The Free Lunch Effect

The Value of Decoupling Diversification and Risk

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Whether professional or not, many investors are familiar with the most well-advertised feature of diversification, namely that it may reduce the risk of a portfolio while maintaining the same level of expected return. This concept is so attractive and so intuitive that it is easy to see diversification and the reduction of risk as the same thing. They are not.

In this piece, we will discuss why thinking about diversification and risk independently may help investors build more efficient portfolios. In particular, we introduce a way to think about the diversification potential of portfolios, or the *Free Lunch Effect*. We will also explore certain common allocation methods, including traditional "balanced" portfolios, and the assumptions for the returns of different markets that are embedded within them.

We highlight several key lessons and observations from this exercise:

- Adding assets that reduce risk does not mean an investor is diversifying
- While they may be a comfortable fallback, traditional balanced portfolios often force investors into unintended bets
- Higher volatility diversifiers may be among the most powerful tools an investor has

Risk and Diversification

Let us start by considering a sample stock portfolio, in which an investor buys the S&P 500 Index, perhaps through an exchange-traded fund (ETF) or mutual fund. Using data from July 1984 to February 2016, we observe that this investment would have had a volatility of 15.1%. There are many ways to look at risk—some good, some bad, and none perfect. We think volatility does a good job of contributing to an investor's perspective of the potential for loss or gain—the uncertainty of value—and will use it throughout this piece.

One of the first actions many investors often take to diversify and/or reduce the risk of such a portfolio is to invest a portion of this stock portfolio in bonds. A traditional "balanced" approach is to invest 40% in bonds and 60% in stocks. For the purposes of this analysis, stocks will be represented by the S&P 500 and bonds will be represented by the commonly used Barclays Aggregate Bond Index. Over this period the portfolio would have had a volatility of 9.5%, significantly less risk than that of a portfolio that held only stocks—5.5% less, to be specific. It is tempting (and popular) to think of this reduction in risk as the benefit of diversification. It is also misleading.

To understand why, we have to explore the reason volatility—our measure of risk—declined when we added bonds. There are two reasons why blending stocks and bonds, or any other pair of assets or portfolios, may result in reduced risk. One of those is indeed the benefit of diversification, the impact that portfolios receive from incorporating investments that do not always move together. The second, and in this case more important, reason why a balanced portfolio is often less risky than a stock-only portfolio is that bonds themselves are less risky than stocks.

In *Figure 1*, we show how much each of these two effects drove the reduction in risk of a balanced portfolio. In practice, approximately one-fifth of the reduction in volatility from a 100% stock portfolio to a balanced portfolio actually came from diversification. The remaining four-fifths was driven by the fact that bonds are less risky on their own. In other words, even if stocks and bonds were perfectly correlated (i.e., moved up and down in perfect harmony), a balanced portfolio still would have achieved four-fifths of the risk reduction. The impact of diversification on portfolio risk—let's call this our Free Lunch Effect—is only 1.2%.

Why does this matter? It matters because the de-risking impact carries none of the portfolio benefits of diversification.

As an example, let's say that an investor earns 0.3% return for every 1% of additional risk he or she takes in any single asset investment. In other words, we're assuming that an investment with 10% annual volatility would earn a 3% annual return (i.e., 0.3 x 10% = 3%).* The return of the portfolio falls proportionately for every dollar that the portfolio becomes less risky as a result of allocating to a lower risk investment like bonds. In our example, that means that the de-risking impact of 4.4% would reduce excess returns by 1.3%. This is not a better portfolio than equities, it's just a less risky one.

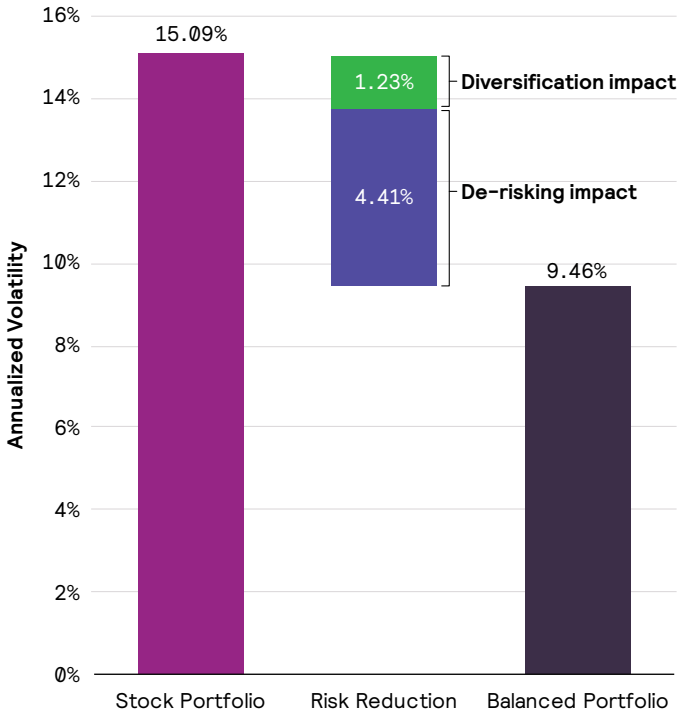
In contrast, the 1.2% diversification impact is different precisely because it does not impact portfolio returns. That means that the efficiency of the portfolio, or the return earned per unit of risk taken, rises. This Free Lunch Effect is at the core of why diversification can be beneficial. The reason for this phenomenon is that when assets move in different directions, it does not necessarily mean that the expected returns for either of those assets will be lower. Thus, any time an asset is added to the portfolio that possesses similar risk-adjusted returns that are not perfectly correlated with existing holdings, it will have this effect.

Over our sample period, it turns out that stocks and bonds had a correlation that was fairly close to zero (0.14), which means that there was very little relationship between the two. *Figure 2* shows how the Free Lunch Effect would have been different had

FIGURE 1

Sources of Risk Reduction in a Traditional Balanced Portfolio

July 1, 1984 – February 29, 2016



Sources: Pertrac, Salient Capital Advisors, LLC
For illustrative purposes only.

these two assets demonstrated different correlations, which helps to understand how large of an impact truly diversifying assets can have not only on risk but on the component of risk reduction that is a result of that diversification.

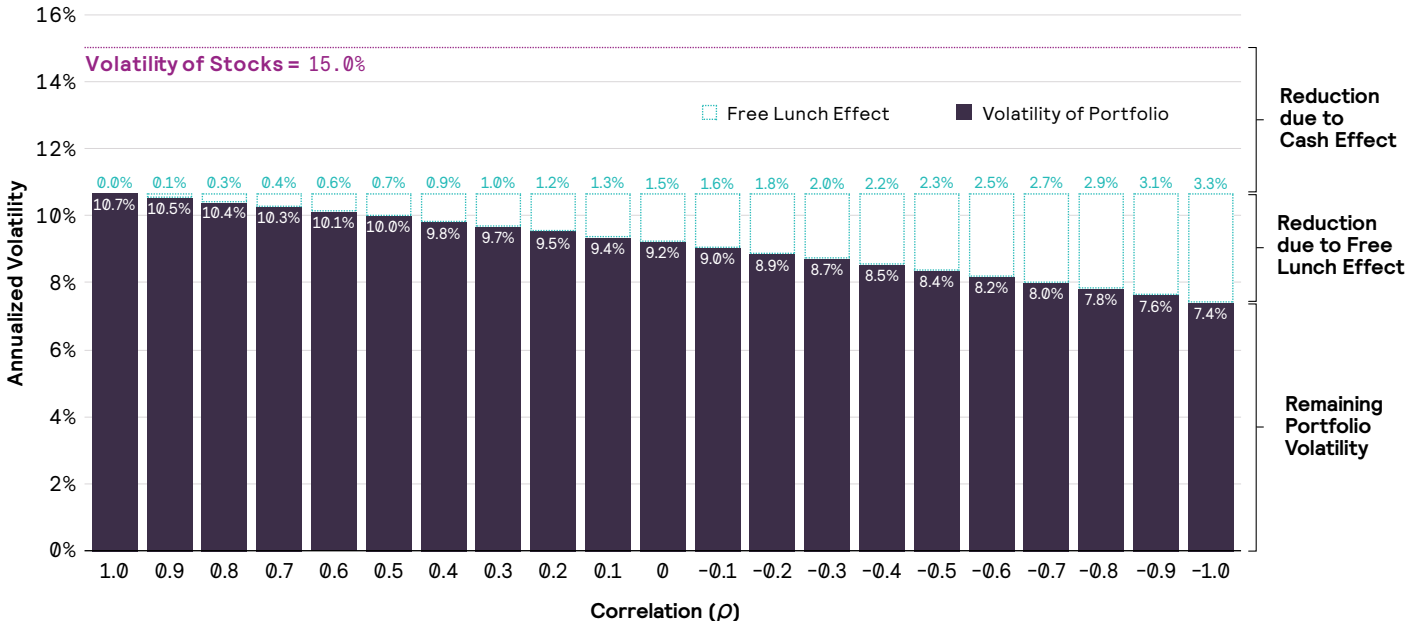
In this case, the exhibit shows how lower correlations—moving left to right—contribute to an increasing reduction in risk, ultimately reaching 3.3% for a case where bonds were perfectly negatively correlated with equities. To be clear, the portfolio remains 60% invested in stocks and 40% in bonds. The only thing that is changing is our assumption about the relationship (correlation) between stocks and bonds changes.

* We typically think about returns like these as excess returns above cash, but given that returns on cash at present are functionally zero, we think it is helpful to abstract from this mechanic.

FIGURE 2

Sources of Risk Reduction by Assumed Correlation

Volatility of a 60/40 Equity/Bond Portfolio, July 1, 1984 – February 29, 2016



Source: Bloomberg

Past performance does not guarantee future results.

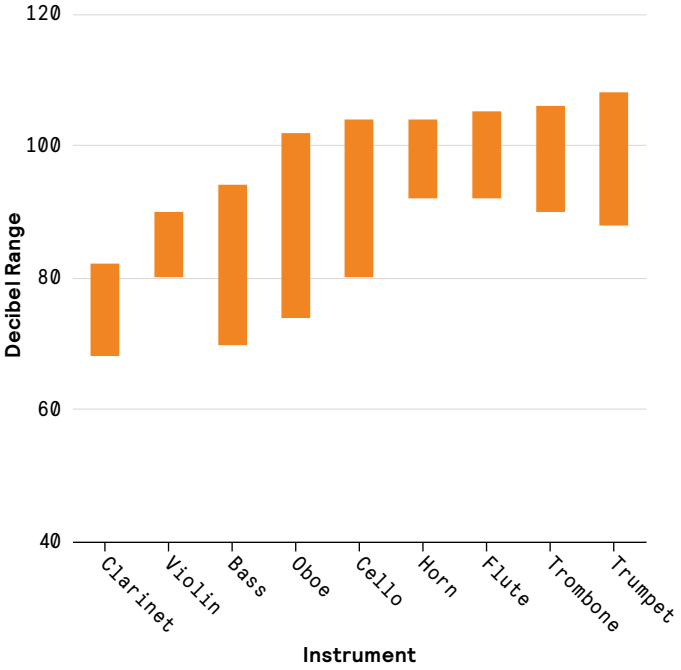
The Role of Volatility in Correlation

The reason that adding bonds alone doesn't do much—even if we assume they are perfectly negatively correlated to stocks—is that a loosely correlated or negatively correlated asset with very little volatility doesn't have the ability to add significant diversification to an overwhelmingly volatile return stream like that of equities. The benefit of shifting to these types of assets is almost indistinguishable from simply shifting to cash instruments instead. This may sound complicated, but it's one we expect intuitively in many other applications.

Consider, for example, a small ensemble of three musicians. You are tasked with directing your little group to play a beautiful chord of three notes, beginning with our trumpet player, who blares out an offensively loud high C. You now have a choice of how to build the chord. You could certainly have your second and third players pick up a clarinet or violin, but even the non-musical among us can see the issue here. No matter how hard our clarinetist blows and no matter how feverishly our violinist bows, we are simply never going to build a beautiful, balanced chord with this obnoxious trumpet playing at maximum volume in our ear. Trumpets are simply a lot louder than clarinets and violins.

FIGURE 3

Typical Decibel Levels of Selected Orchestral Instruments

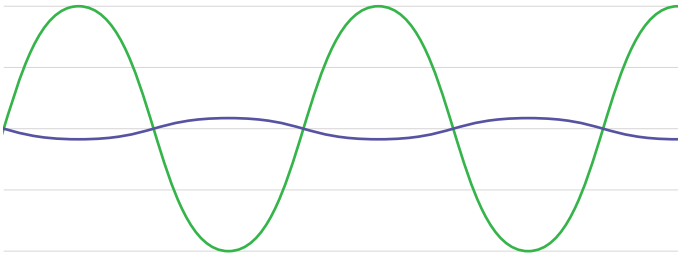


Source: http://www.soundadvice.info/thewholestory/san12.htm, July 2014

For illustrative purposes only.

FIGURE 4

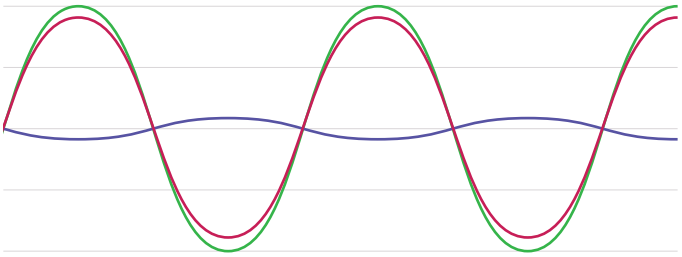
Sine Waves of Amplitude 10:1, ρ = -1.0



Source: Salient Capital Advisors, LLC, April 2016
For illustrative purposes only.

FIGURE 5

Differences Between *Figure 4* Sine Waves



Source: Salient Capital Advisors, LLC, April 2016
For illustrative purposes only.

One alternative, of course, would be to ask our other two members to pick up trumpets as well, or perhaps other loud instruments like trombones and horns. The other alternative would be to look for another violinist or two. Indeed, this is exactly what most professional symphony orchestras do—the number of violinists is typically 6-7 times that of trumpets and trombones and 5-6 times that of horns. Achieving harmony is dependent not only on each instrument playing its role, but on preventing any one instrument from drowning out the rest.*

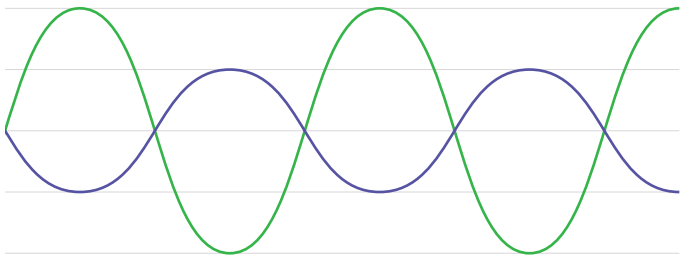
There are more technical examples of this as well for those of us who are not classical music aficionados. You might consider a pair of sine waves, which the shape of sound waves traveling at a single frequency, like a tuning fork or that high-pitched beep that tells you something has gone terribly, terribly wrong with your computer. Waves of water in the ocean take this shape as well.

Now imagine that two waves are moving in perfect opposition to one another (a correlation of -1.0). In our example, one of the waves has significantly greater amplitude, the distance between peaks and troughs, than the other and is moving perfectly in the opposite direction *(Figure 4)*. When we combine the powerful wave with the gentle but opposite wave, the result is the red line in *Figure 5.* You may notice that the resulting line looks nearly identical to the large, sweeping profile of the higher amplitude wave. A return profile with comparably low volatility has little opportunity to diversify.

In comparison, consider the figures below, in which the second wave is much nearer to the level of amplitude (read: volatility) of the first, larger wave, still with a correlation of -1.0. When the two are combined, the resulting wave has significantly reduced amplitude, as shown as the red line in *Figure 7.*

FIGURE 6

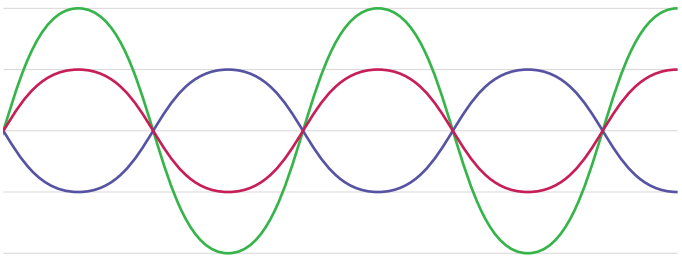
Sine Waves of Amplitude 2:1, ρ = -1.0



Source: Salient Capital Advisors, LLC, April 2016
For illustrative purposes only.

FIGURE 7

Differences Between *Figure 6* Sine Waves



Source: Salient Capital Advisors, LLC, April 2016
For illustrative purposes only.

* For a lovely example of how layering, expanding and removing instruments of differing volume and timbre is used to great effect, look for a good recording of the third Scherzo of Gustav Mahler's Symphony No. 5.

This phenomenon has very real implications for investors. First, we do believe that achieving an appropriate level of risk (the "volume" or "amplitude" of a portfolio) is one of the most important—perhaps *the* most important—task before an asset allocator. But in building portfolios, focusing on the reduction in portfolio risk, rather than the increase in diversification, will lead toward less effectively diversified and ultimately lower-return portfolios.

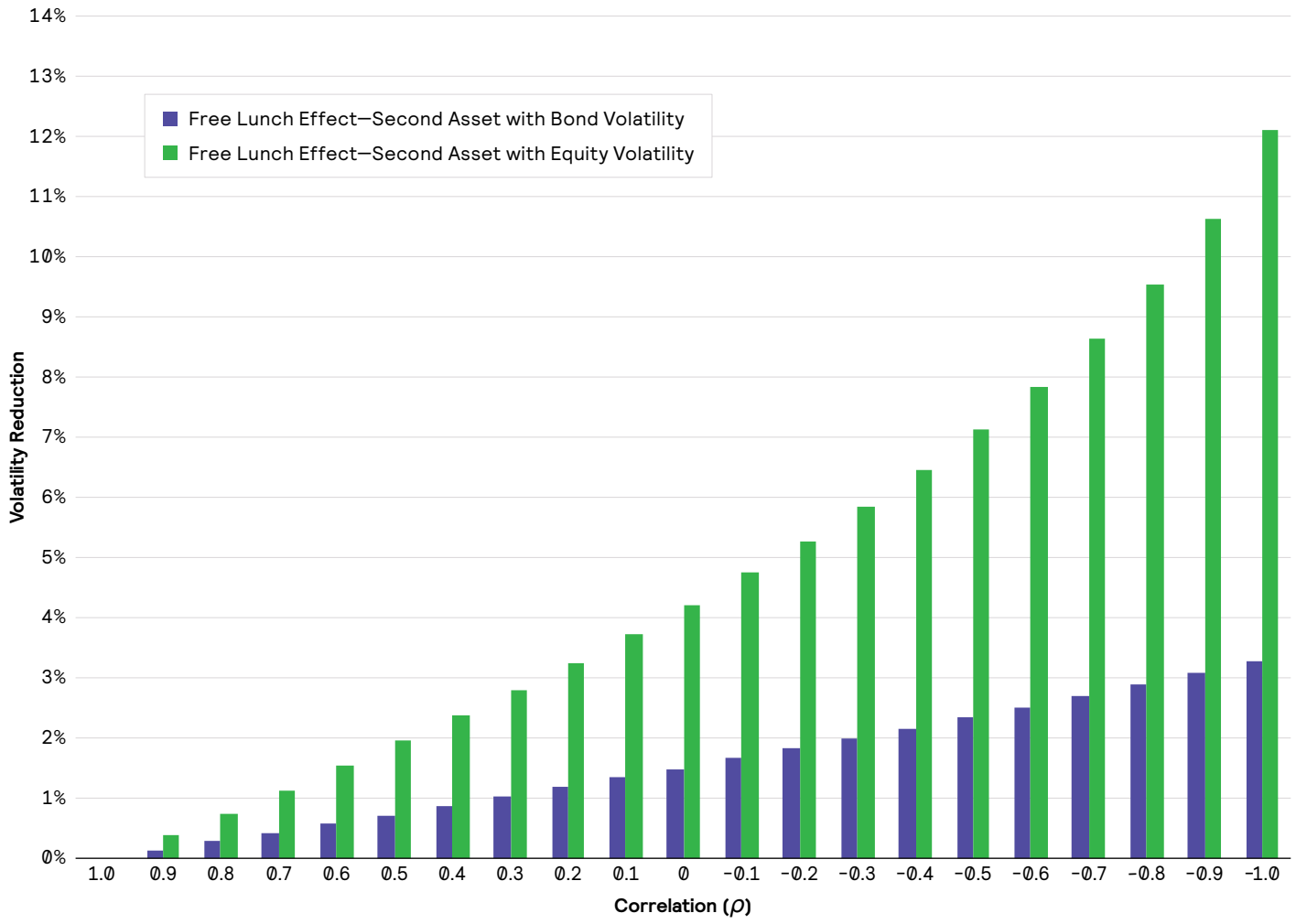
As we observed previously, the Free Lunch Effect associated with a 60/40 stock/bond portfolio was low, even when stocks and bonds were perfectly negatively correlated. Let's now instead consider the risk reduction potential of a theoretical asset with the same volatility as stocks, but at varying levels of assumed correlation. *Figure 8* shows the Free Lunch Effect of diversifying a portfolio with a 60% equity allocation with a 40% allocation to one of two different assets: one with the volatility of bonds and another with the same volatility as equities.

Among the most significant of several important lessons from this analysis is that a higher volatility investment with a positive correlation of approximately 0.10 to equities contributed more diversification to a portfolio than allocating to a low volatility asset with a perfect -1.0 correlation. Bear in mind that we can certainly use leverage to turn low volatility assets into high volatility assets ("adding some violins"), but in either case, adding good diversifiers that match the risk of equities is more powerful than adding lower-risk diversifiers.

FIGURE 8

Free Lunch Effect—High Volatility vs. Low Volatility Diversifier

Volatility of a 60/40 Portfolio (Equities/Secondary Asset), July 1, 1984 – February 29, 2016



Source: Salient Capital Advisors, LLC

For illustrative purposes only.

Diversification and Return Efficiency

While we have reviewed how investors may maximize the Free Lunch Effect, we have only briefly touched upon why we believe this should be important to investors. As we alluded to before, the Free Lunch Effect is the mechanism through which diversification may increase a portfolio's reward versus risk. That means it's time for a refresher on Markowitz and Modern Portfolio Theory ("MPT").[1]

Example 1: Perfectly Correlated Assets with Different Volatilities

Let us first consider an example in which we are investing in two assets. The first is a high risk asset—let's call it "Asset A"—with annual volatility of 20% and an expected return of 10%. The second is a low risk asset—let's call this one "Asset B"—with annual volatility of 4% and an expected return of 2%. While they have different levels of risk, these two assets are otherwise perfectly correlated. They move consistently up and down together. What happens when we invest in a 50/50 mix of these two portfolios?

The answer: the resulting portfolio exhibits a volatility of 12% and an expected return of 6%. Remember that the expected return for a portfolio is always a weighted average of the expected returns of the underlying assets. Because the assets are perfectly correlated, in this case the portfolio's volatility may be calculated in the same way. Why? Because when correlation between two assets equals 1, the volatility of the portfolio becomes just a weighted average of the volatility of the two assets.

FIGURE 9

Two-Asset Modern Portfolio Theory Framework with Correlation A|B = 1

The variance (σ^2) of a portfolio with two assets

$$\sigma^2_{Portfolio} = w^2_{Asset\ A}\sigma^2_{Asset\ A} + w^2_{Asset\ B}\sigma^2_{Asset\ B} + 2w_{Asset\ A}w_{Asset\ B}\sigma_{Asset\ A}\sigma_{Asset\ B}\rho_{Asset\ A|B}$$

$$\downarrow$$

$$\sigma_{Portfolio} = w_{Asset\ A}\sigma_{Asset\ A} + w_{Asset\ B}\sigma_{Asset\ B}$$

Note: When correlation (ρ) between asset classes A and B equals 1, the lower equation for standard deviation (σ) is consistent with the top solving for variance(σ^2) by squaring both sides

It is important to note that adding this asset reduces risk, but it also reduces return. Each of Asset A, Asset B and Portfolio A|B has the same risk/reward. By adding Asset B, you haven't diversified anything, you have only reduced both your risk and return.

FIGURE 10

Risk/Reward of Assets and Portfolio in Example 1 ($\rho_{ab} = 1$)

	Asset A	Asset B	Portfolio A|B
Return	10.0%	2.0%	6.0%
Risk	20.0%	4.0%	12.0%
Return / Risk	0.50	0.50	0.50

Example 2: Uncorrelated Assets with Different Volatilities

The preceeding example is clearly exaggerated, but we believe it's not far from reality for investors attempting to diversify. Certain hedge fund or high yield strategies, for example, are highly correlated with equities but at lower levels of risk. An expectation of a higher return/risk for those investments my exist, of course, an assumption which we will place in context of the Free Lunch Effect later in this paper.

More frequently, investors may attempt to combine two assets which have different volatilities and more moderate correlations. Let us then consider an example in which our assets have volatilities and expected returns identical to what we described in Example 1: Asset A has a volatility of 20% and expected return of 10%, while Asset B has a volatility of 4% and expected return of 2%. Instead of a correlation of 1 between the two assets, however, let's assume a correlation of zero.

As before, the portfolio's expected returns are 6%, a weighted average of the expected returns of Asset A and Asset B. In a purely mathematical sense, correlation has no impact on our expected returns. Unlike *Example 1*, however, our estimate of risk must now take into account the fact that our two assets move completely independently of one another.

In this case, risk falls not to 12% but to 10.2%—the 1.8% is the Free Lunch Effect. It means that we get the same expected return, but with less risk. It may be easier to think of this in terms of returns: an investor is effectively receiving 0.9% in additional returns above an undiversified portfolio with the same risk.

FIGURE 11

Risk/Reward of Assets and Portfolio in Example 2 ($\rho_{ab} = 0$)

	Asset A	Asset B	Portfolio A|B
Return	10.0%	2.0%	6.0%
Risk	20.0%	4.0%	10.2%
Return / Risk	0.50	0.50	0.59

Example 3: Uncorrelated Assets with Same Volatilities

Now let us consider a case in which our two assets remain uncorrelated (ρ_{ab}=0), but where each asset has the same 20% volatility and 10% expected return. As before, the expected return of the portfolio is a weighted average of the two components—since both are 10%, we know that we expect a 10% portfolio return. In this case, the Free Lunch Effect is not 1.8% as in *Example 2*, but a much more significant 5.9%. As a result, this portfolio produces 0.71 units of return for every unit of risk instead of 0.50 for an undiversified portfolio and 0.59 for a portfolio that was diversified with a low volatility asset.

This investor earns 2.93% more than an undiversified investor at the same level of risk.

FIGURE 12

Risk/Reward of Assets and Portfolio in Example 3 ($\rho_{ab} = 0$ at equal volatilities)

	Asset A	Asset B	Portfolio A|B
Return	10.0%	10.0%	10.0%
Risk	20.0%	20.0%	14.1%
Return / Risk	0.50	0.50	0.71

Implicit Expectations of Non-Diversified Investors

In addition to providing a clearer view into a portfolio's potential return efficiency, the Free Lunch Effect also provides a point of comparison considering different views on the risk/reward potential of different asset classes. To this point, we have only considered analysis of risks, or alternatively assumed that each investment had the same Sharpe ratio.

As demonstrated previously, the potential benefit of the Free Lunch Effect is identified by multiplying the effect's magnitude by the weighted average Sharpe ratio of the portfolio's constituents. In other words, by diversifying, you still get the potential "risk/reward" benefit of the units of risk you aren't taking. If considered in light of the equal Sharpe ratio assumption, this identity would consistently lead an investor to identify and invest in the most well diversified portfolio possible. This is the assumption we have made thus far in this piece, and while simplistic, it turns out that the assumption has been approximately true over long historical periods. As pointed out in a prior piece,[2] the long-term Sharpe ratio of U.S. Treasury bonds (0.24), commodities (0.28) and U.S. equities (0.28) are very similar.

Especially over shorter periods, this assumption may be unrealistic for a couple of reasons. First, it is impossible to know with certainty how much of this diversification benefit an investor may receive in the future. Correlations and volatility can be challenging to forecast. Second, investors may believe over a particular time horizon that the potential risk/reward payoff will be different among assets in a way that can be predicted.

This second belief is very common. It is our contention, however, that many investors are implicitly expressing much more of a view on relative risk/reward efficiency of asset classes than they may believe. For instance, consider an example of two assets with the same volatility: the S&P 500 and exposure to the Barclays Aggregate Bond Index that has been levered to get it to the same level of risk (it takes about 5 units of bonds to get to the same level of volatility as stocks).

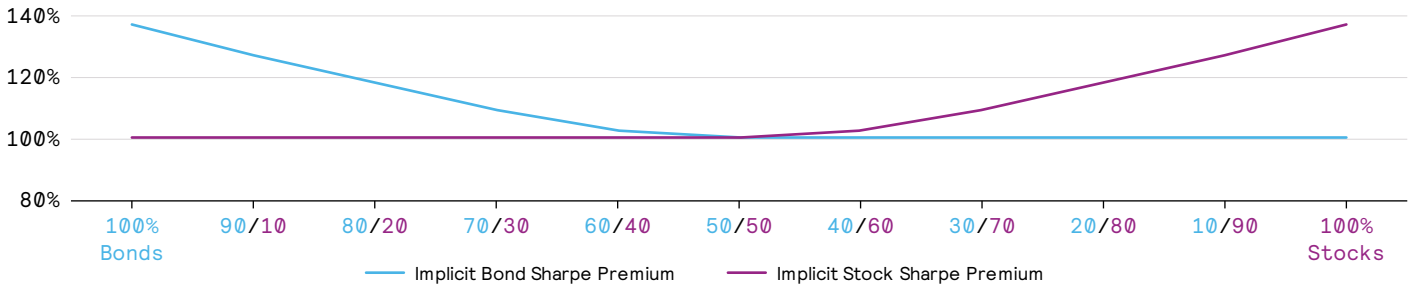
Assuming an equal Sharpe ratio between these two assets, a 50/50 portfolio is provably optimal in risk-adjusted terms. But what if we don't believe that investors will be compensated with the same return for every unit of risk they take in stocks and bonds? If we are confident we are correct, then increasing one allocation may be appropriate. As shown in *Figure 13*, however, an investor who increases his allocation to one asset or another is implicitly assuming that one asset will have a significantly higher relative Sharpe ratio. To allocate 100% of his or her capital to stocks, for example, an investor would need to believe that stocks had a Sharpe ratio at least 1.4 times that of bonds to overcome the loss of diversification. Note that bonds in our example are not just bonds, but a portfolio of 5 units of the Barclays Aggregate Bond Index. That means that a traditional 60/40 portfolio would fall somewhere between the 80% and 90% stock portfolio in *Figure 13*.

Said another way, given the historical relationship between stocks and bonds, an investor in a traditional 60/40 portfolio is not expressing a neutral point of view. The investor is implicitly expressing a view that stocks will earn at least 30% more return per unit of risk taken than bonds. We are skeptical of this outcome from a rigorous strategic asset allocation exercise, but we are even more concerned that many investors may not be aware that they are taking this view.

FIGURE 13

Free Lunch Effect—High Volatility vs. Low Volatility Diversifier

July 1, 1984 – February 29, 2016



Source: Salient Capital Advisors, LLC

For illustrative purposes only.

Implications for Various Diversification Strategies

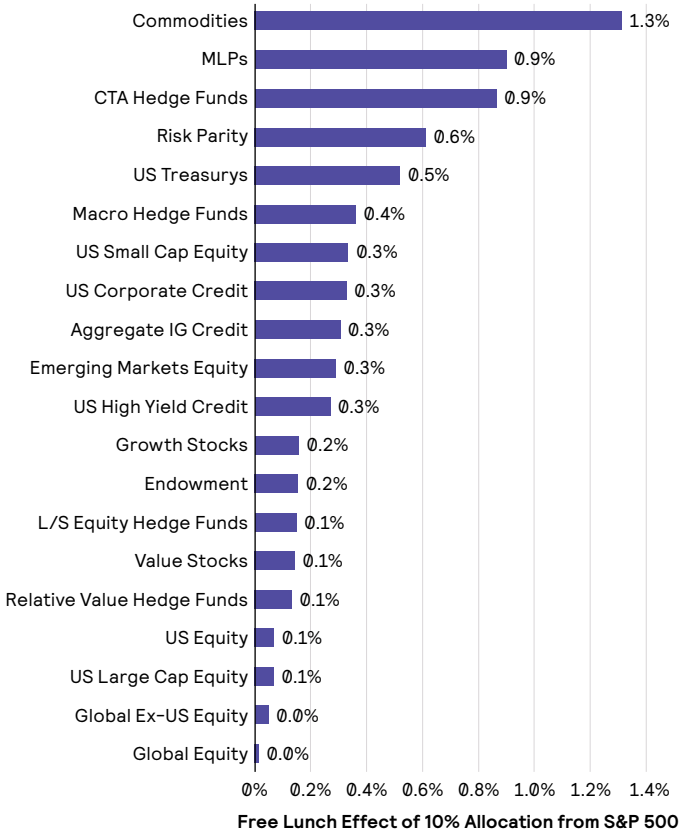
Since the most traditional approaches to portfolio diversification appear to leave a great deal of diversification potential on the table, we believe it is reasonable to consider the alternatives. As demonstrated in the prior section, leveraging exposure to the most diversifying assets—sovereign bonds, for example—is a straightforward way to achieve better diversification of equity portfolios without scaling down risk in a way that would reduce returns; however, many investors have varying levels of comfort with this concept. As a result, it is also useful to consider assets that have meaningful volatility at more moderate levels of correlation with stocks.

Figure 14 shows the historical Free Lunch Effect of adding a 10% allocation to various assets to a portfolio consisting only of the 100% S&P 500. Assets that diversify poorly or moderately from stocks reflect a combination of both good diversifiers with low volatility (aggregate bonds) and poor diversifiers with high volatility (U.S. small cap equities). The Free Lunch Effect relative to an S&P 500 position, however, is different from the impact on an already "diversified" portfolio, for example a traditional "balanced" 60/40 portfolio. *Figure 15* below shows the effect of a 10% allocation to the same markets, but in comparison to the 60/40 portfolio. The figures differ slightly from *Figure 13*, but in general the order and magnitude are both quite similar. This implies that adding 40% exposure to bonds doesn't materially change the performance profile of an equity portfolio, but does reduce the risk. Therefore, the tools that are necessary to diversify most portfolios more efficiently are broadly similar to those that diversify equity portfolios. Why? Because the difference between balanced and stock-only portfolios is largely one of risk, not of the nature of their diversification.

FIGURE 14

Free Lunch Effect Realized by Substituting Selected Assets for 10% of a S&P 500 Portfolio

July 1, 1999 – February 29, 2016



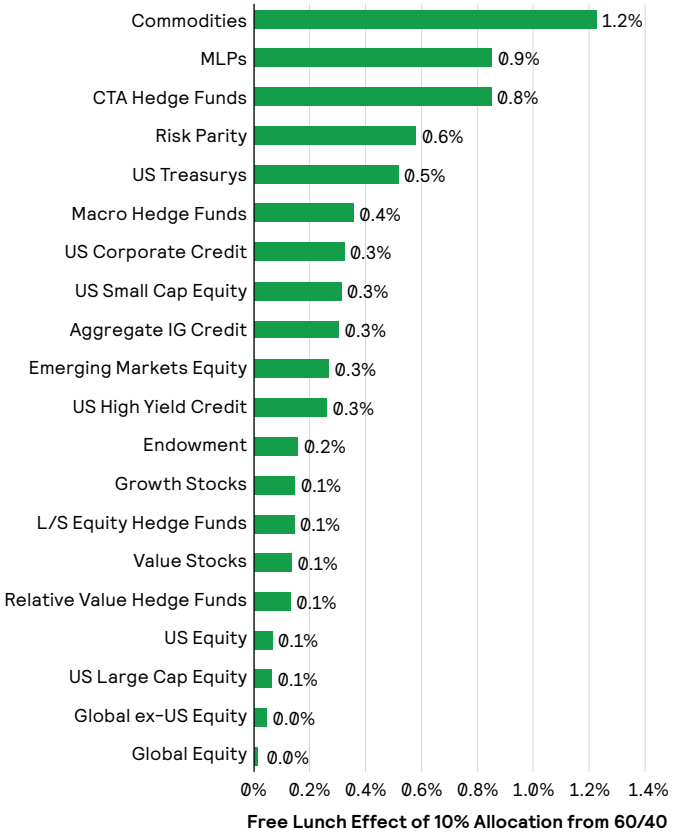
Sources: Bloomberg, Salient Capital Advisors, LLC

For illustrative purposes only. Please refer to appendix for a description of asset classes in this analysis.

FIGURE 15

Free Lunch Effect Realized by Substituting Selected Assets for 10% of a 60/40 Portfolio

July 1, 1999 – February 29, 2016



Sources: Bloomberg, Salient Capital Advisors, LLC

For illustrative purposes only. Please refer to appendix for a description of asset classes in this analysis.

Caveats and Conclusion

It is important to recognize that there are very real challenges in predicting correlations and risk on a forward-looking basis. Indeed, heavy reliance on covariance estimates that combine measures of correlation and risk in the construction of portfolios can lead to unexpected and undesirable results in periods of time where correlations and risk change quickly. In most cases, these unexpected events are still smaller in magnitude than the entirely expected events of the experience of an equity-dominated portfolio, but they do exist.

Yet we remain convinced that while predicting risk is difficult, predicting returns, especially over short periods of time, is far more difficult. We believe that shrewd asset allocators should at a minimum ask themselves whether they are sufficiently confident in their preference for one asset over another as to forgo the benefits of the Free Lunch Effect.

We believe that allocators would be well served by challenging the role of low volatility diversifiers in otherwise high volatility portfolios. While low volatility hedge fund strategies and various corporate bond strategies may appear to diversify, we believe that for many portfolios they function primarily as "de-risking" investments, not diversifying investments.

Our research shows that higher volatility diversifiers can be powerful—among them, we believe managed futures, commodities, MLPs, risk parity strategies and, yes, Treasury bonds are among the most effective. We continue to believe that many investors may benefit from increasing their allocations to these strategies. Whether they do so or not, we believe many investors will gain from thinking about diversification as a distinct and desirable portfolio trait, separate from their view on risk.

Appendix: Data and Methodologies

A **60/40 portfolio** in this analysis refers to a 60% allocation to the S&P 500 Index and 40% allocation to the Barclays Aggregate Bond Index.

Bonds in this analysis refers to the Barclays Aggregate Bond Index.

Stocks in this analysis refers to the S&P 500 Total Return Index.

The **risk-free rate** refers to the return on 3-month T-bills, as accessed via Bloomberg.

The asset classes in *Figures 14* and *15* refer to the following indices:

Asset Class	Index
Aggregate IG Credit	Barclays Aggregate Bond Index
Commodities	S&P GSCI Total Return Index
CTA Hedge Funds	Barclay BTOP50 Index
Emerging Markets Equity	MSCI Daily TR Net Emerging Markets
Endowments	2015 NACUBO–Commonfund Study
Global Equity	MSCI Daily TR Net World USD
Global Ex-U.S. Equity	MSCI Daily TR Net World Ex USA
Growth Stocks	Russell 1000 Growth Index
L/S Equity Hedge Funds	HFRI Equity Hedge (Total) Index
Macro Hedge Funds	HFRI Macro (Total) Index
MLPs	Alerian MLP Index

Asset Class	Index
REITs	FTSE REIT Total Return Index
Relative Value Hedge	HFRI Relative Value (Total) Index
Risk Parity	Salient Risk Parity V15+ Index
U.S. Corporate Credit	Barclays U.S. Aggregate Corporate Bond
U.S. Equity	MSCI Daily TR Net USA USD
U.S. High Yield Credit	Barclays U.S. Corporate High Yield Index
U.S. Large Cap Equity	Russell 1000 Index
U.S. Small Cap Equity	Russell 2000 Index
U.S. Treasurys	Barclays U.S. Aggregate Total Treasury
Value Stocks	Russell 1000 Value Index

Bibliography

1. Markowitz, H. (1952). Portfolio Selection. Journal of Finance, 77-91.

2. Partridge, L., & Croce, R. (2012). Risk Parity for the Long Run. Houston: Salient Partners, L.P.

Glossary

Definition of Terms

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

Macro hedge funds maintain positions in a broad range of strategies in which the investment process is predicated on movements in underlying economic variables and the impact these have on equity, fixed-income, hard currency and commodity markets.

Managed futures are a type of alternative investment. Managed futures accounts can take both long and short positions in futures contracts and options on futures contracts in the global commodity, interest rate, equity and currency markets.

Sharpe ratio measures the risk-adjusted performance of an investment.

Volatility is a statistical measure of the dispersion of returns for a given security or market index.

Weighted average is an average in which each quantity to be averaged is assigned a weight. These weightings determine the relative importance of each quantity on the average.

Index Definitions

Alerian MLP Index is a composite of the 50 most prominent energy MLPs that provides investors with a comprehensive benchmark for this emerging asset class.

Barclay BTOP50 Index seeks to replicate the overall composition of the managed futures industry with regard to trading style and overall market exposure. In each calendar year the selected trading advisors represent, in aggregate, no less than 50% of the investable assets of the Barclay CTA Universe.

Barclays Aggregate Bond Index represents a broad-based measure of the global investment-grade fixed income markets, with index components for government and corporate securities, mortgage pass-through securities and asset-backed securities.

Barclays U.S. Aggregate Corporate Bond Index includes corporate credit of U.S. companies. The maturities of the bonds in the index are between 7-10 years.

Barclays U.S. Aggregate Total Treasury includes U.S. treasuries. The maturities of the bonds in the index are between 7-10 years.

Barclays U.S. Corporate High-Yield Bond Index covers the USD-denominated, noninvestment-grade, fixed-rate, taxable corporate bond market. Securities are classified as high yield if the middle rating of Moody's, Fitch and S&P is Ba1/BB+/BB+ or below.

FTSE REIT Total Return Index measures the stock performance of companies engaged in the ownership and development of the North American real estate market.

HFRI Equity Hedge (Total) Index is comprised of private funds with strategies that maintain both long and short positions primarily in equity securities and equity derivatives.

HFRI Relative Value (Total) Index maintains positions in strategies in which the investment thesis is predicated on realization of a valuation discrepancy in the relationship between multiple securities.

MSCI Daily TR Net Emerging Markets is based on a cap weighted parent index (the MSCI Emerging Markets Index) which includes large and mid-cap stocks across 21 Emerging Markets countries1. The MSCI Emerging Markets Value Weighted Index is based on the MSCI Emerging Markets Index, with emphasis on emerging market mid and large cap stocks with lower valuations.

MSCI Daily TR Net World Ex USA is the same as listed above, but excluding the United States.

MSCI Daily TR Net World USD measures the price performance of markets with the income from constituent dividend payments. The MSCI Daily Total Return (DTR) Methodology reinvests an index constituent's dividends at the close of trading on the day the security is quoted ex-dividend (the ex-date). The MSCI World Index is a free float-adjusted market capitalization index designed to measure equity market performance in the global developed markets.

MSCI Daily TR Net USA USD measures the price performance of markets with the income from constituent dividend payments. The MSCI Daily Total Return (DTR) Methodology reinvests an index constituent's dividends at the close of trading on the day the security is quoted ex-dividend (the ex-date).

The 2015 **NACUBO-Commonfund Study of Endowments** is based on 812 U.S. college and university endowments and affiliated foundations, representing $529 billion in endowment assets are estimated by NACUBO (National Association of College and University Business Officers).

Russell 1000 Growth Index is a large cap growth index measuring the performance of the largest 1,000 U.S. companies with higher price-book ratios and higher forecasted growth values.

Russell 1000 Index measures the performance of the 1,000 smallest companies in the Russell 3000 Index. The Russell 3000 Index represents approximately 98% of the investable U.S. equity market.

Russell 1000 Value Index is a large cap value index measuring the performance of the largest 1,000 U.S. companies with lower price-book ratios and lower forecasted growth values.

Russell 2000 Index measures the performance of the 2,000 smallest companies in the Russell 3000 Index. The Russell 3000 Index represents approximately 98% of the investable U.S. equity market.

S&P 500 Total Return Index is an unmanaged index of 500 common stocks chosen to reflect the industries in the U.S. economy.

S&P GSCI Commodity Index is a composite index of commodity sector returns representing an unleveraged, long-only investment in commodity futures that is broadly diversified across the spectrum of commodities and serves as a measure of commodity performance over time.

Salient Risk Parity V15+ Index represents a quantitatively driven global asset allocation framework. The index is calculated daily, rebalanced monthly, and targets a 15% volatility level. The index is comprised of an equally risk-weighted portfolio of equities, credit, commodities, rates and momentum. The index targets a 15% standard deviation for the index as a whole.

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Please note that the returns presented in this paper are the result of a hypothetical investment framework. Backtested performance is NOT an indicator of future actual results and do the results above do NOT represent returns that any investor actually attained. Backtested results are calculated by the retroactive application of a model constructed on the basis of historical data and based on assumptions integral to the model which may or may not be testable and are subject to losses. Certain assumptions have been made for modeling purposes and are unlikely to be realized. No representations and warranties are made as to the reasonableness of the assumptions. Changes in these assumptions may have a material impact on the backtested returns presented. This information is provided for illustrative purposes only. Backtested performance is developed with the benefit of hindsight and has inherent limitations. Specifically, backtested results do not reflect actual trading or the effect of material economic and market factors on the decision-making process. Since trades have not actually been executed, results may have under- or over-compensated for the impact, if any, of certain market factors, such as lack of liquidity, and may not reflect the impact that certain economic or market factors may have had on the decision-making process. Further, backtesting allows the security selection methodology to be adjusted until past returns are maximized. Actual performance may differ significantly from backtested performance. Backtested results are adjusted to reflect the reinvestment of dividends and other income. The backtested results do not include the effect of backtested transaction costs, management fees, performance fees or expenses, if applicable. No cash balance or cash flow is included in the calculation.

There are special risks associated with an investment in commodities and futures, including market price fluctuations, regulatory changes, interest rate changes, credit risk, economic changes and the impact of adverse political or financial factors. Transactions in futures are speculative and carry a high degree of risk.

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All references to historic returns are based on the hypothetical performance of the strategy as backtested for research purposes. "Expected returns" refer to the general expectations of risk premia arising from various asset classes in the context if a risk-return relationship and are in no way intended to be forward looking projections.

Diversification does not ensure a profit or guarantee against loss.

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