

## the consilient observer

applying cross-discipline frameworks to investing

# The Pyramid of Numbers

## Firm Size, Growth Rates, and Valuation

*Growth is important because companies create shareholder value through profitable growth. Yet there is powerful evidence that once a company's core business has matured, the pursuit of new platforms for growth entails daunting risk. Roughly one company in ten is able to sustain the kind of growth that translates into an above-average increase in shareholder returns over more than a few years. . . . Consequently, most executives are in a no-win situation: equity markets demand that they grow, but it's hard to know how to grow.*

Clayton M. Christensen and Michael E. Raynor  
*The Innovator's Solution*<sup>1</sup>

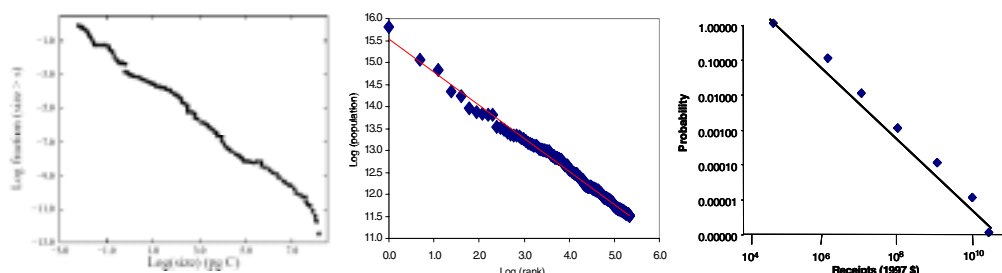
*Analysts and investors seem to believe that many firms' earnings can consistently grow at high rates for quite a few years. The evidence suggests instead that the number of such occurrences is not much different from what might be expected from sheer chance.*

Louis K. C. Chan, Jason Karceski, and Josef Lakonishok  
*The Level and Persistence of Growth Rates*<sup>2</sup>

## Why Big Fierce Animals are Rare

On the surface, the size and frequency distribution for species, cities, and company sizes may not seem like they would have a lot in common. Yet each follows a power law, which looks like a straight line when plotted on a log-log scale. Power laws indicate that there are lots of small occurrences and very few large ones.<sup>3</sup> In nature, there are lots of ants—the combined weight of ants is larger than the combined weight of humans—but very few elephants. Similarly, we have many small companies and a modest number of huge ones. Exhibit 1 shows examples of these distributions side-by-side.

### Exhibit 1: Distribution for Species, City, and Company Sizes



Sources: Juan Camacho and Ricard V. Sole, "Scaling and Zipf's Law in Ecological Size Spectra," *Santa Fe Institute Working Paper*, 1999; <http://www.few.eur.nl/few/people/vanmarrewijk/international/zipf.htm>, Robert L. Axtell, "Zipf Distributions of U.S. Firm Sizes," *Science*, September 7, 2001, 1819.

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Michael J. Mauboussin  
212-325-3108  
[michael.mauboussin@csfb.com](mailto:michael.mauboussin@csfb.com)

Kristen Bartholdson  
212-325-2788  
[kristen.bartholdson@csfb.com](mailto:kristen.bartholdson@csfb.com)

Take species for a moment. Why are large carnivorous animals, like tigers, relatively rare, while small animals, like termites, are so abundant? Ecologists answer by pointing out that all animals have a niche—not just a physical location, but a real place in the grand scheme of things. A species must not only survive in its home, it must successfully interact with the other plant and animal species that share that home.

The niche idea, though, still doesn't explain why the distribution of species looks the way it does. That insight came from Oxford's Charles Elton, who noted that larger animals need smaller animals to sustain them. (Animals rarely prey on animals larger than they are.) So, Elton reasoned, with every increment in body size, there should be an associated loss in numbers. He called this fact of life "The Pyramid of Numbers." Big fierce animals are rare because they have less sources of energy than smaller animals.<sup>4</sup> The species power law distribution is a natural outcome of interacting animals constrained by the laws of physics.<sup>5</sup>

What does this have to do with the stock market? Investors should pay attention to these distributions for three reasons. First, companies, like species, fit into niches. Thinking about these niches and how they change can provide some insight into a company's growth potential.

Second, a strong body of evidence shows that the variance of growth rates is smaller for large firms than for small firms (even though the median growth rate is fairly stable across the population). Further, growth for large companies often stalls, leading to marked share price underperformance as investors recalibrate their expectations.

Finally, investors often extrapolate past growth rates into the future, leading to disappointing shareholder returns for those companies that cannot meet those expectations. Investors who are aware of patterns of growth may be able to avoid unfavorable expectations gaps.

## Find Your Niche

The idea that companies find niches is certainly not new. For example, many aspects of the competitive strategy literature in general, and game theory in particular, address how and why companies should seek profitable niches. The main message here is that the environment, and hence niches, change over time as the result of technological developments, regulatory shifts, and industry exit and entry.

Think of mini-mills versus integrated steel companies, or Internet-based retailers compared to brick-and-mortar competitors. New niches open, and new companies exploit them. A company's ability to adapt to a changing environment is critical—and the number of companies that can do so is small.

As a result, optimal firm size may not be fixed for a particular industry, and comparing the valuations of companies with different economic models doesn't make sense.

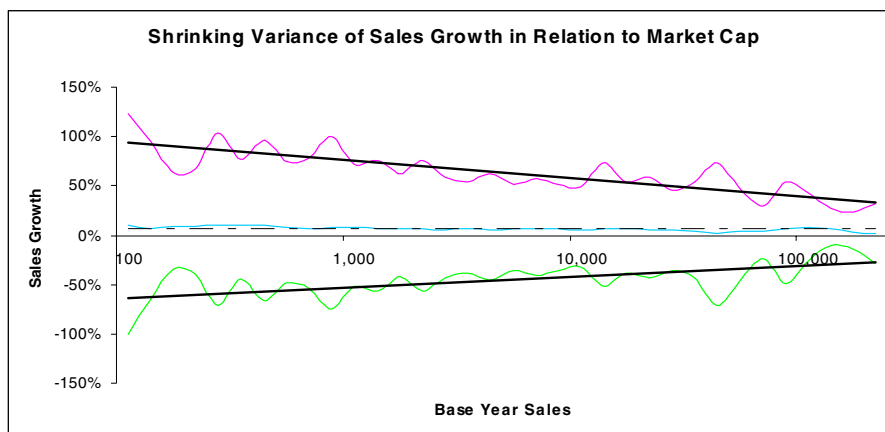
## Dear CEO—We've Made It to the Fortune 50! You're Fired

Studies of firm size distributions and growth rates reveal four stylized facts:

1. *Firm size distributions follow Zipf's Law* (a specific class of power law).<sup>6</sup> What is crucial for investors is that this distribution is very robust in the face of significant economic change. This means that the proportion of very large companies to smaller companies is unlikely to vary much in the future.
2. *Variances of firm growth rates decrease with size.*<sup>7</sup> Our analysis suggests that median growth rates are stable across a large sample of U.S. public companies (sales of \$100 million or more), but that the variance in growth narrows substantially. (See Exhibit 2.) On one level, this observation is common sense—large companies represent a substantial percentage of GDP, so it's unlikely that they will outstrip it to any meaningful degree. (The Fortune 50 represent over 25 percent of GDP.) Yet companies that launch into the Fortune 50 are often those that have realized strong *past* growth, setting up a potential investor expectations mismatch.

This empirical finding is consistent with stochastic models similar to Gibrat's Law. This law, also known as the law of proportionate effect, says that a firm's growth rate is independent of its size. With some modifications, applying Gibrat's Law to a sample of companies generates a Zipf distribution. Classical microeconomics has no satisfactory models to explain these findings.<sup>8</sup>

## Exhibit 2: Shrinking Variance of Sales Growth in Relation to Market Cap

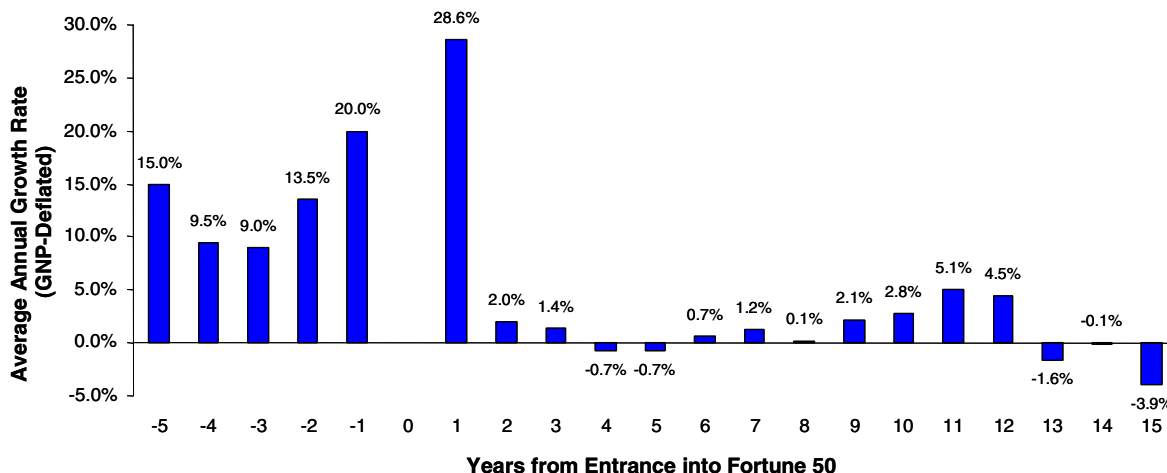


Source: Factset, CSFB analysis.

3. *The growth for large companies often stalls.* This was the conclusion of a detailed study by the Corporate Strategy Board.<sup>9</sup> The research argued that once companies reach a sufficient sales level, they see their growth rate stall. That stall level has risen over the decades, but looked to be in the \$20-30 billion area in the late 1990s.

Exhibit 3 shows the average annual growth rate for companies entering into the Fortune 50 (a ranking based on sales). The data show that companies often enjoy strong growth rates prior to making the top 50 but tend to have rather anemic growth once they attain that group. The high growth rate in the first year suggests that acquisitions catapult many companies into the Fortune 50.

## Exhibit 3: Average Annual Growth Rate for Companies Entering Fortune 50



Source: Corporate Strategy Board, *Stall Points: Barriers to Growth for the Large Corporate Enterprise*, 1998, page 15.

4. Most industries follow an identifiable life cycle.<sup>10</sup> Early on, an industry tends to see substantial growth and entry, then meaningful exit and high economic returns (for the survivors), followed by gradual growth deceleration. In mature stages, companies have muted growth and economic returns close to competitive equilibrium. Large companies tend to be mature companies.

Advising companies what to do in the face of slowing growth is an industry in and of itself. It is true that large companies have a difficult time innovating as successfully as smaller companies for a host of reasons. We enthusiastically recommend a new book by Clayton Christensen and Michael Raynor, *The Innovator's Solution*, which provides managers with a useful innovation framework. But the reality is that not all companies can grow rapidly forever.

## Extrapolative Expectations

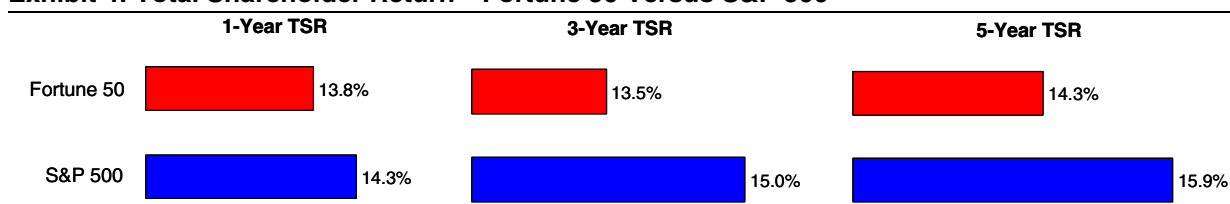
A review of the evidence on firm size and growth rates suggests investors should temper their growth expectations as companies get large. But the reality is that investors tend to extrapolate the recent past, and hence miss declining growth rates. According to Chan, Karceski, and Lakonishok:

*Market valuation ratios have little ability to sort out firms with high future growth from firms with low growth. Instead, in line with the extrapolative expectations hypothesis, investors tend to key on past growth. Firms that have achieved high growth in the past fetch high valuations, while firms with low past growth are penalized with poor valuations.*<sup>11</sup>

Data from the Corporate Strategy Board support this point. Its multidecade study shows that roughly two-thirds of the companies that hit the stall point lose 50 percent or more of their market value (relative to the Dow Jones Industrial Average) within a decade. Ninety-five percent underperform the DJIA by 25 percent or more.

We asked a similar, simple question: How would an equal-weighted portfolio of the Fortune 50, purchased at year-end, fare versus the S&P 500 in the subsequent 1-, 3-, and 5-year periods? We ran the numbers from 1980 through 2002 and found that for each holding period, the S&P 500 outperformed the Fortune 50 portfolio. (See Exhibit 4.) Again, it's hard for the largest companies to meaningfully outperform the market because they are such a large percentage of the market.

**Exhibit 4: Total Shareholder Return—Fortune 50 Versus S&P 500**



Source: Factset, Ibbotson, CSFB analysis.

We also looked at a very simple valuation measure, market capitalization-to-sales, to see if the largest companies stood out. And indeed they do. The current average market cap-to-sales ratio for the top 50 companies is 0.9, the lowest of any decile in the top 500. The average ratio for the 500 largest sales companies is 1.2. Not only did the largest companies have the lowest market-cap-to-sales ratios, the standard deviation of those ratios was much lower than those of other deciles. Neither premium valuations nor premium growth are easy to come by for the largest companies.

None of this is to say that current valuations for the largest companies does not still embed healthy expectations. Based on CSFB HOLT aggregated data, the 50 largest U.S. companies by market capitalization reflect growth and return on investment expectations that are substantially *higher* than those for the S&P 500 in total.<sup>12</sup>

Another way to look at expectations is to break down the percentage of shareholder value that comes from assets in place versus the value attributable to future investments. Today, one-half of the value of the twenty largest U.S. companies is on the come.<sup>13</sup> (See Exhibit 5.)

**Exhibit 5: Large Companies: PV of Cash Flow from Existing Assets Versus Future Investments**

Company <u>Symbol</u>	<u>Company</u>	Market Cap <u>in \$ millions</u>	PV of CF from <u>Existing Assets</u>	NPV of CF from <u>Future Investment</u>
MSFT	Microsoft Corp	\$ 322,699	38%	62%
GE	General Electric Co	319,902	44%	56%
WMT	Wal-Mart Stores	254,025	50%	50%
XOM	Exxon Mobil Corp	246,058	84%	16%
PFE	Pfizer Inc	244,877	41%	59%
C	Citigroup Inc	242,038	46%	54%
INTC	Intel Corp	189,897	47%	53%
IBM	IBM Corp	161,391	62%	38%
AIG	American International Group	157,446	48%	52%
JNJ	Johnson & Johnson	149,365	25%	75%
CSCO	Cisco Systems Inc	147,098	47%	53%
VODPF	Vodafone Group PLC	134,352	38%	62%
GLAXF	GlaxoSmithKline PLC	122,894	54%	46%
PG	Procter & Gamble Co	120,211	36%	64%
BAC	Bank of America Corp	118,538	47%	53%
MRK	Merck & Co	117,151	50%	50%
BRK.A	Berkshire Hathaway-CL A	116,660	70%	30%
KO	Coca-Cola Co	106,241	37%	63%
VZ	Verizon Communications	97,159	94%	6%
MO	Altria Group	90,475	44%	56%
	Average	172,924	50%	50%

Source: Factset, Ibbotson, CSFB analysis.

Economies and markets are certainly vibrant. But underneath the constant change lurk robust patterns of growth and firm size distributions. Mindful investors should take these patterns into account as they assess the growth prospects of companies—especially large ones.



- <sup>1</sup> Clayton M. Christensen and Michael E. Raynor, *The Innovator's Solution: Creating and Sustaining Successful Growth* (Boston, MA: Harvard Business School Press, 2003), 1.
- <sup>2</sup> Louis K. C. Chan, Jason Karceski, and Josef Lakonishok, "The Level and Persistence of Growth Rates," *The Journal of Finance*, Vol. 58, 2, April 2003, 644-684.
- <sup>3</sup> Michael J. Mauboussin and Kristen Bartholdson, *The Consilient Observer: More Power to You, Volume 1, Issue 17*, September 24, 2002.
- <sup>4</sup> Paul Colinvaux, *Why Big Fierce Animals Are Rare* (Princeton, NJ: Princeton University Press, 1978), 10-31.
- <sup>5</sup> James H. Brown and Geoffrey B. West, eds., *Scaling in Biology* (Oxford: Oxford University Press, 2000).
- <sup>6</sup> Robert L. Axtell, "Zipf Distribution of US Firm Sizes," *Science*, September 7, 2001, 1818-1820.
- <sup>7</sup> Stanley, et al., "Scaling Behavior in Economics: I. Empirical Results for Company Growth," *Journal de Physique*, April 1997, 621-633.
- <sup>8</sup> Axtell.
- <sup>9</sup> Corporate Strategy Board, *Stall Points: Barriers to Growth for the Large Corporate Enterprise*, 1998.
- <sup>10</sup> Steven Klepper, "Entry, exit, growth, and innovation over the product life cycle," *American Economic Review*, Vol. 86, 3, 1996, 562-83. Also, Bartley J. Madden, *CFROI Valuation: A Total System Approach to Valuing the Firm* (Oxford: Butterworth-Heinemann, 1999), 18-21.
- <sup>11</sup> Chan, Karceski, and Lakonishok, 671.
- <sup>12</sup> For the upcoming year (T + 1), embedded asset growth is 8.8% for the 50 largest market capitalization companies versus 5.6% for the S&P 500, and CFROI is 8.8% against 7.6%. For 2008 (T + 5), the large companies reflect asset growth and CFROI of 8.9% and 10.9%, respectively. For the S&P 500, the corresponding numbers are 7.2% and 9.0%.
- <sup>13</sup> Financial services stands out as a sector that has increased significantly as a percentage of S&P 500 earnings (about 30% excluding finance arms) and as a percentage of GDP (roughly 21% versus 15% in 1980). Historically, sectors that have risen to such levels (energy and technology) have seen their importance wane. For more on this, see Paddy Jilek, Bradford Neuman, and Arbin Sherchan, "U.S. Investment Digest: Five Tidbits," *Credit Suisse First Boston Equity Research*, September 5, 2003.

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