Sectors Unchained

Building a Case for Sector and Industry Selection

- This is the first in a series of industry reports we plan to publish over the upcoming period. This report uses both stock and industry level data, while employing cross-sectional and time-series methods to study returns, variance and co-movement across US industries. The goal of this anatomical study is to lay the foundation that will be used for constructing a systematic industry selection process.

- The first section of the report reveals the importance of industries in explaining stock returns. Total weighted variance of all stocks was decomposed into components that were attributed to the market, to industry-specific and stock-specific idiosyncratic variance.

  The share of industry-specific idiosyncratic variation remained relatively stable over the last 20 years, accounting for 21% of total variation. Stock-specific idiosyncratic variation accounted for the largest share, representing 54% of total variation, but its share has been on a declining trend. By contrast, contribution of market variation, averaging 25%, has been rising.

  At a more granular level, most sectors exhibited a downward trend in their respective stock-specific variation relative to total variation, with the exception of Energy, Financials, IT, and Health Care—suggesting these areas may offer greater opportunity for stock selection.

- Three approaches were used to examine co-movements among industries and cohesiveness within industries, which may have implications for alpha generation and risk management.

  Using average pair wise intra-industry stock correlations, Semis, Utilities, Energy and Real Estate exhibited most cohesiveness, while Commercial & Professional Services, Software Services, Consumer Services and Media exhibited least cohesiveness.

  The use of a cross sectional equality of means test suggested that Utilities, Energy, Banks and Semis were least similar to the rest of the market on average, while Commercial & Professional Services, Consumer Services, Auto & Components and Food & Staples Retailing were most similar.

  We find that correlation based clustering presents an alternative and economically meaningful way of grouping industries, leading to a potentially more efficacious way of allocating risk within an investment process.

- An industry pairs trading strategy was used as a practical example to show the relationship between the efficacy of mean reversion of two industries and their respective pair wise correlation. A simple strategy of trading pairs of industries with a correlation above 0.3 yielded an IR of 0.5 with relatively consistent performance over a 20 year history.

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See page 36 for analyst certification and important disclosures, including non-US analyst disclosures.

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Motivation

It is quite remarkable how little of traditional sell side *Quantitative* equity research and academic research is focused on sector or industry selection when compared to stock selection….so, what might explain this gap?

It is quite remarkable how little of traditional sell side *Quantitative* equity research is focused on sector or industry selection when compared to stock selection. A cursory examination of academic literature also reveals a similar imbalance between stock and industry in equity research. Typically, Quant equity researchers - buy and sell side - pay great attention to identifying factors driving cross-section of returns within an industry with only perfunctory attention to sector or industry selection. The task of industry selection usually lies with strategists who work with top-down economists, bottom-up fundamental analysts and proprietary indicators to put together sector/industry rankings.

What might explain then, from a Quant perspective, this wide gap in allocation of research brain power between stock selection and industry selection? In our opinion, there is a justifiable belief that systematic industry selection or rotation is deemed a difficult task.

Drivers of industries' fundamentals can be very specific to the industry's line of business

For one, the drivers of industries' fundamentals, such as sales growth and profitability, can be very specific to the industry's line of business. Will the demand for farm machinery (capital goods) by emerging markets, as the rural labor force drifts to more productive urban activities, grow faster than the demand for medical treatment and hospitalization (Health Care Equipment and Services), as the baby boomers in US and Europe age? One could credibly argue that the cross-industry expertise needed to model and tackle such questions is rare or even non-existent.

Industry selection is seen as a macro timing problem

Even if one ignores industry specific minutiae and focuses on broader trends, industry selection is seen as a macro timing problem. Making a call on relative performance of industries is equivalent to making some combination of business cycle and thematic call or simply market timing, which many consider the holy grail of investing. Unlike strategies that rely on factors to be profitable, such as risk premium, providing liquidity, and over- or under-reaction of investors to new information, market timing in large part depends on getting fundamentals right before the majority of the market participants. As such, skepticism about existence of strategies that can time market consistently is understandable.

Industries are constantly evolving as technology continuously reshapes products and services

Industries, just like firms that comprise them, are constantly evolving as technology continuously reshapes products and services. Unlike the composite equity market, which can be studied over a period exceeding one or even two hundred years using a consistent metric such as Robert Shiller's price to rolling 10-year earnings ratio, it appears artificial to consider the nature of an industry to be constant for more than a few decades at best. For example, in 1884, of the 11 constituents of the newly created Dow Jones Transportation Average (the oldest surviving US stock market index) 9 companies were in the business of railroad, one in the steamship business and there was one telegraph company. How different that is from today's stock index! Industries die over time and new ones replace them—that is just how it is.

Only way to compensate for narrow breadth across industries is to have more accurate forecasts

Lastly, the number of assets typically available in making an industry call is much smaller, for instance only 10 sectors or 24 industry groups. The only way to compensate for narrow breadth is to have more accurate forecasts—that is the challenge. One could get more granular and work at industry (68 entities) or sub-industry level (over 120), but then the line between industry selection and stock selection gets blurred.

However…

However…an investment process is inherently incomplete without providing a framework for industry tilts

While acknowledging the aforementioned challenges in modeling industry selection, we nonetheless believe that it is worthwhile to build tools that permit us to have views about industries. An investment process is inherently incomplete without providing a framework for industry tilts.

Industry allocation can play an important role in risk management

Even those who are skeptical about generating alpha systematically using industry selection would likely agree on the importance of industry from a risk management point of view. The recent industry bubbles showcase that even with an efficacious stock selection process in place, mismanaging sector exposures can lead to significant portfolio underperformance.

There has been an increase in demand for building-out frameworks for appropriately allocating risk across sectors

In fact, feedback that we have been receiving from many of our large institutional clients suggests an increase in demand and overall interest in building-out frameworks for appropriately allocating risk across sectors within an investment process. Also, the plethora of ETFs[1] and structured products that have been brought to the market over the last several years, if anything, should provide for more flexibility and help ease the implementation side of things.

Introduction

This is the first in a series of industry reports that lays the foundation for constructing systematic industry selection

This is the first in a series of industry reports we will be doing over the upcoming period[2]. This report uses both stock level and industry[3] level data while employing cross-sectional and time series methods to study returns, variance and correlations across US industries. The goal of this anatomical study of industries is to lay the foundation that will be used for constructing a systematic industry selection process. This introductory research covers several topics, but primarily focuses on:

- How important is industry membership as a driver of stock returns? The total weighted variance of all the stocks is decomposed into components that can be attributed to the market, to industry-specific and to stock-specific idiosyncratic variance. This provides a time-line on the changing importance of market, industries and stocks for explaining variation in stock returns. Also, it allows us to quantify how much opportunity may be offered by stock selection, in total and within individual industries.

- The co-movement among industries is examined from several perspectives. Firstly, *pair wise time series industry correlations* are used to identify which industries, at the index level, cluster together and which are far apart. Do the clusters depend on whether we are in a bull market or a bear market? Are there alternatives to traditional GICS sector classification by clustering industry groups? Secondly, using *pair wise time series stock correlations*, we ask the question: in which industries is the gravitational pull of industry

[1] For more information on the ETF market, please refer to the J.P. Morgan Global ETF Handbook, Kolanovic et al., 2012

[2] The authors wish to thank Sang Han and Narendra Singh of J.P. Morgan Securities LLC for their contribution to this report.

[3] Throughout this report the word "industry" generically refers to a portfolio of "economically similar" stocks – in this sense, depending on the context, industry can be a stand-in for GICS Level I sectors, GICS Level II industry groups and GICS Level III industries.

membership on stock returns the strongest and/or consistent, and in which industries are stocks more or less "tightly knit"? Similarly, based on pair wise stock correlations across industries, which industries are most alike, which are most dissimilar? Thirdly, we employ a test of *cross-sectional equality of means* by industry to test which industries' returns are outliers and which industries are "more like rest of the market". This method can be used to identify industries that are exhibiting unusual or even bubble like behavior.

- Lastly, by taking a sample of common top down macro drivers, we examine the causality relationship between macro and industry returns, and whether there is an advantage or disadvantage in using macro variables at a more aggregated level (sectors) versus more disaggregated levels (industry groups and industries).

The subsequent reports will build on this aforementioned analysis and more importantly focus on the construction and utilization of various signals for conducting industry selection systematically.

Importance of Industry as a Driver of Stock Returns

A fascinating characteristic of industry performance is large multi-year run ups in the performance of one or more industry followed by a spectacular collapse. In the past four decades three industries, Energy, Information Technology and Financials, have gone through what, in retrospect, were considered frothy markets—see Figure 1. During such episodes the absolute and *relative* ability of industries to explain stock-specific variation increases sharply thus giving investors an omen that not all is normal anymore.

Importance of industry in explaining variation of stock returns…

There are many ways of tracking the relative importance of industry versus stocks and each has its strong and weak points. Here we have chosen a relatively simple approach, being well aware of its weakness in that it does not decompose the total variation in stocks into orthogonal components of market, industry and stock-specific contributions. However, the method is very transparent and intuitively appealing and does the job of identifying the relative importance of stocks and industries in explaining total variation.

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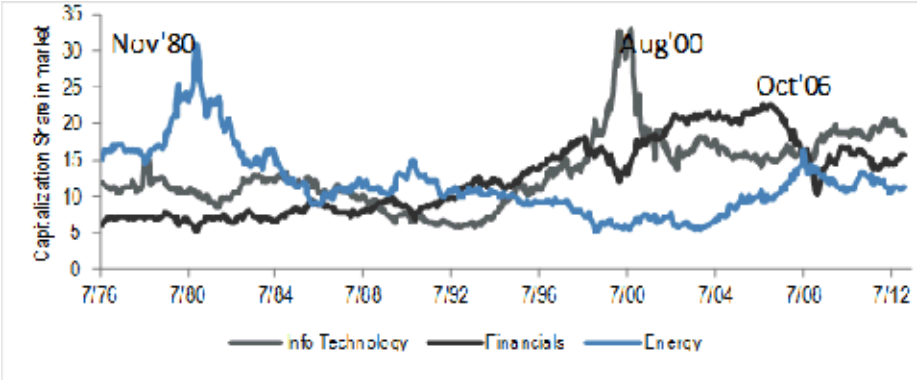
Figure 1: Major Industry Run-Ups over the Past Four Decades



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Methodology

In tracking the importance of industry in explaining variation of stock returns, we have used a simple decomposition approach proposed by Campbell et al. (2001, equation 14). Their approach, based on simplifying assumptions, decomposes weighted stock variance as the following:

Total Variance = Market Variance + Industry-Specific Variance + Stock-Specific Variance

$$\sum_{i=1}^{N} w_{it} \sum_{j=1}^{N_i} w_{jit}\, Var(R_{jit}) = \sigma_{mt}^2 + \sigma_{\epsilon t}^2 + \sigma_{\eta t}^2$$

N is the number of industries and w_{it} is the weight of the industry in the market. N_i is the number of stocks in industry i and w_{jit} is the weight of stock j in industry i. R_{jit} is the total return of stock j in industry i at time t. The left side of the equation is the weighted sum of the variance of individual stock returns. In other words, it can be thought of as the expected variance of all stocks in the market.

On the right hand side, σ_{mt}^2 is the variance of market return[4], $\sigma_{\epsilon t}^2$ is the weighted sum of industry-level idiosyncratic variance and $\sigma_{\eta t}^2$ is the weighted sum of stock-specific idiosyncratic variance.

$$\sigma_{\epsilon t}^2 = \sum_{i=1}^{N} w_{it}\, Var(R_{it}) - \sigma_{mt}^2$$

$\sigma_{\epsilon t}^2$ can be roughly interpreted as the difference between a weighted undiversified industry portfolio (assuming correlations between all industries equal one) and a diversified weighted industry portfolio, which is simply the market; it also captures the distribution of stock variances across the market. The market has lower variance than weighted sum of industry variances because the industry-idiosyncratic error has been "canceled" out or diversified away. Similarly, we proceed from industry to stock level by defining $\sigma_{\eta t}^2$ as the following:

[4] The decomposition exercise was run using total returns for S&P 500 stocks starting from January 1990. In all, there are more than 1200 distinct stocks in our universe, though in any given month we used the stocks that were members of the index at that point. The variance was calculated using a month worth of daily total returns.

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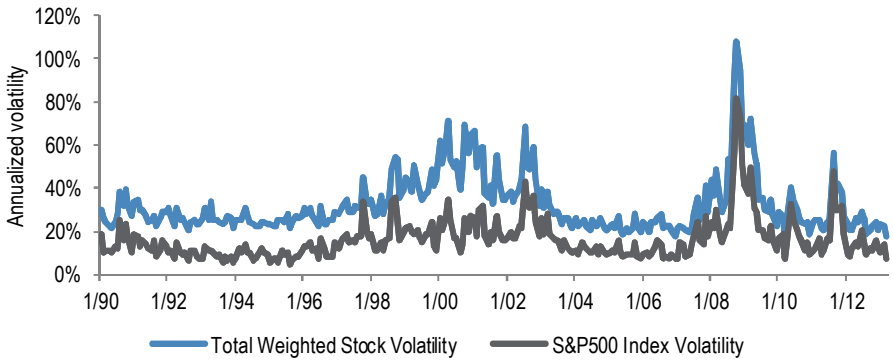
$$\sigma_{\eta t}^2 = \sum_{i=1}^{N} w_{it} \left(\sum_{j=1}^{N_i} w_{jit} \, Var(R_{jit}) - Var(R_{it}) \right)$$

The term $\sigma_{\eta t}^2$ has a similar interpretation – for each industry, the difference between the weighted sum of single stock variances and industry variance is the stock-specific idiosyncratic variance that diversifies away at industry level. More specifically, $\sigma_{\eta t}^2$ is the sum of the stock-specific idiosyncratic variances, weighted by industry weight in the market[5].

Takeaways

Using the above detailed methodology, Figure 2 below illustrates the total weighted stock volatility and market volatility over time. The gap between these two lines is the sum of idiosyncratic industry-specific variation and idiosyncratic stock-specific variation.

Figure 2: Historical Total Weighted Stock Volatility and Market Volatility



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Share of industry group-specific idiosyncratic variation remained relatively stable over the last 20 years, accounting for 21% of total variation on average

The exact decomposition of total weighted stock volatility depends on the level of disaggregation of industries (more on that a bit later). Figure 3 shows the share of total variation explained by the weighted sum of 24 industry-groups specific idiosyncratic variation. On average, over the period 1990-2012, industry group-specific variation accounted for 21.0%. It remained relatively stable throughout the history, with the exception of a few spikes concentrated during industry bubbles.

[5] A more recent paper by Bali et al. (2008) examines a similar decomposition method

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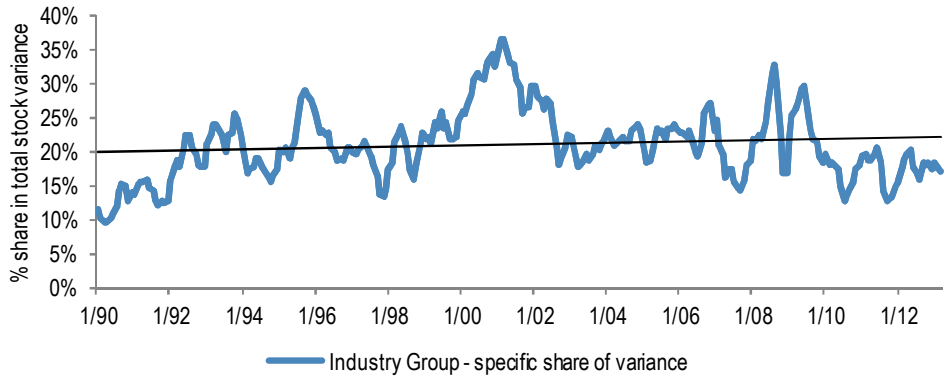
Figure 3: Share of Industry Group-Specific Idiosyncratic Variation Remained Stable over Time



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

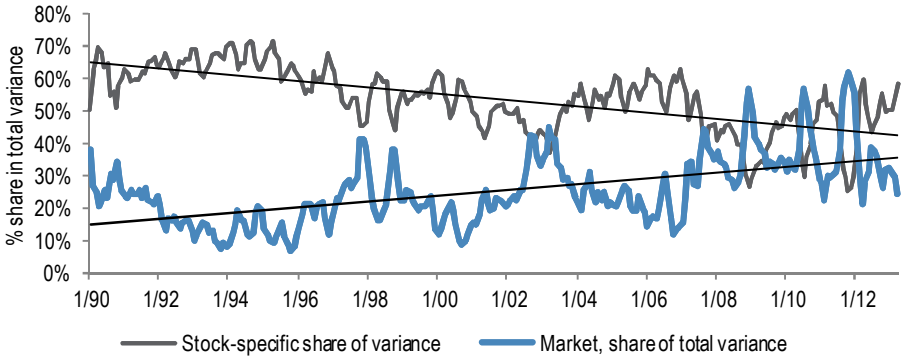
Stock-specific idiosyncratic variation on average represented 54% of total variation…

It is not surprising that stock-specific idiosyncratic error is by far the largest component of total variation, representing 53.8% on average over the sample history. Campbell et al. (2001) reported similar results over a longer horizon (1962 to 1997).

…however, it has been on a declining trend, while the contribution of market variation has exhibited a rising trend over the last 20 years

However, our findings depart from their long-term observations in one crucial aspect. While Campbell et al. found that the stock specific variation component was on a long term upward trend, we find that (at least for the S&P 500 universe), the share of stock-specific variation has been on a downward trend since the mid-90s. On the other hand, the contribution of market variance to total variance, averaging 25.2%, has exhibited a rising trend over that same time period. The rising share of market volatility during and arguably post-financial crisis period is reminiscent of the market level "risk-on, risk-off" paradigm that is commonly believed to have driven equity and other financial markets—see Figure 4.

Figure 4: Share of Stock-Specific Idiosyncratic Variation Falling; Share of Market Variation Rising



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Most sectors exhibited a downward trend in their respective stock-specific variance, with the exception of Energy, Financials, IT, and Health Care…

…suggesting these areas may offer greater opportunity for stock selection.

The same decomposition exercise was done at a more granular level to investigate stock-specific idiosyncratic variation trends within individual sectors. As expected, most of the 10 GICS Level I sectors exhibited a downward trend in their respective share of stock-specific variance. The only exceptions were Energy, Financials and IT which showed an upward trend in stock-specific variance (in part due to their industry-specific bubbles), while Health Care remained flattish throughout the history, suggesting these areas may offer greater opportunity for stock selection.

Furthermore, decomposition of sectors into 24 GICS Level II industry groups show a similar pattern – see Appendix for detailed charts displaying share of stock-specific variance relative to total variance by industry group. While this analysis suggests that decline in stock-specific variance is a relatively widespread phenomenon, it is however worth noting that several industries do exhibit varying and unique trends:

- The energy space has seen a relatively consistent and upward momentum in stock-specific variance since 2000—possibly driven by the marginal increase in demand from emerging markets.
- Among Financial industries, with the exception of Banks which have exhibited a relatively steady downward trend, the other industries have shown the contrary. Real Estate stood out in particular—its stock-specific variance has been on a steady rise since early ‘00s and not surprisingly has remained elevated post-2007.
- The IT sector has seen a relative sharp increase in the share of stock-specific variance post the '08 crisis, with Technology Hardware and Software Services being the main drivers, suggesting renewed interest in those respective industries.
- Within Consumer Discretionary, while the overall sector trend is down, for Consumer Services (Hotels, Leisure, Education) the trend is slightly up and Retailing has also turned up more recently after a long downward trend.

In our opinion at least, these trends are certainly worth tracking, as they may provide equity managers with indication as to where the most/least alpha opportunity may lie from a stock selection point of view.

Stock Idiosyncratic Variance and Pair Wise Correlations

In their paper, Campbell et al. noted the *falling* average pair wise *correlation* among stocks over the period 1962-1997 as an implication of *rising* stock-specific idiosyncratic *variance* even when the market variance has not increased. They note that “declining (stock) correlations allow the volatility of market portfolio to remain the same even if there is an increase in each individual stock’s volatility” (2001, pp.23).

The flip side of the declining stock-specific idiosyncratic variance is the rising average pair wise stock correlation

Since our research, however, indicates a *decline* in the relative share of stock-specific idiosyncratic variance during the last 20 years, it would imply that pair-wise correlation among individual securities should have been on a rise. In fact, as illustrated in Figure 5, that has been the case. The 52-week rolling pair-wise correlation has exhibited an upward trend since the early '90s, where both the shift in level as well as the instability of correlation post-2007 has been striking. For instance, pre-2006 the average correlation of 0.21 was just half the average of 0.41 in the post-2006 period.

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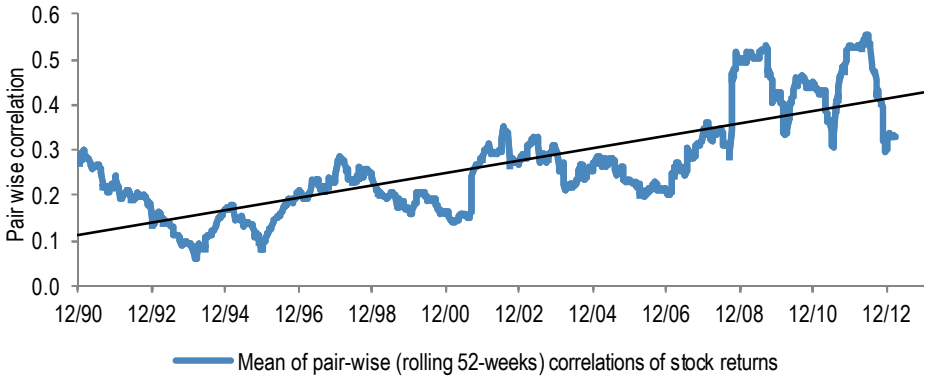
Figure 5: S&P 500 Pair-Wise Stock Correlation



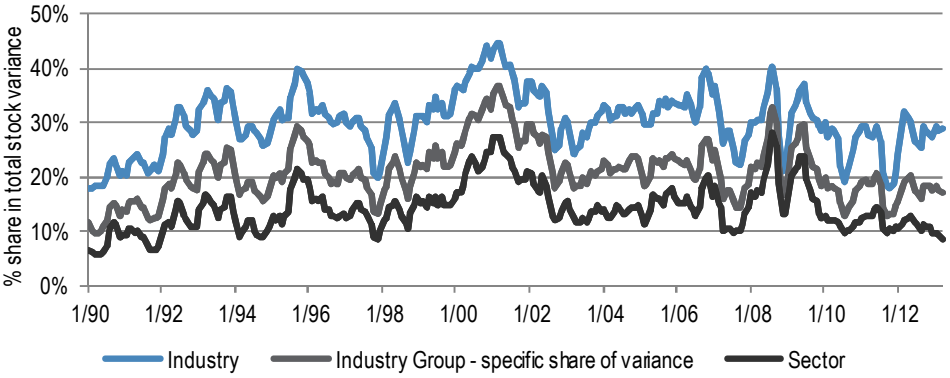
Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

The higher the industry aggregation the greater the diversification and the lower the share of industry-specific idiosyncratic variance relative to total variance

We now turn our attention to the level of aggregation of stocks into various industry levels and what it means for the relative size of industry-specific and stock-specific share of idiosyncratic variance. Sector or GICS Level I has just 10 buckets into which individual stocks are divided, industry group or GICS Level II has 24 buckets and industry or GICS Level III has 66 buckets.

As expected, the higher the aggregation the greater the diversification and the lower the share of industry-specific idiosyncratic variance—see Figure 6. At the highest level of aggregation, namely 10 sectors, average share of industry-specific idiosyncratic variance since 1990 is just 14.3%, while that for Level II (24 buckets) is 21.0% and at the most disaggregate Level III (66 buckets) the share rises to 30.2%.

Figure 6: Idiosyncratic Variation (or Variance) by Industry Levels – Higher Aggregation Implies More Diversification and Less Industry-Specific Idiosyncratic Variation



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Figure 6, also, shows that during the tech bubble (1997-2001) and the financial crisis (2007-2010) the share of industry-specific variation spiked. It is also interesting to note that during these periods of heightened anxiety and overall volatility, the share of market-specific variation has risen while that of stock-specific and, to a smaller extent, industry-specific share has fallen.

The volatility of total variance itself appears to be most driven by the market

Over the entire period, while stock-specific idiosyncratic variance represents the biggest contribution, the *volatility in total variance* itself appears to be most driven by the market. The average and standard deviation of the variance of market-specific, industry-specific and stock-specific components along with the total variance over the whole period is shown in Table 1.

Even though the market's average variance is much smaller than that of stock-specific (which also varies as a function of the level of industry disaggregation), the volatility of market-specific variation is greater than that of stock-specific variation. In fact, the market coefficient of variation is double that of stock, which is remarkably constant around the 0.8 level irrespective of industry disaggregation.

Table 1: Behavior of Variance Contribution

Total variation explained by Market, Industry, Stocks over 1990-2013				
		Average (μ)	Standard Deviation (σ)	Coefficient of Variation (σ/μ)
	Market	3.6%	6.3%	1.75
GICS Level I (10)	Sector	2.0%	2.5%	1.29
	Stocks	6.7%	5.4%	0.81
GICS Level II (24)	Industry Group	2.8%	3.3%	1.18
	Stocks	5.9%	4.7%	0.80
GICS Level III (66)	Industry	3.8%	4.0%	1.07
	Stocks	4.9%	4.0%	0.81
	Total	12.3%	13.0%	1.06

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Industry Co-Movements: Three Perspectives

Three approaches were used to examine co-movements among industries: correlation clustering, average pair wise time series correlations, cross sectional equality of means

Three approaches were used to examine co-movements among industries:

- We examine the *average pair-wise time series correlation* of excess returns of stocks within industries and across industries. This is useful in understanding which industries are more "tightly-knit", i.e. in which industries do stocks exhibit a higher degree of co-movement. It also provides us with a measure of how "close or far", on average, stocks of one industry tend to be from another industry.

- We report the *cross-sectional equality of means*[6] of each industry relative to other industries. This is a useful measure to identify which industries are

[6] The t-test statistics for equality of means, with unknown and possibly unequal variance, is given by:

$t\text{-}stat = (\overline{x}_1 - \overline{x}_2)/\hat{\sigma}$, where $\hat{\sigma} = \sqrt{\frac{s_1^2}{n_1 - 1} + \frac{s_2^2}{n_2 - 1}}$, $\overline{x}_i$ *and* s_i^2, $i = 1{,}2$ are the sample means and variances respectively. The *p-value* is the probability of observing the above t-stat or something more extreme if the null hypothesis (means are equal) is true. Lower p-value indicates that the likelihood of equal means is low (thus, higher likelihood of dissimilarity between sample means 1 and 2).

"outliers" in any point in time. By using a novel approach of framing the difference of industry returns in terms of probability (p-value), we are able to compare the resulting time-series of industries.

- We compare the correlation of standard capitalization weighted industry indices and identify which industries tend to *cluster* together.

We deem that information gleaned from these three approaches can help both from an alpha and from a portfolio risk management perspective.

Average Pair-Wise Correlations

Using average intra- and inter-pair wise correlations to examine cohesiveness within industries and co-movements among industries…

For each stock within an industry group, we calculate pair wise correlation using weekly excess returns with a look back period of 52 weeks, from 1990 to 2013. The calculation in any given week is only for stocks that are members of S&P500 index. For each industry group, we average the correlation of stocks within that group and that with every other industry group (24 in all). Table 2 shows a summary of the pair wise correlations[7].

Table 2: Intra and Inter-Industry Group Correlations

Industry	Mean Intra-Industry Pair Wise Correlation	Mean Number of Pairs	Max Inter-Industry Correlation with:	Min Inter-Industry Correlation with:
SemiSemiEq	0.43	83	TechHwEqp	Utilities
Utilities	0.42	509	FdBevTob	SemiSemiEq
Energy	0.40	464	Utilities	SemiSemiEq
RealEstate	0.39	35	AutoComp	TelecommSv
Banks	0.35	247	DivFinanci	SemiSemiEq
HHPrPdts	0.25	23	FdBevTob	SemiSemiEq
TelecommSv	0.24	47	Utilities	SemiSemiEq
AutoComp	0.23	31	CapitalGd	FdBevTob
FdBevTob	0.20	264	HHPrPdts	SemiSemiEq
Transptn	0.20	61	AutoComp	TelecommSv
Insurance	0.19	188	Banks	SemiSemiEq
DivFinanci	0.19	240	Banks	Utilities
Materials	0.18	814	AutoComp	TelecommSv
Retailing	0.16	310	ConDurAp	Utilities
TechHwEqp	0.14	293	SemiSemiEq	Utilities
HcEquipSvc	0.14	263	PhrmBioLfS	SemiSemiEq
CapitalGd	0.14	858	AutoComp	TelecommSv
PhrmBioLfS	0.13	178	HcEquipSvc	AutoComp
ConDurAp	0.13	221	AutoComp	Utilities
Food/StplR	0.12	67	FdBevTob	SemiSemiEq
Media	0.11	120	ConsSrv	PhrmBioLfS
ConsSrv	0.10	57	ConDurAp	Energy
SftwSvcs	0.09	240	SemiSemiEq	Utilities
CommProfSe	0.06	60	CapitalGd	TelecommSv

Highest intra-industry pair wise correlation: Semis, Utilities, Energy, Real Estate

Least intra-industry pair wise correlations: Commercial & Professional Services, Software Services, Consumer Services, Media

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

There are several points we draw the readers attention to – some unsurprising, others surprising to us:

[7] Recall that these correlations are for excess return, i.e. stock return less market return. We did a similar exercise calculating excess return by subtracting equal weighted returns of all the stocks in S&P500. The table using equal weighted excess return is very similar to Table 2 and is available on request.

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1. The ranking order based on intra-industry group correlations appears unrelated to any typical classification of industries. For instance, in the top 4 we have Semiconductors, a highly cyclical industry and Utilities, a defensive or non-cyclical industry. On the other hand, Technology Hardware and Software are less cohesive industry groups than most – that surprised us. We were not, however, surprised to find that stocks in Commercial and Professional Services were least correlated – it is a very diverse sector.

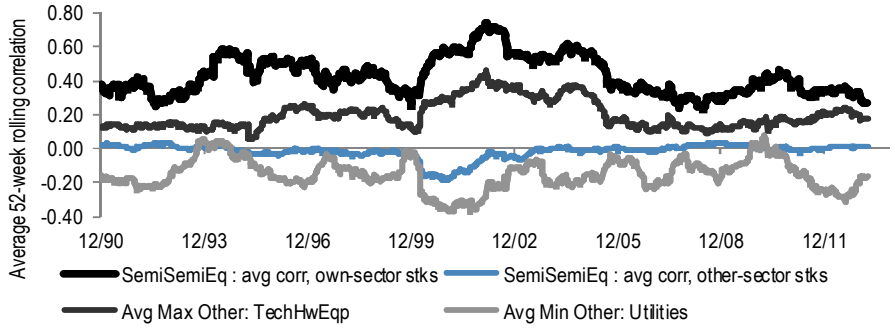
2. The pairing of industries, based on inter-industry correlations, is less surprising. Defensive stocks appear to gravitate towards defensive stocks – for instance stocks across defensive industries (Utilities, Food, Beverages & Tobacco, and Household Products) are closely related. Cyclical stocks are more correlated to cyclical stocks – Tech Hardware and Semis are close, Transportation and Auto industries are close. No surprises here. Indeed this provides rationale for the way Level I sector is aggregated from Level II industry groups.

3. Among the least related stocks (column five in the table), two industries loom large – Semis and Utilities. Semis show up 9 times as least correlated stocks with primarily defensive industries, while Utilities 6 times with cyclical industries. As such, stocks in these industries could act as good diversifiers.

4. Furthermore, on a time-series basis, the rolling correlation rankings are relatively stable. For instance, Semis are outlined in Figure 7, which shows four rolling correlations of excess returns – on top is the Semi intra-industry group correlation, which lingers at the ~0.3 level. Next is Semis correlation with their closest cousin – Tech Hardware and Equipments. The average correlation with all industries combined is close to zero. The correlation with Utilities (the farthest industry) is almost always negative.

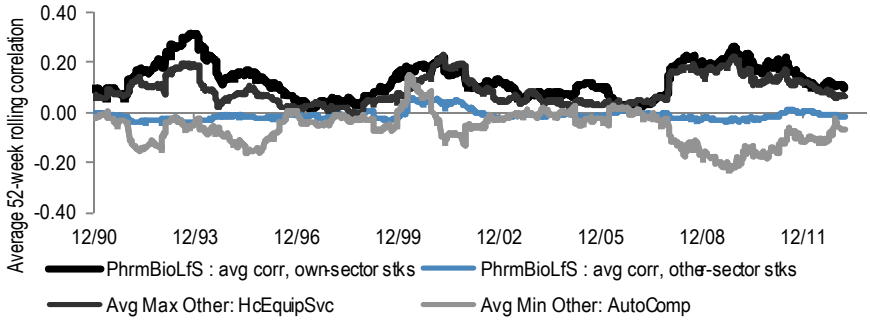
   As another example Figure 8 shows the same correlation analysis for the Pharma industry group. It is interesting to note that the inter-industry group correlation tends to rise around recessions (1990, 2000, 2008) – potentially suggesting investors getting more "industry conscious" in these periods. The rolling correlation charts for all other industries are located under Appendix.

Figure 7: Semiconductor and Semi Equipment: Closest to Tech Hardware, Farthest from Utilities



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Figure 8: Pharmaceuticals and Bio Life Sciences: Closet to HealthCare, Farthest from Auto



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

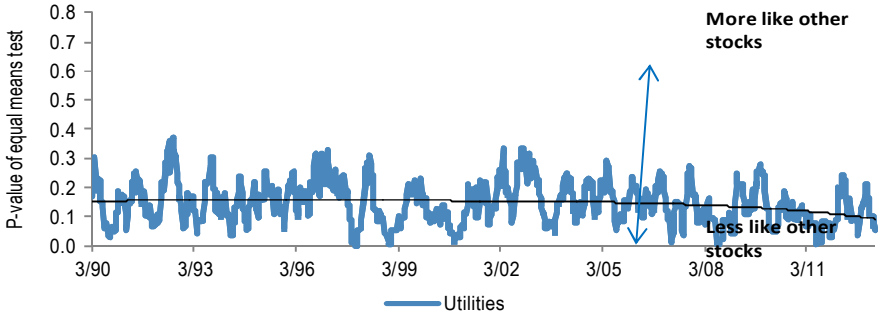
5. As one might expect, the degree of cohesion (size of mean pair wise correlation) is a function of the GICS level aggregation. The higher the level of aggregation (GICS Level I), the lower the level of intra-industry correlations. While intra-industry correlations for Level II are shown in Table 2, the correlations for Level I can be viewed in Appendix.

Cross-Sectional Equality of Means

Using cross sectional equality of means test to examine an industry's *similarity* to the rest of the market...

In this section, instead of examining rolling correlations over time we use the average cross-sectional returns of stocks within an industry to identify industries that are behaving "more like rest of the stocks in the market" or differently. What is novel about this approach is that we can visually track when an industry is breaking away from the rest of the pack fairly early – we use weekly returns to calculate the average return and then use a *t-test for equal means* to compare an industry's own average return with the ex-industry (or market) average return. For example, to take an extreme case, Figure 9 shows the time series of P-values from the t-test with the hypothesis being that the average return of Utilities stocks is equivalent with the rest of the stocks in the market.

Figure 9: Utilities Stock Returns - Lowest Probability of Fitting in with Rest of Market



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Another interesting example is Tech Hardware, where a stock's average return has a low probability of being similar to rest of the market stocks, even though the probability does exhibit a cyclical pattern. Here we can clearly see the tech bubble beginning around 1994 (as the probability of similarity diminishes), peaking in 2001, deflating thereafter. The P-value of Tech Hardware remains below pre-1994 level

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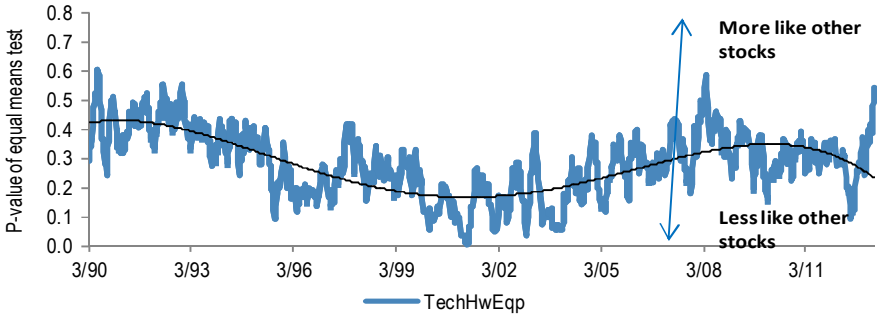
though during the 2008 financial crisis, stocks in this industry did become more associated to the market – see Figure 10.

Figure 10: Tech Hardware Reverts to being an Outlier after 2008 Crisis



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Table 3 summarizes the average P-value for each industry group – where, again, low value implies *low probability* of average stock return within an industry being similar to the broader market, and vice-versa. Additionally, Table 3 contains the current 3 month average P-value – it is interesting that the returns behavior of many typically outlier industry groups (Semiconductors, Utilities, Tech Hardware, Banks) is more alike the overall market as of late.

Table 3: Lower the P-value of an Industry, Lower the Probability of its 'Similarity' with Market

Least similar, on average, industries to the market: Utilities, Energy, Banks, and Semi

…industries most similar to the market: Commercial & Professional Services, Consumer Services, Auto & Components, and Food & Staples Retailing

	Average P-Value	Last 3-months (Jan-Mar 2013)
Utilities	0.15	0.19
Energy	0.15	0.33
Banks	0.18	0.38
SemiSemiEq	0.23	0.40
FdBevTob	0.24	0.37
Materials	0.25	0.33
DivFinanci	0.25	0.35
Insurance	0.27	0.39
HcEquipSvc	0.27	0.34
PhrmBioLfS	0.28	0.34
TechHwEqp	0.28	0.36
CapitalGd	0.28	0.34
Retailing	0.29	0.38
TelecommSv	0.29	0.22
RealEstate	0.30	0.23
HHPrPdts	0.32	0.19
SftwSvcs	0.34	0.20
Transptn	0.34	0.21
ConDurAp	0.35	0.31
Media	0.35	0.28
Food/StplR	0.35	0.54
AutoComp	0.37	0.46
ConsSrv	0.39	0.39
CommProfSe	0.44	0.05

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

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Industry Clusters – Benefiting from Correlations

We study the benefits of using correlations to form industry clusters

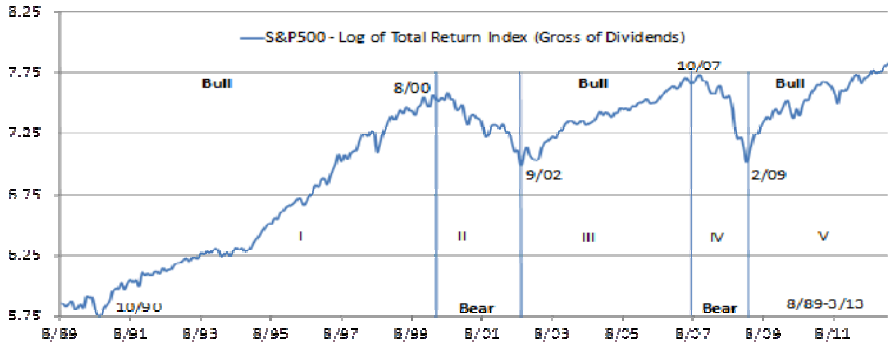
Our final exploration of inter-industry co-movement is at the traditional market capitalization industry level. Unlike the previous two investigations of co-movement that were primarily at stock level (within industry), in this section we have used weekly performance of S&P500 industries' total return indexes. There are three questions we primarily explored:

- Do the correlation clusters of industries depend on whether we are in a bull or bear market?
- What are some potentially alternative approaches to grouping stocks and industries? For instance we examine finer disaggregate industries and show that we can aggregate these back up into larger meaningful groups in a 'smarter' way using a statistical clustering approach.
- Can correlations among industries be exploited in forming alpha strategies? We illustrate an example of a strategy that exploits mean-reversion properties among highly correlated industries.

Industry clustering may present an alternative and economically meaningful way of grouping industries, leading to a potentially more efficacious way of allocating risk within an investment process

To check if the market cycle matters for industry clustering we divided the historical period, 1990-2013, into two parts: periods when the stock market was trending up and periods when it was declining. While this was done with pure benefit of hindsight, it does not violate the purpose of this exercise. Figure11 shows the bull and bear phases.

Figure 11: Bull and Bear Periods of S&P500 Used for Creating Industry Clusters



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Furthermore, Figures 12 and 13 each illustrate a dendrogram of clusters[8] formed among industry groups based on pair wise correlations. The approach, essentially, uses correlations to measure distance between two industry groups – higher the correlation, closer the industries (as illustrated by the height of the box connecting the industries in the Figures 12 and 13; lower distance is equivalent to higher correlation). Then the next closest industry to each of the initial groups is identified and a second and more aggregate group is formed. The process is repeated until all

[8] Please see footnote of Figure 14

industries fall under various levels of clusters, resulting in a hierarchical tree structure or dendrogram[9].

Some initial observations based on correlation based industry clustering

Some initial observations based on the below dendrograms:

- A lot of the usual suspects clustered together during bull and bear periods. Tech Hardware and Semiconductors, Banks and Diversified Financials, Food, Beverages & Tobacco and Household Products are the three most integrated pairs. Health Care Equipment & Services and Pharmaceuticals are also close and are closer to the consumer staples block.

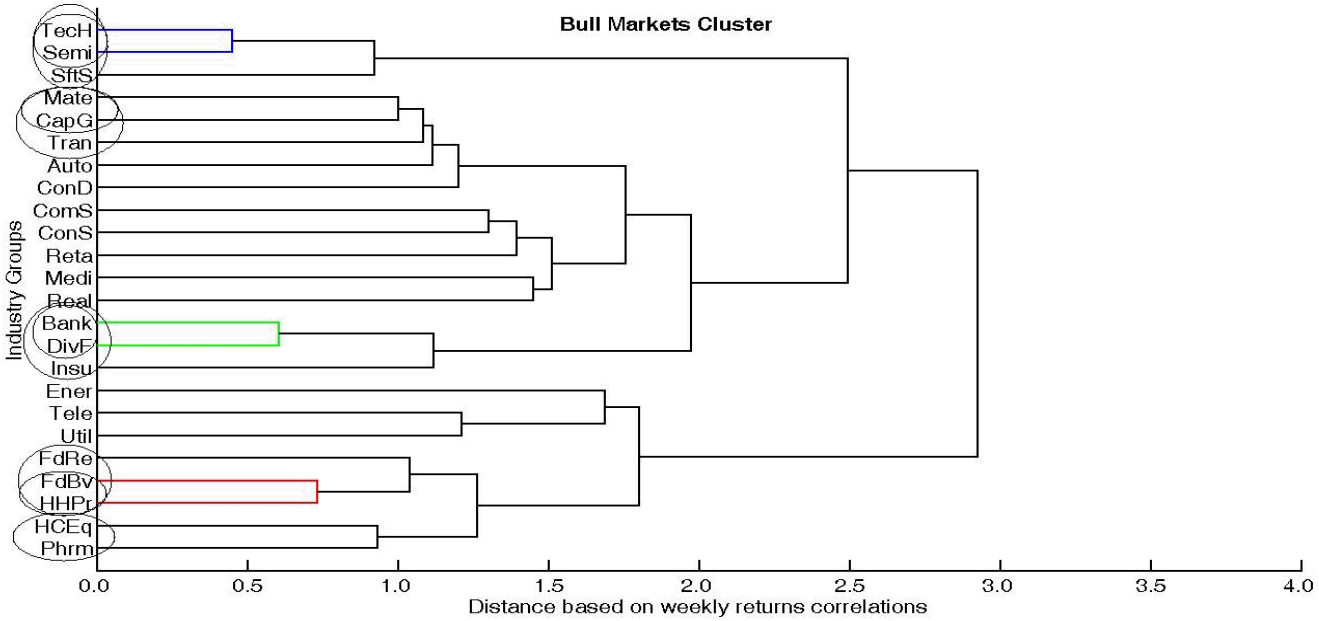
- Tech space, in general, is somewhat isolated as its correlation distance from the rest of the industry groups is relatively far during bull and, especially, bear markets.

- Energy, similarly, sticks out some as a lonely child, especially in bull markets, as its correlation distance to the closest industry pair is the farthest relative to all other pairs. Additionally, it is interesting to note that during both bull and bear markets, Energy gravitates closer to defensive industries.

- When comparing bull to bear markets, it is interesting to observe that while correlation among the less aggregated clusters is higher during bear periods, correlation among the more aggregated clusters is lower during those same periods. This potentially suggests that a clustering approach could be used to introduce a higher degree a diversification within an investment process.

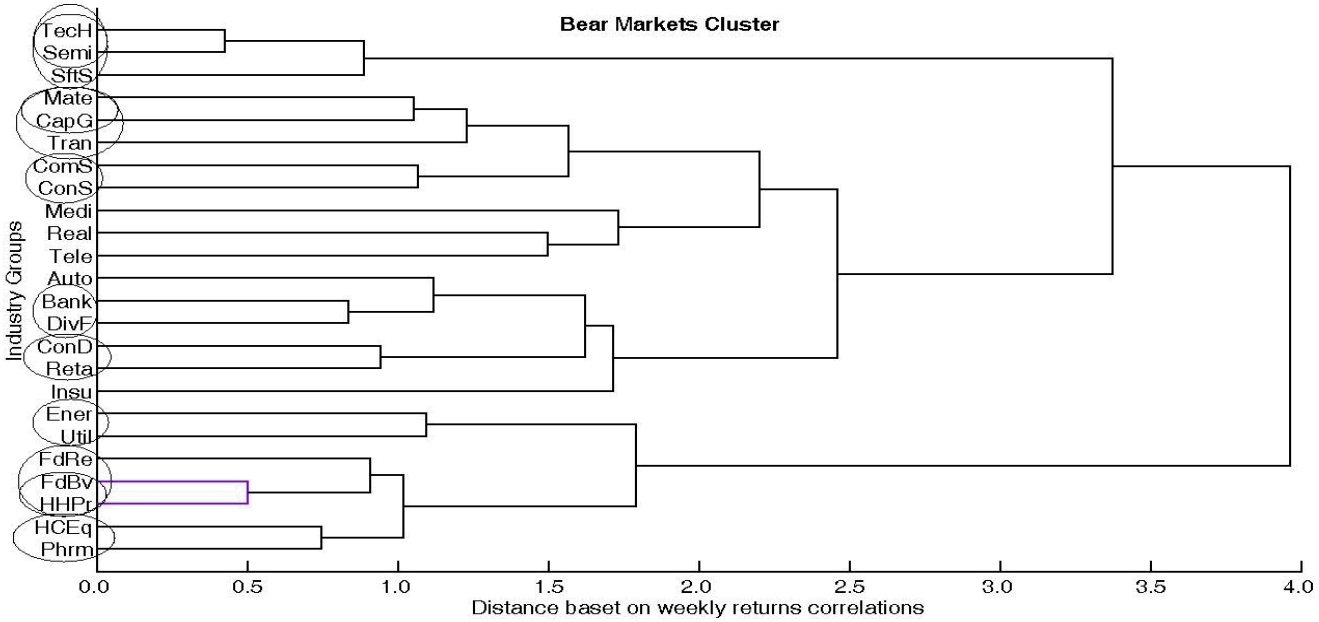
[9] A cluster can be defined as one or more industries that are closest to each other based on inter-correlations, as measured by the Euclidean distance. By successively adding clusters, a hierarchical tree structure (dendrogram) is built, as shown in Figures 12, 13, and 14. The distance between clusters is represented by the length of the line(s) parallel to the x-axis of the dendrogram. The leaves (industries) connected by immediate branches are more similar to each other, while leaves (industries) connected by distant branches are less similar. Essentially, the resulting tree gives a quick visual representation of the similarities and dissimilarities among all industries based on their pair wise correlations.

Figure 12: Industry Group Clusters Based on Correlation of Weekly Returns (Bull Market)



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Figure 13: Industry Group Clusters Based on Correlation of Weekly Returns (Bear Market)



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Industry clusters during both bull and bear markets appear to be similar

In general, the joint behavior of industries during bull and bear markets does not appear to be much different. Most of the clusters are intact. This is reassuring and suggests that, in general, strategies that *rely on the joint behavior* of industries do not necessarily need to be significantly conditioned based on the market phase.

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Industry Clusters – Get Smart

It might make sense to re-construct larger industry clusters from finer sub-groups of industries…

Earlier in the report we drew attention to GICS Level II industry groups whose stocks showed low intra-industry correlation (please see Table 2). This begs the question: does it make sense to examine finer sub-groups of those industries to reconstruct more coherent larger industry clusters? We think there is definitely potential for that.

Obviously joint correlation is just one way of putting groups or clusters together. Essentially we are using the *distance* between total return correlations to decide which industries should be grouped together. In this sense, our clusters express backward looking joint price or return movement.

One could, also, use other more current factors, such as leverage (debt-to-equity) to group industries together and then express a view on leverage in a rising rates environment by underweighting more leveraged group of industries and overweighting less indebted group of industries. Similarly, in a rising growth environment, a group/cluster of industries with higher operational leverage would be preferred over those with lower operational leverage. We plan to examine this approach in more depth in our subsequent reports.

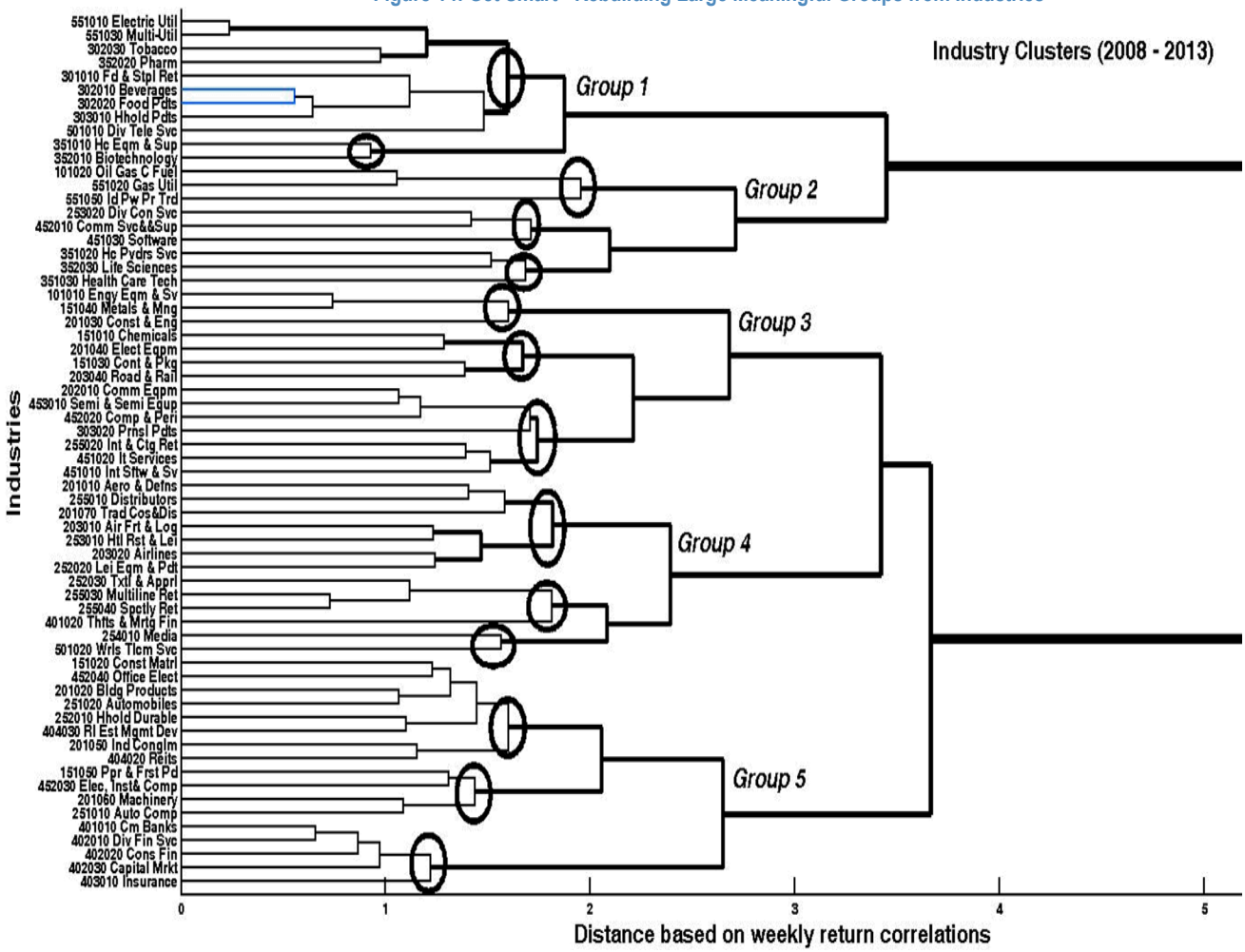
In the meanwhile, return based clusters is not a bad place to start. As we have shown earlier, return based clusters have been relatively stable in the past. Besides, price discovery typically captures most available information in the market. Therefore, any return-based clusters should play an important role when creating aggregate unconventional industry groups. With this in mind, we used GICS Level III industries as the building units for creating larger groups.

A shorter, 5 year, history was used as many smaller and/or newer industries, like internet software, do not have longer histories going back to 1990s. With 5 years of history we were able to use a correlation matrix based on 64 industries. For those interested in what full history (1990-2013) correlation-based clusters would look like, please turn to Appendix where the cluster map uses the full history but is based on only 46 industries.

Defensiveness and cyclicality characterize the correlation-based clusters

We have used the distance between the "tree-like-linkages" that connect industries upstream into 5 major groups—see Figure 14. While the groupings may be somewhat arbitrary, there is economic reason behind them. The industries along the top of the vertical axis slide from deeply defensive (Group 1), to moderate defensives (Group 2), to early cyclicals (Group 3), to consumer (or mid-cycle) cyclicals (Group 4), and to deeply (late cycle) cyclicals (Group 5). In a sense, return correlations neatly tie up with our intuitive notion of how the market "hangs together".

Figure 14: Get Smart - Rebuilding Large Meaningful Groups from Industries



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies
Note: Numerical value next to industry abbreviation is the GICS Level III code.

In order to analytically characterize the correlation based clustering, we illustrate selected common financial ratios for the five groups. Figure 15 reports the market beta (relative to S&P500, 1/08-4/13), dividend yield, 12-month forward price earnings, expected long term growth, expected ROE and Debt/Equity.

The broad characteristics of the groups are in line with the earnings cycle. The deep defensives have the lowest beta, highest dividend yield, relatively lower expected long-term growth rates and high leverage. Market beta rises as we move toward cyclical, where Group 5 has the highest beta of 1.33. Dividend yield is the highest for Group 1 and 2, consistent with our description of them as defensives. Group 5 or late cyclicals appear relatively cheapest, a bit worrisome since that usually happens at the peak of the cycle. Group 3 and Group 4 have the highest expected long-term growth rate – again consistent with our description of them as early to mid-cycle industries. High financial leverage resides at the extremes, namely Group 1 and Group 5.

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Figure 15: Clusters and Their Characteristics - From Deep Defensives to Deep Cyclicals

Group 1: Deep Defensives

301010 Fd & Stpl Ret
302010 Beverages
302020 Food Pdts
302030 Tobacco
303010 Hhold Pdts
352020 Pharm
501010 Div Tele Svc
551010 Electric Util
551030 Multi-Util

351010 Hc Eqm & Sup
352010 Biotechnology

- Dominated by Consumer Staples, Utilities, HealthCare - good Group to hide in a storm
- Lowest Market Beta = 0.73
- Highest dividend payers, Dividend Yield = 2.8%
- Relatively expensive, forward PE= 16.5
- Expected LongTerm Earnings Growth = 8.7%
- Solid Fwd ROE = 18.3%
- Leverage is high with Debt/Equity = 82.7%

Group 2: Shallow Defensives

101020 Oil Gas C Fuel
551020 Gas Util
551050 Id Pw Pr Trd

253020 Div Con Svc
451030 Software
452010 Comm Svc&Sup

351020 Hc Pvdrs Svc
351030 Health Care Tech
352030 Life Sciences

- A mix of big Oil, higher Beta Utilities like Gas and Independent Power Providers plus higher Beta Health Care. Also, what is Software doing in this Group? Recall half of Software is the lower Beta, aging giant MSFT
- Market Beta = 0.96
- Average Dividend Yield = 2.0%
- Cheaper than Group 1, forward PE = 15.5
- LongTerm Growth about same as Group 1 = 8.7%
- Projected ROE below Group 1 = 15.3%
- But so is leverage, with Debt/Equity ratio = 62.7%

Group 3: Early Cyclicals

101010 Engy Eqm & Sv
151040 Metals & Mng
201030 Const & Eng

151010 Chemicals
151030 Cont & Pkg
201040 Elect Eqpm
203040 Road & Rail

202010 Comm Eqpm
255020 Int & Ctg Ret
303020 Prnsl Pdts
451010 Int Sftw & Sv
451020 IT Services
452020 Comp & Peri
453010 Semi & Semi Equp

- Industries in this Group smell growth early and move early - many Materials industries (Metals & Mining, Chemicals), lots of IT(Semis, IT Services, Internet Software, Internet Retailing), and Capital Goods (Elect Equip, Const&Engineer)
- Market Beta = 1.04
- Includes many dividend payers; still relatively lower Dividend Yield = 1.8%
- Slightly cheaper than Group 2, forward PE = 15.2
- Better LongTerm expected growth than defensives = 12.0%
- Good ROE = 18.3%
- But leverage is relatively lower with Debt/Equity = 47.0%

Group 4: Mid-cycle Consumer Cyclicals

201010 Aero & Defns
201070 Trad Cos&Dis
203010 Air Frt & Log
203020 Airlines
252020 Lei Eqm & Pdt
253010 Htl Rst & Lei
255010 Distributors

252030 Txtl & Apprl
255030 Multiline Ret
255040 Spctly Ret
401020 Thfts & Mrtg Fin

254010 Media
501020 Wrls Tlcm Svc

- Group 4 is stuffed with Consumer-based industries: Hotels, Airlines, Leisure Equipment, Retailing, Media, Wireless Telecom, Thrift&Mortgage. We cannot figure out why Aerospace & Defense is doing in this Group - perhaps exposure to Auto industry?
- Market Beta middling = 1.01
- Average Dividend Yield = 2.0%
- Relatively expensive forward PE = 16.9
- Expected LongTerm growth is solid = 12.5%
- High expected ROE = 23.6%
- Middling leverage Debt/Equity = 69.8%

Group 5: Deep Late Cyclicals

151020 Const Matrl
201020 Bldg Products
201050 Ind Conglm
251020 Automobiles
252010 Hhold Durable
404020 Reits
404030 Rl Est Mgmt Dev
452040 Office Elect

151050 Ppr & Frst Pd
201060 Machinery
251010 Auto Comp
452030 Elec, Inst& Comp

401010 Cm Banks
402010 Div Fin Svc
402020 Cons Fin
402030 Capital Mrkt
403010 Insurance

- A motley bunch but common theme is that they are likely to benefit late in the cycle. The Group includes Materials (Construction Material, Paper), Industrials (Machinery, Electric Instruments,Conglomerates), Consumer Discretionary (Auto & Comps, Household Durables) and most of the Financial Sector including Real Estate. The last fact may reflect the effect of the financial bubble and its bursting.
- Highest Market Beta = 1.33
- Relatively lower Dividend Yield = 1.8%
- Look cheapest on forward PE = 13.0
- Unimpressive LongTerm Growth = 10.0%
- Equally unexciting forward ROE = 13.5%
- Very high leverage Debt/Equity = 100.8%

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

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A Practical Example: Exploiting Joint Industry Behavior for Alpha Generation

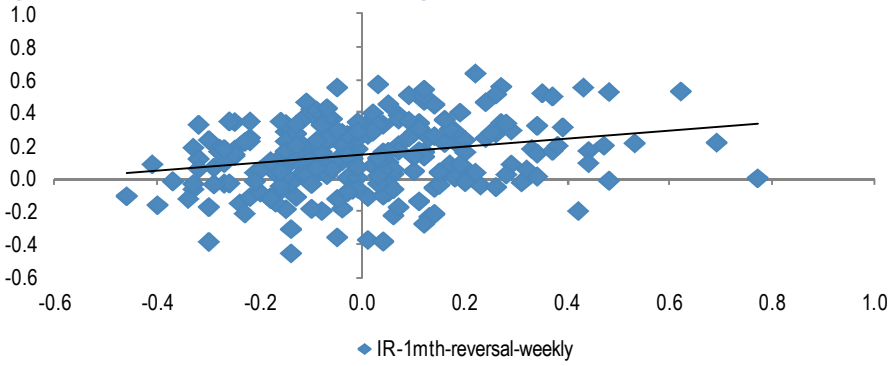
Is efficacy of mean reversion between two industries related to their pair wise correlation?

How can the joint behavior of industries be exploited for alpha generation? Here we give one simple and practical example. Industries that are positively correlated, particularly those that are *co-integrated*, are likely to exhibit mean reverting behavior. To test this idea we back-tested mean reversion on all possible pairs of industry groups (GICS Level II).

Figure 16 plots the Information Ratio (IR) of each pair strategy versus its respective pair correlations[10]. Clearly, the higher the correlation, the higher the respective pair strategy's IR is. Furthermore, the IR of strategies with pair correlations above 0.3 is almost always positive.

Yes, higher the pair wise correlation, stronger the efficacy of a mean reversion based industry strategy

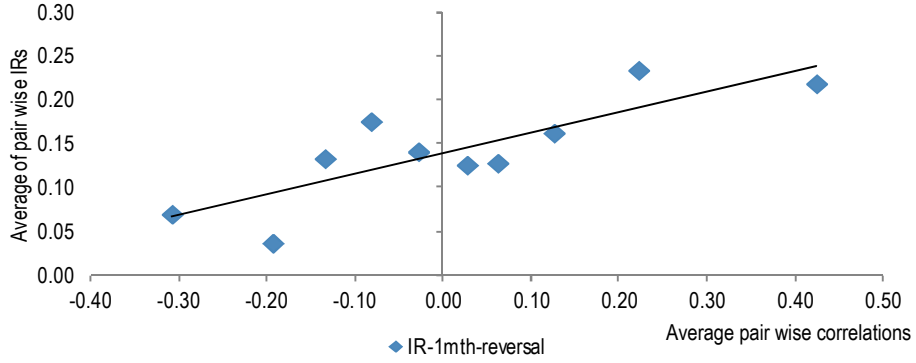
Figure 16: Reversal Individual Pair Trade IR against Excess Return Pair Correlation



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Figure 17 presents the same analysis by first dividing the pair correlations into ten equal buckets and then averaging the IR for each bucket – the positive relationship (between IR and pair correlation) persists, with all buckets exhibiting a positive IR.

Figure 17: Reversal Bucket Pair Trade IR against Excess Return Pair Correlation

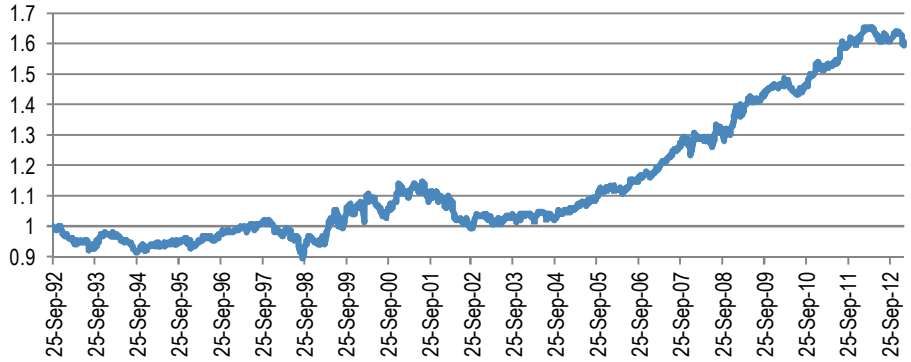


Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

[10] Correlation is computed based on an industry group's excess return

Lastly, we combined all mean reversion pairs with correlation above 0.3 to create a basket trade, with each pair equally weighted. The hypothetical cumulative total return of a dollar invested in such a strategy is shown in Figure 18. The result would have been IR of 0.5 with fairly consistent performance.

Figure 18: Composite Reversal Pair Trade Strategy Hypothetical Cumulative Returns (IR 0.5; Correl Cutoff 0.3)



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

Sectors or Industries: Can Macro Help Discriminate?

One of the key reasons for modeling industry rotation is to optimally incorporate top down macro and industry specific information as an input into predicting relative stock return. One could also use an industry rotation model as an independent alpha source that could potentially be uncorrelated with other asset classes in the portfolio.

In the previous section we saw that greater the industry disaggregation, the smaller the size of stock-specific variation in making stock calls, while greater is the variation contribution of industry component. This implies that ideally we should choose more granular disaggregation of industry—Level II or Level III or even finer. However, there is likely to be a trade-off between the greater opportunities associated with higher level of disaggregation (the spread of industry portfolios' returns is wider) and our ability to forecast those portfolios based on macro trends.

One way to estimate the size of the trade-off is to examine the correlation of macro variables with different levels of industry disaggregation. To that note, we took ten macro variables – 5 related to growth and 5 related to inflation – and examined their correlation with sector, industry group and industry portfolios. As is well known the stock market tends to lead macro variables; in fact, most leading indicators of growth and inflation have one or more financial prices as a component of the indicator. As an example, consider the ISM Manufacturing New Orders Index, a fairly good leading indicator of economic growth in the US. Figure 19 shows lead/lag correlation of one-month change in this indicator and the S&P 500 Index monthly return.

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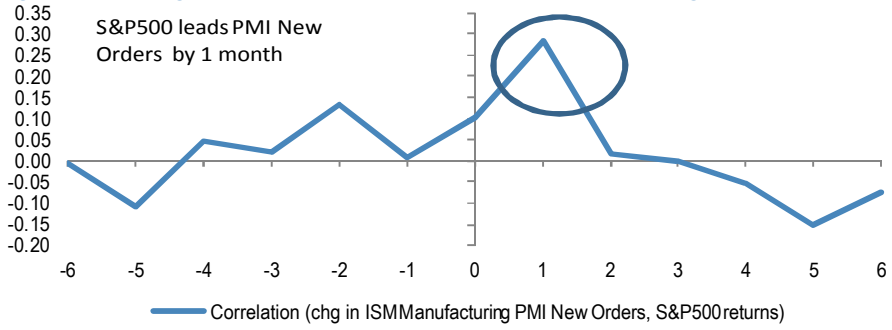
Figure 19: Lead/Lag Relationship between S&P 500 and ISM Manufacturing New Orders Index



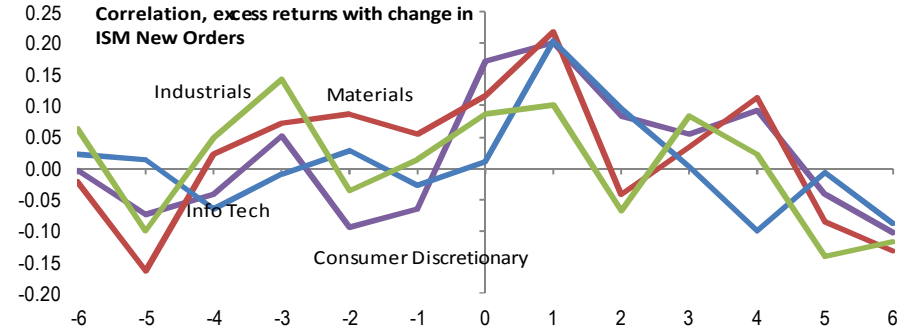
Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

In order to examine the ability of ISM New Orders indicator to discriminate relative performance of sector indices, we examine the lead/lag correlations of excess returns of sector indices and macro indicator. The simple idea is that the larger the dispersion of ISM New Orders' leading correlation with sector excess returns, the better that this indicator can predict relative performance of the sector.

Macro indicators have some predictive power for discriminating across industries

Figures 20 and 21 illustrate the lead/lag of excess returns of ISM with cyclical and defensive sectors respectively. As expected, the cyclical sectors have generally positive correlations with the ISM indicator, while the defensive sectors have generally negative correlations. Like was the case with the market (S&P500), even the sector excess returns, to a large extent, anticipate the change in ISM index. However, the lead time over ISM index is one month (where month = -1) for Materials and Industrials. Even though the sizes of the correlations appear small, for financial time series these are statistically meaningful. Based on statistical distribution of correlation coefficients, the coefficient of 0.09 for Materials has a t-stat of 1.46, while the coefficient of 0.14 for Industrials with a lag of 3 months (where month = -3) has a t-stat of 2.41.

Figure 20: ISM New Orders Discriminates Cyclical Materials and Industrials, but not Info Tech and Consumer Discretionary



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

For defensives, HealthCare, Utilities and Telecom excess returns correlation with respect to change in ISM New Orders is around -0.10 (where month = -2) with t-statistics around 1.70.

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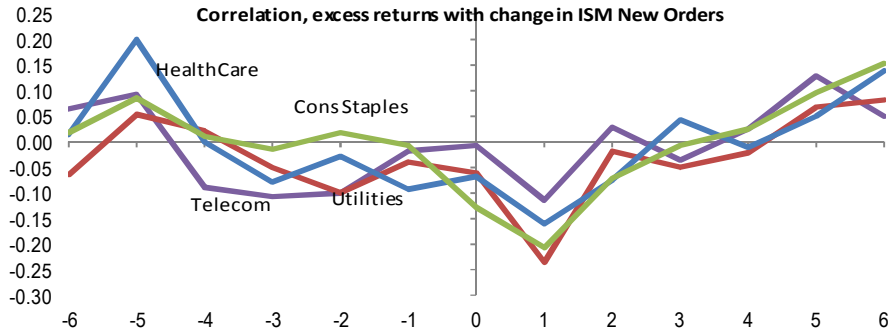
Figure 21: ISM New Orders Discriminates Defensives HealthCare, Utilities and Telecom, but not Consumer Staples



Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

To sum up the effectiveness of the ISM New Orders index as a discriminating factor for relative performance of sector, we took the standard deviation of the correlation as the summary statistic. In the case of ISM New Orders, the standard deviation over 10 sectors works out to 10.1%. We repeated the same exercise for 23 industry groups and 45 industries. To keep the correlations and summary statistics comparable we excluded industries where the return data was not available for the entire time period – see Table 4.

On average, macro indicators discriminate across GICS Level II industries slightly better than at Level I or Level III

Table 4: Standard Deviation of Correlations between Macro Indicators and Excess Return of Industries at Each GICS Level – Results are Similar though Level II has a Small Edge

(09/1989 to 03/2013)	Sectors (GICS Level 1)	Industry Groups (GICS Level 2)	Industries (GICS Level 3)
ISM Manufacturing PMI New Orders	10.1%	9.8%	9.3%
Yield Curve (10 Yr - 3 M)	7.9%	7.7%	8.9%
Moody's BAA-AAA Spread	14.8%	15.0%	14.0%
Conference Board LEI (YoY)	8.1%	8.9%	9.1%
Initial Jobless Claims (4 Wk Avg)	10.9%	10.7%	10.1%
PPI (YoY, SA)	8.6%	9.5%	9.2%
CPI (YoY, SA)	9.5%	10.7%	9.7%
CRB Commodity Price (YoY)	9.6%	9.3%	9.4%
ISM Business Price	11.5%	9.8%	9.5%
Michigan 1 Yr Ahead Inflation Expectation	7.5%	8.7%	8.8%
Average	*9.8%*	*10.0%*	*9.8%*

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

In conclusion, given the slightly higher average standard deviation of correlation (macro indicators versus industries), Level II disaggregation has a small edge in discriminating across industries as compared to Level I and Level III, though the difference is not very significant.

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Appendix

A: GICS Industry Classifications (Level I, II, III)

Sector	Industry Group	Industry
10 Energy	1010 Energy	101010 Energy Equipment & Services
		101020 Oil, Gas & Consumable Fuels
15 Materials	1510 Materials	151010 Chemicals
		151020 Construction Materials
		151030 Containers & Packaging
		151040 Metals & Mining
		151050 Paper & Forest Products
20 Industrials	2010 Capital Goods	201010 Aerospace & Defense
		201020 Building Products
		201030 Construction & Engineering
		201040 Electrical Equipment
		201050 Industrial Conglomerates
		201060 Machinery
		201070 Trading Companies & Distributors
	2020 Commercial & Professional Services	202010 Commercial Services & Supplies
		202020 Professional Services
	2030 Transportation	203010 Air Freight & Logistics
		203020 Airlines
		203030 Marine
		203040 Road & Rail
		203050 Transportation Infrastructure
25 Consumer Discretionary	2510 Automobiles & Components	251010 Auto Components
		251020 Automobiles
	2520 Consumer Durables & Apparel	252010 Household Durables
		252020 Leisure Equipment & Products
		252030 Textiles, Apparel & Luxury Goods
	2530 Consumer Services	253010 Hotels, Restaurants & Leisure
		253020 Diversified Consumer Services
	2540 Media	254010 Media
	2550 Retailing	255010 Distributors
		255020 Internet & Catalog Retail
		255030 Multiline Retail
		255040 Specialty Retail
30 Consumer Staples	3010 Food & Staples Retailing	301010 Food & Staples Retailing
	3020 Food, Beverage & Tobacco	302010 Beverages
		302020 Food Products
		302030 Tobacco
	3030 Household & Personal Products	303010 Household Products
		303020 Personal Products
35 Health Care	3510 Health Care Equipment & Services	351010 Health Care Equipment & Supplies
		351020 Health Care Providers & Services
		351030 Health Care Technology
	3520 Pharmaceuticals, Biotechnology & Life Sciences	352010 Biotechnology
		352020 Pharmaceuticals
		352030 Life Sciences Tools & Services
40 Financials	4010 Banks	401010 Commercial Banks
		401020 Thrifts & Mortgage Finance
	4020 Diversified Financials	402010 Diversified Financial Services
		402020 Consumer Finance
		402030 Capital Markets
	4030 Insurance	403010 Insurance
	4040 Real Estate	404010 Real Estate -- Discontinued 04/28/2006
		404020 Real Estate Investment Trusts (REITs)
		404030 Real Estate Management & Development
45 Information Technology	4510 Software & Services	451010 Internet Software & Services
		451020 IT Services
		451030 Software
	4520 Technology Hardware & Equipment	452010 Communications Equipment
		452020 Computers & Peripherals
		452030 Electronic Equipment, Instruments & Components
		452040 Office Electronics
	4530 Semiconductors & Semiconductor Equipment	453010 Semiconductors & Semiconductor Equipment
50 Telecommunication Services	5010 Telecommunication Services	501010 Diversified Telecommunication Services
		501020 Wireless Telecommunication Services
55 Utilities	5510 Utilities	551010 Electric Utilities
		551020 Gas Utilities
		551030 Multi-Utilities
		551040 Water Utilities
		551050 Independent Power Producers & Energy Traders

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

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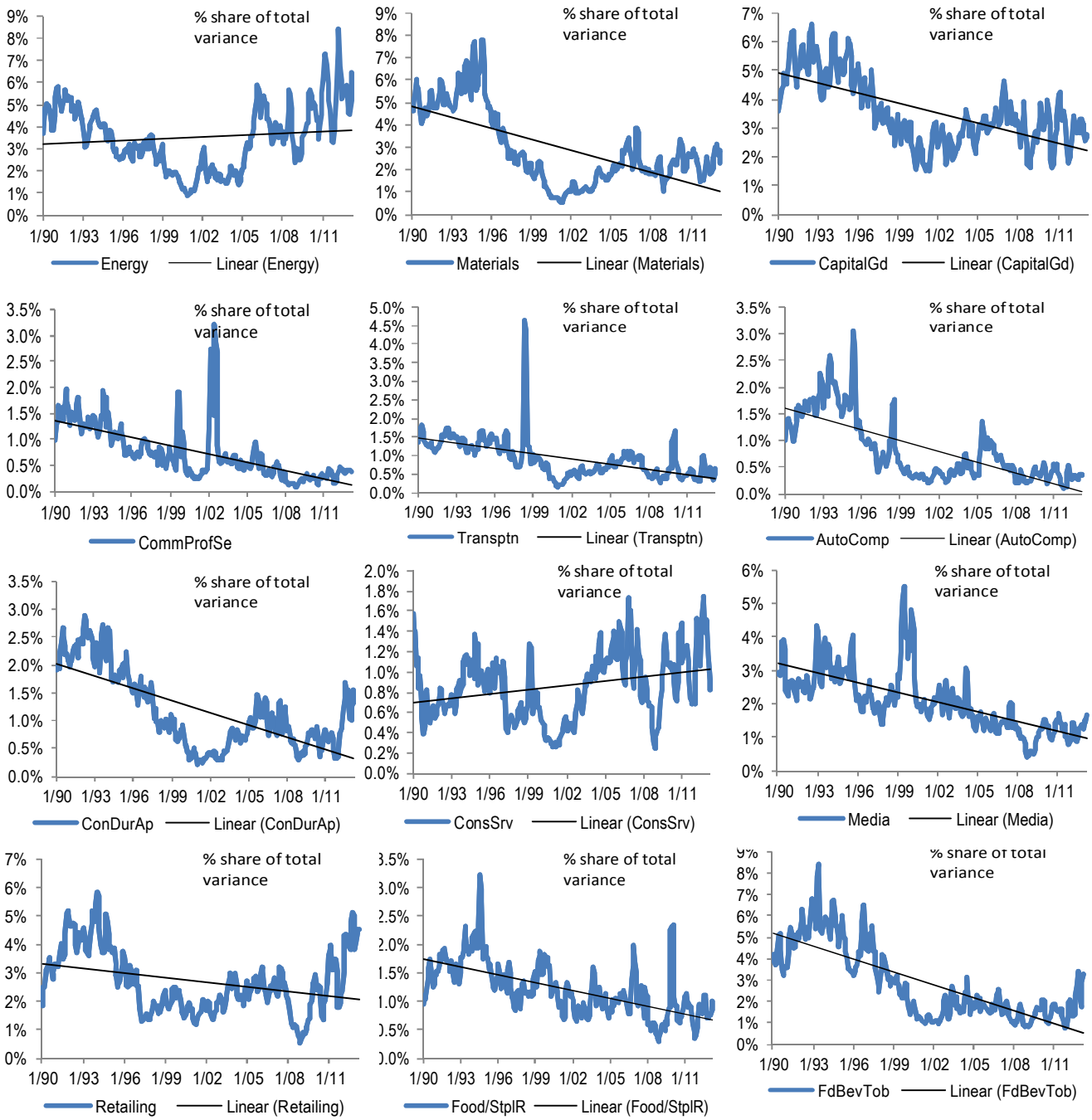
B: Share of Stock-Specific Idiosyncratic Variance – by Industry Groups



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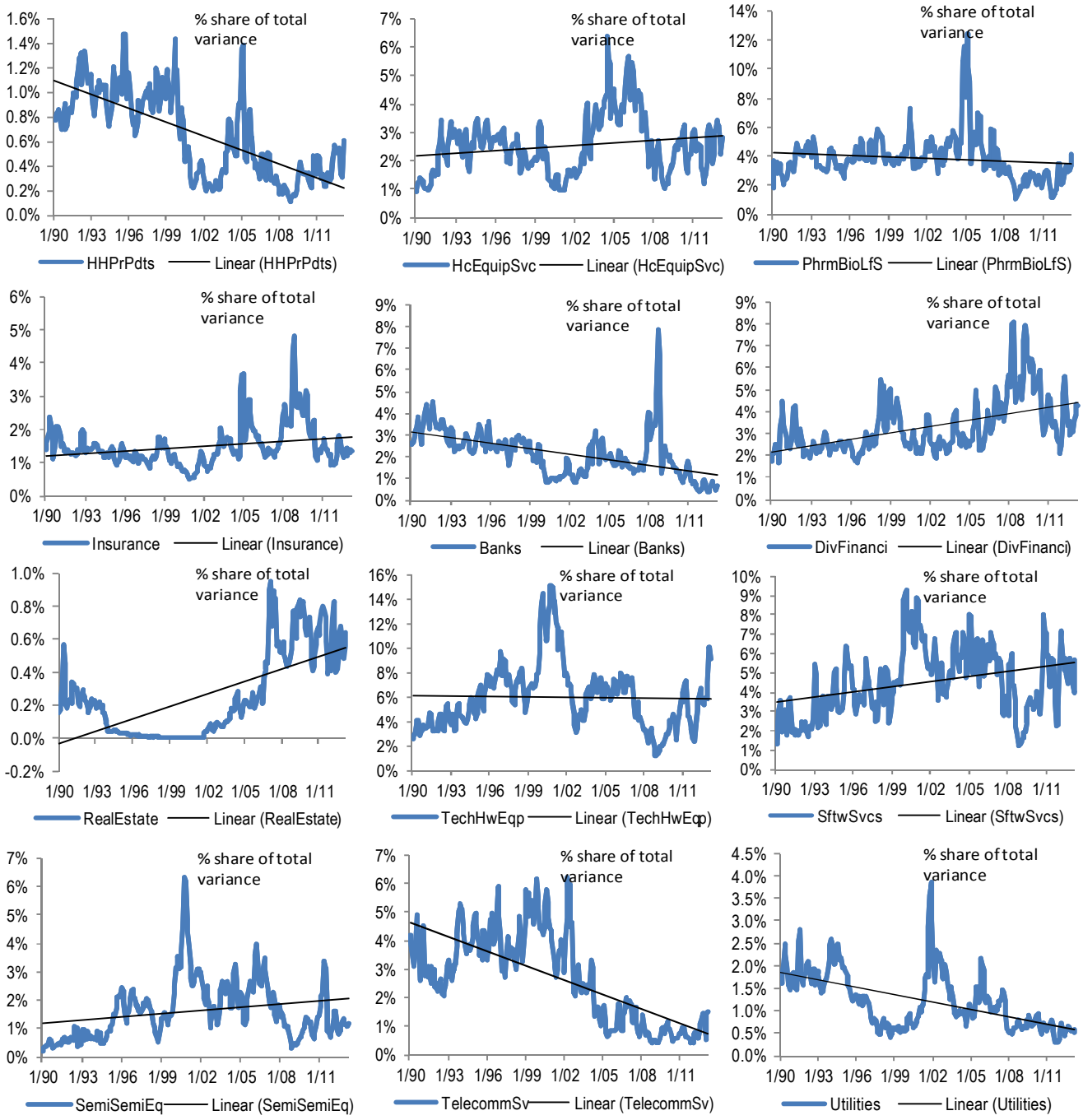

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

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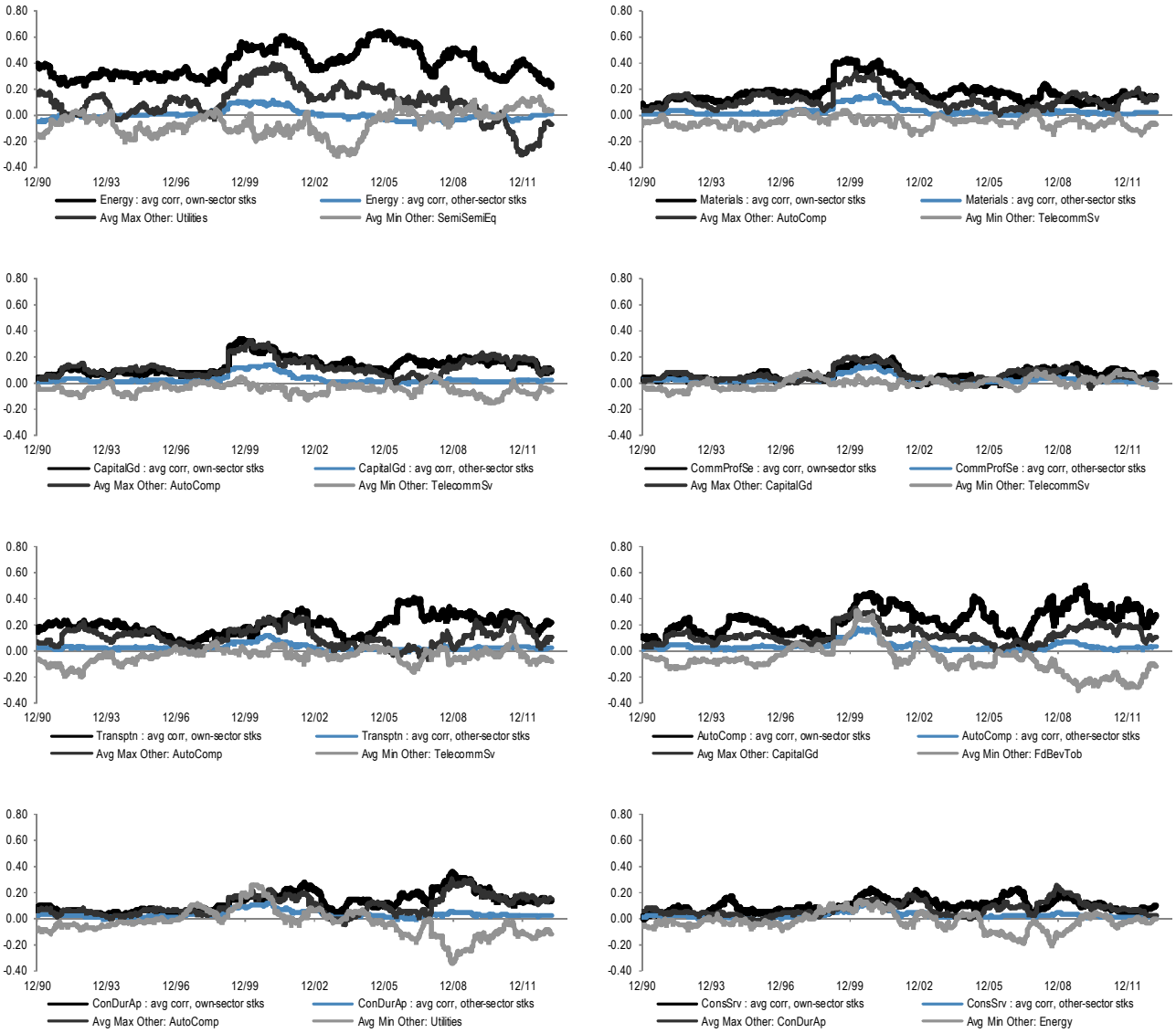
C: Intra- and Inter-Sector Stock Correlations

Industry	Mean Intra-Industry Pair	Mean Number of Pairs	Max Inter-Industry	Min Inter-Industry Correlation with:
Energy	0.40	464	Utilities	Info Tech
Telecom Services	0.24	47	Utilities	Materials
Materials	0.18	814	Industrials	Telecom Srv
Financials	0.15	2511	Cons Discret	Info Tech
Consumer Staples	0.15	887	Utilities	Info Tech
Info Tech	0.14	1713	Cons Discret	Utilities
Health Care	0.11	890	Cons Staples	Info Tech
Industrials	0.10	2071	Materials	Telecom Srv
Consumer Discretionary	0.08	3261	Industrials	Utilities

D: Intra- and Inter-Industry Group Time-Series Correlations



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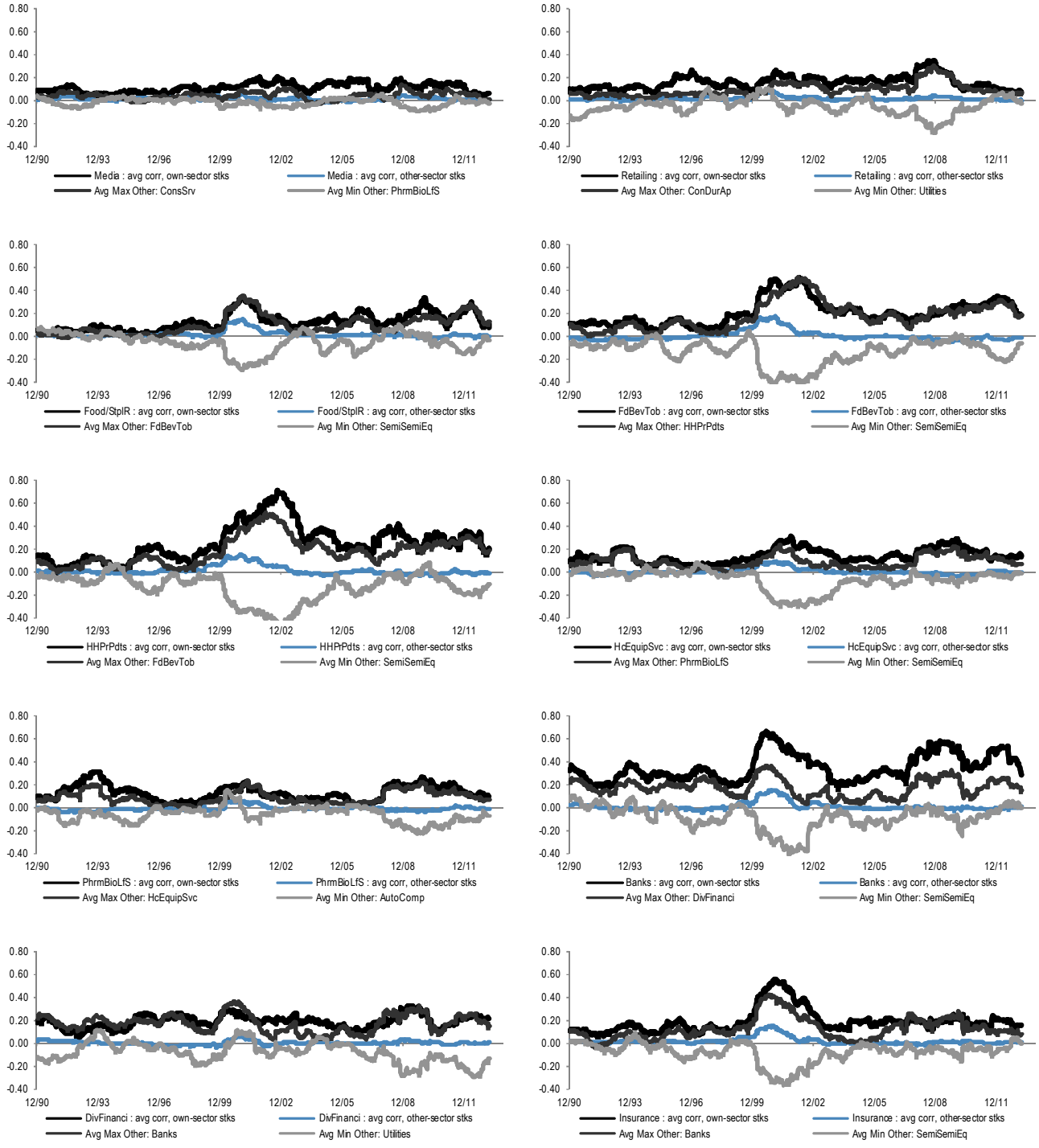

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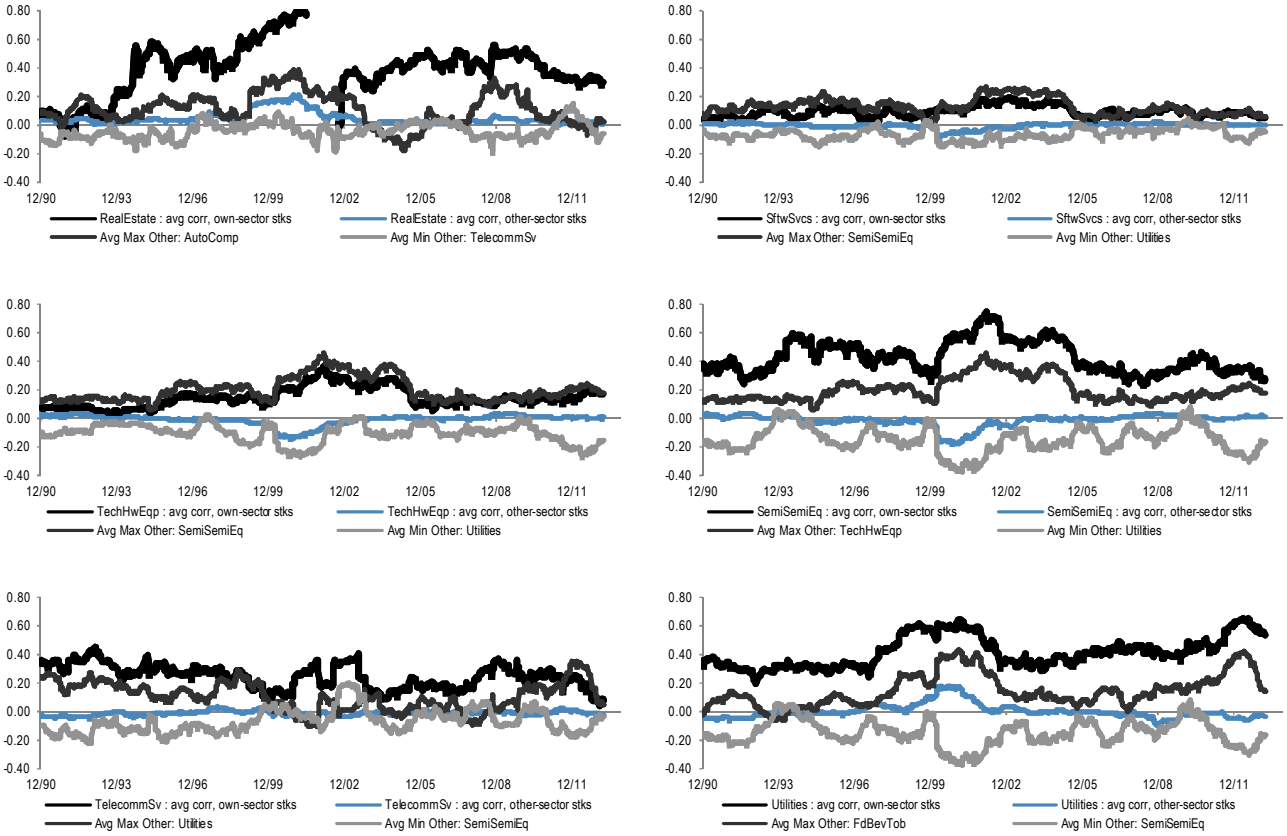

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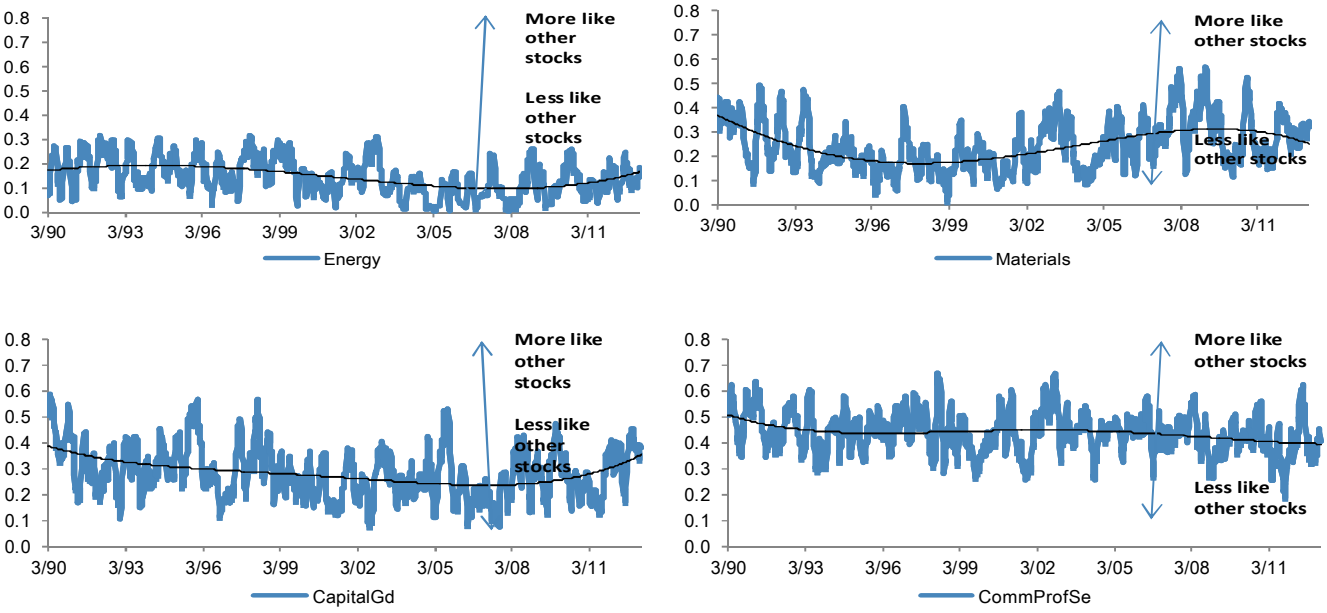
E: Cross-Sectional Equality of Means Test Analysis



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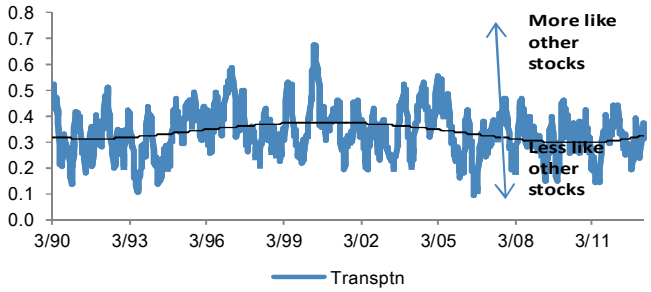

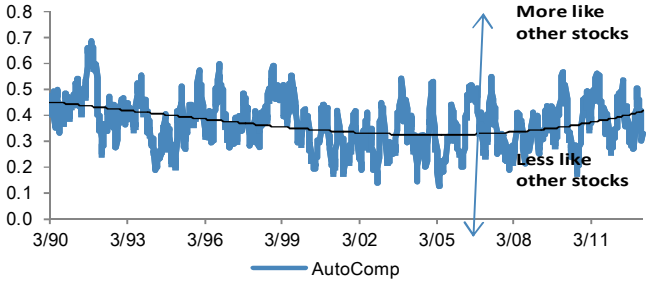

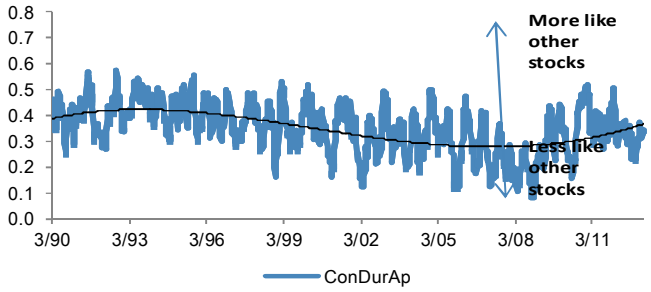

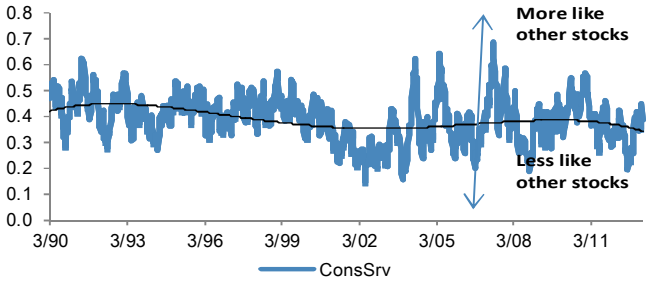

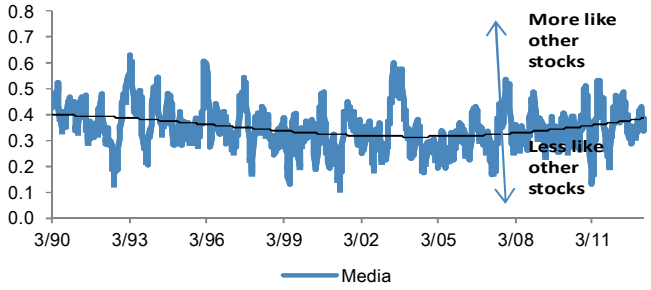

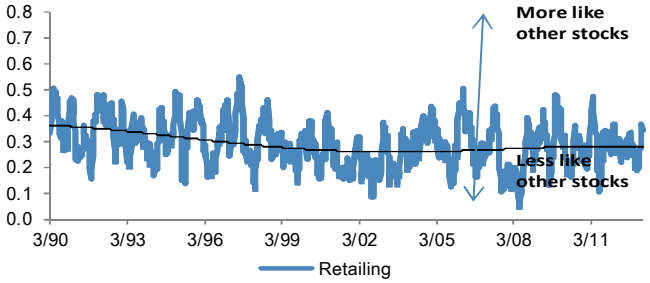

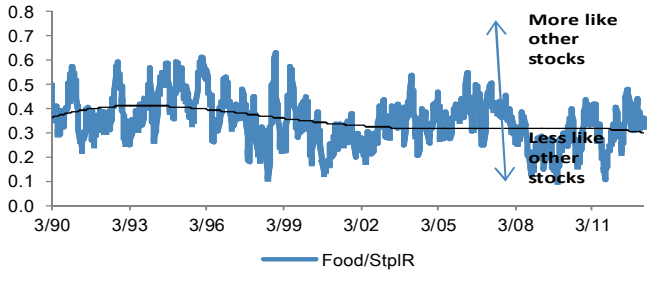

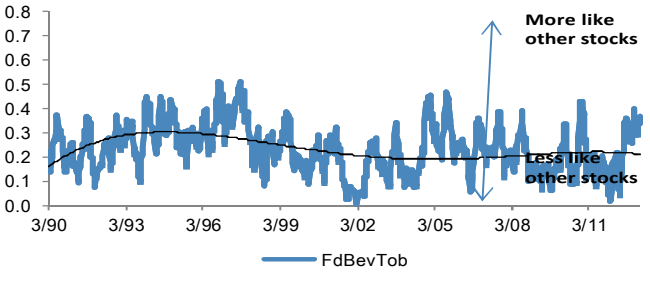

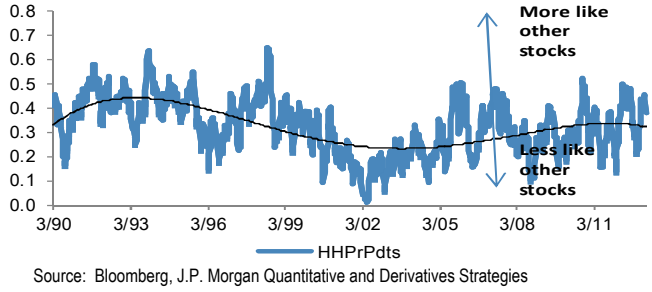

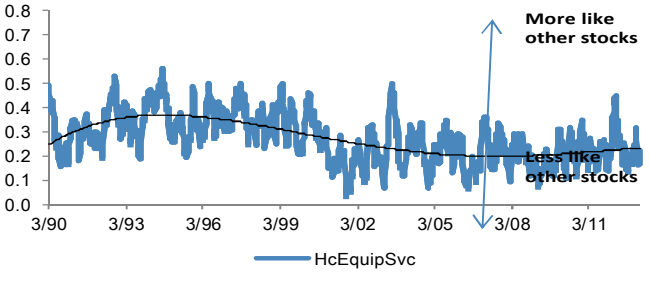

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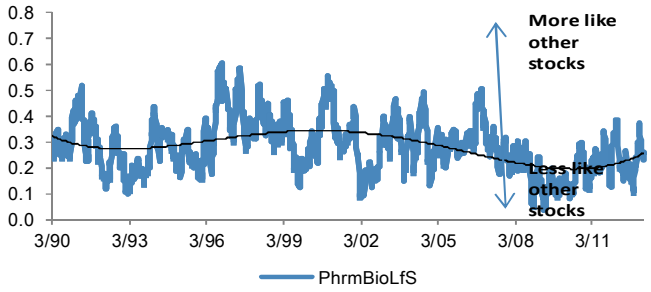

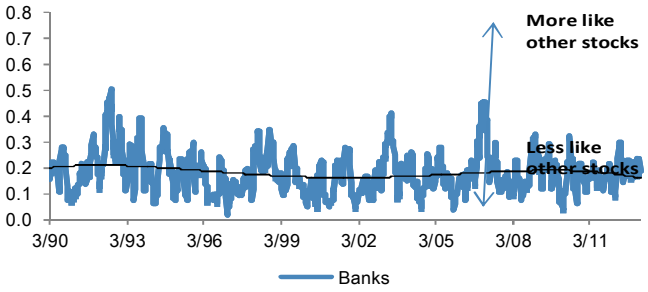

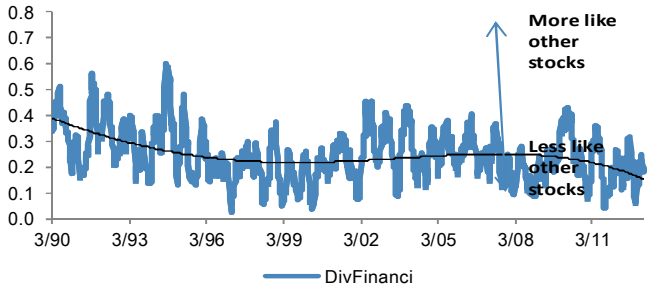

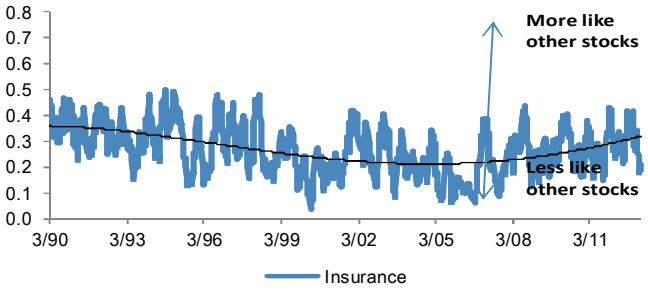

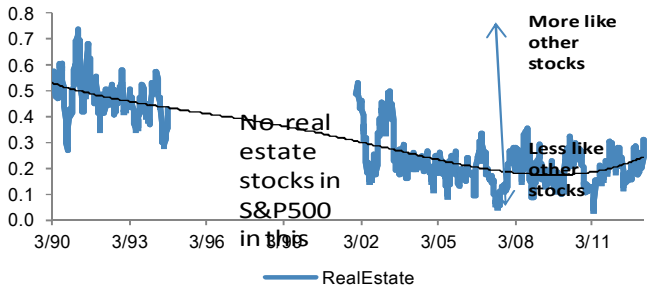

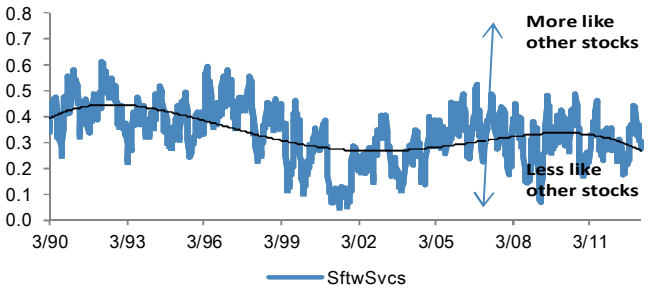

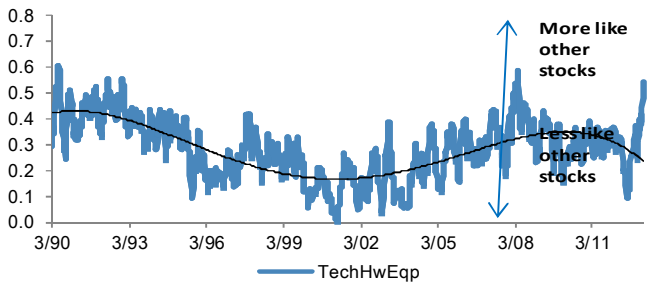

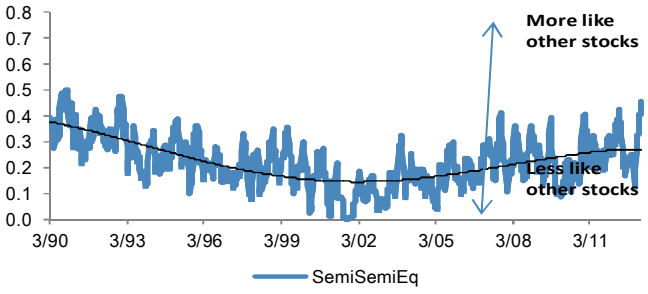

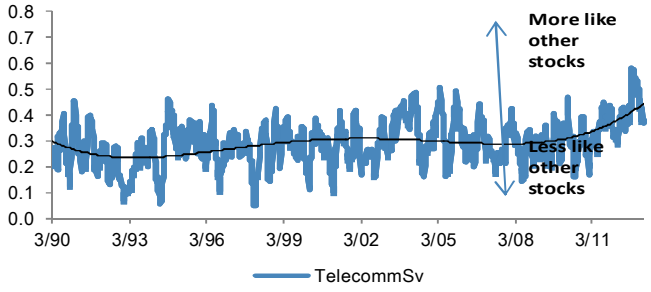

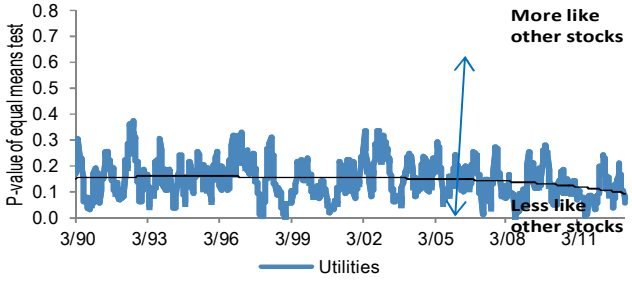

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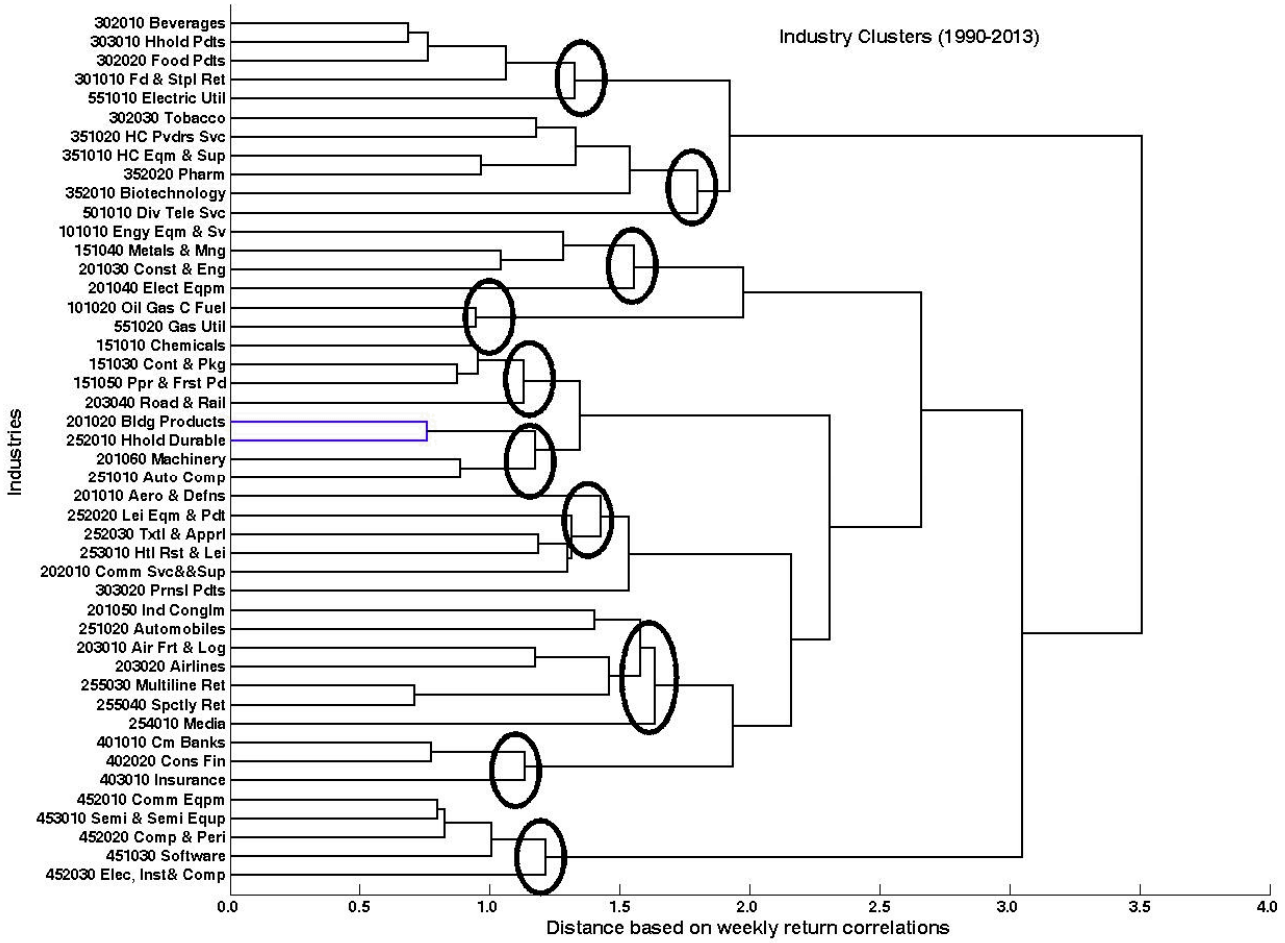
F: Industry Clusters (1990–2013)



Industry Clusters: 1990-2013

302010 Beverages	101010 Engy Eqm & Sv	201020 Bldg Products	201050 Ind Conglm	452010 Comm Eqpm
303010 Hhold Pdts	151040 Metals & Mng	252010 Hhold Durable	251020 Automobiles	453010 Semi & Semi Equp
302020 Food Pdts	201030 Const & Eng	201060 Machinery	203010 Air Frt & Log	452020 Comp & Peri
301010 Fd & Stpl Ret	201040 Elect Eqpm	251010 Auto Comp	203020 Airlines	451030 Software
551010 Electric Util			255030 Multiline Ret	452030 Elec, Inst& Comp
	101020 Oil Gas C Fuel	201010 Aero & Defns	255040 Spctly Ret	
302030 Tobacco	551020 Gas Util	252020 Lei Eqm & Pdt	254010 Media	
351020 HC Pvdrs Svc		252030 Txtl & Apprl		
351010 HC Eqm & Sup	151010 Chemicals	253010 Htl Rst & Lei	401010 Cm Banks	
352020 Pharm	151030 Cont & Pkg	202010 Comm Svc&&Sup	402020 Cons Fin	
352010 Biotechnology	151050 Ppr & Frst Pd	303020 Prnsl Pdts	403010 Insurance	
501010 Div Tele Svc	203040 Road & Rail			

Source: Bloomberg, J.P. Morgan Quantitative and Derivatives Strategies

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