ROBECO
The Investment Engineers

Quantitative Equities

The quant equity crisis of 2018-2020: Cornered by big growth

- The quant equity crisis is ascribed to the underperformance of Value
- Investing in large growth stocks was basically the only way to outperform
- Other factors performed only when they were large growth in disguise

This paper examines the performance of equity factor portfolios during the quant equity crisis of 2018-2020. We find that there was basically only one way to outperform during this period, namely by investing in the largest and most expensive growth stocks. Other factors were only effective to the extent that they provided implicit exposure to the same large growth stocks. Smaller stock portfolios underperformed across the board. Thus, there were numerous ways to fail during the 2018-2020 period, but essentially only one way to succeed. Comparing the quant equity crisis with previous major drawdowns of the Value factor we find that these other periods are better characterized as momentum factor rallies with collateral damage for the Value factor. Moreover, smaller stocks typically still offered possibilities for outperformance. We conclude that the 2018-2020 quant equity crisis posed an exceptional challenge to quantitative managers due to a rare combination of circumstances.

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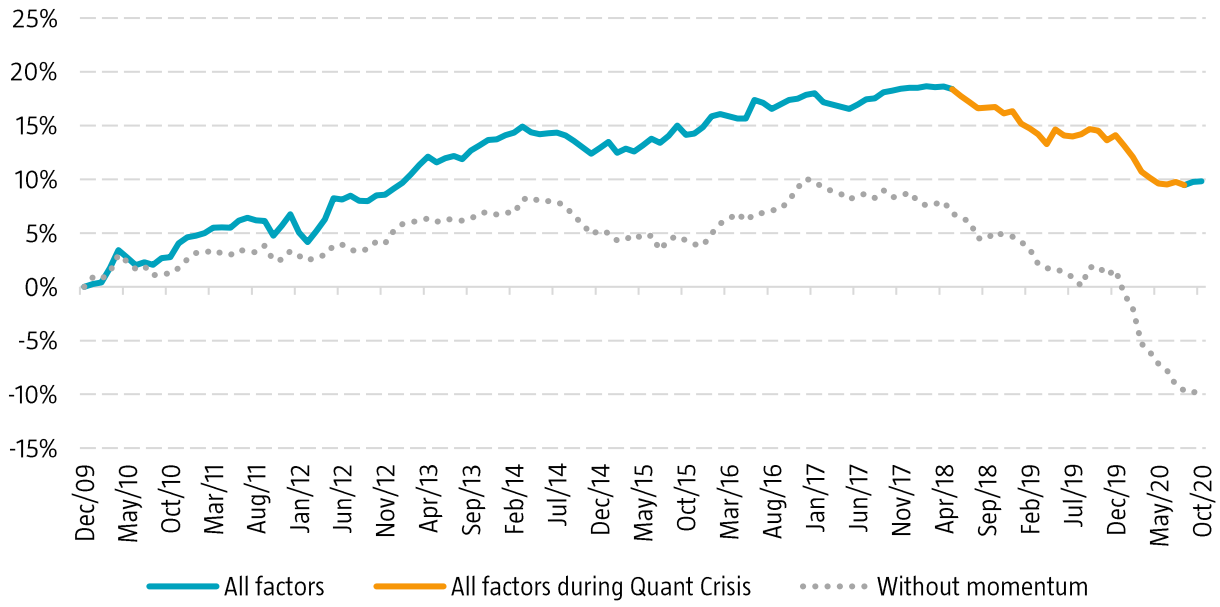
Introduction

Quantitative managers following multi-factor strategies have generally underperformed severely since the middle of 2018. This drawdown is clearly visible in Figure 1, which shows average factor performance in global developed equity markets since 2010. The graph is constructed by computing every month the equally weighted average return of the standard academic factors: size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML). Without the momentum factor, which is not formally included in the 5-factor model of Fama and French (2015), factors even experienced an entire lost decade, consistent with the observations of Blitz (2020).

Figure 1 | Backtested cumulative return of the equally-weighted Fama-French factors, January 2010 to October 2020, global developed markets



Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The HML, CMA, RMW, and WML factors are based on 2x3 portfolios sorted independently on size and the target factor. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

This paper takes an in-depth look at the multi-year drawdown of equity factors that started in 2018. As such, it is related to the asset pricing literature, but differs by focusing on a very specific, relatively short period of time, instead of taking the usual long-term perspective. Our work is also related to studies of previous quant-related crises, although not really comparable because these were very different in nature. For instance, the 2008 financial crisis originated in debt markets, with complex structured products such as mortgage backed securities on subprime loans. Another well-known example is the flash crash in 2010, but this was an intra-day event related to electronic trading in index futures; see Kirilenko et al. (2017). Due to its slow and protracted nature the recent period is also very different from the crash of quant equity factors in August 2007, which was an intra-month phenomenon caused by short-term supply/demand imbalances, as described by Lo and Khandani (2011).

The recent quant equity crisis is commonly attributed to the underperformance of the value factor, which is a key pillar in quantitative stock selection models. The struggles of the value factor have been discussed extensively by Arnott et al. (2020), Blitz and Hanauer (2021), Israel, Laursen, and Richardson (2021), and many others. However, value is just one of the factors used by quantitative investors, so one can wonder why other factors apparently failed to offset, or provide more protection against the losses of the value factor. Moreover, value drawdowns have occurred before, and since quantitative investors rely extensively on backtesting using historical data one might have expected them to be better prepared for such a scenario.

In order to address these questions we conduct a detailed analysis of factor performance during the quant equity crisis, which we define as the period from June 2018 to August 2020. We find that during this period all the outperformance was basically concentrated in one pocket of the market, namely the largest and most expensive stocks. The profitability and momentum factors were also successful among the largest stocks; however, we find that this performance was driven by an implicit exposure to the same large growth stocks. Without an overweight position in large growth stocks it was next to impossible to avoid a (severe) underperformance during the 2018-2020 period.

We also compare the 2018-2020 episode with past major drawdowns of the value factor and find some notable differences. Most importantly, previous value drawdowns are better characterized as momentum rallies, because the outperformance of the momentum factor overshadowed the underperformance of the value factor. As a result, in other words, past value drawdowns did not necessarily cause quant equity crises. Although the momentum factor did have a positive return during the 2018-2020 period, this return was not nearly enough to compensate for the losses incurred by the value factor. This is the first time that the underperformance of the value factor was also the dominant theme in the market.

Another important difference with previous value drawdowns is the sharp underperformance of small stocks compared to large stocks. During previous value drawdowns there were still opportunities for outperformance in smaller size segments. However, during 2018-2020 even the best performing pockets in the small- and mid-cap space could not keep up with large growth stocks and ended up underperforming the market in absolute terms. This has exacerbated the losses for long-only quantitative managers, as they tend to underweight large stocks, to create sufficient active share, and overweight small- and mid-cap stocks, which offer a broad opportunity set due to their sheer number.

Apart from 2018-2020 there is actually only one other true quant equity crisis in our sample, namely in the first half of 2009. The two crises have in common that the main cause was the crash of one particular factor. In 2009, however, it was not the value factor but the momentum factor that blew up, caused by a sharp performance reversal of the stocks that had suffered the largest losses during the 2008 debt crisis. Another notable difference with 2018-2020 is that the 2009 quant equity crisis was a relatively short-lived event, as factors resumed their upward trend within less than half a year.

We conclude that the 2018-2020 quant equity crisis is the result of a major value drawdown that is distinctly different from past value drawdowns, because for the first time the momentum factor failed to offset the losses, and because of the simultaneous severe underperformance of smaller stocks across the board.

Data

We use publicly available data from the Kenneth French data library.[1] Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The HML, CMA, RMW, and WML factors are based on 2x3 portfolios sorted independently on size and the target factor. In addition to these hypothetical long/short portfolios we consider the more granular 5x5 independently sorted portfolios, and for a further understanding of the interaction between value and profitability we consider 2x4x4 triple-sorted portfolios on size, value, and profitability. In order to assess whether the low-risk factor provided relief we also examine 5x5 double-sorted portfolios on size and prior 60-month market beta. In our base-case analyses we use global developed markets data, but for our long-term, pre-1990, triple-sorted, and low-risk analyses we fall back on US data, since global data is not available. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars.

The quant equity crisis of 2018-2020

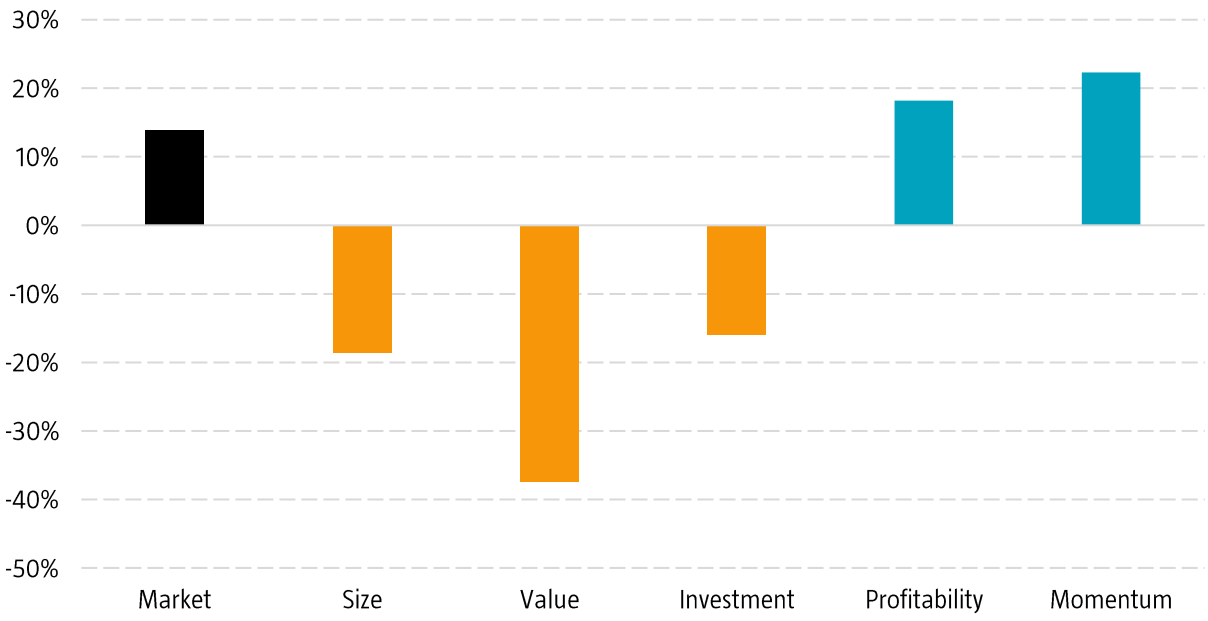
We define the quant equity crisis as the 27-month period from June 2018 to August 2020. We acknowledge that a precise dating is somewhat ambiguous, but consider this period to be the best choice. The start date of June 2018 marks the moment when quant managers began to get in trouble and the first month of significant underperformance of the Fama-French factors. The end date of August 2020 seems most appropriate at the time of writing (December 2020), because factor performance flattened out in subsequent months. Moreover, the value factor started to make a comeback in November 2020. However, it remains to be seen whether this recovery is permanent or whether the quant equity crisis will persist beyond 2020. We do note that our results do not materially change if we define the end date of the quant equity crisis one or two months later.

[1] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Factor portfolios during the quant equity crisis

The performance of the standard academic factors during the quant equity crisis is reported in Figure 2. We observe that the value factor experienced a severe drawdown, consistent with the aforementioned studies on the recent performance of the value factor. The size factor also shows a large drawdown, as does the investment factor. The latter result is not surprising, given the finding of Fama and French (2015) that the investment effect is closely related to the value effect. The profitability and momentum factors seem to have done well though during the quant equity crisis period. Although the gains on these factors are not as large as the losses on the other factors, in particular value, they do appear to be effective at easing the pain for multi-factor investors. However, the Fama-French factors reflect hypothetical long/short portfolios, while in practice most investors follow a long-only approach.

Figure 2 | Backtested cumulative factor performance, June 2018 to August 2020, global developed markets



Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The HML, CMA, RMW, and WML factors are based on 2x3 portfolios sorted independently on size and the target factor. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

In order to address this concern we proceed by examining the detailed performance of the 5x5 sorted portfolios. For reference, we first show the long-term average returns relative to the market of these portfolios in Table 1, using US data from July 1963 until May 2018, so prior to the quant equity crisis. We observe that returns are generally highest in the bottom right of the tables, so for smaller stocks with the 'right' factor characteristics. This confirms the extensive long-term evidence for these factors in the literature, and the well-known result that factor premiums tend to be stronger among smaller stocks. We also note that 72 out of the 100 portfolios exhibit positive market-relative returns, which stems from the fact that smaller stocks have generally outperformed larger stocks.

Table 1 | Backtested annualized market-relative performance 5x5 sorted portfolios, July 1963 to May 2018, US market

	Value					Investment				
	Growth	Q2	Q3	Q4	Value	Agg	Q2	Q3	Q4	Cons
Mega	-0.3%	-0.3%	0.5%	-0.3%	0.9%	-1.1%	-0.3%	-0.1%	0.5%	2.2%
Large	0.2%	0.8%	2.1%	**4.1%**	**3.7%**	-0.7%	2.8%	2.8%	2.7%	2.7%
Mid	-1.5%	2.9%	2.7%	**4.7%**	**5.6%**	-1.5%	**3.2%**	**3.5%**	**4.9%**	**3.8%**
Small	-2.4%	2.2%	**4.1%**	**4.9%**	**5.1%**	-2.2%	**4.1%**	**4.7%**	**4.5%**	**3.5%**
Micro	**-5.9%**	1.7%	2.6%	**5.6%**	**6.5%**	**-3.9%**	**3.5%**	**5.3%**	**5.1%**	**3.7%**

	Profitability					Momentum				
	Weak	Q2	Q3	Q4	Robust	Losers	Q2	Q3	Q4	Winners
Mega	**-3.2%**	-1.6%	-0.2%	-0.0%	0.7%	**-6.1%**	-0.9%	-1.3%	0.5%	**3.0%**
Large	-0.6%	1.7%	2.1%	2.2%	**3.1%**	**-6.1%**	0.3%	1.6%	**3.4%**	**5.9%**
Mid	-1.0%	2.6%	2.7%	2.4%	**4.3%**	**-5.5%**	0.5%	2.2%	2.9%	**7.4%**
Small	-0.8%	2.6%	**3.4%**	2.9%	**4.7%**	**-7.1%**	1.3%	**3.6%**	**5.7%**	**7.5%**
Micro	-1.6%	**4.7%**	**3.7%**	**4.8%**	**2.4%**	**-8.6%**	1.1%	**4.9%**	**6.6%**	**9.4%**

Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The factors are based on 5x5 independently sorted portfolios. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future. Please note double-digit returns are highlighted in bold.

Table 2 shows that the performance of the 5x5 sorted portfolios during the quant equity crisis is basically diametrically opposite to the long-term results. No less than 85 out of the 100 portfolios lag the market over this period, and 70 of these even have a double-digit underperformance. Zooming in on the results for the 5x5 size/value sorted portfolios we observe a massive 53.8% outperformance for the very largest and most expensive stocks, in the top left of the table. Typical examples of this growth rally are the big tech stocks popularly known as FAANG or FANMAG: Facebook, Apple, Amazon, Netflix, Alphabet (Google), and Microsoft. Another appealing example is Tesla, which experienced a more than sevenfold increase of its share price over the quant equity crisis period. The slightly less large or slightly less expensive stocks in Table 2 also show an outperformance, but a bit further away from the top-left corner all other portfolios underperform, to a bigger or smaller extent. This is also visually illustrated in Figure 3.

Table 2 | Backtested cumulative market-relative performance 5x5 sorted portfolios, June 2018 to August 2020, global developed markets

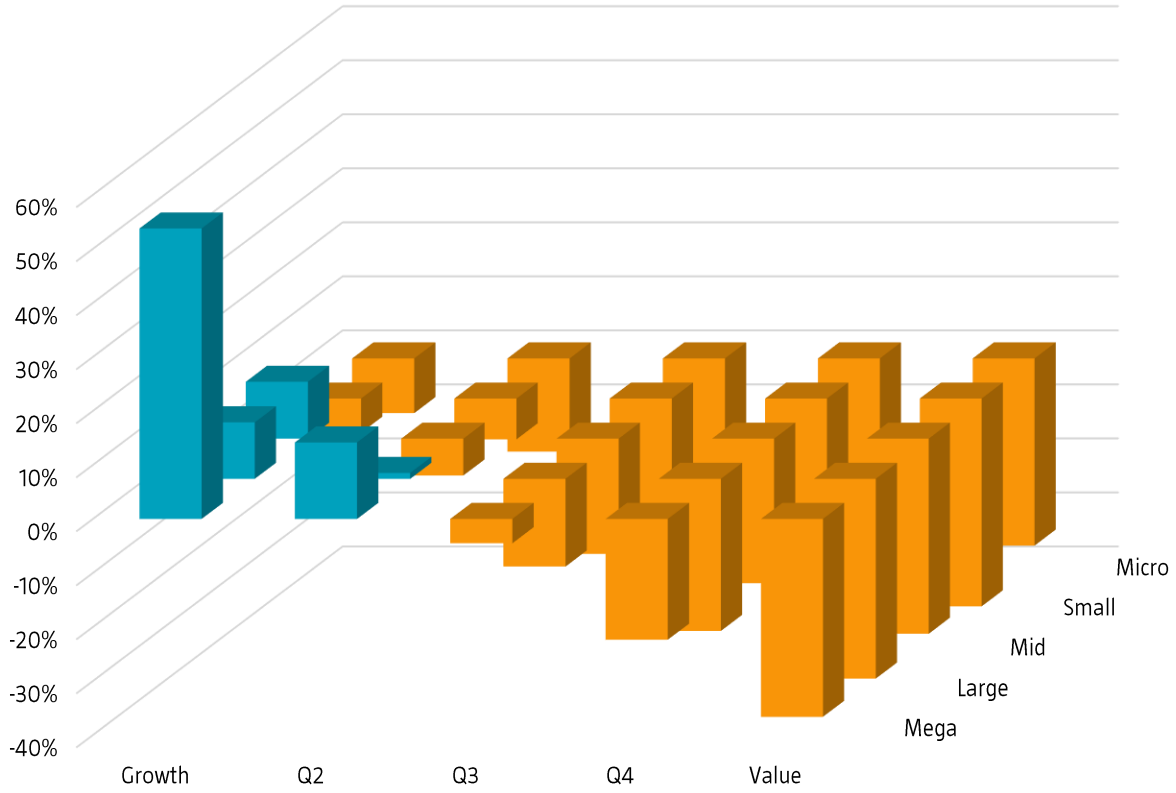
	Value					Investment				
	Growth	Q2	Q3	Q4	Value	Agg	Q2	Q3	Q4	Cons
Mega	**53.8%**	**14.2%**	-4.5%	-22.4%	-36.6%	**29.3%**	**14.4%**	1.3%	-9.5%	6.4%
Large	**10.5%**	1.1%	-16.2%	-28.2%	-37.0%	**13.0%**	-16.4%	-15.3%	-27.3%	-22.0%
Mid	**10.5%**	-6.8%	-21.3%	-26.7%	-36.1%	-5.8%	-18.4%	-24.8%	-28.3%	-26.1%
Small	-6.3%	-7.5%	-25.8%	-26.9%	-38.5%	-19.7%	-20.9%	-22.6%	-29.8%	-34.6%
Micro	-10.1%	-17.2%	-22.0%	-29.1%	-34.7%	-20.8%	-25.7%	-28.3%	-29.0%	-30.7%

	Profitability					Momentum				
	Weak	Q2	Q3	Q4	Robust	Losers	Q2	Q3	Q4	Winners
Mega	-17.1%	-7.9%	-7.1%	9.8%	**30.7%**	-18.8%	-3.8%	4.3%	6.1%	**26.0%**
Large	-7.9%	-23.0%	-17.3%	-12.8%	-9.6%	-27.0%	-20.6%	-13.6%	-6.2%	-3.3%
Mid	-18.2%	-22.6%	-17.2%	-20.0%	-19.1%	-25.5%	-25.5%	-22.3%	-14.0%	-7.2%
Small	-25.7%	-25.2%	-28.3%	-21.8%	-22.9%	-30.6%	-24.3%	-24.2%	-19.8%	-13.0%
Micro	-27.6%	-28.1%	-28.8%	-24.6%	-17.9%	-35.9%	-26.5%	-24.0%	-22.2%	-4.9%

Source: Data library of Professor Kenneth French, Robeco. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The factors are based on 5x5 independently sorted portfolios. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future. Please note double-digit returns are highlighted in bold.

For the 5x5 size/investment portfolios we find very similar results, with a strong outperformance in the top left segment consisting of large stocks with aggressive investment (growth in total assets), and underperformance elsewhere. This illustrates again that value investors should expect little diversification from the investment factor, because the two are closely related phenomena. For the 5x5 size/profitability and size/momentum portfolios we observe a concentrated outperformance in the top right of the tables, and underperformance elsewhere. Thus, the largest stocks with the highest operating profitability and the largest stocks with the highest past returns also outperformed. Among the smaller stocks, the momentum top portfolios also consistently outperform the bottom portfolios, but their absolute returns are simply not high enough to outperform the market as well. Although the outperformances of the mega-cap top profitability and mega-cap top momentum stocks are not as large as the underperformance of the mega-cap value stocks, these factors do appear effective at mitigating the losses. This suggests that a multi-factor approach focusing on the very largest stocks could have made it through the quant equity crisis with limited damage. In the next section, however, we challenge the notion that there was more than one way to outperform in the mega-cap space.

Figure 3 | Visual illustration of backtested market-relative performance 5x5 size/value sorted portfolios, June 2018 to August 2020, global developed markets



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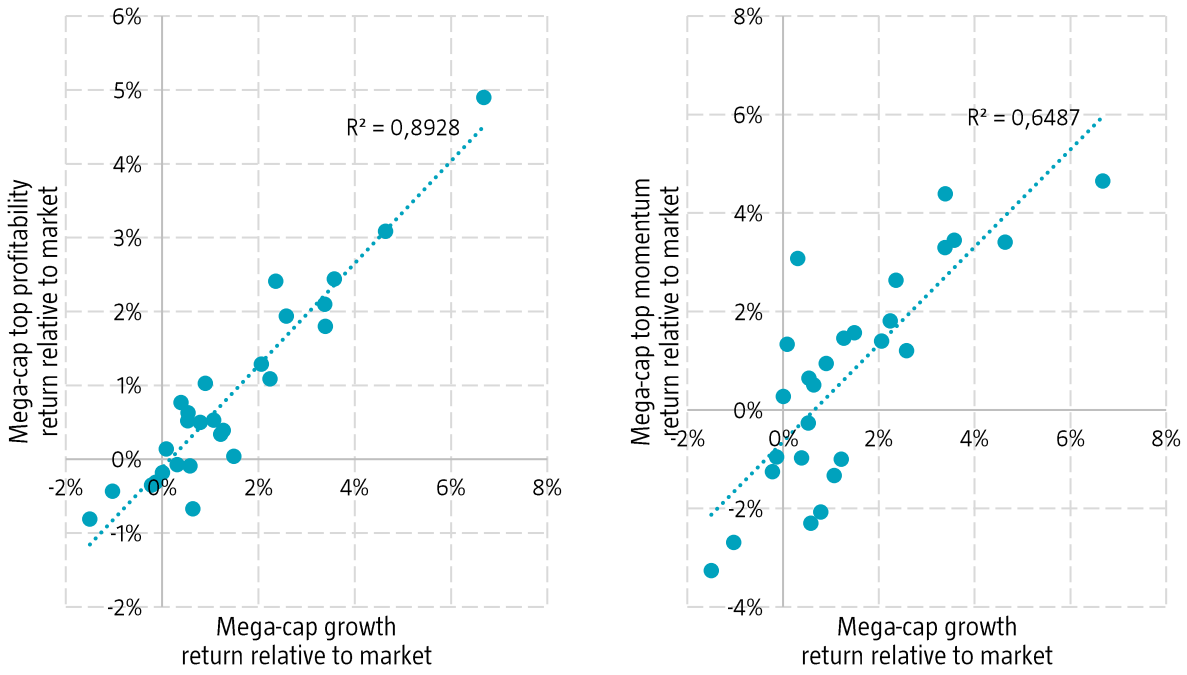
Zooming in on mega-cap profitability and momentum

In this section we will argue that mega-cap profitability and momentum were essentially mega-cap growth in disguise, and that it was only possible to outperform by being short the value factor. We begin by noting that the mega-cap top momentum and mega-cap top profitability portfolios behave very similarly to the mega-cap growth portfolio, with the correlations between the monthly market-relative returns amounting to 75% and 89%, respectively. The scatterplots in Figure 4 visually illustrate how closely their performance lines up. The implication of this strong co-movement is that the outperformances observed in the top right corner of the last two tables in Table 2 are essentially a manifestation of the same phenomenon as the outperformance in the top left corner of the first table. As the mega-cap growth portfolio had the strongest return of all we can conclude that this was the dominant phenomenon during the quant equity crisis period.

Figure 4 | Scatterplots of backtested mega-cap growth versus mega-cap top momentum and mega-cap top profitability market-relative returns, June 2018 to August 2020, global developed markets



Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The factors are based on 5x5 independently sorted portfolios. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

Formal evidence for this is provided in Table 3, which compares the mega-cap top profitability and mega-cap top momentum portfolios with optimized matching portfolios consisting of the five mega-cap portfolios sorted on value. We note that this matching analysis is equivalent to a standard ordinary least squares regression, with the additional constraint that the weights for the explanatory variables are non-negative and sum up to 1. In line with the previous results we find that the matching portfolios for mega-cap top profitability and mega-cap top momentum consist mostly of mega-cap growth. The high R-squared levels show that the fit is very good. We also observe that the returns of the mega-cap top profitability and mega-cap top momentum portfolios are fully explained by their matching portfolios, as their residual (unexplained) returns are both negative. We find a similar result when computing the ex post mean/variance optimal portfolio over the quant equity crisis period. Using all the 100 portfolios in Table 2 as inputs, the maximum Sharpe ratio portfolio consists of 100% mega-cap growth and 0% in each of the other 99 portfolios.

These results imply that the mega-cap top profitability and mega-cap top momentum portfolios effectively came down to watered down versions of mega-cap growth over this period. Thus, rather than providing diversification to the value factor, the profitability and momentum factors are better understood as neutralizing it. Combining value with profitability and momentum was roughly equivalent to having 1x value and 2x growth, i.e. the opposite of value, which adds up to a net growth exposure. In other words, outperformance for multi-factor strategies was only in reach by concentrating on the mega-cap segment, and by allowing the value factor to be completely overruled by other factors and accepting a net negative value exposure. For managers striving for balanced exposure towards all these factors such a mega-cap growth-tilted portfolio would not have been in scope.

Table 3 | Backtested value/growth matching portfolios for top momentum and top profitability in the mega-cap space, June 2018 to August 2020, global developed markets

	Weights							Mean monthly residual
Dependent variable	Mega-cap Growth	Mega-cap Q2	Mega-cap Q3	Mega-cap Q4	Value	Total	R-squared	
Mega-cap top profitability	71.9%	12.1%	0.0%	12.7%	3.3%	100%	99.6%	-0.06%
Mega-cap top momentum	86.2%	0.0%	0.0%	13.8%	0.0%	100%	94.1%	-0.36%

Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The factors are based on 5x5 independently sorted portfolios. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

But could it be that the largest growth stocks performed so well because they were also extremely profitable? In order to shed light on this growth and profitability need to be disentangled from each other. This is done in Table 4, which shows the market-relative performance of the 2x4x4 portfolios in the US market sorted independently on size, value, and profitability. The granularity on the size dimension is reduced to just large versus small here, because with a 5x5x5 triple sort the number of stocks per bucket would become too small. The table clearly shows that all large-cap growth buckets outperformed significantly, regardless of profitability, and that the most extreme outperformance (83.6%) was even realized by large-cap growth stocks with the weakest profitability. In fact, a high profitability only led to outperformance in conjunction with the most expensive valuations. A high profitability combined with less expensive valuations was actually associated with significant underperformance. In other words, profitability was only effective conditional on having growth exposure, while within the growth segment lower profitability actually paid off most. In the small-cap space we again mostly observe large underperformances, consistent with the previous results. In sum, profitability was not the driver of the exceptionally strong performance of growth stocks during the quant equity crisis.

Table 4 | Backtested cumulative market-relative performance 2x4x4 size/value/profitability triple-sorted portfolios, June 2018 to August 2020, US market

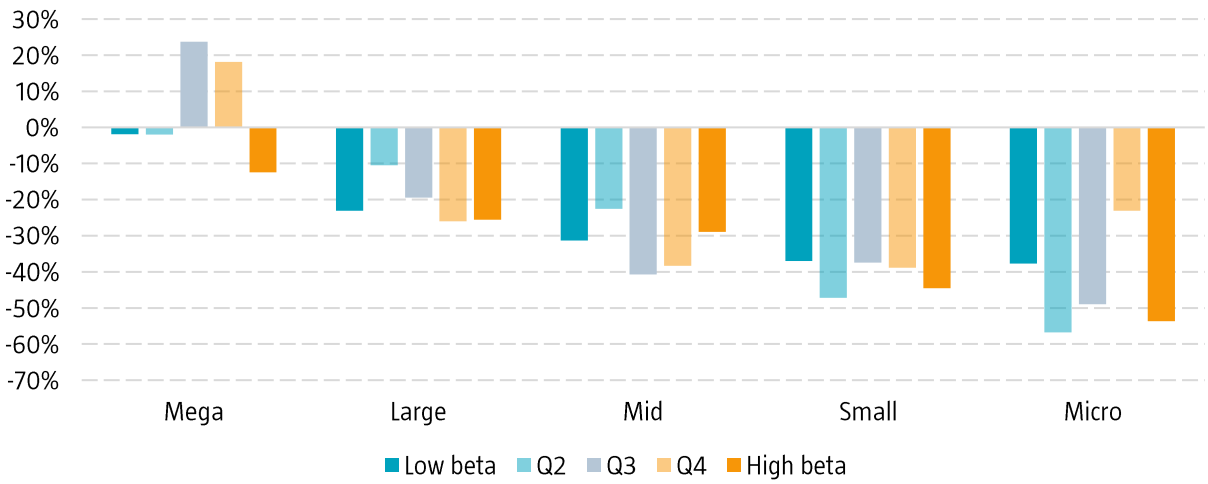
	Large-caps				Small-caps			
	Growth	Q2	Q3	Value	Growth	Q2	Q3	Value
Weak	**83.6%**	-1.5%	**-13.6%**	**-51.1%**	-0.2%	**-26.7%**	**-53.1%**	**-49.8%**
Q2	**54.9%**	4.7%	**-25.5%**	**-51.5%**	**-15.2%**	**-38.8%**	**-62.7%**	**-63.8%**
Q3	**18.9%**	3.2%	**-31.7%**	**-44.1%**	**-20.7%**	**-42.5%**	**-60.1%**	**-56.5%**
Robust	**35.1%**	**-17.6%**	**-38.8%**	**-37.2%**	**-34.3%**	**-51.3%**	**-79.3%**	**-81.3%**

Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The factors are based on 2x4x4 triple-sorted portfolios on size, value, and profitability. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future. Please note double-digit returns are highlighted in bold.

What about the low-risk factor?

In addition to the factors discussed so far, many quantitative investors also target the low-risk effect, i.e. the empirical finding that the relation between risk and return in the cross-section is much flatter than predicted by theory, or even inverted. For an extensive overview of this phenomenon we refer to Blitz, van Vliet, and Baltussen (2020). In order to assess whether the low-risk effect was able to provide some relief during the quant equity crisis we consider the market-relative performance of the 5x5 portfolios sorted on size and market beta that are available for the US market.

Figure 5 | Backtested cumulative market-relative performance 5x5 size/beta sorted portfolios, June 2018 to August 2020, US market



Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The factors are based on 5x5 double-sorted portfolios on size and prior 60-month market beta. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

Figure 5 shows that the lowest beta stocks generally outperformed the highest beta stocks in every size segment, so in that sense the low-risk effect was present during the quant equity crisis. However, we also observe that only mega-caps with medium (Q3) or slightly above-average (Q4) betas outperformed the market, and that all other size/beta portfolios lagged the market. Since most mega-cap growth stocks happen to end up in these beta buckets this is yet another manifestation of the mega-cap growth dominance observed before. Outside the mega-cap segment, all the size/beta sorted portfolios exhibit double-digit underperformances. Altogether this means that the quant equity crisis was also a very difficult period for low-risk strategies, even though risk itself was generally not a priced factor.

Implications

What does all this imply for the performance of quantitative managers using multi-factor strategies during the June 2018 to August 2020 period? To begin with, quantitative managers with an underweight in mega-cap stocks and overweight in smaller stocks were fighting an uphill battle, since pockets of outperformance were almost entirely concentrated in the mega-cap space. Factors that were able to separate winners from losers among smaller stocks still underperformed in absolute terms, due to the lagging performance of smaller stocks in general. This is likely to have had a severe impact on long-only quantitative managers, who tend to have a structural underweight in mega-cap stocks in order to attain sufficient active share and make use of the broad opportunity set offered by small- and mid-cap stocks. Within the mega-cap space the momentum and profitability factors offered an opportunity for outperformance, but only by going diametrically against the value factor. Altogether, these results imply that there were many ways to fail but basically just one way to succeed during the quant equity crisis, namely by investing in large growth stocks, either explicitly or in disguise via other factors.

Comparison with past value drawdowns

In this section we proceed by comparing the 2018-2020 quant equity crisis with past value drawdowns.

Factor performance during value drawdowns

We manually identified the most severe historical drawdowns of the HML factor, using global data augmented with US data for the earlier decades. The results are summarized in Table 5. In addition to the 2018-2020 quant equity crisis we identify four other major value drawdowns since 1963. Interestingly, value drawdowns seem to have a habit of occurring around the turn of a decade, although we may be fooled by randomness here since this inference is based on just a handful of observations.

Table 5 | Backtested cumulative factor performance during major value drawdowns

Start		2018:06	1998:06	1989:07	1979:08	1970:09
End		2020:08	2000:02	1991:12	1980:11	1972:06
Universe		Global DM	Global DM	US	US	US
Market	Mkt	**13.8%**	**23.5%**	**18.1%**	**29.4%**	**31.8%**
Size	SMB	**-18.6%**	2.7%	**-13.3%**	**10.5%**	**11.9%**
Value	HML	**-37.4%**	**-37.5%**	**-25.0%**	**-28.3%**	**-18.1%**
Investment	CMA	**-16.0%**	**-23.6%**	-9.7%	**-13.3%**	**-10.1%**
Profitability	RMW	**18.2%**	-4.9%	**22.1%**	**16.2%**	**18.5%**
Momentum	WML	**22.3%**	**94.8%**	**54.3%**	**72.0%**	**17.4%**
All ex market	1/N	-8.6%	-0.4%	2.8%	7.5%	3.5%
Value/momentum	50/50	**-11.5%**	**13.4%**	8.4%	**12.7%**	-1.5%

Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The HML, CMA, RMW, and WML factors are based on 2x3 portfolios sorted independently on size and the target factor. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future. Please note double-digit returns are highlighted in bold.

The most important insight from Table 5 is that the momentum factor delivered very strong returns during each of the previous major value drawdowns. In fact, the gains on the momentum factor significantly exceeded the losses on the value factor during 3 of the previous 4 value drawdowns, and their returns were similar during the other one. These periods are therefore best characterized as momentum rallies with negative side effects on the value factor, as opposed to the 2018-2020 quant equity crisis which was first and foremost a growth rally, with positive side effects on the momentum factor. This result implies that the quant equity crisis presented a much bigger challenge to quantitative investors with balanced exposure towards multiple factors than previous value drawdowns.

We also observe that in 3 out of the previous 4 value drawdowns the size factor was able to hold its ground or deliver positive returns. A simultaneous breakdown of the value and size factors occurred only once before, namely during the 1989-1991 value drawdown. Thus, most previous value drawdowns were less challenging for quantitative managers with a tilt towards smaller stocks. Finally, we observe that during all value drawdowns the market return tends to be solid, the investment factor fails along with the value factor, which is to be expected given the strong relation between the two factors, and the profitability factor usually does well, albeit not well enough to offset the large losses on the value factor. Altogether, both a 1/N mix of all the factors and a simple 50/50 value/momentum combination were able to offset the large negative returns on the value factor during all previous major value drawdowns. The 2018-2020 quant equity crisis is

the first major value drawdown in more than half a century during which other factors were not able to compensate the losses.

Zooming in on each separate value drawdown

In Table 6 we take a closer look at each of the previous value drawdowns by turning to 5x5 sorted portfolios. For brevity we only report results for the top and bottom quintiles, and not for the three quintiles in between. Panel A of Table 6 shows the performance of factor portfolios during the 1998-2000 period, popularly known as the Tech Bubble. Clearly, this period is best characterized as a momentum rally, with triple digit (>100%) outperformance for many of the top momentum portfolios. The solid momentum returns are present in all size segments and exceed the value losses by a significant margin. Thus, momentum gains more than offset value losses during this period.

Panel B of Table 6 contains the results for the 1989-1991 period. Among all the previous value drawdowns, this period appears to be most comparable with the 2018-2020 quant equity crisis. Small stocks also underperformed large stocks, resulting in 81 of the 100 portfolios underperforming the market, and 61 of those even with double-digit numbers. The results for the size/value sorted portfolios also appear very similar, with a tiny pocket of strong outperformance for the largest growth stocks. The drivers of this rally were mostly found in the health care, biotech, and beverages sectors. Growth was also the dominant theme in the mega-cap space, because the outperformance of growth exceeds the outperformance of mega-cap top momentum and mega-cap top profitability stocks. However, there is one key difference between the 1989-1991 and 2018-2020 episodes, namely that momentum was highly effective and the most dominant factor in all other size segments during 1989-1991. This would have made it easier for multi-factor investors to limit the damage in this period.

Panel C of Table 6 shows the results for the 1979-1980 value drawdown. Similar to the 1998-2000 period this period is first and foremost a momentum rally, with the highest outperformances observed for the top momentum stocks, across all size segments. This rally was driven by the energy and materials sectors, which benefited from rising oil and commodity prices due to the second oil crisis. Interestingly, the largest and most expensive stocks even underperformed the market during this period.

Finally, we consider the 1970-1972 period in Panel D of Table 6. In the mega-cap space, growth was the dominant theme, with the most expensive stocks delivering the highest returns. The stocks in question were popularly known as the Nifty Fifty, and included 'blue-chip' stocks such as Xerox, Polaroid, Coca-Cola, McDonalds, and IBM. Similar to the 2018-2020 quant equity crisis, momentum and profitability provided relief, but not enough to compensate the value losses. However, the picture is different in all the other size segments. Here the dominant theme is the outperformance of top momentum and top profitability stocks, more so than the underperformance of value. Also this period would therefore have been easier to navigate for quantitative managers with multi-factor models.

Table 6 | Backtested cumulative market-relative performance 5x5 sorted portfolios during past major value drawdowns

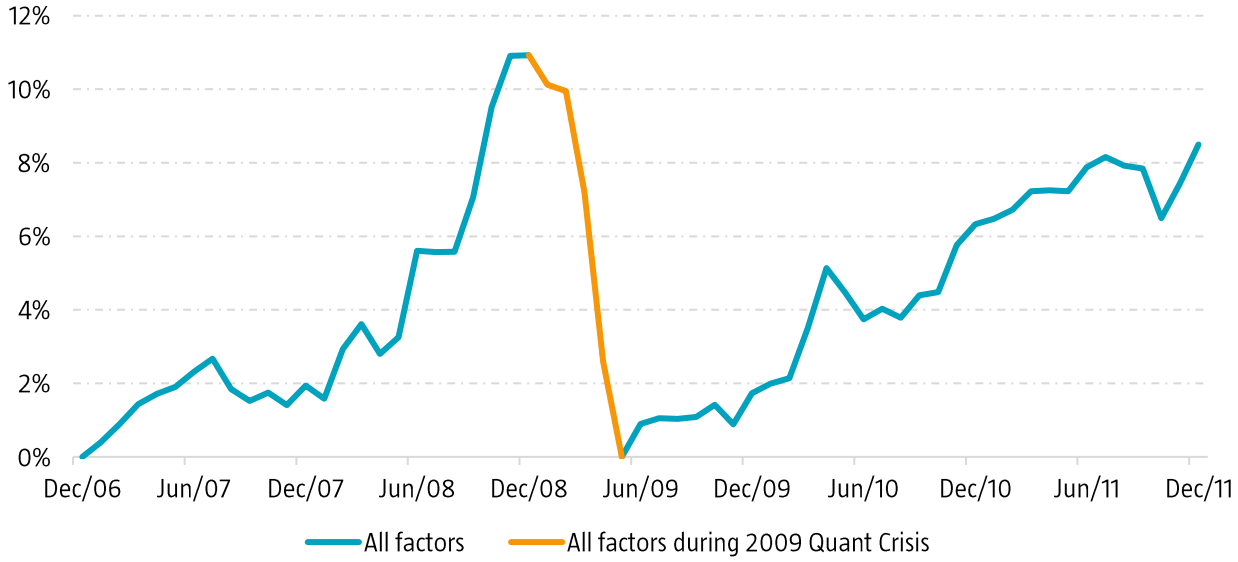
	Value		Investment		Profitability		Momentum	
	Growth	Value	Agg	Cons	Weak	Robust	Losers	Winners
Panel A: 1998:06-2000:02								
Mega	28.8%	-33.4%	34.8%	-12.3%	7.2%	14.4%	-26.4%	101.2%
Large	86.4%	-33.1%	38.2%	-29.0%	21.5%	-4.5%	-43.9%	114.1%
Mid	48.7%	-31.4%	15.5%	-15.9%	21.8%	-6.1%	-45.2%	83.1%
Small	57.7%	-26.4%	28.1%	-5.8%	18.7%	6.2%	-39.7%	116.4%
Micro	70.3%	2.6%	43.7%	35.6%	46.5%	11.3%	-22.1%	115.8%
Panel B: 1989:07-1991:12								
Mega	43.0%	-25.2%	22.7%	-16.5%	-7.2%	36.0%	-32.5%	26.1%
Large	30.8%	-16.5%	24.6%	-26.4%	-15.0%	-1.1%	-28.4%	11.3%
Mid	11.6%	-30.5%	3.2%	-31.1%	-33.3%	-8.7%	-56.9%	34.5%
Small	-0.9%	-44.3%	-11.8%	-35.7%	-31.7%	-3.6%	-64.2%	16.2%
Micro	-24.4%	-47.1%	-35.1%	-29.2%	-38.7%	-14.8%	-74.6%	27.9%
Panel C: 1979:08-1980:11								
Mega	-8.8%	-27.9%	25.6%	-7.3%	-31.0%	-0.1%	-37.0%	67.9%
Large	31.7%	-28.1%	27.7%	-10.6%	-29.5%	24.9%	-31.4%	60.1%
Mid	37.2%	-30.3%	30.2%	-10.0%	-9.6%	23.2%	-32.7%	68.4%
Small	46.3%	-20.0%	40.7%	-6.5%	16.2%	22.8%	-17.5%	69.3%
Micro	62.6%	-8.2%	29.4%	7.2%	19.4%	36.6%	-19.5%	63.4%
Panel D: 1970:09-1972:06								
Mega	24.7%	-7.0%	25.8%	-10.3%	-11.7%	17.7%	-13.4%	10.5%
Large	32.5%	-0.1%	22.9%	6.8%	6.1%	44.3%	-26.5%	40.0%
Mid	36.8%	-7.7%	24.0%	2.5%	-7.8%	43.7%	-8.3%	36.9%
Small	33.3%	15.8%	25.7%	26.5%	18.5%	38.7%	-21.7%	26.7%
Micro	10.1%	8.1%	-3.4%	10.1%	-8.8%	25.6%	-5.8%	43.2%

Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The factors are based on 5x5 independently sorted portfolios. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future. Please note double-digit returns are highlighted in bold.

Comparison with past quant equity crises

From the previous section it follows that the previous value drawdowns were not necessarily quant equity crises, because the other factors were able to compensate the losses on the value factor. Apart from the previously mentioned intra-month quant equity crisis of August 2007, which is not even visible with monthly data, there has been only one other clear quant equity crisis over our entire 1963-2020 sample period, namely in the beginning of 2009. Figure 6 shows that the 1/N mix of factors experienced losses over the January to May 2009 period that were large enough to wipe out all the gains made over the preceding two calendar years. Although the magnitude of the 2009 and 2018-2020 quant equity crises is comparable, their duration is very different. The 2018-2020 crisis was a protracted event that played out over a period of more than two years, while the 2009 crisis lasted less than half a year before factors resumed their upward trend again.

Figure 6 | Backtested cumulative return of the equally-weighted Fama-French factors, January 2007 to December 2011, global developed markets

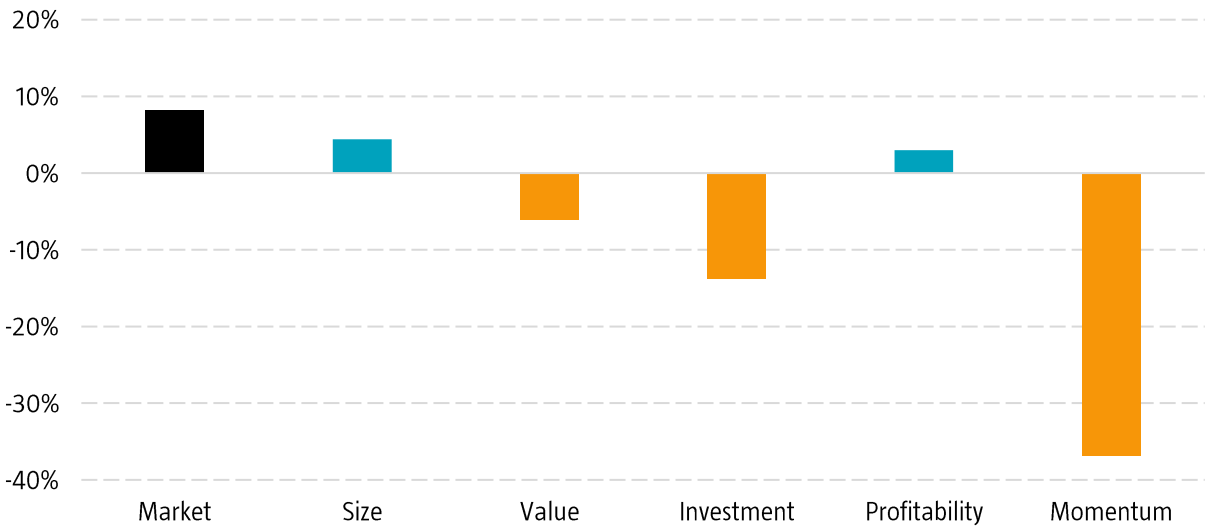


Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The HML, CMA, RMW, and WML factors are based on 2x3 portfolios sorted independently on size and the target factor. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

Figure 7 shows that factor returns were also very different during the 2009 crisis. Not the value factor, but the momentum factor was the main source of underperformance in 2009. This was caused by a sharp reversal of stocks that had suffered large losses during the 2008 debt crisis, particularly banks and insurance stocks. This momentum crash is well-documented and analyzed in e.g. Daniel and Moskowitz (2016). The value and investment factors also experienced negative returns. Only the size and profitability factors remained in positive territory, but only marginally so.

Altogether, the 2009 events illustrate that quant equity crises can have very different causes and that any one factor can torpedo a diversified multi-factor strategy, if the drawdown of that factor is severe enough compared to the returns of the other factors. Based on the experience so far it may seem that the main troublemakers tend to be value and momentum, and that other factors are relatively innocent. Such impressions can be deceiving though, because other factors can also experience significant drawdowns. The profitability factor, for instance, lost over 20% during the 1973-1976 Nifty Fifty bear market, which could potentially also have resulted in a quant equity crisis, were it not for other factors coming to the rescue – that time.

Figure 7 | Backtested cumulative factor performance, January 2009 to May 2009, global developed markets



Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The HML, CMA, RMW, and WML factors are based on 2x3 portfolios sorted independently on size and the target factor. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

Conclusion

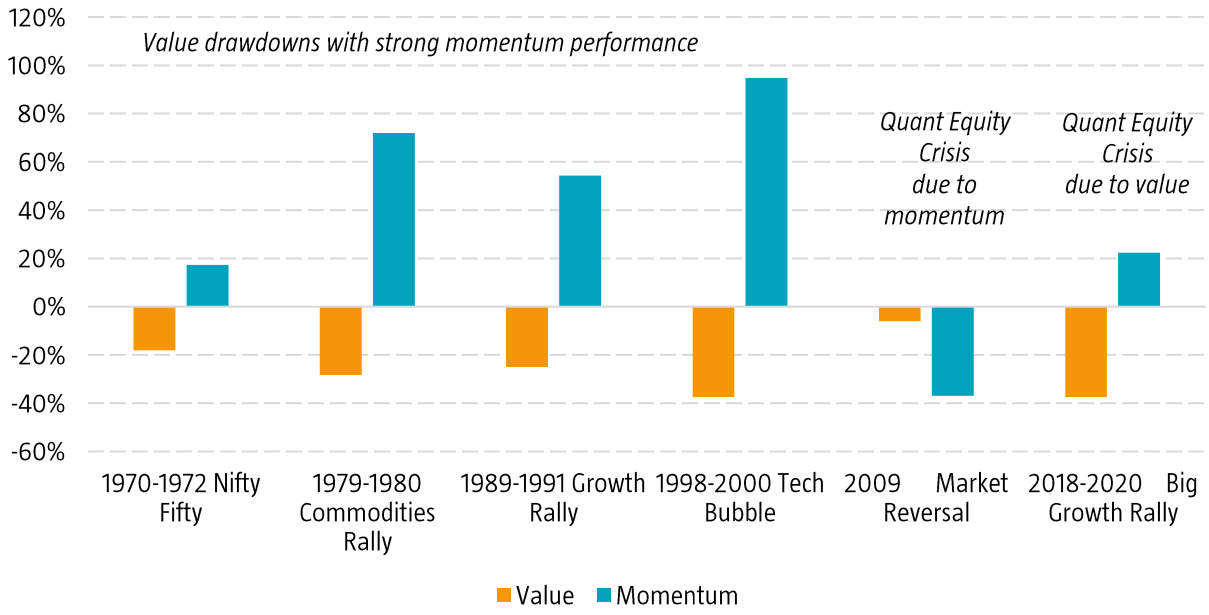
We examined the performance of factor strategies during the quant equity crisis of 2018-2020. Our main finding is that there was basically only one way to outperform during this period, namely by investing in the largest and most expensive growth stocks. Mega-caps with the strongest profitability and momentum characteristics also outperformed, but we find that this is due to their sizable implicit exposure to the same large growth stocks. Moreover, profitability was only effective in the mega-cap space conditional on having a strong growth tilt. Smaller stock portfolios underperformed across the board. Thus, there were numerous ways to fail during the 2018-2020 period, but essentially only one way to succeed.

Comparing the quant equity crisis with previous drawdowns of the value factor we find that these other periods are generally better characterized as momentum factor rallies with collateral damage for the value factor. Moreover, smaller stocks typically still offered possibilities for outperformance. Altogether, previous value drawdowns did not necessarily cause quant equity crises. There is one other clear quant equity crisis in our sample period, namely in 2009, but this crisis was caused by a large drawdown of the momentum factor, and also a relatively short-lived event, lasting less than half a year. The value and momentum performance in these most challenging periods for factor strategies is summarized in Figure 8. We conclude that the 2018-2020 quant equity crisis posed a tougher challenge to quantitative managers compared to what we have seen before in more than half a century of data.

Some have wondered whether the quant equity crisis signifies that factor-based investing is permanently impaired. Of course, only time will tell whether factor strategies will deliver again as they have in the past. One thing we can say with confidence, however, is that based on previous extreme periods the 2018-2020 events fall well within the range of conceivable outcomes. Diversification across different factors can help to mitigate the losses when one factor experiences a large drawdown, but it is not a guarantee for a positive return in all scenarios. The fact that this time the large losses on one factor were not offset by similar-sized or even larger gains on other factors does not imply a structural break, nor that factor premiums which have existed for many decades have disappeared all of a sudden.

In fact, Arnott et al. (2020) and Blitz and Hanauer (2021) have observed that the recent underperformance of the value factor is primarily driven by an extreme multiple expansion of growth stocks which appears unsustainable and bound to mean-revert, at some point. In other words, instead of having been arbitraged away, the value factor has experienced an increase in its expected return to a level well above its historical average. Therefore, we would summarize the 2018-2020 quant equity crisis as an unusual combination of circumstances that culminated in a perfect storm for multi-factor quantitative investors, but also as an episode from which quantitative investment strategies can be expected to recover again in due course.

Figure 8 | Backtested summary graph



Source: Data library of Professor Kenneth French. Next to the capitalization-weighted market portfolio we consider the standard academic factors, size (SMB), value (HML), investment (CMA), profitability (RMW), and momentum (WML), as described in Fama and French (1993, 2015). The HML, CMA, RMW, and WML factors are based on 2x3 portfolios sorted independently on size and the target factor. All portfolios are capitalization weighted, and all returns are compounded total returns in US dollars. These returns reflect hypothetical, backtested portfolios which ignore costs, fees and taxes. Past returns are no guarantee for the future.

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