GLADIUS CAPITAL MANAGEMENT LP

Plan Rebalancing Utilizing Options

CBOE – Risk Management Conference

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REBALANCING BACKGROUND

- Asset class allocation is a key determinant of long-term portfolio performance
  - Fixed asset class allocation targets to keep any one asset class from dominating the returns
- Rebalancing in general reduces risk and enhances risk-adjusted returns
  - Dominant sources of portfolio variation for large scale US pension plans tend to be equities, fixed income, and FX
- Portfolio rebalancing is operationally a buy low, sell high strategy
  - The asset that is below its target allocation is bought, while selling the asset that is above its target allocation
  - A contrarian strategy – buying more of the asset that has shown losses while selling some of the asset that has shown gains – that can be uncomfortable to implement
  - An increase in asset fluctuations triggers rebalancing
    - Plan is effectively ‘long volatility’

APPROACHES TO REBALANCING

- Two approaches to rebalancing:
  - Physical based
    - The traditional way to rebalance is to buy and sell the physical assets directly
      - Physical rebalancing can be range based but is often done at specific times of the month adding one more variable dependency
        - This can actually reduce the number of times physical rebalancing occurs
  - Option based
    - Use exchange-traded options which also accomplish the buying and selling of physical assets, but with the added benefit of collecting an upfront cash premium
      - Monetize the Plan's embedded 'long volatility' position
      - Keep premium even if rebalance does not occur
        - Can be a very significant source of income

REBALANCING BETWEEN ASSET CLASSES

- Mechanics of physical-based rebalancing
  - If equities outperform bonds sufficiently, moving equities to an overweight
    - Sell equities, buy bonds

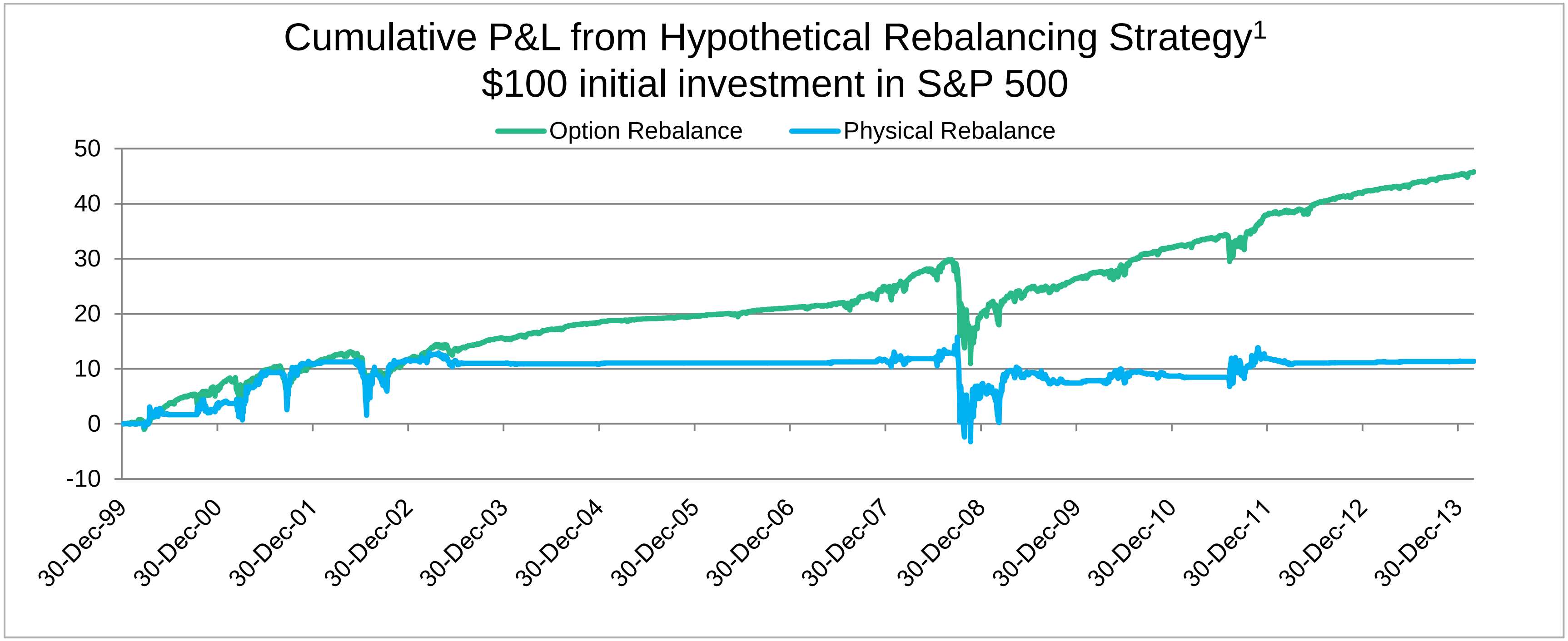
- Mechanics of option-based rebalancing
  - Sell options on equity portfolio with strikes corresponding to rebalancing triggers
  - If upper trigger is hit
    - Short upper trigger option equivalent to selling equities
      - Buy bonds
  - If lower trigger is hit
    - Short lower trigger option equivalent to buying equities
      - Sell bonds
  - Options are sold only on equities, not bonds
    - Bond option premiums are much lower
    - Relative volatility differences between the asset classes

WHY USE OPTIONS TO REBALANCE?

- Index options are historically expensive
  - Demand outstrips supply leading to an elevated implied volatility level
  - Gives edge to rebalancing with options

- Collect premium upfront when selling options
  - Keep premium regardless of whether rebalancing takes place
    - Theoretically, if the Plan was a seller or buyer of equities at those levels, regardless of whether the strike ends in or out of the money, the Plan should be better off collecting the premium
  - Gives clarity to the plan’s behavior during different market periods allowing for predictive risk modeling

WHY USE OPTIONS TO REBALANCE?



Source: Gladius Proprietary Data

Environmental Dependencies for an option-based rebalancing strategy:

- Can outperform or underperform based on implied volatility levels
- Some path-dependency particularly in low volatility markets

[1]The above graph makes certain assumptions which may prove not to be valid and could lead to performance which deviates from what is presented above. These performance results are also hypothetical and derived from model testing but are NOT actual results. The P&L presented is NOT net of any potential fees. This information neither guarantees gains nor ensures losses will be avoided. Past performance is no indication of future results. Please refer to the Disclaimer on Page 2. Additional information is available upon request.

GLADIUS OPTION REBALANCING PROGRAM

- Gladius has managed rebalancing programs since 2011 for institutional clients
  - We recommend a blended approach between physical & option based strategies
    - Allows for the retention of some optionality on whether to trade

- Gladius' role is to work with the end client on determining relevant trigger points for portfolio rebalancing and design and implement option strategies to most efficiently capture the desired behavior
  - Optimization of volatility surfaces coupled with understanding street dynamics & liquidity
  - Expertise in execution
  - Fiduciary alignment

- Bespoke programs - tailored to each specific plan as no asset allocation policies are alike
  - Benchmark allocations
    - Matching tracking errors where liquidity in listed option markets does not exist against specified benchmarks
  - Existing asset mix including geographical weightings
  - Liquidity considerations of underlying plan (funding levels, etc..)

GLADIUS OPTION REBALANCING PROGRAM

- **Frictional Costs**
  - Minimization of frictional costs is the single most critical element of implementation
    - One bad trade can be extremely costly
  - Currently, Gladius has executed option notionals of approximately 24 billion USD for option-based rebalancing programs
    - Aggregate frictional costs across multiple global markets were less than 2 bps*

*The data presented on this page is derived from Gladius proprietary sources. Further details are available upon request.

INSTRUMENT DURATION

- Selection of relevant instruments is extremely important
  - Forward risk, such as dividends, rates, implied borrow
  - Counterparty risk
  - Ability to monetize
  - Liquidity of underlying asset (listed versus OTC)
  - Collateralization rules
    - Clearing of OTC derivatives would cause significant capital posting among the current OTC community
  - Ability to react to movements in other asset classes

WITH THANKS TO

- North Carolina Treasurer Investment Team
- Shawn Wischmeier and Michael Ruetz
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FOR ADDITIONAL INFORMATION

- Please email: info@gladiusgroup.com