



Counterpoint Global Insights

WACC and Vol

Valuation for Companies with Real Options

CONSILIENT OBSERVER | December 21, 2020

Introduction

Twenty-twenty has been extraordinary for a lot of reasons. The global pandemic created a major health challenge and an unprecedented economic shock, there was plenty of political uncertainty, and the stock market's results were surprising to many.¹ The year was also fascinating for investors concerned with corporate valuation.

Theory prescribes that the value of a company is the present value of future free cash flow. The task of valuing a business comes down to an assessment of cash flows and the opportunity cost of capital. The stock prices of some companies today imply expectations for future cash flows in excess of what seems reasonably achievable. Automatically assuming these companies are mispriced may be a mistake because certain businesses also have real option value.

The year 2020 is noteworthy because the weighted average cost of capital (WACC), which is applied to visible parts of the business, is well below its historical average, and volatility (vol), which drives option value, is well above its historical average. Businesses that have real option value benefit from a lower discount rate on their current operations and from the higher volatility of the options available to them.

In this report, we define real options, discuss what kinds of businesses are likely to have them, and review the valuation implication of a low cost of capital and high volatility. We finish with a method to incorporate real options analysis into traditional valuation.

AUTHORS

Michael J. Mauboussin
michael.mauboussin@morganstanley.com

Dan Callahan, CFA
dan.callahan1@morganstanley.com

Real Options Defined

A real option is the right but not the obligation to make an investment in a company, whether it's a new line of business, a distribution center, or a product extension. This type of analysis is useful when the cash flows from a project have a present value that is currently less than the cost of the project. In other words, the net present value (NPV) of the project, its value minus its cost, is negative.

Extractive industries provide a classic example. Say a company can profitably pump oil from a well when the commodity is at \$40 per barrel. Now let's assume that oil is currently priced at \$30 per barrel. The well has a negative NPV based on today's prices but would have a positive NPV if oil rises above \$40 in the future. The well is valuable because the company has a real option to start it when the price is right. The value of this option depends predominantly on the volatility of the price of oil.

As oil prices move up and down the payoffs are asymmetric because options confer a right but not a requirement to act. Oil prices below \$40 don't matter, but the more they exceed \$40 the more valuable the project becomes. Higher volatility drives higher option value.

Real options come in many forms, but most of them value flexibility or contingency.² Flexibility options reflect the ability to defer, abandon, expand, or contract a project. Contingency options capture if-then propositions. For example, if a drug meets certain requirements for efficacy, then we will invest more in it.

Exhibit 1 shows the parallels between financial call options and real options.³ Bear in mind that you should value a company's current operations using a discounted cash flow model (DCF) or a proxy that yields a comparable result. Real options analysis applies to novel activities.

Exhibit 1: Drivers of Value for Call Options and Real Options

Call Option	Real Option	Variable
Stock price	Project value	S
Exercise price	Cost of project	X
Stock price volatility	Asset volatility	σ
Option life	Option life	T
Risk-free rate	Risk-free rate	r

Source: Timothy Luehrman, "Investment Opportunities as Real Options," Harvard Business Review, July-August 1998, 52.

Thinking through the drivers of option value is instructive even if the analogy between financial options and real options is not perfect. Specifically, the inputs are generally more available and the terms more specific for financial options than they are for real options.⁴

However, thinking using a real options framework raises important considerations. These include when a company might exercise the option, the volatility of the underlying asset, and whether the company has access to capital to fund the cost of the project.

Where to Look for Real Options Value

A checklist for where to look for real options has three parts. The first is the quality of management.⁵ Executives effective at real options reasoning are able to identify, create, manage, and exercise real options. Management reputation, proper incentives, and the ability to access capital are all important.

Research reveals that few companies explicitly use real options methods, in part because of their mathematical complexity.⁶ But evidence also shows that practitioners use heuristics that are consistent with real options reasoning.⁷

Next on the checklist is the position of the business. Companies that are leaders in their industry commonly get the first call when opportunities such as joint ventures arise. Size and preeminence are also associated with economies of scale, which are benefits from volume, and economies of scope, which are benefits from variety.

The final item on the checklist is a consideration of the sources, trends, and evolution of uncertainty.⁸ Asset volatility must be high for a company to have substantial real option value. Uncertainty can arise from external shocks such as the pandemic, the potential for disruptive innovation, interactions with competitors, and the impact from political decisions.

We believe that real options value is meaningful for a relatively small percentage of public companies. But investors should be aware of real options value for those businesses and include it as part of the process of valuation.

What Is Going On in 2020

To simplify this analysis, you can think of the value of a company as having two parts. The first is the normal operations, which represent business as usual. You value these by taking the present value of future free cash flow. Alternatively, you can use a multiple, such as price-to-earnings or enterprise value-to-earnings before interest taxes depreciation and amortization (EBITDA), as a proxy for a DCF model. The key point is that the value is a function of the cash flows and the discount rate.

The second part is real options value. Real options were first described formally in 1977, but the underlying ideas are ancient.⁹ This value is modest for most companies because they don't meet the criteria on the checklist. But this component can be important for certain companies. You value those options using the drivers shown in Exhibit 1, and asset volatility is particularly important.

The story is that the pandemic led central banks in advanced economics to quickly adopt fiscal and monetary policies to minimize stress for households and businesses.¹⁰ Many countries followed the playbook developed during the financial crisis of 2008-2009.

The huge amount of liquidity has had the effect of pushing down interest rates. For example, the yield on the 10-year U.S. Treasury note, commonly used as a risk-free rate, started the year at 1.92 percent and was at 0.84 percent at the end of November. This has shifted down the security market line that reflects the risk and reward for various asset classes. In other words, expected returns for most asset classes are now lower than they were at the beginning of the year.

A standard way to estimate the cost of equity capital is to add an equity risk premium (ERP) to a risk-free rate. Aswath Damodaran, a valuation expert and professor of finance at the Stern School of Business at New York University, estimates the ERP every month.¹¹ He imputes the ERP by solving for the discount rate that equates

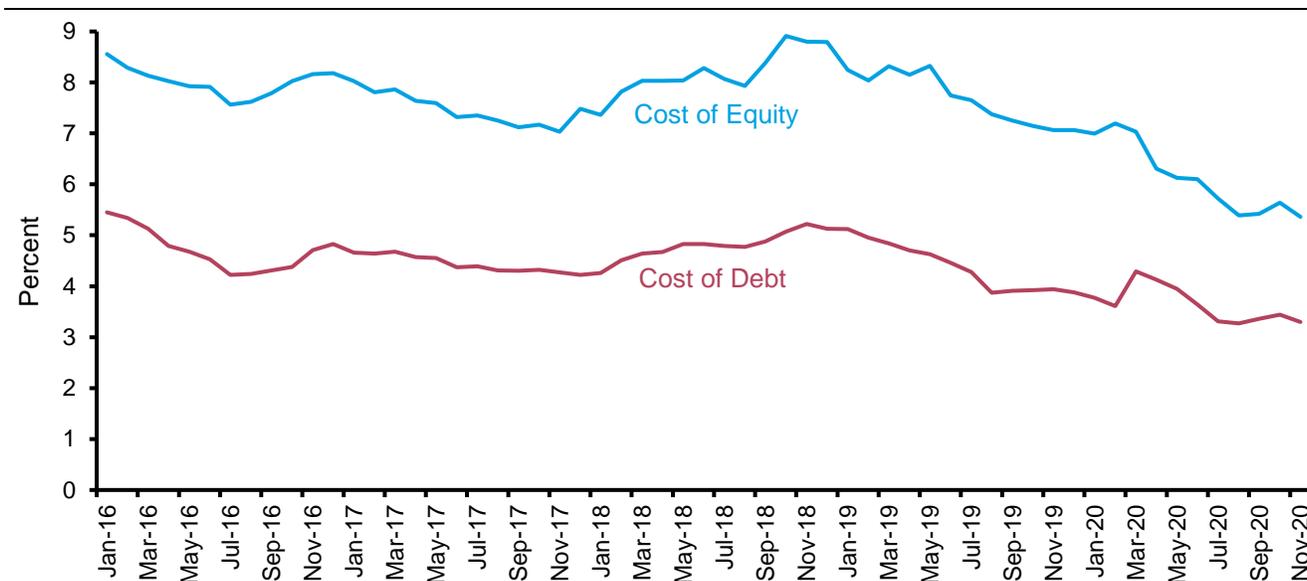
the value of forecasted cash flows to the current price of the S&P 500. His ERP estimate has declined 70 basis points to 4.5 percent in 2020.

Combining the risk-free rate and the ERP suggests that the cost of equity dropped 1.8 percentage points from year-end 2019 as of December 1, 2020. We estimate that the average cost of equity for 2020 is 6.1 percent, 1.8 percentage points below the average of 7.9 percent from 2015 to 2019.

A lower cost of equity leads to a higher present value, all else being equal.¹² One dollar capitalized at 6.1 percent is worth \$16.39 (\$1/.061) and at 7.9 percent is worth \$12.66 (\$1/.079). The value of a dollar of earnings is worth a multiple that is 3.7 percentage points higher now than at the beginning of the year, 16.4 versus 12.7.

The credit spread, the premium over the risk-free rate for owning bonds, has followed a very similar path. Expected returns for stocks and bonds have gone down as a result of an extraordinary amount of liquidity furnished by central banks around the world. Exhibit 2 shows that the cost of equity and cost of debt have moved in tandem over the last five years. During this period, the correlation coefficient (r) between these series was in excess of 0.9 (zero means no relationship and 1.0 reflects the strongest possible positive relationship).

Exhibit 2: Cost of Equity and Cost of Debt, 2016-2020



Source: Aswath Damodaran and Moody's, retrieved from FRED, Federal Reserve Bank of St. Louis, <https://fred.stlouisfed.org/series/BAA>.

Note: Monthly; Cost of debt is the Moody's Seasoned Baa Corporate Bond Yield, aggregated using averages; Cost of equity is the 10-year U.S. Treasury note plus the implied equity risk premium (using projected cash flows based on the trailing 12-month cash flow yield).

Despite a lower cost of capital, the economic fallout nonetheless affected businesses. Some, including those that enable work from home, realized improved sales and profits while others, such as those associated with travel and lodging, suffered substantially. The pandemic has created a great deal of uncertainty.

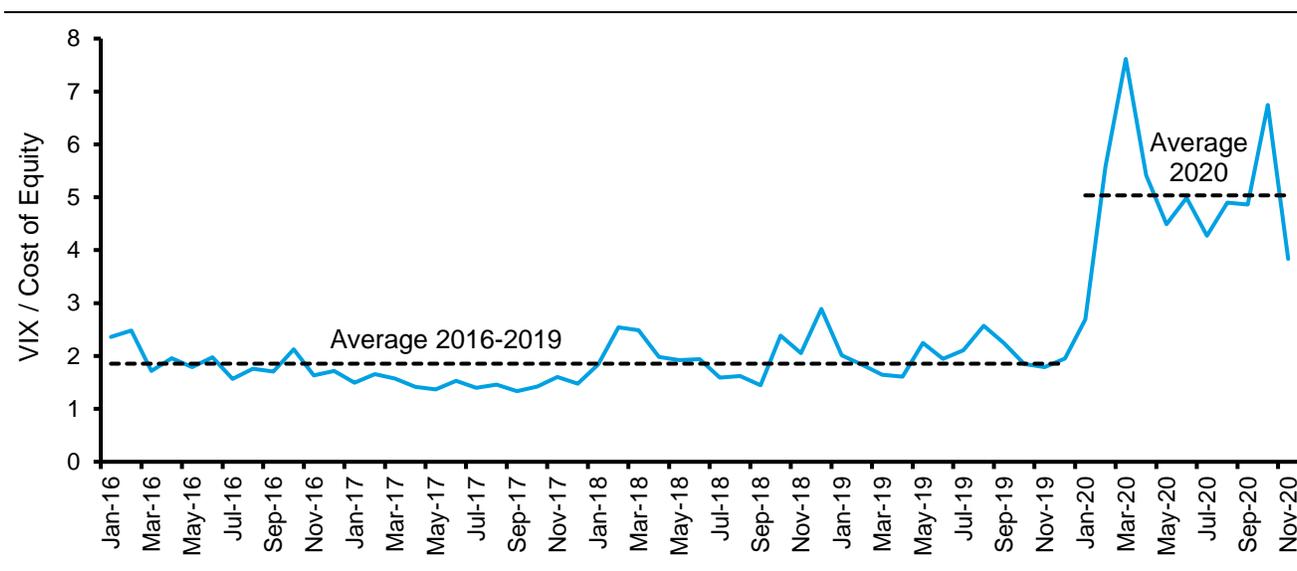
Volatility is one way to measure uncertainty in the stock market. High volatility implies a wide range of potential outcomes and higher option value because the payoffs are asymmetric. The Cboe Volatility Index, or VIX, is a measure of the stock market's annual implied volatility. The VIX is calculated by translating the implied volatility on 30-day options on the S&P 500 into an annual figure.

The monthly average for the VIX through the end of November 2020 was 31.0 percent versus its average of 15.2 percent from 2015 to 2019. The VIX is typically lower than the implied volatility of an individual stock because the S&P 500 is diversified and hence removes most firm-specific risk. The VIX declined in the U.S. following the election but remains more than 5 percentage points above the average.

A financial option with a stock price of \$30, an exercise price of \$40, a life of two years, and volatility of 33 percent is worth about \$2.65. The same option with a volatility of 46.5 percent has a value of roughly \$4.85.¹³

The cost of capital and implied volatility in the market generally move together. Exhibit 3 shows how they have diverged in 2020, leading to the unusual drivers of value that we have seen.

Exhibit 3: Ratio Between the VIX and the Cost of Equity, 2016-2020



Source: FactSet and Aswath Damodaran.

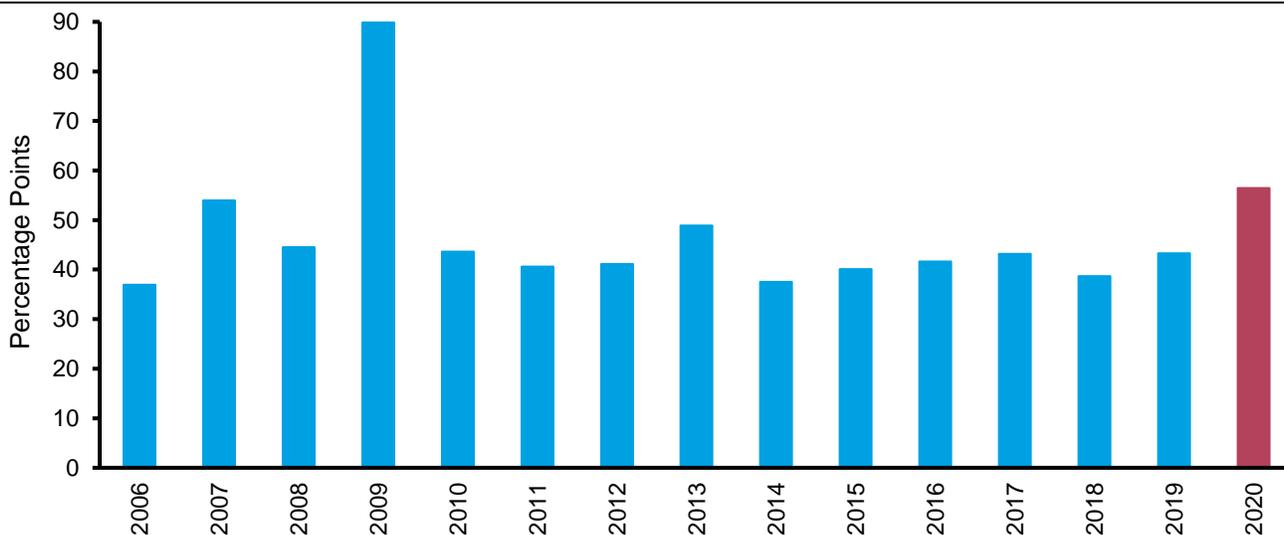
Note: Monthly; Cost of equity is the yield on the 10-year U.S. Treasury note plus the implied equity risk premium (using projected cash flows based on the trailing 12-month cash flow yield).

It is reasonable to ask whether stock price volatility is a reasonable proxy for the volatility of real assets. The pandemic introduced a number of factors that suggest an increase in project riskiness. These include:

- **The timing and strength of the economic recovery.** Estimates from research firms for 2021 real gross domestic product growth in the U.S. span an unusually wide range from 1.5 to 7.1 percent. The pandemic led to an acceleration of some trends, including the penetration of e-commerce, and it is difficult to assess to what degree the world will revert to what it was before COVID-19. Introduce operating leverage and it is easy to see that the potential for cash flow outcomes remains wide.
- **Sorting of the winners and losers after impact of the pandemic subsidies.** The pandemic's effects are akin to a major perturbation to an ecosystem. Companies will die, others will thrive, and some will find new niches. Predicting the outcomes from a shock to a complex adaptive system is notoriously difficult.
- **Evolution of business models.** The pandemic compelled some companies to accelerate their investments and capabilities in certain parts of their business. For example, most brick-and-mortar retailers had e-commerce operations prior to the spread of COVID-19, but the pandemic prompted them to focus on that business to compensate for the lack of store traffic. That effort will lead to changes in organizational capabilities and competitive dynamics.¹⁴

Uncertainty also tends to show up in stock price dispersion, which measures the range of returns for a group of stocks. Exhibit 4 shows that in 2020 the dispersion for the Russell 1000, roughly the 1,000 largest public companies measured by market capitalization, is the highest it has been since the financial crisis in 2009.

Exhibit 4: Dispersion of Returns for the Russell 1000, 2006-2020



Source: FactSet.

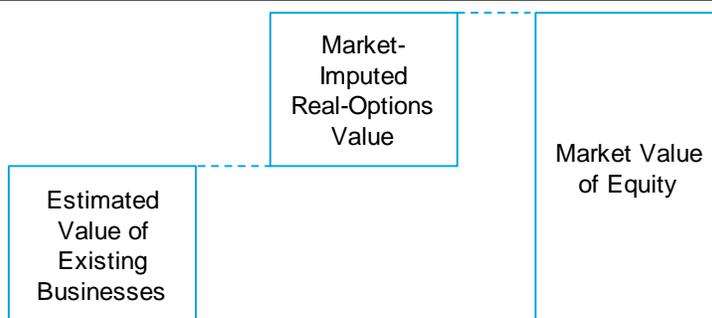
Note: **Past performance is no guarantee of future results.** Russell 1000 constituents at the beginning of each year; Returns are total shareholder returns (TSRs), which reflect stock price appreciation and the reinvestment of dividends; For companies removed from index during the year, TSRs are calculated through date of removal; 2020 figure is annualized using year-to-date data through November 30.

The returns for convertible bonds, which combine a traditional bond with a financial option, are a good indicator of a lower cost of capital and higher volatility. The Bloomberg Barclays US Convertibles Liquid Bond Index has gained 44.2 percent, higher than the 14.0 percent gain for the S&P 500 Index and the 7.4 percent return for the Bloomberg Barclays US Aggregate Bond Index, for 2020 through November 30, 2020. This underscores the likelihood that the value has increased for businesses that are established and have real options.

What to Do About It

One implication of this discussion is that you should not automatically assume a stock is overvalued if it reflects high expectations for the existing businesses. The market imputes real option value to some companies (see exhibit 5). It is appropriate to assess the plausibility of the real option value in those cases.

Exhibit 5: Imputed Real Options Value



Source: Counterpoint Global.

Exhibit 6 guides this analysis. First, you can use the checklist above to assess a company's potential real option value. The columns depict low and high potential. Then you can judge whether the market has assigned value to real options. The rows depict low and high values. The analytical implication from each quadrant is plain.

Exhibit 6: Potential versus Imputed Value for Real Options

		Potential Real-Options Value from Industry, Strategy, and Competitive Conditions	
		Low	High
Real-Options Value Imputed from Stock Price	Low	No Real-Options Analysis Required	Buy Candidate
	High	Sell Candidate	Real-Options Analysis Required

Source: Alfred Rappaport and Michael J. Mauboussin, *Expectations Investing: Reading Stock Prices for Better Returns* (Boston, MA: Harvard Business School Press, 2001), 128.

Traditional valuation analysis suffices when both potential and imputed real options values are low. If the potential for real option value is low but the valuation appears to price in high value, the stock is a sell candidate. Inversely, if the potential is high but the imputed value is low, the stock is a buy candidate as you are getting an option at a low cost or for free. Finally, you have to do real options analysis when both potential and imputed value are high.

In 2000, we did a real options case study on Amazon.com to illustrate the process.¹⁵ With the benefit of two decades of hindsight, the company does appear to have been astute at identifying, creating, and exercising real options to build its business.

Opportunities abounded in the wake of the dot-com bust, but access to capital was limited. The pandemic has shocked the business ecosystem, but there is ample access to capital today to exercise real options.

Conclusion

Along with real pain, strife, and challenge, 2020 has brought a set of conditions that are particularly notable for valuation practitioners. While some companies benefitted and others suffered from the pandemic's repercussions, the policy response had the effect of lowering the discount rate and therefore increasing the value of nearly all asset prices.

At the same time, the fallout from the pandemic has created substantial economic uncertainty that will lead to corporate winners and losers.

The cost of capital and volatility generally move in rough lockstep. This makes sense if there is a relationship between risk and reward. In 2020, however, the cost of capital has fallen to levels well below the average of

recent years and the volatility has risen to above-average levels. The prime beneficiaries of these patterns are companies rich with real options.

None of this discussion should be taken as a justification for any particular company's value. By the same token, the stocks of certain companies warrant additional analysis to assess real option value.

The cost of capital and volatility will eventually synchronize and this valuation issue will fade. But it has been a remarkable feature of the stock market in 2020.

Please see Important Disclosures on pages 11-13

Endnotes

¹ Robert J. Barro, José F. Ursúa, and Joanna Weng, “The Coronavirus and the Great Influenza Pandemic: Lessons from the ‘Spanish Flu’ for the Coronavirus’s Potential Effects,” *NBER Working Paper 26866*, April 2020.

² For more technical definitions, see Jonathan Mun, *Real Options Analysis, Third Edition* (Hoboken, NJ: John Wiley & Sons, 2016). For less technical definitions, see Thomas E. Copeland and Philip T. Keenan, “How Much Is Flexibility Worth?” *McKinsey Quarterly*, No. 2, Spring 1998.

³ The option to abandon can be modeled as a put option.

⁴ Tom Copeland and Peter Tufano, “A Real-World Way to Manage Real Options,” *Harvard Business Review*, Vol. 82, No. 3, March 2004, 90-99.

⁵ Lenos Trigeorgis and Jeffrey J. Reuer, “Real Options Theory in Strategic Management,” *Strategic Management*, Vol. 38, No. 1, January 2017, 42-63.

⁶ Stanley Block, “Are ‘Real Options’ Actually Used in the Real World?” *Engineering Economist*, Vol. 52, No. 3, 2007, 255-267 and John R. Graham and Campbell R. Harvey, “The Theory and Practice of Corporate Finance: Evidence from the Field,” *Journal of Financial Economics*, Vol. 60, Nos. 2-3, May 2001, 187-243.

⁷ Bart M. Lambrecht, “Real Options in Finance,” *Journal of Banking and Finance*, Vol. 81, August 2017, 166-171.

⁸ Martha Amram and Nalin Kulatilaka, *Real Options: Managing Strategic Investment in an Uncertain World* (Boston, MA: Harvard Business School Press, 1999).

⁹ Stewart C. Myers, “Determinants of Corporate Borrowing,” *Journal of Financial Economics*, Vol. 5, No. 2, November 1977, 147-175.

¹⁰ Paolo Cavallino and Fiorella De Fiore, “Central Banks’ Response to Covid-19 in Advanced Economies,” *BIS Bulletin No. 21*, June 5, 2020.

¹¹ See <http://pages.stern.nyu.edu/~adamodar/>.

¹² Michael J. Mauboussin and Dan Callahan, “The Math of Value and Growth: Growth, Return on Capital, and the Discount Rate,” *Consilient Observer: Counterpoint Global Insights*, June 9, 2020.

¹³ For this example we assume firm-specific risk is 50 percent higher than market risk, so volatility is 1.5 times the VIX.

¹⁴ Listen to Modest Proposal, “Better, Cheaper, Faster: Why Companies that Reduce Friction Win,” *Invest Like the Best Podcast*, September 29, 2020, minute 25:30.

¹⁵ Alfred Rappaport and Michael J. Mauboussin, *Expectations Investing: Reading Stock Prices for Better Returns* (Boston, MA: Harvard Business School Press, 2001), 128-132. See <http://www.expectationsinvesting.com/tutorial11.shtml>.

DEFINITIONS OF TERMS

Free cash flow (FCF) is a measure of financial performance calculated as net operating profit after tax minus investment in growth. FCF represents the cash that a company is able generate after laying out the money required to maintain or expand its asset base.

The **cost of capital** is the rate at which you discount future cash flows in order to determine the value today. The weighted average cost of capital blends the opportunity cost of the sources of capital, typically debt or equity, with the relative contribution of those sources.

The **discount rate** is the rate at which you discount future cash flows in order to determine the value today.

The **equity risk premium**, also referred to as simply equity premium, is the excess return that investing in the stock market provides over a risk-free rate, such as the return from government treasury bonds. This excess return compensates investors for taking on the relatively higher risk of equity investing.

The **risk-free rate** is the theoretical interest rate that an investor can earn on an investment that carries zero risk.

The **S&P 500® Index** measures the performance of the large cap segment of the U.S. equities market, covering approximately 75% of the U.S. equities market. The Index includes 500 leading companies in leading industries of the U.S. economy.

Correlation is a statistical measure of how two variables move in relation to each other.

The **Russell 1000® Index** measures the performance of the 1,000 largest companies in the Russell 3000 Index. The Russell 3000® Index measures the performance of the largest 3,000 U.S. companies representing approximately 98% of the investable U.S. equity market. The Russell 3000 Index is constructed to provide a comprehensive, unbiased and stable barometer of the broad market and is completely reconstituted annually to ensure new and growing equities are reflected.

DISTRIBUTION

This communication is only intended for and will only be distributed to persons resident in jurisdictions where such distribution or availability would not be contrary to local laws or regulations.

Ireland: Morgan Stanley Investment Management (Ireland) Limited. Registered Office: The Observatory, 7-11 Sir John Rogerson's, Quay, Dublin 2, Ireland. Registered in Ireland under company number 616662. Regulated by the Central Bank of Ireland. **United Kingdom:** Morgan Stanley Investment Management Limited is authorised and regulated by the Financial Conduct Authority. Registered in England. Registered No. 1981121. Registered Office: 25 Cabot Square, Canary Wharf, London E14 4QA. **Dubai:** Morgan Stanley Investment Management Limited (Representative Office, Unit Precinct 3-7th Floor-Unit 701 and 702, Level 7, Gate Precinct Building 3, Dubai International Financial Centre, Dubai, 506501, United Arab Emirates. Telephone: +97 (0)14 709 7158).

Germany: Morgan Stanley Investment Management Limited Niederlassung Deutschland, Grosse Gallusstrasse 18, 60312 Frankfurt am Main, Germany (Gattung: Zweigniederlassung (FDI) gem. § 53b KWG). **Italy:** Morgan Stanley Investment Management Limited, Milan Branch (Sede Secondaria di Milano) is a branch of Morgan Stanley Investment Management Limited, a company registered in the UK, authorised and regulated by the Financial Conduct Authority (FCA), and whose registered office is at 25 Cabot Square, Canary Wharf, London, E14 4QA. Morgan Stanley Investment Management Limited Milan Branch (Sede Secondaria di Milano) with seat in Palazzo Serbelloni Corso Venezia, 16 20121 Milano, Italy, is registered in Italy with company number and VAT number 08829360968. **The Netherlands:** Morgan Stanley Investment Management, Rembrandt Tower, 11th Floor Amstelplein 1 1096HA, Netherlands. Telephone: 31 2-0462-1300. Morgan Stanley Investment Management is a branch office of Morgan Stanley Investment Management Limited. Morgan Stanley Investment Management Limited is authorised and regulated by the Financial Conduct Authority in the United Kingdom. **Switzerland:** Morgan Stanley & Co. International plc, London, Zurich Branch Authorised and regulated by the Eidgenössische Finanzmarktaufsicht ("FINMA"). Registered with the Register of Commerce Zurich CHE-115.415.770. Registered Office: Beethovenstrasse 33, 8002 Zurich, Switzerland, Telephone +41 (0) 44 588 1000. Facsimile Fax: +41(0)44 588 1074.

U.S.:

NOT FDIC INSURED | OFFER NO BANK GUARANTEE | MAY LOSE VALUE | NOT INSURED BY ANY FEDERAL GOVERNMENT AGENCY | NOT A BANK DEPOSIT

Hong Kong: This document has been issued by Morgan Stanley Asia Limited for use in Hong Kong and shall only be made available to "professional investors" as defined under the Securities and Futures Ordinance of Hong Kong (Cap 571). The contents of this document have not been reviewed nor approved by any regulatory authority including the Securities and Futures Commission in Hong Kong. Accordingly, save where an exemption is available under the relevant law, this document shall not be issued, circulated, distributed, directed at, or made available to, the public in Hong Kong. **Singapore:** This document should not be considered to be the subject of an invitation for subscription or purchase, whether directly or indirectly, to the public or any member of the public in Singapore other than (i) to an institutional investor under section 304 of the Securities and Futures Act, Chapter 289 of Singapore ("SFA"), (ii) to a "relevant person" (which includes an accredited investor) pursuant to section 305 of the SFA, and such distribution is in accordance with the conditions specified in section 305 of the SFA; or (iii) otherwise pursuant to, and in accordance with the conditions of, any other applicable provision of the SFA. This publication has not been reviewed by the Monetary Authority of Singapore. **Australia:** This publication is disseminated in Australia by Morgan Stanley Investment Management (Australia) Pty Limited ACN: 122040037, AFSL No. 314182, which accepts responsibility for its contents. This publication, and any access to it, is intended only for "wholesale clients" within the meaning of the Australian Corporations Act.

Japan: For professional investors, this document is circulated or distributed for informational purposes only. For those who are not professional investors, this document is provided in relation to Morgan Stanley Investment Management (Japan) Co., Ltd. ("MSIMJ")'s business with respect to discretionary investment management agreements ("IMA") and investment advisory agreements ("IAA"). This is not for the purpose of a recommendation or solicitation of transactions or offers any particular financial instruments. Under an IMA, with respect to management of assets of a client, the client prescribes basic management policies in advance and commissions MSIMJ to make all investment decisions based on an analysis of the value, etc. of the securities, and MSIMJ accepts such commission. The client shall delegate to MSIMJ the authorities necessary for making investment. MSIMJ exercises the delegated authorities based on investment decisions of MSIMJ, and the client

shall not make individual instructions. All investment profits and losses belong to the clients; principal is not guaranteed. Please consider the investment objectives and nature of risks before investing. As an investment advisory fee for an IAA or an IMA, the amount of assets subject to the contract multiplied by a certain rate (the upper limit is 2.20% per annum (including tax)) shall be incurred in proportion to the contract period. For some strategies, a contingency fee may be incurred in addition to the fee mentioned above. Indirect charges also may be incurred, such as brokerage commissions for incorporated securities. Since these charges and expenses are different depending on a contract and other factors, MSIMJ cannot present the rates, upper limits, etc. in advance. All clients should read the Documents Provided Prior to the Conclusion of a Contract carefully before executing an agreement. This document is disseminated in Japan by MSIMJ, Registered No. 410 (Director of Kanto Local Finance Bureau (Financial Instruments Firms)), Membership: the Japan Securities Dealers Association, The Investment Trusts Association, Japan, the Japan Investment Advisers Association and the Type II Financial Instruments Firms Association.

IMPORTANT INFORMATION

EMEA: This marketing communication has been issued by Morgan Stanley Investment Management Limited ("MSIM"). Authorised and regulated by the Financial Conduct Authority. Registered in England No. 1981121. Registered Office: 25 Cabot Square, Canary Wharf, London E14 4QA.

Investing involves risk including the possible loss of principal. There is no guarantee that any investment strategy will work under all market conditions, and each investor should evaluate their ability to invest for the long-term, especially during periods of downturn in the market.

The views and opinions are those of the author as of the date of preparation of this material and are subject to change at any time due to market or economic conditions and may not necessarily come to pass. Furthermore, the views will not be updated or otherwise revised to reflect information that subsequently becomes available or circumstances existing, or changes occurring, after the date of publication. The views expressed do not reflect the opinions of all investment teams at Morgan Stanley Investment Management (MSIM) or the views of the firm as a whole, and may not be reflected in all the strategies and products that the Firm offers.

Certain information herein is based on data obtained from third party sources believed to be reliable. However, we have not verified this information, and we make no representations whatsoever as to its accuracy or completeness. The views expressed in the books and articles referenced in this whitepaper are not necessarily endorsed by Morgan Stanley Investment Management.

The information herein is a general communications which is not impartial and has been prepared solely for information and educational purposes and does not constitute an offer or a recommendation to buy or sell any particular security or to adopt any specific investment strategy. The material contained herein has not been based on a consideration of any individual client circumstances and is not investment advice, nor should it be construed in any way as tax, accounting, legal or regulatory advice. To that end, investors should seek independent legal and financial advice, including advice as to tax consequences, before making any investment decision.

Past performance is no guarantee of future results.

Charts and graphs provided herein are for illustrative purposes only. Any securities referenced herein are solely for illustrative purposes only and should not be construed as a recommendation for investment.

This communication is not a product of Morgan Stanley's Research Department and should not be regarded as a research recommendation. The information contained herein has not been prepared in accordance with legal requirements designed to promote the independence of investment research and is not subject to any prohibition on dealing ahead of the dissemination of investment research.

MSIM has not authorised financial intermediaries to use and to distribute this document, unless such use and distribution is made in accordance with applicable law and regulation. Additionally, financial intermediaries are required to satisfy themselves that the information in this document is appropriate for any person to whom they provide this document in view of that person's circumstances and purpose. MSIM shall not be liable for, and accepts no liability for, the use or misuse of this document by any such financial intermediary.

The whole or any part of this work may not be directly or indirectly reproduced, copied, modified, used to create a derivative work, performed, displayed, published, posted, licensed, framed, distributed or transmitted or any of its contents disclosed to third parties without MSIM's express written consent. This work may not be linked to unless such hyperlink is for personal and non-commercial use. All information contained herein is proprietary and is protected under copyright and other applicable law.

Morgan Stanley Investment Management is the asset management division of Morgan Stanley.

This document may be translated into other languages. Where such a translation is made this English version remains definitive. If there are any discrepancies between the English version and any version of this document in another language, the English version shall prevail.