

## Stock Selection: Research and Results September 2016

### *Predicting Stock-Level Volatility: High Vol Today, Low Vol Tomorrow?*

#### *Predictable Volatility: Oxymoron?*

- A question we've been getting frequently from clients is whether it's possible to predict which stocks might be low volatility in the future. The question is rooted in concerns that today's low volatility stocks, which are disproportionately stable, higher-yielding stocks that masquerade as bonds, might not be tomorrow's low volatility cohort. The answer has taken on added urgency in recent weeks with the Fed looming large.
- Over the long-run, past volatility has been a fairly reliable predictor of future volatility. On average stocks in the highest quintile of trailing volatility have year-ahead volatility that's about +12 percentage points higher than the market's volatility, and those in the lowest quintile go on to have future volatility that's about (8) points lower than their peers. That's true even three years into the future, meaning that the average stock doesn't really change its volatility stripes that often.
- However, we noticed that turnover in the low-volatility bucket has been running well above its long-term norm in the past few years. In other words, past low volatility has been a less-reliable predictor of future low volatility. Part of the reason for that is the interest-rate sensitivity of the low-volatility basket. Currently 44% of the stocks in the lowest quintile of volatility also feature in the *highest* quintile of bond market correlation, 1.6 times the normal share, meaning that the low volatility portfolio is more rate-sensitive than usual.

#### *Forecasting a Change in the Weather*

- Given a stock is low volatility today, what predicts higher volatility in the future? It turns out there are some early warning signs if we know what to look for. Instability in a company's fundamentals is an obvious red flag. We measure that risk by assessing the consistency and predictability of a firm's past earnings growth, the amount of leverage it uses, the level and variability of its ROE, and its beta.
- Other precursors of rising volatility include high aggressive ownership, which captures heavy ownership by hedge funds and other high-turnover players, and high failure risk, as measured by our Failure Model. Stocks with fast all-around growth and rapidly increasing capital spending are also more likely to experience an increase in future volatility; it's just really hard to maintain supernormal growth for an extended period.
- The same factors in reverse are useful in predicting which moderately-low volatility stocks, defined as those in the *second*-lowest quintile of volatility, have a chance of moving into the *lowest* quintile. If today's low volatility stocks migrate out of the lowest volatility basket then it's helpful to know which stocks might replace them.
- We also studied the other extreme: given a stock is *high* volatility today what might foretell a decline in future volatility? The factor mix is different from what works for lower volatility stocks. Strong price momentum is the best predictor of declining volatility in a high volatility stock, followed by favorable earnings revisions.

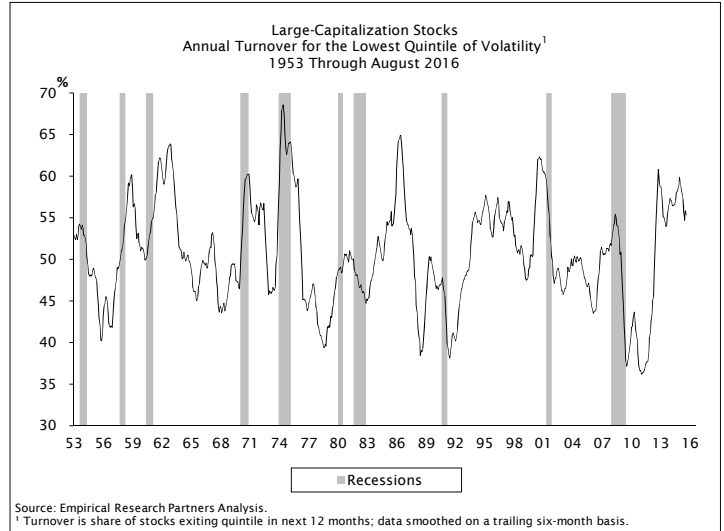
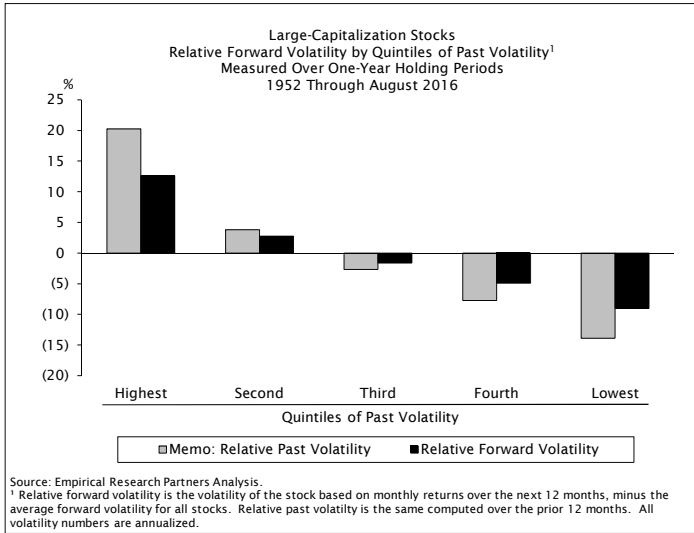
#### *Making Our Volatility Predictions*

- Appendix 1 on page 9 screens our large-cap universe for low volatility stocks with an elevated risk of higher volatility in the future. PG&E, Brown Forman, Nike, Stryker, and Kellogg's feature, among others.
- Moderately low volatility stocks with the right attributes to become tomorrow's lowest volatility stocks are shown in Appendix 2 on page 10. That list includes NASDAQ, Genuine Parts, IDEX, and Ecolab.
- High volatility stocks that might experience a decline in future volatility are presented in Appendix 3 on page 11. United Rentals, Michael Kors, and VMware are among the issues making the cut.

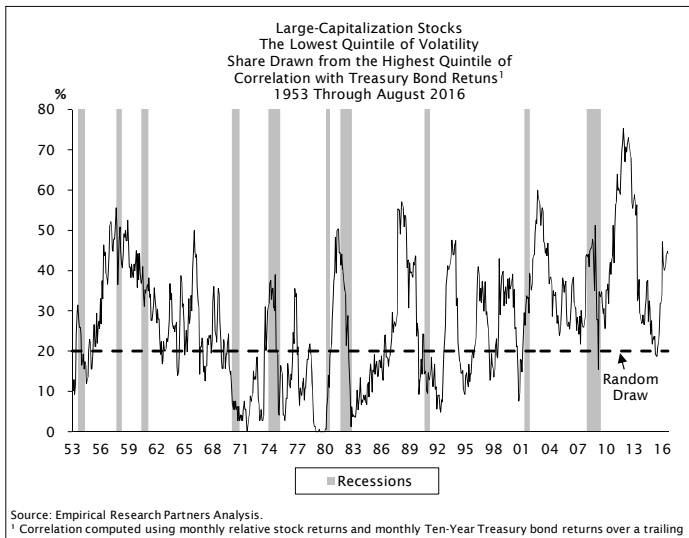
Sunsoo Yano (212) 803-7925 Nicole Price (212) 803-7935 Yi Liu (212) 803-7942 Iwona Scanzillo (212) 803-7915

## Conclusions in Brief

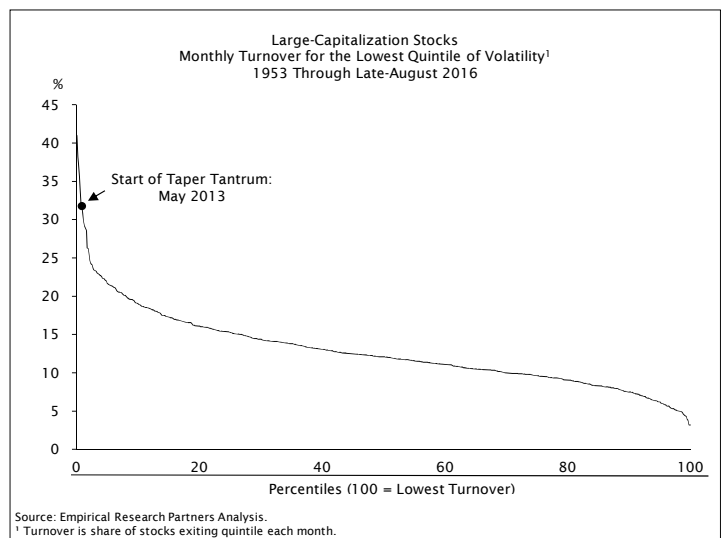
- Past volatility is generally a good predictor of future volatility...
- ...But recently stocks with low volatility have changed their stripes more often:



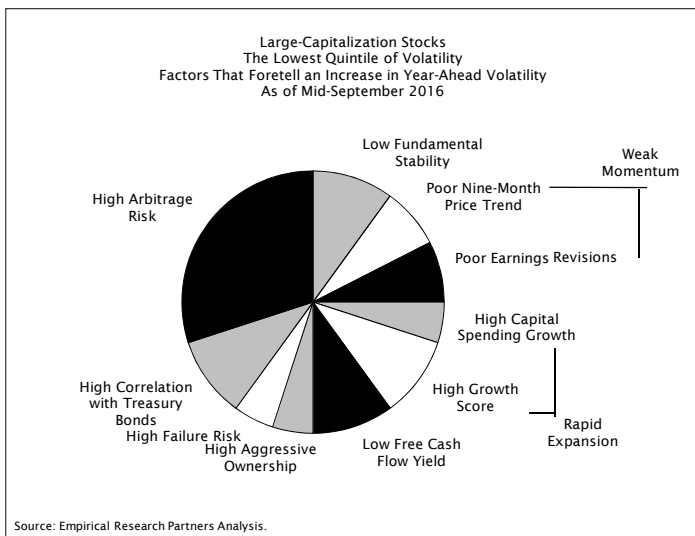
- Stocks that are highly correlated with bond returns are over-represented in the low volatility basket:



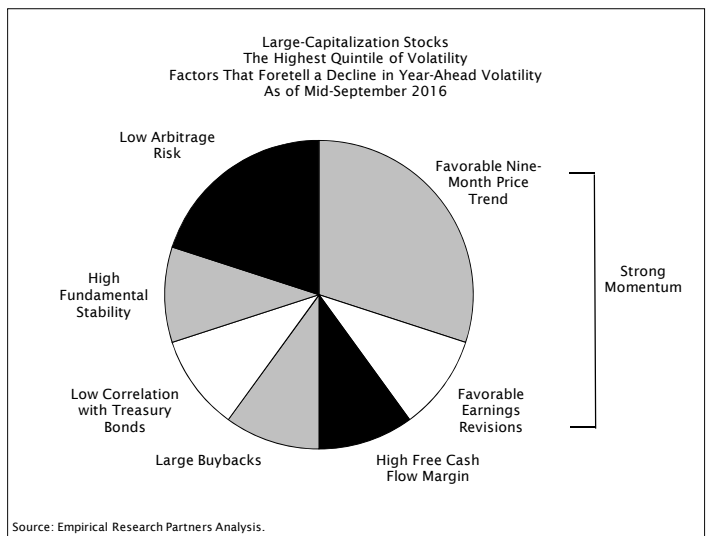
- The Taper Tantrum in 2013 triggered significant turnover in the low volatility cohort:



- We built a model to forecast which low volatility stocks might see rising volatility...



- ...And which high volatility stocks might experience declining volatility:



## Predicting Stock-Level Volatility: High Vol Today, Low Vol Tomorrow?

### Predictable Volatility: Oxymoron?

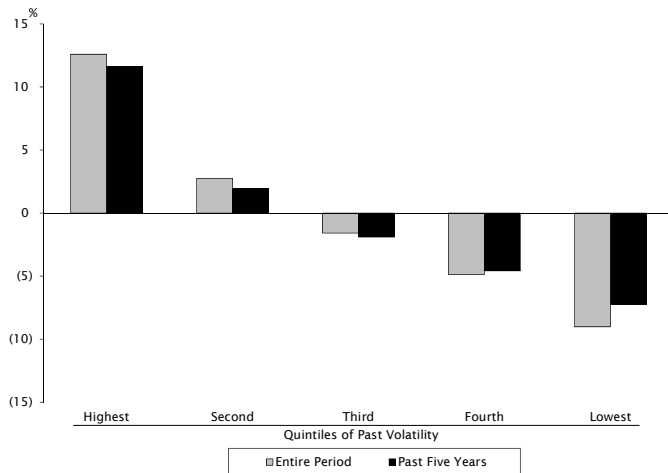
Alchemists tend to get a bad rap these days. Notwithstanding the fact that even the great Sir Isaac Newton dabbled in the dark arts of transmutation, the idea that one might turn a lowly lump of lead into a shiny bar of gold is generally considered preposterous. Or is it? Modern finance thinks nothing of taking that same illiquid bar of gold and transmuting it into an easily-traded equity, with a catchy ticker and a price chart, and 10 free trades a month all for one low price of \$9.99. Or what about taking a boring, defensive stock and turning it into a bond? After all, the latter asset class has been in a 30-year bull market, so why miss out on all the fun? It turns out equity investors haven't missed out; as we wrote last week, the stability/low volatility trade has enjoyed a stellar run, in part because of the tailwind it enjoyed from declining interest rates.<sup>1</sup>

This research picks up the story where that one left off. For Chapter 2 we focus on a very good question several clients have asked us: can we predict which stocks might be low volatility in the future? The genesis of the question was of course the concern that today's low volatility stocks, which tend to be stable, predictable, high dividend yield stocks, might not be tomorrow's low volatility cohort. Events over the last few trading sessions have given the answer added urgency.

It turns out past volatility usually does a pretty good job of predicting future volatility (see Exhibit 1).<sup>2</sup> On average stocks with high and low volatility in the past do indeed continue to have high and low volatility in the future. Stocks in the highest quintile of volatility tend to have future volatility that's about +12 points higher than that of the market, while those in the lowest quintile have year-ahead volatility that's about (8) points less than their peers. That's true even out to three-year holding periods (see Exhibit 2).

However, even though past volatility tends to persist, there is a mean reversion effect; stocks in the highest quintile of volatility tend to see their future volatility over the following year decline by about (8) percentage points on average while the volatility of the lowest quintile increases by about +5 points in the subsequent year (see Exhibit 3). The mean reverting tendency is also shown in Exhibit 4; the grey bars in the chart depict the average volatility for stocks in each quintile in the *prior* year.

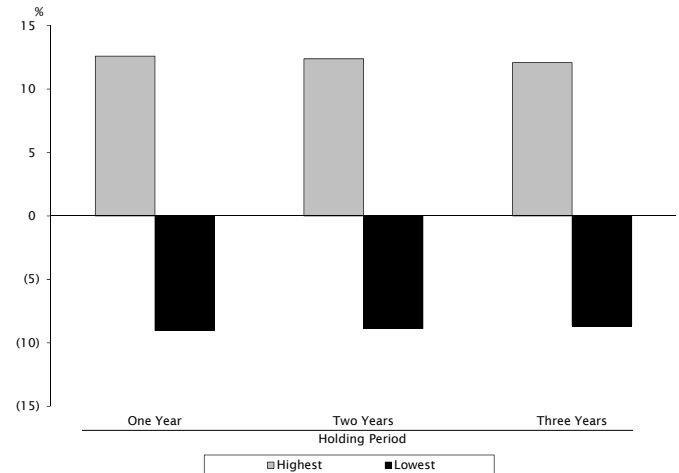
**Exhibit 1: Large-Capitalization Stocks**  
Relative Forward Volatility by Quintiles of Past Volatility'  
One-Year Holding Periods  
1952 Through August 2016



Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative forward volatility is the volatility of the stock based on monthly returns over the next 12 months, minus the average forward volatility for all stocks. All volatility numbers are annualized.

**Exhibit 2: Large-Capitalization Stocks**  
Relative Forward Volatility by Quintiles of Past Volatility and Holding Period'  
Measured Over One- to Three-Year Holding Periods  
1952 Through Late-August 2016



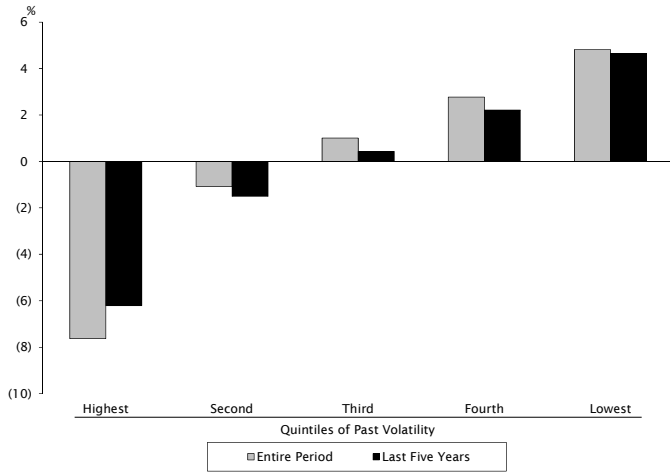
Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative forward volatility is the volatility of the stock based on monthly returns over the next 12 months, minus the average forward volatility for all stocks. All volatility numbers are annualized.

<sup>1</sup> *Portfolio Strategy* September 2016. "The Story Behind Stability."

<sup>2</sup> In our analysis relative volatility refers to the volatility of a stock minus the average volatility for all stocks in the market at that point in time. All volatility numbers are computed using one year of monthly returns and are annualized.

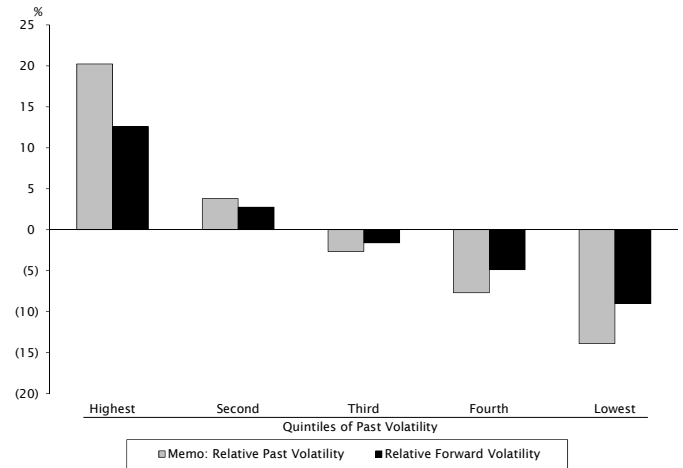
**Exhibit 3: Large-Capitalization Stocks**  
**Relative Change in Volatility by Quintiles of Past Volatility<sup>1</sup>**  
**Measured Over One-Year Holding Periods**  
**1952 Through Late-August 2016**



Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative change in volatility is the volatility of the stock based on monthly returns over the next 12 months compared to that in the prior 12 months, minus the average change in volatility for all stocks. All volatility numbers are annualized.

**Exhibit 4: Large-Capitalization Stocks**  
**Relative Forward Volatility by Quintiles of Past Volatility<sup>1</sup>**  
**Measured Over One-Year Holding Periods**  
**1952 Through August 2016**

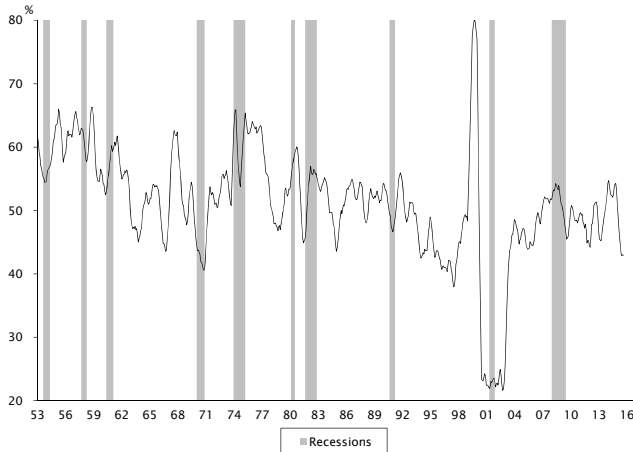


Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative forward volatility is the volatility of the stock based on monthly returns over the next 12 months, minus the average forward volatility for all stocks. Relative past volatility is the same computed over the prior 12 months. All volatility numbers are annualized.

It's important to note that the ability of past volatility to predict future volatility isn't constant over time. One way to measure that is turnover; for example Exhibit 5 plots the share of stocks that exit the highest quintile of volatility over the next year. Interestingly, the turnover rate for stocks in the highest quintile of volatility is at post-Crisis lows, meaning stocks that are volatile are generally maintaining their status. In contrast, turnover among low volatility stocks is running at a rate well above the long-run average (see Exhibit 6). So the client's question was a good one; just because a stock is low volatility today doesn't mean it won't transmute into a high-volatility stock tomorrow. Currently a stock needs to have annualized volatility of less than 18% to fall in the lowest quintile, a threshold that's on par with the long-term average.

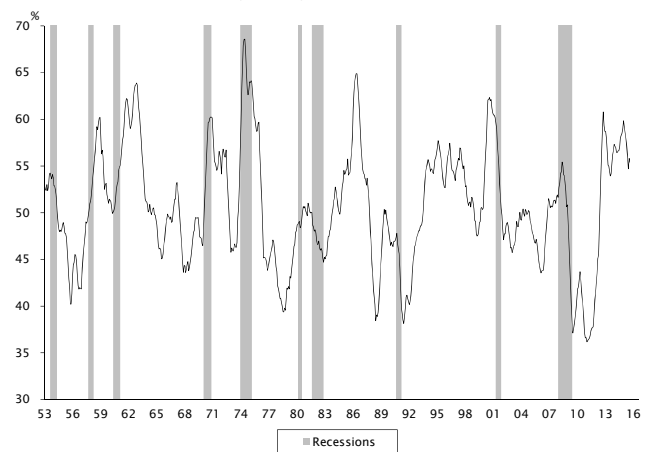
**Exhibit 5: Large-Capitalization Stocks**  
**Annual Turnover for the Highest Quintile of Volatility<sup>1</sup>**  
**1953 Through August 2016**



Source: Empirical Research Partners Analysis.

<sup>1</sup> Turnover is share of stocks exiting quintile in the next 12 months; data smoothed on a trailing six-month basis.

**Exhibit 6: Large-Capitalization Stocks**  
**Annual Turnover for the Lowest Quintile of Volatility<sup>1</sup>**  
**1953 Through August 2016**

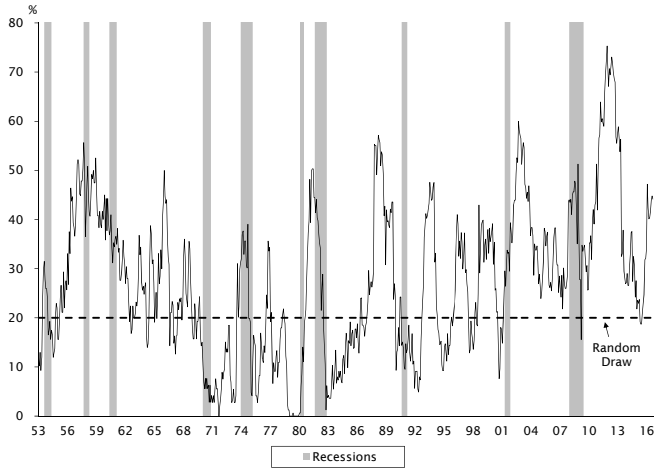


Source: Empirical Research Partners Analysis.

<sup>1</sup> Turnover is share of stocks exiting quintile in next 12 months; data smoothed on a trailing six-month basis.

Part of the reason for the higher turnover has been the interest rate sensitivity of the low volatility basket. For almost the entire post-Crisis period low volatility stocks have disproportionately been stocks that have a high correlation with Treasury bond returns (see Exhibit 7). Currently about 44% of stocks in the lowest quintile of volatility are drawn from the highest quintile of Treasury bond correlation. The start of the so-called Taper Tantrum back in May 2013 was one of the single biggest turnover months for low volatility stocks in the past 60 years (see Exhibit 8).

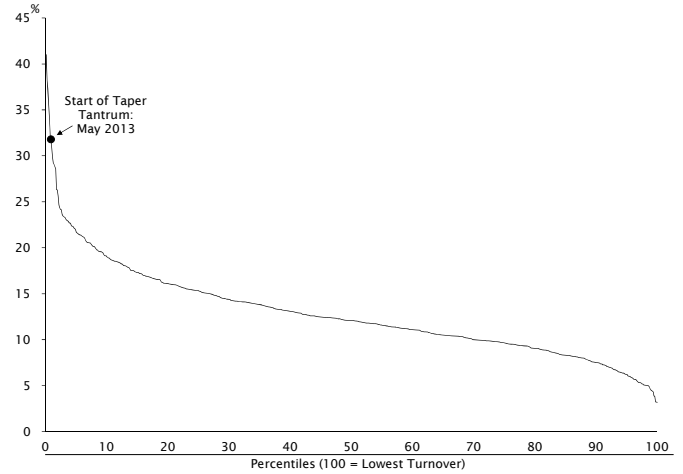
**Exhibit 7: Large-Capitalization Stocks  
The Lowest Quintile of Volatility  
Share Drawn from the Highest Quintile of  
Correlation with Treasury Bond Returns<sup>1</sup>  
1953 Through August 2016**



Source: Empirical Research Partners Analysis.

<sup>1</sup> Correlation computed using monthly relative stock returns and monthly Ten-Year Treasury bond returns over a trailing two-year window.

**Exhibit 8: Large-Capitalization Stocks  
Monthly Turnover for the Lowest Quintile  
of Volatility<sup>1</sup>  
1953 Through August 2016**



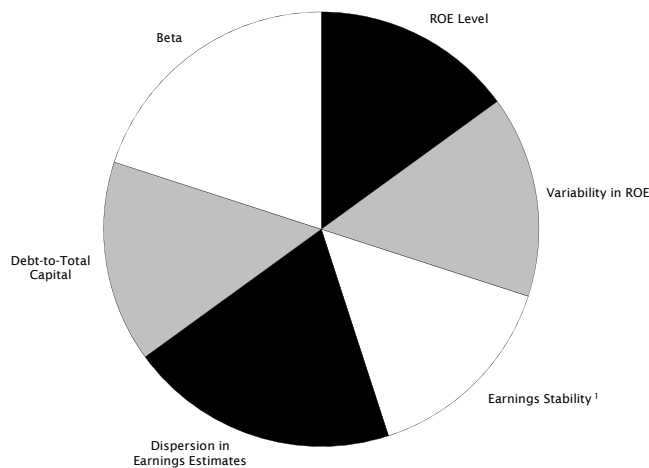
Source: Empirical Research Partners Analysis.

<sup>1</sup> Turnover is share of stocks exiting quintile each month.

**Forecasting a Change in the Weather**

Beyond past volatility, is there anything else that foreshadows future volatility? One plausible candidate is fundamental stability, which we define to be stocks with stable and predictable earnings growth rates, moderate financial leverage, good ROEs, and low betas (see Exhibit 9). It turns out fundamental stability has indeed been a reasonable predictor of year-ahead volatility, particularly for stocks with low stability (see Exhibit 10). Nonetheless, having been a low volatility stock in the past is still a better predictor; stocks with stable fundamentals have year-ahead volatility that’s about (4) percentage points below the market on average, compared to (8) points for stocks with low past volatility (see Exhibit 11). We also noticed that stocks with low aggressive ownership and high bond correlations have also enjoyed lower volatility in the future, although the latter result is once again a byproduct of the bull market in bonds that’s made anything bond-like a fairly low volatility trade.

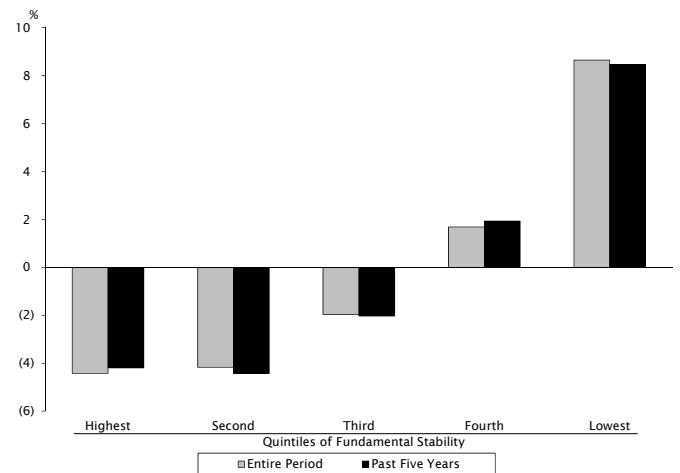
**Exhibit 9: Fundamental Stability Score  
Factor Composition  
2016**



Source: Empirical Research Partners Analysis.

<sup>1</sup> Computed over the trailing 12 quarters.

**Exhibit 10: Large-Capitalization Stocks  
Relative Forward Volatility by Quintiles of  
Fundamental Stability<sup>1</sup>  
Measured Over One-Year Holding Periods  
1952 Through August 2016**

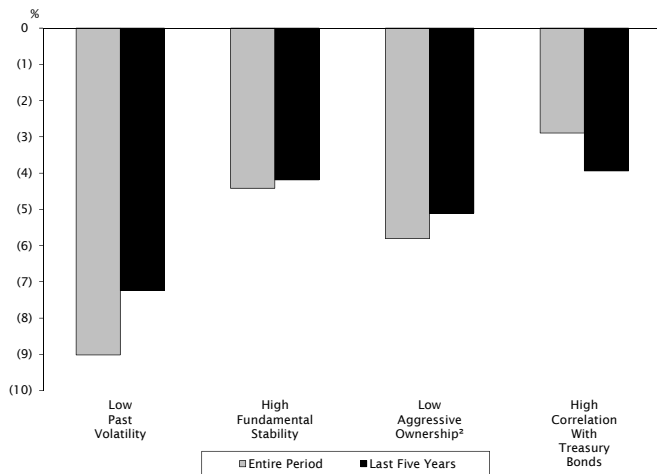


Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative forward volatility is the volatility of the stock based on monthly returns over the next 12 months, minus the average forward volatility for all stocks. All volatility numbers are annualized.

On the flip-side, we found a broader set of factors have been useful in predicting high future volatility (see Exhibit 12). In addition to the opposite of the factors that predict future low volatility, two additional factors are useful in forecasting high volatility: a high risk of failure, as measured by our Failure Model, and low free cash flow yield. As with low volatility, none of the factors work as well as simply assuming stocks with high volatility in the past will continue to be volatile.

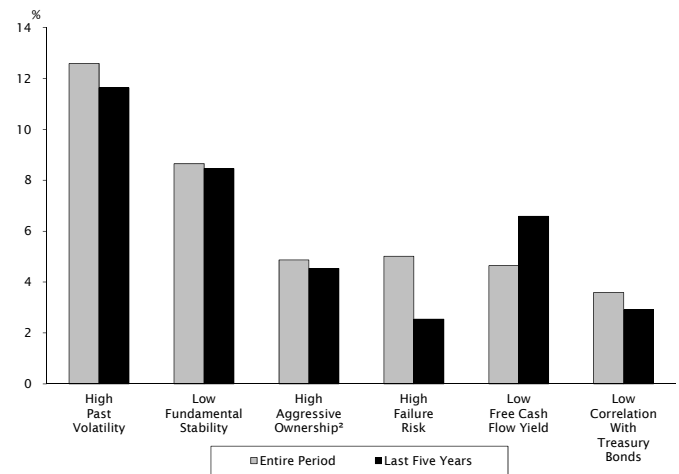
**Exhibit 11: Large-Capitalization Stocks**  
Relative Forward Volatility Contingent on Select Factors<sup>1</sup>  
Measured Over One-Year Holding Periods  
1952 Through August 2016



Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative forward volatility is the volatility of the stock based on monthly returns over the next 12 months, minus the average forward volatility for all stocks. All volatility numbers are annualized. Low and high are defined as lowest and highest quintiles, respectively.  
<sup>2</sup> Aggressive ownership data since 2002.

**Exhibit 12: Large-Capitalization Stocks**  
Relative Forward Volatility Contingent on Select Factors<sup>1</sup>  
Measured Over One-Year Holding Periods  
1952 Through August 2016



Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative forward volatility is the volatility of the stock based on monthly returns over the next 12 months, minus the average forward volatility for all stocks. All volatility numbers are annualized. Low and high are defined as lowest and highest quintiles, respectively.  
<sup>2</sup> Aggressive ownership data since 2002.

However, that's only true *on average*. Yes most stocks tend to keep their volatility profile through time, but what we really care about is the small subset of stocks that do change their stripes. Can we identify low volatility stocks that might see a significant increase in volatility, or high volatility stocks that might experience a big decrease in volatility?

Exhibit 13 studies the subset of stocks that are already low volatility, and looks at factors that predict a big increase in volatility over the following year. It turns out low volatility stocks with unstable fundamentals are much more likely to see a big increase in volatility over the next year, to the tune of about +7 percentage points. Other warning signs that a low volatility stock is about to experience an increase in volatility include high aggressive ownership, which means the stock is heavily owned by hedge funds and high-turnover long managers, and high failure risk, as measured by our Failure Model. Poor price and earnings momentum are red flags too.

Rapid growth can also foretell an increase in volatility. Low volatility stocks with high capital spending growth and a high growth score, a multifactor screen we use to assess all-around growth credentials, tend to experience rising volatility in the subsequent year. It's hard to maintain supernormal growth and cracks in a previously bulletproof story can appear without warning.

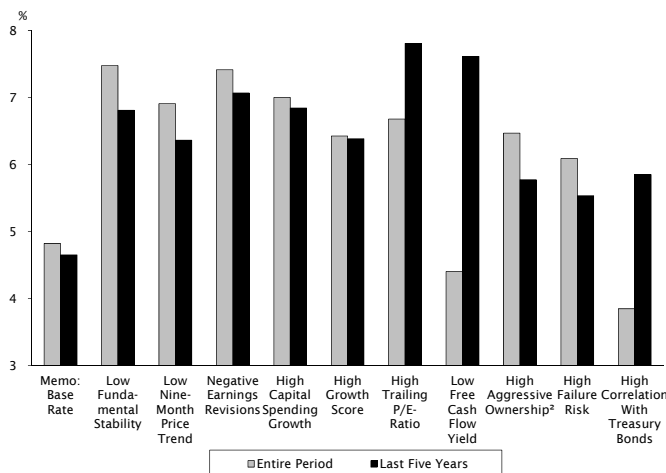
Low volatility stocks trading at high P/E ratios and low free cash flow yields are also more susceptible to an increase in future volatility. The latter has been particularly important in the post-Crisis era; over the past five years low free cash flow yield has been the second most important predictor of higher volatility in the future. That's consistent with all our work on the significance of having free cash flows in the Bretton Woods II era.

Of particular note given today's setting is the fact that a high correlation with bonds has also been a red flag in the post-Crisis years (see the right-most black bar in the chart).

In the past five years all the factors have led to a greater increase in volatility than the mean reversion effect alone, which is depicted in the left-most bars in Exhibit 13; the average low volatility stock experiences an increase in volatility of around +5 percentage points over the following year purely because of mean reversion.

It's more difficult to predict when a high volatility stock will have a big decline in volatility (see Exhibit 14). Part of the reason is that high volatility stocks have often just come through some kind of catastrophe, so predicting which will see declining volatility is a bit like identifying which will bounce back and which are done for; it's not impossible but it's a challenging task. The inverse of the aforementioned factors work to a degree, but most of them don't do much better than just assuming the natural rate of mean reversion, depicted in the left-most bars in the chart. Of all the factors, having a good price chart over the past nine months helps a lot, and having favorable earnings revisions is moderately useful too. When that's the case it's more likely the past high volatility has been caused by a big spike *up* in the share price, rather than a disaster.

**Exhibit 13: Large-Capitalization Stocks  
The Lowest Quintile of Volatility  
Relative Change in Volatility Contingent on Select Factors<sup>1</sup>  
Measured Over One-Year Holding Periods  
1952 Through August 2016**

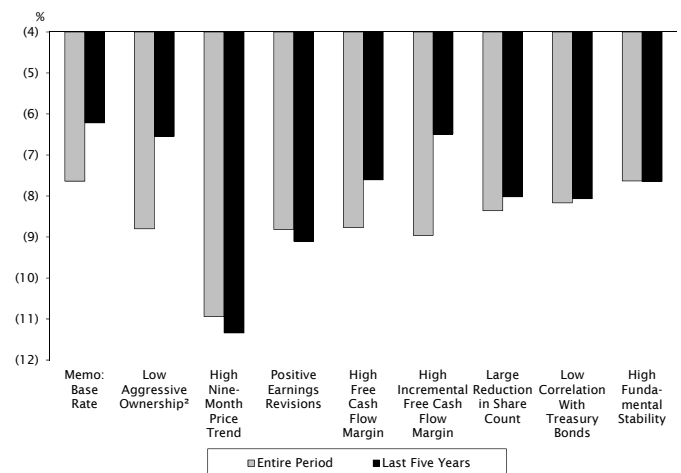


Source: Empirical Research Partners Analysis.

<sup>1</sup> Relative change in volatility is the volatility of the stock based on monthly returns over the next 12 months compared to that in the prior 12 months, minus the average change in volatility for all stocks. All volatility numbers are annualized. Low and high are defined as lowest and highest quintiles, respectively.

<sup>2</sup> Aggressive ownership data since 2002.

**Exhibit 14: Large-Capitalization Stocks  
The Highest Quintile of Volatility  
Relative Change in Volatility Contingent on Select Factors<sup>1</sup>  
Measured Over One-Year Holding Periods  
1952 Through August 2016**



Source: Empirical Research Partners Analysis.

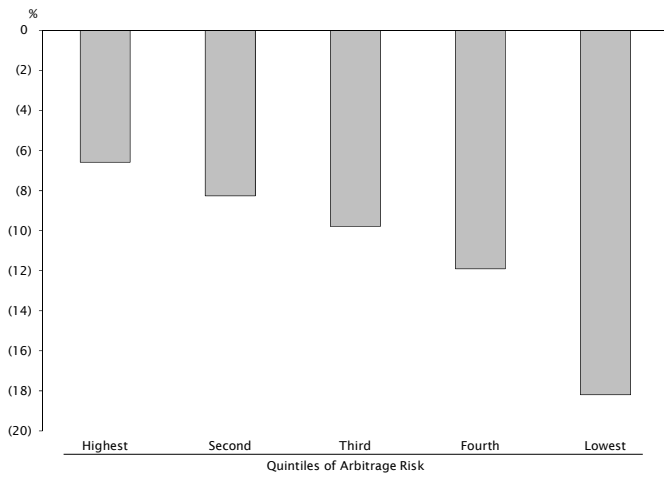
<sup>1</sup> Relative change in volatility is the volatility of the stock based on monthly returns over the next 12 months compared to that in the prior 12 months, minus the average change in volatility for all stocks. All volatility numbers are annualized. Low and high are defined as lowest and highest quintiles, respectively.

<sup>2</sup> Aggressive ownership data since 2002.

We also noticed that arbitrage risk, a factor we use to measure controversy, is particularly effective at forecasting year-ahead changes in volatility. High volatility stocks with *low* arbitrage risk have future volatility that's on average a whopping (18) percentage points lower than the market's volatility (see Exhibit 15). And low volatility stocks with *high* arbitrage risk experience year-ahead volatility that's almost +13 points higher than their peers (see Exhibit 16). We measure arbitrage risk based on daily returns over a trailing three-month window, so it helps capture more recent controversy that's not picked up in the longer-term trailing volatility metric that looks back a year.

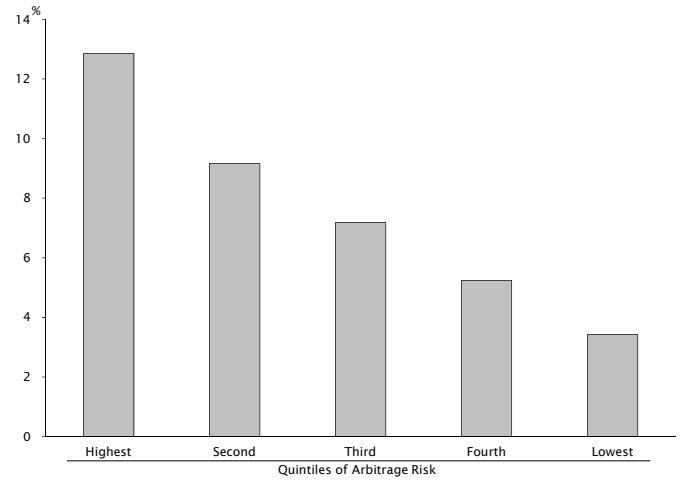
Notice that the magnitude of the predicative power of arbitrage risk is significantly higher than any of the factors shown in Exhibits 13 and 14. Is there any reason to use the other factors or is arbitrage risk so powerful that it subsumes everything else? To investigate that we did some regression analysis to see which factors are still significant in predicting year-ahead changes in volatility, even after arbitrage risk is included among the independent variables. It turns out most of the fundamental factors remain statistically significant and are complementary to arbitrage risk, so we were able to build formal models to predict (1) low volatility stocks that might experience a large increase in future volatility and (2) high volatility stocks that might see declining future volatility (see Exhibits 17 and 18).

**Exhibit 15: Large-Capitalization Stocks**  
**The Highest Quintile of Volatility**  
**Relative Change in Volatility Contingent on Arbitrage Risk<sup>1</sup>**  
**Measured Over One-Year Holding Periods**  
**1952 Through August 2016**



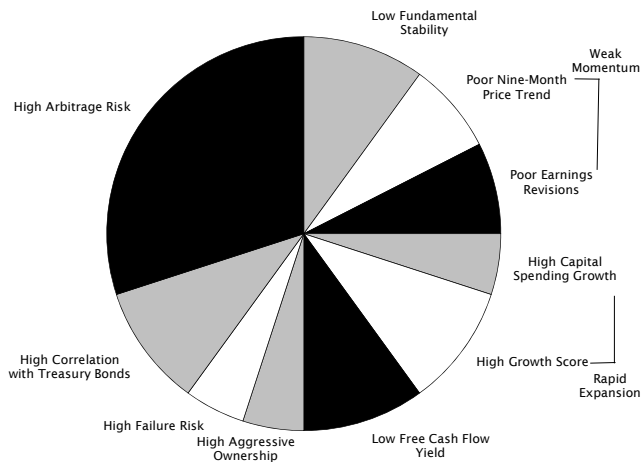
Source: Empirical Research Partners Analysis.

**Exhibit 16: Large-Capitalization Stocks**  
**The Lowest Quintile of Volatility**  
**Relative Change in Volatility Contingent on Arbitrage Risk<sup>1</sup>**  
**Measured Over One-Year Holding Periods**  
**1952 Through August 2016**



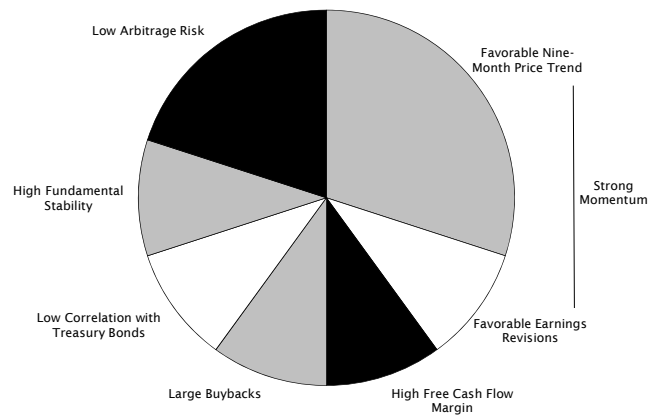
Source: Empirical Research Partners Analysis.

**Exhibit 17: Large-Capitalization Stocks**  
**The Lowest Quintile of Volatility**  
**Factors That Foretell an Increase in Year-Ahead Volatility**  
**As of Mid-September 2016**



Source: Empirical Research Partners Analysis.

**Exhibit 18: Large-Capitalization Stocks**  
**The Highest Quintile of Volatility**  
**Factors That Foretell a Decline in Year-Ahead Volatility**  
**As of Mid-September 2016**



Source: Empirical Research Partners Analysis.

**Conclusion: History Repeats, Kind Of**

Based on the model in Exhibit 17, Appendix 1 on page 9 presents large-cap low volatility stocks with the potential to see a significant increase in volatility over the coming year. We also found that reversing the model is quite effective in forecasting which stocks in the *second* lowest quintile of volatility are likely to move into the lowest quintile. Appendix 2 on page 10 lists these moderately low volatility stocks that might become tomorrow’s lowest volatility cohort.

Appendix 3 on page 11 presents the other extreme: high volatility stocks that could see declining volatility going forward, based on the model shown in Exhibit 18. It’s hard for a high volatility stock to move all the way down into the lowest volatility quintile, so these stocks are more likely to end up somewhere in the middle of the pack.

When it comes to volatility, history does tend to repeat on average, meaning low volatility stocks tend to stay low volatility in the future and high volatility stocks usually remain quite volatile. However, in the post-Crisis era that predictability has diminished and the specter of higher rates can’t be ignored. Gold can become lead very quickly.



**Appendix 1: Large-Capitalization Low Volatility Stocks<sup>1</sup>**  
**Highest Quintile of Forecast Change in Volatility: An Increase Expected<sup>2</sup>**  
**Sorted by Trailing Volatility**  
**As of Mid-September 2016**

		Factors That Foretell an Increase in Volatility (5=Volatility Likely to Increase; 1=Volatility Likely to Decline)														
Symbol	Company	Price	Trailing Volatility (Annualized)	Fundamental Stability (5=Lowest)	Nine-Month Price Trend (5=Lowest)	Three-Month Earnings Revisions (5=Lowest)	Capital Spending Growth (5=Highest)	Growth Score (5=Highest)	Free Cash Flow Yield (5=Lowest)	Aggressive Ownership (5=Highest)	Failure Model (5=Worst)	Correlation With Treasury Bonds (5=Highest)	Arbitrage Risk (5=Highest)	Forecast Change In Volatility (5=Highest)	YTD Returns	Market Capitalization (\$ Billion)
PCG	PG&E CORP	\$62.67	11.0 %	2	2	na	3	2	5	4	3	5	4	5	19.7 %	\$31.6
BF.B	BROWN FORMAN CORP	46.41	12.7	1	5	3	1	5	4	2	1	3	4	5	(5.5)	18.6
NKE	NIKE INC	54.95	13.1	1	5	4	4	5	4	5	1	2	4	5	(11.4)	93.5
SYK	STRYKER CORP	114.42	13.4	3	1	3	5	4	5	1	1	4	4	5	24.0	42.8
K	KELLOGG CO	78.17	13.9	5	3	4	2	4	3	4	3	5	5	5	10.3	27.4
MTN	VAIL RESORTS INC	160.89	14.8	5	1	2	5	4	3	5	3	1	5	5	27.3	5.8
LNT	ALLIANT ENERGY CORP	38.77	14.8	2	1	na	3	2	5	2	2	5	5	5	27.3	8.8
SCG	SCANA CORP	72.85	14.9	2	2	na	4	2	5	2	4	5	5	5	23.4	10.4
VRSK	VERISK ANALYTICS INC	80.72	15.1	5	4	5	5	5	3	4	2	2	4	5	5.0	13.6
PNW	PINNACLE WEST CAPITAL CORP	76.88	15.3	2	1	na	5	2	5	5	4	5	5	5	22.4	8.5
UN	UNILEVER NV	45.38	15.5	3	4	5	1	4	3	1	2	5	4	5	6.9	77.8
EPC	EDGELL PERSONAL CARE CO	76.09	15.5	5	5	2	1	1	5	5	1	5	5	5	(2.9)	4.5
SBUX	STARBUCKS CORP	53.01	15.8	2	5	4	3	5	4	3	1	3	3	5	(10.8)	77.7
ES	EVERSOURCE ENERGY	54.59	15.8	2	4	4	4	2	5	2	2	5	5	5	9.5	17.3
STZ	CONSTELLATION BRANDS	162.68	16.0	4	2	3	5	5	4	5	1	5	3	5	15.0	32.9
AZO	AUTOZONE INC	746.35	16.1	1	5	3	3	5	2	4	3	3	4	5	0.6	22.0
CI	CIGNA CORP	131.89	16.1	1	5	5	3	3	1	5	4	1	5	5	(9.8)	33.8
TARO	TARO PHARMACEUTICALS LTD	116.90	16.3	1	5	3	5	5	1	3	3	4	5	5	(24.4)	5.0
AVT	AVNET INC	41.89	16.4	4	5	5	1	1	4	5	3	1	5	5	(1.0)	5.3
SRE	SEMPRA ENERGY	107.94	16.4	3	3	na	5	2	5	4	1	5	5	5	16.5	27.0
DPS	DR PEPPER SNAPPLE GROUP INC	90.77	16.6	1	5	2	5	4	2	4	3	5	4	5	(0.9)	16.8
CHKP	CHECK POINT SOFTWARE TECHNOLOGIES INC	75.03	16.8	1	5	5	5	5	1	4	3	2	5	5	(7.8)	13.1
WEC	WEC ENERGY GROUP INC	61.47	16.8	2	1	na	5	3	4	1	2	5	5	5	22.8	19.4
TAP	MOLSON COORS BREWING CO	102.58	16.9	3	3	1	2	4	4	na	1	3	5	5	10.6	22.0
CMS	CMS ENERGY CORP	42.81	16.9	3	2	3	3	3	5	4	4	5	5	5	21.3	12.0
ORLY	O'REILLY AUTOMOTIVE INC	275.46	16.9	1	4	2	3	5	4	5	2	3	4	5	8.7	26.1
D	DOMINION RESOURCES INC	75.90	16.9	3	3	2	4	3	5	1	1	5	4	5	15.5	47.7
CRI	CARTER'S INC	97.56	17.3	2	3	4	4	4	2	5	4	2	5	5	10.7	4.9
PNRA	PANERA BREAD CO	201.08	17.4	2	5	3	2	5	4	5	4	3	5	5	3.2	4.8

Source: Empirical Research Partners Analysis.

<sup>1</sup> Drawn from the lowest quintile of volatility, based on monthly returns over a trailing one-year period.

<sup>2</sup> Based on model presented in Exhibit 17.

**Appendix 2: Large-Capitalization Moderately-Low Volatility Stocks<sup>1</sup>**  
**Lowest Quintile of Forecast Change in Volatility: A Decrease Expected<sup>2</sup>**  
**Sorted by Trailing Volatility**  
**As of Mid-September 2016**

		Factors That Foretell a Decline in Volatility (1=Volatility Likely to Decline; 5=Volatility Likely to Increase)														
Symbol	Company	Price	Trailing Volatility (Annualized)	Fundamental Stability (1=Highest)	Nine-Month Price Trend (1=Highest)	Three-Month Earnings Revisions (1=Highest)	Capital Spending Growth (1=Lowest)	Growth Score (1=Lowest)	Free Cash Flow Yield (1=Highest)	Aggressive Ownership (1=Lowest)	Failure Model (1=Best)	Correlation With Treasury Bonds (1=Lowest)	Arbitrage Risk (1=Lowest)	Forecast Change in Volatility (1=Lowest)	YTD Returns	Market Capitalization (\$ Billion)
NDAQ	NASDAQ INC	\$69.80	17.0 %	2	1	3	na	2	na	2	4	3	1	1	21.6 %	\$11.6
GPC	GENUINE PARTS CO	98.62	17.0	1	3	4	4	3	1	1	4	4	2	1	17.2	14.7
DGX	QUEST DIAGNOSTICS INC	83.28	17.5	2	2	2	1	3	2	3	4	5	1	1	19.0	11.6
IEX	IDEX CORP	90.97	17.6	4	2	3	1	4	3	3	2	1	2	1	20.3	6.9
ECL	ECOLAB INC	117.62	17.7	2	4	3	3	3	3	2	2	2	1	1	3.8	34.3
ROK	ROCKWELL AUTOMATION	114.94	17.8	3	2	5	2	4	2	2	3	2	2	1	14.3	14.9
AFL	AFLAC INC	72.02	17.9	4	2	2	na	2	na	1	5	2	1	1	22.5	29.5
WMT	WAL-MART STORES INC	72.09	18.0	1	1	2	2	2	1	1	5	5	2	1	20.2	223.3
ORI	OLD REPUBLIC INTERNATIONAL CORP	18.20	18.0	5	4	1	na	1	na	3	4	2	1	1	0.6	4.8
SLF	SUN LIFE FINANCIAL INC	31.71	18.0	4	4	5	na	1	na	1	4	1	3	1	4.5	19.5
HRS	HARRIS CORP	89.52	18.0	5	3	4	3	3	1	4	2	2	1	1	4.9	11.2
PFE	PFIZER INC	33.65	18.2	2	3	2	5	2	2	2	3	4	1	1	7.2	204.1
JPM	JPMORGAN CHASE & CO	66.19	18.6	5	4	4	na	1	na	1	5	1	1	1	2.5	239.1
PH	PARKER-HANNIFIN CORP	122.39	18.6	4	1	1	1	2	2	3	4	1	2	1	28.3	16.4
DOV	DOVER CORP	68.68	18.7	4	2	4	2	2	1	3	4	3	2	1	14.2	10.7
RY	ROYAL BANK OF CANADA	61.10	18.8	3	2	1	na	2	na	1	4	1	1	1	17.7	90.9
AJG	ARTHUR J GALLAGHER & CO	49.90	18.9	4	2	4	na	2	na	2	3	1	1	1	25.0	8.8
BBT	BB&T CORP	38.08	19.0	3	4	3	na	1	na	1	4	1	3	1	3.2	31.0
VZ	VERIZON COMMUNICATIONS INC	51.20	19.2	2	3	2	3	1	1	1	5	5	2	1	14.5	208.7
TRV	ST PAUL TRAVELERS COMPANIES INC	115.09	19.6	4	4	3	na	2	na	1	4	4	1	1	3.7	33.2
PNC	PNC FINANCIAL SERVICES GROUP INC	90.11	19.8	3	5	4	na	1	na	2	4	1	2	1	(3.7)	44.4
MSI	MOTOROLA SOLUTIONS INC	75.76	19.8	1	3	1	4	1	2	4	1	2	2	1	12.6	12.6
YUM	YUM BRANDS INC	88.39	20.0	1	1	3	2	2	4	5	3	3	2	1	23.1	35.3
EMR	EMERSON ELECTRIC CO	51.19	20.2	3	2	5	1	2	1	1	5	3	3	1	10.1	32.9
PBCT	PEOPLE'S UNITED FINL INC	15.71	20.3	2	4	4	na	1	na	1	4	1	3	1	0.6	4.9
UTX	UNITED TECHNOLOGIES CORP	100.44	20.6	3	3	3	2	1	2	2	3	4	1	1	6.7	84.1
SNPS	SYNOPSYS INC	58.53	21.1	1	1	2	1	3	2	3	3	2	1	1	28.3	8.9
GE	GENERAL ELECTRIC CO	29.43	21.1	5	5	3	1	1	5	1	2	2	1	1	(3.3)	263.7
TWX	TIME WARNER INC	75.71	21.9	4	2	2	3	3	2	3	4	3	1	1	19.0	59.1

Source: Empirical Research Partners Analysis.

<sup>1</sup> Drawn from the second lowest quintile of volatility, based on monthly returns over a trailing one-year period.

<sup>2</sup> Based on model presented in Exhibit 17.

**Appendix 3: Large-Capitalization High Volatility Stocks<sup>1</sup>**  
**Lowest Quintile of Forecast Change in Volatility: A Decrease Expected<sup>2</sup>**  
**Sorted by Trailing Volatility**  
**As of Mid-September 2016**

		Factors That Foretell a Decline in Volatility (1=Volatility Likely to Decline; 5=Volatility Likely to Increase)											
Symbol	Company	Price	Trailing Volatility (Annualized)	Nine-Month Price Trend (1=Highest)	Three-Month Earnings Revisions (1=Highest)	Level Of Free Cash Flow Margin (1=Highest)	Change In Shares Outstanding (1=Largest Buybacks)	Correlation With Treasury Bonds (1=Lowest)	Fundamental Stability (1=Highest)	Arbitrage Risk (1=Lowest)	Forecast Change in Volatility (1=Lowest)	YTD Returns	Market Capitalization (\$ Billion)
URI	UNITED RENTALS INC	\$79.18	53.7 %	2	2	1	1	1	3	3	1	9.2 %	\$6.9
KORS	MICHAEL KORS HOLDINGS LTD	49.62	53.6	2	4	1	1	5	1	1	1	23.9	8.8
CSC	COMPUTER SCIENCES CORP	49.79	53.1	1	4	4	4	2	4	1	1	53.9	7.0
VMW	VMWARE INC -CL A	72.68	46.9	2	3	1	5	3	1	2	1	28.5	30.9
TRMB	TRIMBLE NAVIGATION LTD	26.68	46.6	2	4	2	2	2	2	1	1	24.4	6.6
OKE	ONEOK INC	47.39	45.9	1	4	3	4	4	2	2	1	103.3	10.0
KMI	KINDER MORGAN INC	21.90	45.7	1	3	2	5	5	2	2	1	50.0	48.9
URBN	URBAN OUTFITTERS INC	35.88	45.1	1	1	3	1	5	1	4	1	57.7	4.2
STJ	ST JUDE MEDICAL INC	79.04	43.3	2	3	2	4	4	1	1	1	29.2	22.5
NAVI	NAVIENT CORP	13.77	42.0	2	3	na	1	3	1	2	1	24.8	4.4
HPE	HEWLETT PACKARD ENTERPRISE	22.68	41.8	1	2	4	na	na	3	1	1	50.2	37.8
LVS	LAS VEGAS SANDS CORP	57.33	41.7	1	5	1	2	4	3	2	1	34.7	45.6
TRQ	TURQUOISE HILL RESOURCES LTD	2.97	41.5	2	1	1	3	4	5	3	1	16.9	6.0
EBAY	EBAY INC	31.57	41.1	3	3	1	1	2	2	3	1	14.9	35.7
ANET	ARISTA NETWORKS INC	82.03	40.1	2	3	1	4	1	1	2	1	5.4	5.7
XEC	CIMAREX ENERGY CO	126.99	39.8	1	1	5	3	3	5	2	1	42.5	12.1
VAL	VALSPAR CORP	105.94	39.4	2	3	2	3	4	2	1	1	29.0	8.4
PKG	PACKAGING CORP OF AMERICA	80.40	39.2	2	2	2	1	3	3	1	1	30.9	7.6
CNQ	CANADIAN NATURAL RESOURCES	29.37	38.6	1	1	3	3	4	4	1	1	38.8	32.4
NVDA	NVIDIA CORP	63.67	38.6	1	1	1	2	2	1	2	1	94.7	34.1
PVH	PVH CORP	108.05	37.4	1	2	2	2	4	1	1	1	46.9	8.7
PCLN	PRICELINE GROUP INC	1448.06	36.9	3	3	1	2	2	1	1	1	13.6	71.6
CMA	COMERICA INC	46.35	36.5	3	2	na	2	1	2	1	1	12.5	8.1
HOT	STARWOOD HOTELS & RESORTS WORLDWIDE IN	75.09	35.9	2	4	2	2	2	3	1	1	18.3	12.7
WHR	WHIRLPOOL CORP	161.83	35.4	3	3	3	1	5	2	1	1	12.1	12.2
MELI	MERCADOLIBRE INC	178.91	35.1	1	3	1	3	3	3	4	1	56.8	7.9
NSC	NORFOLK SOUTHERN CORP	92.03	35.0	3	4	3	2	2	1	1	1	11.2	27.0
GRMN	GARMIN LTD	47.75	34.8	1	1	1	2	5	1	3	1	33.1	9.0

Source: Empirical Research Partners Analysis.

<sup>1</sup> Drawn from the highest quintile of volatility, based on monthly returns over a trailing one-year period.

<sup>2</sup> Based on model presented in Exhibit 18.