Portfolio Management for Insurers and Pension Funds and COVID-19: Targeting Volatility for Equity, Balanced and Target-Date Funds with Leverage Constraints

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Coverage

- Background: Why target volatility? Importance of leverage constraints and market crashes.
- Forecasting Volatility and Constructing Portfolios.
- Results: Equity and Balanced Funds with constraints on leverage (briefly - previously covered in 7 December Colloquium Presentation).
- Results: Equity Portfolios for Crisis Periods and Post Crisis, including COVID-19 Crisis
- Summary and Conclusions.

Why Target Volatility?

- Targeting (constant) equity exposure to manage risk assumes constant volatility. Volatility is volatile, targeting volatility is required for constant risk (volatility).
- Theoretical and empirical studies support negative correlation between equity market returns and conditional volatility.
- Recent research demonstrates enhanced returns as well as downside risk reduction from target volatility strategies for equity funds.
- Low interest rates and increased volatility following the Global Credit Crisis and COVID-19 crash highlight importance of enhanced return and downside risk strategies.
- Insurers with variable annuity portfolios, superannuation/pension funds with balanced and target-date funds and alternative investment funds can benefit from targeted constant volatility strategies.

Volatility Feedback

- Volatility feedback and leverage effect:
  - higher (lower) volatility produces a stock market price fall (rise) as the required rate of return on the stock market increases (decreases).(see [Poterba and Summers, 1986], [Campbell and Hentschel, 1992], [Bekaert and Wu, 2000], [Wu, 2001] and [Bollerslev et al., 2006].)

- Demonstrated negative empirical relationship between equity market returns and conditional volatility ([Hocquard et al., 2013], [Moreira and Muir, 2017] and [Doan et al., 2018]).

Volatility Timing Strategies

- Volatility timing strategies typically multivariate and involve forecasting variance-covariance matrix of returns for assets in the portfolio ([Fleming et al., 2001, Fleming et al., 2003], [Han, 2006], [Liu, 2009], [Kirby and Ostdiek, 2012] and [Clements and Silvennoinen, 2013].)

- [Doan et al., 2018] developed a univariate volatility timing strategy and demonstrated substantial improvement in equity return performance, even after allowing for transaction costs - 100 to 350 basis points above the stock index return, and significantly reduced exposure to downside risk from stock market crashes.

- [Moreira and Muir, 2017], consider volatility timing using variance rather than volatility and also find strategies that outperform on a risk adjusted basis.

Target Volatility - Implementation

- Forecasts of market return volatility at the daily level.
- Forecasting approach - an outlier corrected GARCH(1,1) model estimated on daily returns, winsorizing extreme returns before model estimation ([Gregory and Reeves, 2002, Gregory and Reeves, 2010], [Carnero et al., 2007, Carnero et al., 2012], and [Harvey, 2013]).
- Volatility forecasts are used to adjust market exposure to target a constant market volatility - higher volatility forecasts result in reduced market exposure, while lower volatility forecasts result in increased market exposure.
- Adjustments made using stock index futures contracts overlays, results in very small portfolio transaction costs.

Target Volatility - Implementation

- We assess equity portfolios and balanced portfolios (with 65% in equity and 35% in bonds).
- Target-date portfolios for a range of time periods and glide paths of declining equity exposure (not covered here - covered in 7 December Colloquium presentation and in the paper.)
- Different leverage constraints are examined; conservative, moderate and aggressive.
- Results are for the U.S. as it has the largest market of equity, balanced and target-date funds.

Portfolio construction - Equity and Balanced Portfolios

- Daily participation ratio is the weight w_t invested in the market equity portfolio:

$$w_t = \frac{target\ \ volatility}{\hat{\sigma}_t}, \tag{1}$$

  where $\hat{\sigma}_t$ is the volatility forecast for trading day t.
- When forecast volatility for a given trading day is greater (lesser) than target volatility, we sell (buy) futures contracts on the equity market, leading to a decrease (increase) in portfolio volatility.
- Threshold weight change (δ), used to minimize excessive turnover, only change market exposure when new participation ratio differs from the previous by an absolute amount greater than δ.
- In leveraging the equity portfolio, we set different levels of maximum participation ratio, namely 1, 1.5, 2, and unrestricted value.

Data - Equity, Futures

- US market index returns are value-weighted market returns from the KenFrench website from May 1978 to June 2020 (data to April 1982 used to initialize volatility forecasting model).
- The series is adjusted to account for dividend re-investment.
- The same data over January 1926 to 1932 is used to study the performance of target volatility portfolio over the Great Depression.
- Daily settlement price series of futures contracts on the S&P500 from Datastream. The daily returns of futures contracts start in April 1982.
- Bond data are the US bond return index that includes a wide set of government and corporate bonds, provided by Barclays (mnemonic: LHAGGBD). The bond returns start at the same time as equity returns.
- The statistics include the annualized average return in percentage (μ), annualized standard deviation in percentage (σ), return per unit of risk (ϕ), and maximum daily drawdown (Min ret).

Equity Portfolios

Equity portfolio performance statistics with $\delta = 0.1$

	μ	σ	ϕ	Min ret
Market portfolio	11.59	17.70	0.65	-17.41
Maximum participation ratio of 1				
Daily market volatility 0.8%	10.12	12.49	0.81	-9.03
Daily market volatility 1.0%	10.60	13.93	0.76	-14.09
Daily market volatility 1.2%	10.82	14.90	0.73	-17.41
Maximum participation ratio of 1.5				
Daily market volatility 0.8%	11.25	13.81	0.81	-9.03
Daily market volatility 1.0%	12.60	16.64	0.76	-14.09
Daily market volatility 1.2%	13.53	18.84	0.72	-19.15
Maximum participation ratio of 2				
Daily market volatility 0.8%	11.45	13.98	0.82	-9.03
Daily market volatility 1.0%	13.29	17.39	0.76	-14.09
Daily market volatility 1.2%	14.61	20.60	0.71	-19.15
Unrestricted participation ratio				
Daily market volatility 0.8%	11.47	13.99	0.82	-9.03
Daily market volatility 1.0%	13.53	17.51	0.77	-14.09
Daily market volatility 1.2%	15.33	21.19	0.72	-19.15

Balanced Portfolios

Balanced portfolio performance statistics with $\delta = 0.1$

	μ	σ	ϕ	Min ret
Balanced portfolio	11.94	11.74	1.02	-11.32
Maximum participation ratio of 1				
Daily market volatility 0.8%	10.76	8.54	1.26	-5.87
Daily market volatility 1.0%	11.13	9.41	1.18	-9.16
Daily market volatility 1.2%	11.31	10.00	1.13	-11.32
Maximum participation ratio of 1.5				
Daily market volatility 0.8%	11.55	9.38	1.23	-5.87
Daily market volatility 1.0%	12.53	11.14	1.13	-9.16
Daily market volatility 1.2%	13.24	12.52	1.06	-12.45
Maximum participation ratio of 2				
Daily market volatility 0.8%	11.68	9.49	1.23	-5.87
Daily market volatility 1.0%	13.02	11.62	1.12	-9.16
Daily market volatility 1.2%	14.03	13.65	1.03	-12.45
Unrestricted participation ratio				
Daily market volatility 0.8%	11.69	9.49	1.23	-5.87
Daily market volatility 1.0%	13.18	11.70	1.13	-9.16
Daily market volatility 1.2%	14.53	14.04	1.03	-12.45

Holding period returns pre, during and post U.S. Great Depression and Global Credit Crisis crashes

Crash period	Economic event	Before	The crash	After	Full sample
		Market index			
Sep 3, 1929-Jul 8, 1932	Great Depression	40.23	-83.84	334.01	-1.62
		[40.23]	[-41.89]	[34.12]	[-0.17]
Oct 9, 2007-Mar 9, 2009	Global Credit Crisis	17.53	-54.32	218.65	71.06
		[17.53]	[-42.57]	[26.08]	[7.51]
		Target volatility of daily standard deviation of 1%			
Sep 3, 1929-Jul 8, 1932	Great Depression	44.55	-68.07	152.04	16.34
		[44.55]	[-28.82]	[20.31]	[1.63]
Oct 9, 2007-Mar 9, 2009	Global Credit Crisis	22.56	-38.40	149.31	88.23
		[22.56]	[-29.03]	[20.05]	[8.91]
		Target volatility of daily standard deviation of 0.8%			
Sep 3, 1929-Jul 8, 1932	Great Depression	34.70	-59.05	111.09	16.42
		[34.7]	[-23.35]	[16.12]	[1.64]
Oct 9, 2007-Mar 9, 2009	Global Credit Crisis	17.63	-30.28	111.99	73.84
		[17.63]	[-22.54]	[16.21]	[7.75]

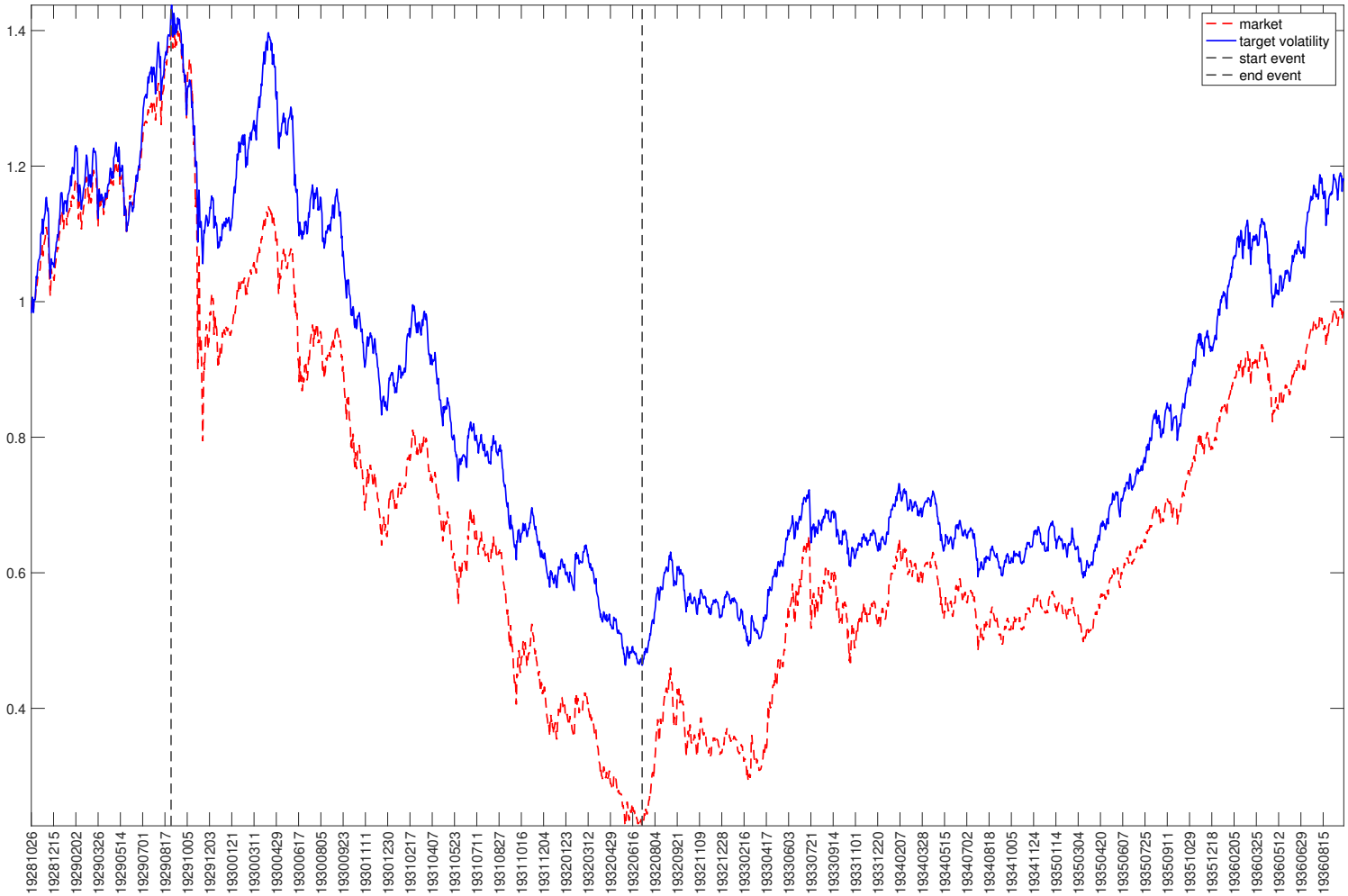
One year prior to the crash, the crash period, five years post crash, target volatility daily 1% or 0.8% standard deviation of market returns, daily threshold weight change 0.1 and maximum participation 1.5., annual returns in brackets [].

Annualized volatility pre, during and post U.S. Great Depression and Global Credit Crisis crashes

Crash period	Economic event	Before	The crash	After	Full sample
Market index					
Sep 3, 1929-Jul 8, 1932	Great Depression	15.65	33.76	28.88	29.77
Oct 9, 2007-Mar 9, 2009	Global Credit Crisis	13.05	37.11	18.65	22.86
Target volatility of daily standard deviation of 1%					
Sep 3, 1929-Jul 8, 1932	Great Depression	18.23	18.93	16.82	17.83
Oct 9, 2007-Mar 9, 2009	Global Credit Crisis	16.14	20.91	15.18	16.59
Target volatility of daily standard deviation of 0.8%					
Sep 3, 1929-Jul 8, 1932	Great Depression	14.83	15.11	13.53	14.31
Oct 9, 2007-Mar 9, 2009	Global Credit Crisis	13.64	16.56	12.03	13.26

One year prior to the crash, the crash period, five years post crash, target volatility daily 1% or 0.8% standard deviation of market returns, daily threshold weight change 0.1 and maximum participation 1.5.

Crash from Great Depression



Holding period returns pre, during and post COVID-19 crash

Portfolio	Before	The crash	After	Full sample
		Market index		
Equity	5.46	-34.27	41.55	-1.89
	[50.02]	[-98.99]	[255.73]	[-3.78]
Balanced	4.29	-23.52	28.20	2.26
	[37.85]	[-94.71]	[147.79]	[4.60]
		Target volatility of daily standard deviation of 1%		
Equity	5.51	-18.61	18.51	1.77
	[50.62]	[-89.52]	[85.92]	[3.60]
Balanced	4.35	-12.64	13.86	3.80
	[38.38]	[-77.24]	[60.67]	[7.80]
		Target volatility of daily standard deviation of 0.8%		
Equity	4.74	-16.19	13.44	-0.42
	[42.44]	[-85.56]	[58.52]	[-0.84]
Balanced	3.84	-11.02	10.62	2.21
	[33.33]	[-72.17]	[44.57]	[4.51]

Pre crash period (1 January 2020 to 19 February 2020), crash period (19 February 2020 to 23 March 2020), post crash period (23 March 2020 to 30 June 2020), annualized returns in square brackets. Equity is value-weighted CRSP index, including dividends and balanced portfolio invests 65% in equity markets and 35% in bond markets. Target volatility daily 1% or 0.8% standard deviation of market returns, daily threshold weight change 0.1 and with maximum participation rate of 1.5

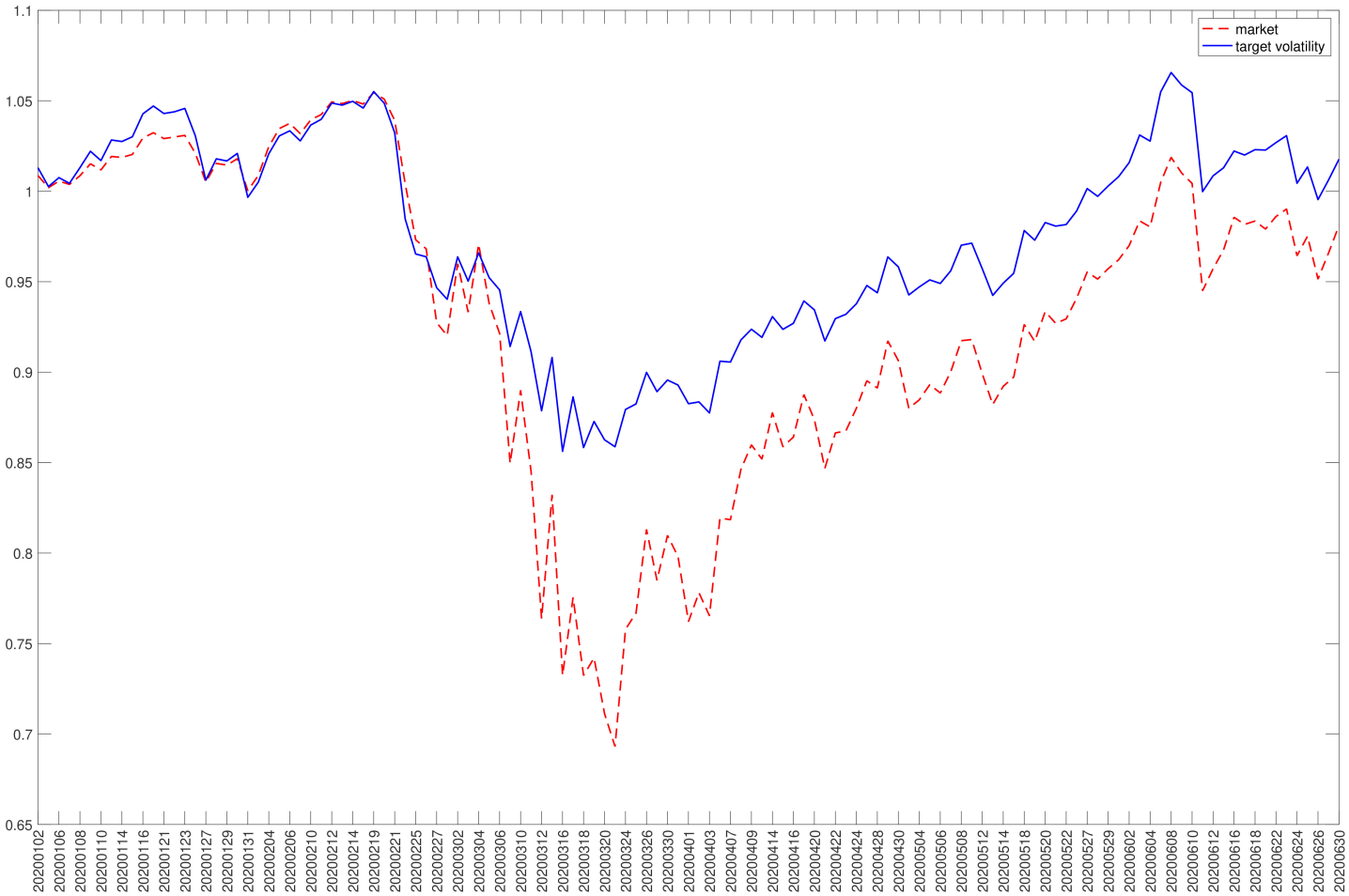
Annualized volatility of returns (in percent) pre, during and post COVID-19 crash

Portfolio	Before	The crash	After	Full sample
		Market index		
Equity	11.35	79.28	38.19	46.07
Balanced	6.71	50.47	24.79	29.64
Target volatility of daily standard deviation of 1%				
Equity	15.13	38.93	20.52	24.58
Balanced	9.19	24.44	13.14	15.62
Target volatility of daily standard deviation of 0.8%				
Equity	12.68	31.92	16.16	19.94
Balanced	7.62	20.10	10.34	12.68

Pre crash period (1 January 2020 to 19 February 2020), crash period (19 February 2020 to 23 March 2020), post crash period (23 March 2020 to 30 June 2020), Equity is value-weighted CRSP index, including dividends and balanced portfolio invests 65% in equity markets and 35% in bond markets. Target volatility daily 1% or 0.8% standard deviation of market returns, daily threshold weight change 0.1 and with maximum participation rate of 1.5.

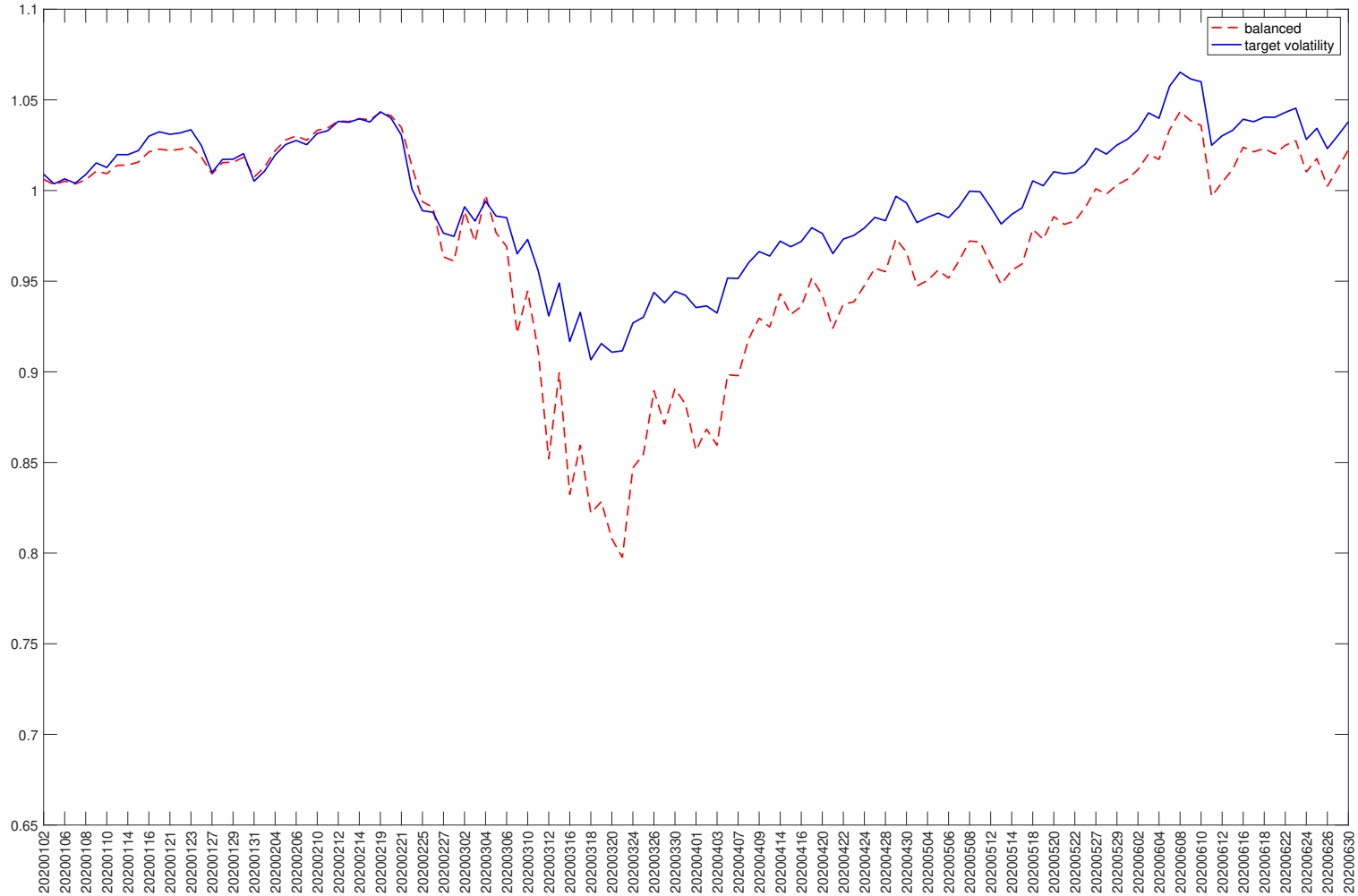
Equity portfolios over the COVID-19 pandemic

US January to June 2020



Balanced portfolios over the COVID-19 pandemic

US January to June 2020



Equity Portfolios for Crisis Periods and Post Crisis, COVID-19 Crisis - Comments

- Target volatility strategies with target volatility of historical market daily volatility reduced downside risk substantially for Great Depression, Global Credit Crisis and COVID-19 market crashes.
- During the COVID-19 pandemic (from 19 February 2020 to 23 March 2020), equity market (CRSP value-weighted index, including dividends) fell 34.27 percent and targeted volatility strategy had a drawdown of 18.61 percent.
- Balanced portfolio with targeted volatility with 65:35 equity bond split had a portfolio decline of 23.52 percent and with targeting average daily volatility on the equity component, the decline was only 12.64 percent.
- Downside, enhanced return and volatility benefits from both targeted volatility for equity and equity and bond holdings in the balanced fund for the COVID-19 crash.

Concluding remarks

- Target volatility strategies have theoretical and empirical support - effective forecasting of volatility to increase or decrease equity exposures enhances return and limits downside, particularly in market crashes.
- Strategies are readily applied for equity only portfolios, balanced portfolios and target date portfolios and are relevant for insurers with variable annuities, pensions funds offering balanced funds and target date funds, or for a return enhanced alternative investments fund.
- Leverage does not impact significantly the higher return per unit risk provided by target volatility strategies, nor the maximum draw-down (minimum return).
- Target volatility strategies enhance return by limiting downside for a range of major market crashes in US including the recent COVID-19 Crisis.

Questions and Discussion

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Questions and Discussion

Insurance: Mathematics and Economics Paper
https://doi.org/10.1016/j.insmatheco.2018.09.010

Original Working Paper
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2614828

Disclosure: Michael Sherris is a Co-Founder and Director of the UNSW staff spinout Qforesight Pty Ltd, established to commercialise Target Volatility research carried out at UNSW and subsequently developed for commercial application.

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