

BLUEMOUNTAIN INVESTMENT RESEARCH

# HOW WELL DO YOU COMPARE?

We are in the business of making comparisons. If we want to generate alpha, then every single investment decision comes down to how that investment compares to an alternative. But what alternative should we use to compare? What is the best analog?

We make comparisons when we decide how to size one position versus another. Relative size depends on relative attractiveness. But how do we compare investments with different attributes? A debt instrument versus an equity instrument? A basis trade versus a curve trade? A liquid investment versus an illiquid investment?

Allocating capital is nothing other than an exercise in comparison. How does one strategy compare to another? We seek diversifying strategies. But diversification means identifying important differences between strategies. How do we best

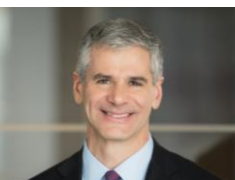
compare across strategies with essential differences?

Comparing is hard work. It requires a lot of thought, discipline, and creativity. It's a skill we constantly seek to hone.

I have asked Michael Mauboussin to ensure that we are focused on excellence in all areas of our investment process. How to compare effectively is one of Michael's current areas of emphasis. We share some of his foundational work on the topic in the attached report. We are happy to discuss specific examples of where and how we are applying the principles.

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# How Well Do You Compare?

Years ago, Dan Ariely, a professor of psychology and behavioral economics at Duke University, was surfing the Web when he found an advertisement for an annual subscription to the *Economist*, a weekly magazine that covers politics, business, and other news. Similar to most magazines, the *Economist* offers both an online and a print subscription.<sup>1</sup>

The prices struck Ariely as odd. They appeared one after the other. He first saw the online version, which was \$59. Seemed reasonable. Next was the print version at \$125. A little pricey, but still sensible. Finally, the price for both the print and online version was also \$125. He did a double take. Why buy the print version only when you can get the print and online version together for the same price?

Comparing is something we humans do quite naturally, but you and I are not always good at it. If you are a perfectly rational person, you gather all of the salient information about your alternatives and select the option that maximizes your utility. This is a fancy way of saying you pick what makes you happy. You might favor either the online or the print version of the *Economist*, but it is clear that if you prefer print you should choose the offer with the free digital version.

Ariely suspected there was more to the story. So he did some experiments with his students in business school. The first group of subjects saw all three offers. Sixteen percent chose the online offering, 84 percent the print and online version, and none selected print only.

For the second group of subjects, Ariely dropped the option to select the print-only version. That no one in the first group selected that option underscored the obvious point that it was an unattractive choice even for those students who preferred print. With the option omitted, you would still expect the preference for digital versus print in the second group to be similar to that of the first group.

But that is not what Ariely saw when he tallied the choices of the second group. Now, 68 percent of the students went with the online version and only 32 percent with the print version (see exhibit 1). In effect, the unattractive option was a decoy that swayed the choices in the first group and boosted the *Economist*'s hypothetical sales by more than 40 percent.

Those sharp business school students did not compare as economic theory dictates they should have. How Ariely presented the options shaped their ultimate choices. We are not optimized for choosing. The way alternatives appear and how we think shape our decisions.

Dan Gilbert, a professor of psychology at Harvard University, summarizes the situation well: "The facts are these: (a) value is determined by the comparison of one thing with another; (b) there is more than one kind of comparison we can make in any given instance; and (c) we may value something more highly when we make one kind of comparison than when we make a different kind of comparison."<sup>2</sup>

## Exhibit 1: Subscription to the Economist Magazine—Options Offered Affect Choices

Economist.com	SUBSCRIPTIONS	Economist.com	SUBSCRIPTIONS
OPINION	<b>Welcome to</b>	OPINION	<b>Welcome to</b>
WORLD	<b>The Economist Subscription Centre</b>	WORLD	<b>The Economist Subscription Centre</b>
BUSINESS	Pick the type of subscription you want to buy or renew.	BUSINESS	Pick the type of subscription you want to buy or renew.
FINANCE & ECONOMICS	<input type="checkbox"/> <b>Economist.com subscription</b> - US \$59.00	FINANCE & ECONOMICS	<input type="checkbox"/> <b>Economist.com subscription</b> - US \$59.00
SCIENCE & TECHNOLOGY	One-year subscription to Economist.com, Includes online access to all articles from <i>The Economist</i> since 1997.	SCIENCE & TECHNOLOGY	One-year subscription to Economist.com, Includes online access to all articles from <i>The Economist</i> since 1997.
PEOPLE	<b>16%</b>	PEOPLE	<b>68%</b>
BOOKS & ARTS	<input type="checkbox"/> <b>Print subscription</b> - US \$125.00	BOOKS & ARTS	<input type="checkbox"/> <b>Print &amp; web subscription</b> - US \$125.00
MARKETS & DATA	One-year subscription to the print edition of <i>The Economist</i> .	MARKETS & DATA	One-year subscription to the print edition of <i>The Economist</i> and online access to all articles from <i>The Economist</i> since 1997.
DIVERSIONS	<b>0%</b>	DIVERSIONS	<b>32%</b>
	<input type="checkbox"/> <b>Print &amp; web subscription</b> - US \$125.00		
	One-year subscription to the print edition of <i>The Economist</i> and online access to all articles from <i>The Economist</i> since 1997.		
	<b>84%</b>		

Source: Dan Ariely, *Predictably Irrational: The Hidden Forces That Shape Our Decisions* (New York: Harper, 2008), 1.

The ability to compare effectively is a vital skill in investing. Exhibit 2 shows the types of choices an investor, or investment manager, faces. Comparing well requires understanding the objective, considering the correct alternatives in fair fashion, and avoiding many common mistakes in assessment.

This report is about how investors compare. We start with a discussion of how people compare in general, with an emphasis on when we compare effectively and when we tend to make mistakes. We specifically consider the comparable

company analysis that investors use as part of their valuation work. The multiples of earnings and cash flow of the peer group that an investor selects can make the focal company appear relatively cheap or expensive.

Next, we turn to methods to improve the process of comparison. Here we share some tools to manage or mitigate some of the mistakes that we might make if we are not sufficiently careful.

Finally, we discuss a means to construct a comparable company analysis. An investor can use this approach to select securities and hedge.

## Exhibit 2: Example of the Comparisons Investors Must Make

Choice A	Choice B	Basis of Comparison
Consume	Save	Current versus future utility
Active management	Rules-based management	Skill versus cost
Stocks	Bonds	Expected risk versus reward
Liquid	Illiquid	Expected reward versus access to capital
XYZ Corporation	ABC Incorporated	Relative attractiveness versus fair value

Source: BlueMountain Capital Management.

## Methods We Use To Compare and Their Limitations

**Analogy.** Cognitive scientists have spent a great deal of time studying how we compare.<sup>3</sup> The primary mechanism we use is analogy. Analogy is an “inference that if two or more things agree with one another in some respects they will probably agree in others.”<sup>4</sup> Douglas Hofstadter, a renowned professor of computer and cognitive science, has suggested that analogy is “the core of cognition.”

The application of analogical thinking generally has four steps.<sup>5</sup> First, we select a source analog that we will use as the basis of comparison with the target. Usually, the source comes from our memory. Second, we map the source to the target to generate inferences. Here, we are often looking for similarities. Third, we assess and modify these inferences to reflect the differences between the source and the target. Finally, we learn from the success or failure of the analogy.

For example, Andy Grove, then chief executive officer of Intel, heard about how mini-mills had disrupted the integrated mills in the steel industry.<sup>6</sup> He saw similar dynamics in the microprocessor industry, with Intel as the equivalent of the integrated mills. This encouraged him to lead the effort to launch a low-end microprocessor, called Celeron, to avoid a plight similar to that of the integrated mills. Grove drew an analogy that successfully shaped Intel's strategy.

Analogy can be a powerful way to compare, but there are common mistakes in its application. Here are a few based on the first three steps:

**Step 1 mistakes:** Most people rely on their memories to retrieve analogies.<sup>7</sup> Psychologists call this the availability bias, and it shrinks the scope of inquiry. Because our experiences and memories are limited, we fail to identify proper analogies.<sup>8</sup> This is a recurring source of failed decisions. For example, you can imagine a company's chief executive officer (CEO) comparing a current acquisition, by analogy, to a past acquisition that was successful. The CEO fails to consider a larger sample of deals that likely provide a richer analogy because the prior success is what comes to mind.

So the first failure is not finding an appropriate analogy because of a lack of breadth. Limited or biased recall and search is the source of this shortcoming.

**Step 2 mistakes:** The second failure is a lack of depth. This is a faulty inference based on the superficial features of the analogy. Another way to say this is the analogy suggests correlation but fails to identify causality. Solid theory is rooted in causality. The process of theory building raises the level of understanding from one based on attributes to one based on circumstances.<sup>9</sup>

Clayton Christensen, a professor of management at Harvard Business School, introduces this idea through man's quest to fly. The obvious analogy is birds or, more accurately, animals with wings and feathers. Not all animals with wings and feathers can fly, and not all animals that fly have wings and feathers. But as Christensen likes to point out, the correlations are high.

The intrepid humans who sought to fly pursued a logical strategy. They fashioned wings covered with feathers, attached them to their arms, went to a high spot, jumped, and flapped. Then they crashed. The attributes of wings and feathers are not enough for flight. Much later, scientists learned how lift, and hence flight, works. The circumstances of flight allow us to fly 350-ton aircraft around the world.

Speaking of large aircraft, Boeing provides a case for this mistake in the world of business.<sup>10</sup> Many companies, including Apple, Cisco, and Dell, have enjoyed the financial benefits of outsourcing. A company that outsources hires external suppliers to provide goods or services the company used to deliver internally. For instance, Apple outsources some assembly of its iPhones to Foxconn. This allows Apple greater focus, more profits, and less capital intensity. These are generally good things in the world of business.

Aircraft are complex, which is why Boeing had historically used an approach called “build to print.” The idea is that Boeing designed its aircraft internally, and only then outsourced some of the components to external suppliers. The tight control over design was the strength of build to print, but it also slowed development and assembly time and required more capital.

For the 787, dubbed the Dreamliner, Boeing came to see their own business as analogous to the successful companies that were outsourcing. The inference was that if outsourcing worked for Apple and Cisco, it should work for Boeing as

well. Boeing outsourced the design of the 787. The goal was to have 1,200 components sent to Boeing that its mechanics would assemble into a plane in 3 days, down from the 30 days normally needed to put together an aircraft of that size. Think of a large and complex Lego set with the parts ready to click together.

The first jet came back in 30,000 pieces, many of which did not fit into place. At great expense and delay, Boeing had to take on design work in-house to make sure they could deliver a functioning plane. The outsourcing effort failed.

Management researchers have studied when industries must be vertically integrated and when they can be horizontally structured.<sup>11</sup> The key is modularity, or having discrete components that work together. When there is little modularity, the industry must remain largely vertically integrated.

Think of the personal computer industry in the early 1980s. IBM was involved with almost all aspects of the machine, from chips to drives to software. To build a functioning computer required tight coordination. Once the components of a personal computer were modularized, the industry flipped from a vertical to a horizontal structure.

Boeing's inference was off because the aircraft industry is not modularized in the same way that consumer technology is. The attribute of outsourcing didn't work because the circumstance of modularity was absent.

Another example of superficial inference is the performance of stars. Organizations from sports teams to businesses assume they can improve results by hiring a star. In some cases, this works. For example, stars are crucial to the success of professional basketball teams. But in most cases, chasing stars does not pay off.<sup>12</sup>

Boris Groysberg, a professor of organizational behavior at Harvard Business School, has examined the portability of star performance. One of his most detailed studies was of star Wall Street analysts who switched firms. He found that their performance "plunged sharply" as compared to analysts who stayed put. The mistaken inference is that the skill resides solely in the star. This fails to consider the organizational structure that surrounds the star.

The mistake in the second step is relying on superficial similarities that cause us to make faulty

inferences. One reason we do this is because we are satisfied to rely on correlations without understanding causality.

**Step 3 mistakes:** The third failure has to do with the inferences we draw based on whether we focus on the similarities or the dissimilarities between the source analog and the target.<sup>13</sup> Psychologists call this the "contrast model," and it says the similarity between two entities is a weighted function of matching and mismatching features.

Amos Tversky, an influential psychologist well known for his collaboration with Daniel Kahneman, showed that researchers can manipulate how subjects compare either by directing their attention among choices or by presenting the same choice in different ways.

In one famous study from the early 1970s, Tversky asked the first half of his subjects which pair of countries is more similar: West Germany and East Germany or Sri Lanka and Nepal. Twenty of the 30 subjects said that West and East Germany were more similar.

He then asked the second half of the subjects which pair is more different. You would expect answers in the latter experiment to be the complement of the first, suggesting that one-third would designate West and East Germany more different. But that's not what Tversky found. In fact, 21 of the 30 subjects said West and East Germany were more different.

This study shows that what we pay attention to has an influence on how we assess similarity. Tversky also showed that we tend to place greater emphasis on common features than uncommon ones. We will explore more rigorous ways to study similarity.

But the combination of analogies drawn from memory and how we allocate our attention creates a wide avenue for poor choices.

**Heuristics and biases.** Tversky collaborated with Kahneman to identify a series of heuristics, or rules of thumb, that we use in making decisions. Heuristics have the benefit of saving us time, but also introduce bias. The representativeness heuristic describes the degree to which the target is similar to the source based on salient features. The bias that arises is we tend to overweight the importance of salient qualities and hence predict poorly.<sup>14</sup>



In the investing world, you can imagine scenarios where the focus on similarities or differences matters. Say you are analyzing a company as a potential turnaround candidate. One natural way to assess the likelihood of success is to scan your memory for prior turnarounds, either successful or failed, that are in the same industry. From there, whether you focus on the similarities or the differences between your source turnaround and the target case you are analyzing can lead to disparate conclusions.

Kahneman and Tversky also defined the framing effect.<sup>15</sup> While not strictly related to analogy, framing shows that how a proposition is presented can lead to different choices. Framing is a core idea of prospect theory, which describes the ways we make decisions in the face of risk that depart from normative economic theory. Both how we describe comparisons and how we direct our attention have a strong influence on how we choose.

One example is what psychologists call broad versus narrow framing. Broad framing means that you should consider a risky decision in the context of your total risk. So if you add a security to your portfolio, you consider its risk in the context of the diversified portfolio. Narrow framing, which captures common behavior, says that we dwell on the individual risk in isolation. Ever notice that you are loathe to sell a stock at a loss and are keen to sell it at or above the price you paid? That is a case of narrow framing. You are not comparing the investment based on its role in your overall wealth but rather based on what you paid for it.

Recent events come to mind more readily than distant ones and hence often get too much weight in our decisions. The result is recency bias. For example, general managers of sports franchises must value and compare the services of players. A player who has recently had strong results will likely get a more attractive contract than one with weak results, even if luck played a big role in those short-term outcomes. Managers who offer these rich contracts underestimate the importance of regression toward the mean.

Something similar happens in the investment management industry.<sup>16</sup> A substantial body of research shows that institutional investors tend to hire money managers after a period of superior results and fire managers following inferior results. The research also shows that, on average, the

fired managers go on to perform better than the hired ones. Once again, the combination of recency bias and regression toward the mean leads to unwise choices.

Analogy is a natural and potentially robust way to compare, but you must be careful to avoid the common mistakes, including a lack of breadth and depth as well as misallocation of attention. In each of these cases, we can use systematic strategies to improve our outcomes.

**The role of intuition.** Intuition, similar to analogy, is a common and rapid way to make decisions. Intuition is our capacity for rapid insight without detailed reflection or reason.<sup>17</sup> Researchers studied three dozen decisions by senior executives and found that intuition was a “major or determining factor” in 85 percent of them.<sup>18</sup> It is related to analogy in the sense that it is a form of pattern recognition. While intuition can be a valuable guide to choosing well, there are important boundaries defining its usefulness.

Daniel Kahneman popularized the idea of System 1 and System 2 thinking.<sup>19</sup> System 1 is your experiential system. It is “fast, automatic, effortless, associative, and difficult to control or modify.” System 2 is your analytical system. It is “slower, serial, effortful, and deliberately controlled.” Intuition is valuable when you train your System 1 in a task that is stable and linear.

Chess is a classic example of where intuition works well. Great chess players can see quickly which player has the advantage on the board and can rapidly identify very good moves. They see the board in familiar configurations called “chunks.”<sup>20</sup> But these players can do this only after a great deal of study, typically thousands of hours. Also essential is that the rules and features of the game are unchanging. Change the rules overnight and all bets are off about grandmaster skill.

Intuition guides a substantial percentage of decisions, or choices, where it really should not be used at all. Because few elements of business or markets are stable and linear, our intuitions are not very useful.

You hear a lot about executives or investors who made intuitive decisions that succeeded wildly, but you don’t hear a lot about intuitive decisions that were flops. For example, we remember that Michael Eisner, then CEO of Disney, backed the hit show, *Who Wants to Be a Millionaire?* But we

don't recall that he thought *Lost* was a loser (he rated it 2 on a scale of 1 to 10, 1 being the worst) even though it went on to be a smash hit. We undersample failure, which makes intuition look more effective than it really is.

**Choose now, rationalize later.** Another relevant mental process is our tendency to make up our minds about something first and then seek explanations to justify our choices later. The formal name for this is "choice-supportive bias." This taps into our desire to be consistent. Even if our choices are the result of a faulty intuitive process, our minds will work hard to make the stories consistent with the choices. We then seek additional information to confirm our decisions and dismiss or discount information that counters our choices. The psychologist Thane Pittman once said, "I'll see it when I believe it."<sup>21</sup> That was a slip of the tongue, but it is an accurate description of how most of us fall for the confirmation trap.

**Time and choice.** Time adds a wrinkle in the process of comparing. For example, psychologists and economists note that we tend to have inconsistent discount rates when we make short-term versus long-term decisions.<sup>22</sup> If you ask someone whether they prefer \$20 today or \$22 tomorrow, they often select the \$20 today. But if you ask them if they want \$20 in a year or \$22 in a year and a day, they generally pick the \$22. This implies a high discount rate in the short term and a low one in the long term. Because of the implied shape of the curve that reflects these discount rates, scientists call this "hyperbolic discounting."

Hyperbolic discounting isn't just revealed in the lab. In the early 1990s, the U.S. military trimmed its staff. As a result, the Department of Defense offered a choice between a lump sum and an annuity as a severance package for 65,000 military personnel. The annuity was worth approximately 80 percent more than the lump sum. More than one-half of the officers selected the lump sum and almost all of the enlisted soldiers did so.<sup>23</sup>

Psychologists and economists have teamed up with neuroscientists to understand how the brain chooses between an immediate and a distant payoff. They found that the limbic structures were active when the choice was a smaller but immediate reward (\$20 today versus \$22 tomorrow). Impulsive behavior and dysfunctions,

including drug addiction, are linked to the limbic system.

The prefrontal and parietal cortex, areas associated with deliberative processes and cognitive control, are active when subjects select the larger but delayed rewards (\$20 in a year versus \$22 in a year and a day).<sup>24</sup> Different parts of your brain can be in a metaphorical battle, with the victor determining how you decide.

Stress also affects our choices between now and later.<sup>25</sup> Robert Sapolsky is a neurobiologist and primatologist at Stanford University who has studied stress in great detail. He points out that the stress response is incredibly effective at dealing with crises. But if we suffer from chronic stress, usually the result of psychological stressors, our minds and bodies act as if we are in a constant state of emergency. This is very unhealthy.

When we are stressed, we focus on the here and now and pay little attention to the future. Roughly one-half of institutional investors and asset managers say that career risk, getting fired for poor results, is a factor for them.<sup>26</sup> An investment manager worried about getting sacked will tend to focus on opportunities that promise near-term payoffs at the expense of those that may offer higher returns in the long term.

**Coherent arbitrariness.** As we turn our attention to investing, one more useful concept is "coherent arbitrariness," which says that we are not very good at understanding the absolute values of things but are good at figuring out the relative differences.<sup>27</sup> To show this, researchers manipulated the values that subjects assigned to various goods by introducing anchors. For example, subjects were prompted to write down the last two digits of their phone numbers and then were asked how much they would be willing to pay for a variety of products, including a bottle of wine. Those with low numbers placed a lesser value (average of \$8.64) on the wine than those with high numbers did (\$27.91). This relationship held true across a range of products, showing that the relative ranking was consistent for all. The initial price was arbitrary but the ranking was coherent.

This is relevant in the context of markets when investors focus on the relative value among securities rather than considering whether the securities are trading near fundamental values. In

the experiment using goods, the anchor was digits in a phone number. In markets, researchers have found that markers such as an index's or a stock's 52-week high serve as an anchor.<sup>28</sup>

**Comparable company analysis.** It is common for an investor to assess the relative attractiveness of a company's stock or bonds by comparing the valuation to the appropriate securities of comparable firms. Common metrics for stocks include multiples such as price to earnings (P/E), enterprise value to earnings before interest, taxes, depreciation, and amortization (EV/EBITDA), and price to book (P/B), as well as dividend and free cash flow yield. The common metric for bonds of similar maturities and terms is yield.

Which companies an analyst selects as the basis of comparison can play a large role in shaping the conclusions he or she reaches. There are two basic approaches to selecting peer companies.<sup>29</sup> The first, which most fundamental investors use, is based on industry classification. The most popular of these is the Global Industry Classification Standard (GICS). GICS classifies companies by sectors, industry groups, industries, and sub-industries. The narrower definitions are more specific but have fewer companies.

The second approach selects companies based on the fundamental characteristics that drive value. Two companies in different industries may have more in common with one another than they do with other firms in their respective

industries. The approach using GICS misses the connection while the approach using fundamental drivers captures the link. Most fundamental investors and investment bankers do comparable company valuation analysis based on industry peers.<sup>30</sup>

Both approaches have the same goal: use an input (GICS or fundamental characteristics) to generate an output (valuation). When researchers examined how analysts actually select companies for comparison, they found that analysts pick peers with high valuations when they want to argue that a stock is cheap.<sup>31</sup> It appears that the comparable company analysis is less an exercise in objectivity and more an exercise in persuasion.

Another flaw in selecting industry peers is that multiples may vary for justifiable economic reasons.<sup>32</sup> For instance, two companies with the same growth rate in earnings but with different returns on invested capital will justifiably trade at dissimilar P/E, EV/EBITDA, and P/B multiples. A failure to recognize the impact that return on invested capital has on valuation can lead to superficial, and incorrect, conclusions.

Comparable company analysis, like many of the methods we use to compare, can be an effective tool if used appropriately and misleading if used improperly.

Exhibit 3 reviews the common methods we use to compare and describes the limitations of each.



### Exhibit 3: Method We Use to Compare—Description and Limitations

Methods	Description	Limitation(s)
<b>Analogy</b>	Inference that if things agree with one another in some respects they will likely agree in others	<i>Lack of breadth:</i> Limited or biased recall and search <i>Lack of depth:</i> Reliance on superficial similarities <i>False inferences:</i> Pay too much attention to similarities or dissimilarities
<b>Heuristics</b>	Rules of thumb	Introduce biases, including representativeness heuristic, framing effect, and recency bias
<b>Intuition</b>	Our capacity for rapid insight without detailed reflection or reason	Guides many decisions where it should not be used, particularly in environments that are not stable and linear
<b>Choose now, rationalize later</b>	Make up our minds first and then seek explanations to justify our choices later	Even if choices are the result of a faulty intuitive process, our minds will work hard to make the stories consistent with the choices
<b>Time and choice</b>	How we choose between now and later	We tend to have inconsistent discount rates when we make short-term versus long-term decisions (hyperbolic discounting)
<b>Coherent arbitrariness</b>	We are not very good at understanding the absolute values of things but are good at figuring out the relative differences	We are highly influenced by anchors, even if they are irrelevant
<b>Comparable company analysis</b>	Assessing relative attractiveness of a company's stock or bonds by comparing the valuation to the appropriate securities of comparable firms	Can be more an exercise in persuasion than objectivity (e.g., analysts picking peers with high valuations to argue a stock is cheap)

Source: BlueMountain Capital Management.

## How We Can Improve How We Compare

We need to address the common mistakes in order to improve our ability to compare. Dan Lovallo, Carmina Clarke, and Colin Camerer, researchers who study decision making, describe the problem of relying too much on analogies drawn from memory and offer a solution they call

"similarity-based forecasting."<sup>33</sup> They suggest considering two dimensions (see exhibit 4). The first is the reference class, or what you are comparing to. The second is the weighting, or how much emphasis you should place on a particular analogy or feature.

**Exhibit 4: Similarity-Based Forecasting**

		<b>Reference Class</b>	
		<b>Recall</b>	<b>Distribution</b>
<b>Weighting</b>	<b>Event-based</b>	Single analogy	Reference class forecasting
	<b>Similarity-based</b>	Case-based decision theory	Similarity-based forecasting

Source: Dan Lovallo, Carmina Clarke, and Colin Camerer, "Robust Analogizing and the Outside View: Two Empirical Tests of Case-Based Decision Making," *Strategic Management Journal*, Vol. 33, No. 5, May 2012, 498.

They start by recognizing that most of us use a single analogy that we draw from memory. The reference class is one analogy, and we place all of our weight on it. If you happen upon a proper analogy, this is a quick and efficient way to compare. But single analogies can be very misleading because the scope of inquiry is too narrow.

You can prompt decision makers to consider more than one analogy and to weight them relative to the focal decision. This is called "case-based decision theory" and is generally better than single analogy recall. But it also runs the risk of having too little breadth and depth. Lovallo, Clarke, and Camerer ran an experiment with private equity investors and found that prompting the investors to consider relevant, additional cases improved the quality of their forecasts. There are ways to be effective with case studies, but executives and investors are generally not as careful as they should be in curating and developing appropriate cases.<sup>34</sup>

We tend to compare by relying on recall. Kahneman wrote, "People who have information about an individual case rarely feel the need to know the statistics of the class to which the case belongs."<sup>35</sup> This suggests we typically stop at the boundary of our memory. The decision-making research shows that the thoughtful integration of

an appropriate reference class improves the quality of comparisons and forecasts.<sup>36</sup>

"Reference-class forecasting" asks the question, "What happened when others were in this position before?" It is an unnatural way to think because it deemphasizes memory and experience and requires a decision maker to find and appeal to the reference class, or base rate. But research in social science shows that the proper integration of a reference class improves the quality of forecasts. Since comparisons often rely on forecasts, reference-class forecasting is a marked improvement relative to relying solely on memory.

For example, say you are comparing two companies, one with sales of \$40 billion and the other \$4 billion, that both have an expected annual sales growth rate of 20 percent in the next 5 years based on the average projections of analysts. In this case, you can examine the past five-year growth rates of all companies of comparable sizes to get a sense of the plausibility of achieving that growth. The percentage of \$40 billion companies reaching that rate of growth is less than half that of \$4 billion companies. Reference-class forecasting confirms that rapid growth occurs more frequently for smaller firms than for bigger ones.

Reference-class forecasting goes from using memory for comparison to a large distribution that reflects an appropriate reference class. But the approach evenly weights each outcome in the distribution. When we compare the growth rates of \$40 billion and \$4 billion companies, we are not asking whether some of the companies in the sample are more similar to the focal company.

Lovullo, Clarke, and Camerer argue for "similarity-based forecasting," which uses a large distribution but then weights some of the cases more than others based on how similar they are to the relevant target.

Mergers and acquisitions (M&A) provide a good example. Historically, M&A deals have failed to create value for the acquiring company around two-thirds of the time. But acquirers fare better when they pledge a small premium, pay with cash instead of stock, and do a tuck-in as opposed to a swashbuckling deal to chart a new strategic course.<sup>37</sup> In comparing alternatives for capital allocation, an executive should consider the full reference class but may weight certain deals more than others based on their similarity to the transaction at hand.

**Formal models.** We now turn to the geometric and feature-based models of similarity.<sup>38</sup> The geometric model places entities in space based on specified dimensions and measures similarity based on how close two entities are to one another. The feature-based model categorizes and weights similarities and dissimilarities. These are formal models that have a connection to two

approaches used in machine learning. The geometric model is associated with "analogizers" and the feature-based model is related to "connectionists."<sup>39</sup>

**Geometric model.** The geometric model is a workhorse of similarity analysis and hence a powerful tool for comparison. The idea is to rank entities across a number of dimensions to see which entities are closest to one another.

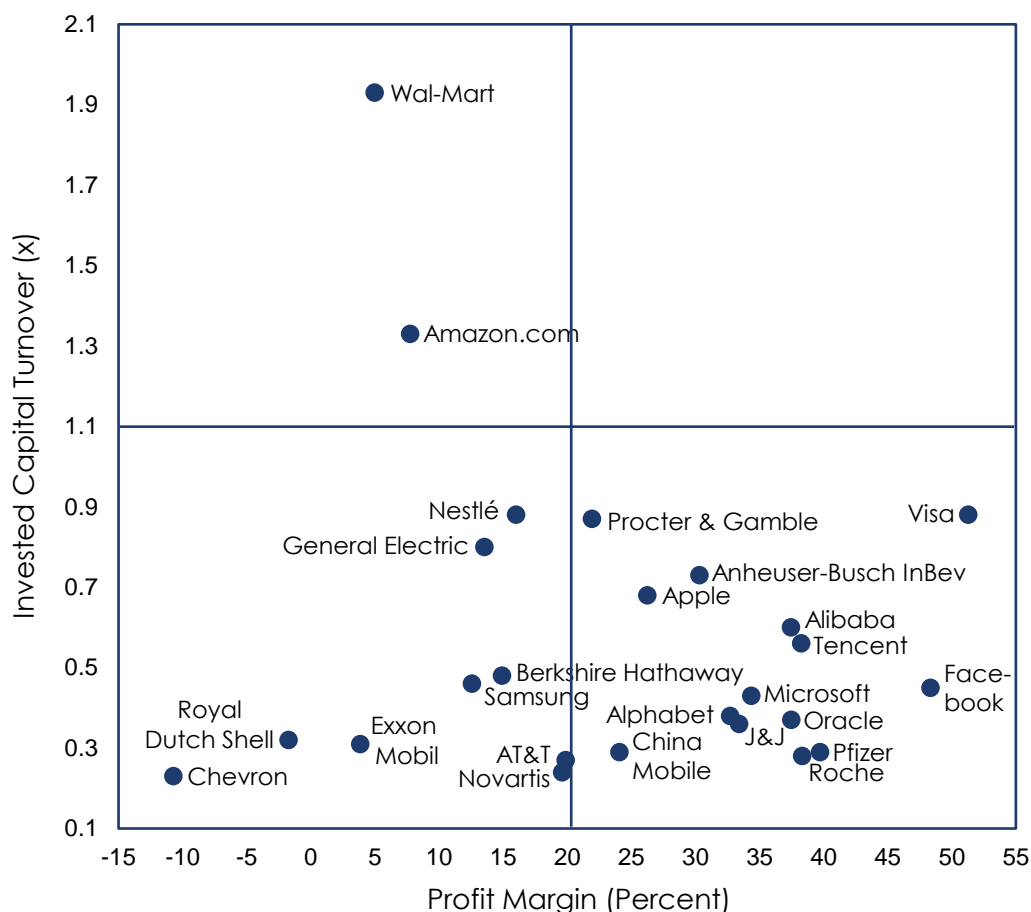
Exhibit 5 shows a simple analysis of corporate performance based on two dimensions, profit margin and invested capital turnover, for the top 25 global non-financial companies based on market capitalization. The closer two companies are in Euclidean space, the more similar they are. While this basic example has two dimensions, we can use this technique to measure similarity in many dimensions.

Amazon.com and Netflix started with a version of this approach for their recommendations to their users ("if you liked that book/movie, you should like this one"). This follows the principle of the "nearest neighbor" algorithm in computer science.

There has also been a wave of research using the geometric model that is based on text and search analysis.<sup>40</sup>

Naturally, the main challenge is to identify dimensions that are related to the goal of the analysis. Amazon.com wants you to buy more books and Netflix wants you to watch more movies. In investing, we want dimensions that will help us explain valuation.

**Exhibit 5: A Simple Geometric Model for Profit Margin and Invested Capital Turnover**



Source: Credit Suisse HOLT and BlueMountain Capital Management.

Note: Data reflects latest fiscal year as of October 9, 2017; Profit margin represented by Cash Flow Return on Investment margin.

**Feature-based model.** As we have seen, Amos Tversky and others showed that we are not always rigorous when we consider similarities and differences. He developed the feature-based model to better explain similarity. The equation at the heart of his model says:

Similarity between A and B = A and B's common features - the features that A has but B doesn't - the features that B has but A doesn't.

The research assigns a weight to each of the three terms: common features, A but not B, and B but not A. More weight is allocated to common features when seeking similarity, and more weight is placed on distinct features when looking for differences.

The connectionists use a neural network, a model inspired by how the brain works, to learn and generate results. The representations in the network are commonly based on features. One business example is targeted marketing.

Similarity-based forecasting plus the two models of similarity provide us with the tools we need to sidestep the common mistakes we make when we compare (see exhibit 6). These approaches may have been difficult to implement in the past as the result of a dearth of accessible data and computational power. Today we have the resources to employ them effectively. Still, few investors use the available theoretical and practical tools.

## Exhibit 6: Methods to Improve the Process of Comparison

Method	Application
<b>Similarity-based forecasting</b>	Use a large distribution but then weight some of the cases more than others based on how similar they are to the relevant target
<b>Geometric model</b>	Place entities in space based on specified dimensions and measure similarity based on how close two entities are to one another
<b>Feature-based model</b>	Categorize and weight similarities and dissimilarities

Source: BlueMountain Capital Management.

## Improved Comparison: An Example from the World of Investing

We can apply these lessons to improve comparable company analysis. The ability to compare the securities of companies effectively is important for generating risk-adjusted excess returns, determining which companies an analyst should follow, and for hedging risk. Further, the process of coming up with quality comparisons itself provides for a better understanding of businesses and the drivers of value.

We use similarity scores as a way to compare well and to sidestep the limitations of traditional comparable-company analysis. Recent research shows that an approach based on similarity provides "significantly more accurate valuation estimates than industry classification approaches."<sup>41</sup>

Our approach is based on a geometric model, which considers multiple dimensions and uses distance as a measure of similarity. Our universe is 900 of the largest publicly-traded companies in the U.S., measured by market capitalization, and the dimensions include analyst coverage, stock price correlation, and fundamental results. We weight the dimensions and place the greatest emphasis on fundamentals.

Take Amazon.com as an example of the differing returns between comparisons based on GICS and similarity scores. Amazon.com's GICS industry group, "Retailing," includes 48 companies in our universe. Of the 47 companies closest to Amazon.com based on similarity score, only 7 are in Retailing. The similarity score provides insight for comparison that the GICS industry group cannot.

## Conclusion

Comparing, essential to effective decision making, comes naturally to humans. But our basic approach of relying on analogy can limit our ability to compare effectively. In particular, we fail to incorporate sufficient breadth and depth into our comparisons, and we can be easily swayed by the presentation of information or the allocation of our attention.

Cognitive and computer scientists have articulated formal models of similarity that can help overcome our limitations and add rigor. One such model considers entities based on a number of dimensions and calculates similarity based on how close those entities are to one another.

This discussion has direct application to comparable company analysis. It is common for

an investor to compare the valuation of a focal company, usually based on multiples of earnings or cash flow, to a group of peer companies. Those companies are generally in the same industry as the focal company.

Research also shows that analysts arguing for a higher valuation will select peers that make their company look inexpensive.

A similarity score, properly calculated, can allow investors to better seek risk-adjusted excess returns, to define research coverage, and to hedge effectively. The use of similarity scores is a good example of the melding of discretionary and systematic strategies, drawing on the strengths of each.



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