Invesco

# Risk & Reward

## Research and investment strategies

## #03

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# Risk & Reward #03/2022

# Stabilizing equity portfolios through dynamic volatility management

By Carsten Becker, Julian Keuerleber, Dr. Martin Kolrep und Alexander Tavernaro

While most investors are open to equity exposure in a low volatility market, they tend to shy away as volatility increases. To counteract equity volatility, asset managers have traditionally added perceived 'safe haven' assets like government bonds to the portfolio. But this strategy has been less successful in the current phase of strongly rising bond yields. We suggest an alternative approach that controls equity portfolio volatility without government bonds.

**After more than a decade of rising global equity markets and declining bond yields, the last 12 months have marked an inflection point. Persistent inflation, more hawkish central banks and geopolitical uncertainties have prompted an increase in equity market volatility. With that, many investors have begun to rethink their asset allocation.**

There have been several volatile phases in recent years – in late 2018 when the trade conflict between the US and China began, in the first half of 2020 when COVID-19 broke out and the current phase resulting from the Russian invasion in Ukraine and the rapid rise in inflation.

The yield on 10-year US Treasuries has climbed from around 1% in 2021 to almost 3.5% in mid-July 2022, leading to heavy losses on the bond markets. At the same time, the MSCI World Index, as a proxy for global equity markets, has declined well

Actively managing portfolio volatility may be a better way to make the daily movements of the portfolio more tolerable.

over 20% from its all-time high in early 2022. As shown in figure 1, US equities have experienced a very weak first half of the year, and US bonds have had by far their worst first half in at least 32 years. Such parallel losses in bonds and equities are unusual and an indication of significant stagflation fears. Almost the only perceived safe-haven left is cash, which still also yields negative rates in some parts of the world. Investors are thus confronted with a new reality.

Needless to say, such periods are usually exceptionally volatile. Looking at long-term volatility, equities come in at around 16% p.a., with a high degree of variation around the average. But every time equities experience a massive drawdown coinciding with a sharp rise in volatility, investors question their usefulness as a long-term investment and may opt for an exit at the wrong moment. Actively managing portfolio volatility may therefore be a better way to make the daily movements of the portfolio more tolerable and avoid any possibly ill-timed impulse to sell.

## The concept

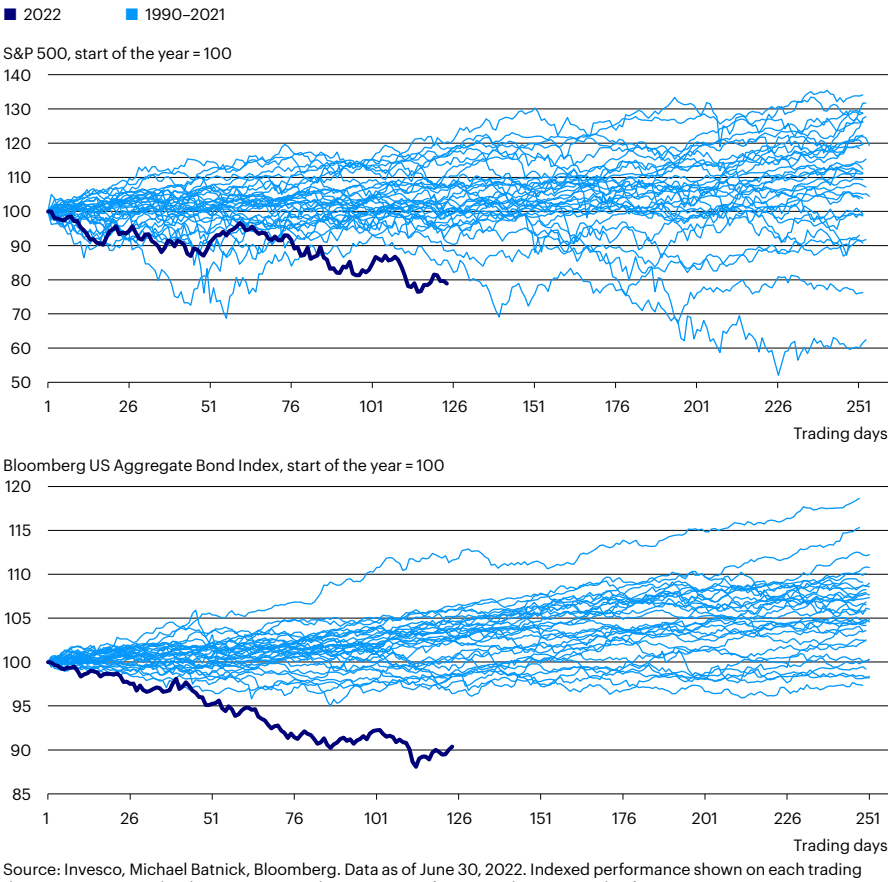
In this article, we show how the volatility of an equity portfolio can be controlled without adding a fixed proportion of government bonds. Instead, daily price movements can be kept within certain limits by adjusting the equity ratio to accord with prevailing market volatility.

Our basic idea is intuitive and simple: Assuming a given long-term volatility – 16% p.a. for global equities in our example – the equity allocation can be scaled in such a way that it corresponds to the portfolio's target volatility. For example, for a desired portfolio volatility of 12%, the strategic allocation to equities would be 75%. But as global equity market volatility is not constant over time, the equity allocation needs to be flexible to keep portfolio volatility at the desired level. Therefore, the equity exposure has to be reduced in times of high equity market volatility and increased when it subsides to normal levels.

## Adding a TAA module

To determine the specific equity allocation at a given point, a tactical asset allocation (TAA) module may be included. This allows the equity allocation to be adjusted based not only on current market volatility, but also on the market outlook. Then, the combination of asset allocation and risk management will lead to an equity allocation above the strategic allocation only when the outlook is positive and market volatility is below the long-term average. If volatility is above the long-term average, the equity allocation will be below the strategic allocation.

Figure 1
**A painful first half of the year**




Source: Invesco, Michael Batnick, Bloomberg. Data as of June 30, 2022. Indexed performance shown on each trading day per respective calendar year, 1990 until 2022. Past performance does not predict future returns. An investment cannot be made in the index.

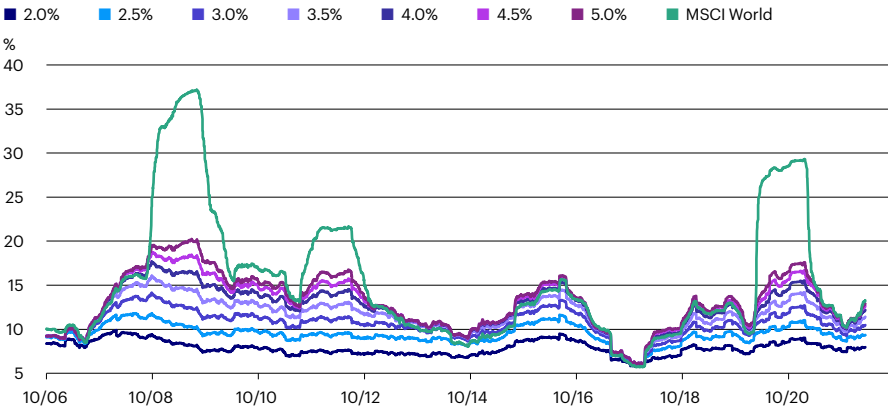
## Volatility forecasts

Since our overarching goal is to adjust the equity exposure based on market volatility, accurate market risk forecasts are important. Such forecasts are often derived implicitly from options or explicitly from volatility indices such as the VIX. Alternatively, they can be based on the expected shortfall (ES) of equity markets, using, for example, a t-GARCH Copula approach with daily data and a 99% confidence level. In our view, such an approach has some advantages: First, there is no need to assume normally distributed returns and, second, time changing volatility may be captured more precisely. From this alternative approach, we expect more reliable risk estimates and thus better risk management. First and foremost, however, an ES approach can forecast the magnitude of extreme market movements, which are a particular source of anxiety for investors in times of crisis.

## Simulation results of the pure model

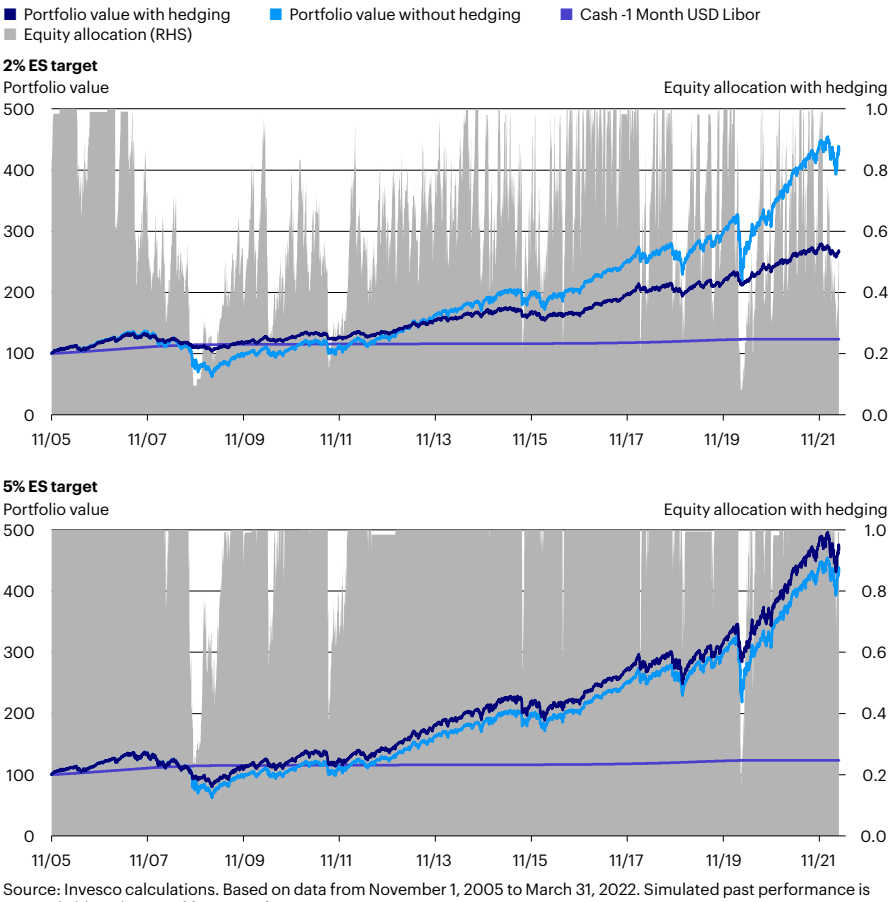
We backtested our basic model for multiple risk levels. Figure 2 shows the simulated one-year rolling volatility based

Figure 2
**Simulated one-year rolling volatility for different expected shortfall targets**




Source: Invesco calculations. Based on data from November 1, 2005 to March 31, 2022.

Figure 3
**Simulations for a 2% ES target and a 5% ES target compared**




Source: Invesco calculations. Based on data from November 1, 2005 to March 31, 2022. Simulated past performance is not a reliable indicator of future performance.

Realized volatility heavily depends on the specified expected shortfall.

on a passive replication of developed global equities as measured by the MSCI World Index. The realized volatility heavily depends on the specified ES: With a conservative ES target of 2%, volatility would typically stay below 10% p.a., with an average well below 8%. Conversely, a more aggressive ES target of 5% would have resulted in an average volatility of 13.2% p.a., with a maximum of 20.2%. These numbers are particularly interesting when compared to the passive equity index: With an average rolling volatility of 15% and a maximum of 37.2% p.a. (during in the Global Financial Crisis), even the highest risk model, with an ES target of 5%, would have reduced the maximum volatility by 17 percentage points.

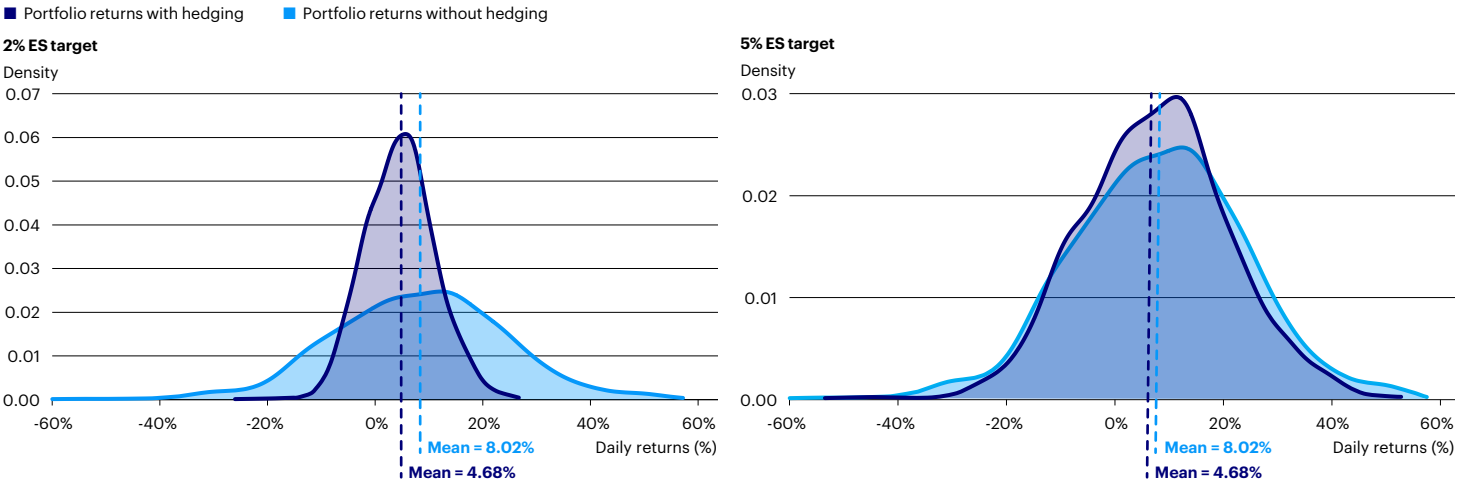
However, reducing volatility requires interventions via the risk management process. These can be stronger (for more defensive risk levels) or less so (for more aggressive levels). Figure 3 shows a 2% ES simulation on the left and a 5% ES simulation on the right. As expected, a lower target risk would have led to stronger and more frequent risk hedging, and consequently to more frequent changes of the net equity exposure (gray bars).

This can be illustrated even better by a density chart (figure 4), showing the daily return distributions of the simulation for the two ES targets of 2% and 5%. In the defensive model (2% target), extreme losses are expected to be less frequent, but as the simulation shows, that could come at the expense of lower participation in strongly rising markets. The 5% version, on the other hand, is likely to be invested in the equity market for longer periods, mirroring more closely the return distribution of the index. Only in extreme cases, such as during the Global Financial Crisis or the COVID-19 sell-off, would risk management have initiated a hedge. However, even these occasional interventions would have reduced volatility considerably.

Finally, table 1 summarizes the results of our simulations, not just for target ES of 2% and 5%, but also for many target values in between.

As expected, simulated returns, as well as standard deviation and average equity exposure, rise with the ES target. For targets of 4.0% and above, simulated returns are higher than those of an equity index portfolio – but with a lower average equity allocation, a much lower standard deviation, a lower maximum drawdown, and a much better Sharpe Ratio.

Figure 4
**Density charts of the simulations for the pure model**




Source: Invesco calculations. Based on data from November 1, 2005 to March 31, 2022.

Table 1
**Backtest results of the pure model**

| | Cash | MSCI World | ES target | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2.0% | 2.5% | 3.0% | 3.5% | 4.0% | 4.5% | 5.0% |
| Return p.a. | 1.25 | 8.59 | 5.76 | 6.7 | 7.45 | 8.16 | 8.59 | 8.88 | 9.07 |
| Standard deviation p.a. | 0.13 | 17.35 | 7.92 | 9.49 | 10.72 | 11.71 | 12.5 | 13.06 | 13.5 |
| Sharpe Ratio | 0.00 | 0.42 | 0.57 | 0.57 | 0.58 | 0.59 | 0.59 | 0.58 | 0.58 |
| Max drawdown | 0.00 | -58.15 | -22.57 | -28.23 | -33.08 | -36.74 | -39.33 | -40.82 | -42.93 |
| Average equity exposure | 0.00 | 100.00 | 65.98 | 76.69 | 83.94 | 88.79 | 92.14 | 94.09 | 95.45 |

Source: Invesco calculations. Based on data from November 1, 2005 to March 31, 2022. Simulated past performance is not a reliable indicator of future performance.

The backtest results are also much better than those of a portfolio with a constant equity allocation.

The backtest results are also much better than those of a portfolio with a constant equity allocation. Take the 4.0% case as an example: In the model, the average equity allocation would have been 92.14%, leading to a return of only 7.91% (8.59% x 92.14%) rather than 8.59% – and volatility would have been 15.98% (17.35% x 92.14%) rather than 12.50%. There are similar improvements for the other indicators and ES targets.

### Simulation results of the model with TAA

Next, we added a tactical asset allocation model. In our example, it is based on the three concepts: Valuation, Investor Positioning and Economic Environment. With such a model, the equity exposure can be dynamically adjusted based on the asset manager's tactical outlook. As table 2 shows, using the current version of the Invesco Quantitative Strategies[1] TAA model would have reduced returns, but it would have reduced volatility even more, leading to higher Sharpe Ratios and lower maximum drawdowns compared to the pure model.

### Replacing the MSCI World with a factor-based underlying

Finally, as equity factors can explain risk and return in equity markets, we performed another simulation, replacing the market-capitalization weighted MSCI underlying with a factor-based underlying. Again, we used the model commonly used by Invesco Quantitative Strategies as an example.[2] It explicitly captures the factors Momentum, Quality and Value.

Figure 5 shows the return distribution of the backtested factor model (which also includes the TAA model from the previous step); table 3 shows the full results. For all three ES targets, the simulated Sharpe Ratio is higher, showing a better risk-adjusted performance. All in all, combining the proposed volatility management approach with a TAA model and a factor model can lead to a more balanced return distribution.

Table 2
**Backtest results with TAA**

| | Cash | MSCI World | ES target | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2.0% | 2.5% | 3.0% | 3.5% | 4.0% | 4.5% | 5.0% |
| Return p.a. | 1.25 | 7.57 | 5.7 | 6.58 | 7.38 | 7.7 | 7.81 | 7.86 | 7.86 |
| Standard deviation p.a. | 0.13 | 13.94 | 7.65 | 8.9 | 9.78 | 10.38 | 10.81 | 11.18 | 11.5 |
| Sharpe Ratio | 0.00 | 0.42 | 0.58 | 0.6 | 0.63 | 0.62 | 0.61 | 0.59 | 0.58 |
| Max drawdown | 0.00 | -58.15 | -21.81 | -25.71 | -28.2 | -30.52 | -32.53 | -34.57 | -36.61 |
| Average equity exposure | 0.00 | 100.00 | 76.02 | 85.46 | 90.89 | 93.69 | 95.34 | 96.43 | 97.16 |

Source: Invesco calculations. Based on data from November 1, 2005 to March 31, 2022. Simulated past performance is not a reliable indicator of future performance.

## Customization of the model

This model can be adapted to different investors' needs by changing its three main input parameters:

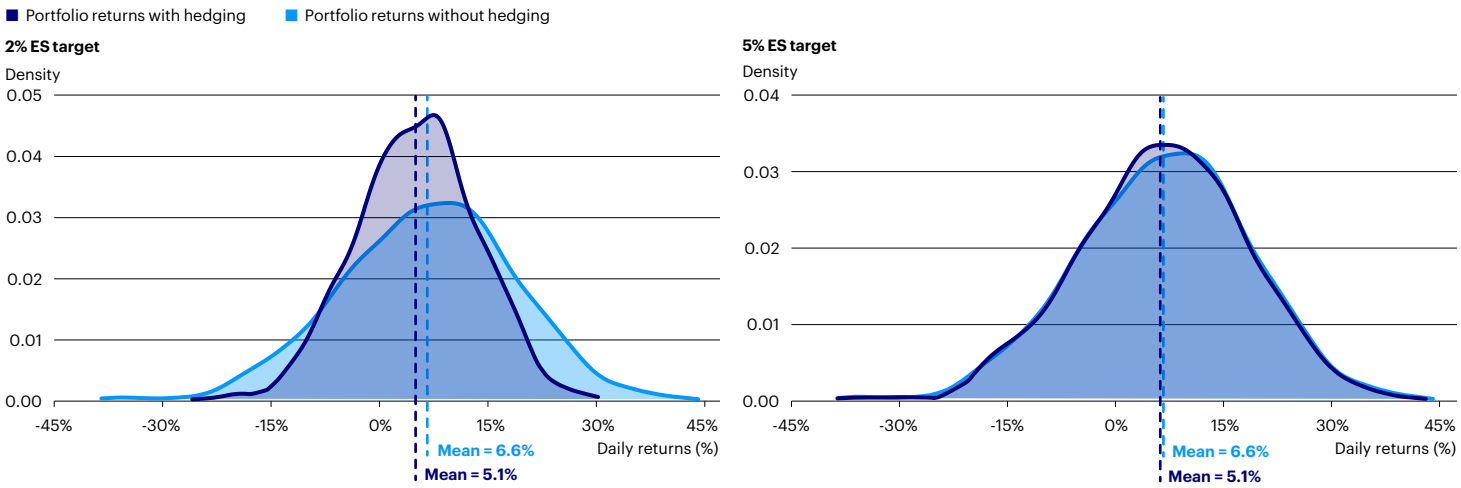
1. Underlying: By changing the equity underlying, the model can be tilted towards a desired level of risk. For very risk-averse investors, the underlying could include a low volatility tilt, while leverage could be introduced for more aggressive investors. Other criteria, such as sustainability preferences could also be considered in this step. Furthermore, the capitalization-weighted underlying can be replaced by a factor-based underlying.

2. TAA model: By changing the impact of the tactical allocation model, the portfolio can be positioned more defensively or aggressively vis-à-vis the equity market outlook.

3. Risk level: Depending on the ES target, the risk management process can react more aggressively or more conservatively.

To model possible alternatives, we created simulations of one very defensive and one very aggressive approach. For the defensive case, we used a defensive low volatility equity underlying and set the strategic allocation in the risky asset portion at 50%. In contrast to a pure equity investment, investors would have been able to achieve significantly lower drawdowns with very limited volatility. For the aggressive case, we used a global factor-based equity underlying that is fully invested in the market and can lever the exposure to 115% when the tactical model generates positive market outlooks. This led to simulated returns above those of a non-levered model, but also produced higher volatility and maximum drawdowns. However, risk-adjusted results still looked attractive, which shows that a large variety of model combinations may be used.

Figure 5
**Density charts of the simulations for the model with TAA and factor strategy**




Source: Invesco calculations. Based on data from November 1, 2005 to March 31, 2022. The density charts are calculated based on a 55% hit-rate for the tactical asset allocation model.

Table 3
**Backtest results with TAA and factor strategy**

| | Cash | Underlying | ES target | | |
|---|---|---|---|---|---|
| | | | 2.0% | 3.5% | 5.0% |
| Return p.a. | 1.25 | 7.95 | 7.24 | 8.32 | 8.18 |
| Standard deviation p.a. | 0.13 | 12.84 | 9.02 | 11.03 | 11.78 |
| Sharpe Ratio | 0.00 | 0.52 | 0.66 | 0.64 | 0.59 |
| Max drawdown | 0.00 | -46.52 | -30.80 | -38.53 | -43.58 |
| Average equity exposure | 0.00 | 100.00 | 86.94 | 97.51 | 98.99 |

Source: Invesco calculations. Based on data from November 1, 2005 to March 31, 2022. Simulated past performance is not a reliable indicator of future performance.

Our approach is designed to keep the volatility of an equity portfolio under control during phases of elevated risk due to price fluctuation.

## Conclusion

We have developed an approach designed to keep the volatility of an equity portfolio under control when price fluctuations lead to elevated risk. Instead of re-allocating to a perceived safe haven (government bonds), the model has the potential to achieve lower volatility and enhance returns by dynamically adjusting equity market exposure based on current expected market volatility and the current equity market outlook.

**Notes**
1 Details are available upon request.
2 For a detailed description of the model see Factor investing: the third pillar of investing alongside active and passive, Risk & Reward #2/2018.

## About the authors


**Carsten Becker**
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Carsten, along with the Global Portfolio Analytics team, conducts performance and risk analytics for various SFI strategies with a focus on attribution of risk-controlled multi-asset strategies.

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Senior Portfolio Manager
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Alexander is responsible for various global and regional equity and multi-asset portfolios.

# “Investors want equity-like returns with lower volatility”

Interview with Dr. Martin Kolrep and Alexander Tavernaro

**Dr. Martin Kolrep**
Senior Portfolio Manager
Invesco Quantitative Strategies

**Alexander Tavernaro**
Senior Portfolio Manager
Invesco Quantitative Strategies

**Risk & Reward spoke to Dr. Martin Kolrep and Alexander Tavernaro, Senior Portfolio Managers at Invesco Quantitative Strategies who helped develop the dynamic volatility management model.**

**Risk & Reward**
*Your approach seems so straightforward. Why have 60/40 portfolios been so popular for so long when volatility management can achieve much better results?*

**Martin Kolrep**
60% equities, 40% bonds have been an easy way to achieve the best of both worlds – high returns and downside risk mitigation in times of crisis. Over the past 30 or 40 years, bond yields have declined considerably and, as we all know, falling bond yields mean rising prices. So bond returns far exceeded the interest rate of the day. Add in the traditional negative correlation between equities and bonds, and bonds become a useful complement to an equity investment – when equity markets were rough, bonds delivered a positive return. Normally, you have to pay for risk mitigation, but bonds were one of very few options I know that delivered a premium.

Looking at the recent crises, however, 60/40 has not worked as well. Equity valuations declined in the first half of this year, and bonds followed suit. In fact, signs of an equity-bond correlation flip were already visible during the Covid crash in 2020, albeit less pronounced. So there was ample warning.

In any case, we have to think differently now. One alternative is buying options, another is dynamic hedging. Both concepts have one thing in common: They can do without bonds.

**Risk & Reward**
*As with all active investment approaches, your model relies on forecasts – and forecasting can be a messy business. Are volatility forecasts more reliable than return forecasts?*

**Alexander Tavernaro**
Oh yes, by far! Volatility forecasts are a bit like weather forecasting. If you forecast tomorrow’s weather to be like today’s, your chances of being near the mark are already quite high. And it’s not much different when it comes to volatility. Major jumps in volatility from one day to the next are extremely rare. Volatility spikes typically build up over time, something we call ‘volatility clustering’. There are periods of higher volatility and periods of relative stability. A volatility regime typically lasts for months – if not years. Market volatility tends to build up and then recede again. Asset managers can make use of this typical behavior when forecasting.

**Risk & Reward**
*Could you tell us a bit more about how a GARCH-Copula model works in this context?*

**Martin Kolrep**
A t-GARCH-Copula model takes account of some crucial features of capital market returns that traditional models replace with a simplifying assumption of normal distribution, with independent and identically distributed random variables. But real returns are not normally distributed; extreme (negative) returns occur more frequently than normal distribution assumes.

Volatility isn’t constant – even though violent swings are rare, the dynamics can change considerably. Experience shows that traditional risk models tend to underestimate risk when markets fluctuate strongly and overestimate it when markets are calm. And the co-movement of asset classes isn’t constant either. In turbulent phases, an apparently well-diversified portfolio may suddenly lose out considerably because several asset classes suddenly begin heading in the same direction. t-GARCH-Copula replaces traditional assumptions with something more realistic.

**Risk & Reward**
*The simulated results of the ‘pure model’ – i.e., volatility forecast only, no TAA, no factor model – look pretty impressive already. What convinced you that adding TAA and factors could further improve the outcome?*

**Alexander Tavernaro**
That’s very simple: Our confidence in adding value through TAA and factor investing comes from our practical experience. But on top of this, both elements have the potential to improve diversification.

**Risk & Reward**
*We are curious to learn more about model development at Invesco. Can you tell us a bit about how the dynamic volatility management model was developed?*

**Martin Kolrep**
All of our models are based on factors and indicators. The team and its individual members look for relations that are evidence-based and proven. They must contain what we call a motivation (or a rationale), meaning that all factors and indicators have to be plausible. Typically, they are based on economic and financial market relationships or behavioral approaches. Of course, they should also be predictive of future price developments – which is, after all, what active management is all about. However, for diversification, we also may include indicators that have a risk-reducing effect and thus contribute to a stable return profile.

Indicators should above all be robust with respect to their specification. When the utility of an indicator depends too much on its parameterization, there is a high risk of future failure. We avoid looking too much at the past, focusing instead on the future. And we aim for consistency: Our indicators should perform well in different market and economic environments. Diversification is also key, so that weaknesses of one indicator under a particular regime can be compensated by other indicators with complementary characteristics. Finally, persistence matters: The more an indicator has proved successful throughout different cycles, the more confident we are in its forecast quality.

**Risk & Reward**
*Will your approach retain any advantages when markets normalize and correlations between stocks and bonds turn negative once again?*

**Alexander Tavernaro**
The backtests of our model have been quite encouraging, even when correlations between stocks and bonds were more normal. But there is no telling exactly when we will get back to such a "typical" environment. The most important constant is that investors want equity-like returns with lower volatility. Basically, we can build a portfolio with any desired level of volatility. The beauty of our approach is that our model volatility has been much more consistent than that of a typical plain equity portfolio. Negative surprises are much less frequent, and we can keep investors closer to their targets.

**Risk & Reward**
*Do you have some encouragement for equity investors whose nervousness is growing in light of the current spate of crises?*

**Martin Kolrep**
What is happening right now in terms of market movement and volatility is not unusual. To me, it is all about preparation. Modifying a portfolio setup during a crisis may not be a wise thing to do. If a portfolio is considered too risky, there may be a flaw in the approach. Have the portfolio guidelines been adhered to? Has something unexpected happened? And, if so, why? But if everything is in order, I would stay calm.

If equity markets are going up, things are easy for everyone. But in times of crisis, it helps to be prepared. Investors who have done their homework and keep a cool head may even turn a crisis into investment success.

**Risk & Reward**
*Thank you for your insight.*

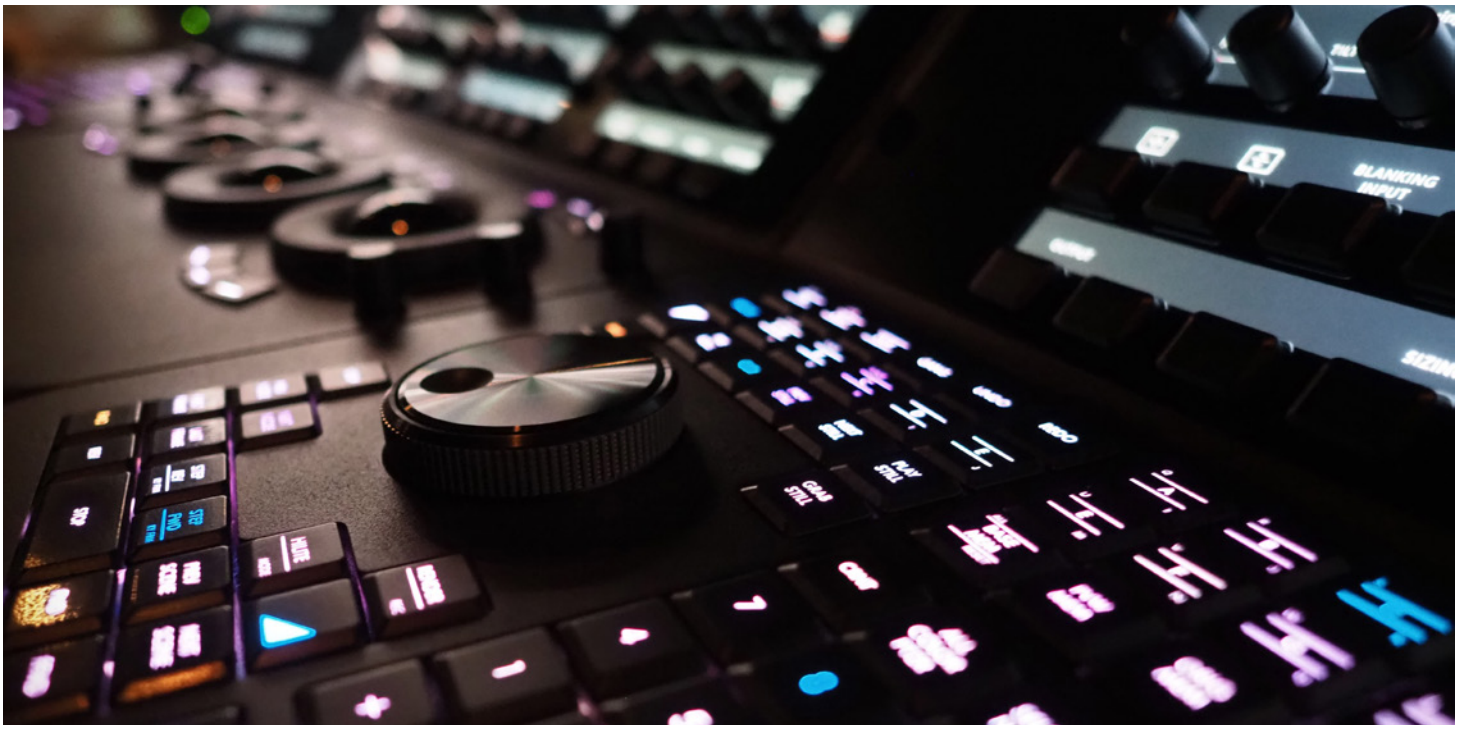
# Life beyond bonds for income and defense

By John Burrello, Scott Hixon and Scott Wolle

For decades, the so-called 60/40 portfolio was considered a wise way to invest – 60% stocks to seek growth and 40% bonds to generate income and stabilize returns in turbulent times. But over the years, the income from bonds has steadily declined and, during the latest market correction, a positive correlation has emerged between bonds and equities. So, given that bonds are no longer delivering the sought-after benefits, the time has come for an alternative: In this article, we explore an innovative asset allocation approach.

**Historically, income investors have had the luxury of earning yield while simultaneously reducing portfolio risk. Assets like high-quality bonds and dividend stocks provided sufficient income and helped reduce volatility, serving as safe havens from equity market shocks. But recently, it has become difficult to generate attractive income without adding equity-like risk to portfolios. Greater yield often results in heightened sensitivity to economic growth, and high-income assets may exacerbate losses during equity bear markets.**

We have written before about the importance of maintaining diversified exposure to the major global macro factors: growth, inflation, and defense.[1] Low interest rates have been pushing income investors into concentrated stock portfolios, equity-like bonds (i.e., high yield and convertibles), illiquid assets, and/or leverage to generate yield. This means high income is often earned without economic diversification and, just like stocks, is heavily dependent on benign growth and inflation environments. There are few strategies available for investors seeking high and stable income while also



reducing their reliance on strong future economic growth and rising stock markets.

A combination of a diversified global equity portfolio with a high-income defensive equity index option strategy may be an attractive approach to help address this challenge (figure 1). In addition to dividends, high income can be earned from option premiums without leverage or increasing downside risk. The trade-off for earning this income advantage is less upside potential, not more downside risk; this contrasts with other high-income equity or multi-asset strategies which often bear more risk and/or sacrifice diversification to reach high yields.

In contrast to common "covered call" strategies, which cap upside potential for the entire portfolio, we will discuss a simple combination of a traditional uncapped equity portfolio and a fully collateralized index option income strategy with pre-defined upside potential and downside buffers. We can think of this approach as two distinct sub-portfolios: 1) the equity portfolio and 2) the option income strategy, which can be combined in customized weights to achieve specific yield and market participation objectives:

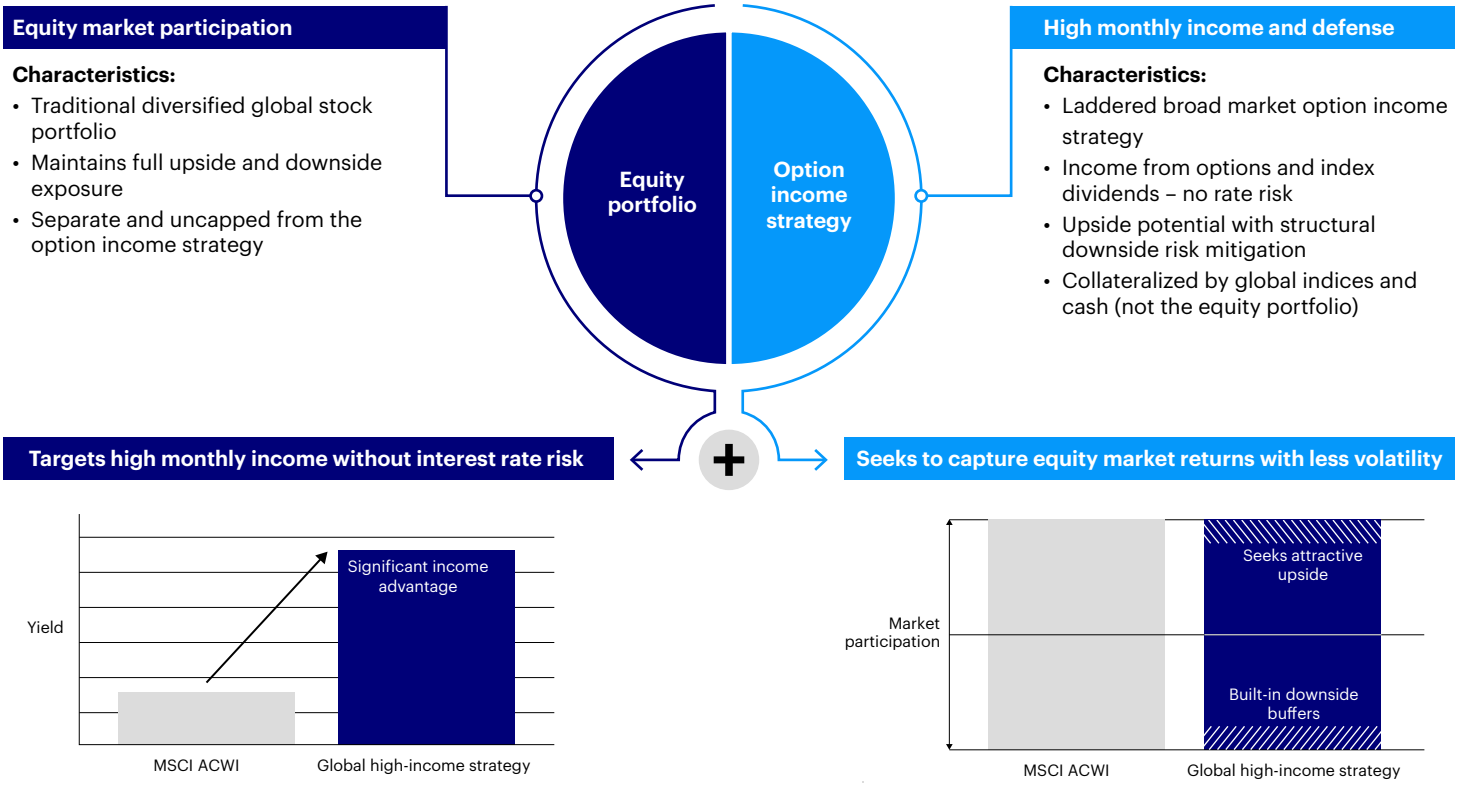
1. **Equity portfolio (role = growth potential):** Highly diversified and customizable, and maintains full upside and downside potential like most traditional equity portfolios. Separate and uncapped from the option income strategy.
2. **Option income strategy (role = yield and defense):** A high-income portfolio with exposure to defensive equity index options – fully collateralized by global equity indices and cash – which accepts less upside potential in return for pre-defined fixed income and downside buffers.

The equity portfolio seeks growth from global stocks which will, of course, vary over time and is uncertain. The option income strategy primarily seeks pre-determined, contractual and consistent monthly income, which can be collected whether markets rise or fall. If markets rise sharply, the growth of the equity portfolio is likely to be higher than the income earned by the option income strategy. If markets deliver low returns or losses, the option income strategy is likely to earn attractive yields and perform better than the equity portfolio. In the global equity markets, no one can predict which type of return – income or growth – will be best from month to month. Therefore, an efficient way to earn high consistent income and compound wealth over the long-term can be to maintain access to both.

The investment philosophy of this approach is quite simple – to seek attractive income and growth with lower volatility than global equity markets, like traditional balanced stock/bond portfolios. Importantly, its sources of income are without significant interest rate risk (in

The investment philosophy of this approach is quite simple – to seek attractive income and growth with lower volatility than global equity markets.

Figure 1
**High-income and defensive global equity portfolio without duration**




Source: Invesco. For illustrative purposes only. Diversification does not guarantee a profit or eliminate the risk of loss. There is no guarantee objectives and/or targets will be met.

contrast to traditional balanced stock/bond portfolios).

Correlation-based defense with bonds has likely become less reliable, and real yields are low (figure 2). The option income strategy can offer structural defense – without reliance on future correlations – and attractive income. It can play the primary roles that bonds have in balanced portfolios in the past: to dampen equity risk while supplementing capital growth through consistent real yields.

Of course, portfolio construction details matter. Option income strategies can be designed and implemented in a variety of ways, and a robust research process is important for understanding how different choices can impact outcomes. We will explore some of the design and implementation details of option income strategies that can impact performance.

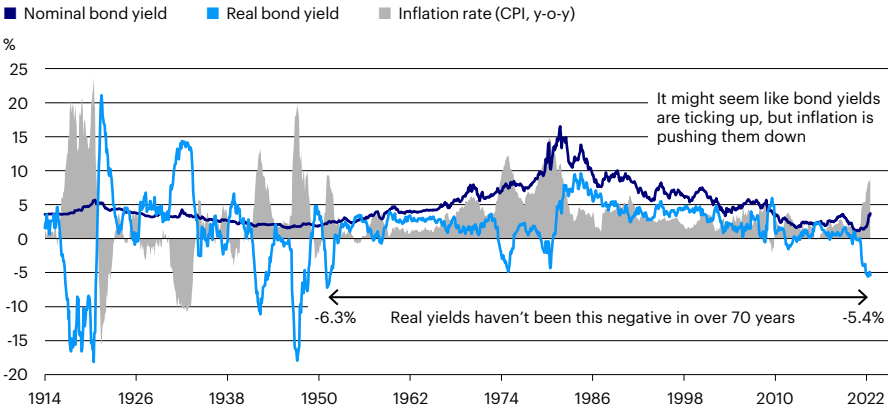
## The global income challenge

The Global Financial Crisis, European Sovereign Debt Crisis and, most recently, the Covid-19 crisis have all triggered massive central bank policy responses – interest rate cuts, quantitative easing, and torrents of liquidity – in efforts to stimulate economic growth around the world. From an asset price perspective, the responses to these "history book" events have spurred their intended results – global economic calamity has been abated (as of this writing), and both stocks and bonds have been rising (yields falling) almost relentlessly for more than a decade (figure 3).

Figure 2

**With an increase in inflation, bond prices have declined – but real yields are still extremely low**

Bond allocations are not providing enough income to keep up with inflation

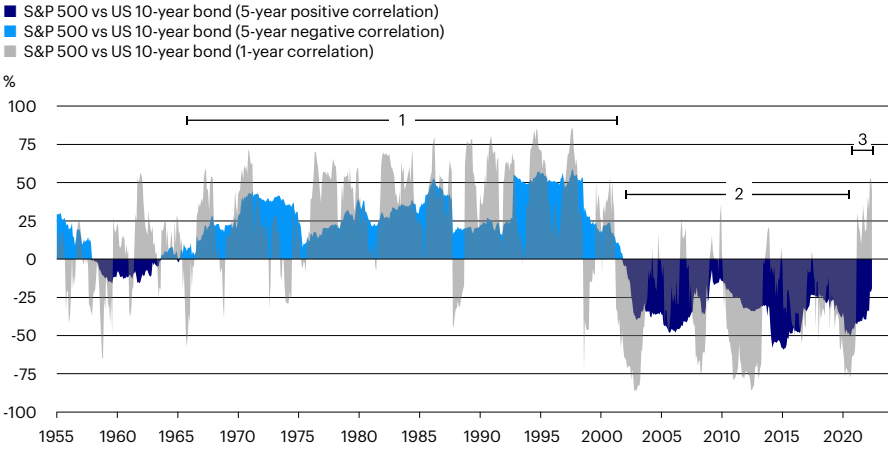



Source: Invesco, Bloomberg, Morningstar Direct. Data period: January 31, 1914 – June 30, 2022. Bond yields are represented by US 10-year Treasuries from January 31, 1914 to December 31, 1975 and by the Bloomberg US Agg Bond Index from January 31, 1976 to June 30, 2022. Diversification does not guarantee a profit or eliminate the risk of loss. For illustrative purposes only.

Figure 3

**Most investors hedge equity risk by diversifying with bonds, but bond-based defense relies on future correlations staying negative**

Should investors rely on bonds as the primary tool for reducing equity risk in the future?




1 Historically, stocks and bonds have often moved together – particularly when inflation and interest rates were higher.
2 Bonds had been an effective hedge (negative correlation) for the longest period since at least 1950.
3 ...until recently, when inflation jumped and correlations became positive again.

Source: Invesco, Bloomberg, DataStream. Data period: January 31, 1955 – June 30, 2022. Diversification does not guarantee a profit or eliminate the risk of loss. For illustrative purposes only.

Option markets can be used in many ways, so a robust process for strategy design and implementation is important for achieving these objectives.

That is, until 2022. Equity markets have corrected sharply as the impact of unprecedented central bank stimulus and global supply chain disruptions sparked unexpected inflation. At the same time, bonds have had one their most violent selloffs on record. Bonds are often held as a form of correlation-based defense. They can only be safe havens if they rise when equities fall, which is far from guaranteed (figure 4). Bonds have been an effective hedge for the last couple of decades but, over the longer term, they have tended to move in the same direction as stocks. This positive stock/bond correlation has been prevalent again across global markets this year, to the detriment of traditional 60/40 portfolios.

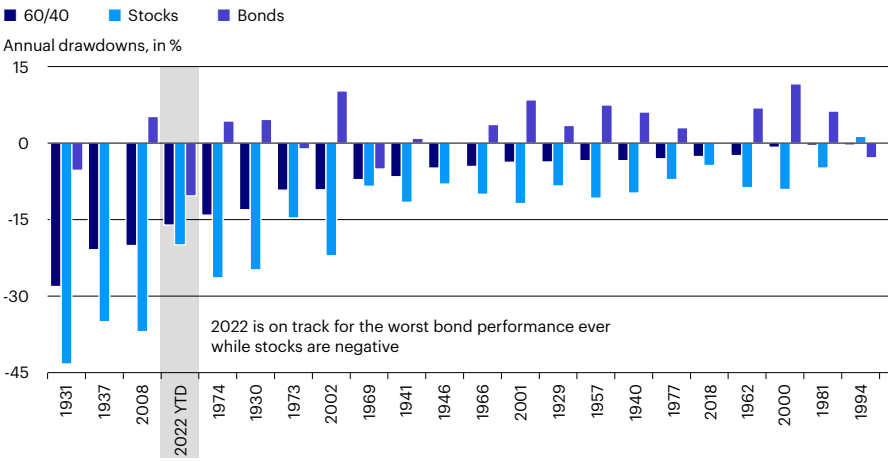
### Defensive income with equity index options

On the heels of the longest bull markets for stocks and bonds in history, many investors prefer to generate sufficient yield while also reducing portfolio risk, a dynamic that was once considered trivial when interest rates were higher but is now far in the rear-view mirror.

As discussed above, one potential solution is to generate income from equity dividends and liquid options on equity indices. This can be done defensively – without interest rate risk, without leverage, and without sacrificing diversification or liquidity. Option income strategies can include structural downside risk reduction. By collecting equity index option premiums on a portion of a diversified equity portfolio, we can make a straightforward trade-off:

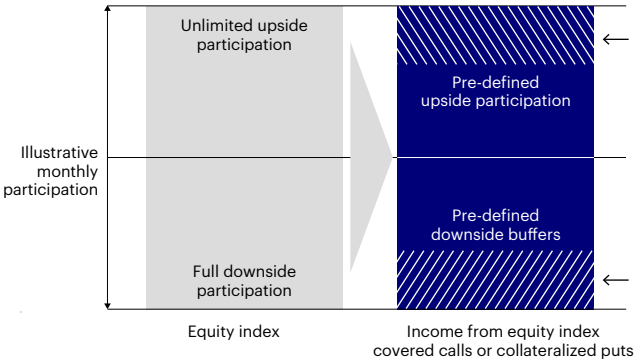
- Seek both higher up-front income and contractual downside buffers
- Capture less of the market's potential upside

Figure 4
**When the "40" isn't helping the "60": Sometimes both stocks and bonds lose money**
For investors seeking to reduce equity risk, relying on bonds as a safe haven has not worked recently




Source: Invesco, Bloomberg, Morningstar Direct. Data period: January 31, 1914 – June 30, 2022. Bond yields are represented by US 10-year Treasuries from January 31, 1914 to December 31, 1975 and by the Bloomberg US Agg Bond Index from January 31, 1976 to June 30, 2022. Diversification does not guarantee a profit or eliminate the risk of loss. For illustrative purposes only.

Figure 5
**Stylized covered call and collateralized put market participation profile***
Equity index options can generate attractive income while reducing risk




Accepting less upside potential can generate attractive up-front income

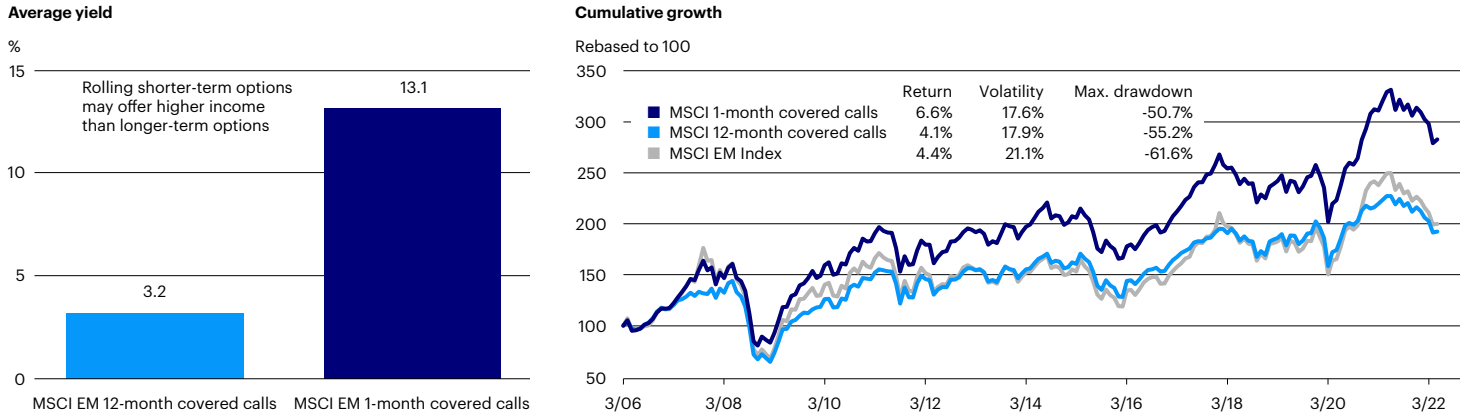
Downside risk is contractually reduced through income, strike selection, and/or option spreads

**Potential Benefits**
- Enhanced yield
- Smaller drawdowns
- Lower volatility
- High liquidity
- Maintain diversification

**Potential Trade-Offs**
- Less upside potential
- Requires active management

* Due to put-call parity, covered calls and cash-collateralized puts with the same strike prices and expiration dates have equivalent payoff profiles. This is a generalized illustration to show reduced upside and downside participation resulting from defensive option strategies relative to the equity index. In addition to covered calls and collateralized puts, our strategy typically includes a long put option in an effort to further truncate downside risk and enhance liquidity. The actual participation levels will vary based on the strategy's selected options and with market conditions.
Source: Invesco. For illustrative purposes only. Diversification does not guarantee a profit or eliminate the risk of loss.

Figure 6
**One-month covered calls have historically outperformed 12-month**
Shorter-term options can be more efficient for both income and total returns than longer-term options




Source: Invesco, Bloomberg, OptionMetrics. Data as of May 31, 2022. MSCI EM options with closest to 12-month and 1-month tenors and closest to 0.25 delta strike prices were selected for this analysis. Simulation is hypothetical and not representative of a live investment strategy. An investment cannot be made in an index. For illustrative purposes only.

Option markets can be used in many ways, so a robust process for strategy design and implementation is important for achieving these objectives.

For example, covered calls and cash-collateralized puts (where a call option is sold against a long equity position, or a put is sold against a cash position) are common options-based strategies for generating income. On the surface, many option income strategies might seem to be roughly the same – in that they may use the same basic option structure with the same trade-offs. Figure 5 illustrates, for both covered calls and cash-collateralized puts, how upside potential is reduced in return for up-front income and some downside protection.

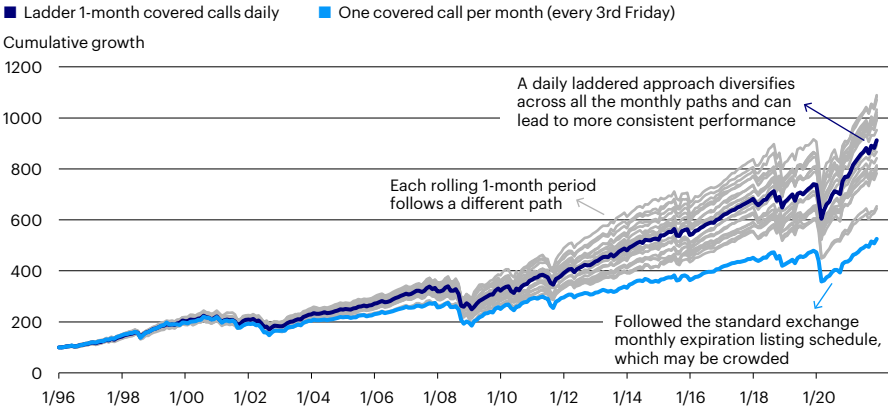
However, when designing a systematic option income strategy, there are multiple choices that must be made, and each can be consequential to long-term performance (figure 5). We now explore three specific design choices:

1. Which expiration date should be selected?
All options have expiration dates, which can range from one day to many years, each with different income potential. We can observe which expiration date selection strategy might be more efficient by analyzing current and historical data. For example, assume we are focused on generating income from option premiums on the MSCI Emerging Markets Index: Is it more efficient to collect one large premium for the whole year, or twelve smaller monthly premiums?

We have simulated both strategies – one 12-month covered call per year versus twelve 1-month covered calls per year (figure 6). The results offer some evidence that selecting expiration dates can be a crucial decision. Collecting option income more frequently with shorter-term expiration dates can be more efficient from both an annualized yield and total return perspective.[2]

2. How many option positions should be implemented (i.e., one at a time, or a laddered approach)?

Figure 7
**A historical view of single 1-month and daily laddered 1-month S&P 500 covered call strategies**




Source: Invesco, Bloomberg, OptionMetrics. Data period: January 31, 1996 – December 31, 2021. Simulated performance is hypothetical and not representative of a live investment strategy. S&P 500 Index call options with a target delta of 0.50 were used for this analysis. For illustrative purposes only.

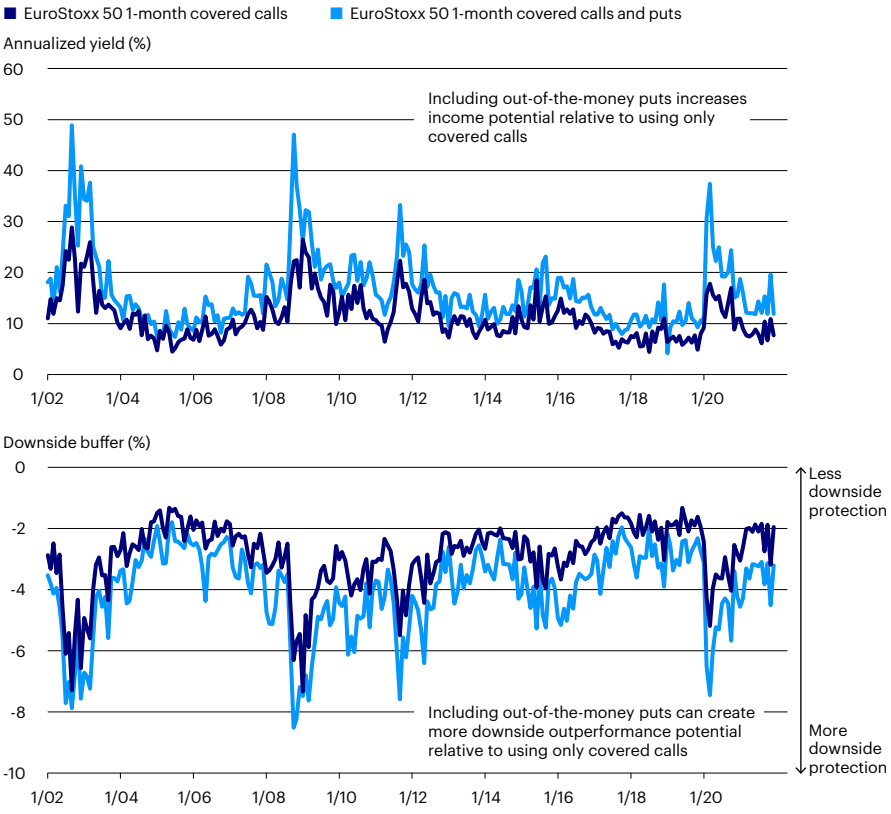
We can choose to collect income from rolling just one 1-month covered call per month (i.e., once every third Friday), or we can diversify our income strategy over the course of a month by laddering our 1-month options (i.e., sell a 1-month covered call every day). Since equity market and option prices change every day, increasing the number of 1-month covered calls held in a portfolio can add diversification benefits and reduce path dependency. A daily laddered approach captures changing market conditions more frequently and allows for more adaptive income generation (figure 7). It also results in smaller trade sizes, which reduces market impact costs and increases liquidity. In our example, laddering diversifies the strategy away from any single path of returns.

### 3. Should income be generated from calls, puts, or both?

It is also worth asking whether covered calls are always the most efficient option structure for generating income, and if there is an opportunity to use cash-collateralized puts as well.

Figure 8

**Income from puts can be higher than calls with the same payoff probability, and because equity market risk tends to be skewed to the downside, put options can be valuable tools for investors seeking high income and downside buffers**




"Downside buffer" refers to the potential downside outperformance relative to the index for each option. "Downside buffers" measure the index loss avoided by the options and where the first equity market losses begin.

Source: Invesco, Bloomberg, OptionMetrics. Data period: January 31, 2002 – December 31, 2021. Approximately .50-delta covered calls and a combination of .25-delta calls and puts with approximately 30 days until expiration were used for this analysis, such that each strategy had an equivalent initial beta of approximately 0.50 to the EuroStoxx 50 Index. Simulated performance is hypothetical and not representative of a live investment strategy. Performance, whether actual or simulated, is no guarantee of future performance.

Figure 9

**Simulated total return and yield comparisons to a 50/50 combination of global equities and global equity index option income strategy with an expected long-term beta of 0.80**

| | MSCI ACWI | 80% ACWI / 20% Global Agg | Global High Yield | EM Debt | Global Low Vol | 50% Global Equity / 50% Option Income |
|---|---|---|---|---|---|---|
| Return p.a. (%) | 5.64 | 5.18 | 5.48 | 4.84 | 6.07 | 6.84 |
| Volatility p.a. (%) | 16.18 | 13.46 | 10.54 | 8.85 | 11.66 | 12.45 |
| Equity beta | 1.00 | 0.83 | 0.54 | 0.38 | 0.66 | 0.76 |
| Conditional equity beta (-3%)* | 1.00 | 0.85 | 0.97 | 0.95 | 0.89 | 0.80 |
| Average yield (%) | 2.57 | 2.51 | 7.45 | 5.67 | 3.54 | 6.57 |

* Conditional on MSCI ACWI Index monthly returns of less than 3%.
Source: Invesco, Bloomberg, Morningstar Direct. Data period: May 31, 2006 – June 30, 2022. Bond yields are represented by US 10-year Treasuries from January 31, 1914 to December 31, 1975 and by the Bloomberg US Agg Bond Index from January 31, 1976 to June 30, 2022. Diversification does not guarantee a profit or eliminate the risk of loss. For illustrative purposes only.

As we have shown, the payoff profile of cash-secured puts is equivalent to that of covered calls. However, if we shift the put strike price below the current price of the equity index, puts may have benefits for equity income portfolios.[3] Downside protection is increased as the distance between the current price, and the put strike creates a downside buffer. In addition, income from puts can be higher than that of calls with the same payoff probability (figure 8).[4]

With a focus on these three choices, our option income strategies generally aim for high and consistent income through:

- Fully collateralized short-term options, without financial leverage
- Daily laddering for more adaptivity and diversification
- Flexibility to generate income from both covered calls and cash-collateralized puts

### Combining equities with a high-income, defensive option strategy

Now we combine an option income strategy having a long-term expected beta of 0.6 with a diversified global equity portfolio with beta of 1. Both are assigned a weight of 50%, resulting in an overall expected beta of 0.8. This is similar to the beta of many lower-volatility equity or multi-asset income and growth strategies. Importantly, the strategy's beta can remain stable as equity markets fall, while other high-income strategies tend to experience accelerated losses when defense is needed most (figure 9).

As such, there are a few interesting use cases for the strategy:

- A global equity allocation with higher income and lower volatility than the MSCI ACWI Index
- A complement or replacement for multi-asset income and growth strategies
  - Similar income and expected equity risk
  - No interest rate risk or reliance on stock/bond correlations
  - Potentially more diversified
- A potentially higher income replacement for high yield, emerging market debt or preferred equity (all of which can have equity beta of more than 0.80, particularly as markets fall)
- Enable investors with 60/40 or other balanced portfolio allocations to increase income, reduce bonds and keep the same equity participation profile

### Conclusion

Many investors are assuming more risk than desired to achieve their investment income goals, and their portfolios bear more equity risk and less diversification than they have historically. Combining a traditional equity portfolio with an option income strategy can offer defensive high income and growth without sacrificing diversification. This approach may enable investors to achieve their income objectives, participate in global equity market growth, and reduce reliance on correlation-based defense via bonds.

“Combining a traditional equity portfolio with an option income strategy can offer defensive high income and growth without sacrificing diversification.

**Notes**

1 For more information on this topic from the Invesco Global Asset Allocation Team, see: “When Yields Rise (2012), The Trouble with Bonds” (2015), “Portfolio Defense and Low Bond Yields” (2020), “A Macro Approach for Integrated Portfolio Management” (2021).

2 While this example is based on the MSCI Emerging Markets Index, we observe similar outperformance for selling shorter-term options relative to longer-term options on other major equity markets as well.

3 While in-the-money covered calls can be used to create the same payoff profiles as out-of-the-money collateralized puts, market convention is generally to trade out-of-the-money options when possible.

4 Equity option markets generally price the tendency for equity market returns to be negatively skewed. Also, because investors are generally long equities, the demand for downside protection with puts is typically greater than the demand for call options, which can make puts more expensive than calls. See: “What does Implied Volatility Skew Measure?”, Mixon 2011 and “The Skew Risk Premium in the Equity Index Market”, Kozhan, et al, 2013 for more robust discussions on option skew dynamics.

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# Stocks move on surprises: Using sentiment information for active portfolio management

By Elizabeth Cohen, Alan Feder, Kamran Rafieyan and Matt Titus

At Invesco, one of our most recent innovations has been the development of a sentiment scoring system that uses NLP and machine learning to extract sentiment signals from quarterly earnings calls. Because stock prices are often volatile around earnings calls, we have identified them as a potential source of alpha. This aligns with the notion that markets are not efficient and stocks move on new information.


**With recent advances in modeling, the availability of lower cost computing power and access to curated alternative datasets, more investment firms are using Artificial Intelligence (AI) – including Natural Language Processing (NLP) – to generate alpha. NLP enables computers to understand human language, analyze the meaning of words and deliver outputs including keyword extraction, topic classification, and more.**

Such technology is not limited to quantitative research. As the Deloitte Insights 2022 Investment Management Outlook concludes: "An overwhelming majority (85%) of respondents that use AI-based solutions in the pre-investment phase either strongly agreed or agreed that AI helped them generate alpha. Nearly three-fourths of our survey respondents said that they would increase their budget for alpha-generating technologies such as AI, including NLP, (71%) and alternative data (74%) over the next 12–18 months."

And Invesco is no exception. In this article, we describe the Invesco Sentiment System, including backtesting information, current applications and possible future developments. This system allows our active equity teams to use sentiment signals to enter and exit positions, size them and monitor large numbers of companies more efficiently. The sentiment system is also used by our trading alpha platform.

## Our sentiment model

Most companies have four earnings calls per year, and transcripts of the calls are produced within hours after the end of the call. We source the transcripts from FactSet®, which identifies each paragraph by speaker and segment (e.g., Presenter, Q&A). The dataset comprises more than 200,000 transcripts from over 10,000 companies since 2008. Of these, 58% come from the US, 7% from Canada, 4% from India and 4% from UK companies, with each of the remaining countries representing 3% or less.

We start by calculating sentiment scores based on pre-defined lists of positive and negative words. These are tailored specifically to a financial context and sourced from the Loughran-McDonald Dictionary of Finance terms. We chose this dictionary as the best reflection of the

financial context. For example, the term 'liabilities' might be perceived as negative in a general discussion, but is considered a neutral standard term in finance.

To generate a sentiment score, we extract the total number of positive words in the text and the total number of negative words, and calculate the score as follows:

$$100 \times \frac{\left(\begin{array}{l}\text{total \# of positive words} - \\ \text{total \# of negative words}\end{array}\right)}{\left(\begin{array}{l}\text{total \# of positive words} + \\ \text{total \# of negative words}\end{array}\right)}$$

Earnings calls typically consist of three distinct sections: CEO's prepared remarks, CFO's prepared remarks and analyst questions and answers (Q&A). We score these sections separately. In addition, we calculate sector-normalized scores, comparing a company to its universe and sector.

We also calculate a score comparing the current call to the previous one. For example, if the raw sentiment score was 34 in the previous quarter and is now 16, the 'change score' would be -18. We calculate this as 'surprises', and changes are likely to move stock prices considerably. If the company has long been doing well, much of that may already be reflected in the stock price. However, new information that materially differs from that of the previous quarter may shift sentiment – and stock prices – dramatically.

## Backtest results

For every company in the Russell 1000, we calculated the various monthly sentiment scores from March 2016 to December 2021.[1] For each of these scores, we constructed a portfolio comprising the 25% of stocks with the best scores, and rebalanced it monthly. To isolate the impact of sentiment scores, we limited sector deviations and mitigated sector allocation effects. Portfolio turnover turned out to be similar to that of a typical active mutual fund, raising no concerns about transaction costs.

Figure 1 shows the backtest results for the sector-normalized change scores: the total change score, the combined CEO and CFO change score and the Q&A change score, compared to the Russell 1000 and other portfolios. The Q&A change score portfolio performed consistently and substantially outperformed the Russell 1000 over the backtest period. Annual outperformance was 150 basis points, which would be material over the long term.

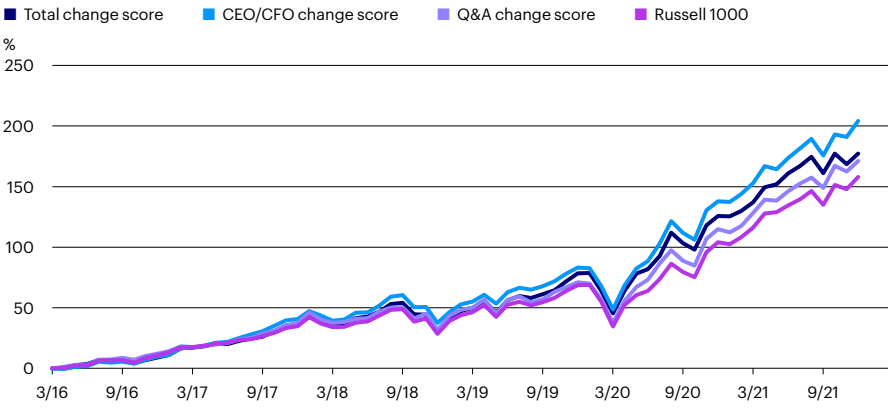
To confirm that exhibited performance was not reliant on any single period in the backtest, figure 2 presents the annual excess returns for the Q&A-based sentiment score portfolio relative to the Russell 1000. The simulated outperformance is also summarized in table 1.

To find out if the Q&A change score is useful for all sectors, we conducted a Brinson attribution. Excess returns are decomposed into allocation effects and security selection effects. Table 2 shows that, in the backtest, the score worked across most sectors and that the majority of performance was due to security selection. This indicates that our sentiment system can be implemented broadly by our active equity teams.

The tracking error of the portfolio vs the Russell 1000 ranged between 2.0% and 2.5% for most of the backtest period, but

> "The majority of performance was due to security selection.

Figure 1
**Simulated cumulative portfolio and benchmark returns**




Source: Factset, Invesco Sentiment Score. Monthly data from March 2016 to December 2021. Past performance (actual or simulated) does not predict future returns. This is a model portfolio. For illustrative purposes only. This does not represent an existing/actual product. Performance shown is simulated. The simulation presented here was created to consider possible results of a strategy not previously managed by Invesco for any client. Simulated performance is hypothetical. It does not reflect trading in actual accounts and is provided for informational purposes only to illustrate these strategies during specific periods. There is no guarantee the simulated results will be realized in the future. Invesco cannot assure the simulated performance results shown for these strategies would be similar to the firm's experience had it actually been managing portfolios using these strategies. In addition, the results actual investors might have achieved would vary because of differences in the timing and amounts of their investments. Returns shown for this simulation would be lower when reduced by the advisory fees and any other expenses incurred in the management of an investment advisory account. Simulated performance results have certain limitations. Such results do not represent the impact of material economic and market factors might have on an investment advisor's decision-making process if the advisor were actually managing client money. Simulated performance also differs from actual performance because it is achieved through retroactive application of a model investment methodology and may be designed with the benefit of hindsight.

jumped to between 4.0% and 4.5% during the heightened volatility of 2020. Absolute volatility of the portfolio is in line with the benchmark. Predicted beta for the portfolio ranges from 0.96 to 1.05.

To understand how quickly the signal decayed, we then constructed a hypothetical long-short portfolio (20% in each segment) for every day and looked at the returns over the following 1 and 2 days, 1 and 2 weeks, 1, 2 and 3 months (figure 2). As it turned out, the sentiment signal had a much slower decay rate than expected. Although most of the return occurs in the first week, as might be expected, the sentiment score appears to provide significant predictive value after that initial period. After 16 days, more than a third of the price movement still has not been realized. Thus, our investment teams have adequate leeway to use the signal for their investment processes.

## Further developments

We are currently researching machine learning to improve our dictionary, as well as expanding our model to include deep learning techniques, which will enable the model to gain knowledge and enhance its predictive capability further.

The most straightforward of these approaches is using machine learning to tweak a dictionary. Currently, we use the Loughran-McDonald dictionary for our sentiment calculations. By expanding and weighting the words in the dictionary, we intend to add positive and negative scaling to the score. Moreover, we are testing a word vector model – developed in-house – to find new words that have similar meanings to our current dictionaries.

In the area of deep learning, the current model is based on a simple bag-of-words approach. By incorporating deep learning attributes into the model, we will be able to use contextual clues when assessing

Table 1
**Q&A change score portfolio and Russell 1000 in comparison**

| | Q&A change score portfolio (return in %) | Russell 1000 (return in %) | Difference |
|---|---|---|---|
| **Total** | **171.19** | **157.99** | **13.20** |
| 2016 (since 31 March) | 12.14 | 10.76 | 1.38 |
| 2017 | 22.43 | 21.69 | 0.74 |
| 2018 | -4.12 | -4.79 | 0.67 |
| 2019 | 29.87 | 31.43 | -1.55 |
| 2020 | 25.67 | 20.97 | 4.70 |
| 2021 | 26.23 | 26.45 | -0.23 |

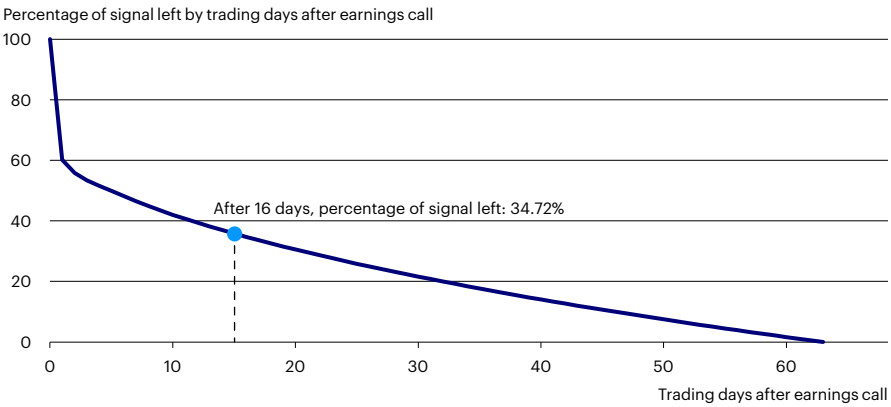
Source: Factset, Invesco Sentiment Score. Monthly data from March 2016 to December 2021. There is no guarantee that the simulated returns will be achieved in the future.

Table 2
**Sector attribution of the Q&A change score portfolio (simulated)**

| | Q&A change score | | | Russell 1000 | | | Attribution analysis | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average weight | Total return | Contribution to return | Average weight | Total return | Contribution to return | Allocation effect | Selection effect | Total effect |
| **Total** | **100.00** | **171.19** | **171.19** | **100.00** | **157.99** | **157.99** | **3.75** | **9.45** | **13.20** |
| Communication Services | 8.68 | 126.25 | 12.79 | 9.93 | 140.91 | 15.06 | 0.53 | -0.69 | -0.16 |
| Consumer Discretionary | 11.09 | 202.40 | 21.24 | 10.58 | 200.16 | 19.67 | 0.44 | 2.30 | 2.75 |
| Consumer Staples | 7.59 | 94.65 | 8.25 | 7.12 | 77.17 | 5.86 | -0.36 | 2.32 | 1.96 |
| Energy | 4.82 | 9.42 | 1.52 | 4.64 | 12.83 | 0.78 | -0.53 | 0.72 | 0.20 |
| Financials | 11.61 | 139.88 | 17.07 | 12.95 | 141.08 | 19.30 | 0.79 | -0.69 | 0.09 |
| Health Care | 14.24 | 107.12 | 17.81 | 13.80 | 131.96 | 19.29 | -0.14 | -4.08 | -4.22 |
| Industrials | 9.66 | 92.05 | 11.93 | 9.64 | 107.14 | 11.99 | 0.28 | -1.59 | -1.31 |
| Information Technology | 23.07 | 490.79 | 72.95 | 21.83 | 356.99 | 56.52 | 2.24 | 14.19 | 16.43 |
| Materials | 2.52 | 74.27 | 2.58 | 2.93 | 119.52 | 4.20 | 0.28 | -1.51 | -1.23 |
| Real Estate | 3.64 | 79.38 | 3.03 | 3.57 | 88.69 | 2.85 | 0.18 | -0.39 | -0.21 |
| Utilities | 3.07 | 51.43 | 2.01 | 3.00 | 76.33 | 2.48 | 0.05 | -1.14 | -1.09 |

Source: Factset, Invesco Sentiment Score. Monthly data from March 2016 to December 2021. There is no guarantee that the simulated performance will be achieved in the future.

Figure 2
**Q&A change score decay rate**




Source: Invesco Sentiment Score. Monthly data from March 2016 to December 2021.

sentiment. There are a number of state-of-the-art, pre-trained models – including BERT and FinBERT – that may produce score accuracy and improvements. BERT and FinBERT are a class of models known as 'transformers', which interpret relationships between all words in a sentence, and even words in different sections of text. BERT is an acronym for Bidirectional Encoder Representations from Transformers, and FinBERT is the version of the model that is trained on financial texts.

We are also exploring an expansion of our NLP work beyond quarterly earnings calls, into other text sources such as regulatory filings, news articles and social media. While some of these, such as social media posts, may seem too noisy and short-sighted for use by our long-term investors, aggregating many posts over multiple days may expose underlying investor sentiment using a 'wisdom-of-crowds' approach.

## Conclusion

While early adoption of machine learning and NLP in investment management has occurred largely among hedge funds and quantitative investors, several factors are increasing adoption across other capabilities. The rapid uptake in practical application of these advanced technologies, due to the rise of newly accessible datasets, developments in computing power, storage and cloud, and the growth of new methods for analyzing data using ML, is rapidly reducing the barriers for entry across investment managers who previously used manual processes to filter through volumes of unstructured data.

It is widely accepted that AI can be transformative when it comes to ingesting and synthesizing information, so that knowledge can be extracted more easily and efficiently. With our sentiment system and new plans to incorporate additional sources and advanced tech, our investment professionals have access to innovative signals that can save time in fundamental analysis and trade execution, increase alpha and improve the risk and reward profile of our equity strategies.

> AI can be transformative when it comes to ingesting and synthesizing information.

## Trading alpha: the Enceladus story

The Invesco trading alpha platform, Enceladus, also incorporates the sentiment score to enhance its proprietary predictive models. The Enceladus trading platform is designed to speed up or slow down the execution of our systematic order flow to improve execution quality. The benefits of using signals to improve execution quality are measured using standard performance benchmarks from third-party providers. To date, the set of orders using signals for execution have consistently outperformed the set of orders not using signals. The addition of the sentiment score has enabled us to incorporate a proprietary signal and gain a competitive advantage.

From a trading perspective, signals must include a prediction period (daily open-to-close), a direction and a strength. The strength component is important, as it is used extensively in signal-driven strategies; a strong correlation between signal quality and strength is preferred. While relatively sparse, given that earnings calls occur quarterly, the quarter-over-quarter sentiment change score proves strong enough to deliver enhanced performance in the period following the calls.

**Note**
1 Even though earnings calls take place only once a quarter, ranks and sector-relative scores change every month due to new information from other companies.

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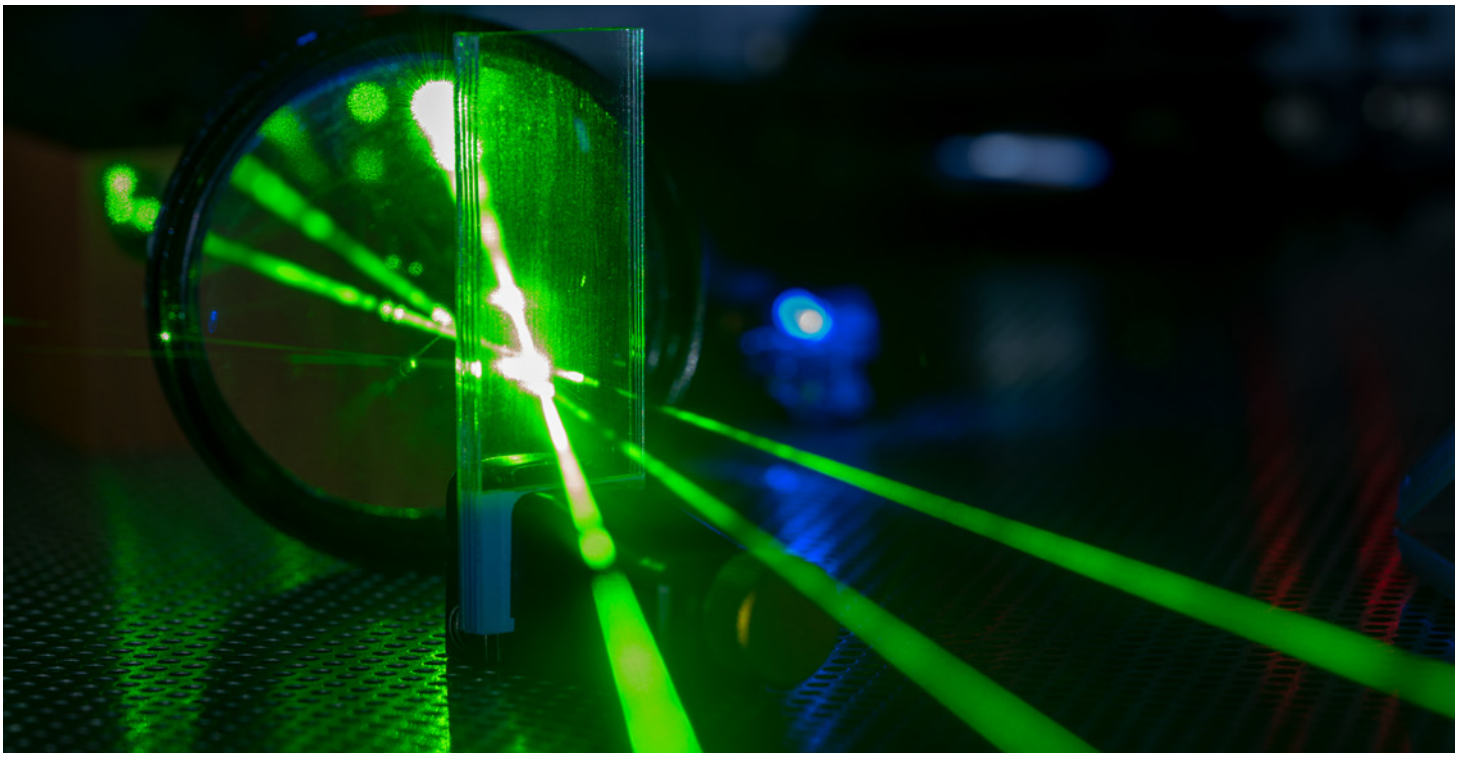
# ESG portfolio construction in an ESG-divergent world

By Satoshi Ikeda, Nancy Razzouk and Hao Zou, Ph.D.

ESG ratings from competing sustainability data providers may differ significantly. We explore the divergence between the ESG scores of Sustainalytics and MSCI and its potential impact on equity and fixed income portfolios. Do different raters lead to materially different portfolios?

**Practitioners and academics report a substantial degree of divergence in ESG rating scores. A recent study reports an average correlation 0.61 between the ESG scores of prominent agencies. This is well below the correlation between credit ratings from Moody's and Standard & Poor's, which is estimated at 0.92. The choice of rater may affect the portfolio holdings – but does it also affect performance, risk and factor attribution?**

Our analysis is based on the ESG composite scores from two leading ESG rating providers: MSCI and Sustainalytics. For equities, we apply the scores to the Invesco Quantitative Strategies (IQS) global developed large midcap universe, comprising 3,200 stocks, which by construction is largely equivalent to the MSCI World universe. 98.8% of the market capitalization of this universe is covered by MSCI ESG data and 95.6% by Sustainalytics. For fixed income, we use the Bloomberg Global Bond Index, comprising of 14,133 bonds, where the coverage is 80.8% and 61.5% for MSCI and Sustainalytics, respectively. Since Sustainalytics scores are not industry-neutralized, we subtract the industry averages from the raw scores to make them comparable with MSCI.



As of March 31, 2021, the Pearson correlation of the two composite rating scores was 0.42 in the equity universe. We observe a similar statistic in the fixed income universe. It clearly shows that the correlation is low for the major two ESG raters. We then divided our universes into five equal buckets based on their MSCI and Sustainalytics scores and constructed a distribution matrix through double sorting (table 1). Only 30.7% of all stocks belong to the same bucket according to the two raters, with more than two-thirds spread across the other four.

On the other hand, there is no significant heterogeneity in the spectrum of ESG ratings. The rating disagreements are uniformly distributed in the cross section, and they are not skewed toward better or worse rated companies.

There are even some 70 companies which one agency considers a leader while the other one classifies it as a laggard. Table 2 shows the top five and bottom five companies that fall into the top right corner (i.e., laggards in MSCI and leaders in Sustainalytics) or the bottom left corner (i.e., leaders in MSCI and laggards in Sustainalytics) in table 1.[2] Due to their considerable market valuation, the ESG rating divergence between these companies is not negligible.

## Consequences for portfolios

What does this mean for a portfolio? Will portfolio characteristics change drastically if we use ESG scores from a different rater? To find out, we compare factor exposures and risk-return characteristics.

### Equities

We construct optimal portfolios that have minimal tracking error to the model portfolio, which is a multi-factor portfolio that combines momentum, quality and value factors and would serve as an anchor for implementing live portfolios, subject to various constraints. One constraint is specifically related to ESG, where we impose that the ESG exposure of the optimal portfolio be no less than that of the benchmark, times a multiplier.

We use MSCI, Sustainalytics and the combined MSCI-Sustainalytics scores in the constraints, as well as varying the constraint multipliers from 100% to 130% (i.e., the constraints are tighter with bigger multipliers). All scores are industry neutralized as noted above.

We combine MSCI and Sustainalytics scores as follows: first each set of scores is industry neutralized and put on a standard normal distribution. We then calculate the average of the two standardized scores. Lastly, we re-standardize the combined scores to standard normal distribution.

Table 1
**MSCI and Sustainalytics ratings in comparison (in %)**

| | | Sustainalytics | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | Total |
| **MSCI** | 1 (laggards) | 8.0 | 5.5 | 3.5 | 1.8 | 1.0 | 19.8 |
| | 2 | 4.1 | 5.5 | 4.7 | 3.4 | 2.4 | 20.2 |
| | 3 | 3.2 | 4.3 | 4.6 | 4.2 | 3.6 | 19.8 |
| | 4 | 2.8 | 3.0 | 4.2 | 4.6 | 5.4 | 20.1 |
| | 5 (leaders) | 1.2 | 1.7 | 3.0 | 6.2 | 8.1 | 20.2 |
| | Total | 19.3 | 20.0 | 20.1 | 20.2 | 20.4 | 100.0 |
| | | Sum of diagonal cells: 30.7 | | | | | |

Source: Invesco. Data as of March 31, 2021. Global developed large-mid cap universe. Totals may include differences due to rounding.

Table 2
**Leaders or laggards?**

**MSCI: 1 (laggards) – Sustainalytics: 5 (leaders)**

| Name | MSCI | Sustainalytics |
|---|---|---|
| Company 1 | 2.4 | 6.9 |
| Company 2 | 3.7 | 7.1 |
| Company 3 | 2.9 | 6.1 |
| Company 4 | 3.6 | 6.4 |
| Company 5 | 2.9 | 6.4 |

**MSCI: 5 (leaders) – Sustainalytics: 1 (laggards)**

| Name | MSCI | Sustainalytics |
|---|---|---|
| Company A | 8.3 | 2.3 |
| Company B | 7.6 | 4.2 |
| Company C | 7.7 | 4.0 |
| Company D | 8.5 | 4.1 |
| Company E | 7.9 | 4.1 |

Source: Invesco. Data as of March 31, 2021. IQS global developed large-mid cap universe. Top 5 names based on market capitalization.

We run the portfolio optimization from July 2009 to March 2021. The universe is the global developed large-mid cap universe, and the strategy is to target 3% active risk relative to the MSCI World benchmark.

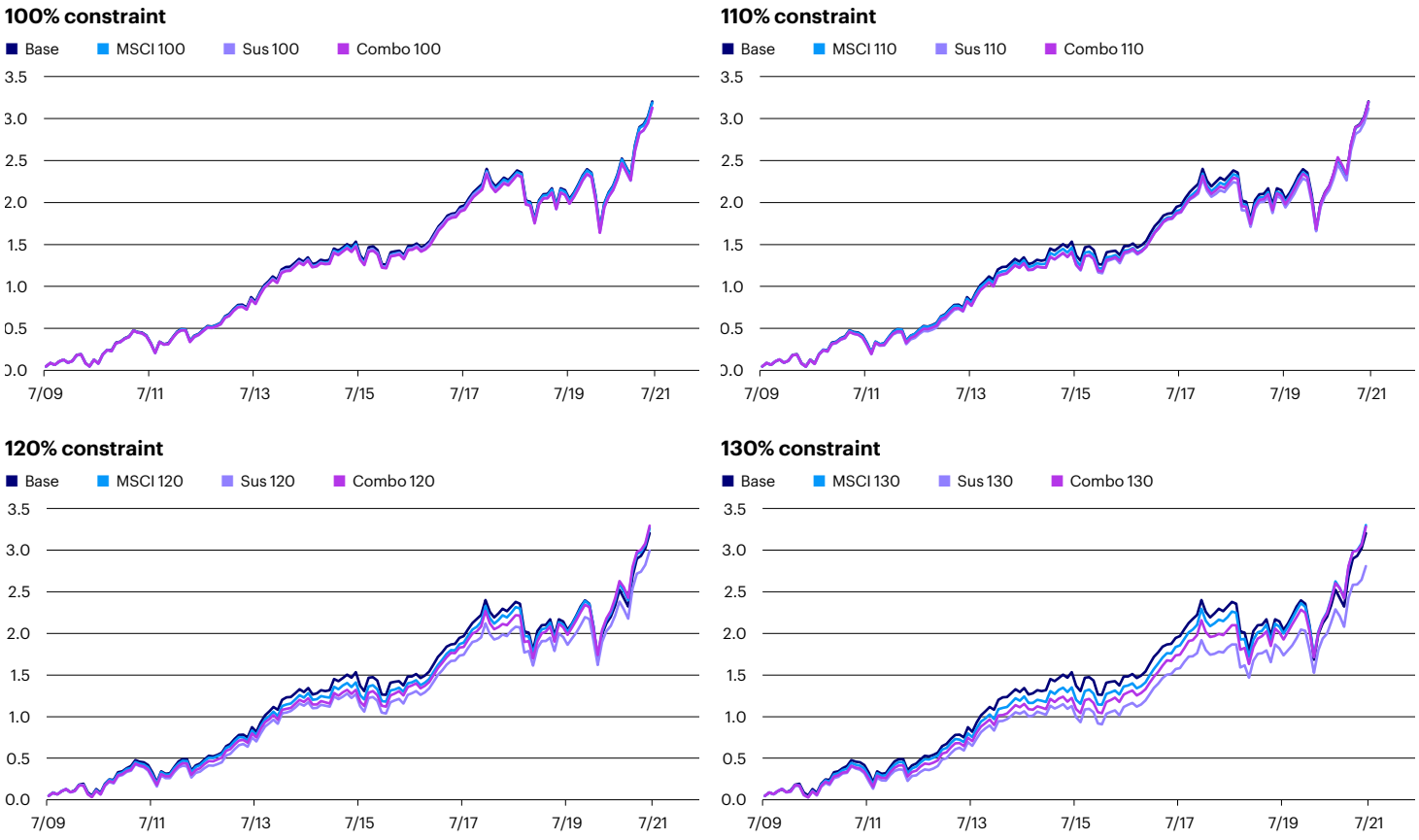
Table 3 summarizes our main results. The "base" portfolio denotes the optimal portfolio with no ESG constraints; 100%, 110%, 120% and 130% indicate the constraint multipliers applied on ESG, whereas "MSCI", "Sustainalytics", and "Combined" denote the ESG scores used in the constraints. We show results for the average annualized turnover, average number of assets in the portfolio, net portfolio returns and active

Table 3
**Simulated equity portfolios using different ESG ratings and constraints multipliers**

| | Base portfolio | 100% MSCI | 100% Sustainalytics | 100% Combined | 110% MSCI | 110% Sustainalytics | 110% Combined | 120% MSCI | 120% Sustainalytics | 120% Combined | 130% MSCI | 130% Sustainalytics | 130% Combined |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turnover p.a. (%) | 79.37 | 79.68 | 79.12 | 79.59 | 79.91 | 78.11 | 77.91 | 79.67 | 74.58 | 75.78 | 78.97 | 71.04 | 73.45 |
| Avg. number of assets | 184 | 184 | 182 | 182 | 177 | 171 | 173 | 170 | 153 | 155 | 160 | 128 | 137 |
| Return p.a. (%) | 13.10 | 13.06 | 12.92 | 12.92 | 13.07 | 12.91 | 13.08 | 13.24 | 12.60 | 13.31 | 13.32 | 12.14 | 13.28 |
| Net active return p.a. | 1.41 | 1.37 | 1.23 | 1.23 | 1.38 | 1.22 | 1.39 | 1.55 | 0.91 | 1.62 | 1.63 | 0.45 | 1.59 |
| Active risk | 2.95 | 2.86 | 2.86 | 2.84 | 2.81 | 2.80 | 2.70 | 2.73 | 2.80 | 2.71 | 2.72 | 2.92 | 2.79 |
| Net IR | 0.48 | 0.48 | 0.43 | 0.43 | 0.49 | 0.44 | 0.52 | 0.57 | 0.33 | 0.60 | 0.60 | 0.15 | 0.57 |
| Momentum | 84.06 | 84.03 | 82.76 | 83.56 | 83.30 | 78.63 | 80.59 | 81.27 | 71.24 | 75.63 | 77.58 | 61.97 | 67.86 |
| Quality | 75.39 | 75.11 | 74.50 | 74.79 | 74.72 | 72.26 | 73.71 | 73.43 | 68.35 | 69.91 | 71.14 | 61.40 | 63.24 |
| Value | 88.09 | 86.90 | 86.36 | 86.31 | 84.01 | 80.62 | 80.96 | 79.17 | 71.25 | 72.39 | 73.07 | 58.66 | 60.41 |
| Size | -37.37 | -36.66 | -34.75 | -35.63 | -34.93 | -29.12 | -31.50 | -32.82 | -23.84 | -27.12 | -30.99 | -20.15 | -22.82 |
| Volatility | 12.32 | 11.82 | 10.95 | 11.10 | 10.49 | 7.74 | 8.41 | 8.66 | 4.24 | 5.00 | 6.71 | 0.69 | 1.05 |

Source: Invesco. Based on monthly data from July 2009 to July 2021. The exposures are shown for informational purposes only.

Figure 1
**Cumulative returns for portfolios using different ESG raters and constraint multipliers**




Source: Invesco. Based on monthly data from July 2009 to July 2021.

returns, active risk, portfolio IR, as well as average factor exposures (momentum, quality and value) and other style exposures (size and volatility).

We see that, when the ESG constraint multiplier is 100%, the results are very similar to the base portfolio, regardless of the ESG score used. This multiplier is the closest to what we currently use in practice, which gives us comfort that using different ESG scores does not drastically change the nature of our portfolios. However, as we move to higher constraint levels (especially at 120% and 130%), we observe that the ESG rating provider does matter. Generally, there are larger differences between the portfolios based on MSCI scores and the other two. For example, with a constraint of 130%, the net IRs for MSCI, Sustainalytics and the combined score are 0.60, 0.15 and 0.57, respectively (compared to an unconstrained net IR of 0.48). We can also see that tighter ESG constraints generally result in lower value exposures and lower volatility exposures, which are also important findings.

Figure 1 shows the cumulative portfolio returns for time series perspective. Consistent with table 3, the cumulative returns are very similar at the low constraint levels (100% and 110%) and less similar when the constraint levels are higher (120% and 130%).

How do we rationalize the results? The key here is that the base portfolio (without ESG constraints, but optimized to target exposures to value, momentum and quality factors) already has good ESG exposures. This further implies that the targeted factors are quite "green". Applying a 100% constraint alters the portfolio very little relative to the base case, which has an ESG exposure comparable to the benchmark. When we increase the constraint slightly to 110%, it is relatively easy to find stocks with better ESG exposures without sacrificing factor exposures, and hence the resulting factor exposure and performance do not change much. However, it becomes more challenging to maintain factor exposure as we further increase the constraint levels to attain the desired ESG exposure.

Applying a 100% constraint alters the portfolio very little relative to the base case, which has an ESG exposure comparable to the benchmark.

### Fixed income

For fixed income securities, we conduct a similar empirical analysis with data from March 31, 2021. We build 6 industry-neutral portfolios and compare the score change according to both providers.

The portfolios consist of all the bonds in the universe that have a score with both providers. The first step consists of ranking the bonds according to both providers, then removing the bottom percentile as per the ranking of one provider and observing the impact it has on the overall portfolio score.

In table 4, portfolio A is created by removing the bottom 10% of bonds based on the Sustainalytics score and reweighting the bonds selected in the portfolio to match the original portfolio's sector and rating exposure. To create portfolio B and C, we follow the same process of filtering based on Sustainalytics rank and reweighting the remaining bonds to match original portfolio sector and rating profile. We remove the bottom 50% of bonds in portfolio B and the bottom 90% of bonds in portfolio C.

The same process is repeated using MSCI scores. We remove the bottom 10% of low ranking ESG bonds in portfolio D, bottom 50% in portfolio E and bottom 90% in portfolio F. The result is summarized in table 5.

When we remove the 10% and 50% of bonds with the lowest Sustainalytics rating, the overall score of the portfolio improves within the same range according to both providers. When we apply a more rigid filtering, keeping only the top 10% of ESG bonds, there is a larger score divergence between the scoring of

Table 4
**ESG scores of portfolios excluding bonds with lowest Sustainalytics scores**

| | **Original portfolio** | **Portfolio A** without bottom 10% | **Portfolio B** without bottom 50% | **Portfolio C** without bottom 90% |
|---|---|---|---|---|
| **Sustainalytics portfolio score** | 6.14 | 6.31 | 6.82 | 7.75 |
| **MSCI portfolio score** | 6.03 | 6.15 | 6.76 | 6.93 |

Source: Invesco. Data as of March 31, 2021.

Table 5
**ESG scores of portfolios excluding bonds with lowest MSCI scores**

| | **Original portfolio** | **Portfolio D** without bottom 10% | **Portfolio E** without bottom 50% | **Portfolio F** without bottom 90% |
|---|---|---|---|---|
| **Sustainalytics portfolio score** | 6.14 | 6.15 | 6.31 | 6.70 |
| **MSCI portfolio score** | 6.03 | 6.31 | 7.61 | 9.07 |

Source: Invesco. Data as of March 31, 2021.

providers. Removing a large amount of bonds according to one issuer reduces the diversity of bonds. Given the divergence between providers, it is unlikely for all issuers to have a very high ESG score according to both providers. Selecting only high ranked bonds according to one provider improves the portfolio score according to the other provider, but to a lesser extent.

The divergence is more significant if we use MSCI score for ranking and filtering. When removing the bottom 10%, the portfolio score is very similar according to both providers, but we then see a larger divergence when we remove 50% and a very large divergence when we remove 90%. According to MSCI, the portfolio with the top 10% of names appears to have a very high ESG score versus Sustainalytics scoring, where it improves but not as much.

Results in the fixed income space are largely consistent with those in the equity space, though we should note that the analysis approaches are different, i.e., point in time analysis in fixed income versus time series analysis in equity. Given enough diversification, the portfolio will have a good ESG score based on either provider. On the other hand, if we pursue a stringent ESG incorporation, the choice of ESG rater does matter.

Results in the fixed income space are largely consistent with those in the equity space.

## Conclusion

This article explores the divergence of ESG data and its potential impact on portfolio characteristics. We confirm that ESG scores from different raters significantly diverge. We investigated the potential impact on portfolios from incorporating these ESG scores as constraints. We found that the portfolios are not significantly impacted by the choice of ESG rater given enough diversification. On the other hand, when we pursued a very stringent ESG incorporation, ESG raters had a larger impact and we saw a divergence in portfolio characteristics. The findings will be useful for broader investors who wish to incorporate ESG through better use of ESG data.

**Notes**

1 Cp. Berg, Kölbel and Rigobon (2020). Gibson, Krueger and Schmidt (2020) report a similar figure.
2 Note that we use industry-neutralized Sustainalytics scores, as described above.

## References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