

Wiley Finance Series

STRATEGIC RISK MANAGEMENT

Designing Portfolios and Managing Risk

CAMPBELL R. HARVEY
SANDY RATTRAY
OTTO VAN HEMERT

A close-up photograph of a human eye. The iris is a light, hazy color. The pupil is dark and contains a clear, circular reflection of a digital data visualization, likely a stock market or financial chart, with various colored lines and points. The skin around the eye is a warm, natural tone.

WILEY

Strategic Risk Management

Founded in 1807, John Wiley & Sons is the oldest independent publishing company in the United States. With offices in North America, Europe, Australia, and Asia, Wiley is globally committed to developing and marketing print and electronic products and services for our customers' professional and personal knowledge and understanding.

The Wiley Finance series contains books written specifically for finance and investment professionals as well as sophisticated individual investors and their financial advisors. Book topics range from portfolio management to e-commerce, risk management, financial engineering, valuation, and financial instrument analysis, as well as much more.

For a list of available titles, visit our website at www.WileyFinance.com.

Strategic Risk Management

Designing Portfolios and Managing Risk

CAMPBELL R. HARVEY
SANDY RATTRAY
OTTO VAN HEMERT

WILEY

Copyright © 2021 by John Wiley & Sons, Inc. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the Web at www.copyright.com. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

For general information on our other products and services or for technical support, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Library of Congress Cataloging-in-Publication Data:

Names: Harvey, Campbell R., author. | Rattray, Sandy, author. | Van Hemert, Otto, author.

Title: Strategic risk management : designing portfolios and managing risk / Campbell R. Harvey, Sandy Rattray, and Otto Van Hemert.

Description: First edition. | Hoboken : Wiley, 2021. | Series: Wiley finance | Includes index.

Identifiers: LCCN 2021005741 (print) | LCCN 2021005742 (ebook) | ISBN 9781119773917 (hardback) | ISBN 9781119773948 (adobe pdf) | ISBN 9781119773924 (epub)

Subjects: LCSH: Portfolio management. | Risk management.

Classification: LCC HG4529.5 .H378 2021 (print) | LCC HG4529.5 (ebook) | DDC 332.6—dc23

LC record available at <https://lccn.loc.gov/2021005741>

LC ebook record available at <https://lccn.loc.gov/2021005742>

Cover Design: Wiley

Cover Image: © Mike Robinson

10 9 8 7 6 5 4 3 2 1

Contents

Foreword	ix
<i>By Martin Leibowitz</i>	
Preface	xiii
<i>By Sandy Rattray</i>	
Acknowledgments	xvii
CHAPTER 1	
Seeking Crisis Alpha	1
Introduction	1
Data	4
Strategy	8
Performance	10
Skewness	14
Crisis Alpha	17
Concluding Remarks	20
Appendix 1A: Sensitivity Analyses for Equity and Bond Crisis Alpha and Smiles	22
References	25
CHAPTER 2	
Can Portfolios Be Crisis Proofed?	27
Introduction	27
Crisis Performance of Passive Investments	29
Active Hedging Strategies: Time-Series Momentum	41
Active Hedging Strategies: Quality Stocks	46
Can Portfolios Be Crisis Proofed?	57
Concluding Remarks	61
Appendix 2A: Long Puts Using OTC Put Option Data from a Broker	63

Appendix 2B: Longer View of Gold	65
Appendix 2C: Additional Results for Quality Stocks	66
References	70
CHAPTER 3	
Risk Management via Volatility Targeting	71
Introduction	71
Our Approach	73
U.S. Equities	77
U.S. Bonds and Credit	84
Futures and Forwards	91
Portfolios	93
Volatility Scaling and the Sharpe Ratio of Risk Assets	97
Concluding Remarks	100
Appendix 3A: Other Risk Metrics	102
Appendix 3B: Autocorrelation of Variance	106
References	107
CHAPTER 4	
Strategic Rebalancing	109
Introduction	109
Comparing Rebalanced and Buy-and-Hold Portfolio Returns	112
Impact of a Simple Trend Strategy Allocation	115
Strategic Rebalancing	125
Strategic Rebalancing versus a Direct Allocation to Trend	129
Concluding Remarks	131
Appendix 4A: Certainty Equivalent Performance Gain	132
Appendix 4B: Adding Trend to a 100 Percent Rebalanced Portfolio	134
Appendix 4C: The 30–70 Portfolio	138
References	138
CHAPTER 5	
Drawdown Control	140
Introduction	140
Drawdown Greeks	142
Manager Replacement Rules	148
Drawdown-Based Risk Reduction Rules	155
Concluding Remarks	156
Appendix 5A: Heteroskedasticity for U.S. Stocks	158
References	162

CHAPTER 6	
Man versus Machine	164
Introduction	164
Classification of Hedge Funds	167
Risk Factors	169
Empirical Analysis: Macro Funds	172
Empirical Analysis: Equity Funds	178
Diversification Potential of Different Hedge Fund Styles	183
Concluding Remarks	186
Appendix 6A: Fund Classification Method	187
Appendix 6B: The Recent Rise of Liquid Alternative CTA Mutual Funds	190
References	193
CHAPTER 7	
Out-of-Sample Evidence from the COVID-19 Equity Selloff	195
Introduction	195
The Best Strategies During the COVID-19 Equity Selloff	196
Volatility Targeting	207
Strategic Rebalancing	207
Concluding Remarks	209
Notes	211
About the Authors	223
Index	225

Proceeds from this book will be donated to The Access Project, which supports students from disadvantaged backgrounds to access top universities through tuition and in-school mentoring. Please visit <https://www.theaccessproject.org.uk/> for more information.

Foreword

By Martin Leibowitz

Active funds devote considerable effort to the search for excess returns, but risk considerations often fail to get anywhere near the same level of attention. The authors of this book, Campbell Harvey, Sandy Rattray, and Otto Van Hemert, take risk seriously and give it the consideration it deserves.

Risk considerations can get short shrift in many ways. For example, historical returns typically are reported without reference to the risk taken to achieve them. Unfortunately, without a better understanding of the risk involved, it is difficult to estimate the likelihood that such (possibly fortuitous) returns can be repeated.

In the standard risk management approach, the focus is on setting volatility constraints associated with various targets and benchmarks. Such constraints often are based on the probability of a significant downdraft that could adversely impact the current investment strategy. In actuality, the commonality of such constraints across a wide range of funds suggests that some peer group pressure might also be at play.

Once risk limits have been established, managers generally are permitted to roam relatively freely in the search for higher returns. Risk considerations are then relegated to ensuring that returns stay within the pre-established bounds. In effect, this approach tends to put risk assessment in a box that is removed from day-to-day fund management.

In the asset allocation context, this fence-posting behavior is built on the belief that the maximum expected return is equivalent to the optimal return. However, that may not be the case when the fund's "true" objectives are considered.

This book's authors make the case that the position of a fund relative to its risk boundaries should be integrated into any consideration of investment shifts. The challenge is garnering sufficient incremental return from new investments to justify all incremental risks.

In theory, each incremental investment initiative or allocation shift should be based on a holistic risk/return valuation. This valuation should include an understanding of the interaction between marginal investment

changes and the probability of success relative to various absolute and/or market-sensitive performance goals. An absolute goal might be to achieve a specific return or some given level of spending. Market-sensitive goals might include a desired probability that the fund's performance will exceed that of a peer group, market benchmark, or customized reference portfolio.

When such market-sensitive targets are considered, correlations between investment and target returns become important. The incremental return advantage versus a moving target will be improved if the portfolio and the target are closely aligned along the primary dimension of risk.

Significant risk events are likely to spawn a need for portfolio rebalancing. Most funds do rebalance at both prescribed time intervals and following sufficiently sizeable market moves. However, the rebalancing process can easily devolve into a mechanical regimen that simply moves the fund back to its preordained policy portfolio.

This auto-rebalancing protocol is based on the presumption that significant market events do not seriously impact going-forward prospects. This presumption is based on the belief that, over time, the market presents the same face to investors—both before and after major market moves. This equilibrium-mandated framework is comforting because it relieves fund managers of the need to peer into the clouded world of uncertainty and tease out revised policy portfolios. While it is true that a return to a prior equilibrium often occurs, it is also true that significant risk events can change the market's going-forward return characteristics as well as the fundamental risk tolerance of the fund itself!

In this book, Harvey, Rattray, and Van Hemert take a broader view of the rebalancing problem. They make the case that, rather than being based on a fixed periodic timetable, rebalancing should be more closely attuned to market conditions. For example, discernible changes in a market's prospective risk should play an important role in shaping the rebalancing process. It serves little purpose to speedily rebalance against a strongly trending market.

Harvey, Rattray, and Van Hemert provide concrete illustrations and techniques for more fully integrating risk considerations into both the rebalancing process and the day-to-day management of the fund. For example, they show how volatility scaling provides a risk management function by reducing allocations when risks are increasing. They also study a range of investment strategies and assess how each strategy performed historically in times of crisis.

Although the research in this book was conducted prior to the COVID-19 outbreak, a postscript has been added to show how their approach fared during the first two quarters of 2020. It appears that both

volatility scaling and strategic rebalancing did serve to improve portfolio performance.

The authors' focus on these asset management issues is grounded in their fund management experience, their deep understanding of the latest financial theory, and their own published work. (In this regard, it should be noted that Professor Harvey was recently named the "2020 Quant of the Year" by the *Journal of Portfolio Management* for outstanding academic contributions to the field of quantitative finance.)

In this book, the authors—each with their exceptional credentials in this area—have been most generous in sharing their hard-won insights with the investment field at large.

President, Advanced Portfolio Studies LLC,
and Senior Advisor to Morgan Stanley

Preface

By Sandy Rattray

One of our core beliefs at Man Group is that risk management of portfolios is just as important as alpha generation. Based on a number of articles we've published over the past five years, this book is derived from some of the key areas of risk management where we have had something to add and the practical experience we have as fund managers. The motivation for writing this book often came from questions asked by our clients that we thought would be interesting to others, and sometimes from specific problems that we were thinking about ourselves.

In *Seeking Crisis Alpha* (Chapter 1), we write about a theme that is close to our hearts: the ability of time series momentum to produce strong returns in weak market environments. We challenge the consensus view that this feature is limited to generating alpha in weak equity markets by finding very similar results in bond markets. We also show that time series momentum has some similar features to a long (put and call) options strategy. Aside from our momentum funds, we have directly used the protective feature of momentum in our long-only multi-asset programs. The chapter was written to respond to the many comments we received: that futures momentum could only protect against equity market drawdowns. Even with a 25-year history for our flagship trend fund, we needed to generate additional historical returns going back to the 1960s to test for protection against bond market selloffs.

We develop this theme further in *Can Portfolios Be Crisis Proofed?* (Chapter 2) by exploring a range of crisis alpha strategies. These include: long S&P 500 put options, long U.S. Treasury bonds, long gold and long protection on credit spreads, as well as futures momentum and long high-quality, short low-quality equities. We argued that put options are the most reliable, but most expensive, strategy, and that U.S. Treasury bonds have historically been unreliable. Credit protection and long gold fit somewhere between options and Treasuries, on both reliability and cost. Time series momentum and quality combine the attractive features of positive returns in both good and bad periods (at some reliability cost).

We have, over the years, built solutions for clients utilizing equity options, credit protection, times series momentum, and equity quality to fit specific investor preferences. Our motivation was to try to create a single framework for these strategies.

Risk Management via Volatility Targeting (Chapter 3) takes a different approach to risk management by focusing on methods to keep asset and portfolio volatility stable over time. This is in contrast to most investment strategies, which try to keep exposure stable over time. Many systematic hedge fund strategies use some form of volatility targeting, while risk parity is one of the few long-only approaches to use this technique. We show that scaling positions by an expected volatility (using recent historical returns) produces more stable risk outcomes in all the asset classes that we study (i.e., reduced tail losses and more stable experienced volatility). In equities and credit, volatility scaling somewhat increases historical Sharpe ratios, perhaps because these assets show a leverage effect themselves (becoming naturally more volatile with lower prices). Volatility targeting has been a mainstay of our Man AHL hedge fund and long-only strategies for many years, and we continue to believe that it has helped us limit portfolio drawdowns historically.

In *Strategic Rebalancing* (Chapter 4), we summarize several years' worth of research on the impact of rebalancing on portfolio returns. For us, rebalancing is core to almost all portfolio management, and yet its risk characteristics are woefully underexplored. Rebalancing has many benign features, including the obvious risk balancing and less obvious return improvement. However, we show that rebalanced portfolios generally underperform buy-and-hold portfolios in extreme market environments where assets show strong momentum (because the rebalancing keeps buying the underperforming asset and selling the outperforming asset). It is possible to rebalance better by taking account of this momentum effect (i.e., delay rebalancing when momentum is against you). This has maintained the advantages of rebalanced portfolios by retaining the asset class balance, but reduces the underperformance that rebalancing introduces in stress periods. The chapter was prompted by a client remarking that rebalancing is a "short volatility" strategy, which caused us to start exploring the topic in much more depth and realizing the importance of active choices in rebalancing strategy.

In *Drawdown Control* (Chapter 5), we explore the impact of cutting risk when drawdowns occur. This is an approach very commonly used by investors and yet barely mentioned in academic literature. We show that drawdown rules can be effectively used to weed out strategies (or managers) who lose the ability to generate alpha, and that this improves portfolio risk-and-return characteristics.

All of the tools we advocate are quantitative. In *Man vs. Machine* (Chapter 6), we look at both the risk and performance of systematic versus discretionary hedge fund strategies. This started as a performance comparison project in response to a client query. It ended up focusing on risk-adjusted returns. We found that discretionary and systematic macro managers are united in their long exposure to volatility, which can help in crises. For equity funds, discretionary managers have shown higher performance than systematic ones, but this difference is entirely explained by discretionary managers having larger factor exposures, especially to the market and size factors.

How have our suggestions held up in 2020? Well, at the time of writing, it's too early to tell. But in *Out-of-Sample Evidence from the COVID-19 Equity Selloff* (Chapter 7), we take a look. The results show that these risk management techniques remained effective and we continue to rely on them in our own fund management strategies. We have added this analysis as a final chapter to the book.

Many of the chapters of this book are based on work that was published in the *Journal of Portfolio Management* with a number of our colleagues at Man Group. We are grateful for their support over the past few years and their comments on our manuscript.

The book provides, we hope, a practical insight into how to manage risk well. There has been no better test than the recent market events of the first half of 2020. While we are clearly not out of this period of turbulence, we believe that our approach to strategic risk management provides some guidance on how to better manage risk through difficult periods. That's half the challenge of being a portfolio manager, and often the more-overlooked half.

Acknowledgments

The authors have greatly benefited from the insights of their coauthors on much of the foundational research for this book: Mark Ganz, Nick Granger, Carl Hamill, Edward Hoyle, Russell Korgaonkar, Eva Sanchez Martin, Matthew Sargaison, Andrew Sinclair, Daniel Taylor, and Darrel Yawitch.

The authors also appreciate both detailed comments and discussion with many of their colleagues at Man Group, including Giuliana Bordigoni, Richard Bounds, Tom Bowles, Paul Chambers, Michael Cook, Yoav Git, Keith Haydon, Chris Kennedy, Lawrence Kissko, Anthony Ledford, Charles Liu, Andrea Mondelci, Shanta Puchtler, Jayendran Rajamony, Mark Refermat, Graham Robertson, and Drake Siard.

The authors would like to thank their colleague, Darshini Shah, for her great help in this production of the book, her unceasing good humour and her encouragement in bringing this to the finish line.

Seeking Crisis Alpha

INTRODUCTION

The idea of risk management is to provide some protection during adverse events. However, the cost of that protection must be balanced against the benefit. For example, in a strategy that uses costly long put options to eliminate the downside, the portfolio's return should not be greater than the risk-free rate. By contrast, we focus on the idea of crisis alpha, which uses dynamic methods that lower risk and also preserve excess returns. In this sense, they provide alpha when it is most needed—during crisis periods.¹

Trend following is one technique that works especially well with a crisis-alpha strategy. Theoretically, trend-following strategies sell in market drawdowns (mimicking a dynamic replication of a long put option) and buy in rising markets (mimicking a dynamic replication of a long call option). This resembles a long straddle position and induces positive convexity. While it is possible to purchase the long straddle directly, that is expensive. Implementing a trend-following strategy is not expensive, but it is not as reliable as taking option-based insurance.

Much of our book focuses on these costs and benefits. We assess the after-cost performance of different strategies (including option-based strategies) in various risk-on events.

Our starting point is a deep dive into time-series momentum (trend-following) strategies in bonds, commodities, currencies, and equity indices between 1960 and 2015. Over the last few years, institutional investors have turned to futures trend-following strategies to provide “crisis alpha.”² Our analysis shows that these momentum strategies performed consistently both before and after 1985, periods which were marked by strong bear and bull markets in bonds, respectively.

We document a number of important risk properties. First, returns are positively skewed, which is consistent with the theoretical link

between momentum strategies and a long option straddle strategy. Second, performance was particularly strong in the worst equity and bond market environments, giving credence to the claim that trend following can provide equity *and* bond crisis alpha. Putting restrictions on the strategy to prevent it being long equities or long bonds has the potential to further enhance the crisis alpha, but reduces the average return. Finally, we examine how performance has varied across momentum strategies based on returns with different lags and applied to different asset classes.

Backdrop

Government bonds have experienced an extended bull market since 1985. This is illustrated in the left panel of Figure 1.1, where we plot the cumulative excess return of U.S. 10-year Treasuries and the S&P 500 index, relative to the U.S. T-bill rate. This shows a steady increase in cumulative bond returns since 1985. The right panel of Figure 1.1 plots the drawdown level, which rarely exceeded 10 percent for bonds in the post-1985 period. A trend-following strategy holding a (predominantly) long bonds position would have benefited from the consistent upward direction after 1985.

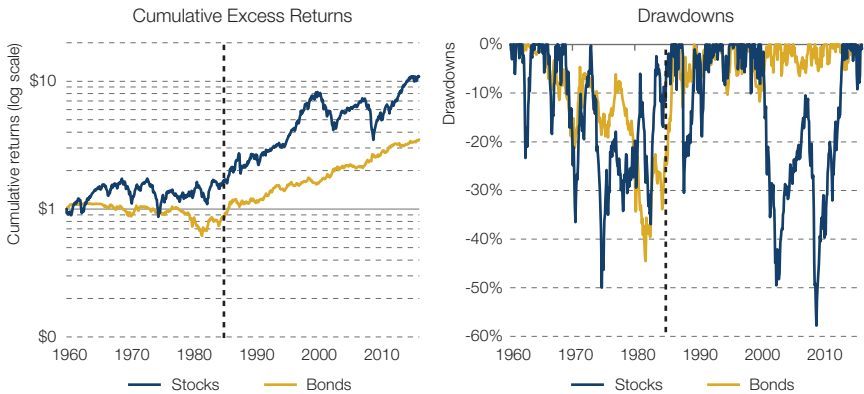


FIGURE 1.1 Cumulative excess returns and drawdowns in the stock and bond markets (1960–2015). The left panel shows the cumulative return of stocks (S&P 500 index) and bonds (U.S. 10-year Treasury), in excess of the U.S. T-Bill rate. The right panel shows the drawdown relative to the highest cumulative return achieved to date for both stocks and bonds. The data period is January 1960 to December 2015 and the dashed, vertical line separates the pre- and post-1985 period.

The strong bond performance was driven by significant interest-rate compression. U.S. yields fell from almost 16 percent in the early 1980s, to

below 2 percent in March 2016. While in some countries yields have turned slightly negative, most economists believe yields cannot become very negative, and as such we are unlikely to see a similarly large yield compression in future decades. In light of this, it is natural to ask whether, in the absence of a bond market tailwind, trend-following strategies can maintain performance and protect against bond-market stress similar to that seen in the 1960s, 1970s, and early 1980s.

Outline

In this chapter we seek to shed light on three questions by studying trend-following strategies from 1960 onwards:

1. Should we expect futures trend following to be profitable in an environment where government bond yields rise?
2. Are the protective characteristics of trend following confined to equities, or do they work for government bonds as well?
3. Is it possible to improve the protection characteristics of a futures momentum strategy by removing the ability to be long equities?

Importantly, there is a stark difference between the pre-1985 period and the post-1985 period. Between 1960 and 1985, bonds experienced negative excess returns on average while stock markets provided modest positive average excess returns and quite frequent drawdowns (Figure 1.1).

In the first section, we discuss the available data to ground our understanding of the markets between 1960 and 1985. The second section defines a straightforward momentum strategy. Extending our analysis back to 1960 requires us to use monthly data and augment the available history of futures and forward returns with proxies based on cash returns, financed at the local short-term rate.

In the next section, we show that strategies based on the past four months' returns (lag 1 to 4) experience consistently strong performance, as do strategies based on returns of almost a full year ago (lags 9 to 11). However, strategies based on returns at the intermediate horizon (lags 5 to 8) underperform consistently over time and across asset classes. Next, we form a momentum strategy that places weights on historical lagged returns, such that it best matches the representative BTOP50 managed futures index (we label our strategy *momCTA*) and find that this replicating strategy allocates almost all weight on lags 1 to 4, thus largely ignoring the predictability of lags 9 to 11.

In the two sections that follow, we show that *momCTA* inherits two important risk characteristics that are particularly associated with

momentum strategies based on recent returns. In the section about skewness, we show that *momCTA* has positively skewed returns, in particular when returns are evaluated over multiple months. (We specifically consider 3- and 12-month evaluation windows.) We argue this result is intuitive and related to the strategy's property of adding to winners and cutting losers, which is similar to the dynamic replication of a long option straddle position.

Then, in the section on crisis alpha, we show that *momCTA* performed particularly well in the worst equity and bond market environments, giving empirical support to a claim that trend-following can provide crisis alpha for both equities *and* bonds. Performance was strong in not only the worst but also the best equity and bond market environments, revealing a well-known equity market smile and a lesser-known, but even more pronounced bond market smile.

We find that the equity and bond crisis alpha was further enhanced when we restricted the equity and bond position to be non-positive. However, this comes at the cost of lower general performance and unfavorable cross-market effects. Indeed we find that a non-positive equity (bond) restriction worsened the performance during bond (equity) market declines.

DATA

Many other papers that have looked at trend-following strategies start their analysis well after 1960. Moskowitz, Ooi, and Pedersen (2012), for example, evaluate trend-following strategies from 1985 onwards “to ensure that a comprehensive set of instruments have data.” We believe that starting in 1960 strikes the right balance for our research question; however, using a sample period that starts in 1960 presents certain challenges. Starting earlier than 1960 is problematic for commodities because one either has to omit the asset class before 1960; rely on imperfect and only intermittently available data; or rely on spot returns, thus ignoring the roll yield component of return.³ Starting in 1960 provides an opportunity to study the worst bond market drawdown the United States experienced since at least 1900, as the 10-year yield rose from below 5 percent in 1960 to a peak of almost 16 percent in the early 1980s.

In Table 1.1, we provide an overview of the securities used in our analysis, and report the start date and some summary statistics. While we start the evaluation of momentum strategies in 1960, our data start as early as 1950 to allow for a so-called warm-up period for obtaining the volatility and correlation risk estimates needed in the strategy construction. For securities with data starting after 1960 only, we maintain a warm-up period of one year so that they are included in the momentum strategy return one year after the reported data start date.

TABLE 1.1 Data. This table provides the start date for the securities used in this chapter, as well as some descriptive statistic for monthly security returns. The euro (EUR/USD) is augmented with the deutsche mark prior to the January 1999 introduction of the euro.

	Cash start date	Futures/ forwards start date	Mean (annual)	Standard deviation (annual)	Skewness	Kurtosis
BONDS						
Australian 10yr Bond	Jan-77	Dec-84	0.21%	3.60%	-0.45	23.48
Canadian 10yr Bond	Jan-50	Feb-90	1.68%	6.31%	0.25	6.12
French 10yr Bond (OAT)	Jan-50	Jun-12	2.17%	5.68%	-0.29	5.50
German 10yr Bond (Bund)	Jan-50	Jun-83	3.08%	5.10%	-0.33	1.95
Italian 10yr Bond (BTP)	Jan-50	Sep-11	2.72%	10.14%	0.40	2.26
Japanese 10yr Bond (JGB)	Jan-72	Mar-83	3.16%	5.86%	0.13	6.39
UK 10yr Bond (Gilts)	Jan-50	Nov-82	1.85%	6.32%	0.25	3.00
US 2yr Note	Jan-50	Jul-05	0.83%	2.70%	0.71	12.16
US 5yr Note	Jan-50	Oct-91	1.52%	5.06%	0.24	6.12
US 10yr Note	Jan-50	May-82	1.87%	6.80%	0.43	3.86
US 30yr Bond	Jan-50	Sep-77	1.84%	9.80%	0.27	3.40
COMMODITIES - AGRICULTURALS						
Cocoa (CSCE)	N/A	Sep-59	3.76%	30.68%	0.65	1.40
Coffee (CSCE)	N/A	Aug-73	4.73%	37.20%	1.22	4.24
Corn	N/A	Jul-59	-2.06%	23.66%	1.20	6.57
Cotton	N/A	Jul-59	2.58%	23.29%	0.68	3.49
Lean Hogs	N/A	Sep-69	3.45%	26.00%	0.24	1.23

(Continued)

TABLE 1.1 (Continued)

	Cash start date	Futures/ forwards start date	Mean (annual)	Standard deviation (annual)	Skewness	Kurtosis
Live Cattle	N/A	Nov-64	4.76%	16.95%	-0.29	2.11
Soyabeans	N/A	Jul-59	5.58%	25.66%	1.56	10.81
Soyameal	N/A	Jul-59	9.79%	30.29%	1.94	13.86
Soyaoil	N/A	Mar-68	7.57%	31.38%	1.42	6.64
Sugar (CSCE)	N/A	Jan-61	0.55%	42.53%	1.10	2.99
Wheat	N/A	Jul-59	-1.59%	24.89%	0.72	3.29
COMMODITIES - ENERGIES						
Brent Crude Oil	N/A	Jun-88	13.05%	34.42%	0.47	3.13
Gas Oil	N/A	Apr-81	8.41%	31.73%	0.49	2.03
Heating Oil	N/A	Mar-79	7.97%	32.88%	0.70	3.22
Natural Gas	N/A	Apr-90	-5.70%	54.36%	1.82	10.71
RBOB Gasoline	N/A	Dec-84	16.42%	36.43%	0.43	2.52
WTI Crude Oil	N/A	Oct-83	7.29%	33.35%	0.25	2.04
COMMODITIES - METALS						
Aluminium (LME)	N/A	Jan-80	-2.10%	22.21%	1.00	4.23
Copper (COMEX)	N/A	Jul-59	10.06%	27.32%	0.36	3.41
Gold	N/A	Dec-74	1.43%	19.30%	0.39	3.27
Nickel	N/A	Jul-79	7.04%	34.74%	1.44	9.15
Palladium	N/A	Nov-05	11.62%	32.63%	-0.15	3.92
Platinum	N/A	Mar-68	4.31%	27.77%	0.36	4.46
Silver	N/A	Jan-72	4.58%	32.39%	0.65	4.85
Zinc	N/A	Jan-75	1.97%	24.65%	-0.02	1.33