Research Working Paper Series

Benefits (and Pitfalls) of Long-Term Investing

Dr Geoff Warren
Research Director
Centre for International Finance and Regulation

This page intentionally left blank

Benefits (and Pitfalls) of Long-Term Investing

Dr Geoff Warren

Centre for International Finance and Regulation

Geoff.Warren@cifr.edu.au

OCTOBER 2014

Synopsis

This paper outlines the benefits of long-term investing, as well as the pitfalls. Three key advantages held by long-term investors include: the capacity to adopt positions where payoff timing is uncertain; the ability to exploit opportunities generated by the actions of short-term investors; and latitude to invest in unlisted and/or illiquid assets. These advantages provide access to a broader investment opportunity set than available to short-term investors. Strategies suited to long-term investors include: capture of risk premiums arising from the actions of short-term investors; returns from liquidity provision; value investing; exploiting pricing discrepancies across segmented markets; long-term thematic investing; adding economic value to assets through engagement and control; investing in complex assets; and certain types of dynamic strategies. Pitfalls of long-term investing relate to their reliance on expectations about the long-term, when the distant future can be hard to predict; and vulnerabilities related to organizational, agency and alignment issues. Investing in illiquid assets and dynamic strategies are examined in detail.

1. Introduction

We consider the benefits and pitfalls of long-term investing. We highlight how long-term investors have access to a broader range of investment strategies, many of which stem from opportunities related to the actions or aversions of the shorter-term investors which can dominate markets. This makes long-term investing worth pursuing, at least for those who have scope to do so. We also warn that long-term investing holds no guarantee of success. A long-term investor still needs to execute well; and there are various pitfalls to skirt. How to design an investment organization to successfully pursue long-term investing is the topic of the next paper.

This paper comprises two parts. Part A addresses the general concepts: those who want to draw out the main messages may want to focus on these sections. Advantages held by long-term investors when operating in asset markets are identified, and linked to a range of investment strategies suited to those with long horizons. The pitfalls of long-term investing are also discussed. Part B examines two of these strategies in detail: returns from exposure to illiquidity, and dynamic strategies aimed at improving investment outcomes over the long haul. This is the second paper in a series on long-term investing by institutional investors. The first paper (Warren, 2014a; 'Paper 1') examines the nature and determinants of investment horizon, as well as the debate on short-termism versus long-term investing. The third paper (Warren, 2014c; 'Paper 3') puts forward our recommendations and suggestions for designing investment organizations with a long-term approach, drawing on the experience of the Future Fund.

In Paper 1, we propose two characteristics of a long-term investment horizon: discretion over trading; and an investment approach that focuses on long-term value and returns, as opposed to near-term price changes. We build on these notions in identifying three advantages held by long-term investors. The first advantage is the capacity to adopt positions where payoff timing is uncertain. This advantage directly flows from the ability to hold positions through difficult times as a consequence of having discretion over trading; and is abetted by a focus on long-term value or returns when identifying opportunities. The second advantage is the ability to exploit opportunities generated by the actions of short-term investors. Such opportunities can arise as a consequence of short-term investors either being required to trade or being short-sighted in their evaluations, thus leading to assets becoming either mispriced or offering unusually high (or low) long-term expected returns. In some circumstances, this may be mutually beneficial, given the diffuse motives and incentive structures of different investors. The third advantage is the latitude to invest in unlisted and/or illiquid assets, which widens the range of accessible investments. This advantage reflects the nature of unlisted and illiquid assets, investment in which typically requires discretion over trading and a long-term approach.

A key benefit of long-term investing is that it offers access to a broader opportunity set. Long-term investors can, in theory, attempt to implement any strategies available to short-term investors, plus some. Eight investment strategies are identified that are most suitable for long-term investors, allowing them to exploit their advantages. These strategies are briefly detailed in Figure 1 on pages 11-12. Two strategies - risk premium capture and liquidity provision - rely on exploiting opportunities generated by short-term investors. We list a range of premiums associated with risks to which short-term investors may be averse, including short-term market fluctuations (market risk premium, volatility premium), illiquidity, commodity price risk, insurance exposures and the risk of underperforming a benchmark or peers. Other strategies are suitable to long-term investors largely because of payoff timing uncertainty, or because they involve illiquid assets. These include: value investing; exploiting pricing discrepancies across segmented markets; long-term thematic investing; adding economic value through engagement and control; and investing in complex assets. Long-term investors are also suited to dynamic strategies which recognize that expected returns can fluctuate, thus creating opportunities to lower risk and/or enhance returns earned over the passage of time.

We also address the pitfalls of long-term investing. Long-term investing is no guarantee of success: a long-term investor must still execute well. Perhaps the gravest danger relates to errors in forming long-term expectations,

in particular mis-estimating long-term value or expected returns. Long-term investments typically involve a high level of commitment due to their long duration and sometimes illiquid nature. Getting expectations wrong may lead to being lodged in an underperforming asset for an extended period before the error is discovered, after which unwinding the position may prove tortuous and costly. The task is made all the more difficult because long-term prediction is hard, given the potential for regime shifts and the proliferation of possible outcomes over an extended time horizon. Feedback mechanisms can be hazy, as any misconceptions about the long term may take time to become apparent. Further, long-term investors face a number of points of vulnerability that are rooted in organizational, agency and behavioural influences. While long-term investments may attract broad support at the outset, commitment to positions can be sorely tested on many levels if success does not become evident within a certain period of time. Long-term investing programs can also be hampered by issues of alignment with employees or external managers who may be operating on shorter horizons.

Having established the general concepts, Part B then drills down into two areas of particular interest: illiquidity, and dynamic strategies. While access to the illiquidity premium is typically considered a major benefit of long-term investing, it is often interpreted simplistically. The central issue is the extent to which illiquid assets are priced to compensate for the expected additional costs, risks and constraints associated with illiquidity. These include higher transaction costs, the additional cost of sourcing and maintaining investments, the risk of being required to sell at unattractive prices at the wrong time, and the possibility of ending up with a sub-optimal portfolio due to failure to trade. Long-term investors may extract additional returns where they are less impacted by these costs and risks than the marginal investor. As the marginal investor can vary across markets and through time, the illiquidity premium is neither consistent nor ubiquitous. At times there may be no meaningful illiquidity premium. It is dangerous to assume that a premium must be available just because an asset is illiquid. The message is that illiquid assets need to be considered in the context of the long-term value or expected returns on offer. Further, the time-varying nature of pricing for illiquid assets suggests they may be suitable targets for a dynamic approach.

The type of dynamic strategy we examine entails buying when asset prices are low and expected returns are high; and selling when prices are high and expected returns are low. Such strategies seek out mean reversion, and are closely aligned with value investing. Often opportunities will arise from the actions of short-term investors who are required to trade, notably in less liquid markets. We initially present a basic two-period model that outlines the nature of such strategies, and how they may enhance the risk/return trade-off for long-term investors at the expense of short-term investors. We then address their practical application, which is illustrated using data for Australian unlisted property. We establish that there are two potential strategies. One involves committing to an asset with the willingness to sell if prices move too high. The other entails withholding investment with an intention to buy if prices move too low, e.g. retaining cash as an option on future opportunities. Our analysis suggests that a mix of both can be optimal in many circumstances, implying being partially invested and holding some cash in reserve. A caveat is that there must be a sufficiently high probability of a meaningful price decline within a reasonable time to justify holding cash. We also demonstrate that dynamic strategies are not just return-seeking, but can reduce risk over the long term; and how they may result in extended periods of underperformance before paying off. The latter attribute makes them mainly suitable for long-term investors.

This paper is arranged as follows. Part A covers the key concepts over four sections. Section 2 provides background, including a brief recap of the literature on the benefits of long-term investing, as covered in Paper 1. Section 3 discusses the three advantages held by long-term investors, and identifies the eight investment strategies that they are well suited to pursue. Section 4 addresses the pitfalls of long-term investing. Section 5 provides a general conclusion. Part B singles out two areas for examination in depth. Section 6 considers the returns from exposure to illiquid assets. The final two sections investigate dynamic strategies. Section 7 presents the underlying concepts and a basic model. Section 8 addresses their practical application - discussing implementation issues, and illustrating a dynamic strategy using property market data.

Part A

General Concepts

2. Background

Paper 1 provided an overview of the private and public benefits of long-term investing as purported in the literature. Our prime focus in this paper is the *private benefits* that might accrue to institutional investors in particular. The range of benefits identified in the literature is recapped below, listed under three headings: return opportunities, lower costs and reduced risk. The list provides the backdrop for Section 3, where we establish a framework for identifying the benefits of long-term investing.

(a) **Return opportunities** – The literature highlights various return opportunities that are well suited to long-term investors, including:

- *Exploiting mispricing*s: This concept is closely related to value investing. It partly derives from the idea that some combination of short-termism, information uncertainty and limits to arbitrage can lead to prices deviating from fundamental value, which might be exploited by investors with longer horizons, see Treynor (1976), Ang and Kjaer (2011), WEF (2011).

- *Accessing risk premiums:* By far the major focus of most commentators is the illiquidity premium, e.g. Ang and Kjaer (2011); Croce et al. (2011); WEF (2011); ASFA (2014). Section 6 of this paper provides a critical review of the illiquidity premium. Other risk premiums mentioned as suited to investors with longer horizons include: the rewards of dealing with complexity (Treynor, 1976; WEF, 2011); the volatility premium (Jones, 2012; Warren, 2012); and the market risk premium in general (WEF 2011).

- *Rewards from providing liquidity:* Croce et al. (2011) point out that illiquidity in markets holds out not only the prospect of illiquidity premiums, but also implies opportunities for making returns by providing liquidity when it is needed and valued.

- *Capturing long-term themes:* WEF (2011) suggests that long-term investors are well placed to take advantage of secular themes or macro trends.

- *Value-add opportunities:* The notion that long-term investors can benefit from helping to improve corporate decision-making through engagement is implicit in a wide-ranging literature discussing the link between investor horizon and effective monitoring (e.g. Kay, 2012). It is identified explicitly by WEF (2011). Illiquid, unlisted assets also present a range of opportunities to add value that may not be present in listed markets, including scope to add economic value to assets directly (Kaiser, 2005); exploiting the information asymmetries[1]; and taking advantage of disparate pricing across markets that are segmented due to illiquidity or other pricing frictions.

(b) **Lower costs** – Long-term investing can lower costs by controlling leakages that arise from aspects such as unnecessary turnover; forced sales; behavioural errors (e.g. buying high, and selling low); and misalignment between managers and end-investors (see Gray, 2006; Croce et al., 2011; WEF, 2011). Ambachtsheer et al. (2013) identify the leakages from the investment chain arising from adopting a short-term perspective, and then estimate the benefits from adopting a long-term approach. They suggest that terminal savings might increase by 25% over a 20-year accumulation period through changes such as feasible reductions in turnover of assets and managers, engagement with companies to reduce unwarranted merger activity, and better-aligned incentive structures.

(c) **Reduced risk** – Two ways are suggested by which long-term investing may reduce risk:

- *Better diversification:* It is often claimed that long-term investors are better able to diversify, via a greater capacity to access a broader range of assets, including illiquid alternatives, and hence potentially

---

[1] The requirement to trade only on 'publicly available information' does not always apply in private markets.

create more efficient portfolios (see Sa-Aadu et al., 2010; Cumming et al., 2014). Illiquid alternative assets are often viewed as a path to diluting the heavy exposure to equity-related risks contained in most portfolios (see Leibowitz and Bova, 2007). However, this benefit is sometimes overstated.[2]

- *Risk is lower from a long-term perspective:* Some commentators allude to the idea that risk seems lower when viewed over longer horizons, e.g. Gray (2006). This perception is sometimes tied to 'time diversification' (see Kritzman, 1994; Thorley, 1995; Bennyhoff, 2009). However, in essence, it ultimately boils down to the influence of mean reversion, under which the annualized volatility of wealth reduces with horizon.

One issue with the benefits of long-term investing as identified in the literature is that they are often expressed as a grab-bag of notions or ideas, without any underpinning theory or conceptual basis. Treynor (1976) is a notable exception. Treynor's starting point is to specify the advantages held by long-term investors, and identify conditions under which long-term investing is likely to be successful. In Section 3, we draw and build on Treynor's tradition by presenting a general framework.

3. General Framework: Advantages and Strategies

We place the benefits of long-term investing within a framework in two stages. In Section 3(i), we identify *three advantages* held by investors with longer investment horizons, linking them to the discussion in Paper 1. Then in Section 3(ii), we relate these advantages to *eight investment strategies*. An account of how the Future Fund approaches selected strategies appears in Section 3(iii).

(i) Three Advantages Held by Long-Term Investors

Three key advantages held by long-term investors are:

a) Capacity to adopt and hold positions where payoff timing is uncertain;

b) Ability to exploit opportunities generated by short-term investors; and,

c) Latitude to invest in unlisted and/or illiquid assets.

These three advantages[3] directly stem from the two key indicators used to characterize investment horizon as proposed in Paper 1. Recapping, the first indicator is the extent of *discretion over trading*, i.e. the latitude that an investor has in deciding when they buy and sell. The second is related to *investment approach* or the manner in which investment decisions are made - specifically the information used and whether it focuses on drivers of long-term value and returns, as opposed to near-term price changes. The three advantages proposed comprise a

---

[2] The diversifying benefits of illiquid assets can appear greater than they are for two reasons. First, covariances can be understated due to pricing adjustment lags that stem from (generally infrequent) appraisal valuations and thin trading. Second, movements in illiquidity risk and equity risk premia may be more correlated than generally appreciated, to the extent that illiquid assets and equities both tend to perform poorly in times of tight liquidity conditions or during market crises.

[3] We received some feedback querying whether lower transaction costs and lower capital gains taxes should be recognized as key benefits of long-term investing. Arguably these are side-effects of longer holding periods, rather than a primary source of advantage in their own right. Net excess return is what matters, not minimization of costs. The real advantage held by a long-term investor relates to greater capacity to manage and optimize the trade-off between liquidating, paying the transaction costs and taxes, and investing a (diminished) amount elsewhere; versus continuing to hold and deferring the costs associated with exit. This advantage relates to discretion over trading. It is worth noting that some shorter-duration strategies can be high turnover and high cost, and yet generate high returns, e.g. momentum. We further develop the link between discretion over trading, investment horizon and costs in the context of discussing illiquidity in Section 6.

workable list that spans most of the benefits of being a long-term investor. The advantages as listed are not necessarily comprehensive or distinct. Indeed, they might be considered mutually reinforcing, such that the greatest opportunities should exist when all three advantages are evident.

Advantage 1: Capacity to Adopt and Hold Positions Where Payoff Timing is Uncertain

Long-term investors have the capacity to pursue investment opportunities where the timing of the payoffs is highly uncertain, but there is a high probability that it will occur eventually. Basically, they have the luxury to be primarily concerned with *if, rather than when,* a payoff will occur. This advantage is closely related to *patience* and the ability to be *far-sighted*. To successfully exploit this advantage, long-term investors need to be able to insulate themselves from the influence of near-term noise and uncertainties, and keep their sights on the ultimate goal. There should be little pressure to take action or deliver outcomes immediately. This requires discretion over trading and the capacity to focus on long-term value or returns, i.e. the two characteristics that indicate a long investment horizon. By contrast, the focus of short-term investors on near-term price changes can make it difficult for them to pursue such opportunities. Indeed, the aversion of many investors to such opportunities can be what permits them to occur in the first place. It is not unusual to see some investors avoiding what may be potentially attractive investments because of near-term uncertainties, the prospect of negative news flow for the immediate future, or the lack of evident 'catalysts' for market prices to adjust.

This advantage is implicit within many of the discussions in the literature. For instance, Treynor (1976) refers to "ideas that require reflection, judgment and special expertise for their evaluation and hence travel slowly." This is an acknowledgement that long-term investors are well suited to pursue investments where short-term uncertainty exists and value may only become evident over time. Jones (2012) mentions "tolerance for path-dependence", which is the conditional ability to withstand and survive losses along the path to securing gains. That is, long-term investors should have greater capacity to sustain positions regardless of the path by which returns are realized. However, being able to do so requires limited risk of losing funding (discussed as 'limits to arbitrage' by Shleifer and Vishny, 1997), and restraints on the organizational or behavioural pressures to react when losses occur (see first dot point in Section 4(ii)). Also relevant are the concepts of hyperbolic discounting (Laibson, 1997) and myopic loss aversion (Benartzi and Thaler, 1995). These attributes can engender inconsistency in the pricing of risky investments through time (see discussion in Paper 1). Long-term investors may be well placed to exploit any pricing anomalies associated with these aspects.

Advantage 2: Ability to Exploit Opportunities Generated by Short-Term Investors

A second advantage held by long-term investors is that they may be able to exploit opportunities that arise as a consequence of the actions of short-term investors. Paper 1 raised the idea that if the balance is tilted too far towards short-term investing in the markets, this may create opportunities for long-term investors. On one level, these opportunities may arise out of *mispricing* that stems from the actions of short-term investors (as argued by Treynor (1976) and others, for instance). However, 'mispricing' is not necessary. Opportunities can also arise from *differences between investors with varying horizon*s, such that short-term investors may be willing to reward long-term investors for facilitating their divergent needs. Scholes (2004) identifies two specific ways by which this can occur: liquidity provision and risk transfer.

Liquidity provision is closely related to returns from illiquidity, which is the focus of attention in Section 6, Section 7 and to a lesser extent Section 8. At this point we merely observe that long-term investors have a comparative advantage in providing liquidity to short-term investors. This advantage stems not only from discretion over trading. It is supported by the capacity to focus on long-term value and expected returns, which underpins evaluation of opportunities. The capacity to adopt positions where payoff timing is uncertain (i.e. advantage 1) may also play a role.

Opportunities related to risk transfer can arise where short-term investors value certain risks differently to long-term investors. Long-term investors would look to exploit this advantage through seeking out situations where prices are being set by short-term investors who require a premium to compensate them for a risk that operates within a shorter time frame. Alternatively, this might be interpreted as targeting situations where short-term investors are willing to 'pay' to mitigate some short-term risk. Listed below are some risks that are typically of more concern to short-term investors than long-term investors. Many of these risks reflect the drivers of investment horizon discussed in Paper 1.

- *Illiquidity risk* – The compensation for illiquidity risk is known as the illiquidity premium. It reflects the additional return required by the marginal investor for the risk that they could incur high transaction costs at inopportune times. The illiquidity premium can stem from the actions of short-term investors to the extent that the marginal investor has a short investment horizon. The illiquidity premium should be distinguished from returns to liquidity provision, which is addressed separately below. The effects of illiquidity are discussed in detail in Section 6.

- *Concern with short-term relative performance* – Some institutional investors will be concerned with the risk of underperforming either their benchmark or peer group over shorter horizons, due to the potential impact on funds under management, performance bonuses or careers.[4] The idea that pricing may reflect the influence of delegated management, combined with monitoring using benchmarks, is acknowledged within the academic literature.[5] In addition, short-term investors that are measured against peers may have an aversion to positions that require moving away from the herd. For example, it can be difficult to alter exposure to a widely-held asset class (e.g. equities) due to the peer risk entailed, even when prices or expected returns appear out-of-kilter from a long-term perspective. To the extent that asset prices are driven out-of-line with value on a long-term buy and hold basis by short-term investors focusing on their relative performance, opportunities may be presented for long-term investors.

- *Lack of tolerance for short-term market volatility* – Short-term investors may pay to avoid short-term market volatility as a whole for a number of reasons. Short-term volatility in asset values can matter where concerns exist over short-term obligations related to capital requirements, solvency or spending commitments, e.g. defined benefit fund sponsors, insurance companies, leveraged investments, and pension fund members nearing retirement. In addition, some institutional investors may be concerned with the impact of short-term market volatility on their own income, either via the effect on fund flows and hence assets under management, or their personal remuneration. This will particularly be the case where performance is evaluated on an absolute, rather than relative, basis. Behavioural factors can also decrease tolerance for short-term market volatility, e.g. myopic loss aversion (see Benartzi and Thaler, 1999).

- *Fluctuations in risk tolerance and associated risk premiums* – Risk premiums on offer may fluctuate where a short-term investor is the marginal investor, and their tolerance for accepting risk varies over time. Potential sources of such fluctuations include changes in investor risk aversion, and shifts in the perceived quantum of risk. Long-term investors may exploit these fluctuations where two conditions are met. The first is where they have a more stable (or less pro-cyclical) risk aversion than short-term investors. The second is where the quantum of risk differs across time horizons (Campbell and Viceira, 2005) and the fluctuations relate primarily to short-term risk. Either way, long-term investors would look to accept more

---

[4] Mandate requirements and rebalancing tolerances may also cause institutional investors to react to market developments, e.g. credit rating changes.

[5] The influence of institutions managing portfolios against benchmarks has been related to various pricing anomalies, including: the influence of index inclusion or exclusion on price movements (Petajisto, 2011) and valuation ratios (Belasco et al., 2012); outperformance of low beta and low volatility stocks (Baker et al.2011); and the amplification of volatility and generation of countercyclical Sharpe ratios (Basak and Pavlova, 2013). An overview of the economic implications of index inclusion is provided by Wurgler (2010). Vayanos and Woolley (2013) present a theory whereby momentum and reversal patterns are explained through the interaction between career-concerned institutional investors and fund flows.

risk if risk premiums spike due to heightened concerns over near-term risk by short-term investors, and conversely reduce risk exposures when premiums are low.

The capacity of long-term investors to accept risks to which short-term investors are averse requires a capacity to look through the period when exposure to risk is priced highly in the market, and focus on the payoff from holding the position through time. This requires an ability to determine long-term value or expected returns from taking the position, as well as discretion over trading to retain the exposure.

Advantage 3: Latitude to Invest in Unlisted and/or Illiquid Assets

The fact that long-term investors have greater latitude to invest in unlisted and/or illiquid assets presents them with a broader opportunity set than is available to short-term investors. Most of the associated benefits are recognized in the literature, and were identified in Section 2. They include: the possibility that unlisted and illiquid assets may be more subject to market imperfections that give rise to opportunities; adding economic value to unlisted assets through direct control; exploitation of information advantages in unlisted markets by certain investors; and scope for greater diversification. Unlisted assets may offer exposure to sectors, themes and strategies that are not readily available in listed markets.

The latitude that long-term investors have to adopt exposure to unlisted and/or illiquid assets relates to our two indicators of investment horizon. Unlisted and/or illiquid assets demand a longer investment horizon not only because illiquidity makes transacting costly, but also because the timeframe involved in establishing and subsequently exiting positions may be prolonged. The large cost and long lengths of time involved require commitment, which in turn calls for a focus on long-term value or expected returns when evaluating assets. Further, discretion over trading is required. While some degree of discretion is essential, investors that have considerable discretion can buy and sell when it is most beneficial to do so. Hence discretion over trading enhances their advantage from investing in this type of asset.

(ii) Eight Strategies Suited to Long-Term Investors

The main benefit of long-term investing is that it offers access to a broader opportunity set than is available to short-term investors. Long-term investors can, in theory, attempt to do anything that a short-term investor can do, plus some. Figure 1 lists and briefly describes eight classes of investment strategy that are suited to investors with long horizons. It also relates each strategy to the three advantages outlined above. Figure 1 aims to present an organized menu of opportunities which long-term investors may find beneficial to pursue. Most of the strategies are touched on either in Paper 1 or elsewhere in this paper. Part B delves into three of the strategies in detail: capturing the illiquidity premium (strategy 1b), liquidity provision (strategy 2) and dynamic strategies (strategy 8). Value investing (strategy 3) is also touched on in the process, given that the dynamic strategy being investigated is essentially value-based.

Figure 1: Strategies Suited to Long-Term Investor

Investment Strategy	Description	Advantage Being Exploited		
		Payoff Timing Uncertainty	Facilitating ST Investors	Unlisted / Illiquid Assets
1. Risk premium capture (risk transfer)	Market aversion to short duration risks can generate a range of premiums that might be captured by long-term investors.			
a) Market risk premium	Concerns over short-term losses have potentially contributed to the historically large market (equity) risk premium. Long-term investors are well placed to capture this premium, aided by any tendency towards mean reversion by markets over the long term.	Yes	Yes	Possibly
b) Volatility	A volatility premium is observed in variance swaps and volatility futures, with evidence that it is a manifestation of aversion to short-term market fluctuations. Specifically, pricing of volatility derivatives can be linked to large premiums on (OTM) put options.	Yes	Yes	No
c) Illiquidity premium	Long-term investors have scope to access a premium from illiquid assets to the extent they are less impacted by the costs and risks associated with illiquidity than the marginal investor. Key points of difference between short-term and long-term investors include the impact of transaction costs, and exposure to the risk of being forced to sell assets at considerable cost at the wrong time. These issues are discussed in detail in Section 6.	Yes	Yes	Yes
d) Commodities (backwardation)	The Keynes/Hicks theory of normal backwardation proposes that hedgers will pay risk premiums to speculators (investors) in forward commodity markets, which appears in the form of the 'roll yield'. However, it has been debated whether the 'financialization' of commodity markets might have attenuated any premium over more recent years.	Yes	Yes	No
e) Reinsurance	This involves accepting risks that insurers wish to shed due to concerns over short-term solvency, capital or poorly diversified books, e.g. catastrophe bonds.	Yes	Yes	Possibly
f) Relative performance risks	Situations may exist where the influence of benchmark or peer-relative risk can result in premiums being available. Examples include: low pricing for ex-benchmark assets; price effects from benchmark rebalancing; and low beta/low volatility anomalies.	Yes	Yes	Not central
2. Liquidity provision	This strategy entails two elements. First is capturing 'price impacts' by taking the other side of trades, including acting as market-maker or underwriter in private markets. Second is exploiting shifts in overall market pricing arising from fluctuations in liquidity levels or illiquidity risk premiums. The latter is discussed in detail in Sections 6 and 7.	Yes	Yes	Yes
3. Value investing	This entails buying assets that are underpriced and/or offering elevated expected returns; while avoiding those overpriced and/or offering low expected returns. Often it involves trading against momentum and market opinion. Payoff timing can be open-ended.	Yes	Possibly	Possibly

Investment Strategy	Description	Payoff Timing Uncertainty	Facilitates ST Investors	Unlisted / Illiquid Assets
4. Pricing discrepancies across segmented markets	Pricing discrepancies can occur across markets that are related yet segmented due to frictions. These discrepancies may stem from embedded behavioural biases, such as the psychologies or belief systems of distinct investor cohorts in insulated markets. They are best exploited by long-term investors, as these strategies often involve uncertainty in the mechanism and timing of any re-alignment. Examples include unjustified discrepancies between unlisted assets and their listed counterparts (e.g. unlisted property vs. REITs; unlisted vs. listed infrastructure); as well as geographical disparities (e.g. property markets across regions or countries; dual-listed stocks). Potential strategies range from selective direction of available funds; switching exposure between counterparts; and possibly direct arbitrage (only available where it is feasible to short the highly priced component).	Yes	Often	Often
5. Long-term thematic investing	Long-term thematic investing entails positioning to benefit from slow-moving but persistent trends. As the payoffs typically accumulate over time and may be swamped by volatility over the short-term, this strategy is mainly suitable for long-term investors and likely to be overlooked by short-term investors concerned with near-term price changes. Examples might include the impact of long-term macroeconomic trends, demographic changes, cultural shifts, technological developments and environmental change.	Yes	Not central	Possibly
6. Value-add through control and engagement	Long-term investors might apply their influence towards generation of additional returns through creation of economic value. This strategy relates to the concept of 'universal ownership'. It also incorporates adding value to private market assets. Strategies include: – Engagement with companies to encourage actions that enhance value (activism) – Sustainable investing (including SRI, ESG), specifically positive investing – Adding value to private assets by changing or incentivizing management, supplying finance, and possibly providing expertise (the private equity model).	Possibly	Not central	Often
7. Complex assets	Complex assets may be available at attractive prices as a consequence of opaque value, which can stem from information uncertainty or asymmetry, coupled with the time required for uncertainty to be resolved. Complex assets are well suited to long-term investors with the resources and patience to perform in-depth evaluation and wait for the payoff. Such assets are more likely to be available in private markets, but not necessarily.	Yes	Possibly	Often
8. Dynamic strategies	Dynamic strategies recognize that expected returns can vary through time. Their aim is to follow the optimal path in generating value over the long term. They typically involve buying when returns are high and selling when they are low, which often amounts to a counter-cyclical approach that stands against consensus. There may be overlap with other strategies, e.g. value investing. Dynamic strategies are examined in detail in Sections 7-8.	Often	Often	Possibly

(iii) How the Future Fund Approaches Selected Strategies

The Future Fund's perspective on some the strategies listed in Figure 1 is relayed below. Included is an account of how they view the illiquidity premium and approach thematic investing. They also have an interesting take on the inter-relation between value investing and momentum strategies.

Illiquidity Premium (Strategy 1c)

When the Future Fund invests in illiquid assets, it requires additional returns to compensate for three costs associated with illiquidity. The first relates to the loss of flexibility to reallocate capital to potentially more attractive opportunities for a defined period of time, without bearing unacceptably high transaction costs. They call this the 'opportunity cost of illiquidity', and note that some market participants would view the entire liquidity risk premium as related to this opportunity cost.[6] It reflects a surrendering of the right to sell a given investment for the minimum expected holding period should it become overvalued, or to buy equivalent investments (including liquid proxies) should they fall in value. The second component is the incremental 'cost of liquidity provision' for an illiquid investment. This cost is imposed by the need to effectively balance at-call liquidity requirements and currency risk at the portfolio level, in the presence of the greater pool of illiquid and/or offshore investments. The third component is the 'commitment cost of capital', and relates to the contingent liability of non-discretionary undrawn capital commitments. An example of the latter would be capital held aside to satisfy drawn-downs by private equity funds. The combination of these three components sets the required hurdle rate of return for investing in an illiquid asset, relative to a liquid equivalent.

The above characterization differs somewhat to the presentation of the illiquidity premium in this paper under Section 6. This reflects differing purposes. Section 6 aims to characterize the nature and source of the opportunity derived from illiquid investments. It focuses on what determines the 'gross' expected return on illiquid assets, and the conditions under which long-term investors are likely to earn returns in excess of their required return. The Future Fund characterization is directed towards building up the required return, to which the return on offer may be compared.

Thematic Investing (Strategy 5)

The Future Fund has identified seven secular themes that may influence the manner in which it invests.[7] These include: debt and deleveraging; policy and politics; demographics; globalization and emerging wealth; resource scarcity; technological innovation; and inflation. The Future Fund views the policy management of the deleveraging process in various parts of the developed world as the key driver of global economic outcomes at present.

While the Future Fund is prohibited under its Investment Mandate from direct investment or execution in overseas markets without ministerial exemption, it has collaborated with investment managers to access these themes. For instance, in 2010 the Future Fund co-invested with a manager to offer credit to small and mid-sized corporations in Europe, filling a market gap left by banks that had pulled away from providing credit. This investment aligned with the Future Fund's long-term themes, and could be seen as capturing an opportunity arising as a consequence of capital scarcity related to the actions of 'investors' responding to short-term pressures (in this case, tightening regulation and excessive leverage compelling European banks to shrink their balance sheets). Another example is the awarding of

---

[6] This opportunity cost could be priced as two barrier options: a 'down and in' call plus an 'up and in' put with 'knock-in' levels at a suitable spread around 'fair' or market value.

[7] An account appears in "The Wizards of Oz: Australia's Future Fund Investment Wizardry", *Institutional Investor*, 15 May 2013 (p28).

mandates to equity managers with the specific purpose of capturing the theme of increasing consumption related to the growth of the middle class in emerging markets. These investments are both good examples of the type of strategies that can be most readily pursued by long-term investors who are unconcerned with either an immediate payoff, or relative near-term performance versus a specific benchmark or peers.

Value Investing (Strategy 3) and Momentum

There is a general perception that value investing sits within the realms of longer investment horizons, while momentum strategies are inherently short term. This view is implicit across much of the commentary on long-term investing versus short-termism discussed in Paper 1. It also seems a natural conclusion given the high turnover and short holding periods typically associated with momentum strategies, often averaging less than a year. Nevertheless, the Future Fund maintains that momentum strategies may be of value to long-term investors. In addition to having proved a persistent source of excess returns (with behaviourial roots that suggest they may be sustainable), momentum investing can provide a source of both cross-sectional and temporal diversification for the natural value bias embedded in the portfolios of long-term investors. Value strategies are premised on mean reversion, and rely on successfully estimating the 'value' to which prices may eventually revert (see discussion in Section 4). One of the problems is that 'value' is a moving feast, as there is always potential for shifts in fundamentals, i.e. regime change. Combining momentum with value strategies may help to create a more robust long-term outcome by hedging some of the vulnerabilities of an inherent value bias related to the difficulty of anticipating shifts in value. That is, momentum strategies might help to protect the portfolio in instances where value shifts unexpectedly because they have a chance of 'latching on' to the underlying changes in fundamentals as they unfold.

4. Pitfalls of Long-Term Investing

Long-term investing is by no means a guarantee of success. Access to a broader opportunity set offers potential only. Long-term investors still must execute well. There is nothing about long-term investing that prevents mistakes. What differs is the type of errors to which long-term investors are most exposed, and their points of vulnerability. These are discussed below. We also identify some of the constraints that long-term investors may face.

(i)   Potential Errors: Forecasting the Distant Future Is Hard!

Arguably the most important error to which a long-term investor is exposed relates to incorrect expectations about the long term. Many long-term investment strategies rely on evaluating the potential long-term payoffs in terms of scope for correction of mis-pricings or the magnitude of long-term expected returns. While estimates may be explicit or implicit, any investment must be based on some sense for the magnitude of the opportunity, as well as the risk involved. Reliable estimates are not easy to come by. Errors can occur for a number of reasons. They could simply be the result of poor analysis or bad forecasting. Errors can also occur as a consequence of unanticipated changes to fundamentals along the path, such as regime shifts in the underlying profitability of an industry, the economic environment or market conditions. In some instances, gauging the opportunity can be difficult because the fundamentals are opaque. For example, potential returns under thematic investing can be tricky to explicitly estimate, and are subject to the inherent uncertainty of outcomes over long horizons. It can also be hard to judge the extent to which a given theme is priced at the point of entry.

The underlying issue is that forecasting the distant future is hard to do. What is known about the long term can be quite limited and often of low confidence. The future is replete with a multitude of

possible scenarios that may proliferate with horizon, and even trend towards entropy. The risk of regime shift is ever-present. There are few constants that can reliably generate returns over the long haul. Attributes such as competitive advantage, access to growth options and good management do not last forever. Indeed, predicting long-term outcomes is arguably harder than predicting what happens next within a prevailing regime. If long-term investing offers excess returns, it is not because the long term is easier to predict. It is because the long term is undervalued by the market.

The consequences of erroneous expectations can go beyond merely undermining the foundation for a position. Prediction errors can have particularly weighty implications when long-term investments are involved. This is because the feedback mechanisms are hazy when investments are based on expectations about a distant future that will not arrive any time soon. It can take some time before any errors start to become apparent. Long-term investors may find themselves holding an investment that has underperformed expectations over a considerable period before the error is fully recognized. The concept of 'value traps' is relevant here: assets that appear cheap are sometimes lowly priced for good reason, which may only become evident afterwards. Even once the error becomes apparent, extraction from such positions can prove problematic. Often an underperforming asset will continue trading on seemingly low prices, at which an exit may seem unjustified, even though the initial rationale for the position has disappeared. Further, many of the strategies pursued by long-term investors involve assets that entail commitment. For instance, it can be difficult to trade out of unlisted, illiquid or opaque assets. [8] And if their fundamentals are under pressure, a large haircut may be required to secure an exit. Many investors are reluctant to acknowledge sunk costs. Basically, long-term investors who make errors face the risk of getting 'locked-in' to underperforming positions. In contrast, short-term investors more typically invest in a manner that facilitates turning over their positions, including the utilization of stop-losses. They are less likely to get entrapped, and henceforth move on to try again.

The above discussion is related to the fundamental law of active management and the concept of breadth versus skill, which also has a time dimension (see Grinold and Kahn, 2011). Long-term investments tend to be of lower breadth to the extent that positions are adopted over longer periods and turned over less often. By contrast, short-term strategies, such as trading or momentum investing, tend to be higher breadth because more positions are taken per unit of time.[9] The fundamental law implies that strategies with lower breadth rely on greater skill to generate a given level of excess return. Equivalently, return forecasts need to be more accurate to ensure a level of success.

Another error that can be made by long-term investors is implementing at the wrong time or price. This issue is discussed with respect to dynamic strategies under Section 8, where the practical implementation of such strategies is addressed. Buying an asset too early or at a higher price than subsequently observed does not invalidate a position. However, it does entail an opportunity cost and implies a sub-optimal result. For many unlisted investments, implementation is rarely neat. Opportunities to secure assets may come up only occasionally, and pressure to 'secure the deal' may lead to an investor paying more than hoped. This is the risk of suffering the 'winner's curse'. Possessing discretion over trading and maintaining price discipline is required; but can prove difficult when time and resources have already been committed to a transaction.

(ii) Organizational, Agency and Alignment Issues

Three points of vulnerability are listed and discussed below that are rooted in problems related to organizational design, agency arrangements, alignment and associated behavioural effects. Dealing with these issues is a focus of our attention in Paper 3.

---

[8] Flyvjerg (2009) explains how the benefits from major infrastructure projects are often overstated. A related point is that undisciplined buyers may be exposed to overpaying for unlisted assets due to the 'buyers curse', aided by lack of any discipline on prices that might stem from the inability of informed players to short.
[9] Momentum and other high breadth strategies face their own problems, including the ability and cost of implementing (the implementation coefficient), and limits to the extent to which positions are truly independent.

- **Reliance on commitment and fortitude** – Success in long-term investing requires the capacity to sustain positions. Sometimes this can be difficult to achieve. It is possible for payoffs to take considerable time to eventuate, or for losses to be initially generated and then persist for an uncomfortable period. Under such circumstances, various organizational and behavioural influences may act to undermine commitment to positions. The fact that most investments are made under uncertainty without guaranteed success can help foster doubt and a questioning of underperforming positions. Such doubts can arise from various quarters. The investment board or the funding entity may have lower tolerance for short-term underperformance than initially presumed. Support for long-term investing may be expressed at the outset, but might prove not so solid in the face of seemingly poor results. Organizations comprise of individuals who may hold varying beliefs. Others with a different view may advocate for reversal of the position. Even those responsible for making a decision can suffer from self-doubt if a position is not turning out as expected. Positions are often adopted under agency arrangements. Doubt may be directed at the agent, notwithstanding broad support for the type of strategy being pursued. A response could be to blame the manager, sack them, and get a new one. Deciding whether to hold or fold is often a tortured decision. In some instances, the outcome may be to close a position that should have been retained.

- **Employee alignment** – Investment staff could be operating on shorter horizons than their organizations or the strategies they are pursuing, due to the fact that they are managing their own incentives or careers. Remuneration arrangements that are truly long-term are rare in the fund management industry, where it is standard practice to offer the prospect of regular bonuses. As an example, the Future Fund adopts a three-year evaluation period for the component of variable remuneration related to investment performance. This is clearly shorter than the horizon of the organization itself. While this shorter period aligns with their internal investment planning horizon, it also recognizes the realities of the market for investment talent. Investment staff may be concerned about their prospects for promotion or their own market value. Investment managers tend to be more attractive on the job market or have greater scope to set up their own operation if they have generated recent strong performance, than if their potential to deliver is yet to be demonstrated or is under a cloud.

- **Manager alignment** – A related consideration for long-term institutional investors is that their external managers may have short horizons. This can arise as a consequence of the influence of short-term performance on the success of both the fund management organization and its managers, due to the link to assets under management and remuneration. Such problems can be compounded when investing via open-ended, pooled vehicles.

(iii) Constraints

Long-term investors may also face constraints on their ability to pursue long-term investing, or make full use of the broader opportunity set they have available. For example, the fact that the Future Fund can use only external managers arguably limits their ability to pursue value-added strategies at the margin, as reliance must be placed on external agents to act on their behalf. However, the Future Fund has designed its investment process to 'optimize' around this constraint. In particular, they have forged creative and strategic partnerships with external managers and counterparties that emphasise strong alignment in order to mitigate principal-agent problems.

Typical constraints that may be faced by many long-term investors include the following:

- **Ability to respond to opportunities** – The ability to respond may be constrained by limited internal resources, or the time that is required to evaluate and trade unlisted assets. Opportunities that may appear to exist at face value may not be implementable due to a lack of suitable assets or vehicles. Asset allocation becomes harder to implement when illiquid assets are involved.

- *Mutually exclusive strategies* – Certain strategies may be mutually exclusive. For instance, harvesting risk premiums requires being invested, while liquidity provision needs cash to be held aside to facilitate purchases. Once risk budgets are spent, it becomes difficult to commit to a new opportunity that adds to the exposure. Further, any strategies that represent a real option will be spent once commitment is made and the option 'exercised'.

- *Lack of access to leverage or short-selling* – Some strategies may not be accessible due to borrowing or shorting constraints. For instance, a situation where unlisted property was valued more highly than REITs cannot be exploited beyond just selling out of unlisted property. As an aside, the Future Fund Act places very tight restrictions on the use of leverage by the Board of Guardians.

- *Currency effects* – International investments involve composite exposures of the underlying asset and its base currency, which can be hard to disentangle without potential consequences. In particular, neutralizing the currency exposure through hedging may have cash flow implications that could undermine the capacity to sustain positions over the long term. If an overseas asset is hedged and the investor's home currency depreciates, the loss on the hedging contract must be settled with cash. This can create difficulties if the asset being hedged cannot be liquidated, as the cash must be sourced from elsewhere in the portfolio.

5. General Conclusion

This paper addresses the benefits of long-term investing, as well as the pitfalls. Our two characteristics that indicate a long-term investment horizon – discretion over trading, and an investment approach that focuses on the long term – are traced through to three advantages, and henceforth to eight investment strategies that long-term investors may pursue in exploiting these advantages. Pitfalls for long-term investors are identified. The point that adopting a long-term horizon is no guarantee of success needs to be emphasized. Long-term investing may offer potential benefits, but execution is critical. In this respect, an investment management organization needs to be designed appropriately if long-term investing is to be pursued successfully. How this might be done is the central topic of the third paper in this series.

Part B of this paper now drills down to investing in illiquid assets and dynamic strategies.

Part B

Detailed Focus on Two Strategies:

A) Returns from Exposure to Illiquidity

B) Dynamic Strategies

6. Returns from Exposure to Illiquidity

It is entirely logical for investors to expect some additional return from illiquid assets, to the extent that illiquidity imposes costs, risks and constraints, which require compensation. This section reviews concepts and evidence relating to the nature and magnitude of the illiquidity premium. Two main messages emerge. This first is that illiquidity premiums are not necessarily substantial, ubiquitous or consistent. A sizable premium need not be available in all illiquid assets at all times. There is considerable evidence that compensation for illiquidity exposure varies over time. The second message is that, to the extent that illiquid assets do offer additional returns, the ability to access these returns will vary across investors. This follows from the notion that illiquid assets partly offer additional *gross* returns as compensation for their greater costs and risks; yet these costs impact on various investors to differing extents. Investment horizon is critical here: it is long-term investors that are best placed to extract maximum benefit from illiquid assets. A combination of a longer horizon and discretion over trading means that long-term investors are less impacted by both the costs and risks associated with illiquidity, for reasons we expand on below.

Our examination of the returns to illiquidity proceeds as follows. Section 6(i) discusses how illiquidity relates to investment horizon. Section 6(ii) follows with an investigation of how illiquidity manifests in asset pricing and asset returns. Having established the underlying concepts, Section 6(iii) then reviews the literature on illiquidity and asset pricing. Illiquidity has previously been investigated in some depth by the author in a previous paper (Leung and Warren, 2007). The discussion here draws upon that work, which is updated and redirected towards the implications for long-term investors. In particular, the global financial crisis (GFC) of 2007-2009 was instructive given that illiquidity played a central role, most notably in bond markets. It also spurred an active research agenda in related areas. Section 6(iv) summarizes by drawing out the implications for investors.

(i) Illiquidity and Investment Horizon – Basic Concepts

'Liquidity' has multiple meanings. Here it is discussed in an asset market context - also known as 'market liquidity'. A good definition is "the ability to trade large quantities quickly at low cost with little price impact" (Liu, 2006, p631). In essence, liquidity relates to the cost and ability to transact. Illiquid assets potentially have two adverse effects for investors. The first is that investing in illiquid assets is more costly, reflecting both higher transaction costs and the other costs associated with aspects like evaluating and maintaining investments. Second, illiquidity can give rise to risk related to transactional costs and ability, including the possibility that the investor may diverge from their 'optimal' portfolio due to any failure to transact (loss of flexibility).

Transaction and other costs play a central role in illiquidity. Illiquid assets are typically associated with higher transaction costs, particularly in terms of the price concessions needed to consummate a trade, i.e. wider bid-ask spreads and larger market impact. Many illiquid assets also entail significant additional other costs, such as those related to locating, evaluating, securing, monitoring and maintaining investments.[10] The opportunity costs identified by the Future Fund (see Section 3(iii)) might be considered as components of the additional costs associated with illiquidity. In particular, costs associated with the management of at-call liquidity facilities and the contingent liability of non-discretionary undrawn capital commitments both relate to maintaining an investment program

---

[10] Vayanos and Wang (2013) identify six market imperfections that contribute to illiquidity, including transaction costs, participation costs, asymmetric information, imperfect competition, funding constraints and search costs. Investors in illiquid assets may need to commit resources to build the infrastructure to deal with these imperfections. Many (although not all) illiquid assets involve private markets in which it is more costly to operate, be it either via direct investment or through managers, where fees are typically relatively high.

involving illiquid assets. Illiquid assets should be priced to provide an expected return that compensates for all expected costs, to the extent that they impact on the marginal investor.

A key feature of transaction costs is that their impact varies with investment horizon.[11] The longer an asset is held, the less that transaction costs reduce realized returns, as they get amortized across more periods (see Amihud and Mendelson, 1986). For example, transactions costs of 10% for a round trip (i.e. 5% on both purchase and sale) will roughly reduce returns by 10% if the asset is held over 1 year; but only 2% pa for a 5-year holding period; 1% pa for a 10-year holding period; and so on. Further, transaction costs may vary with market conditions and across investors.

Illiquidity can also manifest in a sub-optimal portfolio due to failure to transact, notwithstanding indications that trading is desirable. In such situations, the impact depends on the circumstances under which the investor doesn't transact. An investor can find themselves in one of three situations, each with increasingly severe consequences:

a) *Trading is feasible and optional, but it is costly* – Here an investor has the choice of whether to incur the cost of transacting (e.g. accepting a price discount to secure a sale), or persisting with a sub-optimal portfolio. In this situation, persisting with a sub-optimal portfolio may be chosen as the lesser of two potential 'costs'. Many of the theoretical models mentioned below in Section 6(ii) analyze comparable situations, under which they find that the cost of illiquidity is not overly large.

b) *Trading is feasible, mandatory and costly* – Essentially this is the situation where an investor becomes a forced seller. It might be motivated by the need to meet redemptions, margin calls or prudential requirements. Here the cost of transacting *must* be incurred, no matter how large. Under such situations, the risks are compounded if the need for mandatory liquidation goes hand-in-hand with high costs of transacting. For instance, the costs, and hence risks, of illiquidity will mount if investors are more likely to become forced sellers in times of market stress. Risks are further heightened if other investors need to sell at the same time, say because many funds are receiving redemptions in response to poor performance. The academic literature related to such situations was discussed in Paper 1.

c) *Trading is required, but is infeasible* – This situation can emerge where trading is required due to (say) redemptions or a loss of funding, yet becomes infeasible due to some restriction - possibly that no market exists at the time. The latter (briefly) occurred within the corporate bond markets during the GFC. Needless to say, the consequences of being in such a situation could be dire, perhaps even threatening business survival. The potential 'cost' is also difficult to quantify.

The discussion above presents what is a complex picture of how illiquidity may impact various investors. A key point is that long-term investors are less affected by the costs, risks and constraints imposed by illiquidity. Discretion over trading – one of the two indicators of a long-term investor identified in Paper 1 – is pivotal for two reasons. First, long-term investors have the *option* to continue holding. Effectively, they can use their discretion over trading to manage around the transaction costs. They may defer the cost of exit, and hence spread the total cost of transacting in illiquid assets over more periods. Indeed, at the extreme they can even avoid the cost of exit altogether by retaining an asset indefinitely. Second, discretion over trading means that long-term investors are *never* placed in either the second or third situations of being a forced seller that needs to accept a large haircut, or (worse) needing to sell but being unable to do so. The worst situation they face will be the need to choose between trading versus persisting with a sub-optimal portfolio. The implication is that investors with high discretion over trading are less exposed to the risks associated with illiquidity.

---

[11] A similar view might be taken of capital gains tax effects upon exit. Such taxes effectively amount to a cost (or benefit) that is incurred along with the transaction, and could be deferred by continuing to hold the investment.

Admittedly, it is unrealistic to expect that long-term investors will retain full and unfettered discretion over trading. Nevertheless, they can possess considerably greater discretion over trading than other, more short-term investors. The implication is that illiquidity is of less consequence to long-term investors, who are better placed to reliably access any higher returns on offer from illiquid assets. They also have scope to pursue dynamic strategies involving illiquid assets, as will be discussed in Sections 7 and 8.

(ii) Illiquidity, Asset Prices and Returns

Before providing a review of the evidence on the illiquidity premium, it is important to establish how illiquidity manifests in the pricing of assets and the expected returns on offer. The presentation below is designed to be informative, rather than mathematically precise. The aim is to establish three points:

a) *Basis of pricing is the impact on the marginal investor:* Asset prices and hence the gross (i.e. pre-cost) expected returns on illiquid assets will reflect the *compensation required by the marginal investor* for the expected costs, risks and constraints associated with illiquidity.

b) *Net returns will vary across investors:* The return that an investor realizes from an illiquid asset depends on aspects such as holding period, and the level of transaction and other costs they actually incur. Investors with longer horizons can expect to earn more after costs than the market clearing rate of return set by the marginal investor, reflecting amortization of costs over longer expected holding periods and the ability to avoid large transaction costs, such as those associated with becoming a forced seller. The existence of transaction and other costs also create difficulties for the measurement of realized net returns and hence identification of the realized premium from holding illiquid assets. Indeed, different investors will achieve differing net outcomes from the same observed market return series.

c) *Valuation measures are the best indication of available return premiums:* Given the tenuous nature of return-based measures, valuation measures provide a better indication of the potential advantage in holding an illiquid asset at any point in time. The extent to which an illiquid asset sits at a valuation discount (or yield premium) to a liquid counterpart directly reflects the extent to which additional returns are available as compensation for both the illiquidity premium and expected transaction and other costs.

Characterizing Expected Returns under Illiquidity

Figure 2 sets the scene for discussion by identifying components of the expected net return from investing in an illiquid asset. Net return refers here to the return that the investor expects to realize after any costs. The first component is the gross return that the investor expects the market to deliver, prior costs. This return is available to all investors and is typically observed in many databases. For instance, equity returns based on period-to-period prices reflect the average experience of a buy and hold investor without any direct allowance for transaction and other costs that would have been incurred by investors trading in the market.[12] The gross market return might be thought of as comprising the return to a comparable asset that is completely liquid, plus any compensation for illiquidity exposure. The latter comprises the compensation for *both* the expected *costs* and *risks* associated with illiquidity. Compensation for illiquidity risk is the illiquidity risk premium, which much of the (more recent) academic literature attempts to extract by comparing returns from illiquid and liquid assets.

---

[12] Closing prices may include the impact of transaction costs where the final trades reflect either a buy trade (at the ask price, including any market impact) or a sell trade (at the bid, including any market impact). However, these effects wash out as noise in a time series measured over multiple periods, where closing prices reflect a spectrum of buy/sell trades. This is related to the concept of 'bid-ask bounce' (see Roll, 1984).

The other component of net return is the expected cost of accessing the asset. This comprises transaction costs on entry, transaction costs on exit and any other costs.[13] As discussed earlier, these cost components are typically larger for illiquid assets and can be inherently investor-specific. In particular, expected exit cost is investor-specific because it depends on the circumstances under which exit occurs. It will be a complex function of aspects such as the investor's intended holding period, expected market conditions upon exit, their discretion to respond to changes in market conditions in choosing the time of exit, and other investor-specific aspects, such as market access and capital gains taxes. The effect of the entry costs on net return can also be investor-specific, even though the entry cost may be known at purchase. This is because the return impact depends on holding period. The investor-specific nature of the cost components means that investors will have different expectations for the net return from the same asset, even if they share the same expectation for gross return.

The investor-specific nature of costs also plays havoc with estimating the illiquidity premium from return data. The cost of transacting is an integral component of realized returns from illiquid assets, yet it cannot be readily accounted for in analyzing available return data. Estimation of a realized net return requires assumptions about *when* transactions occur and *at what cost*. These aspects are not only hard to observe, but will always be specific to a particular investor or assumed strategy.

Figure 2: Anatomy of Expected Returns from Illiquid Assets

---
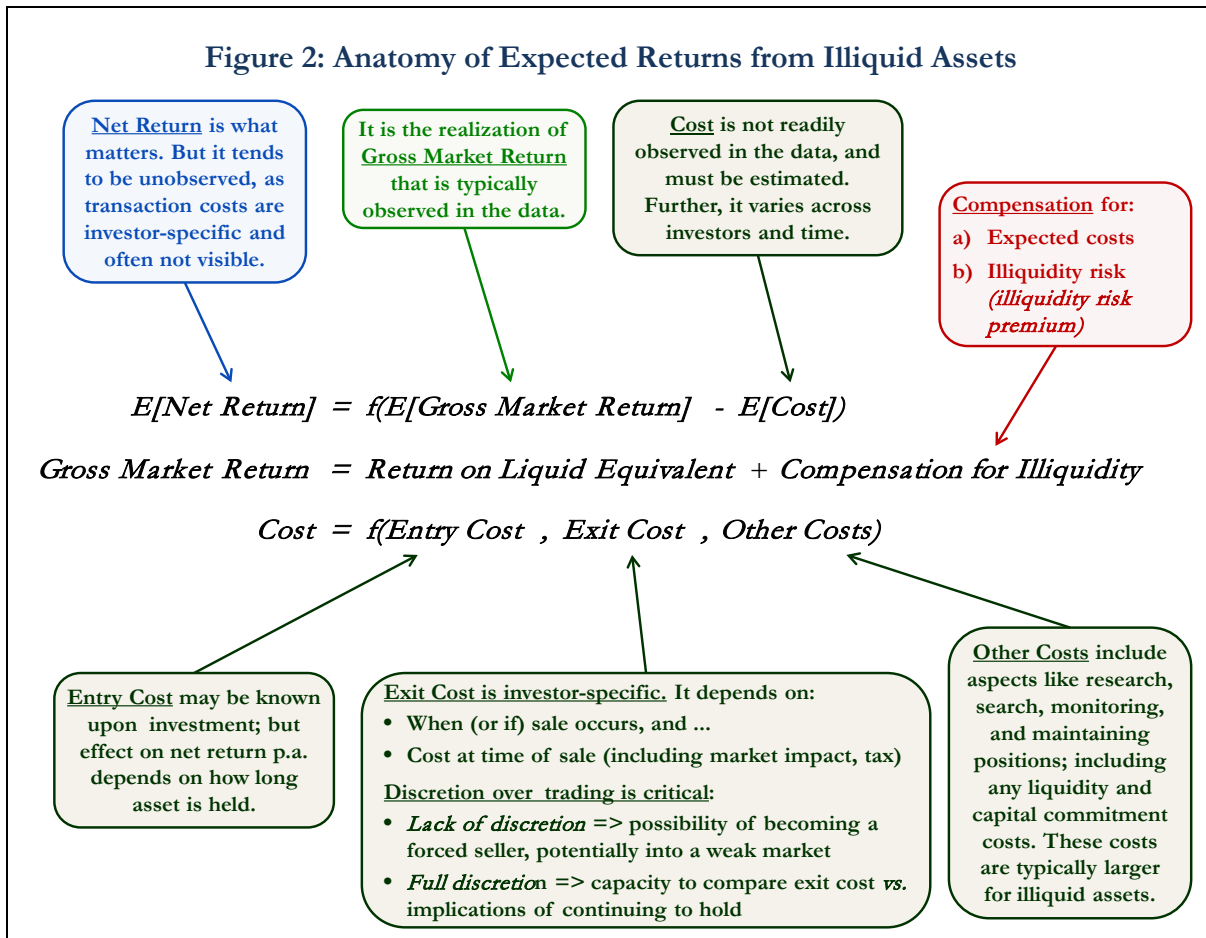
[13] These other costs are related to establishing an infrastructure to invest in illiquid assets, including locating, evaluating, securing, monitoring and maintaining investments, including liquidity and capital commitment cost. These costs can be minimal in very liquid markets. For instance, for US Treasuries, transaction costs are very low, and there is an absence of other costs related to market imperfections identified by Vayanos and Wang (2013), such as participation costs, search costs and asymmetric information.

Illiquidity, Price Levels and Valuation Measures

We now investigate how illiquidity translates into the level of prices, valuation ratios and yields. Consider two assets that are equivalent in all respects except for their liquidity. Both assets generate free cash flows from operations with the same expected value and riskiness. One asset is totally liquid, and can always be traded at zero cost at all times. The other is illiquid, meaning that transaction costs are incurred upon trading. Further, exposure to illiquidity often entails an element of non-diversifiable risk, related to the chance of suffering poor returns and possibly the need to liquidate in adverse times, thus justifying an illiquidity premium. Under these circumstances, the price of the illiquid asset should sit at a discount relative to the liquid asset for two reasons. First, the expected present value of transaction costs – which can be considered a negative cash flow – should be impounded in the asset price. Second, the need to compensate for illiquidity risk via an illiquidity premium amounts to a higher discount rate being applied to the available cash flows for the illiquid asset.[14]

Equations (1) and (2) present these concepts in the form of valuation expressions for the liquid and illiquid asset respectively. Equation (1) values the liquid asset. It appears in the form of a standard constant-growth dividend discount model, for an asset that generates an expected free cash flow (CF) growing at the constant rate (g) in perpetuity, discounted at the rate of k_{LIQ}. Equation (2) values the illiquid asset. It incorporates additional terms for the liquidity premium (LP_{ILLIQ}), the transaction cost on entry (TC_{Ent}), and the net present value of the expected transaction cost on exit ($NPV(E[TC_{Exit}])$). The latter is the present value of what could be a complex distribution of potential future exit dates and transaction costs (including any price discounts to 'fair value' upon exit). Note that we ignore other costs here, although clearly their present value might also be included in Equation (2) as an additional term. Equation (2) can be considered as representing the quoted mid-point market price[15] for the illiquid asset that would be viewed as reasonable by a marginal investor who is impacted by illiquidity. Equation (3) represents the price discount for the illiquid asset relative to its liquid counterpart, derived as the ratio of Equation (2) to Equation (1) minus one. It says that illiquid assets should sell at a discount to the extent that the illiquidity premium or expected transaction costs are greater than zero. Equation (3) also doubles as an estimate for the valuation discount on which the illiquid asset will trade, noting that income from operations (i.e. CF) is a common denominator under the assumptions. Similarly, the reciprocal of Equation (3) generates the cash flow yield premium for the illiquid asset.

Valuation Equations

$$P_{LIQ} = \frac{E[CF]}{k_{LIQ} - E[g]} \tag{1}$$

$$P_{ILLIQ} = \frac{E[CF]}{k_{LIQ} + LP_{ILLIQ} - E[g]} - TC_{Ent} - NPV(E[TC_{Exit}]) \tag{2}$$

Illiquidity Price Discount (= Price/Cash Flow Multiple Discount)

$$\frac{P_{ILLIQ}}{P_{LIQ}} - 1 = \frac{k_{LIQ} - g}{k_{LIQ} + LP_{ILLIQ} - g} - \frac{(k_{LIQ} - g)(TC_{Ent} + NPV(E[TC_{Exit}]))}{CF} - 1 \tag{3}$$

---

[14] It may be debated whether the illiquidity premium should be incorporated only via the discount rate applied in estimating the expected present value of exit costs, and not the discount rate applied to operating cash flows. In any event, we put aside this issue to avoid over-complicating the exposition.

[15] Actual transaction prices may deviate from this value, reflecting the bid-ask spread or market impact when transacting. Our presentation effectively treats any such deviations from the mid-point as a transaction cost.

Where:

P_{LIQ}	=	Price of liquid asset, period 0
P_{ILLIQ}	=	Price of illiquid asset, period 0
CF	=	Free cash flow from operations, period 1
g	=	Growth rate in free cash flow, beyond period 1
k_{LIQ}	=	Cost of capital for the liquid asset
LP_{ILLIQ}	=	Liquidity premium required in illiquid asset
TC_{Ent}	=	Transaction cost on entry
$NPV(E[TC_{Exit}])$	=	Net present value of the expected transaction cost on exit
$E[.]$	=	Expectations operator

Figure 3 gives a sense for the order of magnitude for potential price discounts. Estimates are presented across indicative assets at three different levels of illiquidity denoted 'reasonable', 'limited' and 'poor'. The baseline assumptions for the liquid asset include a cost of capital of 10% and a constant growth rate of 4%, which translates to a multiple of 16.7 times on prospective free cash flow and a free cash flow yield of 6%. Across the range of illiquid assets, we allow for illiquidity premiums of 0.5%, 1.0% and 3.0% and entry costs of 1%, 2% and 5%. Exit costs are modeled based on a simple distribution which allows for a 10% probability of selling the asset in each of years 1 through 10. For most part we assume a 'normal' transaction cost upon exit, equal to that on entry. However, under the 'limited' and 'poor' liquidity cases we allow for a small probability (of 1% and 2% per period) of incurring a much larger cost (of 10% and 25%) through becoming a forced seller. The price and valuation discount ranges from -10% under 'reasonable' liquidity, to -18% under 'limited' liquidity, to -41% under 'poor' liquidity. The free cash flow yield premiums are +0.6%, +1.0% and +4.1% respectively. These estimates seem within the ballpark of magnitudes reported in the literature, as discussed in Section 6(iii).

Figure 3: Indicative Price Discount for Illiquidity

	Completely Liquid Asset	Illiquid Asset		
		Reasonable Liquidity	Limited Liquidity	Poor Liquidity
Operating Cash Flows				
Free Cash Flow in Year 1 (*CF*)	$1.00	$1.00	$1.00	$1.00
Growth Rate (*g*)	4.0%	4.0%	4.0%	4.0%
Discount Rate:				
Liquid Asset (k_{LIQ})	10.0%	10.0%	10.0%	10.0%
Illiquidity Premium (LP_{ILLIQ})	na	0.5%	1.0%	3.0%
Transaction Costs:				
Entry Cost (TC_{Ent})	na	1.0%	2.0%	5.0%
Exit Cost ($NPV(E[TC_{Exit}])$)	na	0.7%	2.0%	5.9%
Exit Cost Assumptions				
- Horizon in Years		10	10	10
- Probability of Exit Each Year		10.0%	10.0%	10.0%
If Sale:				
- Probability of Normal Sale		10.0%	9.0%	8.0%
- Probability of Forced Sale		na	1.0%	2.0%
- Cost of Normal Sale		1.0%	2.0%	5.0%
- Cost of Forced Sale		na	10.0%	25.0%
Price in Year 0	$16.67	$15.12	$13.72	$9.90
Price / Free Cash Flow Multiple	16.7	15.1	13.7	9.9
Free Cash Flow Yield	6.0%	6.6%	7.3%	10.1%
Discount vs. Liquid Asset		*-10%*	*-18%*	*-41%*
Yield Premium vs. Liquid Asset		*0.6%*	*1.3%*	*4.1%*

Source: Author estimates

How should these estimates be interpreted? It is important to recognize that they reflect fair value for a representative marginal investor who values an asset on the basis of certain assumptions. In the examples as presented, the estimates reflect an investor who sees themselves as equally likely to exit at any time over the next 10 years, with some risk of doing so as a forced seller under two of the three cases. The price discount reflects the compensation that this marginal investor requires to cover the expected cost of transacting and the risks involved in being exposed to illiquidity. The *yield premium* is perhaps the best guide to the amount of *additional gross market return* that is on offer to cover these aspects. The further implication – and the most important in the current context – is that this yield premium provides a guide for the potential 'fat' available to investors who would be able to invest in the asset at near-zero cost. Such investors are most likely to be long-term investors. They can expect to earn an additional return in the illiquid asset somewhere greater than the expected liquidity premium, but less than the estimated yield premium. The actual expected return will depend on their expected transaction costs and holding period.

Expected Return and Investment Horizon

Figure 4 draws on the analysis underpinning Figure 3 to demonstrate how returns are investor-specific and depend on holding period. It hence illustrates the advantage faced by long-term investors in illiquid assets. We draw the underlying pricing and exit cost data from the 'limited' liquidity (middle) case. Two lines are plotted. The lower solid line plots the internal rate of return that the marginal investor expects to realize depending on how long they end up holding the illiquid asset. The longer they hold, the higher the return. This is a simple reflection of the fact that we have assumed the same expected exit cost and pricing parameters whichever year they exit, so that deferring exit leads to a larger internal rate of return (IRR) as transaction costs are 'amortized' over more periods.[16] The upper dashed line plots the expected IRR per holding period for a long-term investor who differs in two respects. First, they perceive an equal chance of exiting in each of the next 20 years (versus 10 years for the marginal investor). Second, we assume that the long-term investor only ever pays a normal exit cost as they will never be a forced seller. Clearly the illiquid asset presents as a far more attractive investment to a long-term investor who benefits from the combination of a longer horizon and capacity to avoid the costs associated with being a forced seller. They can expect to earn a return premium over the marginal investor, who sets the market price.

---

[16] In actual fact, the decision to exit will not be random, but is likely to occur in response to market developments, e.g. the sale may occur either when it is required, or perhaps because the price moves too high. The latter aspect is the focus of the dynamic strategies addressed in Sections 7 and 8.

Figure 4: Internal Rate of Return per Holding Period
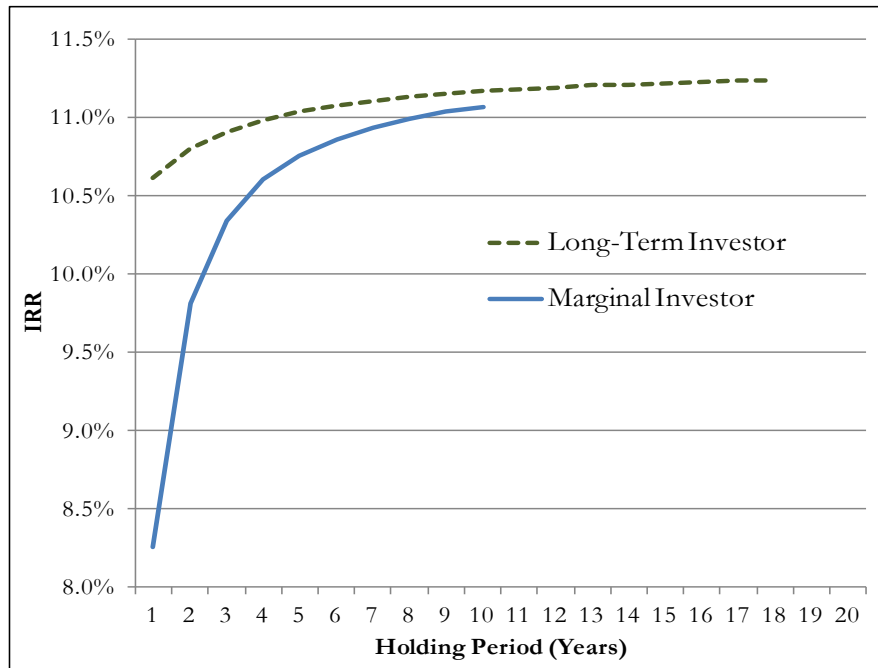
Source: Author estimates

Identity of the Marginal Investor

Given that the capacity of long-term investors to generate excess returns from illiquid assets relies on them being less impacted by illiquidity than the marginal investor, the identity of the marginal investor is central. If the marginal investor is a long-term investor with discretion to continue holding if so desired, the compensation required, and hence the excess return available, may be much diminished. The converse applies if the market is populated by short-term investors who need (or may need) to trade. Three considerations are relevant in this respect:

- *The identity of the marginal investor may be influenced by self-selection or clientele effects.* Investors will tend to gravitate towards assets offering a level of illiquidity that meets their needs. Illiquid assets are thus more likely to be held by investors with high tolerance for illiquidity; while investors with a low tolerance for illiquidity are unlikely to be found operating in illiquid markets in the first place. To the extent that the marginal investor is one that perceives the costs and risks associated with illiquidity to be low, the impact on pricing may be greatly attenuated.

- *Participants might take into account the likely reaction of other players when pricing assets.* Elements of game theory can creep into price determination. If the counterparty is perceived as having much to gain, most people attempt to negotiate some of the benefit for themselves. For example, a corporate seller of a private business to a private equity fund could have some sense of the potential value of the business under a future IPO. The seller is likely to bear this in mind when negotiating the deal.

- *The marginal investor can change over time.* Markets for illiquid assets are often 'thinner', in the sense that there are typically fewer buyers and sellers. This can make the market equilibrium sensitive to fluctuations in the identity and balance of buyers and sellers, and the terms on which they are willing to deal. Prices can be volatile as a result. At times, illiquid assets can be purchased in a 'buyers' market', where sellers are either desperate or driven by other agendas, and confronted by a limited number of picky buyers. For instance, the compensation for illiquidity may increase because some

investors unexpectedly lose their security of funding and hence develop a need for liquidity, as happened, for instance, in the fixed income markets during the GFC and in the convertible bond markets in 2005 (see Mitchell et al., 2007). At other times, illiquid assets are highly sought after and it becomes a 'sellers market'. This seems to describe the current market for core unlisted property and infrastructure.

Concluding Comments

It defies logic that illiquidity premiums will *always* be large and consistently available. Self-selection, clientele effects and negotiating positions can reduce the degree to which illiquidity influences asset prices. The available illiquidity premium can depend on the relative market power of buyers versus sellers, which may shift over time. Evidence examined in Section 6(iii) confirms that the illiquidity premium can vary substantially across markets and through time. This helps underpin the potential value of dynamic strategies, to be investigated in Sections 7 and 8.

Another message is that returns available from illiquid assets can be over-stated due to a failure to properly account for the costs of transacting in illiquid assets. Gross market returns are often the object of empirical analysis. This does not satisfactorily account for the effect of costs on realized net returns because it implicitly assumes that an investor could have traded at the observed price without cost. The estimated returns are hence not realizable, as real trades would incur hidden transaction costs, including market impact. Returns could further be reduced by the other additional costs associated with investing in illiquid assets. Examining gross market returns in isolation can thus create an illusion that the illiquid asset generates a return premium that is unavailable to many investors. Against this background, we now review the evidence from the literature.

(iii) Literature on Illiquidity and Asset Pricing

The preceding discussion provides background for interpreting what is a large and growing body of literature on the relation between illiquidity and asset prices or returns. We selectively summarize this literature, with the aim of conveying a sense for the findings, rather than providing comprehensive coverage. Our review is divided into four parts: theoretical models, the relation between illiquidity and returns; price or valuation discounts for illiquidity; and evidence of time-variation in illiquidity premiums. The broad conclusion is that, while some premium is typically on offer for holding illiquid assets, its magnitude is unclear and probably less than it appears at face value. The premium also varies across markets and through time.

As discussed above, the larger costs associated with illiquid assets are influential in determining how much additional return can be extracted from illiquid assets. The fact that costs are not effectively accounted for in the data, plus the notion that their effect varies across investors, serves to obscure measurement of the illiquidity premium. If anything, measures of the additional return to illiquid assets extracted from the data tend to provide a sense of the *maximum* incremental return available to investors who incur minimal transaction and other costs and hold for long periods. Available evidence seems to suggest that an illiquidity premium of well below 2% pa might be expected in most instances. However, the premium can expand substantially on occasions, when markets are under stress and liquidity is highly valued.

Theoretical Models of the Illiquidity Premium

A number of authors attempt to derive the illiquidity premium from theoretical models (e.g. Constantinides, 1986; Heaton and Lucas, 1996; Vayanos, 1998; Browne et al. 2003; Huang 2003; Lo et al., 2004; Longstaff, 2001, 2009; Ang et al., 2013). While results are highly dependent on the particular

model and its parameterization, in most cases the derived premium is quite modest. The majority of reported illiquidity premiums sit in the 0.5%-2% pa range under plausible parameters; although higher and lower numbers can be teased out. Affording investors the flexibility to manage around the costs of illiquidity is a key aspect restricting the magnitude of the premium under these models. One such element is permitting investors to trade-off incurring transaction costs against portfolio optimality, under the assumption that assets can be traded at some price. Another element is allowing investors the latitude to restrict exposure to illiquid assets in the first place. Under these conditions, the illiquidity premium (i.e. the additional return in excess of compensation for transaction costs) becomes tied to the extent to which transaction costs and constraints act as a barrier to achieving a more optimal portfolio, with the latter typically evaluated under some asset pricing model encapsulating investor objectives, e.g. a utility function. As the loss of utility from failing to attain the optimal portfolio is often not large, relatively modest illiquidity premiums emerge as a consequence.

Illiquidity and Realized Returns

Another approach involves extracting the ex post premium for illiquidity from return data. This task is made difficult by the fact that any premium for illiquidity risk is not directly observable, and controls are required for elements such compensation for expected transaction costs and other forms of risk. Basically, illiquid assets often appear to generate higher returns than liquid assets. But care is needed to distinguish how much of this additional return is due to an illiquidity premium, compensation for expected trading and other costs, or returns associated with other risk factors. In particular, the effects of illiquidity may need to be disentangled from other risks related to size, given that that size and illiquidity tend to be highly correlated. An account of selected results from the literature appears below.

- **Listed equities** – A number of authors have analyzed equity market data to tease out the illiquidity premium after allowing for various controls (e.g. Pástor and Stambaugh, 2003; Dimson and Hanke, 2004; Acharya and Pedersen, 2005; Liu, 2006; Watanabe and Watanabe, 2008; Lee, 2011; Amihud et al. 2013). It is often difficult to extract a clean measure of the "average liquidity premium" from these papers, as modeling methods and presentation varies considerably. Nevertheless, the results point to a *return difference* between the least liquid and most liquid stocks in the order of 5%-8% pa (based on either quintile or decile portfolio sorts). However, these results are based on reported closing prices, and hence reflect 'gross' returns that fail to account for the differential cost of transacting illiquid versus liquid stocks. After controlling for expected costs, the 'pure' compensation for illiquidity risk appears like it could in the order of 1%-2% pa for developed markets (e.g. see Acharya and Pedersen, 2005; Lee, 2011). Unsurprisingly, estimated premiums are much higher within emerging markets (see Bekaert et al. 2007; Lee, 2011).

- **Fixed income** – Houweling et al. (2005) extract a measure of the illiquidity premium from returns in Euro denominated bonds during the period 1998 to 2001, after controlling for exposure to risk factors and various characteristics. They estimate a significant but modest illiquidity premium of between 13bps and 23bps, although their analysis is based around sorting into 2 or 4 portfolios. Lin et al. (2011) find much larger returns to illiquidity for corporate bonds in the context of factor models and portfolio sorts across a sample which includes sub-investment grade issues over the period from January 1994 to March 2009. The gross return difference across high-low decile portfolios sorted by liquidity exposure is 3.5%-4.1% pa, including an estimated illiquidity risk premium component of 2.7%-3.3%, based on their illiquidity betas and the illiquidity risk premium.

- **Hedge funds** – Sadka (2010) uncovers a tendency for hedge funds to load on illiquidity. He finds that funds with the most significant exposure to illiquidity risk subsequently outperform those with low exposure by about 6% pa on average over the period 1994–2008, while having generated negative performance during liquidity crises. Teo (2011) confirms and extends Sadka's findings in

reporting that hedge fund returns arising from exposure to illiquidity are magnified by fund flows, such that better performance is associated with larger inflows. Further, the effects from flows appear stronger in times of market stress. It should be remembered that these returns derive from the nature of the underlying investments held by hedge funds, and not as a return to the illiquidity of the hedge fund structures themselves.

- **Private equity** – The extent to which private equity generates excess returns has been a topic of considerable debate in the literature. Notwithstanding this, Franzoni et al. (2012) and Kinlaw et al. (2014) attempt to estimate the component of private equity returns that can be attributed to illiquidity. Both come up with estimates of around 2½%-3% pa. However these estimates should be considered of low reliability, given the difficulties involved in analyzing the coarse cash flow and appraisal valuation data that is available for private equity funds. They also do not allow for the additional costs incurred by investors in private equity funds, such as research, monitoring and capital commitment costs.

- **Property** – Analysis of the relative performance of listed and unlisted property investments reveals no clear evidence of an illiquidity premium. Pagliari et al. (2005) find no significant difference between US REIT and unlisted property returns over the period 1981 to 2001 after controlling for property type, leverage and appraisal valuations. Indeed, REITs outperformed unlisted property, while the deviation from NTA averaged approximately zero over the period. Shuck and Howard (2004) examine returns in Australia, the UK and the US and similarly found that listed property outperformed unlisted property. These findings may reflect the time periods being examined, bearing in mind that REITs suffered heavily around the time of the GFC. Properly controlling for all differences to ensure a like-with-like comparison is also difficult. Nevertheless, the results do nothing to suggest that there is a reliable illiquidity premium available in unlisted property markets.

Price or Valuation Discounts for Illiquid Assets

Section 6(ii) discussed how illiquid assets should trade at a price discount or yield premium in reflection of the combination of any illiquidity premium (i.e. higher discount rate) and the capitalized value of the transaction and other costs expected by the marginal investor. Consistent with this notion, ample evidence exists that illiquid assets can indeed trade at substantial price discounts or yield premiums, often of similar magnitudes to the estimates presented in Figure 3.

- **Equities** – Price discounts of between 15% and 30% have been observed for private companies relative to public company counterparts. Kooli et al. (2003) examine this issue in some depth. They point to previous literature reporting discounts ranging between 14% and 47%. Their own analysis, based on acquisitions matched by firm characteristics, reveals discounts of between 17% and 34% based on valuation multiples, or 16% based on regression analysis controlling for other factors. Officer (2007) also compares acquisition multiples on private company transactions with those on comparable public companies. The average discount ranges between 15% and 30% across four valuation measures. Discounts are also observed for listed stocks, where there exists an equivalent exposure but differences in liquidity. Silber (1991) finds that US restricted stock traded at a discount of over 30% over the period 1981-1988. Hou and Howell document discounts averaging 70%-80% for restricted stock in the Chinese market. Dimson and Hanke (2004) find that equity-linked bonds[17] traded at discounts of between 1% and 9% to their indices in the UK during the 1990s. Aguiar and Gopinath (2005) document fire-sales of Asian companies during the crisis of 1997-98, with the 1.3x median price/book ratio for acquisitions during 1998 being over 60% below that observed during 2006.

---

[17] These products were similar to an ETF over a specific index, but were relatively illiquid.

- **Sovereign bonds** – Given that default risk is typically insignificant in sovereign bonds, these markets offer an arena to study the pricing effects of differences in liquidity that abstracts from any confounding effects from cash flow risk. Ample evidence emerges that differences in liquidity can be associated with meaningful differences in pricing or yields. One piece of evidence arises from the yield differences between "on-the-run" and "off-the-run" issues. For example, Amihud and Mendelson (1991) document an average yield premium of 43bps on US treasury bills over treasury bonds with less than 6 months to maturity, which they attribute to relative liquidity. Longstaff (2004) estimates price discounts for treasury-guaranteed bonds issued by Refcorp of around 10%-15% versus comparable US treasuries. Boudouhk and Whitelaw (1991) report yield differentials between the benchmark Japanese government bond and other comparable bonds of between 30bps and 100bps. Unfortunately, the clarity of these tests is polluted by the possibility that "on-the-run" issues may offer other attributes such as repo 'specialness'. Vayanos and Weill (2008) investigate this issue. They suggest that the majority of the average difference of about 50bps between on-the-run and off-the-run US treasuries can be explained by specialness, leaving a relatively small role for illiquidity under their analysis. Some authors have examined the impact of illiquidity on the relative pricing of US conventional and inflation-linked bonds, generating estimates that inflation-linked bond yields contain an illiquidity premium averaging about 30bps-70bps (see D'Amico et al., 2010; Pflueger and Viceira, 2011; Christensen and Gillan, 2012).

- **Corporate bonds** – Illiquidity is an important feature in the pricing of corporate bonds (see Chen et al., 2007). Indeed, Bao et al. (2011) argue that illiquidity is a more important determinant of credit spreads than default risk. They estimate that for two bonds in the same rating category, a one standard deviation difference in illiquidity leads to a 65bps difference in yield spread. de Jong and Driessen (2012) estimate that the illiquidity risk premium averaged about 60bps for US investment grade and about 150bps for speculative grade bonds over the period 1992-2002, along with similar estimates for Europe. Liu et al. (2006) examine interest rate swaps. Although their estimated illiquidity premium averaged only 7bps over the period 1988 to 2002 (versus 31bps for expected default), it jumped into the 10bps-60bps range after the Long Term Capital Management (LTCM) incident. They also find the illiquidity yield premium to increase with maturity, rising to around 70bps for 10-year maturities.

- **Property** – Benveniste et al. (2001) use regression analysis to compare the pricing of REITs and unlisted property. They estimate the uplift in value that might be attributable to the listing of property. Their regression slope indicates that price increases with liquidity, indicating that the improvement in liquidity achieved through listing may increase value by 12%-22%. However, their regression equation has a negative intercept and listed property still trades around NTA on average. The authors interpret their results as reflecting the notion that the benefits of greater liquidity can be offset by the greater costs associated with being listed, leaving listed property priced around NTA on average.

- **Infrastructure** – There is limited academic evidence on the impact of illiquidity on returns and pricing in infrastructure. Nevertheless, we offer some observations based on the experience of the Future Fund from its operations in this area. Over recent years, transactions have occurred in the private infrastructure markets at prices that at times well exceed the valuations of comparable listed infrastructure (notionally allowing for differences in the nature of the assets, leverage and risk). An underlying cause seems to be a large volume of long-term funds earmarked for investment in unlisted infrastructure, relative to the restricted supply of available assets. As a consequence, the marginal investor in the unlisted market appears to be a long-term investor with high tolerance for illiquidity. Segmentation appears to have occurred between the unlisted and listed markets, with prices in the listed markets seemingly set at the margin by equity investors who demand a premium for illiquidity. There are potential reasons for some pricing discrepancy, such as a willingness to pay

a 'control premium' for unlisted assets, and the risk that some listed entities may suffer from poor shareholder alignment with the attendant risk of value-decretive corporate actions. Nevertheless, the magnitude of the difference suggests the absence of any illiquidity premium for unlisted infrastructure. Looking forward, scope exists for a significant increase in supply, given the increasing global focus on infrastructure funding and (in Australia's case, at least) privatization plans. It will be interesting to see if this leads to an illiquidity premium emerging for unlisted infrastructure.

- **Other** – Brenner et al. (2001) report an average discount of around 20% between equivalent non-tradable and exchange-traded options on the Israeli shekel.

Variation in Compensation for Illiquidity Exposure over Time

The notion that illiquidity varies through time is not only intuitive, but is strongly supported by the empirical evidence. In part illiquidity varies because it is related to market and economic conditions (see Jensen and Moorman, 2010; Næs et al., 2011). During bear markets there tend to be more sellers than buyers, so that large price concessions can be required to secure a transaction. This makes the prices of illiquid assets sensitive to market conditions, which in turn establishes illiquidity as a systematic risk. The fact that the compensation for illiquidity exposure can vary considerably provides the foundation for considering a dynamic approach to capturing the returns associated with illiquid assets.

- **Equities** – Pástor and Stambaugh (2003) established that illiquidity is a priced factor which varies over time and is correlated with both return realizations and the average level of stock returns. Watanabe and Watanabe (2008) explicitly examine the time-varying nature of illiquidity premium in the US equity market. They uncover two liquidity states. The high liquidity state that applied the majority of the time, during which the illiquidity premium is flat. The low liquidity state was observed about 10% of the time, during which they observe a return spread of *over 5% per month* across decile portfolios with high versus low exposure to illiquidity risk. Xue and Zheng (2010) also provide evidence of differing liquidity states by applying the Acharya and Pedersen (2005) liquidity CAPM to S&P500 stocks over the 2004-2006 and 2007-2008 periods. They find that the market required greater compensation for illiquidity during the GFC (2007-2008), reflected in changes in both the magnitude of the illiquidity risk premium and the liquidity betas of stocks. Ben-Raphael et al. (2013) conduct a long-term analysis back to the 1930s. They find that illiquidity premiums available in the US equity market have declined over time, reaching minimal levels in all but the smallest stocks during more recent years. In summary, the literature suggests that illiquidity premiums in equity markets may be available only in certain market segments or at certain times, rather than being ubiquitous.

- **Fixed income** – Similar evidence of time-varying illiquidity premia emerge from the analysis of bond markets. For instance, estimates of the illiquidity component in the yield differential between conventional and inflation-linked bonds (TIPs) has been found to range from a few basis points, up to over 200bps in the early years of TIPs issuance and again during the GFC (see D'Amico et al., 2010; Pflueger and Viceira, 2011; Christensen and Gillan, 2012). In corporate bonds, the estimates by Liu et al. (2006) of the illiquidity premium contained in corporate bond swap rates start from low or even negative levels prior to the LTCM incident in 1998, then jump into the 10bps-60bps range. Dick-Nielsen et al. (2012) generate specific estimates of the variation in the illiquidity component in corporate bond spreads associated with the GFC. They find that it moved from 4bps prior to the GFC up to 93bps for BBB debt, and from 58bps to 197bps for speculative grade debt; before reverting to almost pre-crisis levels by mid-2009. Bao et al. (2011) also find that changes in illiquidity are a significant driver of credit yield spread changes through time, particularly during the GFC. We add our own comment here that the blow-out in corporate bond spreads during the GFC and their subsequent reversion can only be explained by allowing for large variations in the illiquidity

premium. For instance, the US Baa-treasury yield spread moved from 100-150bps to 700-800bps during the GFC, and has since returned to 200-250bps. Given that Moody's report a default rate for Baa debt that averages about 0.7% since 1970, with a maximum of 1.6% in 1938, it is clear that such large swings in the credit spread cannot be fully explained by default risk alone.[18]

(iv) Discussion

The concepts and empirical evidence reviewed in this section deliver the following messages with regard to the ability of long-term investors to extract additional returns from illiquid assets:

- *Long-term investors are well placed to extract any additional returns from illiquid assets.* The key advantage of long-term investors derives from discretion over trading, which leads them to be less impacted by both the additional costs and risks associated with illiquid assets.

- *The marginal investor matters.* Long-term investors should only expect a benefit to the extent to which they are less impacted by the costs, risks and constraints associated with illiquidity than the marginal investor. Investors are well advised to consider the identity of the investor or group of investors that are setting prices before committing funds to illiquid assets.

- *The illiquidity premium can be over-stated.* In part, this arises from the impression given from examining gross returns without properly accounting for the impact of costs on realized returns. The evidence seems to suggest that the illiquidity risk premium component might average something like 0.5%-2%, where one exists. Additional returns might be available, but only to long-term investors that are less impacted by the implicit transaction costs that are reflected in prices. In any event, the 5%-8% additional returns to illiquid assets quoted in some studies seem unattainable.

- *Return premiums associated with illiquidity can vary considerably across markets and time.* Illiquidity premiums can be observed in both equity and fixed income markets, although they may only be significant in certain segments and at certain times. Interestingly, no conclusive evidence has emerged that investors can access additional returns by choosing unlisted rather than listed assets in either property or infrastructure; although there is some evidence that additional returns may be available in private equity, where assets appear to be available at a discount to listed markets. The main message is that it should not be presumed that a premium always exists for illiquid assets.

- *Valuation discounts or yield premiums contain valuable information.* The extent to which an illiquid asset sits at a valuation discount (or yield premium) to comparable liquid assets is directly linked to the compensation for both illiquidity risk and expected costs. Valuation measures hence provide a guide to the broad magnitude of the additional returns that may be available to a long-term investor in a market at a particular point in time.

It is worth reflecting on why illiquidity premiums might appear in equities and fixed income markets, yet not necessarily for unlisted property or infrastructure. We contend that the varying nature of the marginal investors in these markets may be an important influence. Equity and fixed interest investors typically demand and value greater liquidity. Meanwhile, investors operating in private markets may not do so to the same extent. Ang (2013) also argues along these lines, speculating that illiquidity premiums may vary across asset classes because they are priced like 'silos' reflecting institutional constraints, slow-moving capital and limits to arbitrage. He also suggests that illiquidity premiums may be small in some

---

[18] Some of the spread may be explained by the credit risk premiums and allowance for the possibility of ratings transition. On the other hand, the default rate does not allow for recoveries, and hence over-estimates the expected loss from default. In any event, these factors can only explain a small portion of the variation in spreads.

asset classes because they are populated with investors who overpay in chasing the illusion of higher returns; while equity and fixed income markets may be populated by risk-averse investors who pay for the privilege of being able to trade promptly.

Perhaps the most important take-away for long-term investors is that compensation offered for exposure to illiquidity can vary across markets and through time. This implies that a more selective approach towards investing in illiquid assets may be appropriate, rather than simply buying them on the presumption that an illiquidity premium exists. This insight plays to one of the real advantages held by long-term investors: discretion over trading. Long-term investors have the capacity to buy illiquid assets when the illiquidity premium is particularly high, without requiring an immediate return or relying on the capacity to exit any time soon. Conversely, they can consider selling when the return premium offered by illiquid assets diminishes. We now pursue this insight through examining dynamic strategies.

7. Dynamic Strategies: Concepts and a Basic Model

This section builds on the concepts raised in Section 6 to investigate how long-term investors might benefit from pursuing dynamic strategies that are well suited to illiquid assets. The particular strategy we examine involves timing both entry and exit to exploit fluctuations in prices or long-term expected returns that could arise from price pressures from short-term investors who need to trade. Effectively we depict a strategy which combines value investing with a form of liquidity provision. The strategy leverages off the two key indicators of a long-term investment horizon proposed in Paper 1: discretion over trading, and an investment approach that is focused on long-term value and returns. In addition, the strategy relates to one of the purported public benefits of long-term investors, being their capacity to act as a stabilizing force in the market. Hence we claim that there is both private and public benefit from fostering long-term investment with capacity to adopt strategies of the type being outlined. This section comprises three parts. Section 7(i) sets out the conceptual foundations of the strategy. Section 7(ii) then illustrates and investigates the fundamental tenets of the strategy under a basic two-period model. Section 7(iii) summarizes the key messages and acknowledges the shortcomings of our model.

(i)   Conceptual Foundations

The capacity to identify variation in expected returns over time sits at the foundation of any dynamic strategy. Expected returns may fluctuate for either rational reasons (e.g. justifiable changes in risk aversion), or due to mispricing. Regardless of the reason, the aim is to maximize the long-term outcome by becoming more exposed to assets when they offer high returns (prices are low); and limit exposure when expected returns are low (prices are high). In this sense, dynamic strategies of the type being examined are aligned with value investing.

Such dynamic strategies involve a number of challenges. The first is estimating either expected long-term returns or long-term value, i.e. the level towards which markets are expected to revert. This is a critical and non-trivial task, and was discussed in Part A, Section 4(i). A further layer of complexity relates to how expected returns[19] and/or prices[20] might evolve in the future. If prices mean-revert due to either changes in expected returns or cash flows, it can crystallize and even amplify any payoffs from a position. Alternatively, if pricing moves to even more extreme levels in the initial instance, it would have been preferable to have held off on putting the position in place. While strategies of the type being examined ultimately anticipate mean reversion in expected returns and/or prices, it is still necessary to consider the path by which this occurs to maximize the outcome.

Illiquidity provides one possible source of fluctuations in expected returns and hence opportunities for long-term investors who are pursuing dynamic strategies. The motivation behind the dynamic strategy being addressed in this section is that a long-term investor can benefit from positioning themselves as the counterparty to those requiring liquidity. In other words, long-term investors may be able to dynamically capture the 'transaction costs' that others are willing to pay in order to trade. The strategy might be encapsulated by: "*If somebody is willing to sell at a low price, then buy from them. And if somebody else is willing to pay a high price to buy, then sell to them.*"

Illiquidity may provide opportunities for long-term investors to trade at attractive prices in a number of ways. On one level, they can act as counterparty to another (short-term) investor that is keen to trade, thus 'earning' the market impact that the investor is willing to pay to secure a trade. The discussion in

---

[19] The idea of future changes in expected returns aligns with the concept of changes in the investment opportunity set and intertemporal hedging demand (see Merton, 1971; Campbell and Viceira, 1999).
[20] The evolution of prices can reflect innovations in expected cash flows as well as expected returns. We skirt around this issue, notwithstanding the importance of the distinction.

Section 6 implicitly assumed that transaction costs were paid by all investors. In doing so, it glossed over the fact that there must be somebody benefitting on the other side when market impact costs are involved. Being a 'market maker' or underwriter on specific transactions may assist at the margin. However, this is unlikely to be the primary motivation for pursuing a dynamic approach over the long term.

Of greater importance is the possibility that the ruling market (mid) price for illiquid assets can move well out of alignment with long-term value. Illiquidity could play a role in two ways. First, overall price levels may be impacted by pressure from short-term investors responding to funding shifts. Second, fluctuations in the level of illiquidity and associated illiquidity risk may induce swings in the compensation required for illiquidity by the marginal investor. For instance, prices may be forced too high due to buying pressure from investors with money to spend, combined with a decrease in the required illiquidity premium due to the presence of ample liquidity in the market. Conversely, prices could be pushed too low due to pressure from forced sellers responding to loss of funding, combined with an increase in the required illiquidity premium in an environment where liquidity is highly valued. Another driver could be changes in the physical supply of assets. For instance, an increase in asset supply may notionally decrease the liquidity available to sellers, resulting in reduced prices and increased expected returns. The literature discussed in Section 6 provides evidence of swings in the illiquidity premium. Casual observation also suggests that these types of fluctuations are part of the fabric of market booms and busts.

The idea that funding shifts may create pricing pressure which induces mispricing has received attention in the academic literature. For instance, Brunnermeier and Pedersen (2008), as well as Vayanos and Woolley (2013), model circumstances where a shift in funding or fund flows can result in episodes of mispricing and over-shooting. Paper 1 cited a number of papers that provide empirical evidence of funding shifts having significant pricing effects, which can culminate in price reversals as well as underperformance by the managers involved (e.g. Coval and Stafford, 2007; Mitchell et al., 2007; Chen et al., 2010; Campbell at al. 2011; Khandania and Lo; 2011). Illiquidity also seems linked to mispricing. Sadka and Scherbina (2007) document such a link by investigating stocks with high analyst disagreement. Sadka (2006) finds a relation between momentum and post-earnings announcement drift anomalies, and fluctuations in illiquidity and associated risks.

There is also evidence that financial crises can play a role in mispricing or fluctuations in expected returns over time. Muir (2014) analyzes equity pricing and credit spreads around recessions, financial crises and wars across 14 countries over 140 years. He finds that price declines during financial crises can be largely explained by increases in expected returns, rather than decreases in cash flows; and that these declines are subsequently reversed. Although Muir does not directly examine the role of funding or illiquidity in these episodes, it seems likely that these would play a role.

Essentially, the combination of a need to trade and time-variation in the impact of illiquidity on investors with shorter horizons can provide opportunities for long-term investors to trade at attractive prices. Further, long-term investors may be able to best exploit these opportunities by pursuing a dynamic strategy that combines value investing with elements of liquidity provision.

Two ingredients are essential to capture the opportunities being considered, both reflecting the features which distinguish long-term investors, as discussed in Paper 1. First, discretion over trading is required not only in order to make an initial trade at the appropriate time, but also to allow time for positions to come to fruition. Strategies of the type being considered often involve going against the market, including acting in contradiction to evident buying or selling pressure, momentum and quite possibly consensus opinion. Immediate losses are a distinct possibility; and the timing of any payoff will be

open-ended. Second, capacity to identify long-term value or estimate long-term expected return requires an investment approach that is focused on long-term value and its drivers.

(ii) Basic Model

This section presents a basic model of expected payoffs under a situation where a long-term investor pursues a dynamic strategy designed to exploit the opportunities arising from price pressure stemming from the actions of short-term investors. While the model grossly simplifies how such a strategy might be applied in practice, it nevertheless serves to capture and reflect its essence and properties. Under the model, a long-term investor maximizes the 'long-term' outcome over two periods, anticipating the possibility that asset prices may be pushed too high or too low by short-term investors during the first period. The investor has two strategies from which to choose. One is to hold the risky asset with the intention to sell if it becomes highly priced. The other is to hold cash (or some other liquid asset), with the intention to buy the risky asset if it becomes too lowly priced, i.e. cash as an option.[21] Our model indicates that a long-term investor can outperform relative to a buy and hold strategy by adopting a dynamic approach; and that some combination of the two dynamic strategies will often be optimal. In addition, short-term investors underperform on an asset-weighted basis because fund flows induce them to buy when asset prices are high and sell when they are low.

The main features of the model are as follows:

Basic Set-up

− It is a two period model. An initial strategy is selected at the end of period 0, an action may be taken at the end of period 1, and the two-period outcomes are evaluated through to the end of period 2.

− There are two assets: a risky asset and a risk-free asset. Borrowing is not permitted. The risky asset is somewhat illiquid, so that its valuation (price/cash flow ratio) is responsive to price pressure.

Investors

− There are two investor types: a long-term investor, and a population of short-term investors.

− The long-term investor may be thought of as investing a fixed endowment for two periods. They are concerned about the distribution of wealth at the end of period 2. Their aim is to choose the strategy that maximizes the Sharpe ratio over the two periods.[22] The long-term investor chooses an initial allocation between the risky and risk-free assets in period 0, and anticipates the ability to trade at the end of period 1.

− Short-term investors might be thought of as comprising open-ended mutual funds that must invest all their available funds in the risky asset. They may receive fund inflows (or outflows) at the end of period 1, in which event they must buy (or sell).

− Fund flows received by short-term investors at the end of period 1 are specified as a function of the asset performance over period 1. The calibration assumes that the percentage inflow equals the excess return during period 1 (i.e. realized return less the discount rate). For instance, given a discount rate of 11%, a 31% return during period 1 would lead to inflows of 20% of funds as at end-period 1; while a return of -9% would lead to outflows equivalent to -20%.[23]

---

[21] The first strategy might be formally considered as a long position in the asset coupled with a perpetual 'up and in' barrier put option; while the second as holding cash plus a perpetual 'down and in' barrier call.

[22] We check that the selected strategy also maximizes the utility of wealth in period 2, assuming a power utility function. We find that the optimal strategy can change with the assumed risk aversion coefficient.

[23] The model contains no formal link from fund flows to performance, although the intuition is that they would be co-determined. Nevertheless, modeling flows as a direct function of realized return generates such a link, in

Free Cash Flows

– The risky asset generates (free) cash flows at the end of period 1 and period 2. Cash flows generated during period 1 are available for investment during period 2.

– The distribution of cash flows is the same in both periods, i.e. independent and identically distributed (iid). There are three possible cash flow outcomes during each period: above expectation (*up, +14%*), in line with expectation (*expected, +4%*) and below expectation (*down, -6%*).

– For the purposes of pricing and valuation, cash flows are expected to grow in perpetuity at their expected value, i.e. *g=4%*.

Asset Prices and Valuation

– The risky asset is priced using a constant growth discounting model in each node by applying conditional discount rates and a standard growth rate (*4%*). Prices are converted into prospective price/cash flow multiples and cash flow yields for the purposes of presentation.

– *Low, mid* and *high* discount rates are specified conditionally in each cash flow node. This produces 9 nodes (3*3) for period 1, as well as 81 paths (3*3*3*3) across both period 1 and period 2.

– In specifying the conditional discount rates, a skew is assumed whereby the increase in the discount rates occurring in the lower part of the distribution exceeds the decrease in the discount rates occurring in the upper part. There are two reasons for this. First, it recognizes the non-linear price response to discount changes (i.e. greater impact from decreases than from increases). Second, it accords with the notion that sales due to outflows by short-term investors can have a larger impact than purchases following inflows (for supporting evidence, see Brennan et al., 2012 and Nagel, 2012).

– The return on the risk-free asset is 4% in each period.

Figure 5 details the key input assumptions for cash flows, discount rates and the corresponding price/cash flow multiples and cash flow yields. We apply standardized conditional probabilities of 40% in the central case and 30% in both the high and low cases with respect to both cash flows and discount rates. However, the assumed discount rates are skewed towards being somewhat higher relative to the average in the lower part of the distribution (see second last dot point above). The intersections of the cash flow and discount rate distributions are used to generate the distribution of risky asset prices and returns for period 1 and period 2. The last two columns in Figure 5 report the risky asset returns for period 1, and the associated fund flows encountered by short-term investors. The expected return for period 1 of around 10% is less than the discount rate due to the skew built into the discount rate. Nevertheless, the distribution of returns has a mild positive skew, reflecting non-linear effects arising from upward versus downward changes in the discount rate.[24] Expected returns have a standard deviation of about 17%, which is approximately in line with equity-like investments. Flows range between about +30% and -32%, but the expected flow is near zero.

---

effect, by ensuring that performance and flows move in conjunction. Modeling in this manner avoids a circular calculation; while arguably it matters little whether the starting point is taken as returns or flows.

[24] If anything, our calibration is conservative to the extent that it fails to generate the negative skewness that is often observed in risky asset returns.

Figure 5: Two-Period Model of Dynamic Strategies – Key Assumptions

Free Cash Flow (CF)			Discount Rate (DR) and Valuations				Returns & Fund Flows, Period 1	
State	Probability	CF % Growth	State	Probability	Discount Rate (%)	Price/ E[CF]	Asset Return	Fund Flows for Short Term Investor
			Low	30%	10.0%	16.7	41%	30%
Up	30%	14%	Mid	40%	10.8%	14.8	26%	15%
			High	30%	12.0%	12.5	7%	-4%
			Low	30%	10.3%	16.0	23%	12%
Expected	40%	4%	Mid	40%	11.0%	14.3	11%	0%
			High	30%	12.5%	11.8	-7%	-18%
			Low	30%	10.5%	15.4	8%	-3%
Down	30%	-6%	Mid	40%	11.3%	13.8	-3%	-14%
			High	30%	13.0%	11.1	-21%	-32%
Expected Value		*4.0%*			*11.2%*	*14.1*	*9.6%*	*-1%*
Standard Deviation					*0.9%*	*1.7*	*16.7%*	*17%*
Risk-Free Rate					*4.0%*			

Source: Author estimates

The same baseline cash flow and discount rate distributions are applied in both period 1 and period 2. An important point is that this structure generates mean reversion for the risky asset during period 2 in the following manner. Bear in mind that the risky asset must trade on a low, mid or high discount rate at the end period 2. Thus if the asset attains a low discount rate (i.e. is highly priced) at the end of period 1, it faces a 30% conditional probability of being valued using the same low discount rate at the end of period 2, and a 70% conditional probability of being valued using a higher discount rate. This induces a negative skew in period 2 for highly priced assets. Conversely, assets trading on high discount rates at the end of period 1 face a 70% conditional probability of being priced using a lower discount rate at the end of period 2. Thus a lowly priced asset faces a positive skew for period 2. This structure is in line with the intuition that once the valuation reaches some extreme, there is only one way to go if there is going to be a change. Nevertheless, mean reversion is by no means guaranteed under the model. A highly priced asset can still perform well and a lowly priced asset poorly during period 2 by virtue of cash flow realizations. Nevertheless, selling highly priced assets and buying lowly priced assets at the end of period 1 remains a 'good bet' under the model.

Having set out the structure of the model, we now examine various strategies. The baseline strategy involves buying the risky asset and holding it for both periods. We also estimate the outcome for short-term investors, allowing for the fact that they are required to trade in response to fund flows at the end of period 1. With respect to the dynamic strategies available to the long-term investor, Figure 6 provides a schematic of strategy 'A', which involves investing initially in the risky asset and then selling it at the end of period 1 if it is trading on a high price/cash flow (low discount rate). Figure 7 provides the comparable schematic for strategy 'B', which entails investing initially in cash and then buying the risky asset at the end of period 1 if it is trading on a low price/cash flow (high discount rate). We also evaluate a mixed strategy 'C', under which strategies A and B are combined in order to maximize the expected Sharpe ratio.

Figure 6: Schematic of Dynamic Strategy A – Invest in Asset, Cash Out End-Period 1 If Multiple High

PERIOD 0: ACTION	PERIOD 1			END-PERIOD 1: ACTION	PERIOD 2			
	Cash Flow	Price/CF	Prob		Return	CF	P/CF	Cumulative Return (p.a.)	Cum Prob

14% branch

Description	Price/CF	Prob	Action	CF	P/CF	Cumulative Return (p.a.)	Cum Prob
Large Inflows for ST Investors	16.7	9%	Cash Out	na	na	21.0%	9.0%
Some Inflows for ST Investors	14.8	12%	Retain	14%	16.7	30.7%	1.1%
				14%	14.8	23.6%	1.4%
				14%	12.5	14.2%	1.1%
				4%	16.0	22.4%	1.4%
				4%	14.3	16.1%	1.9%
				4%	11.8	6.1%	1.4%
				-6%	15.4	14.3%	1.1%
				-6%	13.8	8.6%	1.4%
				-6%	11.1	-1.8%	1.1%
	12.5	9%	Retain	14%	16.7	31.4%	0.8%
				14%	14.8	24.3%	1.1%
				14%	12.5	14.8%	0.8%
				4%	16.0	23.1%	1.1%
				4%	14.3	16.7%	1.4%
				4%	11.8	6.6%	1.1%
				-6%	15.4	14.9%	0.8%
				-6%	13.8	9.2%	1.1%
				-6%	11.1	-1.2%	0.8%

4% branch

Description	Price/CF	Prob	Action	CF	P/CF	Cumulative Return (p.a.)	Cum Prob
Some Inflows for ST Investors	16.0	12%	Cash Out	na	na	13.3%	12.0%
	14.3	16%	Retain	14%	16.7	25.0%	1.4%
				14%	14.8	18.2%	1.9%
				14%	12.5	9.2%	1.4%
				4%	16.0	17.1%	1.9%
				4%	14.3	11.0%	2.6%
				4%	11.8	1.4%	1.9%
				-6%	15.4	9.3%	1.4%
				-6%	13.8	3.8%	1.9%
				-6%	11.1	-6.1%	1.4%
Some Outflows for ST Investors	11.8	12%	Retain	14%	16.7	25.8%	1.1%
				14%	14.8	19.0%	1.4%
				14%	12.5	9.9%	1.1%
				4%	16.0	17.9%	1.4%
				4%	14.3	11.7%	1.9%
				4%	11.8	2.1%	1.4%
				-6%	15.4	10.0%	1.1%
				-6%	13.8	4.5%	1.4%
				-6%	11.1	-5.5%	1.1%

-6% branch

Description	Price/CF	Prob	Action	CF	P/CF	Cumulative Return (p.a.)	Cum Prob
	15.4	9%	Cash Out	na	na	5.8%	9.0%
Some Outflows for ST Investors	13.8	12%	Retain	14%	16.7	18.9%	1.1%
				14%	14.8	12.5%	1.4%
				14%	12.5	3.9%	1.1%
				4%	16.0	11.4%	1.4%
				4%	14.3	5.6%	1.9%
				4%	11.8	-3.5%	1.4%
				-6%	15.4	4.0%	1.1%
				-6%	13.8	-1.2%	1.4%
				-6%	11.1	-10.6%	1.1%
Large Outflows for ST Investors	11.1	9%	Retain	14%	16.7	19.9%	0.8%
				14%	14.8	13.4%	1.1%
				14%	12.5	4.7%	0.8%
				4%	16.0	12.3%	1.1%
				4%	14.3	6.5%	1.4%
				4%	11.8	-2.7%	1.1%
				-6%	15.4	4.8%	0.8%
				-6%	13.8	-0.4%	1.1%
				-6%	11.1	-9.9%	0.8%

	Period 1		Period 2	
Expected Return (p.a.)	9.6%	*(100% in Asset)*	11.3%	*(Mix)*
Standard Deviation	16.7%		12.2%	

Source: Author estimates

Figure 7: Schematic of Dynamic Strategy B – Invest in Cash; Buy Asset End-Period 1 If Multiple Low

PERIOD 0: ACTION	PERIOD 1			END-PERIOD 1: ACTION	PERIOD 2				
	Cash Flow	Price/CF	Prob		Return	CF	P/CF	Cumulative Return (p.a.)	Cum Prob
		16.7	9%	Retain Rf		na	na	4.0%	9.0%
	14%	14.8	12%	Retain Rf		na	na	4.0%	12.0%
						14%	16.7	29.3%	0.8%
						14%	14.8	22.3%	1.1%
						14%	12.5	13.0%	0.8%
						4%	16.0	21.1%	1.1%
		12.5	9%	Buy Asset		4%	14.3	14.9%	1.4%
						4%	11.8	4.9%	1.1%
						-6%	15.4	13.1%	0.8%
						-6%	13.8	7.4%	1.1%
						-6%	11.1	-2.8%	0.8%
		16.0	12%	Retain Rf		na	na	4.0%	12.0%
Invest in Risk-Free Asset	4%	14.3	16%	Retain Rf		na	na	4.0%	16.0%
						14%	16.7	33.3%	1.1%
						14%	14.8	26.1%	1.4%
						14%	12.5	16.5%	1.1%
						4%	16.0	24.9%	1.4%
	Some Outflows for ST Investors	11.8	12%	Buy Asset		4%	14.3	18.4%	1.9%
						4%	11.8	8.2%	1.4%
						-6%	15.4	16.5%	1.1%
						-6%	13.8	10.7%	1.4%
						-6%	11.1	0.2%	1.1%
		15.4	9%	Retain Rf		na	na	4.0%	9.0%
	-6%	13.8	12%	Retain Rf		na	na	4.0%	12.0%
						14%	16.7	37.1%	0.8%
						14%	14.8	29.7%	1.1%
						14%	12.5	19.8%	0.8%
						4%	16.0	28.5%	1.1%
	Large Outflows for ST Investors	11.1	9%	Buy Asset		4%	14.3	21.8%	1.4%
						4%	11.8	11.3%	1.1%
						-6%	15.4	19.9%	0.8%
						-6%	13.8	13.9%	1.1%
						-6%	11.1	3.1%	0.8%
Expected Return (p.a.)			4.0%	*(100% in Cash)*				8.3%	*(Mix)*
Standard Deviation			0.0%					12.0%	

Source: Author estimates

Figure 8 reports the expected two-period outcomes for the various strategies. The baseline strategy of buying and holding the risky asset over both periods provides a reference point. The buy and hold strategy delivers wealth in period 2 that is 21.9% greater than period 0 and has a standard deviation of 20.6%. Annualised these numbers indicates a change in wealth (i.e. 'return') of 10.4% pa and a standard deviation of 13.2% pa, equating to a Sharpe ratio of 0.49.

The short-term investor fares worse than the buy and hold strategy by about 1.2% pa. To see this, it is necessary to evaluate their performance on a money-weighted basis to account for the effect of fund flows at the end of period 1. This is reflected in the IRR reported in the last column of Figure 8. Note that short-term investors achieve the buy and hold return on a time-weighted basis, which is the usual way of reporting returns in the investment industry. Nevertheless, the IRR is notably lower than the buy and hold return as a consequence of the assumed relation between flows and realized returns during period 1. High realized returns attract inflows, yet reflect a move into highly-priced territory in certain states, which in turn signals low expected returns during period 2. Conversely, low realized returns attract outflows but can be associated with a move into lowly-priced territory and high returns

in period 2. The upshot is that short-term investors have a tendency to add to their positions when prices are high, while selling when prices are low, which reduces their money-weighted returns. Our estimated impact of about -1.2% is in the same ballpark as Fiesen and Sapp (2007), who find that money-weighted returns are about 1.6% less than time-weighted returns for US equity mutual funds. Friesen and Sapp also provide support for the intuition underpinning our model. They find that the difference between money-weighted and time-weighted returns may be attributed to return-chasing behavior by mutual fund investors. It is also largely sourced from funds that are exposed to growth and momentum, rather than value.

Figure 8: Outcomes over Two Periods

Investment Strategies			Wealth End-Period 2 (per $1)			Two-Period Change in Wealth (pa)			IRR
Strategy	Period 1	Period 2	Mean	Standard Deviation	Skewness	Mean Change	Standard Deviation	Sharpe Ratio	
Risk-Free Asset (Rf)	Rf	Rf	1.082	0.000	0.00	4.0%	0.0%	0.00	4.0%
Risky Asset (A), Buy & Hold	A	A	1.219	0.206	0.19	10.4%	13.2%	0.49	10.0%
Short-Term Investor	A	A ± Flows							8.8%
Dynamic Strategies:									
(A) Start with Risky Asset	A 100%	P/CF High => Rf	1.240	0.192	0.05	11.3%	12.2%	0.60	11.0%
(B) Start with Risk-Free Asset	Rf 100%	P/CF Low => A	1.172	0.184	1.92	8.3%	12.0%	0.36	8.0%
(C) Optimal Combination	A 71%, Rf 29%	P/CF High => Rf P/CF Low => A	1.220	0.160	0.33	10.5%	10.2%	0.63	10.2%

Source: Author estimates

The first dynamic strategy (A) that a long-term investor may follow is to start fully invested in the risky asset, and then sell at end-period 1 if the asset becomes highly valued (i.e. priced on a low discount rate). Under our baseline assumptions, this is the strategy that maximizes expected wealth at the end of period 2. The strategy generates an expected change in wealth of 11.3% pa, with a standard deviation of 12.2% pa, indicating a Sharpe ratio of 0.60. This finding accords with the intuition that long-term investors have an opportunity to increase their returns while reducing risk through remaining fully invested until assets become over-priced (i.e. offer low expected returns), at which point they may sell out and move to a low risk alternative, such as cash.

Selling out when an asset becomes overvalued may sound an obvious thing to do. But it is often difficult to execute in practice for many institutional investors who face pressures to remain fully invested. For instance, divestment may be inconsistent with mandates, as institutions are often appointed to remain fully invested in a specific asset class or maintain a certain portfolio structure, e.g. a '70/30' balanced fund. Peer group pressures can also induce funds to remain fully invested when markets are running hot. One of the benefits of being a long-term investor with full discretion over trading can be a greater capacity to sell out of highly priced assets, providing of course that organizational design accommodates and supports such a course of action.

The second dynamic strategy (B) entails starting by investing in the risk-free asset (i.e. cash), and then buying the risky asset at end-period 1 if it is lowly valued (i.e. priced on a high discount rate). Of all the strategies involving the risky asset, this offers the lowest expected change in wealth (8.3% pa), standard deviation (8.3% pa) and Sharpe ratio (0.36). The reason is that this strategy misses out on the relatively attractive expected return and Sharpe ratio offered by the risky asset on an unconditional basis, most notably including period 1. The implication is that holding cash as an option to take advantage of future

opportunities arising from selling pressure may be unattractive as a *stand-alone* strategy for a long-term investor in many cases.

Nevertheless, a number of caveats need to be placed on the idea that holding cash as an option is unattractive. First, our model suggests that a long-term investor may find it optimal to hold aside *some* cash to take advantage of opportunities. We address this possibility in the next paragraph. Second, the attractiveness of holding cash as an option depends in part on risk aversion. Strategy B not only offers low risk, but is also positively skewed due to only investing in the risky asset when the upside potential well exceeds the downside risk. If the efficacy of the strategies is evaluated based on utility of wealth in period 2, rather than the Sharpe ratio, starting with cash, rather than the risky asset, becomes attractive at high risk aversion levels (specifically a coefficient of relative risk aversion of around 8). Third, the baseline results reflect the assumption that the risky asset is 'fairly priced' in period 0. The implication of altering this assumption is also investigated below.

To evaluate whether a mixed dynamic strategy may be optimal for the long-term investor, we solve for the combination of strategy A and B that maximizes the Sharpe ratio. The optimal combination under the baseline inputs is an initial investment of 71% in the risky asset and 29% in the risk-free asset. This combination delivers an expected change in wealth of 10.5% pa, a standard deviation of 10.2% pa and a Sharpe ratio of 0.63. Relative to the buy and hold strategy, the optimal combination delivers a slightly higher return at lower risk, and is also more positively skewed. This suggests that a long-term investor might benefit from partially committing their funds, holding some cash in reserve to put to work if opportunities arise as a consequence of sell-offs due to (say) price pressure from short-term investors. The result that some cash optimizes the Sharpe ratio is robust to changes in the cash flow and discount rate assumptions, including removal of the skew in discount rates, although clearly the magnitudes involved vary with the inputs.

Finally, we consider the impact of changing the initial pricing conditions for the risky asset. The baseline inputs assume that the risky asset is 'fairly' priced at period 0 in accordance with the constant growth discount model. Figure 9 plots the change in the initial risky asset weight that optimizes the Sharpe ratio for differing Price/Cash Flow multiples at period 0. It confirms that initial valuation conditions matter in discussing the extent to which one should be invested. Full initial commitment to the risky asset is indicated at a multiple of just below 12½-times. Full initial commitment to cash (the risk-free asset) is indicated at a multiple of just above 16-times. These multiples represent a spread of about ±12%-13% around the 'fair' multiple of 14.3-times under the valuation model using baseline inputs. The estimates suggest that partial commitment to a risky asset, coupled with some amount of cash held in reserve, may be an optimal strategy across a relatively wide range of situations. The key exception is when an asset approaches some valuation extreme.

Figure 9: Optimal Risky Asset Weight for Period 1 vs. Valuation at Period 0
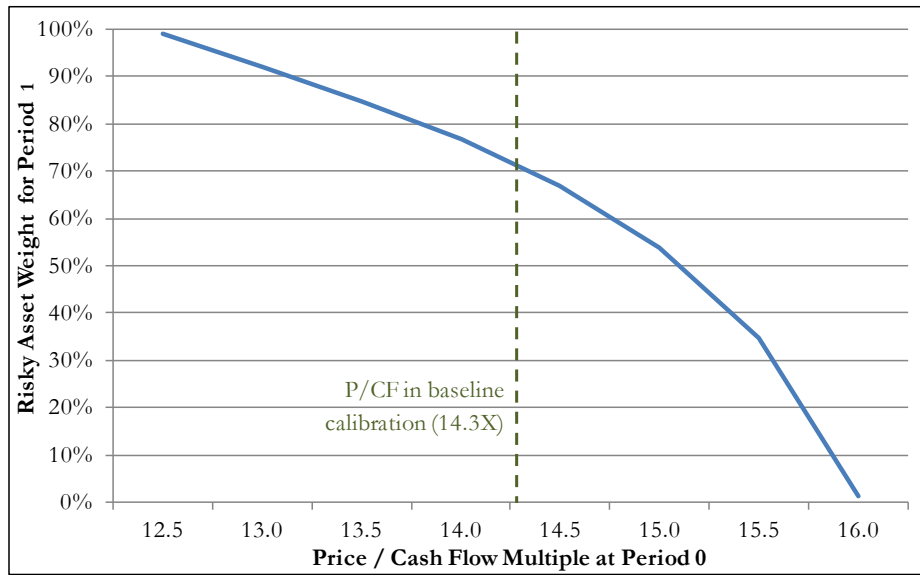
Source: Author estimates

(iii) Summary

The discussion and basic model presented in this section establishes the following points:

- One of the key advantages faced by long-term investors with discretion over trading and an ability to identify long-term value is the scope to enhance returns through dynamic strategies aimed at exploiting time-varying expected returns, including any mispricing.

- Illiquidity presents a key potential source of time-varying expected returns, specifically fluctuations in the compensation required for illiquidity exposure, combined with price pressure from short-term investors required to trade in response to fund flows regardless of price. In this respect, the dynamic strategy may be considered a form of liquidity provision that aims to exploit the situation by taking the other side of the trade.

- Our basic model indicates potential for long-term investors to earn additional returns of perhaps 1% pa at the expense of short-term investors through pursuing such a strategy. Alternatively, the strategy might be viewed as providing scope to reduce risk. Either way, the risk/return trade-off is substantially enhanced.

- Our model suggests that it will often be optimal for a long-term investor to partially commit to a risky asset, while holding some cash in reserve as an option to take advantage of opportunities such as buying opportunities arising from sell-offs.[25] One exception is when asset valuations sit towards some extreme (i.e. very high or low expected returns are on offer). In this event, full commitment to either cash or the asset might be warranted.

---

[25] Consideration of dynamic strategies of the type examined here illustrates the substantial value of the free option to call up cash that can be available to funds operating in unlisted markets, such as private equity.

- Our model is a simplification of the real world. While we believe it captures the essence of the dynamic strategies that might be pursued by long-term investors, some of the important aspects that it fails to take into account are listed below:

    - *Uncertainty is likely to be higher in practice than portrayed in the model* – The model implicitly assumes that the probability distribution of payoffs and discount rates is known, when in practice they are typically estimated under considerable uncertainty (even Knightian uncertainty).

    - *The real world consists of more than just two periods of discrete length* – Investment is typically undertaken as a continuous pursuit, with investors monitoring and reacting to markets on an ongoing basis. Related issues include the following:

        - *The effectiveness of holding cash as an option partly relies on how soon an opportunity emerges* – Holding cash can have an opportunity cost if it takes a long while before low prices or high expected returns emerge. This issue will be highlighted and discussed in Section 8.

        - *Outcomes depend on the time period over which they accrue* – The model is based on the assumption that each period represents one year. Market adjustments occur in effect on variable timetables. In particular, if the market takes longer to readjust, the realized annualized returns would be attenuated. This is an important consideration for long-term investing, where the timing of payoffs can be open-ended and possibly manifest over a number of years.

    - *Menu of assets is wider than considered* – The model assumes two assets: a non-descript risky asset, and a risk-free asset. In practice, institutional investors have access to a wide range of assets.

    - *Implementation matters* – Our simple model ignores implementation issues such as the cost of running the strategy and the ability to transact.

With this background, Section 8 will now address the application of dynamic strategies in practice.

8. Dynamic Strategies: Practical Application

We now expand on the concepts and basic model of Section 7 in two ways. First, we identify practical issues to address when applying a dynamic strategy. Second, a basic dynamic strategy is illustrated using data from the Australian unlisted property market.

(i) Practical Issues

Recapping, the type of dynamic strategy considered here entails buying when long-term expected returns are high (prices are low) and selling when expected returns are low (prices are high), partly in anticipation of mean-reversion. Implementation of such strategies involves two main challenges. The first is *estimation*. Depending on how the strategy is designed, an estimate may be required of long-term expected return given current prices, as well as the mean reversion level for either expected returns and/or price, i.e. 'fair value'. The mean reversion level provides both a benchmark against which an asset may be evaluated and a target for potential exit from a position.

The second challenge is identifying *when* to trade and at *what price*. This requires balancing the possibility of immediate mean reversion versus continuation towards even more extreme levels (often associated with momentum). The ideal would be to put in place positions once assets are near the extreme in expected return and/or price relative to the mean reversion level. With this in mind, the following issues arise in implementing this type of strategy in practice.

a) ***Estimation*** – It is by no means a trivial task to estimate long-term expected returns given current price, or the mean reversion level for expected returns and/or price. Challenges include forming assumptions about long-term or sustainable cash flows, uncertainty over the parameters for any pricing model, and even choosing the pricing model to use in the first place. Lack of data is often a hurdle to overcome. In some unlisted markets, the investor may be able to influence value themselves by adding economic value to the asset. In Section 4, we nominated estimation error as the most significant source of risk faced by long-term investors. Mis-estimation can lead investors to be attracted to a losing position, which they might potentially become locked into if the asset never appears to reach a level that justifies exiting the position (e.g. 'value traps' that keep underperforming despite looking cheap).

b) ***Signal to enter a position: identification of an extreme*** – As mentioned, the ideal is to enter a position as an asset approaches its extreme in expected return and/or price. The confidence interval for deviations from the mean reversion level will clearly be a point of focus ('margin for error'), but is not the only consideration. The trade-off between the risk of missing out on opportunities versus moving too early may need to be evaluated.[26] Non-price information might also be taken into account. For instance, there could be some influence acting on prices that may prove unsustainable over the long run. Examples include abnormal buying or selling pressure from funding shifts; swings in risk or uncertainty aversion; temporary mismatches in asset supply relative to demand; or extreme economic or monetary conditions that should not last. Long-term themes might also be relevant. In practice, it may be beneficial to develop heuristics or rules of thumb for entering (and exiting) positions that can be applied flexibly. This would permit other considerations to be incorporated as required, including the degree of confidence in the signal.

c) ***Signal to exit[27] a position*** – Under the type of dynamic strategy being addressed, it is important that the exit decision is not a mirror image of the entry decision. Without asymmetry between the entry and exit criteria, net gains will be limited. For example, say the entry signal was when an asset was (say) 20% below fair value. A symmetric exit rule of closing the position when the asset crosses back over the 20% threshold would result in no net excess price gains,[28] given the purchase and sale occur at the same level relative to fair value. Inherently, the type of dynamic strategy being addressed must rest on anticipation of mean reversion. Accordingly, the exit signal should include the asset approaching, or perhaps crossing, the benchmark mean reversion level. Other non-price information might potentially be taken into account.

d) ***Cash as an option and opportunity cost*** – Section 7 raised the concept that holding some cash in anticipation of future opportunities might be optimal in many instances. Indeed, a prerequisite to take advantage of low prices or high expected returns is that funds are held aside.[29] The problem with holding cash is that it involves an opportunity cost as long as the target asset continues to generate an adequate return. The practical implication is that the timing by which any opportunity is likely to emerge becomes a consideration. If an opportunity takes a long time to eventuate, then the opportunity cost of holding cash will likely be greater than if an opportunity unfolds soon. This complication was not drawn out in the basic model of Section 7, but will become evident in the analysis presented in Section 8(ii) below.

---

[26] This could be modeled, or based on judgment. Another approach is to progressively build a position once trade region has been reached.

[27] 'Exit' may be considered as returning to the long-term neutral position, whatever it may be.

[28] This statement assumes that cash flow forecasts are correct, at least on average.

[29] Funds need not be held aside in cash. They could be placed in another alternative asset that holds its relative value while the price of the target asset declines.

e) **Portfolio context** – Most of the discussion so far has focused on a two-asset choice between cash and a risky asset. In practice, investors hold portfolios of multiple assets, which may accommodate a multitude of dynamic strategies. One pertinent example for long-term investors is the ability to move funds between listed assets and their unlisted alternatives, such as listed and unlisted property, listed equity versus private equity, and so on.

f) **Capacity to sustain any position** – A critical issue is the capacity to sustain positions which have uncertain payoffs with open-ended timing. It is not unusual for dynamic strategies of the type being examined to incur initial losses and a slow turnaround: a point that will be illustrated by the analysis presented in Section 8(ii). Maintaining a position can require considerable individual and organization fortitude, often under imperfect information where self-belief is being questioned. This key point of vulnerability is discussed in Section 4.

g) **Implementation challenges** – Listed below are some implementation challenges for dynamic strategies. The analysis of Section 8(ii) will allow for transaction costs and implementation lags.

- *Costs and taxes*: Trading involves transaction costs, potentially including tax effects. Transaction costs are particularly important in illiquid and/or unlisted assets. The size of the holding can be relevant, as it may be more difficult and costly to trade in large parcels. There may be other costs associated with illiquid assets, including those related to liquidity management and capital commitments (see Section 6).

- *Implementation lags*: It can often take some time to implement a strategy, particularly where illiquid and/or unlisted assets are involved. Lags can stem from the time it takes to identify opportunities, search and evaluate potential investments, and then consummate a transaction.

- *Internal capability*: Opportunities may require an internal capability in order to identify, evaluate and manage them.

We now investigate some of the issues raised above by applying a dynamic strategy to representative data for Australian unlisted (i.e. direct) property.

(ii) Application to Unlisted Property

The analysis presented in this section illustrates the practical application of a dynamic strategy and the challenges involved. Our application generates trade signals from capitalization rates (i.e. yields) on Australian prime office property. The signal is applied by notionally investing in either unlisted property, cash, or some mix. The illiquid nature of unlisted property is recognized by assuming that trades occur at a lag and incur significant transaction costs. While not truly implementable, the analysis is instructive. It indicates that long-term investors could have benefited from the strategy relative to buying and holding unlisted property, albeit more through risk reduction than increased returns in this instance. It highlights the issues with applying such strategies in practice, including the possibility that they may underperform over short to medium horizons.

Our analysis draws on available data with some shortcomings. The capitalization rate series is a rough proxy. It reflects only prime CBD offices, and splices data from various sources. Prior to 1980 the series reflects only Sydney and Melbourne, to which a fixed adjustment (+0.44%) was applied to calibrate the levels. It then expands to capture an average of 4 capital cities until 2007, when a series with more comprehensive coverage is utilized. Returns to unlisted property are estimated based on the Mercer/IPD Australia Core Wholesale Property Fund Index and its predecessor, the Mercer Unlisted Property Index. This index reflects returns on broad-based unlisted property portfolios for a sample of Australian institutional investors, the constituents of which have been expanded over time. Accordingly, the capitalization rate and return series are not fully aligned, which may hamper the

effectiveness of the signal. The cash return series is constructed from 90-day bank accepted bill yields. All data is quarterly.

Our application of the dynamic strategy reflects a combination of data constraints, guidance from the basic model of Section 7, sensitivity to practical implementation issues, and intuition. Details are described below and summarized in Figure 10. Shortcomings and issues will be discussed after the analysis is presented.

- *Neutral position* – The neutral position is invested 80% in unlisted property and 20% in cash. Inclusion of some cash reflects the basic model of Section 7, and tests the benefits of holding cash as an option. Results are reported for a neutral position of 100% unlisted property for contrast.

- *Entry signal* – The entry signal for adopting a 'long' position of 100% in unlisted property is once the capitalization rate crosses into the top quintile as estimated from data up to the decision point. Conversely, the signal for entering a 'short' position of 0% in unlisted property and 100% cash is once the capitalization rate crosses into the bottom quintile. The choice of quintiles as the cut-off is consistent with the intuition that an investor might require a confidence level in the order of 80% to adopt a non-neutral position. (We did not optimize the cut-off, but chose what seemed reasonable.)

- *Exit signal* – The signal for returning to the neutral position is once the capitalization rate crosses back over its median, as estimated from data up to the decision point.

- *Starting point* – We commenced the analysis with a neutral position in December 1990. This quarter was chosen as a point where the capitalization rate was in line with its historical median, so that neither the dynamic strategy nor the buy and hold strategy had an initial advantage.[30]

- *Implementation* – The investor is assumed to hold an unlisted property portfolio that earns the same return as the Mercer/IPD property index. All trades incur a transaction cost of 6%[31] of the value traded; and occur 4 quarters after the signal to trade is received. The lag makes allowance for the time it takes to locate properties and consummate trades. The lag works to the benefit of the strategy. This is neither entirely fortuitous, nor unreasonable. Unlisted property returns are highly persistent, in part due to the lagged adjustment of valuations under appraisal pricing.[32] It is likely that lagged values better reflect 'real' market prices at which trades might occur, than values at the signal date. We assume that the portfolio is rebalanced to target weights only upon a trade.

- *Effective weightings* – The average weighting in unlisted property across all 102 quarterly periods is 76%. The strategy spends 76% of the time in neutral, 14% short and 10% long.

Figure 11 plots the capitalization rate series, along with the dynamically estimated median and upper and lower quintiles. Trade points incorporating the 4-quarter lag from the signal are identified with markers. The strategy undertakes two trades over 23 years. A long position is adopted in December 1993, following the property market collapse of the early-1990s. This episode fits the bill of a funding-driven, illiquidity event. The Australian property market was placed under considerable pressure at the time by a combination of bankruptcies by over-geared property investors, withdrawal of some banks from lending, and an overhang from the unlisted property trust sector that was suffering widespread requests for redemptions.[33] The position was exited in March 1997. A short position was adopted in

---

[30] Results from the analysis are sensitive to the starting point.

[31] A cost of 6% was suggested by the Future Fund's property team.

[32] The unlisted property return series has a serial correlation of 0.77 at a quarterly lag. We understand that, over much of the analysis period, some funds valued one quarter of their properties every quarter, while others valued the entire portfolio once a year. This implies a 3-4 quarter lag before all appraised values catch up with the market.

[33] MLC provides an account of this episode, see:
http://www.mlc.com.au/resources/MLC/Implemented%20Consulting/Static%20Files/pdf/Unlisted%20property.pdf

September 2007 and exited in December 2009, thus sitting out of the property market during the GFC. The property team of the Future Fund suggests that the reduction in capitalization rates prior to the GFC reflected a combination of capital flowing into the sector; ready credit availability with lower spreads and often light terms and covenants; and supportive growth in rents. This describes a situation where property valuations were being elevated by strong investor demand and abundant liquidity - also consistent with a role for liquidity effects in setting up trading opportunities for long-term investors.

Figure 10: Summary of the Dynamic Strategy

	Portfolio Weight			Realized Portion of Time
	Unlisted Property	*Cash*	*Total*	
Targets:				
Long Position	100%	0%	100%	*14%*
Neutral	80%	20%	100%	*76%*
Short Position	0%	100%	100%	*10%*
Realized Average	*77%*	*23%*	*100%*	*100%*

Trading Rules	
Go Long	Cap rate crosses into top quintile
Go Short	Cap rate crosses into bottom quintile
Move back to Neutral	Cap rate crosses the median
Lag from Signal to Trade	4 quarters (1 year)
Transaction Cost - Property	6%
Rebalancing	Only when a trade occurs

Source: Author

Figure 11: Capitalization Rates for Australian Prime Office Property and Trade Points
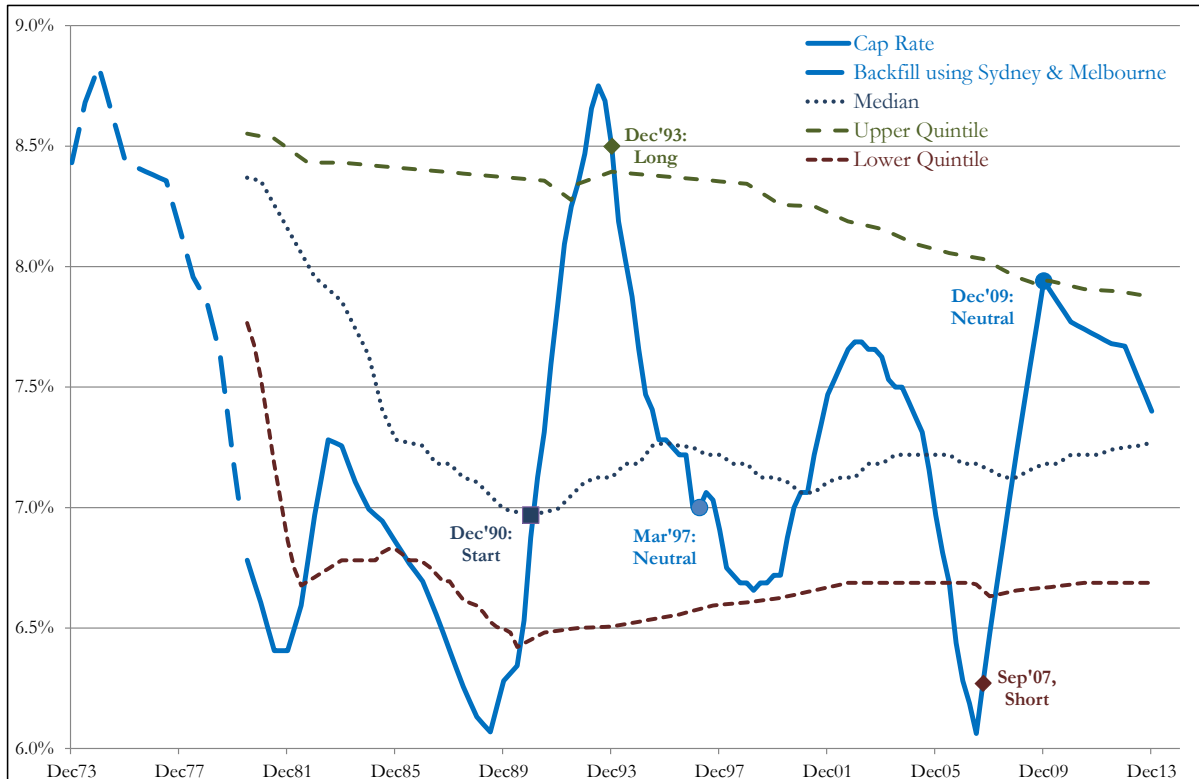
Source: Jones Lang LaSalle, BIS Shrapnell, CBRE, author estimates

Figure 12 tabulates the results. Figure 13 and Figure 14 compare the relative wealth indices for the strategy, a buy and hold in unlisted property, and cash. The strategy generates returns that are only modestly higher than the buy and hold strategy, by 0.06%-0.07% pa. Its main benefit is to significantly lower the volatility of wealth, especially over longer holding periods. For instance, the standard deviation of the change in wealth over 3-, 5- and 10-year rolling periods is 3%-4% pa less for the strategy than for the buy and hold. The strategy not only lowers volatility by investing in cash (23% average weighting), but also by being more selective when it commits to the property market. In particular, Figure 13 reveals that the strategy avoids the volatility of the GFC period. It is also less exposed during the sell-off during the early-1990s episode. While the strategy does not perform as well as cash during this earlier episode, it makes up for it later.

Figure 12: Outcomes Compared for Strategy vs. Buy and Hold and Cash

| *Quarterly data over period:* *December 1990 to December 2013*	Outcome for Each Investment			Strategy versus:		Note: Strategy with Neutral = 100% Property
	Strategy	*Unlisted Property*	*Cash*	*Unlisted Property*	*Cash*	
Compound Return	**7.10%**	**7.03%**	**5.67%**	**0.06%**	**1.42%**	**7.25%**
Analysis of Change in Wealth:						
Mean (pa):						
- Over 1-quarter	7.15%	7.14%	5.68%	0.01%	1.48%	7.34%
- Over rolling 4-quarters (1 year)	7.51%	7.69%	5.63%	-0.18%	1.87%	7.82%
- Over rolling 12-quarters (3 years)	8.18%	8.57%	5.60%	-0.39%	2.58%	8.71%
- Over rolling 20-quarters (5 years)	8.54%	8.95%	5.64%	-0.41%	2.90%	9.15%
- Over rolling 40-quarters (10 years)	9.09%	9.74%	5.56%	-0.65%	3.53%	9.81%
Standard Deviation (pa):						
- Over 1-quarter	3.3%	4.5%	0.8%	-1.2%	2.52%	4.0%
- Over rolling 4-quarters (1 year)	5.2%	7.8%	1.4%	-2.6%	3.85%	6.5%
- Over rolling 12-quarters (3 years)	6.9%	10.1%	1.5%	-3.2%	5.40%	8.4%
- Over rolling 20-quarters (5 years)	7.7%	11.3%	1.7%	-3.6%	6.02%	9.5%
- Over rolling 40-quarters (10 years)	9.3%	13.3%	1.5%	-4.0%	7.87%	11.9%
Portion of Time Underperforming:						
- Over 1-quarter				65%	21%	4%
- Over rolling 4-quarters (1 year)				72%	25%	8%
- Over rolling 12-quarters (3 years)				72%	16%	10%
- Over rolling 20-quarters (5 years)				63%	11%	8%
- Over rolling 40-quarters (10 years)				87%	6%	11%
Portion of Time Underperforming by more than -1% pa:						
- Over 1-quarter				30%	20%	4%
- Over rolling 4-quarters (1 year)				27%	19%	8%
- Over rolling 12-quarters (3 years)				20%	10%	9%
- Over rolling 20-quarters (5 years)				15%	10%	7%
- Over rolling 40-quarters (10 years)				13%	4%	6%

Source: Mercer/IPD, author estimates

Figure 13: Wealth Indices (Log Scale)
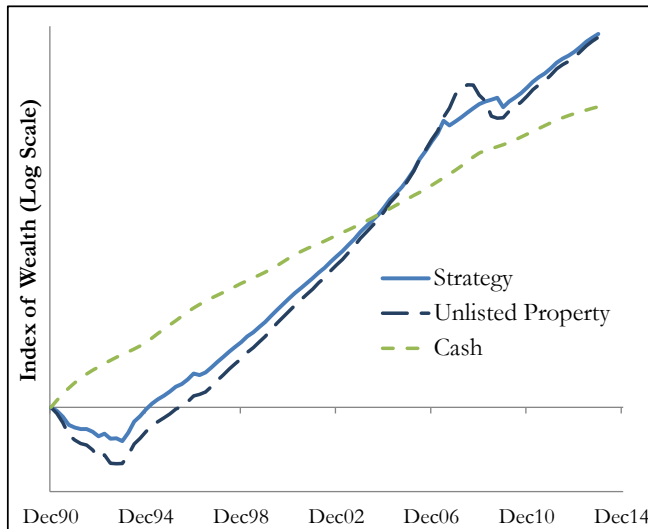
Source: Mercer/IPD, author estimates

Figure 14: Relative Wealth for Strategy
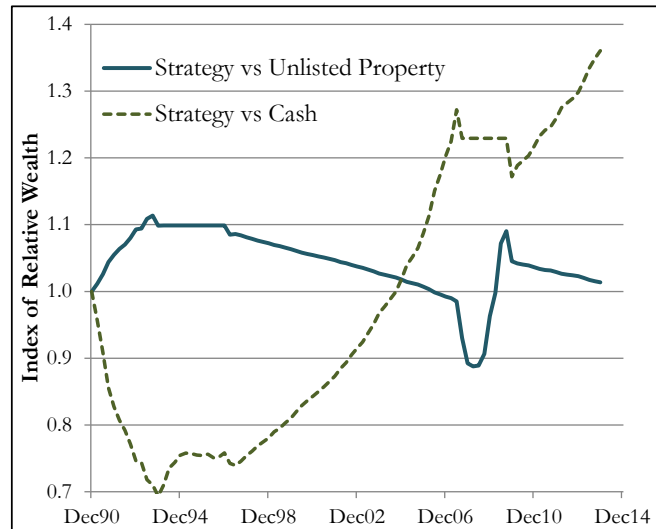
Source: Mercer/IPD, author estimates

The analysis raises a number of issues with respect to the application of dynamic strategies by long-term investors:

- *Dynamic strategies can be a way to reduce risk as much as increase return* – A message that arises from both the basic model and the application to unlisted property is that dynamic strategies can reduce risk. Most notably, this is achieved by being willing to sell out of assets that offer low expected returns and/or are 'overvalued'. As discussed earlier, the option to sell out is often only available to long-term investors with discretion over trading. Many short-term investors face pressure to be fully invested due to their mandates or concerns over relative performance versus a benchmark or peers.

- *Using cash as an option requires the time dimension to be considered* – Figure 14 depicts the concept that holding cash can entail an opportunity cost, which can accumulate the longer it takes for a buy opportunity to arise. The effect of holding 20% in cash while the property market delivers solid returns manifests as a gentle downtrend in the relative wealth generated by the strategy versus unlisted property between March 1996 and September 2007, and again after December 2009. Indeed, a neutral position of 100% invested (the equivalent of Strategy A in Section 7) seems to generate a better result for the data set. Nevertheless, this does not rule out the possibility that holding cash as an option may be worthwhile under certain circumstances. Rather, it illustrates the importance of evaluating the likelihood of an opportunity to buy arising within a reasonable period of time when implementing this type of dynamic strategy.

- *Dynamic strategies may entail short-term performance risk* – The analysis provides an indication of how dynamic strategies may underperform some benchmark, possibly often and for extended periods. Figure 12 reports the portion of time that the strategy underperforms unlisted property and cash across various horizons. Over 1-year rolling periods, the strategy underperforms unlisted property 72% of the time, as well as underperforming by more than -1% during 26% of the time. It also underperforms cash 25% of the time over 1-year periods. While the time spent underperforming reduces with horizon, it remains meaningful even over 5-10 year periods. The full benefits only become evident over the entire life of the strategy (i.e. the very long term). This confirms the extent to which such strategies are only suitable for long-term investors that are unconcerned with the risk of short to medium term underperformance.

- *The strategy might be improved by incorporating other information* – The strategy as applied here may understate the potential benefits to a long-term investor by basing the trade signal on one narrow indicator - the capitalization rate for office property. This issue extends well beyond relying on an imprecise series that is mismatched with the return series, and the uncertainty this adds in identifying extreme price points.[34] Such a simple signal ignores other relevant information that may be available to a long-term investor. In particular, estimation of long-term fair value and/or expected return may be improved by considering the outlook for long-term cash flows. Incorporating such information would focus the investment approach towards long-term drivers of value and expected returns, which aligns with the second indicator of long-term investment, as identified in Paper 1. In addition, long-term investors might take into account other evidence that pricing is at an unsustainable extreme in generating trade signals, as discussed in Section 8(i). For instance, a long position might be confirmed and encouraged if capitalization rates at the high end of the range were accompanied by evidence of price pressure from forced sellers.

- *Asset universe to which the dynamic strategy is applied* – Long-term investors face a wide menu of assets to which dynamic strategies might be applied. In particular, only long-term investors are well placed to pursue dynamic strategies involving illiquid and/or unlisted assets. Further, dynamic strategies could be conducted in a broader portfolio context, involving other assets apart from cash. Another risky asset with a lower opportunity cost than cash might be used as the alternative asset. In the context of property markets, considering listed property (REITs) as a third choice in addition to cash is only likely to enhance the potential outcome.

In summary, long-term investors have the capability to adopt dynamic strategies which may not be suitable for short-term investors due to the nature of the payoff timing, the requirement for discretion over trading, and the need for a keen perspective on long-term drivers of returns or value to implement effectively. Our analysis illustrates the potential benefits from dynamic strategies, including the scope to reduce risk, as well as potentially increase returns, over the long term. Indeed, our analysis probably understates the potential benefits because it is based on more limited information and a narrower asset opportunity set than might be available in practice.

---

[34] The capitalization rate series was relatively stationary over the analysis period, which was beneficial to the strategy. If the trade analysis is commenced earlier using the same rules, the results deteriorate considerably. This serves as a warning regarding the difficulties associated with estimation when data is limited, as is often the case.

References

Acharya, Viral V. and Pedersen, Lasse Heje (2005), "Asset Pricing with Liquidity Risk", *Journal of Financial Economics*, 77(2), 375-410

Aguiar, Mark, and Gopinath., Gita (2005), "Fire-Sale Foreign Direct Investment and Liquidity Crises", *Review of Economics and Statistics*, 87(3), 439-452

Ambachtsheer, Jane, Fuller, Richard and Hinchoda, Divyesh (2013), "Behaving Like an Owner: Plugging Investment Chain Leakages", *Rotman International Journal of Pension Management*, 6(2), 18-27

Amihud, Yakov and Mendelson, Haim (1986), "Asset Pricing and the Bid-Ask Spread", *Journal of Financial Economics*, 17(2), 223-249

Amihud, Yakov and Mendelson, Haim (1991), "Liquidity, Maturity, and the Yields on U.S. Treasury Securities", *Journal of Finance*, 46(4), 1411-1425

Amihud, Yakov, Hameed, Allaudeen, Kang, Wenjin and Zhang, Huiping (2013), "The Illiquidity Premium: International Evidence", *Working Paper*, Stern School of Business, New York University, July 16

Ang, Andrew (2013), "Illiquid Asset Investing", *Working Paper* (book chapter posted on SSRN; January 13)

Ang, Andrew and Kjaer, Knut N. (2011), "Investing for the Long Run", *Working Paper*, November

Ang, Andrew, Papanikolaou, Dimitris and Westerfield, Mark (2013), "Portfolio Choice with Illiquid Assets", *NBER Working Papers*, No. 19436, September

ASFA (2014), "Financial System Inquiry: Submission", *Association of Superannuation Funds of Australia*, March

Baker, Malcolm, Bradley, Brenda and Wurgler, Jeffrey (2011), "Benchmarks as Limits to Arbitrage: Understanding the Low-Volatility Anomaly", *Financial Analysts Journal*, 67(1), 40-54

Bao, Jack, Pan, Jun and Wang, Jiang (2011), "The Illiquidity of Corporate Bonds", *Journal of Finance*, 66(3), 911–946

Basak, Suleyman and Pavlova, Anna (2013), "Asset Prices and Institutional Investors", *American Economic Review*, 103(5), 1728-1758

Bekaert, Geert, Harvey, Campbell R. and Lundblad, Christian (2007), "Liquidity and Expected Returns: Lessons from Emerging Markets", *Review of Financial Studies*, 20(5), 1783-1831

Belasco, Eric, Finke, Michael and Nanigian, David (2012), "The Impact of Passive Investing on Corporate Valuations', *Managerial Finance*, 38(11), 1067-1084

Benveniste, Lawrence, Capozza, Dennis R. and Seguin, Paul J. (2001), "The Value of Liquidity", *Real Estate Economics*, 29(4),633-660

Bennyhoff, Donald G. (2009), "Time Diversification and Horizon-Based Asset Allocations", *Journal of Investing*, 18(1), 45-52

Ben-Rephael, Azi, Kadan, Ohad and Wohl, Avi (2013), "The Diminishing Liquidity Premium," *Journal of Financial and Quantitative Analysis* (forthcoming)

Benartzi, Shlomo and Thaler, Richard, H. (1995), "Risk Aversion or Myopia? Choices in Repeated Gambles and Retirement Investments", *Management Science*, 45(3), 364-381

Benartzi, Shlomo and Thaler, Richard, H. (1999), "Myopic Loss Aversion and the Equity Premium Puzzle", *Quarterly Journal of Economics*, 110(1), 73-92

Boudouhk, Jacob and Whitelaw, Robert F. (1991), "The Benchmark Effect in the Japanese Government Bond Market", *Journal of Fixed Income*, 1(2), 52-59

Brennan, Michael J., Chordia, Tarun, Subrahmanyam, Avanidhar and Tong, Qing (2012), "Sell-Order Liquidity and the Cross-Section of Expected Stock Returns", *Journal of Financial Economics*, 105(3), 523-541

Brenner, Menachem, Eldor, Rafi and Hauser, Shmuel (2001), "The Price of Options Illiquidity", *Journal of Finance*, 56(2), 789-805

Browne, Sid, Milevsky, Moshe A. and Salisbury, Thomas S. (2003), "Asset Allocation and the Liquidity Premium for Illiquid Annuities", *Journal of Risk and Insurance*, 70(3), 509-526

Brunnermeier, Markus K. and Pedersen, Lass Heje (2008), "Market Liquidity and Funding Liquidity", *Review of Financial Studies*, 22(6), 2201-2238

Campbell, John Y., Giglio, Stefano and Pathak, Parag (2011), "Forced Sales and House Prices." *American Economic Review*, 101(5), 2108-2131

Campbell, John Y. and Viceira, Luis M. (1999), "Consumption and Portfolio Decisions when Expected Returns are Time-Varying", *Quarterly Journal of Economics*, 114(2), 433-495

Campbell, John Y. and Viceira, Luis M. (2005), "The Term Structure of the Risk-Return Trade-off", *Financial Analysts Journal*, 61(1), 34-44

Chen, Long, Lesmond, David A. and Wei, Jason (2007), "Corporate Yield Spreads and Bond Liquidity", *Journal of Finance*, 62(1), 119–149

Chen, Qi, Goldstein, Itay and Jiang, Wei (2010), "Payoff Complementarities and Financial Fragility: Evidence from Mutual Fund Outflows", *Journal of Financial Economics*, 97(2), 239-262

Christensen, Jens H.E. and Gillan, James M. (2012), "Could the U.S. Treasury Benefit from Issuing More TIPS?", *Federal Reserve Broad of San Francisco Paper Series*, June

Constantinides, George M. (1986), "Capital Market Equilibrium with Transaction Costs", *Journal of Political Economy*, 94(4), 842-862

Coval, Joshua and Stafford, Erik (2007), "Asset Fire Sales (and Purchases) in Equity Markets," *Journal of Financial Economics*, 86(2), 479-512

Croce, Raffaele Della, Stewart, Fiona and Yermo, Juan (2011), "Promoting Longer-Term Investment by Institutional Investors: Selected Issues and Policy", *OECD Journal: Financial Market Trends*, 1, 1-20

Cumming, Douglas J., Haß, Lars Helge and Schweizer, Denis (2014) "Strategic Asset Allocation and the Role of Alternative Investments", *European Financial Management*, 20(3), 521–547

D'Amico, Stefania, Kim, Don H. and Wei, Mon (2010), "Tips from TIPS: The Informational Content of Treasury Inflation-Protected Security Prices" *Finance and Economics Discussion Series*, No. 19, Federal Reserve Board

De Jong, Frank and Driessen, Joost (2012), "Liquidity Risk Premia in Corporate Bond Markets", *Quarterly Journal of Finance*, 2(2)

Dick-Nielsen, Jens, Feldhütter, Peter and Lando, David (2012), "Corporate Bond Liquidity Before and After the Onset of the Subprime Crisis", *Journal of Financial Economics*, 103(3), 471-492

Dimson, Elroy and Hanke, Bernd (2004), "The Expected Liquidity Premium: Evidence from Equity Index-Linked Bonds", *Review of Finance*, 8(1), 19-47

Flyvbjerg, Bent (2009), "Survival of the Unfittest: Why the Worst Infrastructure Gets Built – And What We Can Do About It", *Oxford Review of Economic Policy*, 25(3), 344-367

Franzoni, Francesco, Nowak, Eric and Phalippou, Ludovic (2012), "Private Equity Performance and Liquidity Risk", *Journal of Finance*, 67(6), 2341-2373

Friesen Geoffrey C. and Sapp, Travis R.A. (2007), "Mutual Fund Flows and Investor Returns: An Empirical Examination of Fund Investor Timing Ability", *Journal of Banking and Finance*, 31(9), 2796–2816

Gray, Jack (2006), "Avoiding Short-Termism in Investment Decision Making", *CFA Institute*, December

Grinold, Richard C and Kahn, Ronald N. (2011), "Breadth, Skill, and Time", *Journal of Portfolio Management*, 38(1), 18-28

Heaton, John and Lucas, Deborah J. (1996), "Evaluating the Effects of Incomplete Markets on Risk Sharing and Asset Pricing", *Journal of Political Economy*, 104(3), 443-487

Hou, Wenxuan and Howell, Sydney (2012), "Trading Constraints and Illiquidity Discounts", *European Journal of Finance*, 18(1), 1-27

Huang, Ming (2003), "Liquidity Shocks and Equilibrium Liquidity Premia", *Journal of Economic Theory*, 109(1), 104-129

Jensen, Gerald R. and Moorman, Theodore (2010), "Inter-temporal Variation in the Illiquidity Premium", *Journal of Financial Economics*, 98(2), 338-358

Jones, Brad (2012), "Navigating the Long Run", *Deutsche Bank Special Report*, 21 February

Kaiser, Ronald W. (2005), "Analyzing Real Estate Portfolio Returns", *Journal of Portfolio Management*, 31(5), 134-142

Khandania, Amir E. and Lo, Andrew W. (2011), "What Happened to the Quants in August 2007? Evidence from Factors and Transactions Data", *Journal of Financial Markets*, 14(1), Pages 1–46

Kay (2012), "The Kay Review of UK Equity Markets and Long-Term Decision Making: Final Report", *The UK Crown*, July

Kinlaw, William, Kritzman, Mark and Mao, Jason (2014), "The Components of Private Equity Performance: Implications for Portfolio Choice", *MIT Sloan Working Paper*, No. 5084-14

Kooli, Maher, Kortas, Mohamed and L'Her, Jean-François (2003), "A New Examination of the Private Company Discount; The Acquisition Approach", *Journal of Private Equity*, 6(3), 48-55

Kritzman, Mark (1994), "What Practitioners Need to Know ... About Time Diversification", *Financial Analysts Journal*, 50(1), 14-18

Laibson, David (1997), "Golden Eggs and Hyperbolic Discounting", *Quarterly Journal of Economics*, 112(2), 443-477

Leibowitz, Martin L and Bova, Anthony (2007), "Gathering Implicit Alphas in a Beta World", *Journal of Portfolio Management*, 33(3), 10-18

Leung, Andrew and Warren, Geoff (2007), "Illiquidity: A Story of Haircuts and Perms", *Russell Research Report*, September. *(Please contact Geoff Warren for copies.)*

Lin, Hai, Wang, Junbo and Wu, Chunchi (2011). "Liquidity Risk and Expected Corporate Bond Returns", *Journal of Financial Economics*, 99(3), 628-650

Liu, Weimin, (2006), "A Liquidity-Augmented Capital Asset Pricing Model", *Journal of Financial Economics*, 82(3), 631-671

Liu, Jun, Longstaff, Francis A. and Mandell, Ravit. E. (2006), "The Market Price of Risk in Interest Rate Swaps: The Roles of Default and Liquidity Risks", *Journal of Business*, 79(5), 2337-2359

Lo, Andrew W., Mamaysky, Harry and Wang, Jiang (2004), "Asset Prices and Trading Volume under Fixed Transaction Costs", *Journal of Political Economy*, 112(5), 1054-1090

Longstaff, Francis A. (2001), "Optimal Portfolio Choice and the Valuation of Illiquid Securities", *Review of Financial Studies*, 14(2), 407-431

Longstaff, Francis A. (2004), "The Flight-to-Liquidity Premium in U.S. Treasury Bond Prices", *Journal of Business*, 77(3), 511-526

Longstaff, Francis A. (2009), "Portfolio Claustrophobia: Asset Pricing in Markets with Illiquid Assets", *American Economic Review*, 99(4), 1119-1144

Merton, Robert C. (1971), "Optimum Consumption and Portfolio Rules in a Continuous-Time Model", *Journal of Economic Theory*, 3(4), 373-413

Mitchell, Mark, Pedersen, Lasse Heje and Pulvino, Todd (2007), "Slow Moving Capital", *American Economic Review*, 97(2), 215-220

Muir, Tyler (2014), "Financial Crises and Risk Premia", *Working Paper*, Yale School of Management (January)

Næs, Randi, Skjeltorp, Johannes A. and Ødegaard, Bernt A. (2011), "Stock Market Liquidity and the Business Cycle", *Journal of Finance*, 66(1), 139-176

Nagel, Stefan (2012), "Evaporating Liquidity", *Review of Financial Studies*, 2(7), 2005-2039

Officer, Micah S. (2007), "The Price of Corporate Liquidity", *Journal of Financial Economics*, 83(3), 571-598

Pagliari, Joseph L., Scherer Kevin A, and Monopoli, Richard T. (2005), "Public versus Private Real Estate Equities: A More Refined, Long-Term Comparison", *Real Estate Economics*, 33(1) 147-187

Pástor, Ľuboš and Stambaugh, Robert F. (2003), "Liquidity Risk and Expected Stock Returns", *Journal of Political Economy*, 111(3), 642-685

Petajisto, Antii (2011), "The Index Premium and its Hidden Cost for Index Funds", *Journal of Empirical Finance*, 18(2), 271–288

Pflueger, Carolin E., and Viceira, Luis M. (2011), "An Empirical Decomposition of Risk and Liquidity in Nominal and Inflation-Indexed Government Bonds", *NBER Working Papers*, No. 16892

Roll, Richard (1984), "A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market", *Journal of Finance*, 39(4), 1127–1139.

Sa-Aadu, J., Shilling, James and Tiwari, Ashish (2010), "On the Portfolio Properties of Real Estate in Good Times and Bad Times", *Real Estate Economics*, 38(3), 529-565

Sadka, Ronnie (2006), "Momentum and Post-Earnings-Announcement Drift Anomalies: The Role of Liquidity Risk", *Journal of Financial Economics*, 80(2), 309-349

Sadka, Ronnie (2010), "Liquidity Risk and the Cross-Section of Hedge-Fund Returns", *Journal of Financial Economics*, 98(1), 54-71

Sadka, Ronnie and Scherbina, Anna, (2007), "Analyst Disagreement, Mispricing, and Liquidity", *Journal of Finance*, 62(5), 2367-2403

Scholes, Myron. S. (2004), "The Future of Hedge Funds", *Journal of Financial Transformation*, 10, 8-11

Shuck, Ed and Howard, Juliana (2004), "Property Investment Options and Successful Implementation", *Russell Research Report*

Shleifer, Andrei and Vishny, Robert W. (1997), "The Limits of Arbitrage", *Journal of Finance*, 52(1), 35-55

Silber, William L. (1991), "Discounts on Restricted Stock: The Impact of Illiquidity on Prices", *Financial Analysts Journal*, 47(4), 60-64

Teo, Melvyn (2011), "The Liquidity Risk of Liquid Hedge Funds", *Journal of Financial Economics*, 100(1), 24-44

Thorley, Steven, R. (1995), "The Time Diversification Controversy", *Financial Analysts Journal*, 51(3), 58-76

Treynor, Jack L. (1976), "Long-Term Investing", *Financial Analysts Journal*, 32(3), 56-59

Vayanos, Dimitri (1998), "Transaction Costs and Asset Prices: A Dynamic Equilibrium Model", *Review of Financial Studies*, 11(1), 1-58

Vayanos, Dimitri and Wang, Jiang (2013), "Market Liquidity: Theory and Empirical Evidence", in George Constantinides, Milton Harris, and Rene Stulz, eds.: *Handbook of the Economics of Finance*, 2013, Ch 19

Vayanos, Dimitri and Weill, Pierre-Oliver (2008), "A Search-Based Theory of the On-the-Run Phenomenon", *Journal of Finance*, 63(3),1361-1398

Vayanos, Dimitri and Woolley, Paul (2013), "An Institutional Theory of Momentum and Reversal," *Review of Financial Studies*, 26 (5), 1087-1145

Warren, Geoffrey J. (2012), "Can Investing in Volatility Help Meet Your Portfolio Objectives?", *Journal of Portfolio Management*, 38(2), pp. 82-98

Warren, Geoff (2014a), "Long-Term Investing: What Determines Investment Horizon?", *CIFR Research Working Paper*, May ('Paper 1')

Warren, Geoff (2014c), "Designing an Investment Organization for Long-Term Investing ", *CIFR Research Working Paper*, October ('Paper 3')

Watanabe, Akiko and Watanabe, Masahiro (2008), "Time-Varying Liquidity Risk and the Cross-Section of Stock Returns", *Review of Financial Studies*, 21(6), 2449-2486

WEF (2011), "The Future of Long-term Investing", *A World Economic Forum Report* (with Oliver Wyman)

Wurgler, Jeffrey (2010), "On the Economic Consequences of Index-Linked Investing", *NBER Working Papers,* No. 16376 (September)

Xue, Han and Zheng, Jian (2010), "Pricing Illiquidity Risk and Cost in the Stock Market", *Towers Watson*, June