Dynamic Regime Strategy for Stress Testing and Optimizing Institutional Investor Portfolios

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1. Introduction

In the post 2008 financial crisis, the investment and asset management industry has seen a number of disruptive financial innovations that have the potential to significantly affect the business of traditional active management (Kahn & Lemmon, 2016). Previously, investors had no choice but to choose an active manager who selected those stocks with a certain investment characteristic like value and momentum, in order to outperform the market. Nowadays, institutional investors are able to choose an ETF that will systematically select stocks with characteristics like low volatility and growth at lower cost. Wurtz (2018) observes that the development of the exchange-traded fund (ETF) wrapper and the ability of asset managers and index providers to handle higher quantities of data, has resulted in more choices for institutional investors. With, more choices institutional investors can now choose quantitative investment strategies that span the spectrum of market risk to active risk. Moreover, the quantitative investment strategies have evolved into four general approaches to diversifying and helping to mitigate equity risk: 1) long Treasuries, 2) trend-following, 3) tail risk hedging and 4) alternative risk premia diversifiers, such as carry and value strategies (Baz, Davis, Sapra, Tsai, & Gillmann, 2019). This project falls under the alternative risk premia (ARP) diversifiers.

A recent white paper on Alternative risk premia (ARP) strategies, Carroll & Ramaswamy (2018) notes that ARP strategy is full of industry jargon from alternative beta, exotic beta, risk premia, alternative risk premia, factor investing, among others. In general, these strategies seek absolute returns that are not highly correlated to traditional assets such as stocks and bonds (Carroll & Ramaswamy, 2018). Moreover, ARP strategies continue to evolve with the development of new methods and techniques to sharpen existing signals and systematically extract premia from expensive "hedge" fund strategies. Given the increased complexity and diversity of these strategies, our project will build on Carroll & Ramaswamy, (2018) ARP framework and the Baz et al.'s (2019) Theoretical Framework for Equity-Defensive Strategies.

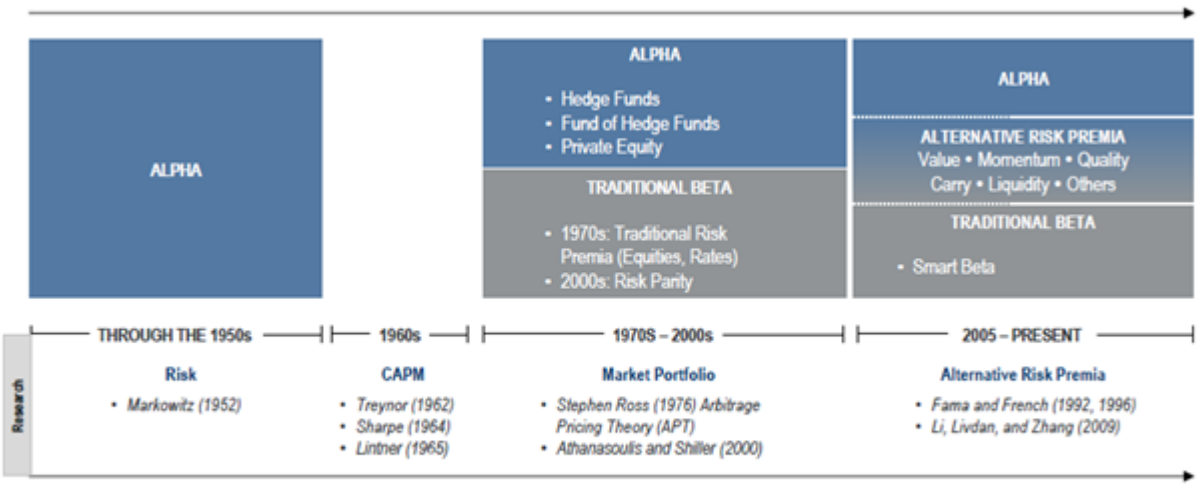

Figure 1: Evolution of Risk Premia Investing—New Ways to Access Old Sources of Return

2. Problem Statement

In the aftermath of the global financial crisis, institutional investors were concerned about the inherent volatility of equity markets (Wurtz, 2018). At the same time, the introduction of ultra-low monetary policy worsened those concerns, with their liabilities increasing as bond rates fell. In addition, these investors typically have liabilities with varying horizons tied to duration or cash flows. In order to best meet the needs of shareholders, many institutional investors look to hedge funds to provide another source of diversifying returns for their portfolios. The project aims to develop a portfolio allocation framework that show the benefits of value and momentum style integration and to presents the effectiveness of alternative integration methods for long-only absolute return funds. The framework is flexible enough to be applicable to any asset class for either long-short, long- or short-only styles. The project output is a stand-alone trading system, that can be classified as Alternative risk premia (ARP) strategies that uses a portfolio construction philosophy rooted in the principles of consistency, diversification, and downside protection. Specifically, we draw on three building blocks a timing portfolio, construction portfolio, and combine them in order to pursue a range of risk and return objectives. Each component or portfolio is built from the bottom up with a specific objective in mind. For instance, we will generate our portfolios with exposure to risk factors widely acknowledged in academia such as Value, Size, Quality, Momentum and Low Volatility (Mikaelsson & Nilsson, 2017).

3. Previous Studies

This section presents the previous studies and presents how our contribution is unique and how it fills a gap in the market. Our projects relate to a recent and yet growing literature on alternative risk premia (Carroll & Ramaswamy, 2018), equity-defensive strategies(Baz et al., 2019), style integration for assets (Fitzgibbons *et al.*, 2016; DeMiguel *et al.*, 2017; Fernandez-Perez, Fuertes, & Miffre, 2017) and time-varying portfolio optimization (Dangl & Weissensteiner, 2018). For instance, Dangl & Weissensteiner (2018) investigated the optimal asset allocation of long-term investors who show aversion against parameter misspecification in expected returns, and performed a max-min optimization over a set of priors. They found that the risk of parameter

misspecification significantly contributes to the overall predictive volatility and is highly relevant for the asset allocation decision over long investment horizons (Dangl & Weissensteiner, 2018). They argued that neglecting parameter uncertainty leads to overconfidence and extreme portfolio compositions, where cash is used to leverage the investments in real estate and bonds. While, ambiguity against errors in the model parametrization reduces leverage and even turns cash into an interesting investment vehicle. They conclude that stocks and real estate are further relevant asset classes for ambiguity-averse long-term investors, while bonds and gold play only a minor role (Dangl & Weissensteiner, 2018).

Fernandez-Perez, *et al.* (2017) developed a style integration portfolio allocation framework flexible enough to be applicable to any asset class for either long-short, long- or short-only styles. The provided formalized allocation framework that nests any individual style and many integration methods. This flexible framework will be adopted for our project, especially, the alternative integration approaches that emerged from different ways to define the style exposures at each portfolio formation time such as the naïve equal-weighted integration (EWI) and 'sophisticated' integrations based on utility maximization, style rotation, volatility timing, cross-sectional pricing and principal components analysis (Fernandez-Perez, Fuertes, & Miffre, 2017). They found that the improvement in reward-to-risk tradeoff and crash risk profiles afforded by the naïve EWI portfolio (vis-à-vis the standalone style portfolios) is not challenged by sophisticated integration methods that allow for time-varying and heterogeneous style exposures. The findings are robust to trading costs, alternative scoring schemes, variants of the sophisticated integrations, economic sub-period analysis and data snooping tests (Fernandez-Perez, et al. , 2017).

4. Competitor Analysis

The competitive landscape for absolute return trading systems are extremely robust; when you add the institutional desires of reduced directional market risk and macroeconomic sensitivities, a prudent researcher would seemingly need to account for almost every investor on the street. This is driven by the fact that due to their size and sophistication, institutional investors have access to almost any investment strategy possible.

Many institutional investors such as the Harvard Endowment and CalPERS are extremely mature. In their youth, these investors allocated in a similar manner to most other investors; beginning with risk premiums that were the easiest to attain. In most cases, these risk premiums would be the ones that were the least expensive and generally had the largest capacity. Long only, market capitalization weighted exposure to asset classes such as equity, fixed income, and commodities, have almost infinite capacity and are thus, some of the least expensive risk premiums to garner.

On the other extreme end of the spectrum, institutional investors looked to add extremely differentiated strategies to complement their very traditional, long only, broad market exposures. Today, many of these strategies are extremely well known and reside within the world of hedge funds; convertible arbitrage, managed futures, and merger arbitrage are some of the most popular. As one would expect, these strategies target a very specific risk premium, and thus, are extremely capacity constrained. Due to the idiosyncratic nature of the return source, these types of strategies are also associated with significant fee loads as the portfolio managers demand a higher level of compensation for their abilities.

In short, many institutional investors contain a portfolio of two extremes; high capacity and low cost allocations that are extremely sensitive to market directional risk and macroeconomic sensitivities as well as low capacity and high cost allocations that have

almost zero market directional risk and macroeconomic sensitives due to their idiosyncratic nature.

This leaves are large gap for institutional investors, especially the larger ones, who desire absolute return strategies to diversify the majority of the risk in their portfolios which is primarily allocated to long only market betas. Their largest problem is that capacity of the diversifying strategies they seek such as convertible arbitrage are extremely finite, and that the allocation they desire simply isn't possible in the real world. In addition, many of these strategies require lockups and suffer from illiquidity; this creates a problems for investors such as CalPERS who may need to service unforeseen liabilities, yet may not be able to access their capital.

Our opportunity is to create an absolute return strategy to fit between the two extremes which can diversify an institutional investor's exposure to long only market betas, yet lacks the drawbacks of some of the most sophisticated hedge fund strategies such as significant cost, illiquidity, and capacity constraints.

In order to solve for issues with cost, illiquidity, and capacity, many of the strategies we propose on an individual level are well known, and are rife with competitors. These competitors come in the form of not only products but also other asset managers competing to garner similar risk premiums. Below we outline some of our largest core tenants, and their associated challenges as well as much of the opportunity for our strategy has been outlined above. The component we feel is our largest differentiator for what may seem like well-known and seemingly commoditized risk premiums, would be our thoughtful implementation to portfolio construction and how our integrated approach creates a more robust absolute return strategy without depending on a single return driver.

Risk Diversification

Diversification has most likely been the single most emphasized topic in investing over the last fifty years. Traditionally, most investors have diversified their portfolios on the basis of capital while failing to account for the sometimes stark differences in risk between different markets. This holds true in today's markets when locally denominated Chinese A-Share equity markets exhibit significantly higher levels of volatility as compared to more developed equity markets such as their neighbours in Japan. This difference in risk profiles is especially apparent in multi-asset portfolios where an equal capital allocation to Japanese government bonds and Japanese equites would result in a portfolio that lacks meaningful diversification. This is because the contribution to portfolio risk from the equities are significantly greater than that of the bonds; such an unbalanced portfolio will have its outcomes driven by its most volatile assets as they will make up an overwhelming percentage of the risk contained within the allocation.

The major strength of diversifying by risk for investors is that is leads to more consistent outcomes for investors. Using the example of government bonds and equities, these two asset classes have a roughly zero correlation over the long run. This is because government bonds are highly sensitive to inflation expectations while equites are extremely sensitive to growth expectations. By combining these two asset classes where the contribution of risk to the broader portfolio is equivalent, the combination creates more consistent outcomes which are less dependent to changes in either growth or inflation. Most investors are heavily reliant on the equity risk premium, and are extremely sensitive to changes in growth rates around the world, which creates a great opportunity for our strategy to complement the allocation of many investors.

Diversification by risk in lieu of capital is a fundamental believe among many investors, especially some of the larger hedge funds in the world. Some of the largest competitors in the space who comprise risk contribution balanced portfolios are the hedge funds Bridgewater Associates and Applied Quantitative Research. Bridgewater's All Weather

and AQR's Risk Parity are each fund's largest strategy. Additionally, Bridgewater is the world's largest hedge fund, while AQR is the world's second largest.

Having two behemoths in direct competition for assets is an obvious threat as their pedigree and track records will be extremely persuasive in garnering our strategy's potential assets. These fund's are also tenured and have continued to innovate their portfolios over time while ours is still in its infancy. An opportunity for our strategy in comparison to that of Bridgewater and AQR, is that our fund due to its relatively smaller asset base would not have to struggle with some of the capacity concerns tied to asset classes such as commodities, emerging market currencies and credit markets. While these markets may not be integrated into our initial strategy, they would be markets we would add as future enhancements on the basis of robustness and diversification. While Bridgewater and AQR trade both of these markets, the overall size of the fund is limited to their ability to trade the above markets efficiently; otherwise, they would have to remove the asset class and sacrifice maximum diversification or close the fund to new investors.

While two of the largest hedge funds being direct competitors is an obvious threat, their strategies make up the bulk of risk diversified market exposure allocations. Currently, there are no multi-asset ETF's to contend with in the space, and there are very few mutual funds which pursue this type of strategy. In a similar fashion, but on a much more narrow level, there are some risk balanced commodity only strategies run by AQR, Invesco, and Neuberger Berman. Excluding AQR, the other two strategies have tactical components which comprise a significant part of the risk budget.

Our differentiation to an otherwise small space of competing managers and products would be to rely on the risk diversification as the material driver of our core allocation. Our tactical component would be integrated very differently, and will be outlined below. Within the realm of our risk diversification core tenant, our main differentiation would not be the utilization of tactical risk budgeting away from a strategic allocation, but utilizing machine learning. Traditionally, there have been two primary ways to determine the weights of different asset classes within a portfolio; an allocation driven by an inversion of the variance of the contributing asset classes or an allocation similar in thinking to Harry Markowitz's weighting through minimizing the variance of the contributing asset classes. Our differentiated core allocation will utilize graphing and will remove the need for such a reliance on traditional correlation matrices as our graphed approach will account for the interconnectedness of assets based on an asset class lineage, almost a family tree of sorts.

Drawdown Control System

Concerns about drawdowns and how to manage them have been around since individuals began investment. Having a plan in place to proactively manage a drawdown within an investor's portfolio is typically ignored by smaller investors as well as those investors who do not utilize tools such as leverage, shorting, and derivatives as cornerstones to the implementation of their strategies. In order to avoid the risk of ruin within a portfolio, especially those utilizing leverage, shorting, and derivatives, we believe that all portfolios should have a drawdown control system that is systematically implemented.

For many investors large and small, drawdown interventions to a portfolio occur following a large drawdown and are driven by behavioural tendencies; these decisions happen all at once to either significantly reduce the amount of risk being taken by the portfolio manager or to significantly reintroduce the amount of risk in the portfolio back to its original objective. Since the vast majority of strategies being implemented across the investment universe are ran through a discretionary approach, we believe that simply systematizing our drawdown control feature could lead to a much more sustainable process for institutional investors.

Unlike the large, lumpy, and emotional changes to a portfolio risk target which typically coincide with a portfolio's drawdown, we would contend that utilizing a stepped approach would be a strong differentiator and an opportunity for our strategy to have a competitive advantage. As opposed to the a more traditional "tactical allocation" within traditional portfolios, our strategy would utilize CVaR and would run independent to the strategy's market views. The drawdown control system would proactively reduce the overall volatility target of the strategy during a drawdown when the current environment is less favourable.

Systematising a gradual reduction in risk is a fundamental component that we believe is extremely prudent, and would be a major strength for our strategy. While it could be a weakness of our strategy to integrate a feature which reduces our fund's long term risk target over a shorter time period, we believe that avoiding hubris and conceding that our fund could go through an extended period on difficult performance is most important. Relative to almost any competing investment strategy, if our fund were to remain below its long term risk target for an extended period of time, we strategy would most likely deliver uncompetitive returns. While this is a potential weakness, we believe avoiding the risk of ruin, especially in a strategy where we are utilizing leverage, is most prudent as greater returns should never be exchanged for the potential to become another Long Term Capital Management.

The opportunity and threat of a systematized drawdown control system are highly related. There is nothing stopping our competitors from integrating a similar system in order to preserve client capital. Additionally, we have no way of know whether investors would prefer to have or not have a drawdown control system. We believe such a system would be most prudent, however we are fully aware that investors might not view what we see as an opportunity, in the same light. Unfortunately, opportunities and threats related to a systematic drawdown control system seem to be less relevant from a portfolio construction decision than a business and marketability perspective.

Additionally, it would be extremely difficult to ascertain what the competitive landscape looks like for other strategies and their drawdown practices. Most systematic managers do not openly distribute information allowing investors to see how their implement drawdown control; this process becomes even more difficult for discretionary managers as their process for managing drawdowns could change from one drawdown to the next.

Macroeconomic Momentum

The first two core tenants of our strategy were focused on maintaining long term strategic market exposure, regardless of changing market conditions; they were the opposite of market timing. In the next two core tenants discussed, we focus heavily on varying market exposure in attempt to take advantage of divergent market conditions; the true essence of market timing.

Similar to the basis for the above two tenants, momentum has been thoroughly researched and widely implemented for institutional investors. As such, it garnered significant fame and fortune during the 1980's and 1990's within Commodity Trading Advisor (CTA) portfolios. While these strategies profit from the same investor behavioural shortcomings that created the tulip bubble during the 1600's in Holland and the technology bubble during the 1990's in the United States, we understand that this could be a massive strength or weakness.

Since most investors are acutely aware of the success these strategies and the firms who run them namely, AQR, Campbell, Graham, and Winton to name a few, the space is competitive and could see the risk premium diminish over time as all these funds compete for the same source of return. On the other hand, this could be a strength as it helps to validate the efficacy of this behavioural return premium that some investors discount as a game of "hot potato." Because the funds in this space are invariably fiercely competitive

a major weakness would be to understand not just what the size of your trend following strategy is, but also the size of entire trend following ecosystem. Failing to account for the total amount of capital pursuing an outsized trend in Brent Crude Oil for example, could be a major point of weakness for the strategy as many investors looking to capture a similar risk premium could all unwind their trades together if driven by an external shock that might create a large adverse move in a market that has been trending well.

Since most momentum trades are not profitable, yet the few that are deliver outsized gains to more than make up for the numerous small losses, crowed trades and failing to account for the other trend followers in your space could be a major weakness for the strategy. On the other hand, one of the largest strengths of the strategy would be that the risk premium associated with momentum can be traced back into the 1800's as it is perpetuated by initial underreaction to information and the eventual overreaction to information. The behavioural tendencies of investors backed by economic intuition make macroeconomic momentum a strong strength of our strategy.

The large opportunity for our strategy is to develop past traditional price momentum, and to incorporate changes in fundamental momentum as well as sentiment based momentum. Most of the current landscape of investors acting as a CTA or attempting to capture a momentum based risk premium are doing so on the basis of simple price momentum. Capturing the changing momentum centred around items such as revisions to GDP or changing sentiment in the language of central bank minutes is a further opportunity for development that would give our strategy a competitive advantage. The major threat to these lesser utilized momentum characteristics is that there is nothing stopping any of the other funds listed above from competing to capture the same non-traditional risk premiums.

Our differentiating factor is that we would be utilizing a strategic risk diversified portfolio with systematic drawdown control as the core of our portfolio; the momentum component of our portfolio would be integrated to give tactical market exposures depending on the shorter-term market view. Because these two styles of management are rarely combined, anti-market timing with market timing, we feel our integrated approach offers significant investor value as opposed to a simply investing in some of each as typically seen in many investor portfolios.

Deep Value

Finally, our last core tenant is a more extreme variation of value investing that was widely published by Fama and French during 1980's and was implemented by Graham and Dodd in the 1930's. Most investors understand value investing and it merits because the concept is so intuitive; if I go to the grocery store, would I rather purchase something that is more expensive or less? The massive problem with this approach is that grocery store items or financial assets aren't discounted on accident; most times things are cheap for a reason. We can debate if an assets cheapness is fundamental due to that security exhibiting a higher level of risk or behavioural due an emotional bias leaning away from less glamorous securities and towards their "sexier" brethren; in short, the combination of fundamental and behavioural explanations give us confidence in why we believe this is a strength to capture this risk premium. Additionally, its strong negative correlation to macroeconomic momentum only further perpetuates why we believe value investing is a strength to the portfolio.

We understand with value investing being so widespread and so many investors looking to capture this risk premium, we openly admit the potential weakness it poses. From being able to purchase a value-oriented ETF or mutual fund through Vanguard for less than 10 basis points, to titans of the hedge fund world like David Einhorn at Greenlight Capital and David Tepper at Appaloosa Capital Management all competing to capture the value risk premium, the threat from our competition couldn't be higher.

The largest opportunity for our strategy to minimize the omnipresent threats related to value investing is through the following: utilize a lesser trafficked style of value investing called deep value, and to integrate in within the above macroeconomic momentum section to make the trend-following component less vulnerable to sharp reversals.

First, our strategy utilizes deep value as opposed to traditional value investing since there are less managers competing for such an extremely depressed value risk premium. True deep value managers are extremely limited with some of the most recognizable being Greenlight Capital, Appaloosa Capital Management from the hedge fund world and LSV from the mutual fund world. Outside of these three firms, the list of true deep value managers are extremely scarce.

The largest opportunity that differentiates our strategy from the above three, is that these managers are structurally investing in deeply depressed securities, regardless of macroeconomic environment; this means that their returns are generally the greatest following recessions, and struggle to keep pace in the later stages of an economic expansion, much as we have seen with the returns demonstrated by Greenlight Capital in recent years.

In a point of differentiation, our strategy, if ran outside of an integrated approach, would be invested in cash equivalents anytime outside of the market environment demonstrating depressed and extreme valuations. Within our integrated framework, and accompanied by our trend-following strategy, our deep value signals would be as both a market timing signal of when to become long assets, as well as a counter-trend signal to tell us when to pair back our trending exposure in assets that are particularly susceptible to reversal.

In contrast to many of the larger CTA strategies, they utilize traditional value metrics as a counter-trend signal which is constantly active; our strategy is meaningful different is that our value signal is not only a counter-trend signal, but a market timing signal as well. Because our timing signals of macroeconomic momentum and deep value are paired with our non-timing signals of risk balancing and drawdown control, we want to give investors a very different end portfolio which increases and decreases exposure over time, but remains long biased over the long run. We believe our differentiation as compared to traditional trend-following and value investing, an iconic pairing, is what makes our strategy competitive. This should create a great opportunity for success within the portfolio while also helping to insulate our approach from threats.

References

Amihud, Y., Mendelson, H., & Pedersen, L. H. (2013). *Market liquidity : asset pricing, risk, and crises.* Cambridge: Cambridge University Press.

Baz, J., Davis, J., Sapra, J., Tsai, J., & Gillmann, N. (2019, May). A Theoretical Framework for Equity-Defensive Strategies . *PIMCO Quantitative Research*.

Brown, A. (2011). *Red-blooded risk: the secret history of Wall Street.* New Jersey: John Wiley & Sons.

Brown, A. (2016). *Financial risk management for dummies.* Chichester, West Sussex: John Wiley and Sons, Inc.

Carroll, R., & Ramaswamy, R. (2018, March). Overview of Alternative Risk Premia ("ARP") Strategies. *White Paper*. Breton Hill: Neuberger Berman.

Dangl, T., & Weissensteiner, A. (2018). Optimal Portfolios under Time-Varying Investment Opportunities, Parameter Uncertainty and Ambiguity Aversion. *SSRN*. Retrieved from https://ssrn.com/abstract=2883768 or http://dx.doi.org/10.2139/ssr

Eurekahedge. (2003, August). *Long-Only Absolute Return Funds Enter the Alternative Investment Universe (Series 1 of 2).* Retrieved from Eurekahedge: http://www.eurekahedge.com/Research/News/1384/03aug_archive_long_only

Fernandez-Perez, A., Fuertes, A. M., & Miffre, J. (2017). Harvesting Commodity Styles: An Integrated Framework. *Working Paper*.

Ilmanen, A. (2011). *Expected returns : an investor's guide to harvesting market rewards.* Chichester, West Sussex, U.K: Wiley, 2011.

Kahn, R. N., & Lemmon, M. (2016). The Asset Manager's Dilemma: How Smart Beta Is Disrupting the Investment Management Industry. *Financial Analysts Journal*. doi:10.2469/faj.v72.n1.1

Maguire, P., Moffett, K., & Maguire, R. (2018). Combining Independent Smart Beta Strategies for Portfolio Optimization. *arXiv preprint, arXiv:1808.02505.*

Mikaelsson, A., & Nilsson, M. (2017). Smart Beta Factor Investing: Enhancing risk-adjusted returns with exposure to risk factors and empirical evidence of market inefficiencies. *Masters Thesis*. Lund University School of Economics and Management.

Moore, H. (2015, September). *An Institutional Investor Sponsored Report on Smart Beta: From Theory To Practice* . Retrieved from Institutional Investor: https://www.institutionalinvestor.com/images/416/SMART%20BETA%20(Reprint-Complete)

Pedersen, L. H. (2015). *Efficiently inefficient: how smart money invests and market prices are determined.* Princeton: Princeton University Press.

Tulchinsky, I. (2015). *Finding alphas : a quantitative approach to building trading strategies.* Chichester: John Wiley and Sons.

Wurtz, F. (2018, October). *Factor investing & smart beta: The smart beta (r)evolution.* Retrieved May 22, 2019, from Investments & Pensions Europe: https://www.ipe.com/reports/special-reports/etfs-guide/factor-investing-and-smart-beta-the-smart-beta-revolution/10027012.article

vestor.com/images/416/SMART%20BETA%20(Reprint-Complete)>.

Wurtz, Fannie. "Factor investing & smart beta: The smart beta (r)evolution." October 2018. *Investments & Pensions Europe.* 22 May 2019. <https://www.ipe.com/reports/special-reports/etfs-guide/factor-investing-and-smart-beta-the-smart-beta-revolution/10027012.article>