BUILDING A BETTER PORTFOLIO
Balancing Performance and Liquidity
May 2020

Confidential - Not for Further Distribution
For Professional and Institutional Investor use only. Your capital is at risk and the value of investments can go down as well as up.

Grace (Tiantian) Qiu, PhD
GIC
graceqiu@gic.com.sg
+65 6889 8223

Junying Shen
PGIM IAS
junying.shen@pgim.com
+1 973 367 8198

Bruce D. Phelps, PhD, CFA
PGIM IAS
bruce.phelps@pgim.com
+1 973 367 6661
Asset Allocation With Illiquid Private Assets

- Private assets can complicate asset allocation:
  - Unique cash flow patterns – unexpected capital calls and distributions
  - Difficult and costly to liquidate
  - Cash flow demands can disrupt public market asset allocations

- Often, decision making of top-down asset allocation group is separate from that of the bottom-up private market deal team group

- How does the interaction of these two groups affect
  - Portfolio performance?
  - Liquidity risk?
Two Goals of the Paper

1. Model the interaction of top-down asset allocation with bottom-up private asset investing

2. Integrate liquidity management into a multi-asset, multi-period portfolio construction process
# Building Portfolios: Top-Down & Bottom-Up

## OASIS™ Framework Overview

### Top-Down Asset Allocation

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Passive %</td>
<td>no α - generally available for liquidity at low cost</td>
</tr>
<tr>
<td>(β Stocks + Bonds)</td>
<td></td>
</tr>
<tr>
<td>Public Active %</td>
<td>α generating – liquid but costly to provide liquidity</td>
</tr>
<tr>
<td>(α Stocks + Bonds)</td>
<td></td>
</tr>
<tr>
<td>Private % (NAV)</td>
<td>Unavailable for Liquidity</td>
</tr>
</tbody>
</table>

### Bottom-Up Private Market Investing

#### Commitments

- Today: 2%
- 120m: 1%

#### Net Cash Flows

- Today: 0%
- 120m: -0.5%

Source: GIC EIS & PGIM IAS. Provided for illustrative purposes only.
## Key Features of OASIS

- Incorporates private asset commitment strategy into the measurement of a portfolio’s liquidity characteristics
- Models **Private Asset Cash Flows** and **Valuation**
- Reflects the unique characteristics of private assets such as the delay and uncertainty of capital calls and high idiosyncratic risk
- Allows CIOs to express views on the performance of private assets and their **fund-selection skill**
Answering Some Important CIO Questions

- How to formulate a **private asset commitment strategy** to manage private asset exposure and the uncertainty in timing and magnitude of their cash flows over time?
- What should be the **desired allocations** (public vs. private, public passive vs. public active) given my liquidity risk tolerance?
- How would various **market scenarios** impact my portfolio’s liquidity and performance?
Top-Down Asset Allocation

- A CIO defines which assets serve as liquidity sources
- A “waterfall” for sourcing liquidity
  - First sell assets from the least disruptive and expensive level
  - If more assets must be sold, then sell from more disruptive liquidity levels
- A liquidity event occurs when a CIO must move down the waterfall to source liquidity

<table>
<thead>
<tr>
<th>Portfolio Structure &amp; Waterfall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liquidity Sources for...</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Liquidity Level Description</th>
<th>GP Capital Calls</th>
<th>Rebalancing</th>
<th>Dry Powder Creation</th>
<th>Dry Powder Reversal</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Liquid Passive (β stocks + bonds)</td>
<td>Capital Call Reserve</td>
<td>✓</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Available for Liquidity</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>(2) Liquid Active (α stocks + bonds)</td>
<td>Only Available for Capital Calls if Level (1) is exhausted</td>
<td>✓</td>
<td>–</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>(3) Illiquid (NAV)</td>
<td>Unavailable for Liquidity</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Source: GIC EIS & PGIM IAS. Provided for illustrative purposes only.
Portfolio Structure – CIO’s Baseline Portfolio Structure

- For this presentation, we assume the following portfolio structure:

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Liquidity Level</th>
<th>Liquidity Level Description</th>
<th>Baseline Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Liquid Passive</td>
<td>1A</td>
<td>Committed, but Uncalled Capital Call Reserve</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>1B</td>
<td>Uncommitted Capital Call Reserve</td>
<td>0%</td>
</tr>
<tr>
<td>(2) Liquid Active</td>
<td>2</td>
<td>Passive Liquid Available for Liquidity</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Available for Capital Calls if Level 1 is exhausted</td>
<td>45%</td>
</tr>
<tr>
<td>(3) Illiquid (NAV)</td>
<td>3</td>
<td>Unavailable for Liquidity (LP Investment NAV)</td>
<td>15%</td>
</tr>
</tbody>
</table>

Note: Yellow field indicates an investor input. Liquid active management alphas are assumed to be 100bp/y for stocks and 50bp/y for bonds. Source: GIC EIS & PGIM IAS. Provided for illustrative purposes only.
A Portfolio Liquidity Risk Measure – Severity Scores

- A CIO can assign a subjective liquidity severity value to each type of liquidity event

### Liquidity Severity Values – An Example

<table>
<thead>
<tr>
<th>Liquidity Events</th>
<th>Severity Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebalancing Liquidity Shortage (1 type)</td>
<td>1B_RB</td>
</tr>
<tr>
<td>Dry Powder Creation Liquidity Shortage (1 type)</td>
<td>1B_DP</td>
</tr>
<tr>
<td>Dry Powder Reversal Liquidity Shortage (1 type)</td>
<td>1B_DP_RB</td>
</tr>
<tr>
<td>Capital Call Liquidity Shortage (3 types)</td>
<td>1B_CC</td>
</tr>
<tr>
<td></td>
<td>2_CC</td>
</tr>
</tbody>
</table>

Note: Yellow field indicates an investor input. Source: GIC EIS & PGIM IAS. Provided for illustrative purposes only.

- A portfolio’s liquidity severity score quantifies a portfolio’s liquidity risk, across different market environments
Bottom-Up Private Asset Investing

- CIO makes decisions on **how to invest in private assets**:  
  - Vintage diversification  
  - How quickly to build up and maintain private assets exposure (NAV% of overall portfolio)?

- These CIO decisions have **implications** for  
  - Timing and magnitude of net cash flows (i.e., distributions minus calls)  
  - Private asset valuation (NAV)

- Commitment strategy should **match CIO’s objectives**:  
  - Achieve zero net cash flows for minimal disruption to public portfolio; or  
  - Maintain NAV% of the entire portfolio; or  
  - Target a higher NAV% of the entire portfolio
Impact of Commitment Strategy Decision

Given a portfolio asset allocation:
- Measures tradeoff between performance and liquidity risk, incorporating the commitment strategy design
- Helps to select appropriate commitment strategy

Comparison of Commitment Strategies

**Target NAV%**
- Target a certain horizon NAV%
- Stable commitment pattern
- Lower dispersion of NAV growth

**Cash Flow Matching (CFM)**
- Higher NAV% at horizon
- Few liquidity events, esp. in bad economic environments

Source: GIC EIS & PGIM IAS. Provided for illustrative purposes only.
Commitment Strategy & Liquidity Sensitivity to Market Environment

- **CFM**: Fewer 1A_CC liquidity events and uncorrelated with market environment
- **Target NAV%**: All 1A_CCs occur when market is below average
  ➔ Capital call liquidity shortages occur when liquidity is precious

**Liquidity Event Sensitivity to Market Environment**

Past performance is not a reliable indicator of future results. Source: Datastream, GIC EIS & PGIM IAS. Provided for illustrative purposes only.
Impact of Asset Allocation Decision

Given a commitment strategy:

- Evaluates impact on portfolio’s liquidity severity score and performance
- Helps make more informed asset allocation decisions

Private assets, given our assumptions, are more efficient in generating performance than public active assets

Different Portfolio Asset Allocations

Source of both charts: GIC EIS & PGIM IAS. Provided for illustrative purposes only.
Market Scenarios: Impact of U-shape vs. V-shape Recovery

**Given a commitment strategy (e.g., Target NAV%)**

- Economic paths with a V-shape recovery lead to expected portfolio returns higher than those with a U-shape recovery
- A U-shape recovery encounters capital call liquidity shortages more often than a V-shape recovery
  - 3 vs. 0 quarters in 10y horizon

**Liquidity Events Arising from U-Shape and V-Shape Recoveries**

<table>
<thead>
<tr>
<th></th>
<th>U-shape</th>
<th>V-shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occurrence of 1A_CC in 10y</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Expected Horizon Portfolio Return</td>
<td>6.6%</td>
<td>11.3%</td>
</tr>
<tr>
<td>Economic Paths (of 5,000)</td>
<td>193</td>
<td>789</td>
</tr>
</tbody>
</table>

Source: GIC EIS & PGIM IAS. Provided for illustrative purposes only.
CIO Takeaways

CIOs can use the framework to

▪ Analyze how their bottom-up private asset investment activity interacts with their top-down asset allocation decisions

▪ Study how their portfolios are exposed to various liquidity events

▪ Examine how their portfolios behave in various market scenarios

▪ Evaluate the consequences of changing their views on private asset performance relative to public markets

➔ Help CIOs evaluate the tradeoff between expected portfolio performance and liquidity risk
Building a Better Portfolio: Balancing Performance and Liquidity
Important Disclosure

IMPORTANT INFORMATION

Past performance is no guarantee or reliable indicator of future results. All investments involve risk, including the possible loss of capital. These materials are for informational or educational purposes only. In providing these materials, GIC Private Limited and its affiliates (collectively, "GIC") and PGIM are not acting as your fiduciary. While GIC and PGIM have collaborated for purposes of conducting research and developing this material, GIC and PGIM are not joint ventures, affiliated in any way, or collectively providing or offering any services or products.

Alternative investments are speculative, typically highly illiquid and include a high degree of risk. Investors could lose all or a substantial amount of their investment. Alternative investments are suitable only for long-term investors willing to forego liquidity and put capital at risk for an indefinite period of time. Equities may decline in value due to both real and perceived global market, economic and industry conditions. Investing in the bond market is subject to risks, including market, interest rate, issuer, credit, inflation risk and liquidity risk. Commodities contain heightened risk, including market, political, regulatory and natural conditions and may not be suitable for all investors. The use of models to evaluate securities or securities markets based on certain assumptions concerning the interplay of market factors, may not adequately take into account certain factors and may result in a decline in the value of an investment, which could be substantial.

The analysis in the paper is based on hypothetical modeling. There is no guarantee, and no representation is being made, that an investor will or is likely to achieve profits, losses or results similar to those shown. Hypothetical or simulated performance results are provided for illustrative purposes only and have several inherent limitations. Unlike an actual performance record, simulated results do not represent actual performance and are generally prepared through the retrospective application of a model designed with the benefit of hindsight. There are frequently sharp differences between simulated results and actual results. In addition, since trades have not actually been executed, simulated results cannot account for the impact of certain market risks such as lack of liquidity. There are several other factors related to the markets in general in particular of any specific investment strategy, which cannot be fully accounted for in the preparation of simulated results and all of which can adversely affect actual results.

All charts contained herein were created as of the date of this presentation, unless otherwise noted. Performance results for certain charts and graphs may be limited by date ranges, as stated on the charts and graphs. Different time periods may produce different results. Charts and figures are provided for illustrative purposes and are not an indication of past or future performance of any PGIM product or GIC investment.

These materials represent the views, opinions and recommendations of the author(s) regarding the economic conditions, asset classes, businesses, securities or financial instruments referenced herein, and are subject to change without notice. Certain information contained herein has been obtained from sources that PGIM and GIC believe to be reliable; however, PGIM and GIC cannot guarantee the accuracy of such information, assure its completeness, or warrant such information will not be changed. The information contained herein is current as of the date of issuance (or such earlier date as referenced herein) and is subject to change without notice. PGIM and GIC have no obligation to update any of such information: nor do we make any express or implied warranties or representations as to the completeness or accuracy or accept responsibility for errors. Any forecasts, estimates and certain information contained herein are based upon proprietary research and should not be considered as investment advice or a recommendation of any particular security, or securities. These materials are not intended as an offer or solicitation with respect to the purchase or sale of any security or other financial instrument or any investment management services and should not be used as the basis for any investment decision. No liability whatsoever is accepted for any loss (whether direct, indirect, or consequential) that may arise from the use of any information contained in or derived from this report. PGIM and its affiliates and GIC may make investment decisions that are inconsistent with such recommendations or views expressed herein, including for proprietary accounts of PGIM or its affiliates or GIC. The opinions and recommendations herein do not take into account individual client circumstances, objectives, or needs and are not intended as recommendations of particular securities, financial instruments or strategies to particular clients or prospects. No determination has been made regarding the suitability of any securities, financial instruments or strategies for particular clients or prospects. For any securities or financial instruments mentioned herein, the recipient(s) of this report must make its own independent decisions.

The information contained herein is collectively provided by GIC, Singapore’s sovereign wealth fund and PGIM, Inc., the principal asset management business of Prudential Financial, Inc. ("PFI"), and an investment adviser registered with the US Securities and Exchange Commission. PFI of the United States is not affiliated in any manner with Prudential plc, incorporated in the United Kingdom or with Prudential Assurance Company, a subsidiary of M&G plc, incorporated in the United Kingdom. In the United Kingdom and various European Economic Area ("EEA") jurisdictions, the information provided by PGIM, information is issued by PGIM Limited with registered office: Grand Buildings, 1-3 Strand, Trafalgar Square, London, WC2N 5HR. PGIM Limited is authorised and regulated by the Financial Conduct Authority of the United Kingdom ( Firm Reference Number 103418) and duly passported in various jurisdictions in the EEA. For the information provided by PGIM, these materials are issued by PGIM Limited to persons who are professional clients or eligible counterparties for the purposes of the Financial Conduct Authority’s Conduct of Business Sourcebook. In certain countries in Asia, for the information provided by PGIM, information is presented by PGIM (Singapore) Pte. Ltd., a Singapore investment manager registered with and licensed by the Monetary Authority of Singapore. In Japan, for the information provided by PGIM, information is presented by PGIM Japan Co. Ltd., registered investment adviser with the Japanese Financial Services Agency. In South Korea, for the information provided by PGIM, information is presented by PGIM, Inc., which is licensed to provide discretionary investment management services directly to South Korean investors. In Hong Kong, for the information provided by PGIM, information is presented by representatives of PGIM (Hong Kong) Limited, a regulated entity with the Securities and Futures Commission in Hong Kong to professional investors as defined in Part 1 of Schedule 1 of the Securities and Futures Ordinance. In Australia, for the information provided by PGIM, this information is presented by PGIM (Australia) Pty Ltd., ("PGIM Australia") for the general information of its “wholesale” customers (as defined in the Corporations Act 2001), PGIM Australia is a representative of PGIM Limited, which is exempt from the requirement to hold an Australian Financial Services License under the Australian Corporations Act 2001 in respect of financial services. PGIM Limited is exempt by virtue of its regulation by the Financial Conduct Authority (Reg: 103418) under the laws of the United Kingdom and the application of ASIC Class Order 03/1096. The laws of the United Kingdom differ from Australian laws. Pursuant to the international adviser registration exemption in National Instrument 31-103, PGIM, Inc. is informing you of that: (1) PGIM, Inc. is not registered in Canada and relies upon an exemption from the adviser registration requirement under National Instrument 31-103; (2) PGIM, Inc.’s jurisdiction of residence is New Jersey, U.S.A.; (3) there may be difficulties enforcing legal rights against PGIM, Inc. because it is resident outside of Canada and all or substantially all of its assets may be situated outside of Canada; and (4) the name and address of the agent for service of process of PGIM, Inc. in the applicable Provinces of Canada are as follows; in Quebec: Borden Ladner Gervais LLP, 1500 De La Gauchetiere West Street, Suite 900 Montreal, QC H3B 5A4; in British Columbia: Borden Ladner Gervais LLP, 1200 Waterfront Centre, 200 Burrard Street, Vancouver, BC V7X 1T2; in Ontario: Borden Ladner Gervais LLP, 22 Adelaide Street West, Suite 3400, Toronto, ON M5H 4E3; in Nova Scotia: Cox & Palmer, Q.C., 1100 Purdy’s Wharf Tower One, 1950 Upper Water Street, P.O. Box 2380 - St. Central RPO, Halifax, NS B3J 3E5; in Alberta: Borden Ladner Gervais LLP, 530 Third Avenue S.W., Calgary, AB T2P 3R3. PGIM, the PGIM logo and Rock design are service marks, and OASIS is a trademark, of PFI and its related entities, registered in many jurisdictions worldwide.