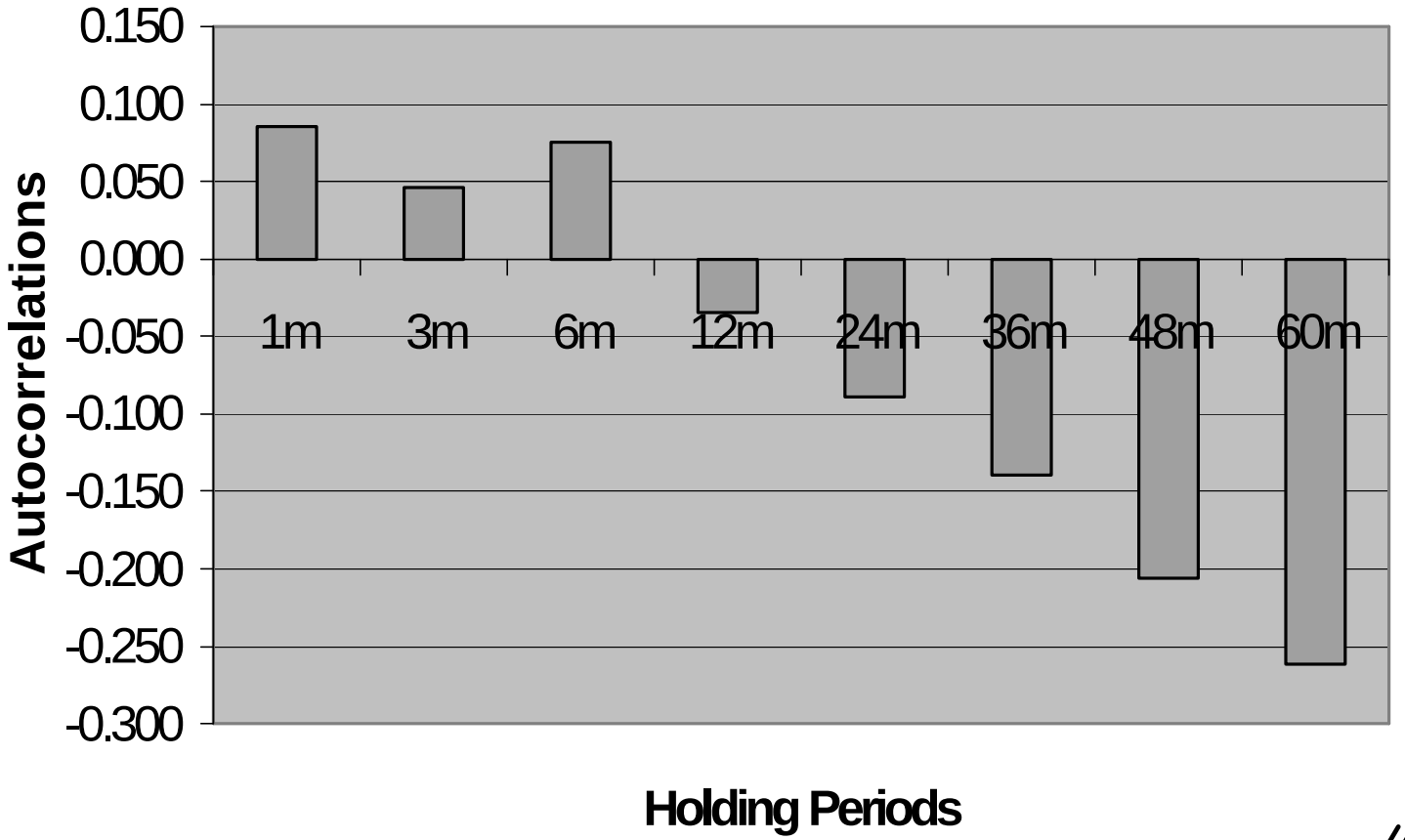
Chart 3. First-order Autocorrelations of MSCI Country Index Returns
18 Developed Market Average: 1969-2001



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Drivers of Market Efficiencies

- Short-term market efficiencies
  - Increasing information flow: financial databases, internet
  - Better trading technology: technology advancement, programming trading
  - More active investment strategies: hedge funds, index arbitrages
  - Same players chasing opportunities worldwide

- Long-term market efficiencies
  - Business cycles and consumption-based capital asset pricing models
  - Behavioral finance and interpretation of information
  - Who are the marginal players?
  - Institution matters: bureaucracy and institutional rigidity

Institutional rigidity and Behavioral Finance

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- How important is asset allocation?
  - Brinson et al (1986 and 1991) original research: 90%
  - Ibbotson and Kaplan (2000), Kritzman and Page (2003): not much
- How do we choose fund managers? Do winners repeat?
  - Goetzmann and Ibbotson (1994), Daniel et al (1997): weak evidence
  - Industry reacts to past performance and often switches styles and managers in the wrong time
- How do managers select stocks?
  - Separation of fundamental and quantitative research
  - No proper investment horizons and single-period optimization
  - Markets aren't good at subtraction and summation

The Term Structure of Market Correlations

- The permanent and temporary components of stock returns

$$R_i(t) = m_i(t) + e_i(t)$$
$$m_i(t) = l_i m_i(t-1) + d_i(t)$$

- Stock returns are little or positively autocorrelated in the short term and negatively autocorrelated in the long term

- How about correlations?

Term-Structure of Market Correlations

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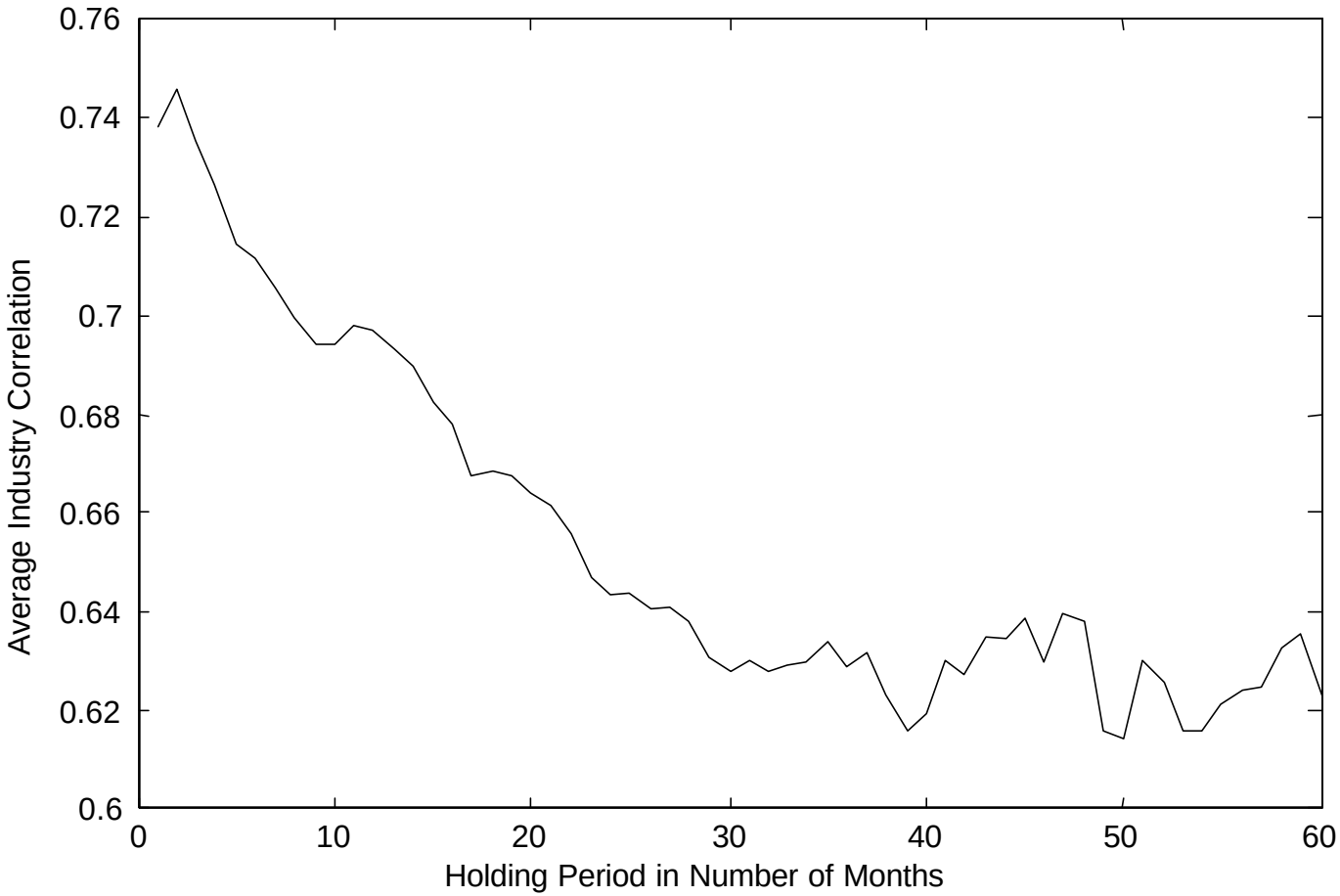
Chart 4. U.S. 12 Average Industry Portfolio Correlations
July 1926-December 2002



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Term-Structure of Market Correlations

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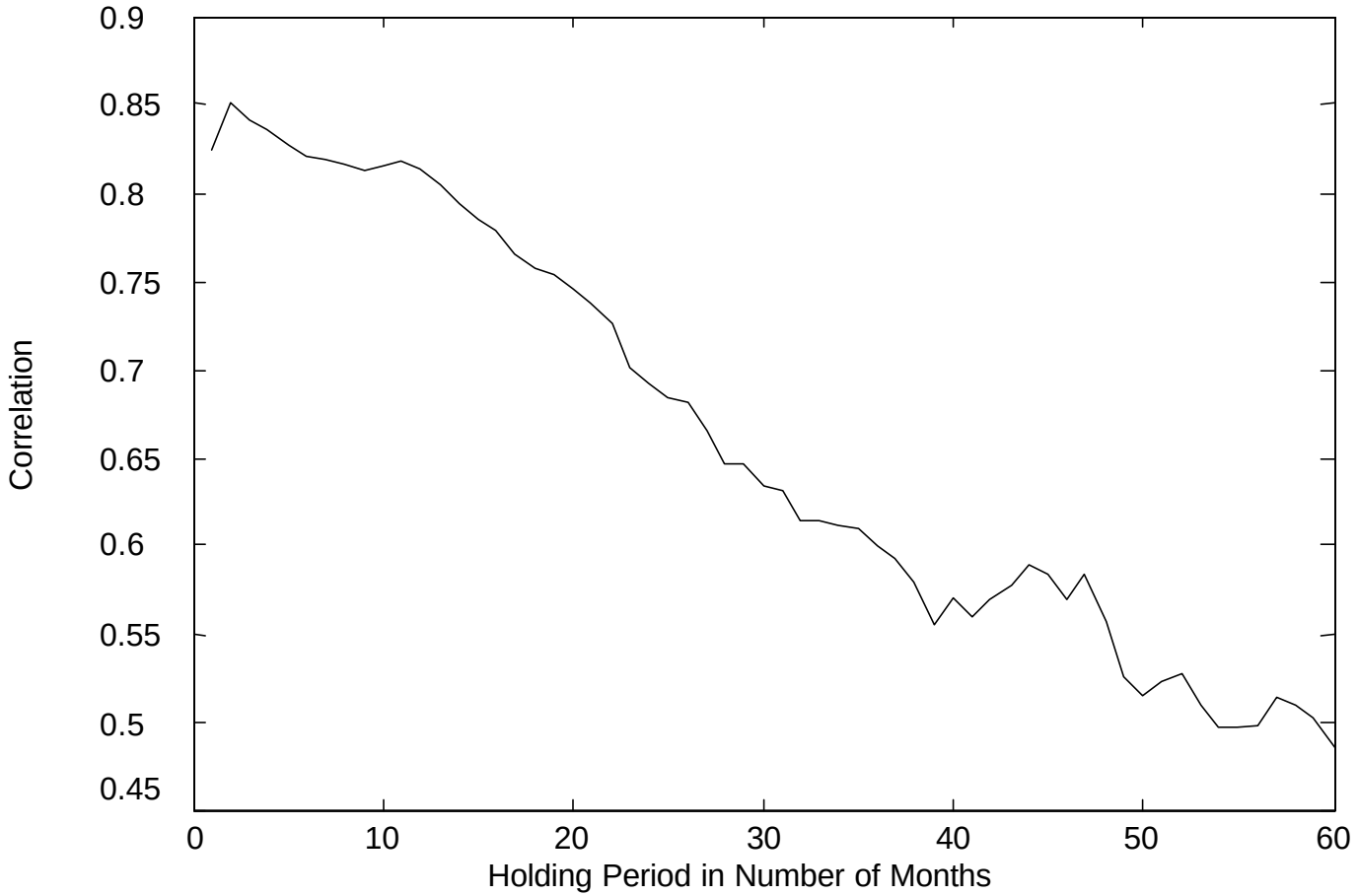
Chart 6: Correlation Structure of U.S. Large and Small Cap Portfolios
July 1926-December 2002



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The Long-term and Short-term Correlations

$$corr(R_i(T), R_j(T))$$

$$= \frac{\sqrt{1-l_i^{\,2}}\sqrt{1-l_j^{2}}}{1-l_i l_j} \frac{T + \frac{l_i}{1-l_i}(T-1-l_i^{\,T-1}) + \frac{lj}{1-l_j}(T-1-lj^{T-1})}{\sqrt{T + \frac{2l_i}{1-l_i}(T-1-l_i^{\,T-1})}\sqrt{T + \frac{2l_i}{1-l_i}(T-1-l_i^{\,T-1})}} corr(R_i(t), R_j(t))$$

The Short-term and Long-term Efficiencies II

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- In the short-term markets worldwide react in a similar fashion
  - Common risk appetites
  - Dominance of noise over information
  - Markets are highly correlated

- In the long-term economic fundamentals emerge and swings in emotion don't matter that much
  - Each industry or market will march to its own drumbeats
  - Markets correlations largely reflect correlated economic fundamentals

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Conclusions

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- Investment horizon matters for market efficiencies
- It is important to combine quantitative and fundamental research: different sources of information
- Understand the driving forces of stock returns in countries and industries
- Go beyond the conventional wisdom
  - Look inward for assumptions and methodology
  - Look outward for new ideas and new ways of acquiring information

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