Alpha Within Factors

RESEARCH BY JESSE LIVERMORE, CHRIS MEREDITH, CFA AND PATRICK O'SHAUGHNESSY, CFA: NOVEMBER 2018

In **Factors from Scratch**, we showed that value investing works through a re-rating process. The process begins when the market develops an expectation that the earnings of certain companies will decline or grow at depressed rates into the future.[1] The market then prices those companies at a discount relative to their current earnings, turning them into "value stocks." Over the short-term, the market usually ends up being right in its expectations: value stocks usually **do** go on to experience declines or slowdowns in their earnings, particularly in comparison with the rest of the market. But over the long-term, they usually recover and return to normal growth. When the market prices value stocks, it tends to underestimate the likelihood and extent of their eventual recoveries. Consequently, it tends to underprice them relative to the actual stream of future earnings that they go on to generate. As the future takes shape, the market adjusts to correct this mistake, re-rating the stocks higher and delivering excess returns to those who buy at the beginning of the process.

To be clear, this narrative describes the **average** outcome of value stocks as a group. Actual individual outcomes inside that group tend to be well-dispersed, with stocks in the group frequently taking paths that deviate from the average. Some value stocks, for example, experience strong earnings growth from the outset, as if they were growth stocks. Unsurprisingly, these stocks, which were initially priced for future earnings weakness, go on to experience large upward re-ratings, generating strong gains for investors. Other value stocks, in contrast, experience earnings declines that exceed even the market's worst expectations, without any subsequent recoveries. Predictably, these stocks get re-rated in the opposite direction, producing losses for investors.

The wide dispersion of outcomes observed in value stocks represents a significant opportunity for investors. We're going to explore that opportunity in this piece. The piece will contain two sections:

1. In the first section, we're going to analyze and quantify the impact that future earnings outcomes have on the returns of value stocks.
2. In the second section, we're going to introduce and evaluate a simple quantitative investment strategy that improves on the returns of a conventional value strategy by tilting its exposure in the direction of value stocks with the highest future earnings growth.

The earnings-related theme that we're going to explore in the piece is an instance of a larger theme that we've been focused on as a firm—the pursuit of "**Alpha within Factors** To achieve differentiated returns, quantitative investors need to do more than just expose their portfolios to popular factors such as value and momentum. They need to implement strategies that can separate good outcomes from bad outcomes *within* those factors. We believe that the successful development and utilization of such strategies represents the future of quantitative investing.

1 We focus on earnings in this piece, but other economically-relevant fundamentals—e.g., EBITDA, free cash flow, sales, book equity, etc. —can be used in its place.

SECTION 1: GROWTH IN VALUE

Real and Fake Value: The Cases of $AAPL and $IBM

For a real-world illustration of the different fundamental paths that value stocks can take after they are purchased, consider the examples of two well-known technology companies: Apple ($AAPL) and IBM ($IBM). In June of 2014, both of these companies had trailing-twelve-month (ttm) price-to-earnings (P/E) ratios in the cheapest quintile of the large cap universe, with $AAPL trading at a ttm P/E of 14.9 and $IBM trading at a ttm P/E of 11.2. The reason the companies traded at low multiples of their current earnings is that market participants were concerned that the earnings might not be sustained (if distributed) and might not grow at normal market rates (if reinvested) over time.

The table below quantifies the performance of the two companies from June 30th, 2014 through October 30th, 2018, showing the month-end total return index ("TR"), price, P/E, ttm earnings per share ("EPS"), and ttm net income in billions of dollars ("NI"):

	Date	TR	Price	P/E	EPS	NI ($B)		Date	TR	Price	P/E	EPS	NI ($B)
$AAPL	6/2014	$1.00	92.93	14.9	6.3	37.7	$IBM	6/2014	$1.00	181.27	11.2	16.2	16.4
	6/2015	$1.37	125.43	15.1	8.3	47.8		6/2015	$0.93	162.66	10.2	15.9	15.6
	6/2016	$1.07	95.60	10.3	9.3	50.7		6/2016	$0.91	151.78	12.2	12.5	12.0
	6/2017	$1.64	144.02	16.4	8.8	45.7		6/2017	$0.95	153.83	13.1	11.7	11.0
	10/2018	$2.46	213.30	18.9	11.3	55.9		10/2018	$0.75	115.40	9.4	12.3	11.3
	Ann Chg	23.6%	21.6%	5.8%	15.0%	9.7%		Ann Chg	-6.5%	-10.1%	-4.0%	-6.3%	-8.4%

As you can see in the left portion of the table, $AAPL went on to grow its earnings at an impressive 15.0% annual rate over the period.[2] This growth wasn't expected in 2014, which is why an upward adjustment in the company's price and valuation occurred. In the end, the ensuing adjustment generated a total return of 23.6% per year for continuous holders of the stock. An annually rebalanced value strategy would have invested in the stock on each rebalancing date from 2014 through 2018, earning the 23.6% return in its entirety and experiencing only one year of negative performance.

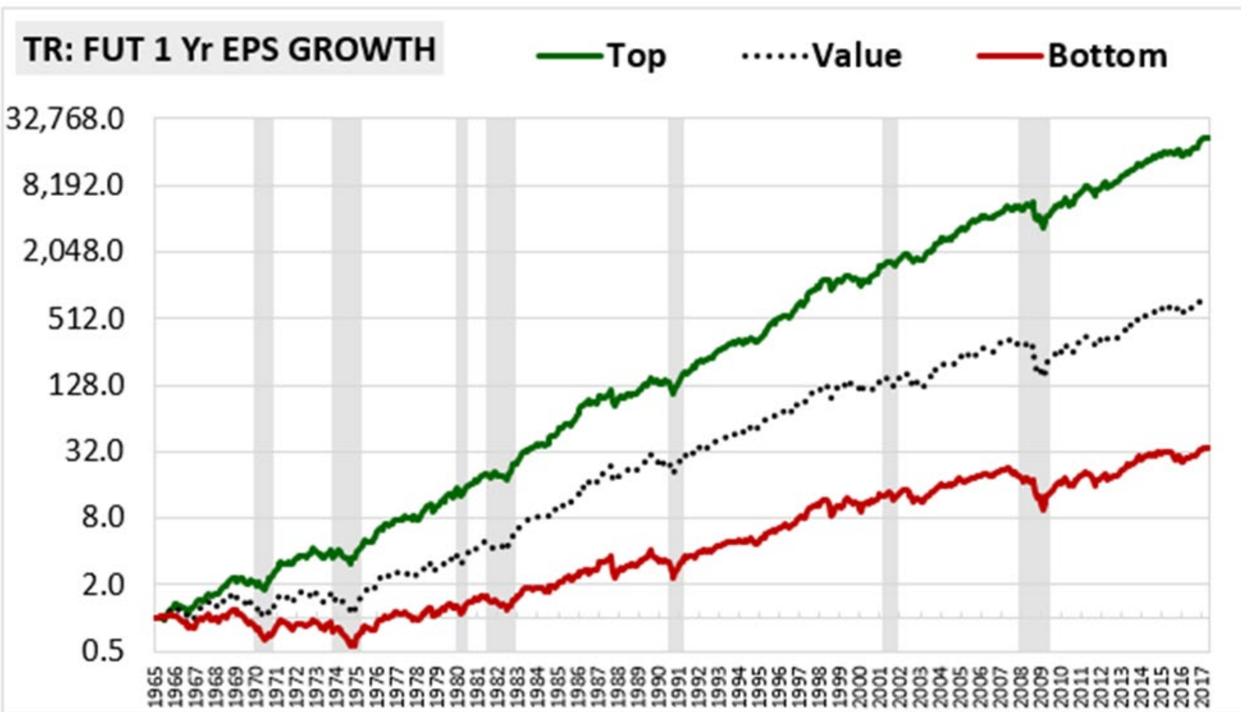
Unfortunately, the future didn't play out as well for $IBM investors. Instead of growing over the period, $IBM's earnings declined, shrinking at a rate of -6.3% per year.[3] When evaluating the severity of this decline, it's important to remember that the company reinvested the majority of its earnings during the period into capital expenditures and share buybacks. The -6.3% number **includes** the growth benefits of that reinvestment, suggesting that the performance of the core business was even worse. Given this outcome, there wasn't any reason for the stock to be re-rated higher. To the contrary, it needed to be re-rated lower, which is what happened. Despite four years of earnings reinvestment, the price fell from $181.27 to $115.40, generating a loss of -6.5% per year for investors, -17.2% relative to the market.

2 Approximately 5.3% of $AAPL's 15.0% annual EPS growth was due to the share-count-shrinking effect of net share buybacks. The other 9.7% was organic.
3 The 10/2018 numbers shown in the table exclude a large tax charge that $IBM took in the 4Q of 2017.

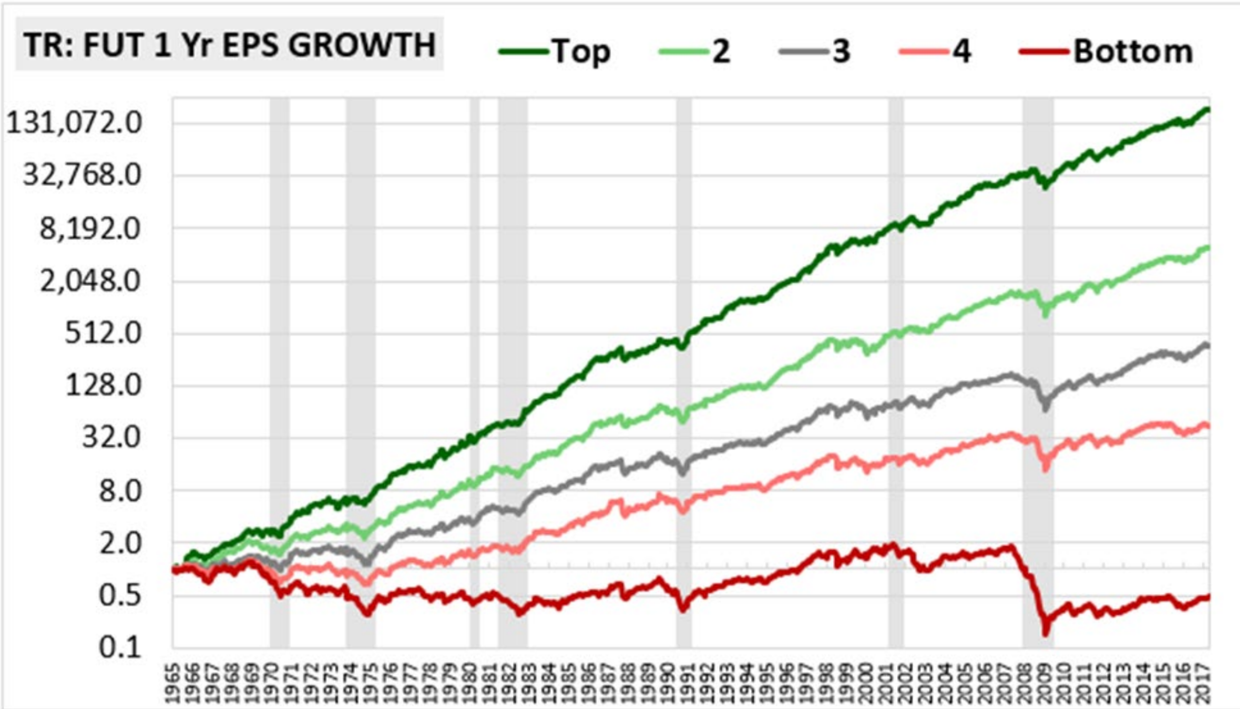
The examples of $AAPL and $IBM illustrate an important and obvious truth that often gets missed in conversations about value. Value works when it's **real**—i.e., when stocks priced cheaply relative to their current earnings sustain and grow those earnings over the long-term. Value fails when it's **fake**—i.e., when stocks priced cheaply relative to their current earnings suffer declines in those earnings that never get recovered. In hindsight, we can see that the value in 2014 $AAPL was real while the value in 2014 $IBM was fake. The results for investors played out accordingly.

The Impact of Future Growth

The chart below offers a dramatic illustration of the difference between real and fake value. To construct it, we build an equally-weighted, annually-rebalanced **value factor** portfolio consisting of the cheapest quintile of large cap stocks on the P/E ratio. On each June rebalancing date, we look out one year into the future and divide the portfolio into two bins based on EPS growth over the **upcoming** holding period, with the first bin containing stocks that rank in the **top half** on future EPS growth and the second bin containing stocks that rank in the **bottom half**. We repeat this exercise in each June month from 1965 through 2017, tracking the cumulative total returns of the two bins:



As you can see in the chart, the top-half growth bin, shown in green, dramatically outperforms the bottom-half growth bin, shown in red. As we increase the number of bins, the return differentiation increases. In the chart below, we increase the number of bins from 2 (halves) to 5 (fifths):



The following table quantifies the performance, showing annualized total returns for the market, the value factor and the value factor separated into halves, thirds and fifths based on future one-year EPS growth:

TOTAL RETURN: 1965 - 2017	TOP	2	3	4	BOTTOM
MKT: LARGE STOCKS			10.72%		
VALUE: BEST QUINT P/E			13.25%		
HALVES: FUT 1 Yr EPS GROWTH	20.45%			5.14%	
THIRDS: FUT 1 Yr EPS GROWTH	23.69%		11.96%		2.45%
FIFTHS: FUT 1 Yr EPS GROWTH	26.52%	17.84%	12.14%	7.55%	-1.34%

As the table makes clear, future earnings outcomes have an enormous impact on the return performance of the value factor. The simple act of dividing the factor into two halves based on future growth is enough to split the return into a massive 20.45% per year on one end and an unimpressive 5.14% on the other. As the number of bins is increased, the spread grows larger. On fifths, for example, the top-ranked bin generates an eye-popping return of 26.52% per year while the bottom-ranked bin generates a loss of -1.34% per year.

Investors in the real world don't have the ability to look into the future and distinguish stocks based on future growth outcomes. The exercise that we're engaging in here may therefore seem like pointless cheating. It's definitely cheating, but it's not pointless. It provides a powerful demonstration of the importance of future earnings outcomes in the generation of the value premium. It clarifies the basic challenge that value investors face: that of finding cheap stocks whose earnings are going to grow.

For interested readers, we've written an appendix in which we separate the returns of each of the above bins into contributions from multiple expansion and earnings growth. We use the results to gain additional insights into the value factor's inner workings.

The Market as a Control Case

Information about future earnings growth is important not just to value investing, but to all investing. A stock, after all, is nothing more than a stream of future earnings, a portion of which gets paid out to the owners and a portion of which gets reinvested into the future growth of the stream. If we know the amount of the future stream and we know the current price, then, **fundamentally**, we know everything that there is to know about the stock.[4] For this reason, we should expect to see strong return differentiation emerge when **any** investment strategy is separated out based on future earnings outcomes—not just the value factor, but **all** investment strategies. If we want to draw particular conclusions about the return differentiation observed within the value factor, we need to compare it to a control case.

A great control case to use is the market itself. We show results for that control case in the table below, conducting the same forward-looking exercise on the equal-weighted large cap market that we conducted on the value factor. In each June month, we look out one year into the future and separate the stocks in the market into different bins based on their future one-year EPS growth numbers:

<table>
<tr><th>TOTAL RETURN: 1965 - 2017</th><th colspan="6">TOP</th><th colspan="6">2</th><th colspan="6">3</th><th colspan="6">4</th><th colspan="6">BOTTOM</th></tr>
<tr><td>MKT: LARGE STOCKS</td><td colspan="30">10.72%</td></tr>
<tr><td>(MKT) HALVES: FUT 1 Yr EPS GROWTH</td><td colspan="15">17.56%</td><td colspan="15">3.00%</td></tr>
<tr><td>(MKT) THIRDS: FUT 1 Yr EPS GROWTH</td><td colspan="10">19.45%</td><td colspan="10">10.75%</td><td colspan="10">0.37%</td></tr>
<tr><td>(MKT) FIFTHS: FUT 1 Yr EPS GROWTH</td><td colspan="6">20.58%</td><td colspan="6">16.53%</td><td colspan="6">11.04%</td><td colspan="6">4.96%</td><td colspan="6">-2.60%</td></tr>
</table>

As expected, we see a similar pattern of differentiation, with the top growth bins generating significantly stronger returns than the bottom growth bins. However, when we compare these results to our earlier results for the value factor, we notice an interesting difference: the value factor receives a greater relative contribution

[4] This point assumes that the earnings have been accurately reported and that they are going to be appropriately stewarded by whoever controls their allocation.

from its top growth bins than the market receives. The table below makes this difference more clear. It shows the annualized geometric **excess** return[5] of each value factor growth bin over the corresponding market growth bin:

EXCESS TOTAL RETURN: 1965 - 2017	TOP	2	3	4	BOTTOM
VALUE: BEST QUINT P/E			2.28%		
HALVES: FUT 1 Yr EPS GROWTH		2.45%		2.08%	
THIRDS: FUT 1 Yr EPS GROWTH	3.55%		1.09%		2.07%
FIFTHS: FUT 1 Yr EPS GROWTH	4.93%	1.13%	0.99%	2.48%	1.28%

As you can see, the excess return of the value factor over the market is noticeably larger for the top growth bins than for the other growth bins. On fifths, for example, the top value factor growth bin earns an extra 4.93% per year over the top market growth bin, whereas the other value factor growth bins only earn between 0.99% and 2.48% over the corresponding market growth bins.

Another noticeable difference is that the **spreads** between the returns of the top growth bins and the returns of the bottom growth bins are more pronounced inside the value factor than inside the market. The table below highlights this difference by showing the annualized geometric top-over-bottom value factor return spreads alongside the same spreads for the market on six different future one-year growth partitionings: halves, thirds, fifths, tenths, twentieths, and fortieths:

EXCESS TOTAL RETURN: 1965 - 2017	VALUE	MARKET
HALVES: TOP over BOTTOM	14.56%	14.14%
THIRDS: TOP over BOTTOM	20.73%	19.01%
FIFTHS: TOP over BOTTOM	28.25%	23.79%
TENTHS: TOP over BOTTOM	37.25%	28.15%
20THS: TOP over BOTTOM	42.92%	33.41%
40THS: TOP over BOTTOM	57.23%	39.64%

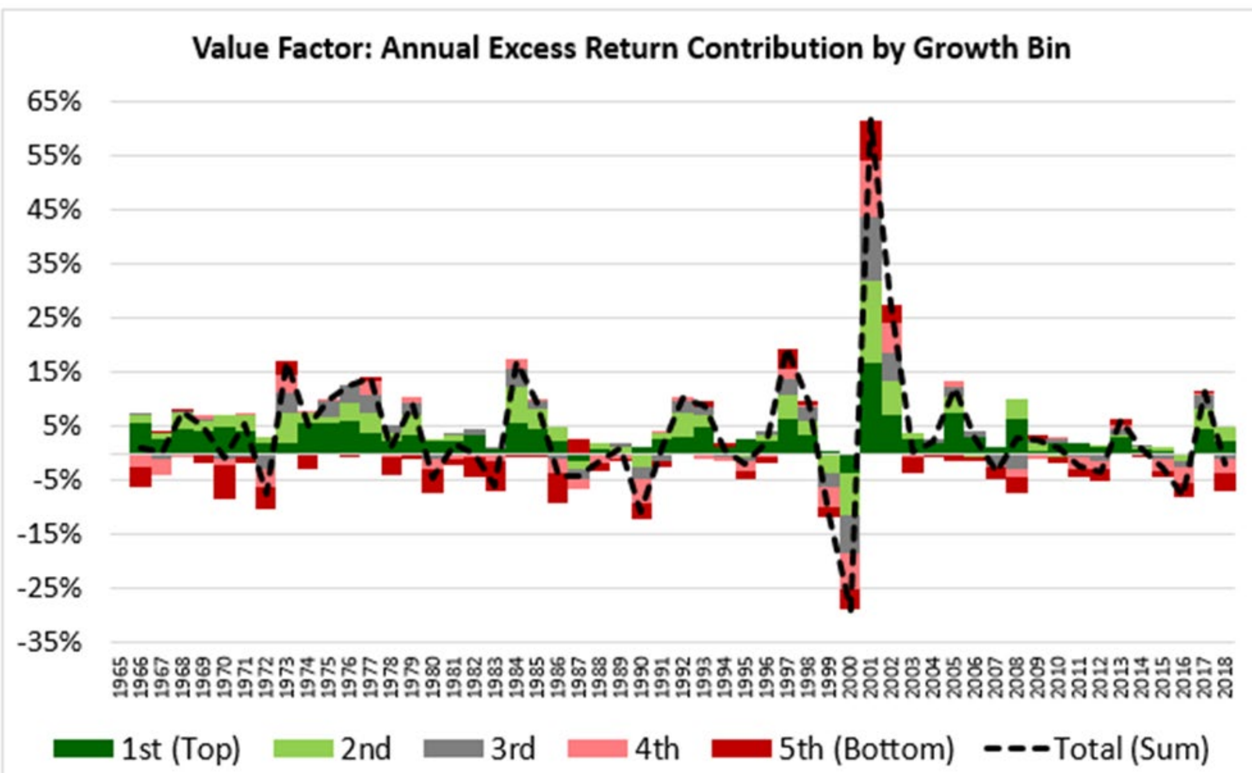
[5] To calculate the annualized geometric excess return, we take the cumulative, non-annualized total return of the specified growth bin of the value factor and divide it by the cumulative, non-annualized total return of the associated growth bin of the market. We then annualize the resulting ratio.

As you can see, the spreads are consistently larger in the value factor than in the market, and they increase more in the value factor than in the market as the partitionings are increased. The implication is that information about future growth outcomes is **more powerful** and **more valuable** when investing in **cheap** stocks than when investing in the market more generally.

Growth Bin Contributions Across History

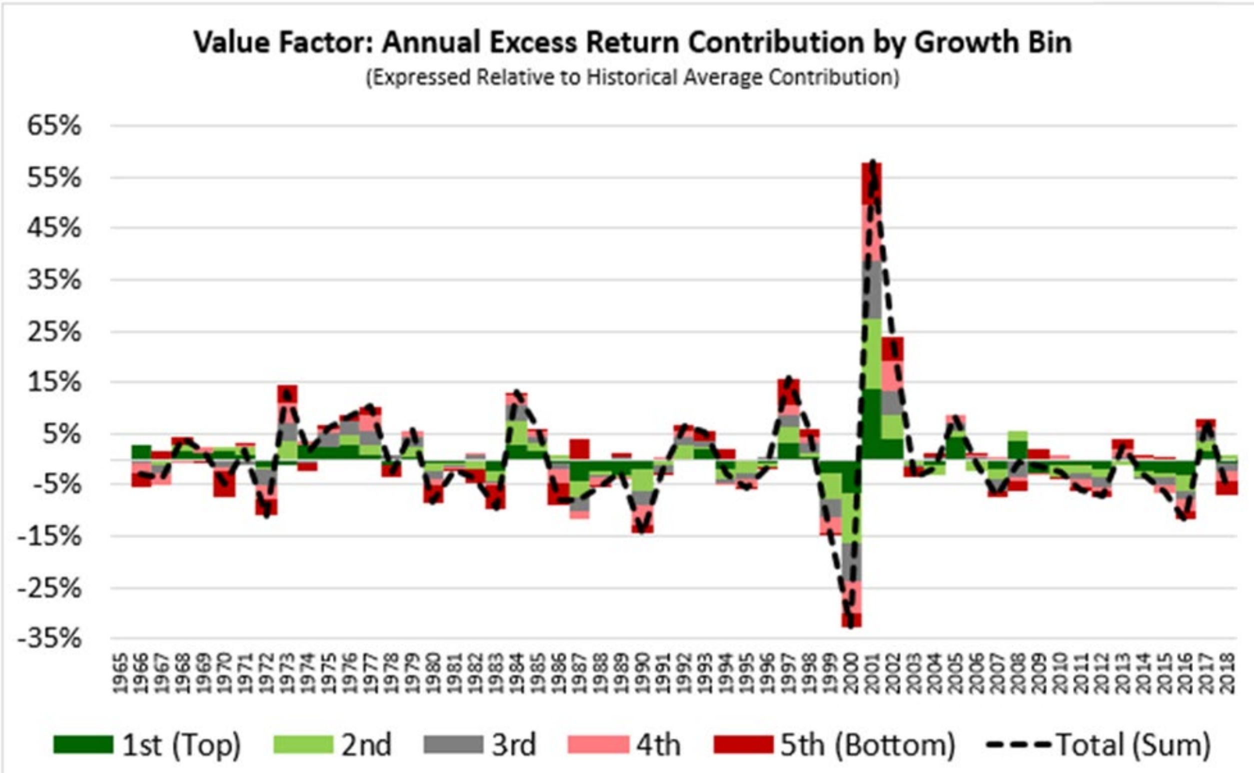
Because the different growth bins of the value factor are equally-weighted partitions of an equally-weighted factor, the factor itself can be represented as a collective "sum" of all of the bins. We can use this fact to decompose the value factor's annual returns into separate contributions from each bin, comparing the current contributions to the historical contributions and drawing conclusions about the drivers of fluctuations in the factor's performance over time.

In the chart below, we show the excess return contribution of each growth bin of the value factor over the return of the broad market (just the simple return of the broad market itself, with no further differentiation based on market growth bins) in each year from 1966 through 2018. The return contribution associated with each year is the contribution from June of the prior year to June of that year. The sum of the different contributions, represented as the dotted black line, is just the excess return of the overall value factor itself:



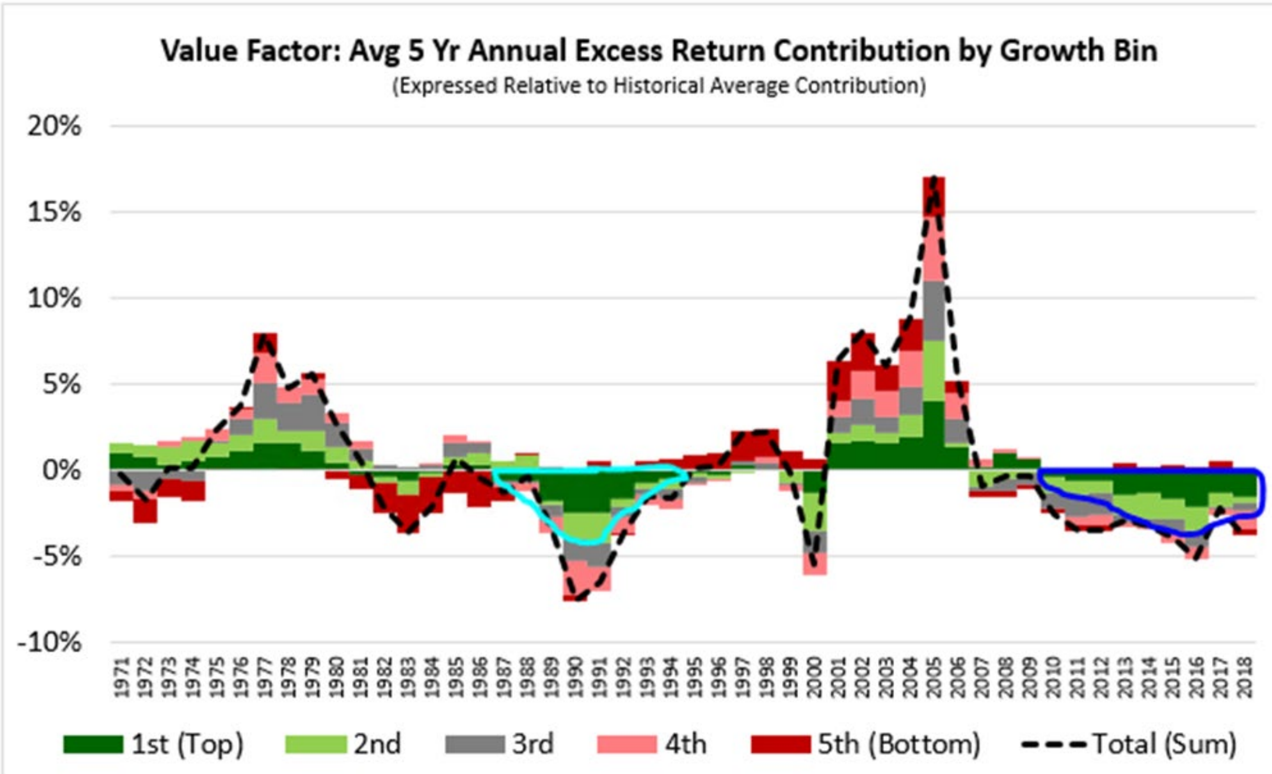
Unsurprisingly, the top growth bins (green, light green) tend to make strong positive contributions to the factor's returns, while the bottom growth bins (red, pink) tend to make negative contributions. The contribution from the middle growth bin (gray) leans positive, but also tends to oscillate from positive to negative in a way that mirrors the factor's overall performance (which is obviously impacted by the oscillations). On the whole, the factor tends to outperform because the positive contributions from the top and middle growth bins tend to outweigh the negative contributions from the bottom growth bins.

In the chart below, we show the excess return contribution of each growth bin **relative to its historical average** contribution. We're looking to see how the contributions have fluctuated over time relative to their historical norms:



Looking specifically at the most recent period of the chart, we notice an interesting change. The contributions from the top growth bins have frequently been negative during the period, suggesting that those bins have failed to contribute as much to the value factor's returns as they did in the past.

To make the change easier to see, the chart below averages the contributions of each growth bin over trailing five-year periods. The recent area of weakness is circled in blue:



As you can see, the recent contribution from the top growth bin has been strongly negative relative to its historical average—indeed, **more** negative than the contributions from the bottom bins.

When the value factor underperforms, our inclination is to blame the underperformance on the trashier parts of the factor, i.e., the "value traps" that sit in its lower growth bins. But those bins aren't always to blame. As we see in the most recent period, the underperformance can just as easily emerge out of weakness in the factor's higher growth bins, which sometimes fail to add to returns in a way that is consistent with their histories. If the positive contributions from the higher growth bins drop off substantially, then there won't be anything to offset the natural weakness found in the lower growth bins, and the factor itself will tend to underperform.

We should note, in passing, that the recent weakness in the value factor's higher growth bins is not a new phenomenon. As you can see in the area circled in aqua, weakness from those bins was also an important contributor to the extended period of underperformance that the factor experienced in the late 1980s.

SECTION 2: CAPTURING THE RETURNS

The challenge in value investing is to identify **real value**—i.e., stocks priced cheaply relative to current earnings that will sustain and grow those earnings over time. The question, of course, is whether we can meet that challenge using **presently-available** information alone. Up to now in the piece, we've been meeting it by cheating, by allowing ourselves to go into the future and identify the targeted stocks in hindsight. In the real world, that isn't an option.

Is it possible to **reliably** identify the top-growing stocks in the value factor using presently-available information? The answer is surely *no*, especially if presently-available information is limited to price and financial statement data. The forces that determine future earnings outcomes in businesses arise out of complex, idiosyncratic chains of causality that are not fully captured in that data.

But the point is, to do well as value investors, we don't need to reliably identify the top-growing stocks in the value space. All we need to do is **tilt** our portfolios in their direction, however slightly. As we saw earlier, the top growth bin of the value factor generates a historical return of more than 26% per year, 16% above the market. If we could manage to capture even a small fraction of that return, we would be doing very well.

Our challenge, then, is to find realistic ways to tilt a portfolio of value stocks in the direction of stronger future growth outcomes. In this section, we're going to introduce and analyze a simple three-step quantitative strategy that seeks to achieve that goal. OSAM doesn't actually use the simplified strategy that we're going to share, but it uses strategies that are based on similar concepts.

Step 1: Improving the Measurement of Value

The first step in the strategy is to improve the measurement of value. Valuation metrics that compare the price of a stock to some fundamental (e.g., earnings, sales, book value, etc.) face the problem of **selection bias**. By definition, they are biased to select companies with exaggerated or overstated expressions of that fundamental. The market knows that the fundamental is overstated, and therefore correctly prices the stock cheaply relative to it. But the valuation metric doesn't know this, and therefore wrongly concludes that the stock actually *is* cheap.

For a highly-relevant recent example of the problem of selection bias, consider the case of Berkshire Hathaway ($BRK-B). If you go online and check the P/E ratio of $BRK-B, you will see that it's unusually low—as of October 2018, the stock is trading at around $205 against trailing earnings of around $19, a multiple of roughly 11. A value strategy defined on the P/E ratio will therefore identify $BRK-B as a value stock and bring it into the portfolio. But when we examine $BRK-B's income statement, we find that the $19 number is illusory, the result of a large one-time tax gain taken in the fourth quarter of 2017.

Consolidated Statements of Earnings - USD ($) $ in Millions	12 Months Ended		
	Dec. 31, 2017	Dec. 31, 2016	Dec. 31, 2015
Revenues:			
Sales and service revenues	$ 132,900	$ 125,700	$ 112,400
Investment gains/losses	1,410	7,553	9,373
Total revenues	242,137	223,604	210,943
Costs and expenses:			
Interest expense	5,394	3,497	3,515
Total costs and expenses	221,237	190,860	175,875
Earnings before income taxes and equity in earnings of The Kraft Heinz Company	20,900	32,744	35,068
Equity in earnings (loss) of The Kraft Heinz Company	2,938	923	(122)
Earnings before income taxes	23,838	33,667	34,946
Income tax expense (benefit)	(21,515)	9,240	10,532
Net earnings	45,353	24,427	24,414
Earnings attributable to noncontrolling interests	413	353	331
Net earnings attributable to Berkshire Hathaway shareholders	$ 44,940	$ 24,074	$ 24,083

The market knows that $BRK-B's recurring future earnings will be significantly less than $19, which is why it is pricing the stock cheaply relative to that number. But the value factor as we've defined it can't tell the difference. It stupidly invests in $BRK-B, thinking that it's getting a bargain.

The Trump tax cuts passed at the end of 2017 have made tax-related accounting distortions such as the one seen in $BRK-B unusually common over the last year. These distortions have caused some investors to wrongly conclude that the value factor is generationally cheap relative to the market. But the apparent cheapness is illusory, a non-recurring consequence of a one-time change in government policy.

The problem with selection bias in the value factor is not that it necessarily causes losses, but rather that it weakens the signal that the factor is trying to capture. Berkshire Hathaway is an excellent company and could very well turn out to be a fantastic investment at its current price. But it's not the value stock that it appears to be. Absent specific information about it, we'd have to say that it's just market **beta**. When it gets inadvertently introduced into a value portfolio, it ends up diluting the exposure that the portfolio is trying to achieve.

A secondary problem with selection bias in the value factor is that it sets the factor up for illusory future earnings declines. Several months from now, when $BRK-B's one-time tax benefit has dropped out of the trailing-twelve-month period, the company will likely be earning something in the area of $10 per year, which means that it will officially experience a 50% decline in its earnings from current levels. Of course, this decline isn't going to be real, and therefore isn't going to hurt anyone, but it will distort the value factor's EPS profile, creating the appearance of a large drop that didn't actually happen.

It goes without saying that quantitative investors should try to represent the fundamentals that they are using in their valuation metrics in the most accurate way possible. In the case of $BRK-B, this would mean ensuring that one-time tax gains are taken out of the earnings measure. But the process of trying to exclude overstatements and exaggerations can quickly turn into a game of "whack-a-mole", where an attempt to eliminate a potential distortion in one area of the market ends up **creating** a different distortion in another. The problem is especially hard to solve when working with several thousands of companies across several decades of historical data.

A more practical solution, then, is to build a composite measure of valuation that averages the inputs of different valuation metrics together. Then, if a company wrongly appears cheap on one particular metric, as $BRK-B did, it won't get drawn into the portfolio, because it will have registered as not being cheap on the others.

At OSAM, we measure valuation using a composite index that takes inputs from the P/E ratio, the enterprise-value-to-ebitda ratio, the enterprise-value-to-free-cash-flow ratio and the price-to-sales ratio.[6] In testing, we've found that this approach generates excess returns that are smoother and more consistent than the metrics in isolation.

From here forward, when we refer to the "value factor", we will no longer be referring to the cheapest quintile of large cap stocks on the P/E ratio. Instead, we will be referring to the cheapest quintile of large cap stocks on our composite index, as defined above. Note that this change will lead to changes in the value factor's performance in certain periods relative to the results shown in prior charts and tables.

Step 2: Removing Value Traps

The second step in the process is to remove companies that are statistically likely to exhibit future fundamental weakness—companies that we will pejoratively refer to as “value traps.” To identify value traps, we score companies in the investment universe on four simplified indices:

1. **Momentum**: a measure of trailing total return; higher is better.
2. **Growth**: a measure of trailing change in earnings; higher is better.
3. **Earnings Quality**: a measure of accruals; lower is better.
4. **Financial Strength:** a measure of leverage; lower is better.

As a rule, we remove any company that scores in the bottom 10th percentile of the market on any of these indices. We use a low percentile as the cutoff point because we want to maximize the number of stocks remaining in the factor, so as to maximize the statistical reliability of the result. The strategy is able to substantially improve the performance despite a low cutoff point because the indices exhibit their greatest predictive power at the **bottom end** of the spectrum—that is, they predict bad stocks better than they predict good stocks, and the predictions get better as the rankings get lower.

[6] We exclude the popular price-to-book ratio because we believe that it does more harm than good. For an extensive analysis of its shortcomings, see this recent piece by our colleague Travis Fairchild.

In the table below, we highlight the performance differences between value stocks, value traps and the large cap market by calculating a series of **arithmetic** averages for each category. More specifically, we calculate the arithmetic average excess total return over the **next** year of every value stock, every value trap, and every large cap stock that existed between December 1962 and May 2017.[7] We also show the **allocation** of value traps to each future EPS growth bin of the value factor—i.e., the **percentage** of value trap stocks that were also stocks in those value factor growth bins:

1962 - 2017	Avg Excess TR	Allocation: Future EPS Growth Bins				
		Top	2nd	3rd	4th	Bottom
MKT: LARGE STOCKS	0.00%	-	-	-	-	-
VALUE: TOP QUINTILE	2.74%	20.0%	20.0%	20.0%	20.0%	20.0%
VALUE TRAPS	0.04%	16.0%	13.8%	16.3%	21.8%	32.1%

Calculating arithmetic averages is a slightly inaccurate way of depicting returns, but in this case, it's sufficient to capture the relevant performance differences. As a group, value stocks generate a 2.74% average excess return over the market, while value stocks that meet value trap criteria generate an average excess return of only 0.04%—essentially no excess return at all. The losses associated with being a value trap, then, are large enough to erase the value premium altogether.

Looking at the area boxed in red, we see that the poor performance of value traps is associated with a substantial increase in allocation to the bottom growth bin of the value factor. A full 32.1% of value traps are stocks that come from that bin, in comparison with 20% of value stocks more generally. The increased allocation to the bottom growth bin is mirrored by a notable decrease in allocation to the median and top growth bins, boxed in gray, light green, and dark green, respectively.

[7] The excess return over the next year of a given stock in a given month is defined relative to the return over the next year of the rest of the market in that month.

In the table below, we show the future one-year EPS growth profiles of the different categories of stocks. The numbers are calculated over one-year periods that begin in each month and that extend out to the same month one year later. We express the growth profiles in the form of average percentile marks, ranging from the 10th percentile to the 90th percentile.[8] In the right-hand column, we show the average of all of the percentile marks:

1962 - 2017	Future One-Year EPS Growth Percentile Mark									Avg
	10th	20th	30th	40th	50th	60th	70th	80th	90th	
MKT: LARGE STOCKS	-52.2%	-19.2%	-4.4%	4.5%	11.2%	17.9%	27.3%	44.9%	95.0%	13.9%
VALUE: TOP QUINTILE	-62.5%	-32.6%	-17.2%	-7.0%	0.7%	7.6%	14.6%	23.7%	42.9%	-3.3%
VALUE TRAPS	-105.7%	-59.5%	-38.2%	-23.4%	-12.7%	-3.0%	6.3%	17.3%	40.9%	-19.8%

As you can see, value stocks that meet value trap criteria exhibit a future growth profile that is significantly more negative than the profiles of the market and the larger value universe. They go negative at the 60th percentile rather than the 30th and 40th percentiles, respectively, and they suffer extreme losses on the lower tail end of the distribution. Their percentile marks average to -19.8%, significantly lower than the average 13.9% and -3.3% observed in the market and the larger value universe, respectively.

The evidence confirms that value traps, which we've identified using simple, currently-observable data points, expose us to more of the **bad** parts of the value factor and less of the **good** parts—a tendency that explains their weak returns. We have no reason to want them in our portfolios, so we take them out.

The table below shows the arithmetic average excess total return and future growth bin allocation of the value factor with value traps **removed** ("Value ex Traps"):

1962 - 2017	Avg Excess TR	Allocation: Future EPS Growth Bins				
		Top	2nd	3rd	4th	Bottom
MKT: LARGE STOCKS	0.00%	-	-	-	-	-
VALUE: TOP QUINTILE	2.74%	20.0%	20.0%	20.0%	20.0%	20.0%
VALUE ex TRAPS	3.60%	22.0%	21.9%	21.2%	19.4%	15.5%

The average excess return increases from 2.74% to 3.60%, a gain of 0.86%. As expected, the improvement is associated with a significant reduction in the value factor's allocation to the bottom growth bin, which falls from 20.0% to 15.5%.

[8] We calculate the average percentile marks by computing the actual percentile marks in each month and then averaging all the months together across history.

In the table below, we show the future one-year EPS growth profile of the value factor with value traps removed:

1962 - 2017	Future One-Year EPS Growth Percentile Mark									Avg
	10th	20th	30th	40th	50th	60th	70th	80th	90th	
MKT: LARGE STOCKS	-52.2%	-19.2%	-4.4%	4.5%	11.2%	17.9%	27.3%	44.9%	95.0%	13.9%
VALUE: TOP QUINTILE	-62.5%	-32.6%	-17.2%	-7.0%	0.7%	7.6%	14.6%	23.7%	42.9%	-3.3%
VALUE ex TRAPS	-48.4%	-23.9%	-11.7%	-3.0%	3.6%	9.8%	16.3%	25.0%	43.5%	1.2%

The lower percentile marks increase significantly, suggesting that the removal is chopping off a substantial portion of the negative left tail of the value factor's EPS growth distribution. Surprisingly, with value traps removed, the 10th percentile of EPS growth in the value factor ends up being **higher** than the market's 10th percentile, coming in at -48.4% versus the market's -52.2%. This is a noteworthy improvement considering that value stocks tend to have future growth profiles that are substantially more negative than the growth profiles of the market.

Step 3: Selecting the Best of What Remains

The third step in the process is to select the highest ranking value stocks out of what remains once the value traps have been removed. To do this, we average the index scores of each company together to form a composite score. We then select the top half of the remaining stocks based on that composite score. We refer to those stocks as "value leaders" and make equal-weighted investments in them to form the final portfolio.

The table below shows the average excess return and future growth bin allocations of value leaders as a group:

1962 - 2017	Avg Excess TR	Allocation: Future EPS Growth Bins				
		Top	2nd	3rd	4th	Bottom
MKT: LARGE STOCKS	0.00%	-	-	-	-	-
VALUE: TOP QUINTILE	2.74%	20.0%	20.0%	20.0%	20.0%	20.0%
VALUE ex TRAPS	3.60%	22.0%	21.9%	21.2%	19.4%	15.5%
VALUE LEADERS	4.40%	27.4%	24.8%	20.0%	16.4%	11.4%

Value leaders generate an average excess return of 4.40% per year, 1.66% higher than the value factor's 2.74% return. The increase in return coincides with a substantial increase in exposure to the value factor's top growth bin (20.0% to 27.4%) and a substantial decrease in exposure to the value factor's bottom growth bin (20.0% to 11.4%).

In the table below, we show the future one-year EPS growth profile of value leaders:

1962 - 2017	Future One-Year EPS Growth Percentile Mark									Avg
	10th	20th	30th	40th	50th	60th	70th	80th	90th	
MKT: LARGE STOCKS	-52.2%	-19.2%	-4.4%	4.5%	11.2%	17.9%	27.3%	44.9%	95.0%	13.9%
VALUE: TOP QUINTILE	-62.5%	-32.6%	-17.2%	-7.0%	0.7%	7.6%	14.6%	23.7%	42.9%	-3.3%
VALUE ex TRAPS	-48.4%	-23.9%	-11.7%	-3.0%	3.6%	9.8%	16.3%	25.0%	43.5%	1.2%
VALUE LEADERS	-33.4%	-15.4%	-4.9%	2.6%	8.9%	14.8%	21.2%	30.7%	50.0%	8.3%

As you can see, the percentile marks for the value leaders strategy are higher than the percentile marks for the value factor at every percentile. The overall average of the marks is +8.3%, a significant improvement over the value factor's -3.3%.

Summarizing the Results

In the table below, we show the future value factor growth bin allocations of all of the strategies that we've analyzed up to this point. Recall that these allocations simply denote the share of stocks in each strategy that fall into the different future EPS growth bins of the value factor. For reference, we've included the allocations of the top and bottom growth bins themselves:

1962 - 2017	Avg Excess TR	Allocation: Future EPS Growth Bins					Net Shift
		Top	2nd	3rd	4th	Bottom	
VALUE: TOP QUINTILE	2.74%	20.0%	20.0%	20.0%	20.0%	20.0%	-
VALUE TRAPS	0.04%	16.0%	13.8%	16.3%	21.8%	32.1%	-20.13%
VALUE ex TRAPS	3.60%	22.0%	21.9%	21.2%	19.4%	15.5%	+7.72%
VALUE LEADERS	4.40%	27.4%	24.8%	20.0%	16.4%	11.4%	+20.13%
TOP GROWTH BIN	13.23%	100.0%	0.0%	0.0%	0.0%	0.0%	+100.00%
BOTTOM GROWTH BIN	-8.08%	0.0%	0.0%	0.0%	0.0%	100.0%	-100.00%

In the far-right column of the table, we show the **net shift** of each strategy towards a full allocation to the **top** value factor growth bin.[9] The scale is defined such that a +100.00% net shift signifies that the strategy has moved from an equal allocation to a 100% top growth bin allocation. A -100.00% net shift signifies the opposite—a shift from an equal allocation to a 100% bottom growth bin allocation.

As you can see in the cell boxed in green, the value leaders strategy exhibits a net shift of +20.13%—an impressive number, considering that it's using only presently-available information. The strategy may not be able to **perfectly** predict the top-growing value stocks in advance, but it's able to strongly tilt the allocation in their direction, which was the goal that we specified at the outset.

In the table below, we present statistical results for the strategies:

1962 - 2017	Avg Excess TR	Statistical Analysis					
		N	eff N	t_m	p_m	t_v	p_v
MKT: LARGE STOCKS	0.00%	247,530	21,115	-	-	-	-
VALUE: TOP QUINTILE	2.74%	49,754	4,242	5.97	0.0000	-	-
VALUE TRAPS	0.04%	12,086	1,017	0.05	0.3984	-3.20	0.002
VALUE ex TRAPS	3.60%	37,668	3,225	6.85	0.0000	1.83	0.075
VALUE LEADERS	4.40%	18,672	1,601	5.89	0.0000	2.47	0.019

Value traps represent roughly 25% of the value universe, with non-trap value stocks representing the remaining 75%. Value leaders represent half of the non-trap value stocks, or roughly 38% of the overall value universe.

The sample sizes ("N") in the analysis are extremely large, but they contain overlapping monthly results—for example, they include $AAPL's returns from January of 2008 to January of 2009, February of 2008 to February of 2009, March of 2008 to March of 2009, and so on. Because these results overlap with each other, they do not represent fully independent samples of the space. To be maximally conservative, we've therefore calculated the t-stats and p-values using **effective** sample sizes ("eff N"), defined as the number of non-overlapping June-to-June samples (roughly one-twelfth of the larger sample sizes).

The columns labeled "t_m" and "p_m" show the t-stats and p-values of each strategy when tested against the market. The results are not particularly informative, however, because the strategies were built from the value universe and therefore already contain the excess returns of the value factor within them. The strategies therefore need to be tested against the value factor itself. We show the results of tests of the strategies against the value factor in columns "t_v" and "p_v." As you can see, the excess return of the value leaders strategy over the value factor is statistically significant to the 0.05 level.

[9] We define the net shift as the change in the allocation to the top bin plus half the change in the allocation to the 2nd bin minus half the change in allocation to the 4th bin minus the change in allocation to the bottom bin.

In the table below, we show the future one-year EPS growth profiles of all of the strategies. The numbers in the columns are averages of the EPS growth values that demarcated the specified percentiles in the strategies across history, from the 10th percentile to the 90th percentile:

1962 - 2017	Future One-Year EPS Growth Percentile Mark									Avg
	10th	20th	30th	40th	50th	60th	70th	80th	90th	
MKT: LARGE STOCKS	-52.2%	-19.2%	-4.4%	4.5%	11.2%	17.9%	27.3%	44.9%	95.0%	13.9%
VALUE: TOP QUINTILE	-62.5%	-32.6%	-17.2%	-7.0%	0.7%	7.6%	14.6%	23.7%	42.9%	-3.3%
VALUE TRAPS	-105.7%	-59.5%	-38.2%	-23.4%	-12.7%	-3.0%	6.3%	17.3%	40.9%	-19.8%
VALUE ex TRAPS	-48.4%	-23.9%	-11.7%	-3.0%	3.6%	9.8%	16.3%	25.0%	43.5%	1.2%
VALUE LEADERS	-33.4%	-15.4%	-4.9%	2.6%	8.9%	14.8%	21.2%	30.7%	50.0%	8.3%
TOP GROWTH BIN	26.8%	29.8%	33.5%	37.9%	43.6%	52.0%	65.0%	89.0%	166.6%	60.5%
BOTTOM GROWTH BIN	-179.0%	-121.9%	-94.6%	-78.6%	-66.6%	-57.2%	-50.6%	-45.0%	-39.8%	-81.5%

Relative to the value factor, the value ex trap and value leaders strategies exhibit increased future EPS growth profiles at all percentiles, achieving the largest improvements at the lower end of the distribution.[10]

[10] The average number shown in the right-hand column is not the actual average future EPS growth, but rather the average of the 10th through the 90th percentile marks. If computed on all stocks, the actual average number would be lower because EPS growth at the far-left end of the distribution is disproportionately negative.

Different Periods of Market History

In the table below, we show the excess returns of the different strategies across different periods of market history:

1962 - 2017	Full Avg	Avg Excess Returns by Time Period					
		1962-1975	1976-1985	1986-1995	1996-2005	2006-2011	2012-2017
VALUE: TOP QUINTILE	2.74%	2.93%	4.82%	2.03%	4.59%	-1.77%	1.84%
VALUE TRAPS	0.04%	-1.83%	1.83%	-0.17%	3.61%	-5.68%	0.70%
VALUE ex TRAPS	3.60%	4.40%	5.54%	2.74%	4.92%	-0.25%	2.25%
VALUE LEADERS	4.40%	5.85%	6.53%	2.89%	6.10%	-0.71%	3.50%
ALPHA: LEADERS - VALUE	1.66%	2.93%	1.72%	0.86%	1.51%	1.06%	1.67%

We define the "alpha" of the value leaders strategy as the difference between its excess return and the excess return of the value factor. As you can see, the value leaders strategy generated positive alpha in every period analyzed. It also beat the overall market in every period except 2006 to 2011, which was the period that overlapped with the financial crisis.

The table below shows the allocation of the value leaders strategy of to the different growth bins of the value factor in each period:

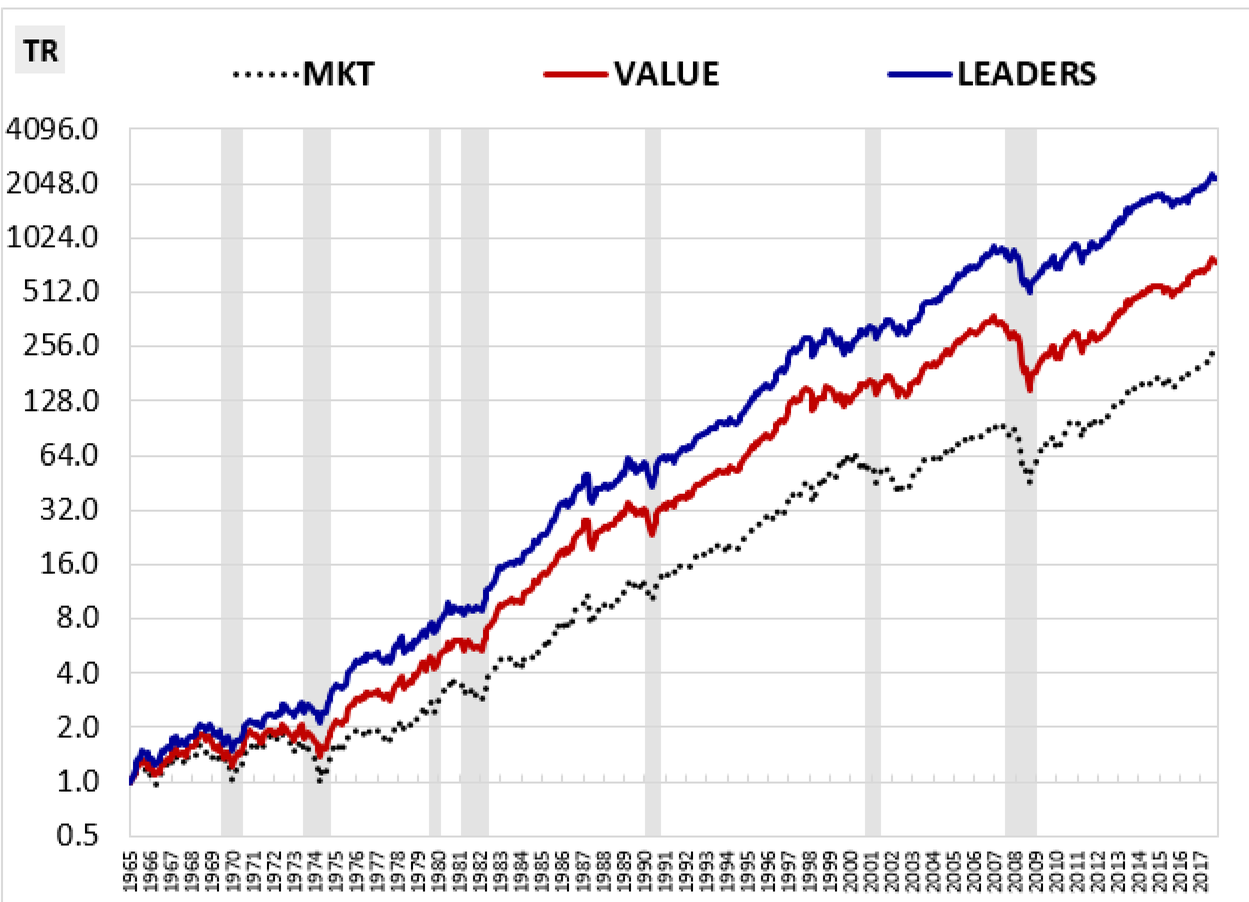
LEADERS: 1962 - 2017	Full Avg	Allocation to Future EPS Growth Bin by Time Period					
		1962-1975	1976-1985	1986-1995	1996-2005	2006-2011	2012-2017
TOP	27.4%	29.2%	28.6%	24.4%	28.1%	27.2%	26.6%
4	24.8%	23.3%	23.8%	25.0%	25.3%	25.0%	26.6%
3	20.0%	21.0%	18.8%	20.4%	20.7%	20.3%	18.5%
2	16.4%	16.2%	17.0%	16.2%	16.2%	17.3%	15.5%
BOTTOM	11.4%	10.3%	11.8%	14.0%	9.6%	10.2%	12.8%
NET SHIFT: TO TOP	+20.13%	+22.48%	+20.23%	+14.84%	+23.09%	+20.79%	+19.30%

We stated at the outset that our goal was to use presently-available information to shift the allocations of the value factor towards higher future growth bins. As you can see in the table, the value leaders strategy **consistently** achieves that goal. The net shift is roughly 20% or higher in every period of the table. The one exception is the period from 1986 to 1995 —a period that, not coincidentally, also represented the low point in the strategy's alpha.

Performance of the Value Leaders Portfolio

The excess returns shown in the tables above were determined by calculating simple **arithmetic** averages of the excess returns of all stocks that fell into the various strategies across history. The disadvantage to this calculational approach is that it penalizes the value leaders strategy relative to the value factor and the market. More specifically, it makes the excess returns of the value leaders strategy over those strategies appear **smaller** than they actually are.[11] For a fully accurate assessment of the value leaders strategy's performance, we need to use a **geometric** approach, where we represent the strategy as an actual portfolio that compounds over time.

In the chart below[12], we show the cumulative total returns of portfolios consisting of the equally-weighted market, the value factor and the value leaders strategy from June 1965 through March 2018. The portfolios are rebalanced annually at the end of each June month:



[11] Arithmetic averaging numerically boosts returns relative to geometric averaging. The boosts tend to be greater when the variance of the series is greater. Because the returns of the value factor and the returns of the market exhibit greater variance than the returns of the value leader strategy, they get larger boosts from the arithmetic averaging. Consequently, the **excess** return of the value leaders strategy over those benchmarks ends up appearing smaller.

[12] We exclude the 1962 through 1965 period because the number of stocks in that period is too small to support a robust analysis.

All told, the value leaders strategy generates a compound annual total return of 15.71%, 4.91% above the equally-weighted large cap universe and 2.34% above the value factor:

PERFORMANCE: 1965 - 2017	TOTAL RETURN
MKT: LARGE STOCKS	10.80%
VALUE: TOP QUINTILE	13.37%
VALUE LEADERS	15.71%
ALPHA: LEADERS - MKT	4.91%
ALPHA: LEADERS - VALUE	2.34%

Using the methods introduced in **Factors from Scratch**, we can decompose the total returns of the strategy into contributions[13] from holding period multiple expansion and holding period EPS growth. The results are presented in the table below:

1965-2018	Return Decomposition		
	MKT	VALUE	LEADERS
TOTAL RETURN	10.80%	13.37%	15.71%
MULTIPLE EXPANSION	-1.21%	26.46%	10.92%
EPS GROWTH	11.24%	-13.63%	4.27%

The improvement in returns is associated with an increase in holding period EPS growth from **negative** 13.63% to **positive** 4.27%. With this increase, the strategy is achieving the goal that we specified at the outset. It's improving the returns of the value factor by tilting the factor's exposure in the direction of value stocks with stronger future earnings growth.

The outperformance of the value leaders strategy is notable for three reasons:

First, it requires only a modest amount of intervention. The percentage of original value stocks retained in the final strategy--38%--is relatively large. Moreover, the strategy is rebalanced annually, rather than quarterly or monthly. These characteristics suggest that the strategy is able to accomplish more with less.

Second, it's occurring entirely in the large cap space, a space in which factor signals are comparatively weak and, according to some, non-existent.

Third, it's associated with a significant shift in allocation towards the value factor's top growth bins, a shift that we **know** is efficacious, given the extreme levels of outperformance produced by stocks in those bins.

[13] Using the terminology of the piece, the return from holding period multiple expansion is just the rebalancing growth and the return from holding period EPS growth is just the holding growth. These returns do not exactly add up to the total return because there is a small return contribution from unrebalanced (end-to-end) change in valuation. To keep things simple, we've left that contribution out of the table.

CONCLUSION—Where We Go From Here

As investors, our goal is to understand and capitalize on every advantage available to us in markets. The discovery of primary factors—e.g., value and momentum—represented an important step toward that goal.

The next step is alpha **within** factors.

In this piece, we showed that it's possible to generate alpha within the value factor by shifting its allocation in the direction of stocks with better future earnings outcomes. We used additional factors that are correlated with those outcomes—specifically: momentum, trailing growth, accruals and leverage—to filter out value traps and identify the strongest companies out of what remains. The reality, of course, is that these additional factors are well-known and widely implemented in markets. In practice, we therefore use methods that are more focused and refined. We also take advantage of the benefits of concentration and size: factor investing is more powerful when applied in a concentrated manner and when used outside of the large cap space.

The advantage to focusing on future earnings outcomes in the context of value investing is that it moves the process beyond the trivial phase, into an area that actually requires expertise. It's easy to find stocks with low P/E ratios, but it's hard to determine whether those stocks will sustain and grow their earnings into the future. For skilled investors, that's a good thing—harder challenges mean less competition and a greater opportunity to outperform.

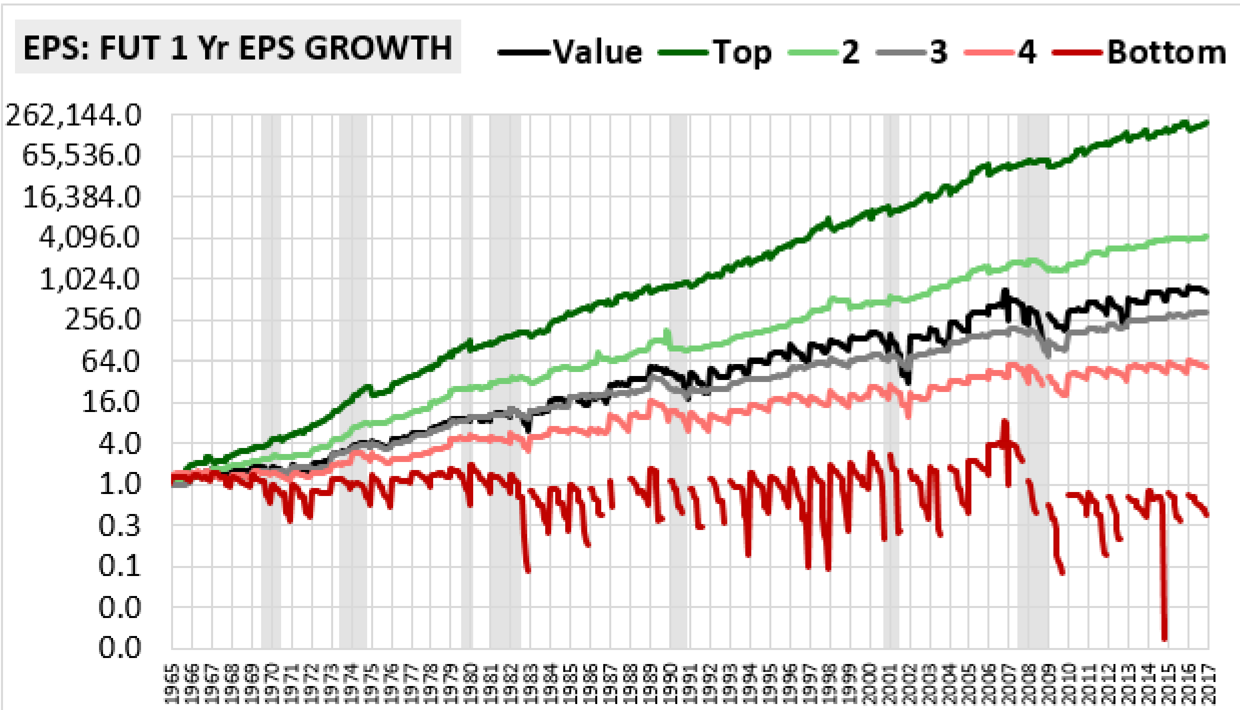
As quantitative investors, our basic approach to finding alpha is the scientific method. We use observation and analysis to identify hypotheses that are likely to be true. We then rigorously test those hypotheses in data, always treating the data as the absolute and final arbiter. But there's another approach that can be used to that end—the approach of differentiated modeling, commonly referred to as "machine learning." In machine learning, we let a computer algorithm come up with a hypothesis by allowing it to train on a subset of the data. We then test and validate what it comes up with on **other** subsets of the data that it has yet to see. Our next paper will examine simple but powerful ways in which machine learning can be used to identify alpha within factors.

In investing research, knowing what to search for is half the battle. The quantitative industry has traditionally searched for companies with strong future returns. But as we've shown in this piece, sometimes a better way to find those companies is to search for strength in a different, more predictable variable: future fundamental growth. We believe that identifying variables that lead to differentiated returns *within* factors is a great way to improve factor investing. We look forward to sharing future findings with you as we continue to explore this promising area of research.

Appendix: Additional Insights into the Value Factor's Inner Workings

In this appendix, we're going to explore the inner workings of the value factor by analyzing the properties and behaviors of its different future growth bins. To follow the analysis, readers will need to have read our earlier piece on the topic, Factors from Scratch.

The chart below shows the EPS of the value factor and its five future one-year EPS growth bins from 1965 through 2017. The black line is the EPS of the value factor itself and the colored lines are the EPS of the different growth bins within it, ranging from the top growth bin in green to the bottom growth bin in red. The vertical gridlines delineate the June rebalancing dates:



We can think of the black line as the aggregate EPS that we would end up with if we took the stocks that make up all of the other lines and threw them together into a single portfolio. If we follow the black line closely, we will notice that it declines substantially during the holding periods (the areas between the vertical gridlines). In Factors from Scratch, we calculated the average holding period decline to be -22.5% per year.

The presence of significant declines in the value factor's EPS growth profile creates the impression that value stocks are bad businesses—an impression that is partially correct. However, when interpreting the declines, we need to consider their origins. They are not being produced uniformly across the factor, but are instead emerging out of the **enormous** negative EPS growth contributions of the bottom growth bin, shown in blood red.

Rather than focus on the black line, we can get a better picture of the EPS profile of the "typical" value stock by examining the gray line, which represents the profile of the median future EPS growth bin. On average, the earnings of the companies in that bin are declining during the holding periods, but the declines aren't as pronounced as they are in the overall factor, which is being disproportionately weighed down by the bottom bin. Despite the small holding period declines, the EPS of the median bin is able to grow by more than the market EPS over time because it benefits from multiple expansion in the underlying companies, which shows up in the form of vertical EPS jumps that take place on the rebalancing dates.

In the table below, we decompose the returns of the value factor's different growth bins into annual contributions from holding period **multiple expansion** and holding period **EPS growth**. The contribution from multiple expansion is shown on the left side of each cell and the contribution from EPS growth is shown on the right side:

DECOMPOSITION: 1965-2017 (MULTIPLE EXPANSION / EPS GROWTH)	TOP	2	3	4	BOTTOM
VALUE: BEST QUINT P/E	+35.9% / -22.5%				
HALVES: FUT 1 Yr EPS GROWTH	+0.0% / +20.1%			+72.4% / -67.9%	
THIRDS: FUT 1 Yr EPS GROWTH	-4.3% / +27.6%		+16.6% / -4.8%	+76.2% / -74.5%	
FIFTHS: FUT 1 Yr EPS GROWTH	-9.3% / +35.4%	+5.5 % / +12.0%	+17.1% / -5.2%	+29.9% / -22.6%	+190% / -192%

Notice that the first row has an entry of "+35.9% / -22.5%." What this means is that from 1965 through 2017, the value factor's total return separated out into an average +35.9% annual gain from multiple expansion during the holding periods and an average -22.5% annual loss from EPS declines during the holding periods. These averages are calculated over 52 holding periods in total, with each holding period beginning in June and lasting for one year.

As we move left into the higher growth bins, we find that EPS growth becomes an increasing contributor to the returns. Similarly, as we move right into the lower growth bins, we find that EPS growth becomes a diminishing contributor to the returns. This result makes sense given that we are literally **defining** bin membership based on EPS growth over the next year, i.e., EPS growth over the holding period of the strategy. Our partitioning therefore directly selects for the growth contributions that the table above decomposes the strategies' returns into.

What is not as clear is why the contribution from multiple expansion increases as we move into lower growth bins, and why it decreases as we move into higher growth bins. In the top third and top fifth bins, for example, the contribution from multiple expansion is negative—registering at -4.3% and -9.3%, respectively—indicating that the multiples of the stocks in those bins are actually **contracting** on average during the holding periods.

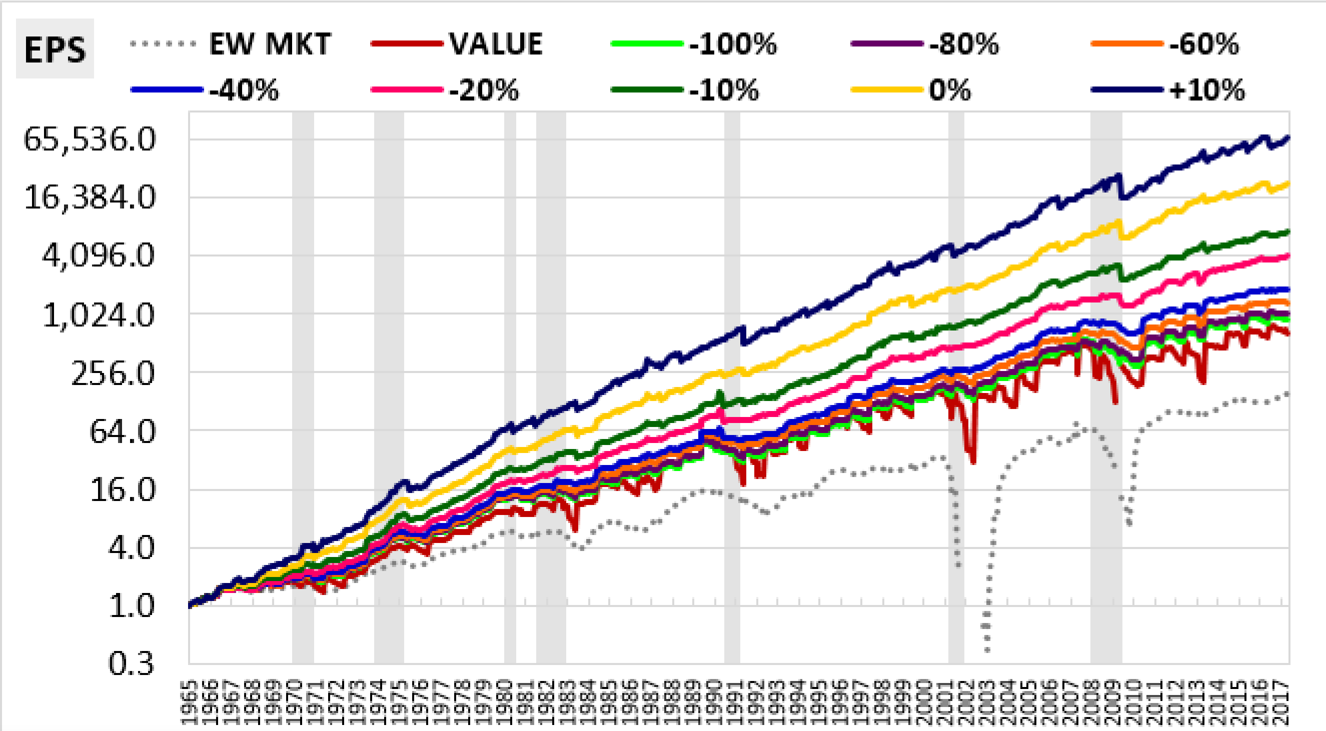
We see this same phenomenon—a shift from multiple expansion to multiple contraction—when we remove companies with negative future earnings growth from the value factor. The table below decomposes the value factor's returns on the assumption that all stocks with EPS growth below a specified cutoff point get removed:

1965-2017	PERFORMANCE AFTER REMOVAL OF STOCKS W/ EPS GROWTH BELOW CUTOFF POINTS									
	LARGE	VALUE	-100%	-80%	-60%	-40%	-20%	-10%	0%	+10%
TOTAL RETURN	10.6%	13.3%	14.2%	14.5%	15.1%	15.7%	17.5%	18.8%	21.6%	24.1%
MULT EXPANSION	-1.0%	35.9%	18.4%	15.3%	12.0%	8.1%	3.7%	0.2%	-1.4%	-6.1%
EPS GROWTH	11.1%	-22.5%	-4.6%	-1.3%	2.6%	7.2%	13.4%	18.3%	22.6%	29.9%
AVG % REMOVED	-	-	5.6%	8.0%	12.3%	19.3%	31.2%	40.7%	52.7%	66.1%

As you can see, the contribution from multiple expansion steadily falls as the as the cutoff points are shifted upwards. Eventually, when all of the negative future growers are cut out of the portfolio, the contribution from multiple expansion goes negative, turning into multiple contraction. The total return of the portfolio dramatically increases in that process, confirming the importance of future earnings growth to the value factor's performance.

The "AVG % REMOVED" row shows the average percentage of stocks removed from the value factor at each cutoff point over **all** years from 1965 to 2017. The actual percentage of stocks that get removed in any specific year varies significantly by year. For example, from 2008 to 2009, 36% of value stocks had earnings growth below the -100% cutoff point, whereas from 2006 to 2007 only 2% of value stocks had earnings growth below that cutoff point.

In the chart below, we show the EPS of the value factor on each of the different cutoff points:



Notice that the value factor's characteristic sawtooth EPS pattern, depicted most clearly in the red line, decays as the cutoff points are increased. At the higher cutoff points, there isn't any sawtoothing at all. The same trend can be seen in the earlier chart of the EPS of the five bins. The lower growth bins showed large amounts of sawtoothing, whereas the higher growth bins showed reduced sawtoothing (and eventually **reversed** sawtoothing). As we explained in Factors from Scratch, the sawtooth pattern is driven by **multiple expansion**. The fact that it's decaying at higher cutoff points and in higher growth bins suggests that multiple expansion is taking place to a lesser extent among the stocks in those bins.

This result poses an interesting challenge to a key thesis in Factors from Scratch. Recall that we argued that the value factor works through a re-rating process in which the future outlook for value stocks becomes less negative, causing the depressed multiples of the stocks to expand. This description is accurate for value stocks as a **group**, and also for the middle and lower future growth bins within it. But those bins aren't where the bulk of the value factor's excess returns come from. The bulk of the value factor's excess returns come from the top future growth bins. If the stocks in the top future growth bins aren't experiencing multiple expansion—if their multiples are, in fact, **contracting**—then how can the thesis be correct?

The short answer is that multiple expansion itself is not central to the thesis. What is central to the thesis is the **upward re-rating process**, i.e., the improvement in the future outlook that occurs during the holding periods. That improvement drives the value factor's returns. It typically occurs in conjunction with multiple expansion, but it doesn't have to occur in that way—a stock can get re-rated upward **without** having its multiple expand, provided that its current earnings are growing rapidly during the course of the re-rating. That's exactly what happens to the stocks in the top growth bins—sentiment towards them improves significantly, causing their prices to increase significantly, but their current earnings are growing rapidly during that same process, outpacing the price increases and causing their P/E multiples to contract (slightly).

To make this point more intuitive, we need to get clear on what a change in the P/E multiple of a stock actually conveys. That's what we're going to do in the next several paragraphs.

In theory, the "P" in the "P/E" ratio represents not only the trading price of a stock, but also the market's best estimate of the present value of its **entire** future stream of earnings, which we can refer to as "E_{ALL}." The "E" in the "P/E" ratio, in contrast, represents only the earnings that the stock has generated over the trailing **one-year** period. To reiterate:

- "P" = the market price; also, the market's best estimate of the present value of "E_{ALL}."
- "E_{ALL}" = the entire **future** stream of earnings (expected or actual).
- "E" = the earnings generated over the **trailing** twelve-month period.

Fundamentally, the correct "P" of a stock is determined by "E_{ALL}", **not** by "E." Indeed, "E" is just a backwards-looking time slice found at the beginning of the stream—it's only important to the extent that it provides an accurate **projection** or **window** into the future trajectory of the stream—i.e., an accurate representation of "E_{ALL}."

In an absolute sense, stocks become "value stocks" when the market comes to expect that their "E_{ALL}" will be **lower** than what is currently being projected by their "E." In the relative sense, stocks become value stocks when the **difference** between the market's estimation of their "E_{ALL}" and what is currently being projected by their "E" ends up being large (and negative) relative to other stocks in the market.

Given that the market sets the price "P" of the stocks based on its estimate of "E_{ALL}", if its estimate of "E_{ALL}" is low relative to what is being projected by "E", then the price "P" that it sets will also end up being low relative to what is being projected by "E." The result will be a low "P/E" ratio, which embeds a belief that current earnings ("E") either won't be sustained or won't grow at normal market rates over the long-term.

To illustrate with an example, the future earnings "E_{ALL}" of IBM ended up being significantly lower than what was projected by the company's trailing one-year earnings "E" as of June 2014. The market had a sense that the future earnings would be lower than what was projected by the trailing earnings at the time, and therefore it priced $IBM at an extremely low P/E ratio on that date. Given the earnings declines that the company went on to suffer, the market was right to price the company at a low P/E ratio. In fact, looking back, the stock's P/E ratio should have been much **lower** than it actually was, because the earnings declines turned out to be much worse than expected, and they were never recovered.

Now, there are two ways that a P/E multiple can expand—a good way and a bad way. Similarly, there are two ways that a P/E multiple can contract—a good way and a bad way. The table below provides a depiction of each way:

	GOOD	BAD
MULTIPLE EXPANSION	E_{ALL} ↑, P ↑, P/E ↑	E ↓, P/E ↑
MULTIPLE CONTRACTION	E ↑, P/E ↓	E_{ALL} ↓, P ↓, P/E ↓

Good Multiple Expansion happens when the market's estimate of "E_{ALL}" increases, causing the price to increase. To the extent that trailing earnings stay constant in this process, the "P/E" will increase as well. This type of increase is what we're referring to when we describe value stocks as benefitting from an "upward re-rating." The market is becoming more optimistic about their future prospects—i.e., their "E_{ALL}"—and the optimism is showing up in both their "P" and their "P/E" ratio, yielding excess returns for investors.

Example: A stock trades at $20 against trailing earnings of $2—a depressed P/E multiple of 10, which expresses the market's belief that the company's trailing earnings are not reflective of its likely future earnings prospects. As more information comes in, the market shifts its view on that front, becoming more optimistic about the earnings that the company will generate in the future. The price therefore increases to $40 and the P/E multiple increases to 20. The stock ceases to be a value stock, and those who bought it when it was a value stock make money.

Bad Multiple Contraction is the reverse of Good Multiple Expansion. It happens when the market's estimate of "E_{ALL}" drops, causing the price to drop. Assuming that trailing earnings stay constant, the "P/E" will fall as well. This type of fall is what we're referring to when we talk about a "downward re-rating"—the kind of re-rating that occurred, for example, in $IBM. The market is becoming more pessimistic about a company's future prospects—i.e., its "E_{ALL}"—and the pessimism is showing up in both the "P" and the "P/E" ratio, producing losses for investors.

Example: Our earlier company is priced at $40 against trailing earnings of $2—a P/E multiple of 20. The market then becomes pessimistic about its future prospects and comes to anticipate a long-term decline in its earnings. The price therefore falls to $20 and the P/E multiple decreases to 10. The stock is now a value stock again, and those who bought it before it became a value stock lose money.

Bad Multiple Expansion happens when the current one year "E" falls, causing the "P/E" to rise. The market's estimate of "E_{ALL}" may fall in this process, and therefore the price "P" may fall, but unless the market's expectation is that the **entire** future earnings stream of the company will fall by the same amount as the current one year earnings, then the fall in "E_{ALL}" and "P" will tend to be **smaller** than the fall in "E", and therefore the "P/E" ratio will tend to rise. Obviously, this is not the kind of multiple expansion that any investor should want. It's associated with losses, not gains.

Example: Our earlier company is trading at $20 against trailing earnings of $2—a P/E multiple of 10. The company then enters a difficult cyclical period in which its earnings fall to 2 cents, a 99% drop. Unless the market thinks that this drop is going to be permanent—i.e., that **all** of the company's future earnings will be 99% lower than previous estimates—then the price is not going to fall by 99%, to 20 cents. Instead, the price might fall by, say, half, to $10. The P/E multiple will then expand from its original value of 10 to a new value of 500. The multiple will have expanded dramatically, but investors aren't going to make any money from it because it's coming from a fall in earnings, rather than a rise in price.

Good Multiple Contraction is the reverse of Bad Multiple Expansion. It happens when the trailing one year "E" rises, causing the "P/E" to fall. The market's estimate of "E_{ALL}" may rise in this process, and therefore the price "P" may rise as well, but unless the market's expectation is that the **entire** future earnings stream will rise by the same amount as the current one year earnings, then "E_{ALL}" and "P" will not rise by as much as "E", and therefore the "P/E" ratio will tend to fall. The multiple will contract, but in a way that is good for investors, because the price and the earnings will both be increasing.

Example: The company in the previous example gets through the difficult cyclical period and sees its earnings increase from 2 cents to $1—a 5000% rise. Obviously, the market's estimate of the company's E_{ALL} is not going to rise by the same 5000% in this process, and therefore the price is not going to rise by 5000%

either. Instead, it might rise by 50%, from $10 to $15. The P/E multiple will then contract from 500 to 15. Though the multiple will have contracted, investors will be much better off, because both the price and the current earnings will be higher.

Crucially, the value factor contains a **mix** of the good kind of multiple expansion and the bad kind. We can find an example of the good kind in the middle fifth growth bin, where the multiple expands on average by 17.1% per year in each holding period amid a modest average decline of -5.2% in the earnings. The fact that the multiple expansion in this bin substantially exceeds the earnings decline confirms that the multiple expansion is happening primarily as a result of a rising **price**. It's the good kind of multiple expansion.

Conversely, we can find an example of the bad kind of multiple expansion in the bottom fifth growth bin, where the multiple expands on average by 190% amid an average earnings drop of -192%. Obviously, the large increase in the multiple does not signify any kind of improvement in sentiment towards the underlying stocks in the bin. It's just mathematical noise—a mirror image of the large one-year EPS declines that the stocks are experiencing, declines that were vividly displayed in the blood red EPS profile in the earlier chart.

In addition to multiple expansion, the value factor also contains the good kind of multiple contraction. As we saw with $AAPL, some stocks in the value factor go on to increase their earnings in the holding period, sometimes by a substantial amount. As stated earlier, the market usually doesn't see these increases as changes that will be fully retained over the long-term, and therefore the prices usually don't increase by as much as the earnings. As a result, the multiples tend to contract. Importantly, though, because these are value stocks that are **already** trading at low multiples, their multiples tend to contract by **much less** in response to the growth than the multiples of similarly situated stocks in the broad market. The table below illustrates the point by decomposing the returns of the different growth bins of the **market** into multiple expansion and EPS growth:

DECOMPOSITION: 1965-2017 (MULTIPLE EXPANSION / EPS GROWTH)	TOP	2	3	4	BOTTOM
MKT: LARGE STOCKS	-1.0% / +11.1%				
HALVES: FUT 1 Yr EPS GROWTH	-51.7% / +34.9%		+34.9% / -32.8%		
THIRDS: FUT 1 Yr EPS GROWTH	-80.0% / 98.8%	-3.4% / +13.8%	+109.0% / -109.8%		
FIFTHS: FUT 1 Yr EPS GROWTH	-118% / +138%	-18.1 % / +33.9%	-3.5% / +14.4%	+9.4% / -4.6%	+153% / -157%

Notice the enormous multiple contraction that takes place in the top growth bins of the market: -51.7%, -80.0%, and -118% for the top half, top third and top fifth bins respectively. This contraction occurs because the stocks are experiencing rapid earnings growth, and the growth is outpacing the price increases. The contraction is orders of magnitude larger than the contraction that we saw in the corresponding growth bins of the value factor: 0.0%, -4.3%, and -9.3% for the top half, top third, and top fifth bins, respectively (see earlier table). A key reason for the difference is that the top-growing stocks in the value factor are experiencing greater price increases alongside their growth, which translates into less multiple contraction. They're getting credit for their pre-existing cheapness, the result of a previous pessimism that now has to adjust upwards.

Ultimately, when we build a bin consisting only of value stocks with the strongest future one-year EPS growth outcomes, we're engaging in a form of selection bias. We're effectively gathering all of the companies in the value factor that are going to experience the good kind of multiple contraction—i.e., the kind in which the "E" will rise rapidly over the one year holding period—and putting them in the same place, inside the same portfolio. Similarly, we're throwing out all of the companies in the value factor that would go on to experience the bad kind of multiple expansion—i.e., the kind driven by one-year earnings drops. What we're left with, then, is an artificially selected **mix** of the good kind of multiple contraction and the good kind of multiple expansion. This mix effectively cancels out, leaving the top growth bins with only a minimal net change in the multiple—a slight contraction, to be exact.

Now, the fact that the multiples of value stocks in the top growth bins contract by small amounts **doesn't** mean that upward re-ratings aren't taking place in those stocks. To the contrary, **enormous** upward re-ratings are taking place in them, far greater than the re-ratings that are taking place in stocks in the middle and lower growth bins. The market is initially pricing the stocks for earnings weakness and is instead seeing earnings strength—a 180-degree discrepancy relative to its expectations. The massive upward adjustment brought about by this discrepancy shows up in the out-of-this-world returns that the stocks go on to generate.

If we want to see multiple expansion show up in the top growth bins, all we need to do is change how we define the bins. Instead of defining the bins based on future one-year earnings growth, which explicitly **selects** for multiple contraction in the higher growth bins, we can instead define the bins based on earnings growth over longer horizons. If, as we have argued, the market looks to the long-term when it re-rates value stocks, then we should expect the return differentials to be just as strong when the growth bins are defined on those horizons.

In the table below, we show the returns of the value factor separated into bins based on future EPS growth over the subsequent **five-year** period. Note that the holding period of the strategy remains one year, but we are no longer defining bin membership based on earnings growth over that year. Instead, we're defining bin membership based on cumulative earnings growth over the next **five** years:

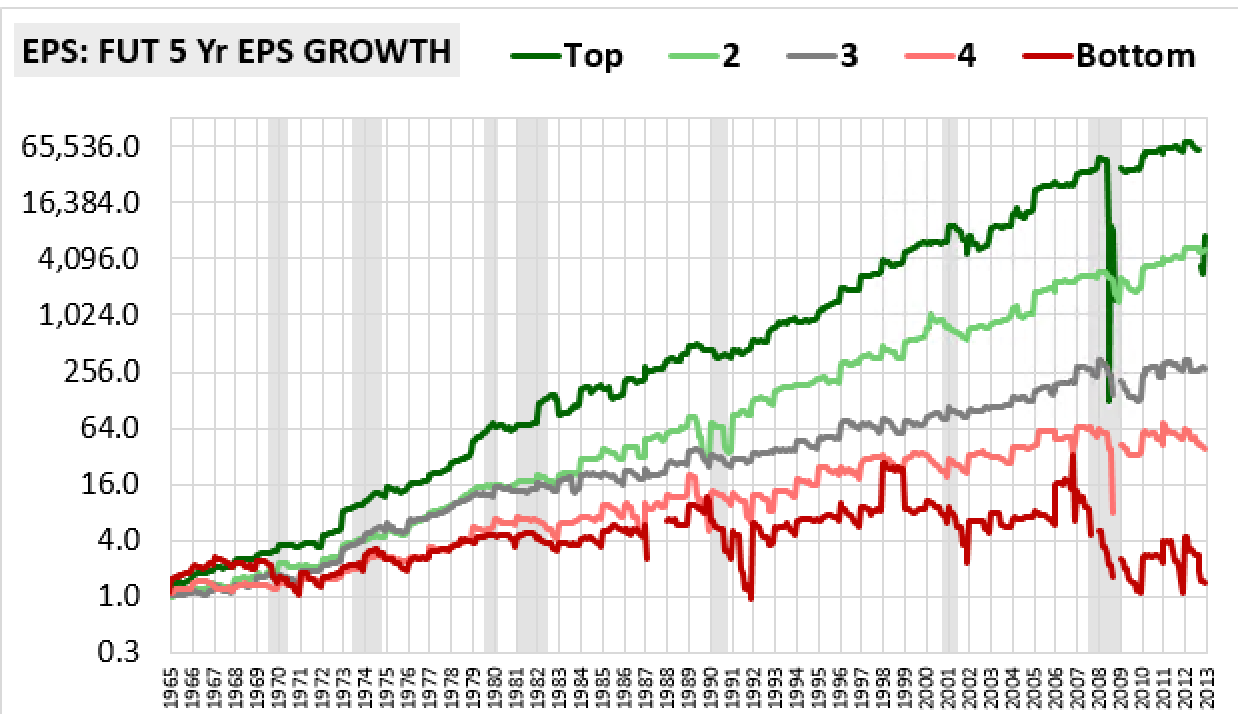
TOTAL RETURN: 1965 - 2017	TOP	2	3	4	BOTTOM
MKT: LARGE STOCKS			10.72%		
VALUE: BEST QUINT P/E			13.25%		
HALVES: FUT 5 Yr EPS GROWTH		21.03%		6.74%	
THIRDS: FUT 5 Yr EPS GROWTH	23.76%		13.09%		4.52%
FIFTHS: FUT 5 Yr EPS GROWTH	26.10%	19.09%	12.40%	8.76%	1.58%

As predicted, the returns of the top growth bins on this new five-year growth definition end up being just as strong as they were on the previous one-year growth definition, confirming that the market is looking to the long-term when it re-rates value stocks.

The following table shows the annual returns of the different growth bins decomposed into average contributions from holding period multiple expansion (left) and holding period EPS growth (right):

DECOMPOSITION: 1965-2017 MULTIPLE EXPANSION / EPS GROWTH	TOP	2	3	4	BOTTOM
VALUE: BEST QUINT P/E	+35.9% / -22.5%				
HALVES: FUT 5 Yr EPS GROWTH	+23.0% / -2.7%			+26.5% / -20.6%	
THIRDS: FUT 5 Yr EPS GROWTH	+22.9% / -1.1%		+22.4% / -9.3%		+26.8% / -23.2%
FIFTHS: FUT 5 Yr EPS GROWTH	+19.6% / +0.8%	+24.2% / -4.9%	+20.7% / +-8.4%	+23.8% / -16.0%	+17.7% / -16.9%

Interestingly, the top growth bins now show strong average **multiple expansion**, in clear contrast to the multiple contraction that we saw earlier when the top growth bins were defined on one-year earnings. This multiple expansion shows up clearly in a chart of the EPS. The top growth bins exhibit the classic sawtooth pattern associated with multiple expansion, where the earnings jump upward on the rebalancing dates (vertical gridlines):



The reason that we now see multiple expansion in the top bins is that we're no longer explicitly selecting for strong future one-year growth in those bins. Instead, we're selecting for strong future **five-year** growth. Many stocks with strong future five-year growth experience weak growth during the **first** year, evidenced by the flattish to negative holding period growth shown in the decomposition. The top fifth growth bin, for example, sees growth of only +0.8% during the holding period, with the top third and top half growth bins only seeing -1.1% and -2.7%, respectively—all well below the market rate of 10%. This weak growth does not impair the returns, of course, because the market is not focused on one-year outcomes. It's focused on the long-term. As the holding period unfolds, it comes to realize that the long-term for these companies is going to be very good. It therefore raises their prices, even as their current earnings remain unchanged. The result is multiple expansion.

It's useful to stop and reflect on the wisdom that the market is demonstrating in this exercise. As the experimenters, we ourselves already know with certainty which stocks are going to have the strongest growth over the next five years. But when the market prices the stocks in real-time, it doesn't directly know that. All it directly knows is that the current earnings of the stocks are coming in weak, below the market growth rate. Still, it's able to read the tea leaves on the underlying companies and accurately detect the strong future earnings that they are eventually going to generate. It's able to look past the current weakness and correctly price the value of those future earnings in the form of multiple expansion **today**, delivering a return to investors **today**, a full five years before the actual fundamental outcome gets set in stone.

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OSAM CONTACT INFORMATION:

O'Shaughnessy Asset Management, LLC ■ Six Suburban Avenue ■ Stamford, CT 06901 ■ 203.975.3333 Tel ■ 203.975.3310 Fax

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